МИНИСТЕРСТВО ОБРАЗОВАНИЯ И НАУКИ, МОЛОДЕЖИ И СПОРТА УКРАИНЫ
ТАВРИЧЕСКИЙ НАЦИОНАЛЬНЫЙ УНИВЕРСИТЕТ ИМЕНИ В. И. ВЕРНАДСКОГО
КАФЕДРА ИНОСТРАННЫХ ЯЗЫКОВ ФАКУЛЬТЕТОВ
ЕСТЕСТВЕННО-НАУЧНОГО ПРОФИЛЯ

Д. С. Бородина, К. А. Мележик

АНГЛИЙСКИЙ ЯЗЫК
ДЛЯ АСПИРАНТОВ

(УЧЕБНОЕ ПОСОБИЕ ДЛЯ ПОДГОТОВКИ АСПИРАНТОВ
И СОИСКАТЕЛЕЙ К ЭКЗАМЕНУ КАНДИДАТСКОГО
МИНИМУМА ПО АНГЛИЙСКОМУ ЯЗЫКУ)

Рекомендовано
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ПОЯСНИТЕЛЬНАЯ ЗАПИСКА

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Секция 1 уроков 11-20 дает комплекс коммуникативных умений и навыков, необходимых ученому для ведения академической коммуникации с зарубежными коллегами. Раздел содержит отобранные в Интернете рекомендации по чтению научного текста, написанию научной статьи и критического обзора литературы, поиску научной информации, составлению аннотаций, этапам работы над диссертацией, подготовке к защите и т.п. Все материалы заимствованы из тех сайтов, которые не налагают ограничения авторского права. Рекомендации сопровождаются инструкциями по изучению материала и заданиями для закрепления коммуникативных умений и навыков

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Тестовые задания по грамматике, равно как и задания и инструкции по развитию навыков чтения научных текстов и академической коммуникации, составлены в соответствии с образцами международных стандартных тестов

Именно поэтому в течение второй половины курса слушателям предлагается самостоятельно работать с научными текстами по своей специальности, представляя индивидуальные отчеты преподавателю. Для этого, в качестве приложения к пособию, подготовлен сборник специальных текстов по соответствующим научным направлениям. Сборник содержит оригинальные тексты, отобранные из публикуемых в Интернете англоязычных научных изданий 2008-2010 гг. по следующим научным отраслям: Биология, География, Математика и информатика, Психология, Управление, Физика и компьютерные системы, Физическая культура и спорт, Химия, Экономика. Тексты тематически группируются таким образом, что могут использоваться как в процессе аудиторных занятий, так и в ходе самостоятельной подготовки к кандидатскому экзамену.

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Объем учебного пособия 46 п.л.

ЧАСТЬ I

Unit 1

Section 1. GUIDELINES FOR READING ACADEMIC TEXTS

MAIN IDEA, MAIN TOPIC, AND MAIN PURPOSE OF THE TEXT

OVERVIEW QUESTIONS: MAIN IDEA, MAIN TOPIC, AND MAIN PURPOSE QUESTIONS

Instruction: After almost every text, the first question you should ask is an **overview question** about the main idea, main topic, or main purpose of the text. **Main idea questions** ask you to identify the most important thought in the text, the main idea or topic of a passage.

There are two types of main idea questions: matching headings with paragraphs or sections, and identifying which sections relate to certain topics. For both types of questions you should use the skill of surveying the text, but because the strategies are slightly different for each question type, we will look at them separately.

Matching headings with paragraphs

- Step 1 Survey the whole text.
- Step 2 Survey the paragraph to identify the topic. The topic sentence is usually the first one in a paragraph. Survey the rest of the paragraph to make sure.
- Step 3 Choose the correct wording of the main idea from the text.

Identifying where to find information

- Step 1 Survey the text
- Step 2 Read the question to identify the topic, underline the key words in the question, read one question at a time.

Text: Family problems

1. Children of divorce.

A. Parental conflict prior to divorce — rather than divorce itself — accounts for many of the emotional and academic problems that children of divorced parents typically experience, according to a June 2008 report. A research team led by sociologist Andrew Cherlin at Johns Hopkins University in Baltimore took a new look at data from surveys of families conducted in Great Britain in the 1960's and in the United States in the 1970's.

B. The British study had compiled academic achievement scores and parent and teacher ratings of behavior for 11,837 unrelated children at age *7* and then at age 11. During the intervening four years, the parents of 239 of the youngsters had divorced or separated. The U.S. survey charted parent's ratings for 822 children. These ratings were also done at four-year intervals. During those four years, 65 divorces or separations occurred.

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C. In analyzing the data, the researchers found that for boys in both surveys, academic and behavior problems existed prior to divorce and did not significantly increase after divorce. Girls in the British study also showed problems prior to parental divorce, but compared with boys, they had a slightly higher rate of problems after divorce.

A Sample Question

- What is the main idea of the passage? Choose the right answer.

(A) Girls usually have more behavior problems connected with divorce then boys.

(B) There is no significant difference in the rate of behavior problems before or after divorce.

(C) Emotional and academic problems increase after divorce for both girls and boys.

(D) Relations between parents account for behavior problems of children.

- Did the result differ in British and American surveys?
- Which line or lines best summarize the author's main idea?

2. Dyslexia reinterpreted.

A. A January 2008 report on the reading disorder known as dyslexia challenged two widespread assumptions: that a clear distinction exists between normal reading abilities and dyslexia, and that dyslexic children cannot shed their reading problems. Pediatrician Sally E. Shaywitz of Yale University School of Medicine in New Haven, Conn., and her colleagues found that dyslexia covers a range of reading problems from mild to severe and often disappears as children progress through elementary school.

B. While the definition of dyslexia remains controversial, a common description holds that dyslexic children exhibit normal intelligence but have difficulty translating strings of letters into words. For example, a dyslexic person might read the word *saw* as the word *was.*

C. The researchers studied data compiled from the Connecticut Longitudinal Study, whose subjects consisted of 414 randomly selected Connecticut children who had entered kindergarten in 2002. Intelligence and achievement tests had been administered to the children at various intervals. The researchers compared the scores from these tests to determine if the children had achieved reading scores that had been predicted on the basis of their intelligence scores. The scientists diagnosed as dyslexic only those children who showed reading scores far below the level predicted by their intelligence.

D. These children displayed a range of reading problems that gradually approached normal reading skills, Shaywitz said. This showed that dyslexia was not an «all-or-nothing» characteristic, but a phenomenon that could be measured in degrees and was part of a normal continuum of reading skills. Moreover, the childrens' reading ability could change markedly over time. For example, of first-graders diagnosed with dyslexia, only 1 in 6 retained that label in the sixth grade.

Note: When there is not a single, readily identified main idea, **main topic questions** may be asked. These ask you what this or that passage is generally «about.»

C. In analyzing the data, the researchers found that for boys in both surveys, academic and behavior problems existed prior to divorce and did not significantly increase after divorce. Girls in the British study also showed problems prior to parental divorce, but compared with boys, they had a slightly higher rate of problems after divorce.

A Sample Question

- What is the main idea of the passage? Choose the right answer.

(A) Girls usually have more behavior problems connected with divorce then boys.

(B) There is no significant difference in the rate of behavior problems before or after divorce.

(C) Emotional and academic problems increase after divorce for both girls and boys.

(D) Relations between parents account for behavior problems of children.

- Did the result differ in British and American surveys?
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Sample Questions

- What is the main topic of the passage? (A) A clear distinction exists between normal reading abilities and dyslexia. (B) Dyslexic children cannot shed their reading problems.
- What does the passage mainly discuss? (A) A definition of dyslexia. (B) A description of dyslexia.
- What is the passage primarily concerned with? (A) Measurements of degrees of dyslexia. (B) Change of childrens' reading ability over time.

3. Alcoholism in families.

A. Environmental influences, rather than genes, play a major role in alcoholism among women of all ages and among men whose drinking problems begin during adulthood, psychologists reported in February 2009. In contrast, genes play a predominant role among men whose alcoholism develops during their teens, said the study's director, psychologist Matt McGue of the University of Minnesota in Minneapolis. The study lends support to the theory that there is more than one type of alcoholism, one of which primarily affects males and begins in adolescence.

B. The group studied consisted of 356 pairs of twins. One twin in each pair had received hospital treatment for alcohol problems. McGue's team found that both brothers in some pairs of male identical twins suffered from alcoholism more often than did both brothers in pairs of male fraternal twins. This was the case only when the treated twin had developed alcohol problems during his teens.

C. By contrast, alcoholism occurred at about the same rate among female identical and fraternal twins, who rarely became alcoholic during adolescence. This finding indicated that environmental factors, which are shared by both identical and fraternal twins, played a more important role than genetic factors in these cases.

Main purpose questions ask *why* the author wrote a passage. The answer choices for these questions usually begin with infinitives.

Sample Questions

- What is the author's purpose in writing this passage?
- What is the author's main purpose in the passage?
- What is the main point of this passage?
- Why did the author write the passage?

Sample Answer Choices

To define_____
To relate
To discuss
To propose_____
To illustrate
To support the idea that
To distinguish between _____and_____
To compare and

4. Drug for autism.

Scientists reported in March 2008 that a drug known to help *obsessive-compulsive disorder* (a mental disorder characterized by obsessive thoughts or

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compulsive habits such as constant hand washing or hair pulling) helps autistic children more than does the drug normally used to treat autism. Psychiatrist Charles T. Gordon and his associates at the National Institute of Mental Health in Bethesda, Md., studied seven autistic children who took two types of antidepressants for five weeks each. The researchers noted that the drug clomipramine worked better than the drug desipramine to reduce the compulsive behaviors, anxiety, social withdrawal, and self-injury that characterize autism. [Bruce Bower]

Main detail questions ask about the most significant information of the passage. To answer such a question you should point out a line or two in the text.

Sample Questions

- What news is emphasized in the passage?
- In what line is the most significant information given?

Caution:

Don't answer the initial overview question about a passage until you have answered the other questions. The process of answering the detail questions may give you a clearer understanding of the main idea, topic, or purpose of the passage.

The correct answers for main idea, main topic, and main purpose questions correctly summarize the main points of the passage; they must be more general than any of the supporting ideas or details, but not so general that they include ideas outside the scope of the passages.

Distractors for this type of question have one of the errors:

They are too specific.

They are too general.

They are incorrect according to the passage.

They are irrelevant (unrelated) to the main idea of the passage.

E.g.: What news is emphasized in the passage? (A) Autism is a kind of obsessive-compulsive disorder; (B) Constant hand washing is typical for all autistic children; (C) Autistic patients can be treated with a drug used for other mental disorders; (D) The drug clomipramine worked increased the compulsive behaviors.

Distractor (A) is too general. Distractor (B) is too specific. Distractor (D) is incorrect according to the passage. Answer (C) is correct.

If you're not sure of the answer for one of these questions, go back and quickly scan the passage. You can usually infer the main idea, main topic, or main purpose of the entire passage from an understanding of the main ideas of the paragraphs that make up the passage and the relationship between them.

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Your best chance for improving your candidate exam score in a short time is to improve your score on the grammar section, and therefore pull up your total score. Although a wide range of grammar points are tested, there are certain points that appear again and again, and you can master these points with the information and practice this book provides. Grammar Section may seem less stressful for you because it is easier to do all the items if you have learned how to.

Grammar sentences are generally about academic subjects: the natural sciences (such as physics or geography), or the social sciences (such as psychology or economics). Any cultural references in the sentences are to the culture of English-speaking countries. Some sentences contain references to people, places, and institutions that you will not be familiar with. It's not necessary to know these references; you should simply concentrate on the grammar structure of the sentences. It's also not necessary to understand all the vocabulary in a sentence; you can often determine a grammar structure or form correctly without a complete understanding of that sentence.

There are two possible approaches to grammar problems: an analytical approach and an intuitive approach. An exam-taker who uses the analytical approach quickly analyzes the grammar of a sentence to see what element is missing or which element is incorrect. Someone who uses the second approach simply chooses the answer that «sounds right» or the one that «sounds wrong». Although the first approach is recommended to post graduate students, the second can be useful too, especially for people who learned English primarily by speaking it and listening to it rather than by studying grammar and writing. If you aren't sure which approach works best for you, keep in mind that you can combine the two approaches: if you get «stuck» (unable to choose an answer) using one method, you switch to another.

A Tip: An excellent way to prepare for grammar section of the exam is to write your own grammar pattern items. Write several items for each of the units in this part of the book. There's no better way to start thinking like a test-writer. This section will develop your ability to recognize grammar and usage suitable for standard written and spoken English.

Errors with articles

Errors with articles are very often hard to notice. This is partly because of the complexity of the article system in English, and partly because articles are «small words,» and one's eye tends to skip over errors involving these words.

The basic uses of articles are explained below:

The indefinite article *a* or *an* is used before singular nouns when one does not have a specific person, place, thing, or concept in mind: an orange, a chair.

The definite article *the* is used before singular, plural, and uncountable nouns when one has a specific person, place, thing, or concept in mind:

the orange, the oranges, the fruit, the chair, the chairs, the furniture.

Section 2. GUIDELINES FOR GRAMMAR TEST

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the orange, the oranges, the fruit, the chair, the chairs, the furniture.

No article is used before uncountable nouns or plural nouns when one does not have specific persons, places, concepts, or things in mind:

An orange — oranges; a chair — chairs; fruit; furniture.

The indefinite article *a* is used before words that begin with a consonant sound *{a chair, a book): an* is used before words that begin with a vowel sound *(an orange, an ocean liner)*. Before words that begin with the letters *h-* and *u-,* either *a* or *an* can be used, depending on the pronunciation of the words: an honor - a hat, an umbrella - a university

There are also some **specific rules** for using (or not using) articles that you should be aware of.

An indefinite article can be used to mean «one.» It is also used to mean «per»:

a half, a quarter, a third, a tenth

a mile a minute (one mile per minute)

an apple a day (one apple per day)

A definite article is used when there is only one example of the thing or person, or when the identity of the thing or person is clear:

The Moon went behind some clouds. (There's only one moon.) Please open *the door.* (You know which door I mean.)

A definite article is usually used before these expressions of time and position:

the morning, the afternoon, the evening; the front, the back, the center; the beginning, the middle, the end; the past, the present, the future;. the bottom, the top.

No article is used in the expression «at night.»

A definite article comes before a singular noun that is used as a representative of an entire class of things. This is especially common with the names of animals, trees, inventions, musical instruments, and parts of the body:

The tiger is the largest cat.

My favorite tree is *the oak.*

The Wright brothers invented *the airplane.*

The oboe is a woodwind instrument.

The heart pumps blood.

A definite article is used before expressions with an ordinal number. No article is used before expressions with cardinal numbers:

the first, the fourth chapter, the seventh volume; Part one, Chapter Four, Volume Seven.

A definite article is used before decades and centuries:

the 1930s, the 1800s, the fifties, the twenty-first century.

A definite article is usually used before superlative forms of adjectives:

the widest river, the most important decision.

A definite article is used in quantity expressions in this pattern: quantifier + *of* + *the* + noun:

many of the textbooks, not much of the paper, some of the water, most of the students, all of the people, a few of the photographs.

These expressions can also be used without the phrase *of the*:

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A definite article is used before the name of a group of people or a nationality. No article is used before the name of a language:

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The Americans are proud of their ancestors, *the Pioneers.* She learned to speak *English* when she lived in London.

A definite article is used when an adjective is used without a noun to mean «people who are.»

Both the *young and the old* will enjoy this movie. *The poor* have many problems.

A definite article is used before an uncountable noun or a plural noun when it is followed by a modifier. No article is used when these nouns appear alone.

The rice that I bought today is in the bag.

Rice is a staple in many countries.

Trees provide shade.

The trees in this park are mostly evergreens.

A definite article is used before the name of a field of study followed by an *of*-phrase. If a field is used alone, or is preceded by an adjective, no article is used:

the genetics of the twentieth century — genetics

the economics of Ukraine — Ukrainian economics

Definite articles are used before the «formal» names of nations, states, and cities. (These usually contain *of*-phrases.) No articles are used before the common names of nations, states, and cities.

the United States of America	America
the Republic of Ukraine	Ukraine
the city of Simferopol	Simferopol

Definite articles are used before most plural geographic names: the names of groups of lakes, mountains, and islands. No article is used before the names of individual lakes, mountains, and islands.

the Great Lakes	Lake Baikal
the Crimean Mountains	Mount Chatyr Dag
the Marshall Islands	Bird Island

There are three main types of errors involving articles:

Incorrect article choice

One of the most common errors is the use of *a* in place of *an* or vice versa. Fortunately, this is also the easiest type of error to detect. Another error is *a* or *an* used in place of *the,* or *the* in place of *a* or *an.*

A eclipse of the sun may be either total or partial.

An must be used before a noun beginning with a vowel sound such as *eclipse.*

Angela Merkel was a first woman in the history of Germany to be elected Chancellor. In a phrase with an ordinal number (such as *first)* the definite article *the* must be used.

Incorrect omission or inclusion of articles

Sometimes an article is used when none is needed, or one is omitted when one is required.

Slag consists of waste materials and impurities which rise to top of melted metals.

The definite article *the* should not be omitted from the phrase *the top of.*

The most asteroids are beyond the orbit of the planet Mars.

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Use of a definite article in place of a possessive pronoun

A definite article may be incorrectly used in place of a possessive word—***its,*** *his, her,* or *their*.

The Crimean Mountains of Ukraine are famous for the rugged beauty.

The should correctly be replaced with *their* because the sentence refers to the beauty belonging to the definite mountains.

Exercise: Identify the correct and incorrect use of articles.

Directions: Underline the forms that correctly complete the sentence.

Only about (the one/one) percent of (the water/water) on Earth is (the fresh/fresh) water.

(The mineral/Mineral) phosphate is (the most/most) common ingredient of all types of (the fertilizers/ fertilizers).

(The/A) process of refining minerals requires (a/an) huge amount of (an electrical/electrical) energy.

(A humor/Humor) runs through (the American/American) literature from (the earliest/earliest) times until (the present/present).

(The ozone/Ozone) layer acts as (a/an) umbrella against (the most/most) of (the Sun's/Sun's) dangerous rays.

In (the early/early) 1800s, Sequoia, (a Cherokee/Cherokee) leader, created (the/a) first written form of (a North/North) American Indian language.

(The Goddard/Goddard) family of (the New/New) England produced some of (the/a) finest furniture made in (the United/United) States in (the seventeenth/seventeenth) century.

(The popcorn/Popcorn) has (a/the) same food value as any other kind of (a corn/corn).

One of (the most/most) important tools for (a research/research) in social science is (a well-written/ well-written) questionnaire.

Native to (the Crimean/Crimean) Steppe, (the/a) wolf disappeared early in (the twentieth/twentieth) century when its chief natural competitor, (the/a) dog, multiplied.

The nineteenth/Nineteenth) century astronomer Alvin G. Clarke built hundreds of (the refracting/ refracting) telescopes during (the/his) lifetime.

The Hawaiian/Hawaiian) Islands are among (the most/most) geographically isolated islands on (the Earth/Earth).

Mini-test

Find explanations for the use of no article, the indefinite article and the definite article in the following sentences:

Parental conflict prior to **divorce** — rather than **divorce** itself — accounts for many of **the** emotional and academic **problems** that **children** of divorced **parents** typically experience.

A research **team** led by sociologist Andrew Cherlin at Johns Hopkins University in Baltimore took **a** new **look** at data from surveys of **families** conducted in Great Britain in the 1960's and in the United States in the 1970's.

Intelligence and achievement tests had been administered to **the children** at various intervals. **The researchers** compared **the scores** from **the tests** to determine if **the children** had achieved reading **scores** that had been predicted on **the basis of** their intelligence scores.

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In (the early/early) 1800s, Sequoia, (a Cherokee/Cherokee) leader, created (the/a) first written form of (a North/North) American Indian language.

(The Goddard/Goddard) family of (the New/New) England produced some of (the/a) finest furniture made in (the United/United) States in (the seventeenth/seventeenth) century.

(The popcorn/Popcorn) has (a/the) same food value as any other kind of (a corn/corn).

One of (the most/most) important tools for (a research/research) in social science is (a well-written/ well-written) questionnaire.

Native to (the Crimean/Crimean) Steppe, (the/a) wolf disappeared early in (the twentieth/twentieth) century when its chief natural competitor, (the/a) dog, multiplied.

The nineteenth/Nineteenth) century astronomer Alvin G. Clarke built hundreds of (the refracting/ refracting) telescopes during (the/his) lifetime.

The Hawaiian/Hawaiian) Islands are among (the most/most) geographically isolated islands on (the Earth/Earth).

Mini-test

Find explanations for the use of no article, the indefinite article and the definite article in the following sentences:

Parental conflict prior to **divorce** — rather than **divorce** itself — accounts for many of **the** emotional and academic **problems** that **children** of divorced **parents** typically experience.

A research **team** led by sociologist Andrew Cherlin at Johns Hopkins University in Baltimore took **a** new **look** at data from surveys of **families** conducted in Great Britain in the 1960's and in the United States in the 1970's.

Intelligence and achievement tests had been administered to **the children** at various intervals. **The researchers** compared **the scores** from **the tests** to determine if **the children** had achieved reading **scores** that had been predicted on **the basis of** their intelligence scores.

Section 1. GUIDELINES FOR READING ACADEMIC TEXTS

OVERALL UNDERSTANDING OF THE TEXT

TONE AND ATTITUDE QUESTIONS

Instruction: A number of other questions are asked that require an overall understanding of the passage. These are often the last questions in a set of overview questions.

Tone questions ask you to determine the author's feelings about the topic by the language that he or she uses in writing the passage. **Attitude questions** are very similar to tone questions. Again, you must understand the author's opinion. The language that the author uses will tell you what his or her position is.

Text: Preserving biological richness

Task: Below are six short separate texts containing general information in the field of biology. For your convenience they are marked with numbers 1-6. The texts are divided into paragraphs, marked with letters. Your task is to understand the texts and determine the authors' feelings about the topics.

1. Protection of plant and animal species

A. In the United States, the need to protect plant and animal species has become a highly controversial and sharply political issue since the passage of the Endangered Species Act in 1973. The act, designed to protect species, in effect requires the preservation of the species' habitats, and policies that preserve land and forests compete with economic interests. In the 1990's, for example, the loggers of forests in the Western United States were challenged legally in their attempt to cut trees for lumber in the Cascade Mountains. The challenge was mounted to protect the endangered spotted owl, whose remaining population occupies these forests and requires the intact, ancient forest for survival. The dilemma pitted the interests of environmentalists against those of corporations and of individuals who stood to lose jobs. After months of debate and legal battles, the fate of the loggers — and the owls — was still undecided in mid-2009.

B. Similar tensions exist between the developed and the developing nations. Many people in industrialized nations, for example, believe that developing nations in tropical regions should do more to protect their rain forests and other natural areas. But the developing countries may be impoverished, with populations growing so rapidly that using the land is a means to temporarily avoid worsening poverty and starvation.

C. Many of the changes to Earth that concern scientists have ***the potential to rob the planet of its biological richness***. ***The destruction of Earth's ozone layer***, for example, could contribute to the general process of impoverishment by allowing ultraviolet rays to harm plants and animals. And ***global warming could***

Unit 2

Section 1. GUIDELINES FOR READING ACADEMIC TEXTS

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C. Many of the changes to Earth that concern scientists have the potential to rob the planet of its biological richness. The destruction of Earth's ozone layer, for example, could contribute to the general process of impoverishment by allowing ultraviolet rays to harm plants and animals. And global warming could

wipe out species unable to quickly adapt to changing climates. **Clearly, protecting Earth's biodiversity is a complex problem.** But solutions to humanity's current problems will come only through coordinated international efforts to control human population, stabilize the composition of the atmosphere, and preserve intact Earth's complex web of life.

Sample Tone Questions

- What tone does the author take in writing this text?
- How could the tone of this text best be described as?

Sample Answer Choices

Look for vocabulary that indicates if the author's feelings are positive, negative, or neutral

- Positive
- Favorable
- Optimistic
- Amused
- Pleased
- Respectful
- Humorous
- Negative
- Critical
- Unfavorable
- Angry
- Defiant
- Worried
- Outraged
- Neutral
- Objective
- Impersonal

If you read the italicized sentences in passage C, would the tone of this passage most likely be positive or negative? Choose the right descriptors from the list above.

2. The world's largest known organism

A. A fungus that was called the world's largest known organism was discovered in a forest near Crystal Falls, Mich., according to an April 2007 report by researchers at the University of Toronto in Canada and Michigan Technological University in Houghton. The fungus is a member of the species *Armillaria bulbosa,* which typically grows by sending out stringlike hyphae under the surface of a forest floor. Occasionally, it sends up edible mushrooms.

B. The researchers performed genetic testing on a fungal network that extended across 15 hectares (37 acres) of the Michigan forest and discovered that the entire growth was genetically identical. They concluded that it was a single individual. The researchers estimated that the fungus weighed more than 10,000 kilograms (22,000 pounds) and had been growing for more than 1,500 years.

C. Then in May, researchers at the Rocky Mountain Forest and Range Experiment Station in Fort Collins, Colo., and at the Washington State Department of Natural Resources reported that for 20 years they had been studying a fungus, *Armillaria ostoyae,* that was 40 times as large as the Michigan fungus. It grows in a pine forest in southwestern Washington and covers more than 600 hectares (1,500 acres). The researchers estimated that the fungus was 400 to 1,000 years old. They and the Michigan researchers said that even larger, yet undiscovered fungi could exist.

D. ***Botanists say, however, that there is no way to be certain*** that all the hyphae underground are attached to each other. If they have become detached, and ***the researchers suspect that this may be the case***, then the giant «organism» would be a group of genetically identical individuals that arose without sexual reproduction from a single parent. That is, the detached individuals would be

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clones, not unlike the world's many plant varieties produced by horticultural cloning techniques. ***Many biologists thus dispute the reports*** that the fungi are the world's largest organisms.

Note: You should keep in mind that, in academic texts, most reading passages have a neutral tone, but sometimes an author may take a position for or against some point. However, answer choices that indicate strong emotion—amused, *angry, outraged,* pleased, and so forth—will seldom be correct.

The italicized words in Passage C show a doubtful tone; and the italicized words indicate a negative attitude. Words like *no way, if, suspect, dispute,* and similar words can «reverse» the tone of the passage.

Notice that Passage C contains negative phrases but the overall meaning of Passages A, B, C is neutral.

3. **A significant step in synthetic molecules evolution**

A. Chemists at the Massachusetts Institute of Technology (MIT) in Cambridge disclosed that ***they had created molecules*** that mimic some of the essential features of living things. In particular, ***they showed for the first time*** that it may be possible for compounds made in the laboratory to reproduce in solution. This is ***a significant step*** that ***may eventually lead to more complex chemical compounds*** that can reproduce in the same manner as DNA (deoxyribonucleic acid), the molecule of which genes are made. Genes are the units of heredity in cells.

B. The compounds — prepared by organic chemist Julius Rebek, Jr., and his colleagues — behave in much the same way as DNA. The synthetic molecules, which are carbon compounds containing nitrogen, oxygen, and hydrogen, combine in a fashion similar to that of DNA, which forms a double *helix* (spiral). And like DNA, the synthetic molecules can make copies of themselves when placed in solutions containing their chemical ingredients.

C. Perhaps ***most startling of all***, and again like natural DNA, the synthetic molecules display the ability to *evolve* (develop and change into a more organized state). For example, bombarding the compounds with ultraviolet radiation causes them to change their structures into new forms that are ***more successful at reproducing*** than the original molecules.

D. Rebek's molecules are different from DNA in important ways, ***however***. They are **not truly** living and have structures quite different from DNA. Many scientists consider the ability to continuously evolve into new forms a sign of life. Unlike the DNA in living cells, however, the synthetic molecules have only a limited ability to evolve into new forms or to store information. But ***the MIT work could lead to other compounds*** that possess these traits.

Attitude questions are very similar to tone questions. Again, you must understand the author's opinion. The language that the author uses will tell you what his or her position is.

Sample Attitude Questions

- What is the author's attitude toward creation of molecules that mimic some of the essential features of living things?
- If you read the italicized phrases in Text 3, would the author's attitude most likely be positive or negative? Choose the right descriptors from the list above.

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4. The chaos theory

A. Ecologists focused much energy on the topic of chaos. Chaos theory is based on the idea that random variations control the behavior of natural systems that change with time, such as the weather and ecosystems. ***The theory predicts, in essence, that science cannot predict*** the changes in some systems. Scientists believe that chaotic systems, such as the weather, are those in which very small changes produce unexpectedly dramatic results.

B. Small changes in temperature, air pressure, or wind speed or direction, for instance, may produce weather wildly different five days later than if that change had not occurred. Because of ***a shortage of precise data from long-term studies*** of ecological systems, however, it has been ***difficult to determine*** where and when chaos is occurring.

C. 18 years ago in October 1991, ecologists David Tilman and David Wedin of the University of Minnesota in Minneapolis reported the results of a five-year study showing that growth patterns of *Agrostis scabra,* a common prairie grass, exhibit many properties of chaotic systems. The scientists planted different groups of the plants in soils with varying degrees of nutrients.

D. The scientists found that plants in nutrient-rich soils grew more unpredictably than the plants in the poorer quality soils. Plants in the better soil grew better during the first two years of the experiment, but their growth became unpredictable in the third year and remained unpredictable for the rest of the experiment. These plants' populations dropped wildly compared with plants in poorer soils.

E. ***The researchers attributed*** this drop to the accumulation of *litter* (dead plant material) at the end of the previous growing season. As litter accumulated, the scientists discovered, it blocked light to the plants. Plant growth thus varied most in the most favorable conditions, suggesting that plants with the most luxurious growth may be susceptible to unpredictable changes.

Organization questions ask about the overall structure of a passage or about the organization of a paragraph.

A Sample Question

Which of the following best describes the organization of the passage?

Answer Choices

- A general concept is defined and examples are given.
- Several generalizations are presented, from which a conclusion is drawn.
- The author presents the advantages and disadvantages of .
- The author presents a system of classification for _____ .
- Persuasive language is used to argue against .
- The author describes .
- The author presents a brief account of_____ .
- The author compares and .

5. Father-Son relations in birds

A. The biologists found that the more closely the older bird was related to the younger, the more successful the older bird was. Fathers who interfered with their sons were the most successful at getting them to help. A typical father visited a son's nest dozens of times a day, blocking the young bird's return and begging for food intended for a young female in preparation for egg-laying. About

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16

40 per cent of the time, the son returned to the nest of his father, at times leaving his own mate with eggs that had little chance to survive as chicks without his help.

B. When the son helped the father, the survival rate of the father's new chicks was almost double the survival rate of chicks brought up without helpers. The biologists suggested that the sons cooperate in order to pass on their fathers' genes, in which they too have a share.

Sample Questions

- What is the author's attitude toward Father-Son relations in birds?
- How would the author probably feel about Father-Son relations in birds?

Answer Choices

- The author's opinion of Father-Son relations in birds is best described as (positive, negative, neutral, objective, impersonal, etc.)
- The author's attitude toward Father-Son relations in birds could best be described as one of (a researcher interest, approval, indifference, curiosity, etc)

6. The three passages below have been scrambled for you to put them in a logical order and find a headline for the text.

?. The biologists also surveyed the two types of tiger salamanders in 10 lakes. The lakes with high levels of bacteria had fewer cannibal salamanders than noncannibals. The scientists concluded that the cannibal salamanders had eaten infected members of the species and subsequently died. Thus, they said, cannibalism is rare in nature because of the high risk for spreading disease.

?. Cannibal tiger salamanders in the laboratory ate their weaker — often sick — neighbors. When they did so, they also consumed the disease-causing viruses or bacteria common to die species and potentially harmful to all members. Many of the cannibals became sick and died from the same diseases as their prey.

?. There is a good reason why very few organisms like to eat their own kind, biologists at Arizona State University in Tempe reported in October 2008. Cannibalism can cause death. David Pfennig and his colleagues studied cannibalism in tiger salamanders because these animals come in two types: those that eat other tiger salamanders and those that do not.

Questions about previous or following paragraphs ask you to assume how the passages are organized, what would be the topic of the text. To find the order of the passages, look for clues in the first lines. To find the topic of the text, look in the last lines.

Sample Questions

- With what topic would the text most likely begin?
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Errors with word forms

By far the most common type of error involves word forms. Most errors of this type involve using one part of speech in place of another. Both the incorrect word and the correction come from the same root *(rapid* and *rapidly,* for example, or *inform* and *information).* The four parts of speech generally involved are verbs, nouns, adjectives, and adverbs. The most common problems are adjectives in place of adverbs and adverbs in place of adjectives. Nouns in place of adjectives and adjectives in place of nouns are also commonly seen. In some word form problems, different forms of the same part of speech may be involved. For example, a noun that refers to a person *(leader)* may be used in place of the field *(leadership).* A gerund (a verbal noun) may also be used in place of an ordinary noun *(judging* and *judgment,* for example).

Parts of speech can often be identified by their suffixes (word endings).

Common noun suffixes

-tion (information), -sion (provision), -ence (independence), -ance (acceptance), -ity (creativity),

-hood (childhood), -dom (wisdom), -th (health), -ery (recovery), -ship (scholarship), -tude (multitude), -ism (capitalism), -cracy (democracy), -logy (biology), -ness (happiness), -ment (experiment).

Suffixes for nouns that refer to persons

-er (explorer), -or (sailor), -ist (psychologist), -ent (student), ee (employee), -ic (comic), -ian (technician), -ant (attendant).

Common verb suffixes

-ize (realize), -en (shorten), -er (recover), -ify (justify), -ate (incorporate).

Common adjective suffixes

-ate (moderate), -ous (dangerous), -al (normal),-ial (remedial), -able (comfortable), -ible (sensible),

-ish (sluggish), -ant (resistant), -y (sunny), -ic (economic), -ical (ogical), -ory (sensory), -less (hopeless),-ive (competitive),-ly (friendly),-ful (colorful).

Common adverb suffixes

-ly (quickly), -ally (historically).

Mini-test

1. Fill in the blanks with the right form of a word.

1. (to protect, protected, protecting, protective, protection) ____ plant and animal species has become a (controversy, controversial) ____ among (policies, politics, politicians**)** ____ and the general public.

2. (research, to research, researching, researcher) ____was performed in (genes, genetic, geneticists) ____(test, to test, to testify, testing) on a fungal network.

Section 2. GUIDELINES FOR GRAMMAR TEST

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3. The (synthetic, synthesize, synthesizing, synthesis) ____ of molecules was (to display, a display, displaying, displayed) ____ in the ability to develop and change into a more organized state.

4. The (to grow, grew, growing, growth) of plants in nutrient-rich soils was more (unpredicted, unpredictable, unpredictably) ____ demonstrated than that of the plants in the poorer quality soils.

5. The biologists found that the older bird, which was (to close, closed and, closely) ____related to the younger bird, was (a success, succeeded, succeeding, more successful, successful) ____compared to other older birds.

6. Very few (kind, kinds) ____ of (animal, animals, animated) ____ organisms are (cannibalizing, cannibal, cannibals, cannibalism) ____.

2. Fill in the blanks with the right form of an article (no article — NA, the indefinite article — IA, the definite article — DA).

(NA, IA, DA) growing body of literature suggests that **(NA, IA, DA)** mothers who violate **(NA, IA, DA)** gender roles by seeking full-time **(NA, IA, DA)** employment are negatively stereotyped and discriminated against.

(NA, IA, DA) psychologists asked **(NA, IA, DA)** undergraduate students to read CVs describing **(NA, IA, DA)** consultant who was either **(NA, IA, DA)** female or male and either **(NA, IA, DA)** parent or not **(NA, IA, DA)** parent.

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3. The (synthetic, synthesize, synthesizing, synthesis) ____ of molecules was (to display, a display, displaying, displayed) ____ in the ability to develop and change into a more organized state.

4. The (to grow, grew, growing, growth) of plants in nutrient-rich soils was more (unpredicted, unpredictable, unpredictably) ____ demonstrated than that of the plants in the poorer quality soils.

5. The biologists found that the older bird, which was (to close, closed and, closely) ____related to the younger bird, was (a success, succeeded, succeeding, more successful, successful) ____compared to other older birds.

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Section 1. GUIDELINES FOR READING ACADEMIC TEXTS

IDENTIFYING THE MAIN POINT OF EACH PARAGRAPH OF THE TEXT

OVERVIEW QUESTIONS: collecting circumstantial evidence in separate passages

Instruction: When analyzing each paragraph of the text you mostly rely on circumstantial evidence. Circumstantial evidence is evidence not drawn from the direct observation of a fact. If, for example, human activities are reducing both the numbers of species on Earth and the potential of land and water for supporting them, then there is circumstantial evidence that many animal species will become extinct. Circumstantial evidence is collected by asking and answering overview questions.

Overview questions ask you to determine the author's attitude to a specific item, the main topic of a passage, the author's main point, the primary purpose of a passage, the organization of a passage, etc. Before answering a variety of overview questions about short passages, read the passages and mark possible answer choices.

Text: The Endangered Web of Life

Earth is a habitat suitable for all

Human beings are only one of millions of organisms sufficiently different from one another to be recognized as species. Until the 1980's, scientists estimated that there were between 3 million and 10 million species on Earth. Then, scientists began to examine populations of insects living in the high foliage of trees in tropical forest, and the experience caused them to increase their estimate to 30 million species. After scientists began to consider the populations of microorganisms in the tropics, the upper limit of their estimates rose to 100 million species. We shall probably never have an accurate count of the different kinds of organisms that share our planet.

We do know, however, that these species — plants and animals together — keep the planet functioning as a habitat suitable for all. Scientists call the variety of life forms Earth's *biological diversity* or *biodiversity.* We also know that human activities are reducing both the numbers of species on Earth and the potential of land and water for supporting them. This process is commonly called *biotic impoverishment* — the loss of the rich birth potential of Earth.

Biotic impoverishment is the result of chronic disturbance of the surface of Earth on land or sea. The result, no matter what its cause, is a reduction in the complexity of the form and structure of nature. Ecologists have found that large-bodied organisms that reproduce slowly are lost most readily. Small-bodied or-

Unit 3

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20

ganisms with short reproductive times often survive. These rapidly reproducing, small organisms are the life forms that compete with human beings most effectively and are regarded as «pests,» such as mice and insects.

Sample Questions

• How the author would feel about a reduction in the complexity of the form and structure of nature?

• Which of the following recommendations would the author most likely support?

A To reduce biodiversity in favor of human beings.

B To reduce human activities in favor of biodiversity.

C To keep up the complexity of the form and structure of nature.

D. To limit reproduction of the life forms that compete with human beings.

• The author would be LEAST likely to agree with which of the following statements?

A We will soon have an accurate count of the different kinds of organisms that share our planet.

B Reduction in the complexity of the form and structure of nature results from human activities.

C Chronic disturbance of the surface of Earth on land or sea helps large-bodied organisms reproduce.

• Which of the following best describes the organization of the passage?

The organization of the passage is:

• Too specific
• Too general
• Incorrect
• Irrelevant
• Correct

The tone of the passage could best be described as

(A) objective
(B) optimistic
(C) angry
(D) humorous

• What does the passage mainly discuss?
• What is the most probable topic of the last paragraph?
• What line can best express the main idea of the second paragraph?

Sample Answer Choices

The passage mainly concerns
The main topic of this passage is
The main topic of the last paragraph is
The main idea of the second paragraph is expressed in the words

The threat of extinction

The loss of biological diversity has become most spectacularly noticeable in the extinction or decline of populations of large and well-known animals. Many animal species have become extinct since the 1700's, among them the California grizzly bear, the dodo, and the passenger pigeon. Hundreds of other animal species are threatened. In North America, endangered species include the black-footed ferret, the California condor, the desert tortoise, and the whooping crane.

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Most species in danger of extinction anywhere in the world are suffering from the encroachment of human beings. The Asian elephant, for example, has become an endangered species due to the expansion of the human population throughout its range in southern Asia. In Africa, the African elephants are being killed off for their tusks. Monkeys and other primates throughout the world are threatened by hunting, capture for medical use, and the destruction of their habitats. And the rhinoceroses, lions, and other large mammals of the African *savanna* (grassy plains with scattered trees) compete for land and life with some of the most rapidly growing human populations in the world.

The loss of biological diversity is most severe, however, in the tropical rain forests. The forests of the tropics are particularly vulnerable to disturbance because the soils have a low capacity for retaining nutrients. Most of the forests' nutrient elements are held in the tissues of plants. When loggers and farmers destroy existing plant cover, the nutrients are washed from the land into streams, and the land itself becomes less able to support life. Destruction of these forests destroys the habitat of hundreds, sometimes thousands, of species — from such creatures as the howler monkey and indigo macaw, to less visible species of plants, insects, and microbes, many of which are not yet known to science.

Sample Questions

- How the author would feel about threatened populations of large and well-known animals?
- The author of the passage would most likely be in favor of which of the following policies?

A Capture of monkeys for medical use.
B Destruction of forests to increase food production.
C Protection of large mammals of the African grassy plains.
D Decline of animal populations for expansion of the human population.

- The tone of the passage could best be described as (choose the right words):

objective, optimistic, angry, humorous, critical, threatening, neutral.

- What is the main idea of the first paragraph?
- Why did the author write the second paragraph?
- What is the author's main point in the third paragraph
- What does the passage mainly discuss?

Sample Answer Choices

The main topic of the first paragraph is
The main topic of the second paragraph is
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Smaller and smaller habitats

The apparently sudden surge of threats to species has brought a parallel surge of interest in what can be done to stop the losses. Scientists and conservationists have been primarily interested in determining how large a park or other reserve must be to prevent a decline in the number of species there. In the case of the large migrating animal populations of the African savannas, the required area is obviously very large. But even the bird populations of the tropical forests in South America's Amazon region require thousands of hectares of intact habitat to avoid rapid losses.

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Animals need large habitats for reasons that are complex and not always easily defined. Each species, however, is dependent on many others. Birds, for example, may depend on the fruit of several different species of trees, each of which may bear fruit at a different time.

Scientists' understanding of habitat size has borrowed from the observations of Charles Darwin, a British naturalist of the 1800's. Darwin showed that the number of different kinds of plants and animals on islands varies with the size of the islands and their distance from continents. The larger the island and the closer it is to a continent, the more species it will have.

Darwin's observation takes on special importance in our time because some human activities are cutting apart the natural landscape. When people build roads or extend cities, the effect is to create «islands» within the once-continuous plant and animal communities of a region. Within these islands, the number of species drops. The amount of the decline depends on how small the island is and its degree of isolation.

Sample Questions

- What are scientists and conservationists primarily interested in?
- What is required to avoid losses of animal populations in Africa and South America?
- Which of the following statements would the author LEAST likely agree with?

A The number of different kinds of plants and animals on islands doesn't vary with the size of the islands.

B The larger the island the fewer species it will have.

C Some human activities are cutting apart the natural landscape.

D The number of species increases in human-made islands.

Which of the following best describes the organization of the passage?

Too specific. Chaotic. Too general. Logically structured. Incorrect.

Irrelevant. Correct. Not clear. Well organized.

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(C) angry

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Point out one most characteristic line that best summarizes the author's attitude in each of the four paragraphs.

What is the author's main point in the passage?

What is the most probable topic of the first/second/third paragraph?

Sample Answer Choices

The author's main purpose in writing is to

The primary purpose of this passage is to

The passage mainly discusses

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The first/second/third paragraph most likely deals with

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Expansion of agriculture

Even modern farming methods may lead to a loss of biological diversity. Chemical fertilizers can cause *eutrophication,* a process that upsets the balance of life by encouraging the abundant growth of certain species to the exclusion of others. In a lake, for example, fertilizer runoff can cause the overgrowth of algae. As the larger amounts of algae die, bacteria and other decay-causing organisms thrive. They use up so much oxygen that fish and other marine organisms begin to die. Despite the chemical «enrichment,» such lakes support fewer species of plants and fish.

The process works in reverse as well. Irrigation, for instance, almost always leads to *salinization,* the accumulation of salts on the land's surface. Salinization occurs because irrigation water evaporates, leaving behind minerals dissolved in the water. This alters the soil chemistry and renders the land less capable of supporting plant life. Finally, agricultural practices may also contribute to soil erosion if croplands are left barren after harvest and before planting.

These problems, though often ignored, are widespread. Officials in India, for example, say that one-third of that nation's land area is so impoverished that it supports no plants. The need to replace agricultural land lost to impoverishment is one of the most important causes of deforestation. Farmers abandon their barren land, clear trees from a forest, and begin the cycle of land impoverishment anew.

Sample Questions

- How the author would feel about a loss of biological diversity?
- Which of the following recommendations would the author most likely support?

Encouraging the abundant growth of certain species.
The chemical enrichment of lakes.
Supporting plant life.
Deforestation to get more farming lands.

- What does the passage mainly discuss?
- What is the author's main point?
- How do modern farming methods affect soil?
- What can fertilizer runoff be the cause of?
- What can irrigation lead to?
- What happens if if croplands are left barren after harvest?
- Which of the following is the whole passage primarily concerned?
- Which of the following statements best summarizes the author's attitude toward?
- What line can best express the main idea of each paragraph?

Sample Answer Choices

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Effects of pollution

1. If we were simply interested in preserving known species, a system of extensive parks and reserves around the world involving both land and water might solve it. But the threats to species arise not simply from hunting and the encroachment of people, with their cities and farms, but also from the general pollution of Earth. The pollution causes an often irreversible series of changes in the environment that reduce its potential for supporting plant and animal life.

2. What are the changes and how threatening are they? The most noticeable evidence on land appears downwind of copper and zinc smelters and other heavily polluting industries. The barren landscapes around Copper Hill, Tenn., Sudbury, Canada, and now on dozens of sites in the former Soviet Union and in Eastern European countries reveal the progressive effects of pollution with oxides of sulfur and various toxic metals such as copper and zinc.

3. In the most extreme instances, the areas consist of barren soil, too toxic for any plant to grow in. In some places, severe damage extends over many square kilometers around the industrial plant that is the source of the pollution. These areas are so stark that the landscape appears moonlike. U.S. astronauts preparing to visit the moon in the 1970's practiced navigating their small moon rover on the barren landscape downwind of the smelters at Sudbury. Such environmental changes are underway over vast areas of Earth. Establishing the link between a particular pollutant and its effect on the landscape can be difficult, however. One of the clearest examinations of the patterns of biotic impoverishment was an experiment at Brookhaven National Laboratory that began in 1961 and ended 15 years later. Here, radiation from the radioactive element cesium 137 caused damage to a forest of oaks and pines.

4. Less than 200 meters (220 yards) from the source of the radiation, the full range of effects was clearly visible. Areas of plant growth formed ringlike patterns around the source of pollution. Immediately next to the source, no plants survived. Outside that zone, where radiation exposures were still very high, there was a zone where only certain mosses and lichens survived. Farther away was a ring of *herbaceous* (green) plants. Farther still, there was a ring of low shrubs, then one of taller shrubs. The most subtle effects occurred farther from the source of pollution, where the forest appeared intact. Pines proved to be the most vulnerable of the tree species. They died off before noticeable effects appeared in the several species of oaks.

5. Oak forests without pines are common in central Long Island and elsewhere in North America where oak and pine trees once grew together. Even an experienced ecologist might overlook this change and assume that nothing had happened to a forest that had actually lost its pines. Such are the difficulties of determining the effects of chronic human disturbance at low levels.

Sample Questions

The author uses a chain principle for the organization of the passage when the last sentence of a preceding paragraph is connected with the first sentence of a following paragraph.

The main idea of the third paragraph is that
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Sample Questions

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Which sentences in paragraphs 1, 2, 3, 4, 5 serve as connecting links to create the chain organization of the passage. Write out these sentences and reproduce the logical chain the author has employed in this passage.

Answer the following questions:

- How the author would feel about supporting plant and animal life?
- Which of the following recommendations would the author most likely support? Or The author would be LEAST likely to agree with which of the following statements? Or The author of the passage would most likely be in favor of which of the following policies?

(A) Hunting and the encroachment of people must be stopped.

(B) Production of oxides of sulfur and various toxic metals such as copper and zinc must be stopped.

(C) The effects of chronic human disturbance should be overlooked.

(D) A system of extensive parks and reserves around the world involving both land and water should be established.

- What are the effects of the general pollution of Earth?
- What are the most noticeable changes caused by the general pollution of Earth?
- Can the link be established between a particular pollutant and its effect on the landscape?
- What trees are the most vulnerable to pollution — oaks 0r pines?
- What might an experienced ecologist overlook?

The tone of the passage could best be described as

(A) objective

(B) optimistic

(C) angry

(D) humorous

- What is the main topic of this passage?
- What is the main idea of the passage?
- What does the passage mainly discuss?
- What is the author's main point?
- Why did the author write this passage?

Sample Answer Choices

This author's main purpose in writing is to

The passage mainly concerns

The main idea of this passage is that

The primary purpose of this passage is to

The main topic of this passage is

The passage primarily deals with

The main topic of the entire passage is

Which sentences in paragraphs 1, 2, 3, 4, 5 serve as connecting links to create the chain organization of the passage. Write out these sentences and reproduce the logical chain the author has employed in this passage.

Answer the following questions:

- How the author would feel about supporting plant and animal life?
- Which of the following recommendations would the author most likely support? Or The author would be LEAST likely to agree with which of the following statements? Or The author of the passage would most likely be in favor of which of the following policies?

(A) Hunting and the encroachment of people must be stopped.

(B) Production of oxides of sulfur and various toxic metals such as copper and zinc must be stopped.

(C) The effects of chronic human disturbance should be overlooked.

(D) A system of extensive parks and reserves around the world involving both land and water should be established.

- What are the effects of the general pollution of Earth?
- What are the most noticeable changes caused by the general pollution of Earth?
- Can the link be established between a particular pollutant and its effect on the landscape?
- What trees are the most vulnerable to pollution — oaks 0r pines?
- What might an experienced ecologist overlook?

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Plural nouns in place of singular nouns and singular nouns in place of plural nouns

Sometimes it is clear that a singular noun is incorrectly used because the verb is plural, or that a plural noun is used incorrectly because the verb is singular.

Sometimes it is obvious that a plural or a singular noun is needed because of the determiners that precede the noun. Certain determiners are used only before singular nouns while other determiners are used only before plural nouns.

Determiners used with singular nouns: a/an, one, a single, each, every**,** this, that.

Determiners used with plular nouns: two, three, four, etc., dozens of, hundreds of, thousands of, a few (of), many (of), a number of, the number of, a couple (of), every one of, each one of, each of, one of, these, those.

Each *contestant* won a prize.

Each of the *contestants* won a prize.

This *flower* is a yellow rose.

These *flowers* are yellow roses.

I only attended one *game* this season.

It was one of the most exciting *games* that I ever attended.

Examples

Many of Chekhov's story have become classics in world literature.

In this item, both the determiner before the noun (*many of*) and the plural verb (*have*) indicate that a plural noun (*stories*) should be used.

Mauna Loa, an active volcano on the island of Hawaii, usually has one eruptions every three years. A singular noun must be used after the determiner *one.*

Errors involving irregular plurals

Most plural nouns in English end in *-s,* but a few are irregular.

Common Irregular Plural Nouns: children, men, women, feet, teeth, mice, fish.

Singular Nouns: child, man, woman, foot, tooth, mouse, fish.

Example

As childs grow older, their bones become thicker and longer.

The correct plural form of *child* is *children*

Errors with plural forms of uncountable nouns

In some items an uncountable noun (such *as furniture, research, sunshine, information, bread,* and so on) is incorrectly given as a plural noun

Example

Some encyclopedias deal with specific fields, such as music or philosophy, and provide informations only on the given subject.

Information is an uncountable noun and cannot be pluralized.

Errors with plural compound nouns

Compound nouns consist of two nouns used together to express a single idea: *grocery store, travel agent, dinner party,* and *house cat,* for example. Only the

Section 2. GUIDELINES FOR GRAMMAR TEST

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Compound nouns consist of two nouns used together to express a single idea: *grocery store, travel agent, dinner party,* and *house cat,* for example. Only the

second noun of compounds is pluralized: *grocery stores, travel agents, dinner parties,* and *house cats.*

(There are rare exceptions to this rule—*sports cars* and *women doctors,* for example—but these are very rare.)

Example

Boris Akunin's detectives stories are admired both by critics and general readers.

The correct plural form of this compound noun is *detective stones.*

Errors involving plural forms of numbers and measurement

Some errors involve numbers + measurements:

They went for a *6-mile* walk. They walked *6 miles:*

In the first sentence, the number + measurement is used as an adjective, and the measurement is singular. In the second, the measurement is a noun, and is therefore plural.

Numbers like *hundred, thousand,* and *million* may be pluralized when they are used indefinitely—in other words, when they do not follow other numbers:

seven thousand acres	thousands of acres
five million dollars	millions of dollars

Example

The U.S. president serves a maximum of two four-years terms.

When used before a noun, a number + measurement is singular.

Thousand of antibiotics have been developed, but only about thirty are in common use today.

The plural form *thousands* should be used.

Exercise: Identify and correct errors involving singular and plural nouns.

Directions: Decide which of the underlined words or phrases in the following sentences would not be considered correct, and write down the correction of the expression at the end of a: sentence.

1. The male mandril baboon is one of the most colorful of all mammal.
2. Zoonoses are diseases that can be transmitted to humans beings by animals.
3. Many championship for automobiles and motorcycle races take place in Sahara,
   Africa.
4. The Newberry Award is granted every years to the authors of outstanding books for
   children.
5. Source of air pollution vary from city to city.
6. Around 75 percents of the earth's surface is covered by water.
7. All college and universities get their funds from a variety of sources.
8. Marble Cave in the Crimea was the home of cliff-dwelling people thousand of years ago.
9. In 1792 a corporation constructed a 60-miles toll road from Philadelphia to Lancaster, Pennsylvania.

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Mini-test

Identify and correct errors involving singular and plural nouns

Quite a few population of insects live in the high foliage of trees in a tropical forests.

We shall probably never have an accurate count of the different kind of organisms that share our planet.

These species — plants and animals together — keeps the planet functioning as a habitat suitable for all.

Scientists call the variety of life form Earth's *biological diversities* or *biodiversities.*

We also know that human activities are reducing both the numbers of species on Earth and the potentials of land and water for supporting them.

This process is commonly called *biotic impoverishments* — the loss of the rich birth potential of Earth.

This rapidly reproducing, small organisms are the life form that compete with human beings most effectively.

The loss of biological diversities has become most spectacularly noticeable in the declines of populations of large and well-known animals.

The species of African elephants are in danger of extinction.

When loggers and farmers destroy existing plant covers, the nutrients are washed into streams.

Eutrophications is a process that upsets the balance of life.

It was a 200 meters long range of radiation.

Each of noticeable effect of radiation appeared in the several species of oaks.

There was a radiation zone where every pine were dead.

Human beings are only one of million of organisms sufficiently different from one another to be recognized as species.

Until the 1980's, scientists estimated that there were between 3 millions and 10 millions species on Earth.

Key to mini-test exercise 1 in Unit 2.

Protecting, controversy, politicians; research, genetic, testing; synthesis, displayed, growth, unpredictably; closely, more successful; kinds, cannibals.

Key to mini-test exercise 2 in Unit 2.

A growing body of literature suggests that mothers who violate gender roles by seeking full-time

employment are negatively stereotyped and discriminated against. Psychologists asked undergraduate students to read CVs describing a consultant who was either female or male and either a parent or not a parent. Students requested and recommended the

consultant less when she was a mother than a woman without children, though fatherhood did

not affect a man's chances of being requested and recommended. Students rated

a mother more communal (warm) but less agentic (competent) than a woman without children.

Other psychologists asked undergraduate and graduate students to evaluate a job applicant depicted as male or female and with or without children. Similarly, participants recommended a mother less often than a woman without children. Fatherhood had no effect on a man's chances of recommendation.

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Section 1. GUIDELINES FOR READING ACADEMIC TEXTS

EXPLICATION OF FACTS AND DETAILS GIVEN IN THE TEXT

FACTUAL QUESTIONS, NEGATIVE QUESTIONS, AND SCANNING QUESTIONS

Instruction: Factual or detail questions ask about explicit facts and details given in the passage. To answer factual questions, you have to locate and identify the information that the question asks about. **Negative questions** ask you to determine which of the choices is not given in the passage. These questions contain the words NOT, EXCEPT, or LEAST. **Scanning questions** ask you to find where in the passage some particular information or transition is located. They are easy to identify: the answers are usually found in the line of the text.

If you are not sure from your first reading where to look for specific answers, use the following **scanning** techniques.

- Focus on one or two key words as you read the stem of each question. Lock these words in your mind.
- Scan the passage looking for the key words or their synonyms. Look only for these words. Do NOT try to read every word of the passage.
- It may help to focus your attention. Don't reread the passage completely—just look for key words.
- When you find the key words in the passage, carefully read the sentence in which they occur. You may have to read the sentence preceding or following that sentence as well.
- Compare the information you read with possible answer choices.

Text: Basics of genetic research

1. **The beginning of genetic science**

A. The new genetic medicine has grown out of the scientific study of *genes,* the basic units of heredity in all living organisms. It has its roots in the work of Gregor Johann Mendel, an Austrian monk who lived in the 1800's. Working for years in his monastery's garden, Mendel crossbred pea plants and observed how traits for height and other characteristics were passed from one generation to the next. Mendel theorized that these traits were determined by «hereditary units» passed on by each plant's male and female parents. From his observations, Mendel theorized that a parent has two hereditary units for each trait, but only one is passed on to an offspring. Mendel further concluded that among these units there were what he called dominant and recessive types. When an offspring inherits a dominant type from one parent and a recessive type from the other, the dominant hereditary unit will always «overrule» the recessive one. The offspring will exhibit the characteristics associated with the dominant type. An offspring could NOT exhibit a trait associated with a recessive hereditary unit EXCEPT only by inheriting two recessive types –one from each parent.

Unit 4

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30

B. Mendel's work laid the foundation for the modern study of genetics. But Mendel died in 1884 without having the LEAST idea about what his hereditary units actually were. And, the importance of his work was NOT recognized until the early 1900's, when three botanists studying heredity each rediscovered Mendel's work. These scientists — Carl Correns of Germany, Erich von Tschermak of Austria, and Hugo de Vries of the Netherlands — all conducted plant breeding experiments and independently obtained the same results as had Mendel. In 1909, Danish botanist Wilhelm Ludwig Johannsen proposed that Mendel's hereditary units be called *genes,* from a Greek word meaning *to give birth to.*

2. **Genes of twin brothers**

A. Genes can influence whether a man becomes heterosexual or homosexual, according to a recent report. The study by psychologist J. Michael Bailey of Northwestern University in Evanston, Il., and psychiatrist Richard C. Pillard of Boston University School of Medicine raised controversy while NOT identifying specific genes involved in homosexuality.

B. Bailey and Pillard recruited and interviewed 161 gay or bisexual men. Each man had an identical twin brother, a fraternal twin brother, or an adopted brother. Identical twins have the same genetic material, while fraternal twins have some but NOT all genes in common. Unrelated adoptive siblings would have NO more genetic similarities than any other unrelated pair.

C. The researchers questioned the men's brothers to determine their sexual orientation. The interviewers found that in 50 per cent of the identical twins, both brothers were homosexual, compared with 24 per cent of the fraternal twins and 19 per cent of unrelated brothers.

D. The researchers concluded that genes may equal or outweigh environmental influences on the development of male homosexuality and heterosexuality. Critics of the study charged that a larger sample of twins or different interview questions about sexuality might have produced different results.

3. **The development of genetic engineering**

A. The next major chapter in the genetic science story was the development of techniques for working with genes. These techniques, called recombinant DNA technology or genetic engineering, were to lead to a variety of medical applications. The first recombinant DNA techniques were developed in the early 1970's by molecular biologists Paul Berg and Stanley Cohen of Stanford University, in Stanford, Calif., and Henry Boyer of the University of California at San Francisco. They and other molecular biologists discovered how to cut a piece of DNA out of one organism and splice it into the DNA of another organism. Berg won the 1980 Nobel Prize in chemistry for his role in this work.

B. The earliest genetic engineering experiments involved splicing pieces of DNA from simple organisms into a *plasmid,* a circular piece of DNA found in bacteria. For these experiments, the scientists used *restriction enzymes,* a kind of «biochemical scissors,» that cut strands of DNA at specific base pair sequences. The scientists could cut a gene from one organism, open a bacterial plasmid, and insert the «foreign» gene.

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C. From the very beginning, recombinant DNA technology raised a number of questions regarding ethics and safety. Scientists, environmentalists, and po-

litical leaders feared the accidental creation of a deadly strain of microorganism. In 1974, a number of distinguished scientists, including Berg, Cohen, and Watson, called for a voluntary ban on gene-splicing experiments until safeguards could be established. Many of the scientists involved in this work met for a conference at Asilomar, Calif., in 1975 to discuss potential dangers and propose research guidelines. In 1976, the National Institutes of Health set standards requiring that laboratories in which these experiments took place be designed to prevent any microorganisms from escaping. EXCEPT ethical concerns about potential abuses of genetic technology that continue to this day, the LEAST likely fears about potential dangers of gene splicing did NOT prove to be largely grounded.

D. Eventually, scientists learned how to splice human genes into plasmids and insert the plasmids into fast-growing bacteria. Whenever the bacteria reproduced, so did the plasmid and the human gene that had been inserted. This process, called gene cloning, made it possible for scientists to create billions of copies of a particular human gene.

Factual questions.

The order of factual or detail questions about a passage almost always follows the order in which ideas are presented in the passage. In other words, the information you-need to answer the first detail question will usually come near the beginning of the passage; the information for the second will follow that, and so on. Knowing this should help you locate the information you need.

Correct answers for detail questions are seldom the same, word for word, as information in the passage; they often contain synonyms and use different grammatical structures.

Factual questions often contain one of the *wh-* question words: *who, what, when, where, why, how much,* and so on. Factual questions often begin with the phrases «According to the passage,...» or «According to the author. ...» When you see these phrases, you know that the information needed to answer the question is directly stated somewhere in the passage.

Sample Questions

- What did Mendel observe while crossbreeding pea plants? (A) Traits for height and other characteristics of plants; (B) How traits were lost while being passed on from parents to an offspring; (C) Hereditary units passed on by each plant's male and female parents.
- How many hereditary units are passed to an offspring?
- What did Mendel's work lay the foundation for?
- In what line does the author shift his focus to sexual orientation?
- Where in the passage does the author first discuss twin brothers?
- According to the passage, a description of twin brothers can be found in paragraph 2. Where in the passage does the author specifically stress absence of genetic similarities?
- In what paragraph does the author first mention the concept of. recombinant DNA technology?
- What did scientists fear about gene-splicing?
- According to the author, definite standards were set by the National Institutes of Health. What standards were required from experimental laboratories?

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Scanning questions

Scanning questions are usually easy to answer. Use the same techniques for scanning given about detail questions. For each question, locate that part of the passage in which the answer will probably be found, and write it out. Don't worry about answering the question itself, only about finding the information. Do these scanning questions as fast as you can.

Sample Questions

- What hereditary characteristics will the offspring exhibit? (A) The characteristics associated with the dominant type;. (B) Traits associated with a recessive hereditary unit; (C) No hereditary types. According to the article, which of the twin brother types were most homosexual?
- In what way are «biochemical scissors» used?
- When did molecular biologists discover genetic engineering?
- Where is the «foreign» gene inserted?
- How is the process of gene cloning performed?

Negative questions

Negative questions often take more time to answer than other questions. Therefore, you may want to guess and come back to these questions if you have time. Scan the passage to find the answers that ARE correct or ARE mentioned in the passage. Sometimes the three distractors NOT, EXCEPT, or LEAST are clustered in one or two sentences; sometimes they are scattered throughout the passage. The correct answer, of course, is the one that does not appear.

Sample Questions

- According to the passage, only one of the following is true: (A) The dominant hereditary unit will sometimes «overrule» the recessive one. (B) The recessive hereditary unit will sometimes «overrule» the dominant one. (C) The recessive hereditary unit will always «overrule» in one case. Which choice is true?
- Which of the following is the LEAST likely: When Mendel died in 1884 he had about what his hereditary units actually were.

(A) a good idea, (B) no idea, (C) a vague idea

- Which of the following is NOT mentioned in the passage? The importance of Mendel's work became widely known (A) in the end of the 19th century, (B) middle of the 20th century, (C) first decades of the 20th century.
- Find the line where it is stated which of the brother types has more common genetic material (A) identical twins (B) fraternal twins or (C) adopted brothers.
- Which of the two types has more genetic similarities: (A) unrelated adoptive siblings or (B) other unrelated pairs?
- Which of the following is the LEAST likely: _____(A) potential abuses of genetic technology or (B) potential dangers of gene splicing?

Scanning questions

Scanning questions are usually easy to answer. Use the same techniques for scanning given about detail questions. For each question, locate that part of the passage in which the answer will probably be found, and write it out. Don't worry about answering the question itself, only about finding the information. Do these scanning questions as fast as you can.

Sample Questions

- What hereditary characteristics will the offspring exhibit? (A) The characteristics associated with the dominant type;. (B) Traits associated with a recessive hereditary unit; (C) No hereditary types. According to the article, which of the twin brother types were most homosexual?
- In what way are «biochemical scissors» used?
- When did molecular biologists discover genetic engineering?
- Where is the «foreign» gene inserted?
- How is the process of gene cloning performed?

Negative questions

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Errors with pronouns

Pronoun errors involve several groups of pronouns.
Personal pronouns
(he, she, it, they, **and** so on)
Reflexive pronouns
*(himself, herself, itself, themselves***,** and so on)
Relative pronouns (adjective-clause markers)
(who, whose, which, that, and so on)
Demonstrative pronouns
*(this, that***,** *these, those)*
For the purposes of this lesson, **possessive pronouns** *{his* house, *their* bicycles) are considered together with personal pronouns.

The greatest number of errors involve personal pronouns.
A pronoun must agree with the noun to which it refers (the pronoun's referent**).**
Most agreement errors with personal pronouns, reflexive pronouns, and demonstrative pronouns consist of a singular pronoun referring lo a plural noun or a plural pronoun referring to singular nouns.

Agreement errors with relative pronouns usually involve the use of *who* to refer to things or *which* to refer to persons. (Note: The relative pronoun *that* can be used in certain sentences to refer to both persons and things.)

Another error involves the use of *this* or *these* in place of *that* and *those. (This* and *these* are used lo refer to things that are perceived as close in time or space; *that* and *those* are used to refer to things that are perceived as distant in time or space.)
Examples
Jackrabbits have powerful rear legs that enable it to leap long distances.
The pronoun referring to the plural noun Jackrabbits must be plural.
The best way for children to learn science is for them to perform experiments himself
The referent is plural (children), so the reflexive pronouns must also be plural (themselves) to agree with it.
The Canadian Shield is a huge, rocky region who curves around Hudson Bay like a giant horseshoe.
The referent for the pronoun who is region. To agree with the referent, the relative pronoun that must be used. The pronoun who can refer only to a person.

Errors in pronoun form
These errors involve personal pronouns. A subject form like he might be used in place of an object form like him, or a possessive pronoun like hers might be used in place of a possessive adjective like her. This type of pronoun error is usually easy to spot.

Section 2. GUIDELINES FOR GRAMMAR TEST

Errors with pronouns

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Incorrect type of pronouns

In some sentences, the wrong type of pronoun is used. For example, a reflexive pronoun might be used when a personal pronoun is needed, or a personal pronoun used when a relative pronoun is required.

Examples

As larvae, barnacles are free-swimming, but as adults they attach them to stones, docks, and hulls of ships.

The reflexive pronoun is required because the subject and object are the same entity: they attach themselves.

A barometer is a device it is used to measure atmospheric pressure.

A personal pronoun (it) cannot be used to connect an adjective clause to the rest of the sentence. A relative pronoun ⌈which or that) must be used instead.

Incorrect inclusion of pronouns

Some errors involve the unnecessary use of pronouns. Often, this type of error occurs when a personal pronoun is used as a subject in a sentence that already has a noun subject. Or it may involve a personal pronoun used unnecessarily in a relative clause.

In a few cases, a relative pronoun is used unnecessarily.

Examples

Block Island in Long Island Sound it is surrounded by cold, dangerous waters.

The subject of the sentence is Block Island; the personal pronoun it is an unnecessary repetition of the subject.

Dutch elm disease, which it is caused by a fungus, can destroy a tree within four weeks.

The pronoun it is not needed.

Certain types of turtles that may live as long as 100 years.

There is only one verb (may live). A sentence that contains a relative clause must have a verb in each clause.

Mini-test

Identify and correct errors involving pronouns

This traits were determined by «hereditary units» passed to each plant.

John’s parents that were on a trip asked his aunt to look after his.

Whether a man becomes heterosexual or homosexual is influenced by their genes.

The twin brothers looked very much alike. To distinguish between they was a problem for their teachers.

The police questioned the man’s brother to determine their alibi.

Berg won the 1980 Nobel Prize it was in chemistry for his role in this work.

Many of the scientists involved in those work met for a conference at Asilomar, Calif. to discuss potential dangers and propose research guidelines.

In 1976, the National Institute of Health set their standards requiring that laboratories in what that experiments took place be designed to prevent any microorganisms from escaping.

A young researcher prefers to make his decisions by him.

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This is your book and that is my.

Negative questions often take more time to answer than other questions. Therefore, you may want to guess oneself.

This should help you locate the information you need yourselves.

Husband and wife, he and she must share the good and the bad between his and her.

The recessive hereditary unit will sometimes «overrule» the dominant one who will become recessive in his turn.

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Section 1. GUIDELINES FOR READING ACADEMIC TEXTS

MAKING INFERENCES AND UNDERSTANDING INDIRECT INFORMATION GIVEN IN THE TEXT

INFERENCE AND PURPOSE QUESTIONS

Instruction: There are questions that require you to make **inferences**. The answers to these questions are not directly provided in the passage—you must «read between the lines.» In other words, you must make conclusions based indirectly on information in the passage. Many text-readers find these questions the most difficult type of reading questions.

Inference questions may be phrased in a number of ways. Many of these questions contain some form of the words *infer* or *imply.*

Purpose Questions ask why the author of a text mentions some piece of information, or includes a quote from a person or a study, or uses some particular word or phrase.

Text: The Chemistry of Cleaning Clothes

Sample item:

Part 1. Have you ever wondered how a cup of detergent cleans soiled jeans, towels, socks, and other articles in your wash, or how cleaning fluid at the dry cleaner whisks away that grease stain from your suit? And why are hair spray, vinegar, club soda, and baking soda surprisingly effective dirt and stain removers in an emergency? The answers lie both in the chemical properties of various types of dirt and stains and in the ways that the cleaning agents chemically interact with them.

- It can be inferred from this passage that

(A) Hair spray, vinegar, club soda, and baking soda are detergents.
(B) A cup of detergent cannot clean in an emergency/
(C) Cleaning fluid can remove a grease stain but cannot remove dirt.
(D) Cleaning agents interact with chemical properties of dirt and stains..

Choice (A) is not a valid inference; because hair spray is a cosmetic product while vinegar, club soda, and baking soda are mostly used as food products.

Choice (B) also cannot be inferred; as the word cup is used in the meaning «any quantity». Besides the use of a detergent doesn't depend on degree of emergency.

Nor can (C) be inferred; because the notion of grease stains and dirt is used as a whole.

Since every substance has chemical properties, it can be inferred that the essence of cleaning is in the interaction of cleaning agents with chemical properties of dirt and stains. Therefore choice (D) is the right inference.

Unit 5

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Part 2. Dirt and stains typically consist of particles, such as minerals from soil, protein and other organic matter from living things, or bits of black carbon. The particles are trapped on cloth fibers by grease and oil, which cannot be dissolved in water. Anything that can loosen the grease and oil from the fibers and *disperse* (scatter) these substances in the wash water or dry-cleaning solution will remove the dirt and stains.

Soaps, detergents, cleaning fluids, and many emergency stain removers are effective cleaners because they can dissolve and *emulsify* (break up and suspend) the oil and grease that holds dirt in place. The grease and trapped soil particles then can be carried away in the water or dry-cleaning solution. But these agents differ widely in their dirt-fighting activities and the conditions under which they work. To understand why, we must understand the chemical nature of soaps and detergents.

The words *soap* and *detergent* are often used interchangeably, but the two cleaners differ considerably. Soaps are generally made from natural fats and oils. Soaps are excellent for cleaning our hands, face, and body, because the loosened dirt is rinsed away immediately. But soaps have definite drawbacks for cleaning laundry. For example, soaps often allow dirt lifted from clothes to re-deposit on the clothes before the wash cycle is finished. And in *hard water* (water containing high levels of minerals), soaps react with minerals to form scum, called soap curd. Soap curd does not dissolve. It is difficult to remove from fabrics, and it makes the fabric feel stiff.

Because of these drawbacks, laundry soaps have largely been replaced by detergents. Detergents are *synthetic* (artificial) mixtures of ingredients that not only clean clothes but also prevent re-deposition of dirt, discourage scum formation, and possess other useful properties. The most important advantage of detergents is the ability to clean effectively in hard water.

Sample Questions:

• Which of the following can be inferred from the passage?

(A) Particles of minerals, black carbon, and organic matter trapped on cloth fibers by grease and oil can be dissolved in the water.

(B Particles of minerals, black carbon, and organic matter trapped on cloth fibers by grease and oil can be loosened from the fibers and dispersed in the wash water or dry-cleaning solution.

• Which of the following would be the most reasonable guess about drawbacks of laundry soaps?

(A) Soaps aren't effective cleaners because they cannot break up and suspend the oil and grease that holds dirt in place.

(B) Soaps can loosen dirt if it is rinsed away immediately.

(C) Soaps react with minerals in hard water.

(D) Soaps make the fabric feel stiff.

• Which of the following would be the right guess about laundry soaps?

(A) Soaps re-deposit dirt on the clothes before the wash cycle is finished

(B) Soaps form soap curd with water.

(C) Soaps clean our hands, face, and body but soaps cannot be used for cleaning laundry.

(D) Soaps are generally natural mixtures while detergents are artificial mixtures.

Part 2. Dirt and stains typically consist of particles, such as minerals from soil, protein and other organic matter from living things, or bits of black carbon. The particles are trapped on cloth fibers by grease and oil, which cannot be dissolved in water. Anything that can loosen the grease and oil from the fibers and *disperse* (scatter) these substances in the wash water or dry-cleaning solution will remove the dirt and stains.

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(C) Soaps clean our hands, face, and body but soaps cannot be used for cleaning laundry.

(D) Soaps are generally natural mixtures while detergents are artificial mixtures.

• Does the passage imply that soaps mostly have drawbacks while detergents mostly have advantages?

Sample answers:
It can be inferred from the passage that . . .
The author implies that . . .
The author suggests that . . .
It is probable that .

Part 3. Both soaps and detergents contain cleaning ingredients known as *surfactants.* Surfactant compounds are *molecules* (linked groups of atoms) attracted to the boundary between two liquids that normally do not dissolve in each other, such as oil and water. One end of the surfactant molecule is attracted to water but not oil, and the other end is attracted to oil but not to water.

This dual nature of surfactant molecules boosts the «wetting» ability of water. This means that water containing surfactants can more easily penetrate and disperse dirt and stains. One end of the surfactant molecule dissolves and emulsifies the grease that traps soil particles on fabrics. The other end dissolves in the surrounding water. As a result of this action, one portion of the molecule pulls away from the other, and this force pulls the grease from the clothes and suspends it in the form of tiny droplets. Washing machine agitation also helps loosen the greasy soil. After the soil droplets are suspended in the water, the thin layer of surfactant molecules around them keeps them separated from the fabric and prevents them from resettling on the clothes. The suspended droplets and the soil clinging to them are then easily rinsed away by the water.

The same principle enables hair spray to remove ink and certain other stains from clothes. Some hair sprays contain alcohol, which behaves chemically in a way similar to surfactants in detergents. One portion of the alcohol molecule penetrates and emulsifies the oils that hold the ink pigments in place. Another portion of the alcohol molecule dissolves in the alcohol solvents also found in hair spray. In this way, hair spray loosens the ink pigments, which can then be removed by conventional laundering with water and detergents.

Purpose Questions
These questions ask why the author of a passage mentions some piece of information, or includes a quote from a person or a study, or uses some particular word or phrase.

Sample item:
• **Question:** Why does the author mention *surfactants*?
• **Answer:** The author refers to *surfactants* to indicate that soaps and detergents must contain these ingredients in order to do the cleaning.

Sample Questions
• Why does the author mention the «wetting» ability of water?
• Why does the author refer to one end and the other end of the surfactant molecule?
• Why does the author mention hair spay?

• Does the passage imply that soaps mostly have drawbacks while detergents mostly have advantages?

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• Why does the author mention hair spay?

• Why does the author use the phrase «dual nature of surfactant»?
Why does the author describe the molecular activity of surfactants?

Sample Answer Choices:

The author refers to / The author describes / The author uses the phrase / The phrase ___proves that /The phrase ___is mentioned to illustrate that
to indicate that
to strengthen the argument that
to provide an example of
to challenge the idea that
to contradict
to support the proposal to
to illustrate the effect of
to make it easy for the reader to understand how

Part 4.

4-1. Compounds called *enzymes* enhance the cleaning action of surfactants. Enzymes are complex molecules made by living organisms. Often called «biological catalysts,» enzymes promote certain chemical reactions without themselves being changed. Enzymatic action is similar to digestive juices in the stomach, which break down food in preparation for digestion in the intestines. Detergent enzymes, made by bacteria in factory production vats, react with and break up stains that are made of proteins. Such stains include blood, meat gravy, milk, eggs, and grass. Enzymes break down these substances into simpler forms that can be removed by other components in the detergent.

4-2. If you're out of enzyme detergents and the stores are closed, try using a meat tenderizer on a protein stain. The tenderizer contains enzymes intended to partially digest proteins in meat before it is cooked. But when poured onto clothing or carpets, the enzymes can also break up protein molecules in stains. (But make sure to rinse the stain with water to wash away the salt, spices, and coloring that are included with the enzymes in the tenderizer.)

4-3. Another group of chemical compounds used in detergents are called *builders.* Builders typically make up more than half the weight of a box of detergent. Their principal function is to soften hard water. These chemicals react with and remove from wash water certain minerals, particularly those containing calcium and magnesium. Such minerals can react with surfactants to form scums that deposit on clothes and interfere with cleaning action. Minerals can also promote redeposition of removed soil particles.

4-4. Another function of builders is to make the wash water alkaline. *Alkali builders* are chemicals that neutralize acids in the water and aid the breakup of oil and fat molecules by rupturing their chemical bonds. Some builders act as buffering agents to maintain the proper alkaline level in the wash water.

4-5. Because ordinary baking soda contains an alkali — sodium bicarbonate — baking soda is handy for neutralizing and removing acid stains such as those made by toilet-bowl cleaners. Because vinegar contains acetic acid, which is mildly acidic, it is useful for breaking up and dissolving such alkaline stains as hard-water residues. You also could use club soda on these residues, because it contains weakly acidic carbonic acid, a compound not found in plain water.

• Why does the author use the phrase «dual nature of surfactant»?
Why does the author describe the molecular activity of surfactants?

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4-4. Another function of builders is to make the wash water alkaline. *Alkali builders* are chemicals that neutralize acids in the water and aid the breakup of oil and fat molecules by rupturing their chemical bonds. Some builders act as buffering agents to maintain the proper alkaline level in the wash water.

4-5. Because ordinary baking soda contains an alkali — sodium bicarbonate — baking soda is handy for neutralizing and removing acid stains such as those made by toilet-bowl cleaners. Because vinegar contains acetic acid, which is mildly acidic, it is useful for breaking up and dissolving such alkaline stains as hard-water residues. You also could use club soda on these residues, because it contains weakly acidic carbonic acid, a compound not found in plain water.

4-6. Some builders also boost the action of surfactants. For example, certain builders help surfactants suspend loosened dirt and keep it from settling back on clothes. Other builders help surfactants emulsify greasy soil by breaking the oily particles into tiny globules.

4-7. In the 1960's, chemicals called phosphates were the most common builders in detergents. Phosphates remove minerals from hard water by combining with them. The compound thus formed is then rinsed away with the water after the clothes are washed.

4-8. But phosphates in waste water were found to harm the environment. Detergent phosphates ultimately ended up in streams and lakes, and because phosphates are nutrients for algae, the chemicals overfertilized the streams and lakes. club soda on these residues, because it contains weakly acidic carbonic acid Eventually, the abundance of algae clogged streams and lakes, setting in motion a process that could kill most of the life in the water. Because of this, detergent manufacturers drastically reduced the phosphate content of their products and began using builders that were less harmful to the environment.

Valid inferences based on sentences

To identify inferences based on sentences read each sentence, then mark the one answer choice—(A), (B), or (C)—that is a valid inference based on that sentence.

Sentence: Enzymatic action is similar to digestive juices in the stomach.

Valid inferences: (A) Enzymes break down food in the intestines. (B) Digestive juices are enzymes that break down bacteria. (C) Enzymes like digestive juices promote certain chemical reactions.

Sentence: But make sure to rinse the stain with water to wash away the salt, spices, and coloring that are included with the enzymes in the tenderizer.

Valid inferences: (A) Tenderizers have to be separated from water. (B) Enzymes have to be separated from tenderizers. (C) Enzymes have to be separated from salt, spices, and coloring.

Sentence: These chemicals react with and remove from wash water certain minerals, particularly those containing calcium and magnesium.

Valid inferences: (A) Builders react with wash water. (B) Builders contain calcium and magnesium. (C) Builders remove calcium and magnesium.

Make valid inferences based on the following sentences:

Alkali builders are chemicals that neutralize acids in the water and aid the breakup of oil and fat molecules by rupturing their chemical bonds.

Certain builders help surfactants suspend loosened dirt and keep it from settling back on clothes.

Detergent phosphates ultimately ended up in streams and lakes, and because phosphates are nutrients for algae, the chemicals overfertilized the streams and lakes.

Valid inferences based on longer passages.

Read the passages. If the statements following the passages are valid inferences based on passages, mark the items TRUE. If the statements cannot be inferred from the passage, mark those FALSE.

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Passage 4-5. Because ordinary baking soda contains an alkali — sodium bicarbonate — baking soda is handy for neutralizing and removing acid stains such as those made by toilet-bowl cleaners. Because vinegar contains acetic acid, which is mildly acidic, it is useful for breaking up and dissolving such alkaline stains as hard-water residues. You also could use club soda on these residues, because it contains weakly acidic carbonic acid, a compound not found in plain water.

Valid inferences: (A) Baking soda, vinegar and club soda are similar in their effect on stains. (B) Baking soda, vinegar and club soda can be used both on alkaline and acidic stains. (C) Each of these — baking soda, or vinegar, or club soda can be used in their own way.

Passage 4-7. In the 1960's, chemicals called phosphates were the most common builders in detergents. Phosphates remove minerals from hard water by combining with them. The compound thus formed is then rinsed away with the water after the clothes are washed.

Valid inferences: (A) In the 1960's, chemicals called phosphates were used as building materials. (B) In the 1960's, chemicals called phosphates were used as detergents for washing clothes. (B) In the 1960's, chemicals called phosphates were used as parts of detergents.

Part 5.

5-1. Interestingly, there is no relationship between a detergent's sudsing action and its cleaning ability. Nevertheless, manufacturers may recommend the use of low sudsing detergents for front-loading tumbler-type washing machines because high levels of suds would cushion clothes as they drop back into the water after being lifted out in the tumbling action. Such a cushioning effect would interfere with the machine's washing action. To appeal to consumers who prefer various amounts of suds, detergent manufacturers include in their formulas special sudsing modifiers. These compounds are long-chain molecules, made from natural fats, that can either boost or depress levels of suds made by dissolved detergents.

5-2. *Bleaches* do not remove dirt particles but make them colorless or nearly colorless. Liquid chlorine bleach is the most powerful of the chemical bleaches used, as laundry aids. Chlorine bleach not only whitens clothes, but also disinfects and deodorizes them. It can, however, remove color from clothes. A less powerful chemical bleach is *oxygen bleach*. Because it is safe to use on most fabrics, oxygen bleach is the one most frequently added to detergents. It is also used in presoak products to aid in cleaning heavily soiled clothes or in helping to remove stubborn stains before clothes are put through a normal washing machine cycle. Some presoak products use enzymes, but these require more time to work than do products using only oxygen bleach. Also, enzyme presoak products should not be used at the same time as chlorine bleach, because chlorine bleach destroys enzymes. By using the products separately, you will get the maximum benefit of each.

5-3. Other laundry aids also do not remove dirt or stains, yet they can make clothes appear cleaner. *Whiteners,* also known as optical bleaches, consist of *organic* (carbon-containing) molecules that can absorb invisible forms of light and,

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5-3. Other laundry aids also do not remove dirt or stains, yet they can make clothes appear cleaner. *Whiteners,* also known as optical bleaches, consist of *organic* (carbon-containing) molecules that can absorb invisible forms of light and,

through a complex process at the atomic level, reemit it as visible blue light. Clothes treated with these compounds come out of a wash looking both brighter and whiter than they did before being washed. *The hydrogen peroxide* found in many medicine cabinets for the treatment of wounds behaves comparably to the bleach we add to washes. When applied to blood stains, for example, peroxide liberates oxygen atoms, which turns red blood pigments into less brightly colored stains. Denture cleaning tablets, which contain oxygen in the same form found in oxygen bleaches, can similarly decolorize stains made by tea and coffee.

5-4. Unfortunately, laundry cleaning agents function only in water, a medium that can damage some natural fabrics, such as silk and wool, which are water-sensitive. When they are wet, water-sensitive fibers swell in diameter and shorten, causing the garment to shrink. The most effective way of removing dirt and stains from water-sensitive articles is dry cleaning. Dry cleaning is a process in which a liquid other than water is used to dissolve and flush away oil and grease along with underlying soils. The most useful solvents in dry cleaning are water-insoluble liquids derived from petroleum, particularly a carbon-and chlorine-containing compound called perchloroethylene. Dry-cleaning solvents, unlike water-based detergents, do not repel oil and grease molecules. Instead, the solvents surround and dissolve these molecules. Many commercial dry cleaners also add special detergents to their solvents to further loosen soil particles.

5-5. A primitive form of dry cleaning is possible using *vegetable shortening* as a «solvent.» The shortening dissolves oils — for example, those in deep-fried snacks or those that hold ink pigments in place. Then a follow-up treatment with hair spray will remove the dissolved oils and pigments. So, the next time you're studying late on a Sunday night, and your pen slips from the paper onto your white pants, where a greasy snack fell without your knowing it, remember your chemistry. A little shortening and hair spray could prevent an ugly stain. [Gordon Graff]

Answering inference and purpose questions. Making valid inferences based on sentences. Making valid inferences based on longer passages.

• Which of the following can be inferred from passage 1?

(A) A detergent's sudsing action and its cleaning ability are closely connected.

(B) Manufacturers may recommend the use of low sudsing detergents for top-loading tumbler-type washing machines?

(C) Consumers prefer various amounts of suds.

(D) Detergent manufacturers are sudsing modifiers made from natural fats.

• Which of the following would be the most reasonable guess about bleaches in passage 2? .

• If the statements following passage 2 are valid inferences, mark the items TRUE. If the statements cannot be inferred from passage 2, mark those FALSE.

(A) Bleaches are a kind of detergents.

(B) Liquid chlorine bleach is a less powerful chemical bleach than oxygen bleach.

(C) Oxygen bleach is weaker then liquid chlorine bleach.

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(A) Bleaches are a kind of detergents.

(B) Liquid chlorine bleach is a less powerful chemical bleach than oxygen bleach.

(C) Oxygen bleach is weaker then liquid chlorine bleach.

(D) Liquid chlorine bleach is safe to use on most fabrics.

(E) Enzyme presoak products should be used at the same time as oxygen bleach.

(F) Use bleaches and presoak products separately.

Answer inference and purpose questions. Make valid inferences based on passages 2-5.

- Does passage 2 imply that bleaches are better or worse than presoak products?
- What does the author refer to in passage 3 sentence: «Clothes treated with these compounds come out of a wash looking both brighter and whiter than they did before being washed.»
- Does he mean that clothes should be treated before being washed, after being washed or in the process of washing?
- Why does the author use the phrase in passage 3: «*The hydrogen peroxide* found in many medicine cabinets…»?
- Why does the author state in passage 4 that laundry cleaning agents function only in water?
- Does the author imply in passage 5 that dry cleaning is better than laundry cleaning?
- Can it be inferred from passage 5 that you can do without detergents to remove stains?
- If so, what sentence or sentences in this passage prove it?

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Adjective/adverb errors

The most common type of word form problem involves the use of an adverb in place of an adjective or an adjective in place of an adverb. A few points to keep in mind:

Adjectives modify nouns, noun phrases, and pronouns. Adjectives often come before nouns:

an *important* test a *quiet* evening a *long* letter

They often answer the question *What kind?*

She is a *brilliant* doctor. (What kind of a doctor is she? *A brilliant one.*)

Adjectives also follow the verb *to be* and other linking verbs.

The glass was *empty.* That song sounds *nice.* They look *upset.*

Adverbs may modify verbs, participles, adjectives, prepositions, adverb clause markers, and other adverbs:

Ann *eagerly* accepted the challenge, (an adverb modifying the main verb *accepted)*

It was a *rapidly* changing situation, (an adverb modifying the present participle *changing)*

She wore a *brightly* colored scarf, (an adverb modifying the past participle *colored)*

Ted seemed *extremely* curious about that topic, (an adverb modifying the adjective *curious)*

We arrived at the airport *shortly* before our flight left, (an adverb modifying the adverb-clause marker *before)*

We arrived at the airport *shortly* before noon, (an adverb modifying the preposition *before)* The accident occurred *incredibly* quickly, (an adverb modifying the adverb *quickly)*

Sometimes adverbs are used at the beginning of sentences, usually followed by a comma. These adverbs sometimes modify the entire sentence rather than one word in the sentence:

Generally, I like my classes.

Usually, Professor Ingram's lectures are more interesting.

Most adverbs tested in this section are adverbs of manner. They are formed by adding the suffix *-ly* or *-ally* to an adjective:

quick quickly, comic comically, comfortable comfortably, historic historically.

Adverbs of manner answer the question *How?*

She treated her employees *honestly.* (How did she treat her employees? *Honestly.)*

A few adverbs *(fast, hard, high,* for example) have the same form as adjectives:

He bought a *fast* car. (adjective)

He was driving so *fast* that he got a speeding ticket, (adverb)

Well is the irregular adverb form of the adjective *good.*

Juan is an exceptionally *good* student. He did very *well* on the last test.

Some adjectives also end in *-ly: friendly, yearly, costly,* and *lively,* for example. That was a *costly* mistake.

Section 2. GUIDELINES FOR GRAMMAR TEST

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Errors with comparatives and superlatives

Most adjectives have three forms: **the absolute** (the basic adjective form), **the comparative**, and **the superlative**.

Comparatives are used to show that one item has more of some quality that another does.

George is *taller* than his brother.

Superlatives are used to show that one item in a group of three or more has the greatest amount of some quality.

He was the *tallest* man in the room.

Let us explain how comparatives and superlatives are formed:

One-syllable adjectives: warm –warmer — the warmest

Two-syllable adjectives ending with –*y:* funny - funnier — the funniest

Other two-syllable adjectives: common - more common — the most common

Adjectives with three or more syllables: important — more important — the most important

Some two-syllable adjectives have two correct forms of both the comparative and the superlative: narrow — narrower/more narrow — narrowest/most narrow; clever — more clever — cleverest — most clever; polite — more polite — politest — most polite.

A «negative» comparison can be expressed with the words *less* and *least. Less* and *least* are used no matter how many syllables an adjective has.

less bright — less expensive
the least bright — the least expensive

The absolute form of a few adjectives ends in -er (*tender, bitter, slender, clever,* and so on.) Don't confuse these with the comparative forms *(more bitter* or *bitterer,* for example).

Many adverbs also have comparative and superlative forms. The comparative and superlative forms of all *-ly* adverbs are formed with *more* and *most.*

more brightly — more importantly
most brightly — most importantly

A few adjectives and adverbs have irregular comparative and superlative forms:

Irregular Comparatives and Superlatives: good/well — better — the best; bad/badly — worse — worst; far — further — the farthest/the furthest.

Mini-test

Identify and correct adjective/adverb errors

Surprising, baking soda is an effective dirt and stain remover.

Cleaning agents interact chemically with various types of dirt and stains because of their chemically properties.

Particles are typically for composition of dirt and stains.

Soaps and detergents are often interchangeable, though they differ most considerable.

Generally, soaps are made from naturally fats and oils.

Curd is difficulter to remove from fabrics, and it makes the fabric feel more stiff.

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The two liquids dissolve in each other most normal.

Often called «biologic catalysts», enzymes promote certainly chemical reactions.

I read in a weekly magazine that club soda contains weakly acidical carbonic acid.

Interesting, liquid chlorine bleach is the most powerfulest of the chemical bleaches.

Clothes come out of a wash looking both more brighter and more whiter than they did before being washed.

Oxygen atoms turn red blood pigments into less brighter colored stains.

Many commercial dry cleaners also add specially detergents to their solvents.

I don’t like studying lately on a Sunday night.

The colder the air the least moisture it can hold.

High humidity makes us feel uncomfortable hot and sticky.

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Section 1. GUIDELINES FOR READING ACADEMIC TEXTS

VOCABULARY IN CONTEXT

VOCABULARY-IN-CONTEXT QUESTIONS

Instruction: How to answer vocabulary questions.

In general, it is easier to answer vocabulary questions based on the context of a passage than it is to answer questions about vocabulary in single, isolated sentences.

In vocabulary-in-context questions, you must determine which words or phrases can best substitute for a word or words in the passage. When answering vocabulary-in-context questions, you must most often depend on the general context of the sentence to help you choose the correct answer.

You should follow these steps to answer vocabulary-in-context items.

1. Look at the word being asked about and try to define possible answer choices. If you are familiar with the word, guess which answer is correct. Do NOT make your answer final yet because you may want to try again later.
2. Read the sentence in which the word appears. If you were familiar with the word and guessed at the answer, make sure that the word that you chose fits with the word as it is used in the sentence. If you were unfamiliar with the word, see if context clues in the sentence or in the sentences before or after help you guess the meaning.
3. If you are not sure which answer is correct, read the sentence with a possible answer choice in place. Does one seem more logical, given the context of the sentence, than the other? If not, do any seem illogical? If they do you can eliminate them.

Text: Weather Terms — Cloudy or Clear?

1. Introduction.

We are all interested in what the weather forecast has to tell us: Will it rain when we want to go to the beach, to the park, or to a ball game? Will there be a heavy snow tomorrow, so that commuter trains and school buses may run on a delayed schedule (or maybe not at all)?

The forecast itself becomes more interesting and more understandable if we look into the meanings of the terms that forecasters use. Some parts of the weather forecast seem easy enough to understand — for example, the predicted high and low temperatures. But weather terms such as «high-pressure system,» «occluded front,» or «temperature-humidity index» sound more complicated. The meanings of these terms become clear, however, once you know something about the major factors that produce the weather and how these factors influence one another.

Unit 6

Section 1. GUIDELINES FOR READING ACADEMIC TEXTS

VOCABULARY IN CONTEXT

VOCABULARY-IN-CONTEXT QUESTIONS

Instruction: How to answer vocabulary questions.

In general, it is easier to answer vocabulary questions based on the context of a passage than it is to answer questions about vocabulary in single, isolated sentences.

In vocabulary-in-context questions, you must determine which words or phrases can best substitute for a word or words in the passage. When answering vocabulary-in-context questions, you must most often depend on the general context of the sentence to help you choose the correct answer.

You should follow these steps to answer vocabulary-in-context items.

1. Look at the word being asked about and try to define possible answer choices. If you are familiar with the word, guess which answer is correct. Do NOT make your answer final yet because you may want to try again later.
2. Read the sentence in which the word appears. If you were familiar with the word and guessed at the answer, make sure that the word that you chose fits with the word as it is used in the sentence. If you were unfamiliar with the word, see if context clues in the sentence or in the sentences before or after help you guess the meaning.
3. If you are not sure which answer is correct, read the sentence with a possible answer choice in place. Does one seem more logical, given the context of the sentence, than the other? If not, do any seem illogical? If they do you can eliminate them.

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2. Precipitation.

It refers to *rain, snow, sleet*, and *hail* — types of moisture that fall from the atmosphere. Moisture enters the atmosphere through the evaporation of water from lakes, rivers, soil, and even green plants on Earth's surface. This evaporated water is called *water vapor.*

At a given temperature and pressure, the air can hold only a certain amount of moisture, and colder air can hold less than can warmer air. The *dew point* is the temperature of the air at which water vapor begins to *condense* (turn to liquid). The vapor may condense on Earth's surface as dew or frost or in the air around tiny particles of dust or pollution.

High in the air, the tiny water droplets form the clouds; but near ground, they create fog. If the temperature of the air is below freezing, the water vapor that forms clouds turns into microscopic ice crystals.

Rain falls when the microscopic *water droplets* in clouds collide, merge, and finally become too heavy for the air to support them. If the air temperature is above about 4 °C (39 °F), *ice crystals* in clouds melt as they fall to Earth, also creating rain. At slightly lower temperatures, the result is sleet. Below about 3 °C (37 °F), the moisture falls as snow.

Hailstones are *frozen raindrops* or *ice pellets* that are swept up by powerful *updrafts* (upward movements of air) in storm clouds and coated with a layer of icy water that freezes. The pellets drop and then get carried back up again to freezing heights by the updraft. But as this process repeats, the hailstones grow until they find their way into a *downdraft* that carries them to the ground. If the hailstones are large enough, they will not completely melt as they fall to Earth, even on a warm summer day.

In weather forecasts, forecasters often refer to the chance of precipitation as a percentage. A 30 per cent chance of rain, for example, means that it rained in the past on 30 days out of every 100 with similar weather conditions.

Clues in the context

Vocabulary in context includes both single words (usually nouns, verbs, adjectives, and adverbs). And two- or three-word phrases. In ordinary reading, there are a number of clues that can help you determine the meaning of an unknown word:

Synonyms

Precipitation refers to rain, snow, sleet, and hail — types of *moisture* that the word *moisture* is a synonym for the word *precipitation.*

Moisture enters the atmosphere through the *evaporation* of water from lakes, rivers, soil, and even green plants on Earth's surface. This evaporated water is called *water vapor.* The word combination *water vapor* is a synonym for the word *evaporation.*

- Find synonyms for the word *hailstones.*

Examples

Very often examples are given in the text to illustrate the meaning of a word:

Will there be a *heavy* snow tomorrow, so that commuter trains and school buses may run on a delayed schedule (or maybe not at all)?

From the example given, it is clear that *heavy* snow is a kind of snow that interferes with traffic.

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From the example given, it is clear that *heavy* snow is a kind of snow that interferes with traffic.

• Find an example explaining the meaning of the word *percentage* in weather forecasts?

Contrast

The meaning of some words may be understood by contrasting them to other words. E.g.: High in the air, the tiny water droplets form *the clouds*; but near ground, they create *fog*.

From the sentence, it is clear that *clouds* are tiny water droplets high in the air while *fog* is tiny water droplets near ground. Since the word signaling contrast (but) is used it is clear that the difference is in the high or low position in the air.

• Explain a contrast in the following: The pellets drop and then get carried back up again to freezing heights by the updraft. But as this process repeats, the hailstones grow until they find their way into a *downdraft* that carries them to the ground.

General context

The meaning of some words can be perceived from the general context they are used in. E.g.: But weather terms such as «high-pressure system,» «occluded front,» or «temperature-humidity index» sound more complicated. The meanings of these terms become clear, however, once you know something about the major factors that produce the weather and how these factors influence one another.

As is generally known, weather is a combination of factors, so clearly the words «high-pressure system,» «occluded front,» or «temperature-humidity index» must mean *major factors producing the weather and influencing one another*.

• Explain the difference between rain, sleet and snow in the following context: Rain falls when the microscopic *water droplets* in clouds collide, merge, and finally become too heavy for the air to support them. If the air temperature is above about 4 °C (39 °F), *ice crystals* in clouds melt as they fall to Earth, also creating rain. At slightly lower temperatures, the result is sleet. Below about 3 °C (37 °F), the moisture falls as snow.

Direct definitions

Sometimes there might be correct definitions of the word in the context of the passage. In an academic text direct definitions of special terms are often given by the author. It helps you make a glossary of special terms in your field. E.g.: The *dew point* is the temperature of the air at which water vapor begins to *condense* (turn to liquid).

• Find a definition of an *updraft*.

Semantic and thematic groups

Semantic groups are formed of words close in meaning; thematic groups are formed of words referring to the same variety or type of objects or phenomena. While making up a glossary it helps if you group them on the principle of similarity or closeness of meaning. E.g.:

Interesting, understandable, easy, complicated, clear;

precipitation, rain, snow, sleet, hail, moisture, evaporation, evaporated water, water vapor.

• What words form a group of types of moisture that fall from the atmosphere?

• Find an example explaining the meaning of the word *percentage* in weather forecasts?

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Word nests

It is easier to memorize words when they are organized into root-related groups of words. E.g.:

Evaporation, to evaporate, evaporated, vapor, water vapor;

forecast, to forecast, weather forecasts, forecasters

- Complete a word nest for the words: frost, freeze, …, …

3. Humidity

It is a measure of the water vapor in the air. *Absolute humidity* is the actual amount of water vapor in a given volume of air. Weather forecasts more often refer to *relative humidity* — a ratio between the actual moisture and the maximum amount of moisture that air at that temperature could hold. If the temperature outside drops to the dew point, relative humidity becomes 100 per cent and fog is likely to form.

Relative humidity affects our comfort. For example, in hot weather, high relative humidity slows the evaporation of water from the skin and makes us feel uncomfortably hot and sticky. In cold weather, high relative humidity conducts heat away from the body and makes the air feel cold and raw.

The *temperature-humidity index* (THI) sometimes mentioned in forecasts was once called the discomfort index. This scale estimates the degree of discomfort caused by hot, moist weather. The higher the reading, the more discomfort people feel. Most people feel comfortable with a THI below 75.

4. Air pressure

It is the weight of the atmosphere pressing down on the surface of Earth. Meteorologists call it *barometric pressure* because the instrument used to measure air pressure is called a *barometer.* The barometer was invented in 1643 by Evangelista Torricelli, an Italian physicist, who demonstrated that the pressure of the atmosphere at sea level could push a column of mercury 76 centimeters (30 inches) up a glass tube. Hence, standard barometric pressure is about 30 inches of mercury at sea level.

In the United States, weather forecasts give barometric pressure in inches. Meteorologists who use the metric system express barometric pressure in units called *bars* and *millibars.* A millibar is one-thousandth of a bar, and standard barometric pressure averages 1,013 millibars at sea level.

Zones of high atmospheric pressure, also called *highs,* contain dense air. In the Northern Hemisphere, many highs form in polar regions because the colder a mass of air gets, the denser it becomes, and this increases its pressure. A high also occurs where an air mass cools in relation to the surrounding air. As the cooling air becomes denser, it sinks. This further compresses the air, warming it somewhat and increasing its ability to hold moisture. As a result, the water drops that make up clouds evaporate, and the sky over a high-pressure zone is usually clear.

But low-pressure zones, or *lows,* contain air that is less dense. Lows form where the air is warm and rises. The warm air cools as it rises, and the water vapor it holds begins to condense. As a result, the sky over a low is generally cloudy.

Changes in barometric pressure help forecast weather conditions. A high with rising barometric pressure typically signals fine, clear weather ahead, whereas a low with falling barometric pressure often indicates bad weather ahead — usually heavy, prolonged rain.

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5. Fronts.

Fronts where most abrupt changes in the weather occur, are the boundaries between huge masses of air, each with its own temperature and moisture content. The movements of these air masses influence local weather. For example, an air mass from the equator can produce balmy weather, while an air mass from northern Canada can bring a cold spell. Air masses of different temperatures meet and do battle along fronts. Fronts were discovered toward the end of World War I (1914-1918) and are so named because the clashing of air masses reminded meteorologists of the clashing of armies along a battlefront.

Strong fronts, which occur where there is a large difference in temperature or moisture between air masses, bring high winds and stormy weather. But weak fronts, where the two air masses are close in temperature, often pass unnoticed, except by meteorologists. In North America, highs, lows, and fronts generally move from west to east and follow curving paths. A front may be warm or cold, depending upon which air mass — the warmer or the colder — is pushing the air ahead of it.

A *warm front* occurs where a relatively warm air mass advances on a colder air mass. The warm air, which is lighter, pushes up and over the edge of the cold air. As the warm air rises, it cools and thereby loses some of its ability to hold moisture. If the air is fairly humid, some of this moisture may turn into rain or snow. If the air is dry, clouds may form but precipitation will be slight. The gentle rain or drizzle that warm fronts often bring usually lasts several days. After the front passes, the temperature rises and the sky clears.

A *cold front* forms where a relatively cool air mass overtakes a warmer air mass. The cold air, being denser, slides under the edge of the warmer air, lifting it rapidly. Tall clouds form as the warm air quickly cools on its steep ascent. The more moisture in the air, the larger the clouds are.

Cold fronts bring bad weather, but they move faster than warm fronts, and the bad weather usually ends soon. If a cold front moves very fast, it may slide under a warm air mass, lift it off the ground, and collide with another cold air mass on the far side of the warm air. In this case, an *occluded front* forms. The word *occlude* comes from a Latin word meaning *to close off,* and the two cold air masses essentially «close off the warm air mass. Occluded fronts usually bring less severe weather than warm or cold fronts and tend to stay in one place for a longer time.

Sometimes air masses meet and do not move, forming a *stationary front.* This kind of front usually brings unsettled weather that lasts a while.

A *thermal inversion* is a weather condition that occurs when a mass of warm air forms over cooler air near the ground. The lighter warm air sits like a lid atop the cooler air, blocking the normal air circulation. In large cities such as Los Angeles, a thick haze of *automobile exhaust, industrial chemicals, and other pollutants* may build up during the thermal inversion. The warm air above is very stable and prevents the pollutants from rising and scattering and results in a type of air pollution often called *smog.*

6. Winds and wind speed.

Wind is simply air in motion over Earth’s surface. The sun’s uneven heating of Earth’s surface sets air in motion. As warm air rises, cool air rushes in to replace it.

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The uneven heating of land and water surfaces along coastlines creates local winds. During the day, the land warms faster than the water and heats the air above it. As this warm air rises, cooler air over the water rushes in to replace it. At night, the land cools faster than the water, and cooler air blows from land to replace warm air rising over the water.

But the strongest winds occur along fronts. The greater the differences in temperature and pressure along the front, the stronger the winds are.

Winds also spiral into low-pressure zones, like water into a whirlpool. For this reason, meteorologists call low-pressure zones *cyclones,* a term that comes from the Greek word for *circle.* A high-pressure zone is called an *anticyclone* because wind flows out of it in the direction opposite that of a cyclone. North of the equator, the winds move counterclockwise around a cyclone and clockwise around an anticyclone due to Earth's rotation. South of the equator, cyclone winds move clockwise; anticyclone winds, counterclockwise.

A *jet stream* is a band of strong winds at a high altitude. Jet streams follow meandering paths from west to east at speeds up to 400 kilometers per hour (400 kph) or 250 miles per hour (250 mph), changing their course frequently. Over the Northern Hemisphere, cold air masses predominate to the north of a jet stream and warm air masses to its south.

Wind chill provides an estimate of the effect of wind speed on air temperature. Wind accelerates the loss of heat from the body, even on a hot day. The faster the wind blows, the more heat the body loses and the colder the temperature feels. On a day with a temperature of 1.7 °C (35 °F), for example, a wind of 8 kph (5 mph) has the effect of lowering the temperature to 0 °C (32 °F). A wind that is blowing twice as fast appears to lower the wind-chill temperature to -5.6 °C (22 °F).

Wind shear is a rapid change in the speed or direction of wind. Wind shear can be dangerous for airplane travel, especially if the change is a *downburst,* a *gust of wind* that blows straight to the ground. Downbursts may develop when precipitation falls through dry air, suddenly cooling the air and making it more dense. The air may then plummet to the ground.

7. Storms.

A *hurricane* or *typhoon* is a violent, swirling storm that develops in a low-pressure area over tropical ocean regions. Hurricanes grow in size and strength as they travel, feeding on heat from the warm water. They peter out when they pass over land or cold water, which robs them of their source of energy. As hurricanes move onto land, their heavy rains often cause floods.

A *tornado* is a small, intense funnel of wind that extends downward from the dark clouds that form during thunderstorms. Wind speeds in a tornado can exceed 320 kph (200 mph). Strong up-drafts of wind inside the funnel are powerful enough to lift automobiles and mobile homes into the air. In the United States, tornadoes occur most frequently in the Midwest in spring.

Winter storms and *thunderstorm*s often form when air that is moist and relatively warm is set in motion, perhaps by an advancing cold front. Water vapor in the air quickly condenses as the warm air rises, forming massive, towering clouds that produce *heavy rains, blizzards*, or *ice storms*.

In thunderstorms, the motion of the air also causes electric charges to build up inside the cloud, producing lightning. Flashes of lightning heat the surround-

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ing air, causing the air to expand violently and create the sound waves known as thunder.

Even when such severe weather is not threatening, it's still a good idea to understand the meaning of common weather terms. And knowing about the actions of fronts, highs, and lows can help you understand why the forecaster predicts that the weather will be fair or foul. [Peter R. Limburg]

Tasks: Answer vocabulary-in-context questions about words or phrases in reading passages.

Directions: Do the tasks and answer the questions about the vocabulary in the passages, and mark the words or phrases that are closest in meaning to the words or phrases that are asked about.

Synonyms

- Find synonyms for *winds*.
- Find synonyms for *wind shear.*
- Find synonyms for *storm.*
- Find synonyms for *winter storms.*

Read the passages and answer the questions:

Fronts, where most abrupt changes in the weather occur, are the boundaries between huge masses of air, each with its own temperature and moisture content. The movements of these air masses influence local weather. For example, an air mass from the equator can produce balmy weather, while an air mass from northern Canada can bring a cold spell.

- How do movements of fronts influence local weather?
- What is clear from the examples given above?

Relative humidity affects our comfort. For example, in hot weather, high relative humidity slows the evaporation of water from the skin and makes us feel uncomfortably hot and sticky. In cold weather, high relative humidity conducts heat away from the body and makes the air feel cold and raw.

- How does relative humidity affects our comfort?

Contrast

Explain a contrast in the following: Zones of high atmospheric pressure, also called *highs,* contain dense air…But low-pressure zones, or *lows,* contain air that is less dense. Lows form where the air is warm and rises.

Explain a contrast in the following: Strong fronts, which occur where there is a large difference in temperature or moisture between air masses, bring high winds and stormy weather. But weak fronts, where the two air masses are close in temperature, often pass unnoticed, except by meteorologists.

General context

- Why is the *temperature-humidity index* sometimes called in forecasts the discomfort index?
- Why do meteorologists call *air pressure barometric pressure*?

Explain the meaning of the word «peter out» in the following sentence: Hurricanes grow in size and strength as they travel, feeding on heat from the

ing air, causing the air to expand violently and create the sound waves known as thunder.

Even when such severe weather is not threatening, it's still a good idea to understand the meaning of common weather terms. And knowing about the actions of fronts, highs, and lows can help you understand why the forecaster predicts that the weather will be fair or foul. [Peter R. Limburg]

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Explain the meaning of the word «peter out» in the following sentence: Hurricanes grow in size and strength as they travel, feeding on heat from the

warm water. They peter out when they pass over land or cold water, which robs them of their source of energy.

What clue is given by the fact that land or cold water robs them of their source of energy?

Direct definitions

- Find a definition of *humidity.*
- Find a definition of *air pressure*.
- Find a definition of *front*.
- Find a definition of *thermal inversion*.

Semantic and thematic groups

- What words form a group of *pollutants*?
- What words form a thematic group for *winter storms?*

Word nests

- Complete a word nest with words for *bars* and *millibars.*
- Complete a word nest with word combinations for *humidity.*
- Complete a word nest with word combinations for *front.*

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Verb problems

Verb errors involving tense

Most tense errors involve the simple (Indefinite) present tense, the simple past tense, and the present perfect tense.

The simple present tense is a general-time tense. It usually indicates that a condition is **always true** or that an action **always occurs**. It may also indicate that an action **regularly occ**urs.

The Earth rotates round the Sun.

The atmosphere *surrounds* the Earth.

John often *stays* at this hotel.

Generally, the lectures of this professor *are* very interesting.

The simple past tense indicates that an action took place at a specific time in the past.

They *moved* to Simferopol five years ago. This house *was built* in the 1990s. Dinosaurs *lived* millions of years ago.

The present perfect tense usually indicates that an action began at some time in the past and continues to the present. It may also indicate that an action took place at an unspecified time in the past.

Mr. Brandon *has worked* for this company since 1990. Mary *hasn't been* to a doctor for a year. Nick *has* recently *returned* from the US.

For a Ukrainian/Russian speaker it is often difficult to see the difference between the simple (Indefinite) tense and the progressive (Continuous) tense. Compare the following sentences:

John often *stays* at this hotel (in general). John is staying at this hotel (now, this week, this summer).

John drives to his office (usually). John is driving to his office (now, today, in the immediate future).

If you want to state a fact you will say: The Earth rotates round the Sun. If you want to emphasize that it is an everlasting process you will say: The Earth is permanently rotating round the Sun (with the adverbs *always, constantly, ever, permanently*).

Errors with verbals

Verbals are participles, gerunds, infinitives, and—for the purpose of this lesson—simple forms of the verb (infinitives without the word *to*).

Participles are verbal adjectives. In this part of the test, participles are often seen before nouns as word adjectives.

Present participles end with *-ing.* When used before a noun, present participles have an active meaning.

Past participles of regular verbs end in *-ed;* the past participles of many common verbs are irregular. Before nouns, past participles have a passive meaning.

It was an *exhausting* 10-kilometer race, (present participle)

The *exhausted* runners were too tired to move after the race, (past participle)

Section 2. GUIDELINES FOR GRAMMAR TEST

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It was an exhausting 10-kilometer race, (present participle)

The exhausted runners were too tired to move after the race, (past participle)

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In the first sentence, the race exhausts the runners. The race «performs» the action. In the second sentence, the runners are exhausted by the race. They receive the action.

Participles are also used in phrases after nouns as reduced (shortened) relative clauses. Again, present participles imply an active idea, past participles a passive one.

The man *stealing* the money was arrested, (present participle; means «who stole»).

The money *stolen* from the bank was recovered, (past participle; means «which was stolen»).

A gerund is a verbal form that ends in *-ing: being, going, giving, building.* Like infinitives, gerunds are often followed by objects: *giving directions, building a house.* Together, a gerund and its object form a **gerund phrase.** They can be the subjects of verbs, the objects of prepositions, and the objects of certain verbs.

Gerunds, by their meaning, are verbal nouns and, as such, are used as other nouns are used. You will generally see gerunds as subjects or objects of verbs or as objects of prepositions.

Note: Infinitives can also be subjects and objects but NEVER objects of prepositions.

Playing cards is enjoyable, (gerund as subject of a verb).

Dancing is a good exercise, (gerund as subject).

He enjoys *going* to good restaurants, (gerund as object of a verb).

He avoids *eating* junk food, (gerund as object of a verb).

He passes the time by *playing* cards, (gerund as object of a preposition).

You can solve this problem *by using* a calculator, (gerund as object of a preposition).

Note: All two- and three-word verb phrases that can be followed by verbals are used with gerunds, not infinitives. This is true even when the verb phrase ends with the word *to.*

I am *looking forward to visiting* with you next summer.

I cannot agree to *going* to New Orleans.

My partner is opposed to our *participating* in this deal.

(This can be tricky because infinitives always begin with the word *to.)*

An infinitive is a verbal form that consists of the word *to* and the simple form of the verb: *to be, to go, to give, to build.* Infinitives are often followed by an object: *to give directions, to build a house.* Together, an infinitive and its object form an **infinitive phrase.**

Infinitives can be used in a variety of ways. Like gerunds, infinitives can be subjects of verbs and the objects of certain verbs (see list). Unlike gerunds, infinitives can NEVER be objects of prepositions.

To read the directions is important, (infinitive as subject of a verb).

To help others is rewarding, (infinitive as subject).

He forgot *to read* the directions, (infinitive as object of a verb).

He attempted to *swim* across the river, (infinitive as object of a verb).

Infinitives are used in several other ways:

It's important *to read* the directions, (infinitive after *to be* + adjective).

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Infinitives are used in several other ways:

It's important *to read* the directions, (infinitive after *to be* + adjective).

It's important *to change* the oil in your car frequently, (infinitive after an adjective).

The first man to *land* on the moon was Neil Armstrong, (infinitive used as an adjective after a noun).

Infinitives can also be used to show purpose. In other words, they explain why an action takes place. (The phrase *in order* + infinitive also shows purpose.).

To learn how to dance, he took lessons.

In order to learn how to dance, he took lessons.

She must take this class to *graduate,* (infinitive used to show purpose).

Infinitives can be used as adjective phrases after noun phrases. You will often see this in structure problems after noun phrases containing the word ***first***. These infinitive phrases often come at the end of a sentence and are set off by commas.

John Glenn was the first American *to orbit* the Earth.

You may see structure items that focus on **passive infinitives.** A passive infinitive consists of the word *to* + *be* + past participle.

Roberta was the first person *to be asked* to speak at the meeting.

Simple forms are the base forms of verbs; they consist of the infinitive without the word *to*. Simple forms are used after the causative verbs *have, make,* and *let:*

He had the carpenter *repair* the door. His father makes him *study* hard. She let her son *go* on the trip.

Common Verbs That Take Verbal Objects

Verbs used with Gerunds: admit, avoid, deny, enjoy, finish, justify, quit, recommend, suggest,

understand.

Verbs used with Infinitives: agree, allow, arrange, attempt, cause, choose, decide, enable, hope, instruct, know (how), learn (how), permit, persuade, require, seem, teach (how), tell, use, warn.

Infinitives are used with *have*, and simple verbs are used with *let* and *make*: I *have to do* my research paper by next Monday. The professor won't *let us waste* time on this experiment. Necessity *makes you look* for options.

Watch for the following errors involving verbals:

the eggs of most birds must be kept warm.

(A) Proper development

(B) By properly developing,

(C) They develop properly

(D) To develop properly,

The only one of these four phrases listed here that can show purpose is choice (D), an infinitive. This expression means, *In order to develop properly.*

In 1959 the political philosopher Hannah Arendt became the first woman a full professor at Princeton University.

(A) to appoint

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In 1959 the political philosopher Hannah Arendt became the first woman a full professor at Princeton University.

(A) to appoint

(B) was appointed
(C) to be appointed
(D) an appointment as

After a noun phrase such as *the first woman* an infinitive is used as an adjective phrase. Because a passive form is needed (Hannah Arendt receives the action; she doesn't perform the action), choice (A) is not the correct infinitive form. Choice (C), a passive infinitive, is best.

The ear is the organ of hearing, but it also plays a role in balance.
(A) maintaining
(B) it maintains
(C) to maintain
(D) maintained

A gerund is used correctly after a preposition. Choices (B), (C), and (D) would not be appropriate after a preposition.

Mini-test

Identify and correct errors involving verbs and verbals

Rain falls when the microscopic *water droplets* in clouds .
(A) are colliding
(B) have collided
(C) collide
(D) will collide

If the temperature outside drops to the dew point, relative humidity 100 per cent and fog is likely to form.
(A) has become
(B) becomes
(C) will become
(D) became

In the United States, weather forecasts barometric pressure in inches.
(A) are giving
(B) Have given
(C) gave
(D) give

The *temperature-humidity index* (THI) sometimes _____in forecasts was once called the discomfort index.
(A) mentioning
(B) mentioned
(C) to mention
(D) is mentioned

At air temperature above about 4 °C (39 °F), *ice crystals* in clouds _____.
(A) will melt
(B) have melted
(C) melt
(D) are melting

Moisture regularly _____the atmosphere through the evaporation of water.

(B) was appointed
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Some parts of the weather forecast seem easy enough .
(A) understood
(B) to understand
(C) understading
(D) understand

Weak fronts, where the two air masses are close in temperature, often pass .
(A) unnotice
(B) to unnotice
(C) unnoticed
(D) unnoticing

The warm air rises to quickly condense into rain.
(A) condensing
(B) condensed
(C) to condense
(D) condense

Generally moving from west to east fronts follow paths.
(A) are curving
(B) to curve
(C) curved
(D) curving

By uneven _____of land and water surfaces along coastlines local winds are created.
(A) heating
(B) heat
(C) heated
(D) heats

A wind of 8 kph has the effect of the temperature to 0 °C.
(A) lowered
(B) lowering
(C) lower
(D) to lower

In thunderstorms, the motion of the air also causes electric charges ____up inside the cloud, producing lightning.
(A) built
(B) build
(C) of building
(D) to build

_____about the actions of fronts, highs, and lows can help you understand the forecasts.
(A) Known
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Flashes of lightning heat the surrounding air, ____the air to expand violently.
(A) are causing
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A front may be warm or cold, _____upon which air mass is pushing the air ahead of it.
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Section 1. GUIDELINES FOR READING ACADEMIC TEXTS

UNDERSTANDING THE TEXT ORGANIZATION

SUBHEADINGS, KEY WORDS, REFERENTS, LINKING WORDS

Instruction: ***Surveying*** the text tells you about the topic or subject of the text. It may also tell you something about how the text is organized (subheadings are especially useful). Surveying may also tell you something about the writer's purpose—whether the intention is to give instructions, to compare, to give information, and so on.

You do not have time to read every word carefully. **Remember that your task is not to understand *all* of the text.** It is often only necessary to **read a *small part of the text* carefully** to answer the questions.

The best way to find details quickly is to use ***scanning.*** Scanning is searching for key words or synonyms by looking quickly through the text. Your eyes move across and down through the text without reading in the normal way. For example, you *scan* when you look for a word in a dictionary. You do not read every word as you search for the word(s) you want.

It is easiest to scan for numbers or words which start with capital letters (such as most names) because these stand out in a text.

In most well-written English texts, every paragraph deals with a specific aspect of a topic. The first sentence of a paragraph usually tells the reader what the rest of the paragraph is about so when you are trying to identify the main idea of a paragraph, you should read the first sentence carefully. Then, keeping the idea of the first sentence in mind, you should quickly check the rest of the paragraph, picking up **only some** of the words. This kind of reading is called ***skim reading*** or **skimming.** Using this technique you will have a general idea of what the writer is saying about the topic.

Of course, when you skim read a text you cannot get as much information from the text as when you read it all carefully, but by skimming you can **quickly** get enough information to help you answer the question. Remember that efficient use of time is one of the most important exam skills.

You will have to adjust the speed of your skimming according to how easy the text is for you to understand. If a paragraph does not have a first sentence which gives the topic of the paragraph clearly, you have to skim more carefully. But don't forget that **you should not read every word**—reading every word will waste too much time.

Don't expect to be able to skim well immediately—you will have to practice. But most experts agree that it is a very important skill, not only for exams but also for all your future reading for study or work purposes

Unit 7

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In most well-written English texts, every paragraph deals with a specific aspect of a topic. The first sentence of a paragraph usually tells the reader what the rest of the paragraph is about so when you are trying to identify the main idea of a paragraph, you should read the first sentence carefully. Then, keeping the idea of the first sentence in mind, you should quickly check the rest of the paragraph, picking up **only some** of the words. This kind of reading is called ***skim reading*** or **skimming.** Using this technique you will have a general idea of what the writer is saying about the topic.

Of course, when you skim read a text you cannot get as much information from the text as when you read it all carefully, but by skimming you can **quickly** get enough information to help you answer the question. Remember that efficient use of time is one of the most important exam skills.

You will have to adjust the speed of your skimming according to how easy the text is for you to understand. If a paragraph does not have a first sentence which gives the topic of the paragraph clearly, you have to skim more carefully. But don't forget that **you should not read every word**—reading every word will waste too much time.

Don't expect to be able to skim well immediately—you will have to practice. But most experts agree that it is a very important skill, not only for exams but also for all your future reading for study or work purposes

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Text: Global Change

A. Scientists around the world believe that human activities are threatening the *biosphere* — the thin skin of Earth where life occurs. The biosphere extends from a few inches below the surface of the deepest ocean trenches, where microbes exist, to Earth's upper atmosphere, where pollen spores are carried by the wind. It includes the human habitat, the only one we know or will know in any time of interest to us, our children, or our children's children.

The biosphere offers an incredible richness and variety of plants and animals and, in the process of maintaining itself, has maintained a habitat suitable for people. The biosphere does not need humanity's presence to continue, but people need nature and the organisms within it to sustain an environment suitable for human life. Despite this fact, humanity in the first decades of the 2000's is destroying the natural systems upon which it depends.

Many factors contribute to this destruction. They include the growth of the human population and the progressive poisoning of nature with the chemical by-products of modern agriculture, industry, power generation, and transportation. Scientists warn of a potentially catastrophic warming of Earth's climate, the depletion of Earth's protective layer of ozone in the upper atmosphere, and the loss of plants and animals.

B. For human beings, these problems may create an increase in human diseases from cancer to cataracts. But they may also lead to dwindling supplies of safe air, water, and food, putting greater and greater strains on governments to protect people's basic needs.

The situation raises issues that are large and complex but far from insolvable. The solutions will rely on scientific and technical research, on developing clear definitions of the problems, and on creating equally clear political and economic solutions.

In June 1992, the leaders of 178 nations convened in Rio de Janeiro, Brazil, to try to set the world on a new course. The meeting, called the United Nations Conference on Environment and Development or simply the Earth Summit, was designed to forge agreement between nations on how to combat such environmental problems as global climatic change, the destruction of forests, and the loss of plant and animal species. Although most scientists were disappointed that the summit delegates did not agree to more forceful solutions, the process itself was an important recognition of the problem of global environmental change

C. At the beginning of 2001, Earth supported about 6.4 billion people, a dramatic rise since 1900, when Earth contained about 1.6 billion people. The United Nations estimates that by the year 2020, the world population will be around 7.4 billion people.

Each day, the world's human population increases by about 250,000 people, or more than 90 million each year. This annual increase is approximately equal to the population of Mexico. The rate at which the human population is growing can be illustrated by how little even catastrophic natural disasters slow it down. For example, the June 1990 earthquake in Iran killed an estimated 40,000 people. Within six hours, new births worldwide replaced the number of people lost from this immense tragedy.

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Population growth is not due simply to an increase in births but to the excess of births over deaths. Improvements in public health and medicine around the world propel population growth by enabling people to live longer. The growth feeds itself as greater numbers of young women survive to childbearing age and start to have children.

D. These advances are causing the world's population to double at a much faster rate than ever before. In the year 1000, the human population grew at a rate so slow that — had it continued — the world population would not have doubled for 575 years. By 1825, the doubling time had decreased to about 100 years. Today, the world's population is doubling in 35 to 40 years.

For Earth as a whole, the rate of population growth in 2001 was 1.7 per cent. This means that the population at the end of the year was 1.7 per cent larger than at the beginning.

But the growth rate varied greatly from country to country. In the richer, industrialized nations — such as the United States, Canada, Japan, and the countries of Western Europe — population growth averaged 0.5 per cent. Germany and Hungary had rates that were slightly less than zero, meaning that their populations were declining. In the developing nations, however, population growth was higher, averaging 2.1 per cent. The highest growth rates occurred in Africa and in Arab states on the Persian Gulf. The populations of Kenya, Tanzania, Zambia, and Uganda grew by 3.7 to 3.8 per cent, as did those of Ivory Coast, Saudi Arabia, and Oman.

Although such percentages may seem insignificant, the difference between a worldwide 1 per cent rate of growth and a 3 per cent rate is the difference between adding 54 million people and adding 200 million people to Earth each year. A sustained worldwide growth rate of 3.7 per cent, for example, would cause Earth's population double in only 20 years.

E. Many economists and social planners believe that economic development is the key to slowing population growth. The sharp difference between the rates of population growth in richer, economically developed nations and the rates in developing nations seems to support this view.

In developing nations, where many people farm for a living, there is an economic advantage to having several children who can help with the work and provide for the parents in old age. When societies become economically and technologically advanced, however, modern agricultural techniques enable the production of the same amount of food using the labor of fewer people. In such societies, large families are unnecessary and may be costly. As a result, family size drops. This so-called *demographic transition* has helped reduce the growth of populations in the wealthier, industrialized nations.

Unfortunately, a rapidly expanding population can by itself prevent a developing nation from improving its economy. A nation's people can become poorer when its population growth outstrips its economic growth. Kenya, for instance, with a 1992 population of 24 million, will have 48 million people in 2012 if the current population growth rate continues. Few experts believe that Kenya's economic circumstances can improve sufficiently during that time to provide adequately for so many people. The nation may be doomed to worsening poverty unless it can limit its population growth.

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F. The human population is expanding in many regions simply because people lack awareness of birth control or the ability to limit the size of their families. Recent United Nations statistics indicate that 90 per cent of women in 10 African nations have not heard of contraception.

In other cases, people in developing countries who want to limit the growth of their families lack access to contraception. Family planning methods are simply not available in large sections of the world. According to a study by the International Statistical Institute in The Hague, the Netherlands, as many as 500 million women in developing countries live too far from health centers to obtain contraceptives.

But attempts to slow population growth confront more than economic or educational problems. Human reproduction is a matter of great t religious and cultural importance as well. The religious teachings of many people prohibit or discourage contraception. And some cultures traditionally value large families as a sign of prestige and power.

G. One of the problems of having an increasing world population is the difficulty of feeding everyone. As many as 13 million people die every year from malnutrition and starvation, despite the fact that global food production continues to increase and total world food supplies are adequate.

Experts say that complex political and economic factors lead to poverty and hunger in various regions. But some scientists fear that current demands for agricultural resources already exceed Earth's capacity to supply the population on a continuing basis. From 1950 until 1984, world agricultural production nearly tripled. In the mid 1980's, however, world agricultural production began to level off, and, in certain places, production declined.

Loss of farmland is a major cause of the decline in agricultural production. Usable farmland is lost for many reasons, but the major causes are erosion and salinization. Erosion occurs when wind and water rob land of its nutrient-rich soil. Salinization is the accumulation of salts on the soil, a problem common in regions where irrigation is used. Finally, as cities grow, they take over land once available for agriculture. The result of all these factors is that less and less land must feed more people.

Dwindling farmland is not the only problem, however. Across the entire globe, overpopulation continues to deplete croplands, fisheries, water resources, and energy supplies. Some scientists fear that uncontrolled population growth will thus produce dangerous conflicts among nations and regions over access to Earth's natural resources.

Matching headings with paragraphs or sections

Matching headings with paragraphs actually means identifying where to find information. Each paragraph in the text needs a heading.

It is useful, while surveying, the text to get an idea of the **organization** of the text, namely, what topics are discussed and in what order.

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Task: Match the following 7 headings with letters A, B, C, D, E, F, G.

Your task is to choose the correct one from the list of headings provided in the box below. In a task type like this, you should skim a paragraph or section before choosing the correct answer from the list. This is because when trying to match long pieces of text (e.g. paragraphs) to phrases (e.g. headings), it is more efficient to skim the long piece of text first. Then you can look through the alternative headings very quickly.

Step 1—Survey the text

Surveying has already been discussed several times in this book. Can you remember what to look at when you survey? A list of headings can give you some useful information to help you quickly understand what each part of the text will be about.

Step 2—Skim read each paragraph

Every paragraph deals with a specific aspect of a topic. The first sentence of a paragraph will most probably tell the you what the rest of the paragraph is about so when you are trying to identify the main idea of a paragraph, you should read the first sentence carefully. Using this technique you will have a general idea of what the writer is saying in each paragraph.

Step 3—Determine which heading is the best match for each of the paragraphs marked by the letters.

Other causes of overpopulation	A
Billions of mouths to feed	B
Poverty and population growth	C
Destruction of human habitat	D
The rate of population growth	E
Human Population Growth	F
Recognition of the problem	G

Scanning paragraphs for key words

The best way to find key words is to use ***scanning*** by looking quickly through the text. Your eyes move across and down through the text without reading it in your normal way.

Also, another source which tells you how to find key words is the *subject* or the *source* of the text. Look at the text **Global Change**. This title can help you understand that key words must concern any kinds of changes or be connected with changes.

E.g.: in paragraph A it is possible to point out the following key words: human activities, biosphere, destruction, growth of population, poisoning of nature, warming of climate, depletion of ozone layer, loss of plants and animals.

Task: Find 5-10 key words in each paragraph

Follow the three-step strategy to make finding the answer easier.

Step 1—Survey the text:

Look at any parts of the text that stand out:

the title, section headings or subheadings,

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any unusual features in the text (e.g. layout or boxes).
Step 2— Make sure you know what you are looking for:
scan for key words or synonyms by looking over the text,
do not read every word.
Step 3—Select 5-10 key words for the whole text:

Out of the body of the key words selected for each of the paragraphs, single out 10 key words for the whole text.

Reference questions

Reference questions ask what noun (called the **referent)** a pronoun or some expression refers to. The correct answer is NOT always the noun that is closest to the pronoun in the passage.

The correct choices are usually other nouns that appear in the passage. If you are unable to decide immediately which referent is correct, substitute the possible choices for the word that is being asked about.

Which is the most logical substitute? In general, reference questions tend to be the easiest type of reading question.

E.g.: The noun ***biosphere*** is the referent for the pronoun ***it*** in the following sentences: The ***biosphere*** extends from a few inches below the surface of the deepest ocean trenches, where microbes exist, to Earth's upper atmosphere, where pollen spores are carried by the wind. ***It*** includes the human habitat, the only one we know or will know in any time of interest to us, our children, or our children's children.

Task: What are the referents for the following italicized words and phrases?

Before identifying the referents for pronouns and other expressions in sentences and very short passages, read the items. Decide which choice is the correct referent for the underlined expression, and mark the answer.

B. For human beings, ***these problems*** may create an increase in human diseases from cancer to cataracts. But ***they*** may also lead to dwindling supplies of safe air, water, and food, putting greater and greater strains on governments to protect people's basic needs.

D. ***These advances*** are causing the world's population to double at a much faster rate than ever before.

E. ***This so-called demographic transition*** has helped reduce the growth of populations in the wealthier, industrialized nations.

G. _____ ***a problem*** common in regions where irrigation is used.

Linking Words

Knowing the meaning and the purpose of linking words in sentences can be very useful for academic reading. For example, in the following passage there are two linking words:

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The biosphere does not need humanity's presence to continue, ***but*** people need nature and the organisms within it to sustain an environment suitable for human life. ***Despite*** this fact, humanity in the final decades of the 1900's is destroying the natural systems upon which it depends.

Both ***but*** and ***despite*** show contrast — ***but*** between clauses and ***despite*** between sentences.

The more common linking words can be divided into **six main groups** according to their purpose.

1. Showing sequence, e.g., finally**,** firstly, secondly, then, next, after this.

• Finally, as cities grow, they take over land once available for agriculture.

2. Giving additional information, e.g., as well, even, in addition, also, besides this, as well as, and.

• They include the growth of the human population and the progressive poisoning of nature…

3. Giving examples, e.g., for example, such as, for instance, be illustrated by.

• The rate at which the human population is growing can be illustrated by how little even catastrophic natural disasters slow it down.

4. Expressing consequence or result, e.g., so that, so, therefore, as a result, consequently.

• As a result, family size drops.

5. Giving reasons or causes, e.g., the cause, be the result of, because of this, due to this, be caused by this, because, result from.

• Loss of farmland is a major cause of the decline in agricultural production.

6. Showing contrast, e.g., but, however, though, although, while, despite, even though, whereas, on the other hand.

• **…**but people need nature and the organisms within it to sustain an environment suitable for human life. Despite this fact, humanity in the final decades of the 1900's is destroying the natural systems…

Note: Even though the above linking words may be in one group, they are often used in different ways in sentences. Check your dictionary or grammar book for examples of how to use these words in grammatically correct ways.

Task: Write out sentences with linking words and phrases and explain their function.

Sample sentence: In the developing nations, however, population growth was higher, averaging 2.1 per cent.

The word 'however' shows that the information in the second sentence contrasts with the information in the first sentence. The main contrast is between industrialized nations and developing nations. Therefore, you can guess that the meaning of «population growth was higher» is similar to the meaning of *excessive* quantities.

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Problems with Verbals

Any of these verbals — participle, gerund, infinitive, or simple form—may be incorrectly used when another one of them is required, depending on the meaning. Take, for example, two sentences:

- I stopped *to talk* with my friend. The infinitive expresses purpose — I stopped because I wanted to talk with my friend.
- I stopped *talking* with my friend. The gerund is an object — I stopped this action because I was pressed for time and had to go.

Incorrect choice of gerunds

- The writer Edgar Allen Poe is usually credited with invent the short story.

After a preposition *{with),* a simple form cannot be used. The correct form is a gerund *{inventing).*

- A single-lens reflex camera allows a photographer seeing exactly what the camera will see.

After the verb *allow,* a gerund *{seeing)* cannot be used. An infinitive (to see) is correct.

Incorrect choice of participles

You may see past participles used incorrectly for present participles or present participles used incorrectly for past participles.

You may also see a main verb used when a participle is required.

- There are probably around 3,000 languages speaking in the world.

Past participle *(spoken)* is required because the idea is passive. The sentence means, «...3,000 languages *which are spoken. ...*»

- For decades, journalist Theodore H. White wrote books described American presidential elections.

Past participle *described* is used incorrectly because the idea is active: the books described the fions. Therefore a present participle, *describing* should be used. (The sentence could also be acted by adding a relative pronoun: *that described.)*

- Nutmeg, widely is used as a spice, is actually the kernel of a tropical spice.

Instead of the main verb *is used,* a past participle *(used)* is required.

Incorrect forms of infinitives

Incorrect infinitive forms such *as for go* or *to going* may be used in place of the correct form, *to go.*

- People need nature and the organisms within it as for sustain an environment suitable for human life.

The correcf form of the infinitive is *to sustain.*

- Viral infections are generally more difficult to treating than bacterial infections.

The correcf form of the infinitive is *to treat.*

Section 2. GUIDELINES FOR GRAMMAR TEST

Problems with Verbals

Any of these verbals — participle, gerund, infinitive, or simple form—may be incorrectly used when another one of them is required, depending on the meaning. Take, for example, two sentences:

- I stopped *to talk* with my friend. The infinitive expresses purpose — I stopped because I wanted to talk with my friend.
- I stopped *talking* with my friend. The gerund is an object — I stopped this action because I was pressed for time and had to go.

Incorrect choice of gerunds

- The writer Edgar Allen Poe is usually credited with invent the short story.

After a preposition *{with),* a simple form cannot be used. The correct form is a gerund *{inventing).*

- A single-lens reflex camera allows a photographer seeing exactly what the camera will see.

After the verb *allow,* a gerund *{seeing)* cannot be used. An infinitive (to see) is correct.

Incorrect choice of participles

You may see past participles used incorrectly for present participles or present participles used incorrectly for past participles.

You may also see a main verb used when a participle is required.

- There are probably around 3,000 languages speaking in the world.

Past participle *(spoken)* is required because the idea is passive. The sentence means, «...3,000 languages *which are spoken. ...*»

- For decades, journalist Theodore H. White wrote books described American presidential elections.

Past participle *described* is used incorrectly because the idea is active: the books described the fions. Therefore a present participle, *describing* should be used. (The sentence could also be acted by adding a relative pronoun: *that described.)*

- Nutmeg, widely is used as a spice, is actually the kernel of a tropical spice.

Instead of the main verb *is used,* a past participle *(used)* is required.

Incorrect forms of infinitives

Incorrect infinitive forms such *as for go* or *to going* may be used in place of the correct form, *to go.*

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The correcf form of the infinitive is *to treat.*

Incorrect verb forms

Some of the verb errors are errors in form. Most verb form problems involve main verb forms: An *-ing* form may be used in place of a past participle, a past participle in place of a past tense form, a simple form in place of an -ing form, an infinitive in place of a simple form, and so on. Some involve irregular verbs that have different forms for the past tense and the past participle—*took* and *taken*—for example. The following information may help you choose the correct form of the main verb.

The simple form follows all modal verbs.

might be	can remember
should study	must know
could go	may follow

(Certain similar modal verbs and word combinations require infinitives.)

ought to attend	used to play
have to hurry	

The past participle is used after a form of *have* in all perfect forms of the verb,

has done	had called
should have said	have run
will have read	could have made

The *-ing* form is used after a form of *be* in all progressive forms of the verb.

is sleeping	has been writing	should have been wearing
was working	had been painting	will be waiting

The past participle is used after a form of *be* in all passive forms of the verb.

is worn	has been shown	would have been lost
is being considered	had been promised	might have been canceled
were told	will have been missed	

Verb form problems may also involve auxiliary verbs: *has* may be used in place of *did, is* in place of *does,* and so on.

Exercise:: Problems involving subject-verb agreement.

Directions: Underline the form that correctly completes each sentence. Then circle the subject with which the underlined verb agrees. The first one is done as an example.

.The first bridge to be built with electric lights (<u>was</u>/were) the Brooklyn Bridge. .

Ethics (is/are) the study of moral duties, principles, and values

There (is/are) two types of calculus, differential and integral.

.George Gershwin, together with his brother Ira, (was/were) the creator of the first musical comedy to win a Pulitzer Prize.

.In a chess game, the player with the white pieces always (moves/move) first.

.The Earth and Pluto (is/are) the only two planets believed to have a single moon.

A number of special conditions (is/are) necessary for the formation of a geyser.

Each of the Ice Ages (was/were) more than a million years long.

The battery, along with the alternator and starter, (makes/make) up the electrical system of a car.

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Teeth (is/are) covered with a hard substance called enamel.

The more-or-less rhythmic succession of economic booms and busts (is/are) referred to as the business cycle.

The number of protons in the nucleus of an atom (varies/vary) from element to element.

All trees, except for the tree fern, (is/are) seed-bearing plants.

Fifteen hundred dollars a year (was/were) the per capita income in the United States in 1950.

Everyone who (goes/go) into the woods should recognize common poisonous plants such as poison ivy and poison oak.

Different forms of the same verb.

From the context of the sentence stem, you'll have to decide which form works best in the sentence. Used alone, an infinitive, gerund, or participle cannot be a main verb.

The verb is active, but it should be passive, or it is passive but it should be active.

If the subject of the sentence *performs* the action, the verb must be in the active voice. If the subject of the sentence *receives* the action, the verb must be in the passive.

- The architect *designed* the building, (active verb)
- The building *was designed* by the architect, (passive verb)

The verb does not agree with its subject. Singular subjects require singular verbs; plural subjects require plural verbs.

The verb is not in the right tense. According to the time words or ideas in the sentence, the appropriate tense must be used.

An unnecessary element comes before the verb. Personal pronouns *{he, she, it),* relative pronouns *{who, which, that,* and so on), or conjunctions *(and, but,* and so on) may be used unnecessarily before verbs in some sentences.

Example

Before the late eighteenth century, most textiles _____ at home.

(A) produced
(B) was produced
(C) producing
(D) were produced

Choice (D) is the best answer. (A) can be considered either an active verb in the past tense or a past participle; both are incorrect. An active verb is incorrect because a passive verb is needed; a past participle is incorrect because a past participle cannot serve as a main verb. (B) is incorrect because the plural subject *textiles* requires a plural verb, *were.* (C) is incorrect because, by itself, an *-ing* form can never be a main verb.

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Mini-test

Identify and correct errors involving verbs and verbals

Human activities _____the biosphere.

(A) threatened
(B) will threaten
(C) are threatening
(D) threaten

The wind (are carried/ carry/ carries/is carried) pollen spores in Earth's upper atmosphere.

In the process (A/B/C/D) itself, the biosphere (maintain/has maintained/ maintained/are maintaining) a habitat suitable for people.

(A) to maintain
(B) of maintaining
(C) maintaining
(D) is maintaining

These problems may (to create/create/creating/ will create) an increase in human diseases.

They may also lead to (dwindle/dwindling/dwindled) supplies of food, (put/putting/to put) greater strains on governments.

Humanity (destroy/ destroyed/is destroying) the natural systems upon which it (depending/depend/depends).

.Improvements in medicine (propels/propel/has propelled) population growth by enabling people to live longer.

The meeting was designed (as to forge/for to forge/to forge) agreement between nations on how environmental problems.

(A) will combat
(B) combat
(C) about combating
(D) to combat

Economic development is the key to (slow/slowing/how to slow) population growth.

The demographic transition has helped (reducing/reduce/to reduce) the growth of population.

This nation may (doom/be doomed/be dooming) to (worsened/worsening) poverty.

One of the problems (to have/having/of having) an increasing world population is the difficulty (to feed/feeding/of feeding) everyone.

Global food production continues and total world food supplies (is/are/was/were) adequate.

(A) to increase
(B) increasing
(C) to be increased
(D) increase

Unfortunately, a rapidly expanding population can by itself (preventing/ prevent/to prevent) a developing nation from (improve/to improve/improving/ improving of) its economy.

Loss of farmlands (are, were, is, was) a major cause of the decline in agricultural production.

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3 percent (are, were, is, was) insignificant for population growth difference between advanced and poor nations.

Usable farmland (lost/is lost/will lost) for many reasons, but erosion and salinization (are, were, is, was) the major cause.

Earth's agricultural resources no longer satisfy the demands the population on a continuing basis.

(A) supplying
(B) by supplying
(C) to supply
(D) as for supply to

Modern agricultural techniques (do/make) it possible (producing/to produce/produce) the same amount of food (to use/ using/by using) the labor of fewer people.

The fact that that the delegates did not agree to forceful solutions (disappoint/disappoints/is disappoint) most scientists.

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Section 1. GUIDELINES FOR READING ACADEMIC TEXTS

TEXT ORGANIZATION AND VOCABULARY IN CONTEXT CONTINUED

SUBHEADINGS, CONTEXT, KEY WORDS, SPECIFIC WORDS

Instruction: Discovering text organization through word meanings. Using the techniques of ***surveying, scanning*** and ***skim reading*** you will find information about the topic of the whole text and its parts. These techniques will also tell you something about how the text is organized. While you are reading, you will probably find many words you do not understand. However, this does not have to be a problem. Firstly, you should decide whether the word is important for you. Understanding the word may not be necessary to understand the text. If you think a word is important, there are some strategies given below you can use to help guess the meaning of the word.

Guessing the Meaning of Words

Supposing you find words you do not understand, it won't be a problem if you get used to follow some regular strategies offered below:

Look at the context

Often you can guess the meaning of a word from the other words around it.

Check the part of speech of a word

Knowing whether the word is a noun (singular or plural), a verb, an adjective or an adverb can help you decide on its meaning within the context. Also, you may already know one form of the word (e.g. the noun *contamination)* but not the others (e.g. the participle *contaminating,* the noun *contaminants,* or the verb to *contaminate),* so you should look closely at the root word to give you a clue.

Use your previous knowledge of English

You may have seen the word in a different context. You can use your previous knowledge and the new context to work out the meaning. Or you may know the separate parts of a word, but may be unfamiliar with the word as a whole. You can use this knowledge to help you work out the meaning.

Check if there is a definition

Sometimes there will be a definition, explanation or example of an unknown word. These can be introduced by a variety of words—*is, means, refers* to, *in other words,* and *i.e.*.

Look for any linking words or discourse markers

Linking words or discourse markers—such as *however, but, therefore, for example, so that, finally*—may help to indicate the meaning of a particular word.

Text: Polluting the Earth

A. As the human population grows, pollution from human activity also increases. Many activities — such as driving automobiles, farming, manufactur-

Unit 8

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Linking words or discourse markers—such as however, but, therefore, for example, so that, finally—may help to indicate the meaning of a particular word.

Text: Polluting the Earth

A. As the human population grows, pollution from human activity also increases. Many activities — such as driving automobiles, farming, manufactur-

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ing, and power generation — release pollutants into the air, water, or soil. Common results of such pollution are changes in the chemistry of the environment.

These chemical changes affect not only the nearby environment — and the people who live there — but also areas hundreds or even thousands of kilometers from the place of release. For example, substances released into the air may be carried by the wind and be deposited far away by rain. Currents in rivers, lakes, and oceans spread pollutants that are dumped into water. Pollution in soil can seep into ground water and appear later in wells. Scientists have found evidence of pollution everywhere on Earth, from the largest cities to the remote and isolated South Pole.

Plant and animal life is sensitive to changes in the chemistry of the environment. For example, scientists have discovered extreme sensitivity in animals and plants that communicate by releasing biochemical compounds called pheromones. Some species can detect and respond to pheromone concentrations of as little as one part in a trillion — the equivalent of one teaspoonful in a lake that is 1 square kilometer (0.4 square mile) in area and 1 to 2 meters (3 to 7 feet) deep.

Such chemical sensitivity suggests to scientists that organisms may be easily affected by small but sudden changes in the chemistry of air, water, and land. Plants and animals may be able to adapt to changes as they evolve over thousands or millions of years. But in time periods measured in a few decades or even centuries, such changes may prove highly disruptive to many forms of life, including human beings.

B. There are many *toxic* (poisonous) pollutants, but the most well-studied are radioactive elements and certain chemical compounds used to kill insects. Radioactive elements give off radiation that is harmful to plants and animals. They have been well studied because scientists can measure and track them easily with instruments that detect the radiation they give off. Such radioactive elements as strontium 90 were distributed worldwide in nuclear-bomb testing in the 1950's and early 1960's.

Strontium 90 chemically resembles the mineral calcium. Plants and animals absorb and store strontium 90 in tissues where calcium normally accumulates. In animals, strontium 90 accumulates in bone and *marrow,* the blood-cell-forming tissue and can cause *leukemia,* a cancer of the blood. Small amounts of strontium 90 in the environment are *a direct hazard* to people.

Certain chemical pesticides used to control insects have also been well studied. Scientists can trace the chemicals' effects because some of the compounds remain in the environment for a long time. In addition, they have been used in large amounts in many parts of the world.

Studies of radioactive and chemical contaminants have taught scientists a great deal about the *hazards of toxins* and their threat to people and nature. One of scientists' most important discoveries was that toxins released into the environment not only circulate widely in air and water, but also may appear in living creatures in concentrations that are tens, hundreds, thousands, or hundreds of thousands of times higher than those measured in the air, water, or soil.

The concentrations may be increased or decreased as toxins are passed up the food chain. For example, a single plant may retain only a small amount of a toxin on its leaves. A rabbit eating many such plants may absorb the toxin in all

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the plants. And when a wolf eats many rabbits over the course of its lifetime, it absorbs the toxin in all the rabbits. In this way, the concentrations of a pollutant that is stored in animal tissues and not excreted may be dramatically larger in the tissues of some animals at the top of a food chain. This process is called biomagnification.

C. Scientists are continuing to amass data concerning the effects of many other types of toxic pollutants. Air pollution, for example, can cause breathing difficulties and other health problems in people, aggravating such diseases such as asthma and pneumonia and contributing to the development of cancer and emphysema. Air pollution also harms plants and animals.

Two of the most serious air pollutants are oxides of sulfur and of nitrogen. A major source of these compounds is the burning *of fossil fuels* (coal, oil, and natural gas) in industry and in transportation. The pollutants often occur with high levels of other toxins such as lead, zinc, and ground-level ozone, a component of smog formed by chemical reactions between car exhausts and sunlight.

Sulfur dioxide and nitrogen oxides also cause acidic precipitation, commonly called *acid rain.* Acid rain results when the airborne pollutants combine with moisture in the air to form sulfuric and nitric acids that fall back to Earth, usually in rain or snow. Since the late 1960's, numerous scientific studies have demonstrated acid rain's effects on the environment. These studies have shown that acid rain hinders plant *photosynthesis* (the process by which plants make food from water, sunlight, and carbon dioxide). Acid rain also contributes to the death of trees, destroys life in lakes and rivers, and damages statues and other structures.

D. Other pollutants under study include the metallic elements called *heavy metals.* These contaminants can pollute air, water, and soil. They include lead, mercury, silver, zinc, iron, copper, nickel, chromium, and cadmium. Some coal is rich in heavy metals, and burning it in electric power stations, incinerators, steel mills, and motor vehicles may produce air pollution containing the metals. The elements enter the atmosphere as extremely small particles called *particulates.* These particulates then fall to Earth and contaminate soil and water.

Scientists are accumulating evidence of the effects of heavy metals in the environment. Studies show that exposure to lead in soil or water can cause nervous-system damage in children, for example, and that if human beings eat mercury-poisoned fish, the effects can be deadly. In March 1991, Joel Schwartz, a scientist with the U.S. Environmental Protection Agency, reported that as many as 60,000 people in the United States may die prematurely each year as a result of particulate pollution. In August 1991, measurements of mercury levels in fish caught in several U.S. lakes prompted officials in 20 states to warn consumers against eating fish from those waters. Heavy metals also threaten the growth of forests by *disrupting* the supply of nutrients in the soil.

E. Acid rain and heavy metals are only a few of the many pollutants that contaminate rivers, lakes, streams, seas, and oceans. Waste from industries is a particularly important cause of water pollution. Factories may dump waste containing toxic chemicals directly into bodies of water or into sewerage systems.

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D. Other pollutants under study include the metallic elements called *heavy metals.* These contaminants can pollute air, water, and soil. They include lead, mercury, silver, zinc, iron, copper, nickel, chromium, and cadmium. Some coal is rich in heavy metals, and burning it in electric power stations, incinerators, steel mills, and motor vehicles may produce air pollution containing the metals. The elements enter the atmosphere as extremely small particles called *particulates.* These particulates then fall to Earth and contaminate soil and water.

Scientists are accumulating evidence of the effects of heavy metals in the environment. Studies show that exposure to lead in soil or water can cause nervous-system damage in children, for example, and that if human beings eat mercury-poisoned fish, the effects can be deadly. In March 1991, Joel Schwartz, a scientist with the U.S. Environmental Protection Agency, reported that as many as 60,000 people in the United States may die prematurely each year as a result of particulate pollution. In August 1991, measurements of mercury levels in fish caught in several U.S. lakes prompted officials in 20 states to warn consumers against eating fish from those waters. Heavy metals also threaten the growth of forests by *disrupting* the supply of nutrients in the soil.

E. Acid rain and heavy metals are only a few of the many pollutants that contaminate rivers, lakes, streams, seas, and oceans. Waste from industries is a particularly important cause of water pollution. Factories may dump waste containing toxic chemicals directly into bodies of water or into sewerage systems.

Sewage itself is another major contaminant of water that can cause ecological problems and such human diseases as cholera and dysentery. Marine life is also *harm*ed by agricultural waste, chiefly runoff containing chemical fertilizers and pesticides. Finally, oil and other petroleum products, that are spilled into bodies of water, *foul* beaches and *kill* sea birds and mammals, such as dolphins and whales.

F. Chemical pollutants released into water or spread through the air are often invisible to the human eye. But the growing masses of solid waste that people produce are an all-too-visible pollutant in the form of trash.

The EPA estimates that by 2000, the United States will generate about 175 million metric tons (193 short tons) of solid waste per year. According to the U.S. National Solid Wastes Management Association, an organization of businesses that collect, dispose of, and recycle trash, about 83 per cent of U.S. solid waste goes into landfill dumps.

In most landfills, operators spread earth over the most recent garbage to keep rats, flies, and other vermin away. But landfills still pose a widespread pollution hazard.

Apart from the land that landfills pollute, they can also poison underground reservoirs of water with metals and dangerous chemicals from packaging materials and other debris. This happens when rain seeps through garbage, dissolves the metals and chemicals, and carries them into the soil. Once in the ground, the compounds slowly filter down to enter water supplies — which are often used for drinking water. As solid wastes fill more and more landfills, this form of water pollution is an increasing concern.

G. To protect people and the environment, most developed nations have placed limits on the amount and types of pollution that can be released into the environment. But laws and political boundaries cannot stop the spread of pollution through the air or through the water. Therefore, nations and states with high levels of pollution can adversely affect those with the strictest pollution laws.

Another difficult question involves what level of pollution is safe. Many laws require that pollution levels not exceed those found to be harmful to people. But, as scientists have learned through the study of DDT and other pesticides, it may be necessary to protect plant and animal life in order to protect people. Doing so would require much more restrictive standards than those based simply on protecting people from direct contamination. Yet experts say that enacting such tough standards is the only way to assure the protection of people from the poisoning of the environment that is now underway.

Task: Match the following 7 headings with letters A, B, C, D, E, F, G.

Your task is to choose the correct one from the list of headings provided in the box. You should skim a paragraph or section before choosing the correct answer from the list. Remember that it is more efficient to skim the long piece of text first and get the idea of the whole text. Then you can look through the alternative headings very quickly.

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From air pollution to acid rain	A
The weighty problem of heavy metals	B
Other water pollutants	C
Solid waste	D
Clearing the water, land, and air	E
Studying the effect of pollutants	F
Pollution from human activity	G

Step 1 Survey the text

The list of headings will give you some clues to help you quickly understand what each part of the text is about.

Step 2 Skim read each paragraph

Every paragraph deals with a specific aspect of a topic. The first sentence of a paragraph may tell you what the rest of the paragraph is about. Therefore while trying to identify the main idea of a paragraph, you should read the first sentence and skim the rest of the paragraph.

Task: Scan the text for key words.

This title **Polluting the Earth** can help you understand that key words must concern any kinds of polluting activities or be connected with effects of pollution. E.g., in paragraph A it is possible to point out the following key words: pollution, pollutants, environment, chemical changes, plant and animal life, chemical sensitivity, pheromones, to adapt.

Follow the three-step strategy to make finding key words easier.

Step 1 Make sure you know what you are looking for.
Step 2 Scan each paragraph for 5-10 key words. Do not read every word.
Step 3 Select 5-10 key words for the whole text.

Task: Use your general background knowledge, understanding of the general context, knowledge of parts of speech and root words.

Your knowledge and experience about what is logical or illogical can help you guess the meaning of some words. Let us take, for instance, the last two passages of paragraph A:

«Plant and animal life is sensitive to changes in the chemistry of the environment. For example, scientists have discovered ***extreme sensitivity in animals and plants*** that ***communicate by releasing biochemical compounds called pheromones***. Some species can ***detect and respond to pheromone concentrations*** of as little as one part in a trillion — the equivalent of one teaspoonful in a lake that is 1 square kilometer (0.4 square mile) in area and 1 to 2 meters (3 to 7 feet) deep.

Such chemical sensitivity suggests to scientists that organisms may be easily affected by small but sudden changes in the chemistry of air, water, and land. Plants and animals ***may be able to adapt*** to changes as they evolve over thou-

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sands or millions of years. ***But*** in time periods measured in a few decades or even centuries, such changes ***may prove highly disruptive*** to many forms of life, including human beings.»

You know that the words ***Plant and animal*** are normally nouns, but here they are acting as adjectives describing the noun 'life'.

Supposing you don't know what «***pheromones*** «are, you may see some structural analogy to the word «***hormones»*** and guess from the context that these ***biochemical compounds*** are released, detected and responded to by plants and animals as signs of their sensitivity and communication.

Your knowledge of the root word can also help you: You may not know the adjective ***disruptive*** but you may compare it to such well-known word nests as «corrupt, corruption, corruptive» and guess that there is some negative meaning about this word. On the other hand, there is a clear opposition of «***may be able to adapt…*** over thousands or millions of years» supported by the linking word ***but*** and the next phrase ***«***in a few decades or even centuries… ***may prove highly disruptive.»*** Therefore you may guess that ***disruptive — disruption*** would mean «death, destruction or disappearance».

Task:

- Basing on paragraph B explain what the process of ***biomagnification*** is and how it works at the top of a human food chain.
- Basing on paragraph C explain what an ***acid rain*** is and how it affects the environment.
- Basing on paragraph D explain what ***particulate pollution*** is and how it affects plants, animals and human beings.
- Basing on paragraph E explain what ***pollutants*** contaminate water bodies and how it affects the water life.
- Basing on paragraph F explain what ***pollution hazard*** is posed by landfills and how they poison underground reservoirs.
- Basing on paragraph G explain what ***restrictive standards*** can protect people and how interests of different nations are interconnected.

Task: Collect ***specific information*** by pointing out groups of synonyms, semantic and thematic groups. Keep it in mind that vocabulary in context includes both single words (usually nouns, verbs, adjectives, and adverbs). and two- or three-word phrases.

- It is claimed in paragraph B that ***Toxic (poisonous) pollutants*** refer to ***radioactive elements and certain chemical compounds***. Continue this list and find all names of toxic pollutants mentioned in the text. Make a thematic group of names of toxins.
- Find two synonyms for the phrase ***solid waste*** in paragraph F.
- Explain a contrast in the following sentence from paragraph B: One of scientists' most important discoveries was that toxins released into the environment ***not only*** circulate widely in air and water ***but also*** may appear in living creatures in concentrations that are tens, hundreds, thousands, or hundreds of thousands of times higher than ***those*** measured in the air, water, or soil.
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Errors with parallel structures

Structures that are often involved in parallelism are nouns, adjectives, verbs, prepositional phrases, gerunds, and infinitives.

Some problems with parallelism are actually word form problems similar to previously discussed.

As a young man, George Washington liked boating, to hunt, and fishing.

In general, errors involving parallelism are easy to identify.

Exercise: Identifying and correcting errors involving parallelism.

Directions: If the underlined form is parallel to other forms in the sentence, mark the sentence *C (Correct).* If the underlined form is not parallel, mark the sentence *I (Incorrect),* and write a correction for the underlined form in the blank at the end of the sentence.

1. Steel is alloyed with manganese to increase its strength, hardness, and *resistance* to wear.
2. Sacramento is the commercial, *industry,* and financial center of California's Central Valley, as well as being the state capital.
3. Philosophers are concerned with questions about nature, *human behavior,* society, and reality.___
4. When taking part in winter sports, one should wear clothing that is lightweight, *warmth* and suitable for the activity.
5. Folklore consists of the beliefs, customs, traditions, and *telling stories* that people pass from generation.
6. Major sources of noise pollution include automobiles and other vehicles, industrial plants, and *heavy construction equipment.*___
7. Because of their hardness, industrial diamonds can be used for cutting, *grind,* and drilling.

Other word form problems

Pairs of words are sometimes confused, including those listed below.

No Used as an adjective before nouns; means «not any.» Also used in the expression *no longer.*

Not... Used to make all other words negatives.

Correct the following examples:

Not gasoline was left in the tank.

This is *no* the station I usually listen to.

I *not* longer listen to that station

Most Used in superlative adjective phrases; also used to mean «the majority.

Almost Used as an adverb to mean «nearly.»

Correct the following examples:

This is the *almost* interesting chapter in the book.

I've read *almost* of the chapters in the book.

I've solved *most* all of the problems in the book.

Section 2. GUIDELINES FOR GRAMMAR TEST

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I've solved most all of the problems in the book.

80

Twice Used as an adjective to mean «two times.»
Double Used as an adjective to mean «make twice as large.»
Correct the following examples:
Henry has *double* as much money as he did before he invested it.
Henry *twice* his money.

Percent Used after a number,
Percentage Not used after a number.
Correct the following examples:
Fifty percentage of the people voted in favor of the initiative.
The *percent* of people who approve of the initiative has been steadily growing.

After Used as a preposition before a noun or as an adverb-clause marker before a clause,
Afterward Used as an adverb, means «after that.»
Correct the following example: We'll go to dinner *afterward* the play.

Ago Used to talk about a time earlier than the present.
Before Used to talk about a time earlier than some other point in time.
Correct the following example: Harold won a gold medal in the Olympics last year, and four years *ago* that, he won a silver medal.

Tell Used with an object; also used in certain set expressions: *tell a story, tell the truth, tell a secret.*
Say Used without an object.
Correct the following examples:
Mr. Hunter *said* us that he'd had a good trip.
Joe *said* a wonderful story.
Mr. Hunter *told* that he'd had a good trip.

Ever Means «at any time.» Used with *not* to mean «never.» Also used in some set expressions.
Never Means «at no time.» Not used with a negative word.
Correct the following example: He hardly *never* goes to that club.

Alive Used after a verb,
Live Used before a noun.
Correct the following examples:
Sue likes to have *alive* plants in her apartment.
Although she forgot to water it for a week, the plant was still *live.*

Around Used as a preposition to mean «in a circular path.»
Round Used as an adjective to mean «circular in shape.»
Correct the following example: The new office building will be an *around* glass tower.
Age Used as a noun, often in these patterns: at the age of 21, 21 years of age.
OId Used as an adjective, often in this pattern: 21 years old.

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Correct the following examples:
Harriet will be thirty years *age* next week.
Operators of motor vehicles must be eighteen years of *old* in Ukraine.

Near Used as an adjective; means «close to.»
Nearly Used as an adverb; means «almost.»
Correct the following examples:
Lynn is looking for an apartment *nearly* the Medical Center.
The two-bedroom apartment she looked at cost *near* a thousand dollars a month.

Some Used as a determiner before a noun to mean «an indefinite amount.»
Somewhat Used as an adverb to mean «slightly.»
Correct the following example: His bicycle is *some* more expensive that the one I looked at yesterday,
NOTE: The distinctions between words such as *desert* and *dessert, stationary* and *stationery, capital* id *capitol* are really spelling problems. Native-speakers of English often make mistakes with these words!

Incorrect forms of words connected with certain fields

This error involves a confusion between the names of fields *(biology,* for example) and the name of a person who practices in that field *(biologist),* or between one of those terms and the adjective that describes the field *(biological).*
• First specializing in industrial photography, Margaret White later became a famous
news photographer and editorial.
The adjective *editorial* is used to describe the field of editing. However, a noun referring to a person *(editor)* is needed in this sentence
• Hunting played an important role in the cultural of ancient people
The noun *culture,* not the adjective *cultural* is needed.
• The galaxy Andromeda is the most distance object visible to observers in the Northern Hemisphere.
The adjective *distant* is needed in place of the noun *distance.*
• Scientists belief that the continents once formed a single continent surrounded by an
enormous sea.
In this sentence, the verb *believe* is needed in place of the noun *belief.*
• Bunsen burners are used to hot materials in a chemistry lab.
In this sentence, the verb *heet* is needed in place of the adjective *hot.*
• A sudden freezing can destroy citrus crops.
Rather than the gerund (*-ing*) form, the noun *freeze* is required.

Mini-test

Identify and correct errors involving parallel structures and word forms
If the italicized form is parallel to other forms in the sentence, mark the sentence *C (Correct).* If the underlined form is not parallel, mark the sentence *I (In-*

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correct), and write a correction for the underlined form in the blank at the end of the sentence.

Many activities — such as driving automobiles, farming, *manufacture*, and power generation — release pollutants into the air, water, or soil. _____

Chemical changes affect not only the nearby environment, people who live there but also distant *areas*. _____

Currents in rivers, lakes, and *ocean* spread pollutants that are dumped into water.

Plants and animals absorb and *are storing* strontium 90 in their tissues. _____

A major source of pollution is the burning *of* fossil fuels in industry and in transportation.

Organisms may be easily affected by *small* but sudden changes in the chemistry of air, water, and land.

Petroleum products that *leak* into bodies of water foul beaches and kill sea birds and mammals

Toxins released into the environment not only *circulate* ( ) widely in air and water, but also may appear in living creatures in *high* ( ) concentrations that are tens, hundreds, thousands, or *hundred of thousands* (_____) of times higher than those measured in the air, water, or *soils* ( ).

Identify word form errors

Scientists have discovered extreme sensitivity in (most/most all) animals and plants that communicate by releasing (somewhat/some) biochemical compounds called pheromones.

Plant and animal life is (almost/most) sensitive to changes in the chemistry of the environment.

Sulfur dioxide and nitrogen oxides cause (double as/twice as) much acidic precipitation as other chemicals.

Laws and political boundaries can (not longer/no longer) stop the spread of pollution through the air or through the water.

60,000 people in the United States may (no/ever/never) live up to (the age of/the old of) 18 as a result of particulate pollution.

Developed nations have (ever/never) actually tried to placed limits on the amount and types of pollution that can be released into the environment.

.High (percent/percentage) of (other/another) pollutants include the metallic elements called *heavy metals.*

(Afterwards/after) many studies scientists have learned that it is (hardly/hard) possible to protect plant and animal life in order to protect people.

Such radioactive elements as strontium 90 were distributed worldwide in nuclear-bomb testing in 1960's and ten years (ago/before) in 1050.

Leaders of advanced nations (said/told) the world they were going to reduce pollution by 50 (percent/percentage) by 2020.

(Near/Nearly) 150 nations were present at the Summit.

The decision is not to be found (round/around) the corner.

(No/Not) (live/alive) plants or animals can be found in the areas of industrial runoff containing chemical fertilizers and pesticides.

correct), and write a correction for the underlined form in the blank at the end of the sentence.

Many activities — such as driving automobiles, farming, *manufacture*, and power generation — release pollutants into the air, water, or soil. _____

Chemical changes affect not only the nearby environment, people who live there but also distant *areas*. _____

Currents in rivers, lakes, and *ocean* spread pollutants that are dumped into water.

Plants and animals absorb and *are storing* strontium 90 in their tissues. _____

A major source of pollution is the burning *of* fossil fuels in industry and in transportation.

Organisms may be easily affected by *small* but sudden changes in the chemistry of air, water, and land.

Petroleum products that *leak* into bodies of water foul beaches and kill sea birds and mammals

Toxins released into the environment not only *circulate* ( ) widely in air and water, but also may appear in living creatures in *high* ( ) concentrations that are tens, hundreds, thousands, or *hundred of thousands* (_____) of times higher than those measured in the air, water, or *soils* ( ).

Identify word form errors

Scientists have discovered extreme sensitivity in (most/most all) animals and plants that communicate by releasing (somewhat/some) biochemical compounds called pheromones.

Plant and animal life is (almost/most) sensitive to changes in the chemistry of the environment.

Sulfur dioxide and nitrogen oxides cause (double as/twice as) much acidic precipitation as other chemicals.

Laws and political boundaries can (not longer/no longer) stop the spread of pollution through the air or through the water.

60,000 people in the United States may (no/ever/never) live up to (the age of/the old of) 18 as a result of particulate pollution.

Developed nations have (ever/never) actually tried to placed limits on the amount and types of pollution that can be released into the environment.

.High (percent/percentage) of (other/another) pollutants include the metallic elements called *heavy metals.*

(Afterwards/after) many studies scientists have learned that it is (hardly/hard) possible to protect plant and animal life in order to protect people.

Such radioactive elements as strontium 90 were distributed worldwide in nuclear-bomb testing in 1960's and ten years (ago/before) in 1050.

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Find and correct the errors

A single plant may retain only a small amount of a toxic on its leaves.

Plant and animal life is sensitive to changes in the chemical of the environment.

Sciences are continuing to amass data concerning the effects of many other types of toxic pollutants.

These chemistry changes affect not only the nearby environment — and the people who live there — but also areas hundreds or even thousands of kilometers from the place of release.

As the human population growth, pollution from human activity also increases.

Apart from the land that landfills pollute, they can also poisonous underground reservoirs of water with metals and dangerous chemicals from packaging materials and other debris.

Finally, oil and other petroleum productions, that are spilled into bodies of water, foul beaches and kill sea birds and mammals, such as dolphins and whales.

Sewage itself is another major contamination of water.

It can cause ecology problems and such human diseases as cholera and dysentery.

Sulfur dioxide and nitrogen oxides also cause acid precipitation, commonly called acid rain.

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Section 1. GUIDELINES FOR READING ACADEMIC TEXTS

REVISION: MAIN TOPIC AND SUBTOPICS, TEXT ORGANIZATION, MAKING INFERENCES, EXPLICATION OF SPECIFIC INFORMATION

MAIN IDEA, SUBHEADINGS, KEY WORDS, VOCABULARY IN CONTEXT, SPECIFIC WORDS

Instruction: This is a revision unit in which you should combine all skills you have employed in the preceding eight units. You will have to start with identifying the main idea, the main topic, or the main purpose of the text. Then follows the task of: matching headings with paragraphs or sections, and identifying which sections relate to certain topics. Basing on circumstantial evidence, inferences and vocabulary-in context you will have to look into specific information given in the text.

Text: Earth's Threatened Ozone Layer

A. One of the most disturbing aspects of the changes in Earth is the rate at which chemical pollutants produced by human activity are destroying the protective layer of ozone in Earth's upper atmosphere. Ozone is a molecule that consists of three oxygen atoms. An oxygen gas molecule consists of two oxygen atoms. Reactions between oxygen and ultraviolet radiation from the sun create a layer of ozone throughout Earth's *stratosphere* (upper atmosphere).

Although ground-level ozone is considered a harmful pollutant, the ozone layer in the stratosphere is beneficial. The layer normally absorbs 95 to 99.9 per cent of the ultraviolet radiation from the sun, protecting life on Earth from this biologically damaging form of energy.

Ultraviolet radiation causes skin cancer — including *malignant melanoma,* a form of the disease that can be fatal — and other health problems. Ultraviolet radiation increases the risk of cataracts, which cloud the lens of the eye and can cause blindness. It may also weaken the human body's disease-fighting immune system. Scientists fear that the continued depletion of the ozone layer in the upper atmosphere will thus cause widespread health problems.

Ultraviolet radiation threatens other forms of life as well. It may interfere with plant photosynthesis, causing ecological damage and reducing agricultural production. Ultraviolet radiation may also damage marine life by killing one-celled plants called phytoplankton, which form the base of the ocean's food chain. *Krill* (small, shrimplike animals) feed on phytoplankton. Krill, in turn, are a major source of food for many sea animals, including penguins, seals, and whales.

B. In 1974, scientists first proposed the idea that manufactured chemicals could threaten the ozone layer. A group of widely used gases called chlorofluorocarbons (CFC's) posed the greatest chemical threat.

Unit 9

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These gases have a variety of uses. Electronic equipment manufacturers use CFC's to clean metal, and CFC's are commonly used as refrigerants and to make foam insulation. Aerosol sprays may also contain the compounds. The United States banned the use of CFC's in aerosol sprays in 1978, but many other countries still permit this use. Finally, halon gases, which are used in fire extinguishers, are also CFC's.

Each year, the world uses approximately 750,000 metric tons (827,000 short tons) of CFC's. Much of those gases are sealed in refrigerators and air conditioners, where they do not threaten the environment. However, some CFC's escape from leaking, poorly serviced, or discarded appliances. Industrial processes such as electronics and insulation manufacturing also release CFC's into the atmosphere.

Once in the upper atmosphere, CFC's react with ozone to destroy it. First, ultraviolet light breaks down CFC molecules. One of the products of this breakdown is the element chlorine. As a single chlorine atom or when combined with one oxygen atom as chlorine monoxide, this element breaks down ozone molecules. Scientists estimate that one chlorine atom can destroy as many as 100,000 ozone molecules.

C. The frigid temperatures and atmospheric conditions above Antarctica favor the destruction of ozone. Scientists believe that tiny ice crystals of nitric acid in Antarctica's upper atmosphere are directly involved. These crystals may help begin the chemical changes that result in the destruction of ozone.

In 1985, British scientists confirmed that chemical reactions had begun to damage the ozone layer above Antarctica. They reported results from ozone measurements taken with instruments on the ground, in airplanes, and put aloft in scientific balloons during the previous 27 years. Their measurements showed a 40 per cent reduction in ozone concentrations over Antarctica from the mid-1970's to 1984. This thinning occurred during September and October — springtime in the Southern Hemisphere. Media reports dubbed the annual thinning a «hole» in the ozone layer.

Many groups of scientists quickly began monitoring the Antarctic ozone layer. In 1986, U.S. National Aeronautics and Space Administration (NASA) scientists confirmed the British findings and found that the hole in the ozone layer was nearly as large as the entire continent of Antarctica. In 1987, scientists reported that the hole was wider and deeper than in 1986, and that it lasted longer. In 2001, scientists reported that, during 1990's, Antarctic ozone levels had dropped to their lowest recorded level.

D. The danger of ozone destruction is not limited to Antarctica, however. In April 2007, the U.S. Environmental Protection Agency (EPA) reported that atmospheric ozone concentrations above the United States decreased by 5 to 6 per cent during the 2000's, three times faster than during the 1970's. The EPA report fueled concerns that cases of skin cancer and deaths due to melanoma would rise dramatically in the United States in future decades.

In October 1991, United Nations scientists reported that ozone losses above the United States and other temperate areas of Earth between the tropics and the poles were taking place during summertime. This alarmed many experts, who

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In February 2002, NASA scientists announced that levels of chlorine monoxide resulting from the breakdown of CFC's were at record levels above the Northern Hemisphere near the Arctic and that these conditions could cause an ozone hole to develop over much of Europe, Canada, Russia, and northern portions of the United States by the year 2010.

For an ozone hole to form, proper weather conditions must also exist. In April 2004, NASA scientists reported that ozone-layer depletion above the Arctic was not as extensive as expected because of unusually warm weather. The weather helped break up a pattern of strong, cold winds called the circumpolar vortex. These winds help trap chlorine monoxide and speed ozone destruction. But scientists said that if the circumpolar vortex lasts longer than usual in future years, a large ozone hole can be expected to develop above the Arctic.

E. Scientists and politicians worldwide are working to slow the destruction of the ozone layer. In September 1987, 24 nations, including the United States, signed an agreement in Montreal, Canada, to limit the production of CFC's. The agreement, called the Montreal Protocol, froze CFC production at 1986 levels, beginning in 1989. The 24 nations also agreed to reduce CFC production by 50 per cent by 1999.

Since the Montreal Protocol, however, most nations have agreed that an even quicker phase-out of CFC's is needed. In June 1990, the world's industrial nations agreed to halt all production of CFC's by the year 2000. Some countries adopted an even more rapid phase-out schedule. Most European nations planned to stop producing CFC's by the end of 1995, and the United States announced in February 1992 that it would also stop making the chemicals by the end of 1995.

But CFC's remain in the atmosphere for at least 75 years before natural processes break them down and the chlorine washes out of the atmosphere as hydrochloric acid in rain. So even if all CFC production stopped immediately, the threat of ozone depletion would continue for more than a century. And the CFC's needed for industry are not easily replaced. There are, however, substitutes for most uses, including refrigeration. The challenge for scientists and chemical engineers is to find substitutes that will be as effective as CFC's — and that will not have some other group of harmful effects.

F. While some researchers concentrate on the car and improving its systems and materials, others focus on the fuel that feeds the car. On at least one occasion, car improvements and fuel refinements went hand in hand. When catalytic converters were developed, the petroleum industry had to make gasoline lead-free. Leaded gasoline produces emissions containing lead, which coats the metals in the converter, rendering them ineffective. Because lead has been linked to cancer and can cause nervous-system damage in children, lead-free gasoline was an important development against automobile pollution.

Researchers continue to search for ways to make better gasoline. Refining crude oil to produce gasoline involves heating the oil and drawing off various types of hydrocarbons as they evaporate. Some hydrocarbons, such as butane,

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are lightweight molecules that evaporate easily. Others, such as benzene, are heavier, have a tendency to form deposits and particulates, and may be cancer-causing.

Petroleum companies can create gasolines that pollute less by using more hydrocarbons from the middle of the weight spectrum — those that are neither very light nor very heavy. Refiners can also break down or «crack» some of the heavier hydrocarbons to yield lighter compounds. Some gasoline additives, such as methyl tertiary butyl ether — commonly known as MTBE — include oxygen atoms in their structure. This helps promote more complete fuel combustion.

G. Researchers are also investigating fuels other than gasoline. Methanol (an alcohol made from ingredients derived from such sources as natural gas, wood, coal, sewage, or garbage) emits smaller quantities of pollutants normally associated with gasoline combustion. But it has less potential energy than does gasoline, and it is more difficult to ignite. Methanol also can *corrode* (eat away) many of the metals, sealants, and resins used in automobiles. Finally, methanol produces formaldehyde, a toxic compound that can irritate the eyes, nose, and throat, and which is thought to cause cancer. On the positive side, methanol burns more completely than does gasoline, and when mixed with 15 per cent gasoline to form a fuel called M-85, it achieves satisfactory starting performance. A «flexible fuel» engine can run on either gasoline or methanol or a combination of both. Special sensors determine the type of fuel in use and relay this information to the central computer system.

Natural gas is another abundant fuel that experts consider an alternative to gasoline. It is composed mainly of methane gas and is cheaper and much cleaner than gasoline. This fuel's major drawback is that, unlike gasoline and methanol, it is not available as a liquid at normal air temperatures and pressures. Natural gas must be carried in a pressurized tank, or, as a liquid, in an insulated tank — unfamiliar additions to a car's design that consumers may reject. Refueling with natural gas could take up to several hours.

Some scientists are interested in hydrogen as the fuel of the future. Hydrogen burns much more cleanly than do other fuels and is easy to produce. But complex technical problems must be solved before it can be widely used in cars.

Electric vehicles are quiet and virtually emission-free. However, the batteries from which they draw energy usually contain toxic chemicals, which become pollutants when the batteries are disposed of. Today's electric cars cannot go as far or as fast as gasoline-driven vehicles because the battery does not offer the same amount of energy as does gasoline combustion. Furthermore, the battery must be recharged regularly, and the energy to do this comes from power plants that are also a source of pollution. Nevertheless, electric vehicles are the likely choice for meeting zero-emission laws that have been established in some areas, such as California.

The ongoing search for ways to make cars cleaner poses a demanding challenge to engineers, as well as chemists, materials scientists, and technicians. The widespread research reflects our newly heightened concerns for the environment along with our old desire to maintain the freedom of movement that the automobile has brought to the developed world.

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Task: Answer the following questions:

- What is the main topic of the passage?

(A) Human activity is destroying the protective layer of ozone in Earth's upper atmosphere.
(B) Manufactured chemicals could threaten the ozone layer.
(C) Scientists are working to slow the destruction of the ozone layer.
(D) Better gasoline will improve the protective layer of ozone.

- What is the author's attitude toward the Montreal Protocol freezing CFC production?
- Where in the four sentences does the author discuss harmful pollutants interfering with the protective layer of ozone in Earth's upper atmosphere?

(A) Although ground-level ozone is considered a harmful pollutant, the ozone layer in the stratosphere is beneficial.
(B) Ultraviolet radiation threatens other forms of life as well.
(C) The frigid temperatures and atmospheric conditions above Antarctica favor the destruction of ozone.
(D) A group of widely used gases called chlorofluorocarbons (CFC's) posed the greatest chemical threat.

Read the passage: Methanol emits smaller quantities of pollutants normally associated with gasoline combustion. But it has less potential energy than does gasoline, and it is more difficult to ignite. Methanol also can *corrode* (eat away) many of the metals, sealants, and resins used in automobiles. Finally, methanol produces formaldehyde, a toxic compound that can irritate the eyes, nose, and throat, and which is thought to cause cancer. On the positive side, methanol burns more completely than does gasoline, and when mixed with 15 per cent gasoline to form a fuel called M-85, it achieves satisfactory starting performance.

- Which of the following can be inferred about methanol?

(A) Methanol causes cancer.
(B) Gasoline doesn't produce toxic compounds.
(C) Methanol is easier to ignite..
(D) The best fuel is a composition of methanol and gasoline.

Task: Match the following 7 headings with letters A, B, C, D, E, F, G.

Antarctica's ozone destruction	A
Ozone losses above the US	B
Ultraviolet radiation	C
Ozone-destroying chemicals	D
Alternatives to gasoline	E
Gasoline refinement	F
Protecting the ozone layer	G

Your task is to choose the correct one from the list of headings provided. You should skim a paragraph or section before choosing the correct answer from

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Your task is to choose the correct one from the list of headings provided. You should skim a paragraph or section before choosing the correct answer from

the list. Remember that it is more efficient to skim the long piece of text first and get the idea of the whole text. Then you can look through the alternative headings very quickly.

Step 1 Survey the text

The list of headings will give you some clues to help you quickly understand what each part of the text is about.

Step 2 Skim read each paragraph

Every paragraph deals with a specific aspect of a topic. The first sentence of a paragraph may tell you what the rest of the paragraph is about. Therefore while trying to identify the main idea of a paragraph, you should read the first sentence and skim the rest of the paragraph.

Task: Scanning the text for key words.

This title **Earth's Threatened Ozone Layer** can help you understand that key words must concern any kinds of polluting activities or be connected with destruction of ozone layer. E.g., in paragraph A it is possible to point out the following key words: chemical pollutants, ozone layer, ultraviolet radiation, to protect, to destroy, to damage, health problems, food chain.

Follow the three-step strategy to make finding key words easier.

Step 1 Make sure you know what you are looking for.

Step 2 Scan each paragraph for 5-10 key words. Do not read every word.

Step 3 Select 5-10 key words for the whole text.

Task: Use your general background knowledge, knowledge of the general context, your knowledge of parts of speech and root words.

Your knowledge and experience about what is logical or illogical can help you guess the meaning of some words. Let us take, for instance, the first passage of paragraph A and the last passage of paragraph B. These two passages are logically connected in that they explain how the reaction of ozone creation and destruction is going on:

«One of the most disturbing aspects of the changes in Earth is the rate at which chemical pollutants produced by human activity are ***destroying*** the protective layer of ozone in Earth's upper atmosphere. ***Ozone is a molecule that consists of three oxygen atoms***. An oxygen gas molecule consists of two oxygen atoms. ***Reactions between oxygen and ultraviolet radiation*** from the sun ***create*** a layer of ozone throughout Earth's *stratosphere* (upper atmosphere).»

«Once in the upper atmosphere, ***CFC's react with ozone to destroy it***. First, ***ultraviolet light breaks down CFC molecules***. One of the products of this ***breakdown*** is the element chlorine. As a ***single chlorine atom*** or when combined with one oxygen atom as ***chlorine monoxide***, this element ***breaks down ozone molecules***. Scientists estimate that one chlorine atom can ***destroy*** as many as 100,000 ozone molecules.»

As you may see, there are words with opposing meanings in these passages: ***to create***, ***to produce, products,*** on the one hand, and ***to destroy, destroying and to break down, breakdown***, on the other hand.

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The list of headings will give you some clues to help you quickly understand what each part of the text is about.

Step 2 Skim read each paragraph

Every paragraph deals with a specific aspect of a topic. The first sentence of a paragraph may tell you what the rest of the paragraph is about. Therefore while trying to identify the main idea of a paragraph, you should read the first sentence and skim the rest of the paragraph.

Task: Scanning the text for key words.

This title **Earth's Threatened Ozone Layer** can help you understand that key words must concern any kinds of polluting activities or be connected with destruction of ozone layer. E.g., in paragraph A it is possible to point out the following key words: chemical pollutants, ozone layer, ultraviolet radiation, to protect, to destroy, to damage, health problems, food chain.

Follow the three-step strategy to make finding key words easier.

Step 1 Make sure you know what you are looking for.

Step 2 Scan each paragraph for 5-10 key words. Do not read every word.

Step 3 Select 5-10 key words for the whole text.

Task: Use your general background knowledge, knowledge of the general context, your knowledge of parts of speech and root words.

Your knowledge and experience about what is logical or illogical can help you guess the meaning of some words. Let us take, for instance, the first passage of paragraph A and the last passage of paragraph B. These two passages are logically connected in that they explain how the reaction of ozone creation and destruction is going on:

«One of the most disturbing aspects of the changes in Earth is the rate at which chemical pollutants produced by human activity are ***destroying*** the protective layer of ozone in Earth's upper atmosphere. ***Ozone is a molecule that consists of three oxygen atoms***. An oxygen gas molecule consists of two oxygen atoms. ***Reactions between oxygen and ultraviolet radiation*** from the sun ***create*** a layer of ozone throughout Earth's *stratosphere* (upper atmosphere).»

«Once in the upper atmosphere, ***CFC's react with ozone to destroy it***. First, ***ultraviolet light breaks down CFC molecules***. One of the products of this ***breakdown*** is the element chlorine. As a ***single chlorine atom*** or when combined with one oxygen atom as ***chlorine monoxide***, this element ***breaks down ozone molecules***. Scientists estimate that one chlorine atom can ***destroy*** as many as 100,000 ozone molecules.»

As you may see, there are words with opposing meanings in these passages: ***to create***, ***to produce, products,*** on the one hand, and ***to destroy, destroying and to break down, breakdown***, on the other hand.

Basing on this opposition you can build a logical chain: ***Reactions between oxygen and ultraviolet radiation create ozone — Reactions between CFC and ultraviolet radiation produce chlorine — Reactions between ozone and chlorine destroy ozone.***

This logical chain presents the main idea of the whole text.

Your knowledge of the root word can also help you make up word nests for your vocabulary, e.g.: to destroy, destroying, destruction, destructive. Make up word nests for the following words: to pollute, to produce, to protect.

Task:

- Basing on paragraph C explain how media called a «hole» in the ozone layer.
- Basing on paragraph D explain what concerns were fueled by ozone losses above the US.
- Basing on paragraph E explain what the threat of ozone depletion means.
- Basing on paragraph F explain the difference between light band heavy hydrocarbons.
- Basing on paragraph G explain the negative and positive sids of methanol.

Task: Collect ***specific information*** by pointing out groups of synonyms, semantic and thematic groups. Keep it in mind that vocabulary in context includes both single words (usually nouns, verbs, adjectives, and adverbs). and two- or three-word phrases.

- It is claimed in paragraph A that ultraviolet radiation causes skin cancer. Continue this list and find other names of health problems.
- Find a synonym for the word ***to stop*** in paragraph E.
- Point out names of alternative fuels mentioned in paragraph G.
- Explain a contrast in the following sentences from paragraph G: Hydrogen burns much more cleanly than ***do*** other fuels and is easy to produce. But complex technical problems must be solved before it can be widely used in cars.
- What is the referent word for the verb ***do***?

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Errors with prepositions

Errors with **prepositions** are among the most difficult errors to catch. Preposition use in English is very complex. For every rule, there seems to be an exception. There are many errors involving prepositions, and they are more difficult to spot.

Prepositions are used in the following ways:

In adverbial phrases that show time, place, and other relationships: in the morning, on Central Avenue, to the park, by a student

After certain nouns: a cause of , a reason for, a solution to.

After certain adjectives and participles: different from, aware of, disappointed in.

After certain verbs: combine with, rely on, refer to.

In phrasal prepositions (two- or three-word prepositions):according to, together with, instead of.

In certain set expressions: by far, in general, on occasion, at last.

There are two main types of preposition errors that you may see your test:

Errors in preposition choice

Such errors take place when the wrong preposition is used according to the context of the sentence.

Some of the rules for choosing the correct prepositions are given below, but you will never be able to memorize all the rules for preposition use in English. The more you practice, though, the more you will develop a «feel» for determining which preposition is correct in any given situation.

There are two particular situations involving preposition choice:

Errors with *from . . . to* and *between . . . and*

Both these expressions are used to give the starting time and ending time. They can also be used to show relationships of place and various other relationships. E.g.:

- He lived in Seattle *from* 1992 *to* 1997.
- He lived in Seattle *between* 1992 *and* 1997.
- Route *66 ran from* Chicago *to* Los Angeles.
- Route 66 ran *between* Chicago *and* Los Angeles.

It will be a mistake to say: The highway runs *between* Simferopol *to* the port of Yalta, a distance of 60 miles.

The correct pattern is *from…to*.

Errors usually involve an incorrect pairing of those words, or the incorrect use of other prepositions. E.g.::

between A *to* B	*from* X *and* Y
between A *with* B	*since* X *to* Y

Errors with *since, for,* and *in*

Since is used before a point in time with the present perfect tense—but never with the past tense. *For* is used before a period of time with the present perfect and other tenses. *In* is used before certain moments in time (years, centuries, decades) with the past tense and other tenses—but never with the present •perfect tense. E.g.:

Section 2. GUIDELINES FOR GRAMMAR TEST

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- He's lived here *since* 1995.
- He's lived here *for* two years.
- He moved here *in* 1995.

Errors involve the use of one of these prepositions for another. E.g.:
He's lived here *in* 1995.
He's lived here *since* two years.
He moved here *since* 1995.
Corn was the population's main item of food *since* at least 2000 years.
Before a period of time (*2,000 years*) the preposition *for* should be used.

Errors with *on*

The pitch of a tuning fork *depends of* the size and shape of its arms.
The correct preposition after the verb *depend* is *on,* not *of.*

Incorrect inclusion or omission of prepositions

A preposition is often used when one is not needed, or not used when one is needed.

According many critics, Mark Twain's novel *Huckleberry Finn* is his greatest work and is
one of the greatest American novels ever written.
The preposition *to* has been omitted from the phrase *according to.*

Some of the most of spectacular caves are found in the Crimean mountains.
The preposition *of* should not be used in this phrase. (When *most* means «majority,» it can be used in the phrase *most of the.* «Most of the people agree...,» for example. However, in this sentence, *most* is part of the superlative form of the adjective *spectacular,* and so cannot be used with *of.*

Exercise: Identify correct and incorrect preposition choice.
Directions: Underline the prepositions that correctly complete the sentences below.

Wage rates depend (in/on) part (from/on) the general prosperity (of/for) the economy.

(For/To) an injection to be effective (on/against) tetanus, it must be administered (by/within) 72 hours (of/for) the injury.

The invention (of/for) the hand-cranked freezer opened the door (for/to) commercial ice-cream production, and (for/since) then, the ice-cream industry has grown (in/into) a four-billion-dollar-a-year industry.

(At/On) the time (of/in) the Revolutionary War, the North American colonies were merely a long string (with/of) settlements (along/among) the Atlantic Coast (between/from) Maine and Georgia.

The probability (of/for) two people (in/on) a group (of/for) ten people having birthdays (in/on) the same day is about one (in/of) twenty.

Showboats were floating theaters that tied up (at/to) towns (in/on) the Ohio and Mississippi Rivers to bring entertainment and culture (to/at) the people (on/in) the frontier.

.Scrimshaw, the practice (of/for) carving ornate designs (in/on) ivory, was first practiced (by/of) sailors working (by/with) sail needles while (in/on) long sea voyages.

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Bird Island, (off/of) the coast (off/of) the Crimea, is famous (for/to) its flocks (of/with) wild geese.

(In/On) order (for/to) an object to be visible, light must travel (from/for) that object (at/to) a person's eves.

Mini-test

Identify and correct errors involving prepositions

Chemical pollutants produced by human activity are destroying the protective layer of ozone *between* Earth's surface *to* upper atmosphere.

Ozone concentrations above the United States decreased by 5 to 6 per cent *from* 1990 *and* 2000.

Ultraviolet radiation causes a range of health problems — *between* skin cancer *with* blindness.

United Nations scientists reported ozone losses since 1991 to 2001 above temperate areas of Earth *between* the tropics *to* the poles.

NASA scientists announce that levels of chlorine monoxide resulting from the breakdown of CFC's have been at record levels *since* 10 years.

24 nations, including the United States, signed an agreement *since* September 1987 planning to limit the production of CFC's.

They promised to limit the production of CFC's *since* at least 20 years.

This agreement has been validated *in* 1991.

Depending *of* their measurements a 40 per cent reduction in ozone concentrations over Antarctica took place *between* the mid-1970's *to* 1984.

On March 1974, scientists first proposed *about* the idea that manufactured chemicals could threaten *to* the ozone layer.

Choose the right preposition

A group (in/of/for) widely used gases called chlorofluorocarbons (CFC's) posed the greatest chemical threat

Researchers continue to search (on/for/in) ways to make better gasoline.

While some researchers concentrate (at/in/on/to) the car and improving its systems and materials, others focus (at/in/on/to) the fuel that feeds the car.

Methanol also can corrode (in/on/no preposition/at/for) many of the metals, sealants, and resins used (in/on/ no preposition/at/for) automobiles.

(In/On) order (for/to) electric engines to be used in automobiles the must be made more effective.

Because lead has been linked (in/on/with/to) cancer and can cause (in/on/no preposition/at/for) nervous-system damage in children, lead-free gasoline was an important development (for/against/about/in) automobile pollution.

(For/To) the organic fuel to be effective (on/against/with/for) pollution, it must be a combination (on/of/in/with) gasoline and methanol.

(At/On) the time (of/in) Earth's dangerous pollution, search for ways to make cars cleaner poses a demanding challenge (for/with/on/to) engineers, as well as chemists.

The concern (of/for) the scientists working (in/on) fuel industry to find a new fuel (of/for/with) automobiles is heightened (by/ along with/at) our old desire to maintain the freedom of movement that the automobile has brought (at/for/to) the developed world.

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Section 1. GUIDELINES FOR READING ACADEMIC TEXTS

REVISION: MAIN TOPIC AND SUBTOPICS, TEXT ORGANIZATION, MAKING INFERENCES, EXPLICATION OF SPECIFIC INFORMATION

MAIN IDEA, SUBHEADINGS, KEY WORDS, VOCABULARY IN CONTEXT, SPECIFIC WORDS

Instruction: This is another revision unit in which you should combine all skills you have mastered in the preceding nine units. You will have to start with identifying the main idea, the main topic, or the main purpose of the text. Then follows the task of: matching headings with paragraphs or sections, and identifying which sections relate to which topics. Basing on circumstantial evidence, inferences and vocabulary-in context you will have to look into specific information given in the text.

The Global Warming Issue

A. Since the early 1970's, Earth's average surface air temperature has increased rapidly — more rapidly than at any time in recorded history. In itself, a change in Earth's climate is nothing new. Throughout the planet's history, warm periods have alternated with *ice ages,* spans of tens of thousands of years during which large areas of Earth were covered by glaciers.

In the past, global climatic changes have been the result of changes in geological and biological processes, cloud cover, ocean currents, and even the amount of radiation the sun produces. These factors continue to affect the Earth. But many scientists fear that the current warming is the result of human activities that produce carbon dioxide and other so-called *greenhouse gases* that accumulate in the atmosphere and trap heat from the sun. These scientists believe that warming from the continued accumulation of greenhouse gases may cause serious environmental, social, and economic problems for people around the world.

Heat-trapping gases such as carbon dioxide, water vapor, and methane are responsible for the natural *greenhouse effect:* They keep the Earth substantially warmer than it would be otherwise.

The Earth is bathed continuously in radiant energy from the sun in the form of light and heat. Some of the heat is absorbed by heat-trapping gases in the atmosphere, and this warms Earth's atmosphere. Some of the light energy from the sun that strikes Earth's atmosphere is reflected back into space. The surface of the Earth absorbs the rest of the light energy and radiates it back again as heat. Some of this heat can be absorbed by the heat-trapping gases.

B. Carbon dioxide is a major greenhouse gas. Natural cycles ordinarily keep the levels of carbon dioxide in the atmosphere from changing rapidly. Some car-

Unit 10

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bon is removed from the atmosphere through plant photosynthesis. An equivalent amount of carbon is released into the atmosphere by animals and plants, including organisms that cause decay. These organisms give off carbon dioxide during a process called respiration. The respiration of decay organisms also releases methane, another heat-trapping gas, into the atmosphere. Throughout most of the planet's recent history, the concentration of carbon dioxide in the atmosphere has not changed from year to year as long as the processes of carbon release and absorption were in balance.

Today, however, humanity releases large quantities of carbon dioxide into the atmosphere through the burning of *fossil fuels* (oil, coal, and natural gas). Before the Industrial Revolution began in the mid-1700's, this release of carbon dioxide was gradual enough that the oceans could absorb any excess and there was little noticeable accumulation in the atmosphere.

The oceans have a very large capacity for holding carbon dioxide. At the surface, the gas dissolves in water. Through complex chemical processes, some of the carbon becomes part of the tissues of marine organisms. Carbon-containing sea shells eventually settle to the ocean floor, forming carbonate sediments such as limestone.

C. Since the Industrial Revolution, the combustion of fossil fuels has soared. At the same time, the human population has increased, and people have cleared more and more forestland to make room for agriculture and other enterprises. This *deforestation* (destruction of forests) leads to still higher levels of carbon dioxide in the atmosphere. When trees are burned, carbon dioxide is released. If the plants are not burned, the branches, leaves, bark, roots, and organic material in the soil decay, releasing carbon dioxide and methane.

About 6 billion metric tons (6.6 billion short tons) of carbon are released into the atmosphere each year through the combustion of fossil fuels. About 3 billion tons are released from deforestation, and an unknown additional quantity comes from the accelerated decay of organic matter.

Scientists have been monitoring carbon dioxide levels in the atmosphere since 1958. That year, the first precise; measurements of the levels of carbon dioxide in Earth's atmosphere were developed by Charles David Keeling at the Scripps Institution of Oceanography in La Jolla, Calif. He and his colleagues set up measuring devices 3,300 meters (11,000 feet) above sea level on Mauna Loa in Hawaii. Since then, Keeling has measured a steady rise in carbon dioxide levels in Earth's atmosphere. For example, in 1990, atmospheric carbon dioxide levels were about 25 per cent higher than those measured in air trapped in ice that formed in 1880.

Scientists believe that the largest source of the increase is the combustion of fossil fuels, which produced about 160 billion metric tons (176 billion short tons) of carbon from 1850 to 1980. Experts estimate that deforestation has released a somewhat lesser amount.

D. Some data are not in question: The carbon dioxide content of the atmosphere is now higher than at any time in the past 160,000 years. The causes are human activities — deforestation and the burning of fossil fuels. The effect of adding carbon dioxide and other heat-trapping gases to the atmosphere will be to make Earth warmer than it would have been otherwise.

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D. Some data are not in question: The carbon dioxide content of the atmosphere is now higher than at any time in the past 160,000 years. The causes are human activities — deforestation and the burning of fossil fuels. The effect of adding carbon dioxide and other heat-trapping gases to the atmosphere will be to make Earth warmer than it would have been otherwise.

But many other uncertainties surround the issue of global warming. Chief among them is when the heat-trapping gases, among the various factors that affect the temperature of the Earth, will dominate and cause a rapid warming.

Most scientists say that the rising levels of carbon dioxide have already caused an increase in Earth's average surface temperature. To establish such a link, the scientists compare the rising carbon dioxide levels with temperature measurements taken during the past 100 years. Until the early 1900's, Earth's average surface temperature was warming slowly. In the 1980's and 1990's, record high annual global temperatures have been recorded, with 1991 being the warmest year on record. The rate of warming since 1980 has been about 0.2 degree Celsius (0.4 degree Fahrenheit) per decade.

These scientists fear that global warming will cause temperatures to increase by as much as 0.5 degree Celsius (0.9 degree Fahrenheit) per decade sometime between 2000 and 2030, perhaps more in the higher latitudes. The temperature increase could severely affect the world's major agricultural regions. Crops could no longer be grown in the Midwestern United States, and the major food-producing regions would shift to Canada and Siberia. The higher temperatures could also melt polar ice, flooding low-lying areas — such as the deltas of Egypt's Nile River, India's Ganges River, and North America's Mississippi River, as well as cities along seacoasts.

Although there is a consensus within most of the scientific community as to the seriousness and causes of the problem, a smaller number of scientists question whether Earth will warm in response to the increasing levels of heat-trapping gases or whether the warming will be a problem for human beings. Their reasons differ. They range from assertions that the warming will be checked by an increase in cloud cover to predictions that plants will grow better on a warmer Earth. The discussion is made more complex by the assertions of U.S. government officials that taking action to curb the use of fossil fuels would be too costly. Many scientists and international leaders dispute this point as well.

E. For ecologists, one crucial question is the effect of higher temperatures on plants and on microorganisms that cause decay. Evidence shows that higher temperatures will have little effect on rates of photosynthesis, a process that removes carbon dioxide from the atmosphere. But the warming will increase rates of respiration among some organisms, thus releasing more carbon dioxide.

A 1 degree Celsius (1.8 degree Fahrenheit) increase in temperature often increases rates of respiration in some organisms by 10 per cent to 30 per cent. Warming will thus speed the decay of organic matter in soils, peat in bogs, and organic debris in marshes. Indeed, the higher temperatures of the last few decades appear to have accelerated the decay of organic matter in the Arctic tundra.

Warming will also change patterns of rainfall and other aspects of climate. Scientists think that such changes destroy large, long-lived plants such as trees and favor small plants with short lifetimes and rapid reproduction. Thus, forests may be destroyed and replaced by shrubs or grassland. The death of some plants and their decay will release more stored carbon into the atmosphere.

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Another important question involves the effect of rising levels of carbon dioxide coupled with the higher temperatures. Together, these factors may increase the amount of carbon plants take in and may increase plant growth, at least under certain circumstances. Abundant evidence from studies of plants in greenhouses seems to confirm this.

Increased plant growth would be beneficial, because plants would remove carbon dioxide from the atmosphere for photosynthesis. But ecologists fear that the stimulation of plant growth must be small. There is no evidence, for example, that the higher temperatures and rising carbon dioxide levels of recent decades has increased the growth of trees worldwide. Although controversy surrounds this point, many experts believe that a rapid warming will lead to the rapid loss of carbon from plants and soils and thus to an acceleration of the warming.

To gather more evidence, researchers analyze air in glacial ice to compile a record of carbon dioxide and methane concentrations in the atmosphere. The data show that as temperatures rose in the past, the concentrations of carbon dioxide and methane also rose. As temperatures fell over thousands of years, the concentrations also fell, though not always in perfect unison.

The pattern is consistent with, but does not prove, the theory that a warming releases carbon stored in vegetation and soils and that a cooling results in storage of carbon there. The processes involved in such transitions are complex, however. Such relatively simple explanations may ultimately need to be changed.

F. How might we stabilize the composition of the atmosphere? That question looms large in the eyes of scientists and political leaders as the levels of carbon dioxide grow. Carbon dioxide and methane have long lives in the atmosphere and, once they are there, Earth may be destined to become warmer. If we find that the climate is becoming too warm, there is no easy or rapid way to remove the gases and return to an earlier climatic pattern.

We may be able to control fossil fuel use and rates of deforestation, but there is no direct way to control the acceleration of decay except by stopping the warming. To stabilize the composition of the atmosphere immediately, we would have to cut present releases by about 4 billion tons of carbon annually. It is not now possible to accomplish this without reducing both deforestation and our consumption of fossil fuels.

Most scientists believe that if immediate global action is not taken, the rapid increases of atmospheric carbon from decay will exceed the reductions possible through control of fossil fuel use and management of forests. In 2008, the United Nations gathered many scientists from around the world to review these issues. This group, the Intergovernmental Panel on Climate Change, concluded that an immediate 60 per cent reduction in fossil fuel use would be necessary. But by April 2008, no nation had accepted that goal, though several had recognized a need for reducing emissions by 20 per cent.

At the Earth Summit in June 1992, leaders from most industrialized nations agreed in principle to return to earlier levels of carbon dioxide emissions — though opposition from the United States prevented them from agreeing to specific targets for emissions, as many scientists had hoped. The leaders also agreed to assist developing nations in limiting their releases of greenhouse gases.

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Task: Answer the following questions:

- What is the main topic of the passage?

(A) The current warming is the result of human activities that produce carbon dioxide.

(B) The concentration of carbon dioxide in the atmosphere caused an increase in Earth's average surface temperature.

(C) Earth may be destined to become warmer.

(D) There is no way to control the acceleration of. global warming.

- What does the passage mainly discuss?

(A) Global climatic changes.

(B) The current concentrations of carbon dioxide.

(C) Warming as a problem for human beings.

(D) Stabilization of atmosphere composition.

- What is the author's attitude toward scientists who question the danger of global warming?

(A) He shares their position.

(B) He strongly disagrees.

(C) He tries to be objective.

(D) He doesn't care.

- Where in the four sentences does the author discuss causes of the current global warming?

(A) Global climatic changes have been the result of changes in geological and biological processes.

(B) Carbon dioxide and other *greenhouse gases* accumulate in the atmosphere and trap heat from the sun..

(C) The Earth is bathed in radiant energy from the sun in the form of light and heat.

(D) Natural cycles ordinarily keep the levels of carbon dioxide in the atmosphere from changing rapidly.

Read the passage: «For ecologists, one crucial question is the effect of higher temperatures on plants and on microorganisms that cause decay. Evidence shows that higher temperatures will have little effect on rates of photosynthesis, a process that removes carbon dioxide from the atmosphere. But the warming will increase rates of respiration among some organisms, thus releasing more carbon dioxide.

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- What do ecologists fear most of al about global warming?

(A) Higher temperatures will have little effect on rates of photosynthesis.

(B) Higher temperatures will accelerate the rates of respiration.

(C) The warming will increase rates of respiration in organic matter.

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Task: Match the following 6 headings with letters A, B, C, D, E, F.

Controlling global warming	A
The controversy over global warming	B
A build-up of carbon dioxide	C
The greenhouse effect	D
Fossil fuels	E
Predicting the course of global warming	F

Your task is to choose the correct one from the list of headings provided. You should skim a paragraph or section before choosing the correct answer from the list. Remember that it is more efficient to skim the long piece of text first and get the idea of the whole text. Then you can look through the alternative headings very quickly.

Step 1 Survey the text

The list of headings will give you some clues to help you quickly understand what each part of the text is about.

Step 2 Skim read each paragraph

Every paragraph deals with a specific aspect of a topic. The first sentence of a paragraph may tell you what the rest of the paragraph is about. Therefore while trying to identify the main idea of a paragraph, you should read the first sentence and skim the rest of the paragraph.

Task: Scan the text for key words

This title **The Global Warming Issue** can help you understand that key words must concern any kinds of human activities causing the global warming or be connected with measures taken to reduce it. E.g., in paragraph A it is possible to point out the following key words: human activities, greenhouse gases, warming, heat-trapping gases, light energy, carbon dioxide, water vapor, methane. Follow the three-step strategy to make finding key words easier.

Step 1 Make sure you know what you are looking for.
Step 2 Scan each paragraph for 5-10 key words. Do not read every word.
Step 3 Select 5-10 key words for the whole text.

Task: Use your general background knowledge and the knowledge of general context, your knowledge of parts of speech and root words. Read this passage from paragraph D**:**

«These scientists fear that ***global warming will cause temperatures to increase*** by as much as 0.5 degree Celsius (0.9 degree Fahrenheit) per decade sometime between 2000 and 2030, perhaps more in the higher latitudes. ***The temperature increase could*** severely ***affect*** the world's major ***agricultural regions***. ***Crops could no longer be grown*** in the Midwestern United States, and the major ***food-producing regions would shift*** to Canada and Siberia. The higher temperatures could also ***melt polar ice, flooding low-lying areas*** — such as the deltas of Egypt's Nile River, India's Ganges River, and North America's Mississippi River, as well as cities along seacoasts.»

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As you may see, the first two sentences present a good example of a logical sequence of actions: ***global warming would cause temperatures — temperatures would increase — the increase would affect agricultural regions.***

The next two sentences present a chain of logical consequences: ***crops could no longer be grown — food-producing regions would shift — polar ice would melt — low-lying areas would be flooded.***

This logical chain presents the main idea of the whole text. The technique of building a logical chain will help you define the main idea and the main topic of any special text.

Your knowledge of the root word can also help you make up word nests for your vocabulary, e.g.: to increase — an increase; to cause — a cause; to produce food — food-producing; to lie low — low-lying; to trap- heat — heat-trapping.

Task:

- Basing on paragraph A give a definition of the greenhouse effect.
- Basing on paragraph B explain why the release of carbon dioxide before the Industrial Revolution was hardly noticeable.
- Basing on paragraph C explain what measurements were developed by David Keeling and his colleagues..
- Basing on paragraph E explain why ecologists think that increased plant growth would be beneficial.
- Basing on paragraph F explain what will happen if immediate global action is not taken.

Task: Collect ***specific information*** by pointing out groups of synonyms, semantic and thematic groups. Keep it in mind that vocabulary in context includes both single words (usually nouns, verbs, adjectives, and adverbs) and two- or three-word phrases.

- Find a synonym for the word ***to give off*** in paragraph B.
- It is claimed in paragraph C that organic materials decay, releasing carbon dioxide and methane. Continue this list and find other names of organic materials.
- Explain a contrast in the following sentences from paragraph F: We may be able to control fossil fuel use and rates of deforestation, but there is no direct way to control the acceleration of decay except by stopping the warming.
- What is the referent word for the word ***that*** in the sentence «For ecologists, one crucial question is the effect of higher temperatures on plants and on microorganisms ***that*** cause decay»?
- Read the following passage from paragraph E: «Another important question involves the effect of rising levels of carbon dioxide ***coupled with*** the higher temperatures. ***Together***, these factors may increase the amount of carbon plants take in and may increase plant growth, at least under certain circumstances. Abundant evidence from studies of plants in greenhouses seems to confirm ***this***.»
- How are the words ***coupled*** and ***together*** connected?
- What is the referent for the word ***this***?

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Preposition use

It is important that you be familiar with the correct usage of prepositions and practice these prepositions in sentences:

Adjectives/Participles + Prepositions (1)

acceptable to, accustomed to, adequate for, afraid of, aware of, based on, capable of, characteristic of, close to, composed of, contrary to, dependent on, different from, disappointed in/with, eligible for equipped with equal to essential to/for familiar with famous for.

Adjectives/Participles + Prepositions (2)

free of	next to	related to
independent of	opposed to	relevant to
inferior to	opposite of	satisfied with
married to	perfect for	suitable for
native to	possible for	surprised at/by
necessary for/to	preferable to	typical of

Opposite of is used for words or concepts that are completely different, such as «large» and «small.» When *opposite* means «across from,» it is not used with *of*. «The bank is *opposite* the post office on Cedar Street.»

Nouns + Prepositions

approach to	exception to	origin of
attention to	experience with	price of
because of	expert on	probability of
contribution to	form of	quality of
component of	group of	reason for
cure for	improvement in	reliance on
increase in	increase in	result of
demand for	influence on	solution to
effect of/on*	interest in	supply of
example of	native of	

effect + *of* + cause

effect + *on* + thing or person affected (The effect o/heat *on* rocks...)

Verbs + Prepositions

account for	compete with	insist on
adjust to	concentrate on	interfere with
agree with/on*	consist of	plan on
attach to	contribute to	participate in
attribute to	cooperate with	refer to
begin with	deal with	rely on
believe in	depend on	result in
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Section 2. GUIDELINES FOR GRAMMAR TEST

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agree with is used with people
agree on is used with an issue, plan, etc. (I *agreed with* Mary *on* that issue.)

Phrasal Prepositions

according to	due to	on account of
ahead of	except for	prior to
along with	in favor of	regardless of
because of	in spite of	thanks to
by means of	instead of	together with

In, On, and At (1)
Expressions of time
+ century *(in the eighteenth century)* + decade *(in the 1990s)*
+ year *(in 1975)* in
+ season *(in the summer)*
+ month *(in July)*
+ parts of the day *(in the morning, in the evening, in the afternoon)*
+ days of the week *(on Wednesday)* + dates *(on October 7)*
+ time of day *(at 6pm; at noon)*
+ night

Expressions of place
+ continent *(in Africa)*
+ country *(in Mexico)*
+ state *(in Pennsylvania)*
+ city *(in Los Angeles)*
+ building *(in the bank)*
+ room *(in the auditorium)*
+ *in* the world
+ street *(on Maxwell Street)*

on + floor of a building *(on the fourth floor)*
+ *on* Earth
at + address *(at 123 Commonwealth Avenue)*

In, On, and At, (2)
The prepositions *in, on,* and *at* are also used in a number of set expressions:

in a book/magazine/newspaper	on a bus/train/etc.	at best/worst
in charge (o0	on fire	at first/last
in common (with)	on the other hand	at once
in danger (of)	on purpose	at the peak (of)
in detail	on radio/television	at present
in existence	on the whole	at the moment
in the front/middle/back		at birth
in general		at death
in practice		at random
in the past/future		
in a row		
in style		
in theory		

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in danger (of)	on purpose	at the peak (of)
in detail	on radio/television	at present
in existence	on the whole	at the moment
in the front/middle/back		at birth
in general		at death
in practice		at random
in the past/future		
in a row		
in style		
in theory		

Other Prepositions

By is often used with forms of communication and transportation:

by car, by plane, by phone, by express mail (Note: if the noun is plural or is preceded by a determiner, the prepositions *in* or *on* must be used:

in cars, on a boat, on the telephone, in a taxi By is also used with gerunds to show how an action happened:

How did you get an appointment with the President? *By calling his secretary.*

With is used to indicate the idea of accompaniment or possession:

Melanie came to the party *with her friend.* He wanted a house *with a garage.*

Without indicates the opposite relationship:

Melanie came to the party *without her friend.* He bought a house *without a garage.*

With also indicates that an instrument was used to perform an action:

He opened the door *with a key. Without* indicates the opposite relationship:

He opened the door *without a key. By* and *for* are also used in the following expressions:

by chance	for example
by far	for free
by hand	for now

For is sometimes used to show purpose; it means «to get.»

She went to the store *for toothpaste and shampoo.*

Mini-test

Identify and correct errors involving prepositions

(Throughout/In/At/On) the planet's history, warm periods have alternated (with/to/by) *ice ages,* spans of tens (of/no article) thousands (of/no article) years during which large areas (on/of) Earth were covered (with/by) glaciers.

(In/At/On) the past, global climatic changes have been the result of changes (at/in/of) geological and biological processes, cloud cover, ocean currents, and even the amount of radiation the sun produces.

Human activities produce (of/no article) carbon dioxide and other so-called *greenhouse gases* that accumulate (by/at/in) the atmosphere and trap heat (on/in/from) the sun.

Natural cycles ordinarily keep the levels of carbon dioxide (by/at/in) the atmosphere (at/on/from) changing rapidly.

(Throughout/In/At/On/Throughout of) most of the planet's recent history, the concentration of carbon dioxide in the atmosphere has not changed (since/from/by) year to year as long as the processes of carbon release and absorption were (at/on/in) balance

The oceans have a very large capacity (in/at//by/for) holding carbon dioxide.

(In/On/At) the same time, the human population has increased, and people have cleared more and more forestland to make room (in/at/of/for) agriculture and other enterprises.

This *deforestation* (destruction of forests) leads (at/in/to) still higher levels of carbon dioxide in the atmosphere.

Scientists have been monitoring (on/in/no article) carbon dioxide levels in the atmosphere (from/since) 1958.

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Scientists have been monitoring (on/in/no article) carbon dioxide levels in the atmosphere (from/since) 1958.

These levels can be compared (by/to/with) the concentrations found (on/for/in) bubbles of air trapped (on/for/in) glacial ice up to 160,000 years ago.

These scientists fear that global warming will cause temperatures to increase (at/0n/in/by) as much as 0.5 degree Celsius (0.9 degree Fahrenheit) per decade sometime (from/between) 2000 and 2030, perhaps more (in/for/at/on) the higher latitudes.

The temperature increase could severely affect (on/no article/at) the world's major agricultural regions.

For ecologists, one crucial question is the effect (on/of) higher temperatures (on/of/at/to) plants and microorganisms that cause decay.

Although controversy surrounds (around/round/no article) this point, many experts believe that a rapid warming will lead (at/in/to) the rapid loss of carbon (of/from/to) plants and soils and thus (of/from/to) an acceleration of the warming.

If we find that the climate is becoming too warm, there is no easy or rapid way to remove the gases and return (at/in/to) an earlier climatic pattern.

In 2008, the United Nations gathered many scientists from (round/around) the world to review these issues. This group concluded that an immediate 60 per cent reduction (of/at/in) fossil fuel use would be necessary. But (at/on/in/by) April 2008, no nation had accepted that goal, though several had recognized a need (to/at/for) reducing emissions by 20 per cent.

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Section 1. GUIDELINES FOR ACADEMIC COMMUNICATION

Study secrets and strategies

Instruction: This text is an adaptation of Jamie Littlefield's recommendations for distance learning students, published in the Internet and free of copyright limitations. You are to read and understand the text with the purpose of acquiring study secrets and strategies, speaking skills and vocabulary well enough to employ these tips, firstly, while reading for your candidate exam, and secondly, while discussing learning strategies and intelligence types with your examiner.

Part 1. Five tips and tricks to help you pass your candidate exam

Most postgraduate students hate candidate exams. They hate the feeling of trying to remember the answer to a question, worrying that they focused on the wrong material, and waiting to receive their results.

Whether you learn at a traditional school or study from the comfort of your own home, ***chances are you'll have to sit through many a test-taking experience***. But, there are a few tricks you can learn now to avoid the worry before ***you're in the heat of the moment***. ***Give these five proven study tips a try*** and see how much better you feel during your next exam.

1. Survey your textbook or workbook before you read. ***Take a couple of minutes to find*** the glossary, index, study questions, and other important information. Then, when you ***sit down to study***, you'll know where to find the answers you are looking for.

Make sure you read any study questions before you read the chapter. These questions let you know what you can probably expect in any ***upcoming*** tests, papers, or projects.

2. Attack your textbook with sticky notes. As you read, summarize (write down the main points in just a few sentences) each section of the chapter on ***a post-it note***. After you have read the entire chapter and summarized each section, go back and review the post-it notes. Reading the post-it notes is an easy and fast way to review information and, ***since each note is stuck*** in the section it summarizes, you can easily find the information you need.

3. Use a graphic organizer to take notes when you read. A graphic organizer is a form you can use to organize information. As you read, ***fill out the form with*** important information. Then, use your graphic organizer to help you study for the test. Try using the Cornell notes worksheet (you can download an example at Jim Burke's website). Not only does this organizer let you record important terms, ideas, notes, and summaries, it also lets you quiz yourself on that information by folding the answers upside down.

Unit 11

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4. Make your own practice test. After you finish reading, pretend you are a professor who is writing a test for the chapter. Review the material you just read and make up your own practice test. Include all vocabulary words, study questions (they're usually at the beginning or end of the chapter), and ***highlighted words*** you can find, as well as any other information you think is important. Take the test you've created to see if you remember the information. If not, go back and study some more.

5. Create visual flashcards. Flashcards aren't just for primary students. Many post graduate students find them useful as well! Before you take a test, make flashcards that will help you remember important terms, people, places, and dates. Use one 3x5 index for each term. On the front of the card, write down the term or question you need to answer and draw a picture that will help you remember it.

This will help ensure that you grasp the study material as you'll find that it's almost impossible to sketch something you don't really understand. On the back of the card write down the definition of the term or the answer to the question. Review these cards and quiz yourself before your actual test.

(After Jamie Littlefield, About.com Guide
http://distancelearn.about.com/od/studyskills/a/testtakingtips.htm)

Answer the following questions:

- Did you hate your exams when you were an undergraduate student? Did you worry much? Or were you indifferent?
- Which of these five tips and tricks given above have you known before?
- Which of them would you like to employ while sitting for your candidate exam?
- Are you hard on your own students when you are examining them?

Prepare a 2 minute story about how you prefer to read for an exam.

Part 2. Smart Study Skills for 7 Intelligence Types

People are smart in different ways. Some people can ***create a catchy song at the drop of a hat.*** Others can memorize everything in a book, paint a masterpiece, or be the center of attention. When you realize what ***you're good at***, you can ***figure out*** the best way to study. Based on Howard Gardner's theory of intelligence, these study tips can help you ***tailor*** your learning for your intelligence type.

Word Smart (Linguistic intelligence) — Word smart people are good with words, letters, and phrases. They enjoy activities such as reading, ***playing scrabble*** or other word games, and having discussions. If you're word smart, these study strategies can help:

- make flashcards
- take extensive notes
- keep a journal of what you learn

Number Smart (logical-mathematical intelligence) - Number smart people are good with numbers, equations, and logic. They enjoy coming up with solu-

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- make your notes into numeric charts and graphs
- ***use the Roman numeral style of outlining***
- put information you receive into categories and classifications that you create

Picture Smart (spatial intelligence) — Picture smart people are good with art and design. They enjoy being creative, watching movies, and visiting art museums. Picture smart people can ***benefit from*** these study tips:

- sketch pictures that go along with your notes or in the margins of your textbooks
- draw a picture on a flashcard for each concept or vocabulary word you study
- use charts and graphic organizers to keep track of what you learn

Body Smart (Kinesthetic intelligence) — Body smart people work well with their hands. They enjoy physical activity such as exercise, sports, and outdoor work. These study strategies can help body smart people be successful:

act out or imagine the concepts you need to remember

look for real-life examples that demonstrate what you're learning about

search for manipulatives, such as computer programs, that can help you master material

Music Smart (Musical intelligence) — Music smart people are good with rhythms and beats. They enjoy listening to cds, attending concerts, and creating songs. If you're music smart, these activities can help you study:

- create a song or rhyme that will help you remember a concept
- listen to classical music while you study
- remember vocabulary words by linking them to similar-sounding words in your mind

People Smart (Interpersonal intelligence) — Those who are people smart are good with relating to people. They enjoy going to parties, ***visiting with friends***, and sharing what they learn. People smart students should give these strategies a try:

- discuss what you learn with a friend or family member
- have someone quiz you before an exam
- create or join a study group

Self Smart (Intrapersonal intelligence) — Self smart people are comfortable with themselves. They enjoy being alone to think and reflect. If you're self smart, try these tips:

- keep a personal journal about what you're learning
- find a place to study where you won't be interrupted
- ***keep yourself involved in*** assignments by individualizing each project

(After Jamie Littlefield, About.com Guide
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Answer the following questions:

- What are you smart in?
- What smart type do you belong to?
- What are you good with?
- What do you enjoy doing?
- How does it help you in doing your research?

Vocabulary and idiom notes to memorize and use

Chances are **you'll have** *to sit through many a test-taking experience*
There are *a few tricks you can learn*
to avoid the worry
In the heat of the moment
To give ***smth (these five proven study tips)*** *a try*
To take a couple of minutes **to find (to do smth)**
To sit down to **study (to do smth)**
To make sure
Upcoming **tests**
A post-it note
Since each note is stuck
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Highlighted ***words***
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Missing conjunctions

Conjunctions are connecting words; they join parts of a sentence. In this lesson, we'll look at two main types of conjunctions. **Coordinate conjunctions** are used to join equal sentence parts: single words, phrases, and independent clauses. When two full clauses are joined, they are usually separated by a comma. The coordinate conjunctions you will most often see are listed in below.

And (addition), **or** (choice, possibility), **but** (contrast), **nor** (opposition)

- Hereford cows are brown *and* white.
- He washed his car *and* cleaned up the garage.
- This plant can be grown in a house *or* in a garden. Her action was very brave *or* very foolish.
- Charlie brought his wallet *but* forgot his checkbook. The book discussed some interesting ideas *but* it wasn't very well written.
- He's never taken a class in sociology, *nor* does he intend to. 1 didn't have breakfast *nor* lunch.

(The conjunction so is used to join only clauses—not single words or phrases.)

Conjunctive adverbs *(moreover, therefore, however, nevertheless,* and so on) are also used to join clauses; they are also often used in test questions as distractors—they seldom appear as correct answers.

Correlative conjunctions are two-part conjunctions. Like coordinate conjunctions, they are used to join clauses, phrases, and words.

So (negation effect) It was a bright clay, *so* she put on her sunglasses.

Both…and, not only…but also (addition) *Both* wolves *and* coyotes are members of the dog family. Dominic studied *not only* mathematics *but also* computer science.

Either…or (choice, possibility), **neither…nor** (negation) We need *either* a nail nor a screw to hang up this picture. *Neither* the television *nor* the stereo had been turned off.

Make the right choice:

1. Blindfish, which spend their whole lives in caves, have___eyes nor body pigments.
(A) not any
(B) neither
(C) nor
(D) without

3. Thomas Eakins studied not only painting ___anatomy -when he was training to become an artist.
(A) moreover
(B) but also
(C) as well
(D) and

Section 2. GUIDELINES FOR GRAMMAR TEST

Missing conjunctions

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(C) as well
(D) and

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4. Although topology is the youngest branch of geometry ___ is considered the most sophisticated.
(A) but it
(B) so it
(C) it
(D) however it

Errors with correlative conjunctions

Correlative conjunctions are two-part adjectives. Errors usually involve an incorrect combination of their parts, such as *neither ...* or or *not only . . . and.* Anytime you see a sentence containing correlative conjunctions you should be on the lookout for this type of error. This is an easy error to spot!

Correlative Conjunctions: neither..nor, both... and, not only...but also, either...or.

Another error is the use of *both . . . and* to join three elements. E.g.:

- The air that surrounds the plant is *both odorless, colorless, and invisible*.

Both…and can be used to join two elements. In this sentence the word *both* must be eliminated.

Errors with coordinate conjunctions

The conjunction *and* is correctly used to show addition; *or* is used to show choice between alternatives; *but* is used to show contrast or opposition.

Execise Identify errors involving conjunctions.

Directions: If the underlined form is correct, mark the sentence *C.* If the underlined form is incorrect, mark the sentence *I,* and write a correction for the underlined form at the end of the sentence.

- Model airplanes can be guided *both* by control wires *or* by radio transmitters.
- Information in a computer can be lost because it is no longer stored *or* because it is stored *but* cannot be retrieved.
- Martin Luther was *not only* a religious leader *and also* a social reformer.
- Although fish can hear, they have *neither* external ears *or* eardrums.
- In all animals, whether simple *and* complex, enzymes aid in the digestion of food.
- The two most common methods florists use to tint flowers are the spray method *or* the
- absorption method.
- Beekeepers can sell *either* the honey *and* the beeswax that their bees produce.
- The alloys brass *and* bronze *both* contain copper as their principle metals.
- The human brain is often compared to a computer, *and* such an analogy can be misleading.
- Rust *both* corrodes the surface of metal *but also* weakens its structure.

Mini-test

Choose the correct conjunction

Some people are smart in music, (and/or/but/nor) they are not so smart in mathematics, (and/or/but/nor) are they smart in computer science.

4. Although topology is the youngest branch of geometry ___ is considered the most sophisticated.
(A) but it
(B) so it
(C) it
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Correlative Conjunctions: neither..nor, both... and, not only...but also, either...or.

Another error is the use of *both . . . and* to join three elements. E.g.:

- The air that surrounds the plant is *both odorless, colorless, and invisible*.

Both…and can be used to join two elements. In this sentence the word *both* must be eliminated.

Errors with coordinate conjunctions

The conjunction *and* is correctly used to show addition; *or* is used to show choice between alternatives; *but* is used to show contrast or opposition.

Execise Identify errors involving conjunctions.

Directions: If the underlined form is correct, mark the sentence *C.* If the underlined form is incorrect, mark the sentence *I,* and write a correction for the underlined form at the end of the sentence.

- Model airplanes can be guided *both* by control wires *or* by radio transmitters.
- Information in a computer can be lost because it is no longer stored *or* because it is stored *but* cannot be retrieved.
- Martin Luther was *not only* a religious leader *and also* a social reformer.
- Although fish can hear, they have *neither* external ears *or* eardrums.
- In all animals, whether simple *and* complex, enzymes aid in the digestion of food.
- The two most common methods florists use to tint flowers are the spray method *or* the
- absorption method.
- Beekeepers can sell *either* the honey *and* the beeswax that their bees produce.
- The alloys brass *and* bronze *both* contain copper as their principle metals.
- The human brain is often compared to a computer, *and* such an analogy can be misleading.
- Rust *both* corrodes the surface of metal *but also* weakens its structure.

Mini-test

Choose the correct conjunction

Some people are smart in music, (and/or/but/nor) they are not so smart in mathematics, (and/or/but/nor) are they smart in computer science.

Many people cannot fix their cars (however/or/so/nor) they have to ask car repair workers.

(However/Or/So/Nor) car mechanics cannot teach languages, (however/or/so/nor) can they bake bread.

John can memorize everything in a book, (moreover/therefore/however/ nevertheless) he can be a good student.(But/ Or/So/Nor) he is not.

Everybody was exhausted after a day-long walking tour, (moreover/therefore/nor/nevertheless) no one wanted to go to bed.

When you realize what you're good at, you can figure out the best way to study, (moreover/therefore/however/nevertheless) you can help others to study.

Make the right choice:

While reading an ad in a French magazine the tourist understood _____the entire text its parts.

(A) any
(B) neither
(C) nor
(D) without

You cannot use _____post-in notes _____ sticking them in the section.

(A) any
(B) neither
(C) no
(D) without

The question is silly impossible to answer.

(A) both
(B) neither
(C) nor
(D) and

Include in your test vocabulary words, study questions, and highlighted words you can find, as well as any other information you think is important.

(A) both
(B) not only
(C) but also
(D) and

Correct the errors

A work of science fiction generally uses scientific discoveries *and* advanced technology, *either* real *or* imaginary, as part of its plot.

Community theater *both* provides entertainment for local audiences *but also* furnishes a creative outlet for amateurs interested in drama.

The heron is a long-legged wading bird that preys on *both frogs,* fish, *and* eels.

For over twenty years after winning the World Chess Championship in 1972, Bobby Fischer played in *either* a tournament *nor* an exhibition game.

Designing fabric requires *not only* artistic talent *but* knowledge of fiber *and* of textile machinery.

Many people cannot fix their cars (however/or/so/nor) they have to ask car repair workers.

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Section 1. GUIDELINES FOR ACADEMIC COMMUNICATION

How to Read and Understand a Science Journal Article

Instruction: This text is an adaptation of Kendra Cherry's recommendations for graduate students and young researchers, published in the Internet and free of copyright limitations. On reading and understanding the text your purpose will be to acquire skills of skim reading scholarly papers in your field and writing a critique of both an article and a dissertation. Your immediate aim will be to employ the tactics and memorize the vocabulary well enough to be ready to discuss the topic, if necessary, with your examiner.

Part 1. A Few Simple Tactics

If you are studying your field, you are going to need to read articles published in academic and professional journals at some point. You might read these articles as part of a literature review for a paper you are writing, or your instructor may even ask you ***to write a critique of an article***. Whatever the reason, it is essential that you understand what you are reading and find ways to then summarize the content in your own words.

Research articles can be complex and may seem daunting, especially to beginners who have no experience reading or writing this type of paper. Learning how to read this type of writing is mostly a matter of experience, but ***utilizing*** a few simple tactics can make this process much easier.

A. Start by Understanding How a Journal Article is Structured:

At first glance, a journal article ***may seem to be a confusing collection of*** unfamiliar terminology and complicated tables. However, most articles follow a fairly standardized format that ***conforms to guidelines*** established by academic associations. By understanding this structure, you'll feel more comfortable working your way through each section.

- **The Abstract:** ***This short paragraph-long section*** provides a brief overview of the article. Reading the abstract is a great way to get an idea for what information the article will cover. Reading this section first can help you decide if the article is relevant to your topic or interests.
- **The Introduction:** The second section of the article introduces the problem and reviews previous research and literature on the topic. This part of the article will help you better understand ***the background of the research*** and ***the current question that is under investigation.***
- **The Method Section:** This part of the article details *how* the research was conducted. Information about the participants, the procedures, the instruments and the variables that were measured are all described in this section.
- **The Results Section:** So what were the actual results of the study? This important section details what the researchers found, so pay careful attention to

Unit 12

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this part of the article. Tables and figures are frequently included in addition to the text.

- **The Discussion Section:** What do the result of the study really mean? In this section, the author(s) interpret the results, ***outline the implications*** of the study and provide possible descriptions of future research that should be conducted.
- **The References Sections:** This section lists all of the articles and other sources cited within the article.

B. Skim through the article:

Once you understand the basic structure of the article, your first step should be to briefly skim through the material. Never ***start by doing an in-depth reading*** of an article before you have skimmed over each section. Attempting ***a thorough read-through*** before you've skimmed the contents is not only difficult; it may be a waste of valuable time.

Skimming is a great way to become familiar with the topic and the information included in the paper. In some cases, you may find that the paper is not ***well-suited*** to your ***needs, which can save time*** and allow you to move on to a research article that is more appropriate.

C. *Take Notes on* Each Section and Ask Questions:

Your next step should be to carefully read through each section, taking notes as you go. Write down important points, but also ***make note*** of any terminology or concepts that you do not understand. Once you've read the entire article, go back are start looking up the information that you didn't understand using another source. This might involve using a dictionary, textbook, online resource or even asking a classmate or your professor.

D. Identify Key Information:

Whether you are looking for information that supports the hypothesis in your own paper or carefully analyzing the article and critiquing the research methods or findings, there are important questions that you should answer as you read the article.

- What is the main hypothesis?
- Why is this research important?
- Did the researchers use appropriate measurements and procedures?
- What were the variables in the study?
- What was the key finding of the research?
- Do the findings justify the author's conclusions?

Answer the following questions:

- Do you structure your own articles along these lines? If you do, how and when did you learn the tactics of structuring?
- Do you agree that knowing these tactics will help write a critique of an article?
- Which of them would you like to employ while writing a critique?
- Does this format conform to Ukrainian officially recognized standards?
- How do you identify key information sources?

Prepare a 2 minute story about the tactics you employ for reading scholarly papers.

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Part 2. Information Sources

A. Note the Sources Cited:

When reading a research article, ***it's all too easy to focus on the main sections and overlook the references.*** However, the reference section can actually be one of the most important parts of the paper, especially if you are looking for further sources for your own paper. Spending some time reviewing this section can indicate important research articles on the topic area in which you are interested.

If you're a home-based student, it can sound like an impossible challenge. Your biggest tool is, of course, the Internet, but how can you decide which sources are important, and then find every one of them?

B. *Sources that Count*

While you're expected to have read everything important that's been written on your topic, it's neither expected nor necessary to have read every word that's been published about the subject. You only have to read the best information.

Primary sources are considered the best place to gather academic research. Primary sources are the journals and books where academics and scientists publish the results of their experiments and studies. The articles in these journals are written by the people who did the studies or by experts who have studied a topic for decades. These are the journals and books that you are expected to use for academic research. Government websites and websites run by managing organizations (such as the website for the American Ivy Society, for a paper on ivy) are also considered primary research, so don't overlook these sources.

Popular magazines, websites, books, and newspapers are secondary sources of information. They take the information published in scholarly journals and make it available to consumers. They usually quote the scholarly journals or books that published the information originally, adding explanations to make the information easier to understand or relate to. At the university, your teachers probably didn't mind if you used secondary sources in your research projects. Now, though, ***they are off-limits***. You may use their lists of references to find the names of the scholarly journals that you should use for your research, but you don't have to use them at all.

C. Using Online Informational Databases

Happily, most scholarly journals and popular magazines can be found online. You will be able to search articles and read abstracts for free, but without an affiliation with a university library, you may have to pay to read the articles you choose to use in your paper. If you choose your school carefully, though, you'll have an online library that gives students free access to several databases filled with both primary and secondary sources. Some of the most useful databases include:

Gale Group--Gives access to millions of full-text articles from thousands of journals. The Gale Group owns a variety of databases, including InfoTrac, Health Reference Center, and Academic ASAP.

Proquest--Use this database to find the full text of articles from nursing, social science, and psychology journals.

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Popular magazines, websites, books, and newspapers are secondary sources of information. They take the information published in scholarly journals and make it available to consumers. They usually quote the scholarly journals or books that published the information originally, adding explanations to make the information easier to understand or relate to. At the university, your teachers probably didn't mind if you used secondary sources in your research projects. Now, though, ***they are off-limits***. You may use their lists of references to find the names of the scholarly journals that you should use for your research, but you don't have to use them at all.

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Newsbank--A good database to use if you are looking for social, economic, government, environmental, sports, health, or science news articles. Newsbank includes over 500 local and national newspapers in its database.

(After Kendra Cherry, About.com Guide)

Answer the following questions:

- Do you always pay attention to references?
- How do you know which sources count?
- Is there a good online library in your field at TNU?
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Vocabulary and idiom notes to memorize and use

To write a critique of ***an article***
It may seem daunting **especially to beginners**
It may seem *to be a* ***confusing*** *collection of*
To conforms to guidelines established by academic associations
This short ***paragraph-long*** section
The background of the research and the current ***question*** that is ***under investigation.***
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Wrong word choice

Word choice errors involve the incorrect use of one word in place of another. The two words may related forms *(other* and *another,* for example) or they may be completely different *(do* and *make,* for example).

Descriptions of some of the most common word choice errors are given below:

Wrong choice of *make* or *do*

The verb *to do* is often used in place of *to make,* and *to make* in place of *to do.* In its basic sense, *make* means to produce, to create, to construct, while *to do* means to perform, to act, to accomplish, these verbs are also used in a number of set expressions:

Set expressions with *Make:*

make advances, make an attempt, make a comparison, make a contribution, make a decision, make a distinction, make a forecast, make a law, make a point, be made of (= be composed of), make up (= compose), make an investment, make a plan, make a prediction, make a profit, make a promise, make an offer, make a suggestion.

To make is also used in this pattern: *make* + someone +adjective (The gift *made* her happy.)

Common Expressions with *Do:*

do an assignment, do business with, do one's duty, do someone a favor, do a job (errand, chore) do research, do one's work.

The auxiliary verb *do* is used rather than repeat main verbs: (My computer doesn't operate as fast as theirs *does.*)

Anytime you see the verb *make* or *do* underlined in the Written Expression section, suspect a word choice error.

Examples:

Cement is done from varying amounts of limestone, clay, and gypsum.

The verb done is incorrect in this sentence. The correct word choice is *made*

Small town newspapers often urge readers to make business with local merchants

The phrase should read *do business with*

Wrong choice of *like* or *alike* and *like* or *as*

The word *alike* is incorrectly used in place of *like,* or *like* is used in place of *alike.* These words are used correctly in the following patterns:

Like A, B ... Like birds, mammals are warm-blooded.

A, like B, ... Birds, like mammals, are warm-blooded.

A is like B ... Birds are like mammals in that they are both warm-blooded.

A and B are alike ... Birds and mammals are alike in that they are both warm-blooded.

Whenever you see the words *alike* or *like* underlined, you should suspect a word choice error.

Section 2. GUIDELINES FOR GRAMMAR TEST

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Whenever you see the words *alike* or *like* underlined, you should suspect a word choice error.

The word *like* is also sometimes confused with the word *as*. When *like* is used in a comparison, it is followed by a noun or pronoun. When *as* is used in a comparison, it is followed by a clause containing a subject and a verb.

- I did my experiment just *as* Paul did. My results were much *like* Paul's.

The word *as* is also used before nouns when it means *in place of* or *in the role of.* This is particularly common after certain verbs: *serve, function,* and *use,* among others.

- The vice-president served *as* president when the president was sick
- Alike their close relative the frogs, toads are amphibians

The word *alike* doesn't follow the pattern *Like A, B*

- Asters, as most perennial plants, bloom once a year.

The word *like* should be used in place of the word *as* before a noun phrase (*most perennial plants*).

Wrong choice of *other* or *another*

Another means «one more, an additional one.» It can be used as an adjective before a singular noun or alone as a pronoun.

- He needs *another* piece of paper.
- I have one class in that building and *another* in the building across the quadrangle.

Other is used as an adjective before a plural noun. It is also used as an adjective before a singular noun when preceded by a determiner such as *the, some, any, one, no,* and so on. It can also be used alone as a pronoun when preceded by a determiner.

- There are *other* matters I'd like to discuss with you.
- One of the books was a novel; the *other* was a collection of essays.
- There's no *other* place I'd rather visit.

Examples:

Willa Cather is known for *My Antonia* and another novels of the American frontier.

Before a plural noun, *other* must be used.

An understudy is an actor who can substitute for other actor in case of an emergency.

Other is used incorrectly in place of *another* before a singular noun

Wrong choice of *because/because of, despite/inspite of* or *although, when/while* or *during*

Certain expressions, such as *because,* are adverb clause markers and are used only before clauses, other expressions, such as *because of,* are prepositions and are used before noun phrases or pronouns.

Adverb-clause Markers (Used with clauses)	**Prepositions (Used -with noun phrases)**
because	because of
although	despite, in spite of
when, while	during

Examples:

- Because migration to the suburbs, the population of many large American cities declined between 1950 and 1960.

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although	despite, in spite of
when, while	during

Examples:

- Because migration to the suburbs, the population of many large American cities declined between 1950 and 1960.

• Before a noun phrase *(migration),* the preposition *because* of must be used.

• Despite most people consider the tomato a vegetable, botanists classify it as a fruit

Before a full clause *(most people consider the tomato a vegetable),* the adverb marker *although* must be used.

Wrong choice of *much* and *many* and similar expressions

Certain expressions can only be used in phrases with plural nouns (many, few, a few, fewer, the fewest, number); others can be used in expressions with uncountable nouns (much, little, a little, less, the least, amount).

Examples:

Pearls are found in much colors, including cream, blue, lavender, and black.

Many must be used with a plural noun *[colors]*.

Even during economic booms, there is a small number of unemployment.

The word *amount* must be used to refer to an uncountable noun such as *unemployment.*

Wrong choice of negative words

The answer choices for this type of item are four negative expressions, such as the ones listed below:

no	adjective	not any
none	pronoun	not one
nothing	pronoun	not anything
no one	pronoun	not anyone
nor	conjunction	and . . . not
without	preposition	not having
never	adverb	at no time

Examples:

- There was *no* milk in the refrigerator.
- They took a lot of pictures, but almost *none* of them turned out.
- There was *nothing* in his briefcase. *No one* arrived at the meeting on time.
- He's never been fishing, *nor* does he plan to go.
- She likes her coffee *without* milk or sugar.
- I've *never* been to Alaska.

The negative word *not* is used to make almost any kind of word or phrase negative: verbs, prepositional phrases, infinitives, adjectives, and so on.

Both *no* and *not* can be used before nouns, depending on meaning:

There is *no* coffee in the pot. (It's empty.) This is *not* coffee. (It's tea.)

The adjective *no* is also used before the word *longer* to mean «not anymore»: I no longer read the afternoon paper.

Example:

There *is* almost ____vegetation in Sahara, a barren region of Africa. (A) not, (B) nor, (C) none, (D) .no

Choices (A), (B), and (C) cannot be used before nouns as adjectives

By the way, probably the most common correct answer for this type of problem is the adjective *no.*

• Before a noun phrase *(migration),* the preposition *because* of must be used.

• Despite most people consider the tomato a vegetable, botanists classify it as a fruit

Before a full clause *(most people consider the tomato a vegetable),* the adverb marker *although* must be used.

Wrong choice of *much* and *many* and similar expressions

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Mini-test

Identify and correct errors involving wrong word choice

If you are *making a research* in your field, you will have to *do a contribution* of an article to academic and professional journals at some point.

To *make a good job* of a literature review for a paper you are writing, it is essential that you understand what you are reading.

Your instructor may ask you to make another assignment or even ask you to write a critique of an article.

Whatever the reason, *do an attempt* and find ways to render the content in your own words.

Research articles can be complex, especially to beginners, therefore if you have no experience reading or writing this type of paper *do a plan* for utilizing a few simple tactics that can make this process much easier.

Choose the right word

Write down important points, (alike/like/as) terminology or concepts that you do not understand.

You look (alike/like/as) you have seen a ghost.

Did you read the entire article, (alike/like/as) you are supposed to have done?

The twins are so much (alike/like/as) that even their mother sometimes takes one for (other/another/the other).

Who did I see coming back home? No (other/another/the other).than Little Dorrit.

It's neither (either/neither/or/nor) expected (either/neither/or/nor) necessary to read every word of the text (when/while/during) preparing to answer at the exam.

(Despite/In spite of/Although) the articles in these journals are written by the people who did the studies or by experts who have studied a topic for decades, they are not always very informative.

You only have to read the best information about your subject (because/because of) primary sources are considered the best place to gather academic research.

There wasn't (many/much/none) useful information in this article.

Government websites (no/never/not/never) longer publish confidential information.

You cannot write a good literature review (without/never/not having) addressing these sources.

(Much/Many/A great amount) of information can be found in academic magazines.

Your teachers probably (not/no/never) mind if you used secondary sources in your research projects.

Now, though, they are (not/no/never).more acceptable.

You may use their lists of references to find (any amount of/much/many) names of the scholarly journals that you should use for your research.

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Section 1. GUIDELINES FOR ACADEMIC COMMUNICATION

The guidelines for a research paper

Instruction: This is another adaptation of Kendra Cherry's recommendations for graduate students and young researchers, published in the Internet without copyright limitations. On reading and understanding the text your purpose will be to acquire guidelines designed to help you research and produce a well written research paper. You will also get to know ideas and vocabulary enabling you to discuss the topic not only with your colleagues but also with your examiner when it comes to taking your candidate exam in English.

Part 1. *Prerequisites* of a well-written paper

The following guidelines are designed to help you research and produce a research paper that is well written, of high quality, correctly cited, and with good analytical content.

Basic guidelines

With almost everything you write, there are some *basic guidelines* **that you should follow:**

THINK **about the purpose and the context of the research paper you are producing.**

STATE **clearly and concisely what it is that you plan to achieve.**

INCLUDE **only relevant material.**

STRIVE **for** *consistency of expression throughout the pa**per**.*

MAKE SURE **you are ACCURATE in all of your statements and in the analysis and presentation of data.**

PRESENT **your information in a logical and effective order.**

CONVEY **your message as simply and clearly as possible.**

MAKE SURE **that your paper is both COHERENT and COMPLETE.**

DO NOT **draw conclusions that are not clearly based on your evidence.**

NEVER **assume that one draft will «do the job.»** *Count on* **producing at least two drafts before producing the final copy.**

ALWAYS *proofread* **and make any needed corrections before** *submitting* **the paper.**

Think about the Purpose of the Paper:

Your purpose may be any one or more of several possibilities:

(1) To show **that you understand certain terms, concepts, or theories.**

(2) To show **that you can do independent research.**

(3) *To apply* **a specific theory or model** *to* **new material or data.**

(4) To provide **new information.**

(5) To demonstrate **your knowledge and understanding of a topic or text.**

Unit 13

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(6) To show **that you can think critically and/or creatively.**
(7) To report **the results of a test that you have performed.**
(8) To demonstrate **that you can apply a particular research methodology.**

Answer the following questions:

- Do you think these basic guidelines are really necessary for writing a good research paper?
- Did you know all these guidelines before? Or did you follow them by intuition?
- Which of them would you not like to employ while writing a paper?
- Do you always have a clearly set purpose before writing a paper?
- Do you set one purpose or a combination of a few ones?

Prepare a 2 minute story about the guidelines follow in writing a good research paper.

Part 2. How most professors grade your paper

Among the key elements that most professors consider when evaluating and grading your work are the following:

- Is there a clear statement of purpose, ***thesis statement***, or research question?
- Is your research ***placed within a broad context*** provided by a review of the relevant literature?
- Is your research or analysis accurate?
- Is your research complete and thorough?
- Does your research demonstrate imaginative development?
- Is your paper organized ***in a logical fashion***?
- Do you demonstrate ***clarity of expression***?
- Is the paper ***free of*** grammar and spelling ***errors*** (have you used spell-check)?
- Have you developed a meaningful conclusion to the research?
- Have you ***linked your conclusions back to the broader purpose of the research***?
- Do you have ***the appropriate citation of sources*** throughout the text and on all graphics and tabular materials?
- Are your references and bibliography complete, correctly presented, and ***in the appropriate style***?
- Did you ***proof read*** the paper before *submission*?

Go through this checklist BEFORE you submit a paper to your professor and make sure you keep a paper and/or disk copy of your paper in your files.

(After Kendra Cherry, About.com Guide)

Answer the following questions:

- Do your professors consider these key elements when evaluating your paper?
- In your opinion, what key elements can be omitted in evaluating your students' papers?
- Do you always proofread the paper before submissio*n*? Or do you prefer to ask someone else to proofread your paper?

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Vocabulary and idiom notes to memorize and use
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Errors in sentence structure

Types of sentences

All sentences consist of one or more clauses.
A simple sentence consists of one clause.
People need vitamins.
The man took a vitamin pill.
Molly lives in northern California.
In the summer, Tom walks to his office.
A compound sentence consists of two independent clauses joined by a coordinating conjunction *and, but* and *or* .

The man took a vitamin pill, and he drank a glass of orange juice. Molly lives in northern California now, but she was raised in Ohio.

A complex sentence consists of an independent clause (called the main clause) and a subordinate clause. Subordinate clauses may be adverb clauses, noun clauses, or adjective clauses. In the examples below, the independent clauses are italicized.

The man took a vitamin pill because he had a cold, (independent clause + adverb clause).

I didn't realize that Nancy was here, (noun clause).

Tom walks to his office, which is located on Broadway, *every day during the summer.* (independent clause + adjective clause).

Incomplete independent clauses

Missing subjects, verbs, objects and complements

As a rule, clauses have a **subject** and a **verb.** Clauses with an action verb often take a **direct object** as well.

The verb missing from an independent clause may be **a single-word verb** *{need, was, took, had,* or **a verb phrase** consisting of one or more auxiliary verbs and a main verb *{will need, has been, take, would have had, had walked).* The verbs may be active *{need, take)* or passive *{was*

After the verb *to be* and certain other nonaction verbs, a **subject complement** is used rather than a direct object. (Subject complements are also known as predicatives or predicate nominatives and predicate adjectives.) E.g.: She is *a doctor*. The ice cream tastes *delicious*. He seems *worried*.

It is common for any of these elements or a combination of two or more of these elements to be missing from the stem. The most common problem in structure involves a missing verb. A missing subject and a missing subject-verb combination are common as well. The missing element may also be part of rather than all of the verb or noun phrase.

The best way to find an error

If the answer choices are fairly short, you should begin by taking a quick look at the answer choices to get an idea of what to look for when you read the

Section 2. GUIDELINES FOR GRAMMAR TEST

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sentence. If the answer choices are long or complicated, begin by reading the stem. Don't analyze it word for word, but as you are reading, try to form a picture of the sentence's overall structure. How many clauses will there be in the complete sentence? Does each clause have a complete subject and verb? Is there a connecting word to join clauses? Are any other elements obviously missing?

Then look at the answer choices. If you're not sure of the answer, try to eliminate as many distractors as possible. Distractors are generally incorrect for one of the following reasons:

- A necessary word or phrase is missing, so the sentence is still incomplete.
- An unnecessary word or phrase is included.
- Part of the answer choice is ungrammatical when put into the stem.

Never choose an answer until you've read the sentence completely; sometimes an option seems to fit in the sentence unless you read every word.

After you have eliminated as many answer choices as possible, read the sentence quickly to yourself with the remaining choice or choices in place of the blank. If an answer doesn't «sound right,» it probably isn't.

Examples:

The art of storytelling almost as old as humanity.

(A) that is
(B) is
(C) it is
(D) being

The correct answer supplies the missing verb. Choice (A) is incorrect because the word that is used to connect a relative clause to a main clause; in this sentence, there is only one verb, so there can only be one clause. Choice (C) is incorrect because there is an unnecessary repetition of the subject (The art of storytelling it...). Choice (D) is not correct because an -ing form (being) cannot be the main verb of a clause.

a few of the sounds produced by insects can be heard by humans.

(A) Only
(B) There are only
(C) That only
(D) With only

The correct answer completes the noun phrase that is the subject of the sentence. The expletive There in choice (B) is incorrectly used. In (C), the word That creates a noun clause, but each clause must have its own verb. (Produced is used as a participle, not a main verb in this sentence.) Choice (D) is incorrect because a preposition may not be used directly before the subject.

when lava cools very rapidly. \

(A) Because pumice is formed
(B) To form pumice
(C) Pumice is formed
(D) Forming pumice

The best answer supplies an independent clause to join to the adverb clause when lava cools very rapidly. Choice (A) consists of an adverb clause; two adverb clauses cannot be joined to form a complete sentence. Choices (B) and (D) are incorrect because they do not contain main verbs, and a clause must contain a main verb. (To form and forming are not main verbs.) The only choice is (C).

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Duke Ellington wrote during his career.
(A) that over a thousand songs
(B) over a thousand songs
(C) over a thousand songs were
(D) there were over a thousand songs

The direct object is missing from this sentence. In choice A, the connecting word that is used unnecessarily. In (C), the verb were is used unnecessarily because there is only one clause and it has a verb (wrotej. In choice (D) the phrase there were is not needed between a verb and its direct object.

Before the invention of the printing press, books ___.
(A) that were very rare
(B) were very rarely
(C) were very rare
(D) as very rare

Choice (A) incorrectly forms an adjective clause; an adjective must be joined to a main clause. Choice (B) contains an adverb; after the verb to be, an adjective is required. Choice (D) lacks a verb. Choice (C) correctly supplies a verb {were).

Mini-test

Identify and correct errors involving sentence structure

_____to read the best information
(A) There is only
(B) Only you have
(C) You have only
(D) You only have

These are the journals and books _____ to use for academic research.
(A) what you expect to
(B) these you are expected
(C) that you are expected
(D) which expect you

They _____ the scholarly journals or books that published the information originally.
(A) usual quotation
(B) usually have been quoted
(C) have usual quoting of
(D) usually quote

You may use their lists of references that you should use for your research, but you don't have to use them at all.
(A) in finding scholarly journals name
(B) for to find a scholarly journals names
(C) to find the names of the scholarly journals
(D).for finding scholarly journal's names

_____, though, you'll have an online library that gives students free access to several databases.
(A) By choosing your school carefully
(B) When choosing your school carefully
(C) If you choose your school carefully

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(B) Only you have
(C) You have only
(D) You only have

These are the journals and books _____ to use for academic research.
(A) what you expect to
(B) these you are expected
(C) that you are expected
(D) which expect you

They _____ the scholarly journals or books that published the information originally.
(A) usual quotation
(B) usually have been quoted
(C) have usual quoting of
(D) usually quote

You may use their lists of references that you should use for your research, but you don't have to use them at all.
(A) in finding scholarly journals name
(B) for to find a scholarly journals names
(C) to find the names of the scholarly journals
(D).for finding scholarly journal's names

_____, though, you'll have an online library that gives students free access to several databases.
(A) By choosing your school carefully
(B) When choosing your school carefully
(C) If you choose your school carefully

(D) Although you will choose your school carefully

Happily, most scholarly journals and popular magazines _____online.

(A) can find

(B) can have found

(C) can be finding

(D) can be found

You will be able to search articles and ____**1**___, but _____**2**_____, you may have to pay to read the articles ___**3**___ in your paper.

1

(A) have read abstracts for free

(B) can read abstracts for free

(C) read abstracts for free

(D) to be reading abstracts freely

2

(A) without an affiliation with a university library

(B) having not affiliation with a university library

(C) not to have affiliation with a university library

(D) not to be affiliated with a university library

3

(A) what you choose to use

(B) when you will choose to use

(C) you choose to use

(D) you are using to choose

_____, the ozone layer in the stratosphere is beneficial.

(A) what ground-level ozone will be considered a harmful pollutant

(B) when ground-level ozone is considering a harmful pollutant

(C) Although ground-level ozone is considered a harmful pollutant

(D) As long as ground-level ozone has considered a harmful pollutant

These scientists fear _____.

(A) what will cause global warming to increase temperatures

(B) that global warming will cause temperatures to increase

(C) what temperatures will cause global warming to increase

(D what global warming will cause temperatures to increase

_____, bacteria and other decay-causing organisms thrive.

(A) As the larger amounts of algae die

(B) Though the larger amounts of algae die

(C) As well as the larger amounts of algae die

(D Because the larger amounts of algae die

They use up _____fish and other marine organisms begin to die.

A) very much oxygen that

(B) so much oxygen that

(C) not much oxygen that

(D)so much oxygen for the

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Section 1. GUIDELINES FOR ACADEMIC COMMUNICATION

Key elements of an outstanding research paper

Instruction: This is an adaptation of Kendra Cherry's recommendations for graduate students and young researchers, published in the Internet without copyright limitations. On reading and understanding the text your purpose will be to acquire the knowledge of key elements of a basic presentation framework, starting with a research question and finishing with a suggestion for a future research. The ideas and vocabulary that you acquire in this section will help you discuss the topic both with your colleagues and at your English candidate exam. Trite as it may sound, you will surely benefit by employing this framework for your presentations.

Presentation framework

Good research papers should be designed around a basic ***presentation framework*** containing four key elements:

1. An Introduction containing ***the broad context for the paper set out at the global, regional, and national levels***. You should provide a broad context for your study that ***fits into*** the accepted theories or concepts that drive the specific sub-discipline for which you are writing the paper.

This introductory section is much like ***a «so what» statement*** that establishes a legitimate reason for conducting the research. Follow this by setting out a clearly stated research question, statement, or hypothesis. Avoid developing research questions that can be answered with a simple yes or no response.

Construct a research question that ***lends itself to rigorous analysis*** in order to reach a conclusion. If you are developing a research hypothesis (i.e***. null and alternative***), make sure it is testable in a quantitative fashion. The Introduction should close with a brief ***«road map»*** of what the paper is going to present and in what order. This section should be no more than 1 to 2 pages in length.

Example: Your paper is about the impact of NAFTA (North American Free Trade Agreement) on Mexico. You should ***begin by explaining the broad-scale or general context*** of economic and political integration. Then ***narrow down to the medium scale*** to place your topic in perspective; i.e. regional economic alliances between groups of states are seen as ***crucial to*** economic development in the coming decades. Next, ***state your research question***, statement, or hypothesis. For example: Has NAFTA created regional inequalities within Mexico and, if so, where are these inequalities evident? An example of this question stated as a testable hypothesis is: ***NULL Hypothesis*** = *There is no significant difference in development among the various regions of Mexico. The* ***ALTERNATE hypothesis*** *would be: There are significant differences among the various levels of development in the regions of Mexico.* Caution: do not simply state a research

Unit 14

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question that could be answered with a simple yes or no response. Try and develop a thesis statement that allows for detailed and rigorous analysis of a specific problem or issue.

Finally, describe the plan of action for your paper. For example: First I provide a brief historical background to economic relationships between Mexico and the United States. Then I analyze regional data to illustrate the concept of regional geographic inequalities. The paper concludes with a summary of key issues suggested by the research, some proposals, comments, and opinions about future directions or actions, and suggestions for future research possibilities.

2. ***A Framework*** for *Analysis section* that provides a broad context for the work to be presented in the third section. This is ***the appropriate place to provide a historical background to*** the issue under research. You should also provide a brief but thorough literature review in this section. Who has written about this topic? What did they have to say? Do you agree with the conclusions or data presented? Is there a gap in the research that you hope to fill or address with your research?

3. Analysis section. This section should be ***the «heart» of your research paper*** and contains the analysis of your research. Here you present your argument or case to support your ***thesis statement***, research question, or hypothesis. Use quantitative analysis, where appropriate, and include graphics, and tabular material to illustrate your key points.

CAUTION!! Tables should not be included just to «fill» or ***«pretty up»*** the paper. Tables are analytical tools and should be used specifically to illustrate a key point or to provide a graphic reference to a key ***spatial pattern*** or concept. All non-text material should be directly referenced in the paper and should be placed as close as possible to the text where first mentioned.

Example: The value of Mexico's currency against the U.S. dollar has collapsed precipitously over the past decade (Table 1).

The Table containing these data should be placed at the top of the first page following its ***parenthetical reference***.

4. **The final section** of the paper should summarize the results of your research and offer some concluding remarks. Restate your hypothesis, statement, or question: i.e. This paper examined the role of the NAFTA in creating regional inequalities in Mexico. My research indicates that ..... etc. Offer some opinions or comments about the likely future related ***to the issue under investigation***. Point out some suggestions for future research. It's always a good idea in this part to point out some of the analytical weaknesses in your own research and to offer suggestions to improve the methodology. Link your conclusions back to the bigger issue or context outlined in the beginning of your paper.

(After Kendra Cherry, About.com Guide)

Answer the following questions:

- Will you set your own research topic in a broad context at the global, regional, and national levels?
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• Do you think this framework is absolutely necessary or you can abide without this or that element?

• Which part of the framework looks most difficult for you and why?

Prepare a 2 minute story about the framework of a good research paper.

Vocabulary and idiom notes to memorize and use

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Errors with other types of clauses

Clauses with *there* and *it*

Some clauses begin with the introductory words *there* or *it* rather than with the subject of the sentence. These introductory words are sometimes called expletives.

The expletive *there* shows that someone or something exists, usually at a particular time or place, these sentences generally follow the pattern *there* + verb *to be* + subject.

Examples:

- *There* are many skyscrapers in New York City.
- *There* was a good movie on television last night.
- The expletive *it* is used in a number of different situations and patterns:

Examples:

- *It* is important to be punctual for appointments, (with the verb *to be* + adjective + infinitive).
- *It* was in 1959 that Alaska became a state, (with the verb *to be* + adverbial + noun clause).
- *It* takes a long time to learn a language, (with the verb *to take* + time phrase + infinitive).
- *It* was David who did most of the work, (with the verb *to be* + noun + relative clause).
- *It* and *there,* along with the verb and other sentence elements, may be missing from the stem.

Examples:

In Michigan,_____over six hundred feet deep.

(A) salt deposits, (B) where salt deposits are, (C) having salt deposits, (D) there are salt deposits

Choice (D) correctly supplies an introductory word *{there),* a verb, and a subject. Choice (A) lacks a verb. Choice (B) contains a subordinator, used to introduce g clause; there is only one verb, however, so there can only be one clause. Choice (C) also lacks a main verb.

_____a tomato plant from seventy-five to eighty-five days to develop into a mature plant with ripe fruit.

(A) It takes
(B) To take
(C) That takes
(D) By taking

Choice (A) correctly completes the sentence with the introductory word //and a verb. Choices (B) and (D) do **not** supply main verbs. Choice (C) incorrectly creates a noun clause.

Incomplete adjective clauses

As mentioned before, there are three types of dependent clauses.

Adjective clauses—also called **relative clauses**—are the most commonly tested of the three. You will see one or two items involving adjective clauses on most tests.

Section 2. GUIDELINES FOR GRAMMAR TEST

Errors with other types of clauses

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Adjective clauses—also called **relative clauses**—are the most commonly tested of the three. You will see one or two items involving adjective clauses on most tests.

Adjective clauses are a way of joining two sentences. In the joined sentence, the adjective clause modifies (describes) a noun (called the **head noun)** in another clause of the sentence. It begins with an **adjective clause marker.**

Example:

I wanted the book. The book had already been checked out. The book *that I wanted* had already been checked out.

The adjective clause in this example begins with the marker *that* and modifies the head noun *book.* Adjective clause markers are relative pronouns such as *who, that,* or *which* or the relative adverbs *when* or *where.*

Examples:

- A neurologist is a doctor *who* specializes in the nervous system.
- This is the patient *whom* the doctor treated.
- Mr. Collins is the man *whose* house I rented.
- That is a topic *which* interests me. *(which* as subject)
- That is the topic *on which* I will write, *(which* as object of preposition)
- Art *that* is in public places can be enjoyed by everyone. *(that* as subject)
- The painting *that* Ms. Wallace bought was very expensive. *(that* as object)
- Here is the site *where* the bank plans to build its new headquarters.
- This is the hour *when* the children usually go to bed.

Like all clauses, adjective clauses must have a subject and a verb. In some cases the adjective-clause marker itself is the subject; in some cases, there is another subject.

Examples:

The painting was very expensive. Ms. Wallace bought it. The painting *which Ms. Wallace bought* was very expensive.

The adjective-clause marker in the joined sentence replaces *it,* the object of the verb *bought.* In the joined sentence, the adjective clause keeps the subject—*Ms. Wallace*—that it had in the original sentence.

This is a topic. It interests me. This is a topic *that interests me.*

The adjective-clause marker in the joined sentence replaces *it.* the subject of the second original sentence. In the joined sentence, the marker itself is the subject of the adjective clause. Notice that the inclusion of the pronoun *it* in the joined sentences above would be an error

Incorrect: The painting which Ms. Wallace bought *it* was very expensive. This is a topic which *it* interests me. This type of mistake is sometimes seen in distractors.

When the markers *which, that,* and *whom* are used as objects in relative clauses, they can correctly be omitted. **Example:** The painting Ms. Wallace bought is very expensive, *{which* is omitted)

The adjective-clause markers *which* and *whom* can also be used as objects of prepositions: **Example:** That is the topic. I will write on it. That is the topic *on which I will write.*

You may also see sentences with adjective clauses used in this pattern: quantity word + *of* + relative clause.

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Examples:

He met with two advisers. He had known both of them for years. He met with two advisers, *both of whom he had known for years.*

I read a number of articles. Most of them were very useful. I read a number of articles, most of which were very useful.

Any part of a relative clause can be missing from the stem, but most often, the marker and the subject (if there is one) and the verb are missing. Any word or phrase from another clause—usually the head noun—may also be missing from the stem.

Example:

Cable cars are moved by cables underground and are powered by a stationary engine.

(A) they run
(B) that they run
(C) run
(D) that run

Choice (A) is incorrect because the pronoun they cannot be used to join two clauses. Choice (B) is not appropriate because the subject they is not needed in the adjective clause; the marker that serves as the subject of the clause. Choice (C) is incorrect because there is no marker to join the adjective clause to the main clause.

Mini-test

Identify and correct errors involving types of clauses

_____1_____, _____2_____ that mothers _____3_____ by seeking full-time employment are negatively stereotyped and discriminated against.

1
(A) By growing the body of literature
(B) There is a growing body of literature
(C) With a growing body of literature
(D) It is a growing body of literature

2
(A) having suggested
(B) that suggests
(C) by suggesting
(D) to suggest

3
(A) who violate gender roles
(B) violating
(C) whose gender roles are violating
(D) which gender roles are violated

Psychologists asked undergraduate students to read CVs _____1_____ , __2_____and either a parent or not a parent.

1
(A) describing a consultant
(B) to describe a consultant
(C) that describes a consultant
(D) for to describing a consultant

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(C) that describes a consultant
(D) for to describing a consultant

2
(A) that was either female or male
(B) who was either female or male
(C) which was either female or male
(D) whom was either female or male

Students requested and recommended the consultant less _____1_____than a woman without children, _____2 ____of being requested and recommended.
1
(A) though she was a mother
(B) when she was a mother
(C) where she was a mother
(D) that she was a mother
2
(A) when fatherhood did not affect a man's chances
(B) though fatherhood did not affect a man's chances
(C) whose fatherhood did not affect a man's chances
(D) that fatherhood did not affect a man's chances
Students rated _____1_____ more communal (warm) but less agentic (competent) than a woman _____2_____

1
(A when a mother was
(B) although a mother was
(C) that a mother was
(D) what a mother was
2
(A) that had children.
(B) who had children.
(C) when had children.
(D) where had children.
Other psychologists asked undergraduate and graduate students to evaluate a job applicant _____1_____ and as a person who may or may not have children.
1
(A) although he or she was depicted as male or female
(B) since he or she was depicted as male or female
(C) as he or she was depicted as male or female
(D) that he or she was depicted as male or female n.
2
(A) because may or may not have children.
(B) who may or may not have children.
(C) that may or may not have children.
(D) when may or may not have children.
.Fatherhood _____of recommendation
(A) it had no effect on a man's chances
(B) there was no effect on a man's chances
(C) though had no effect on a man's chances
(D) because it had no effect on a man's chances

2
(A) that was either female or male
(B) who was either female or male
(C) which was either female or male
(D) whom was either female or male

Students requested and recommended the consultant less _____1_____than a woman without children, _____2 ____of being requested and recommended.
1
(A) though she was a mother
(B) when she was a mother
(C) where she was a mother
(D) that she was a mother
2
(A) when fatherhood did not affect a man's chances
(B) though fatherhood did not affect a man's chances
(C) whose fatherhood did not affect a man's chances
(D) that fatherhood did not affect a man's chances
Students rated _____1_____ more communal (warm) but less agentic (competent) than a woman _____2_____

1
(A when a mother was
(B) although a mother was
(C) that a mother was
(D) what a mother was
2
(A) that had children.
(B) who had children.
(C) when had children.
(D) where had children.
Other psychologists asked undergraduate and graduate students to evaluate a job applicant _____1_____ and as a person who may or may not have children.
1
(A) although he or she was depicted as male or female
(B) since he or she was depicted as male or female
(C) as he or she was depicted as male or female
(D) that he or she was depicted as male or female n.
2
(A) because may or may not have children.
(B) who may or may not have children.
(C) that may or may not have children.
(D) when may or may not have children.
.Fatherhood _____of recommendation
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Section 1. GUIDELINES FOR ACADEMIC COMMUNICATION

How To Write A Critique Paper

Instruction: This is an adaptation of Kendra Cherry's recommendations for graduate students and young researchers, published in the Internet without copyright limitations. You are sure to realize that a postgraduate student's activity starts with collecting special information and critically reviewing scholarly papers in his or her field. On reading and understanding the following text your purpose will be to acquire the standard guidelines along which any critique is written. This will be your long-term goal. However your immediate goal is to get ready to present the ideas through the vocabulary that you acquire in this section at your English candidate exam..

Most postgraduate students will be expected to write ***a critique paper*** at some point. Critiquing a professional paper is a great way to learn more about ***your field articles***, writing, and the research process itself. Students can analyze how researchers conduct experiments, interpret results, and discuss ***the impact of the results***.

Difficulty: Average
Time Required: Variable
Here's How:

1. Read the introduction section of the article.
Is the hypothesis clearly stated? Is necessary background information and previous research described in the introduction? In addition to answering these basic questions, you should take note of information provided in the introduction and any questions that you may have.

2. Read the methods section of the article.
Is the study procedure clearly outlined? Can you determine which variables the researchers are measuring? Remember ***to jot down*** questions and thoughts that ***come to mind*** as you are reading.

3. Read the results section of the article.
Are all tables and graphs clearly labeled? Do researchers provide enough statistical information? Did the researchers collect all of the data needed to measure the variables in question?

4. Read the discussion section of the article.
How do the researchers interpret the results of the study? Did the results support their hypothesis? Do the ***conclusions drawn*** by the researchers seem reasonable? The discussion section offers students a good opportunity to take a position. If you agree with the researcher's conclusions, explain why. If you feel that the researcher's conclusions are incorrect or ***off-base***, point out problems with the conclusions and suggest alternative explanations.

Unit 15

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5. Prepare an outline of your article.

Once you have read the article thoroughly, prepare an outline of your thoughts on the article. Use the following guide to help structure your critique paper:

6. Introduction - Begin your paper by describing the journal article and authors you are critiquing. Provide the main hypothesis or thesis of the paper and explain why you think the information is relevant.

7. Thesis Statement - The final part of your introduction should include ***your thesis statement.*** Your thesis statement is the main idea of your critique.

8. Article Summary - Provide a brief summary of the article, outlining the main points, results, and discussion.

9. Your Analysis - In this section, you should provide your critique of the article. Describe any problems you had with ***the author's premise***, methods, or conclusions. Your critique might focus on problems with the author's argument, presentation, or on information and alternatives that have been ***overlooked***.

10. Conclusion - Your critique paper should end with an overview of the articles argument, your conclusions, and your reactions.

(After Kendra Cherry, About.com Guide)

Answer the following questions:

- Do you agree that critiquing a professional paper is a great way to learn more about your field articles? If you do, how does it help you?
- What do you learn from reading the introduction/the methods section/the results section/the discussion section of the article under analysis?
- What items does the outline of your critique article include?
- Have you ever written a critique?
- What difficulties did you experience and why?

Prepare a 2 minute story about the framework of a good critique article.

Vocabulary and idiom notes to memorize and use

A critique paper
Your field articles
The impact of the results.
To jot down
To come to mind
To draw conclusions
Off-base
Once you **have read**
The author's premise **= assumption, (pre)supposition; (pre)condition, prerequisite**
To overlook **= to miss**

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Incomplete adverb clauses

Full adverb clauses

An **adverb clause** consists of a connecting word, called an **adverb clause marker** (or subordinate conjunction), and at least a subject and a verb. An adverb clause can precede the main clause or follow it. When the adverb clause comes first, it is separated from the main clause by a comma.

Example:

The demand for economical cars increases *when gasoline becomes more expensive.*

When gasoline becomes more expensive, the demand for economical cars increases.

In this example, the adverb clause marker *when* joins the adverb clause to the main clause. The verb clause contains a subject *(gasoline)* and a verb *(becomes).*

The following markers are commonly used:

Examples:

Time: Your heart rate increases *when* you exercise.
Time: Some people like to listen to music *while* they are studying.
Time: Some people arrived in taxis *while* others took the subway.
Time: One train was arriving *as* another was departing.
Time: We haven't seen Professor Hill *since* she returned from her trip.
Time: Don't put off going to the dentist *until* you have a problem.
Time: Once the dean arrives, the meeting can begin.
Time: Before he left the country, he bought some traveler's checks.
Time: She will give a short speech *after* she is presented with the award.
Cause: Because the speaker was sick, the program was canceled.
Opposition (contrary cause): *Since* credit cards are so convenient, many people use them.
Contrast: Although he earns a good salary, he never saves any money.
Contrast: Even though she was tired, she stayed up late.
Condition: If the automobile had not been invented, what would people use for basic transportation?
Condition: I won't go *unless* you do.

In structure items, any part of a full adverb clause—the marker, the subject, the verb, and so on—can be missing from the stem.

Clause markers with *ever*: Words that end with *-ever* are sometimes used as adverb clause markers: *whoever, whatever, whenever, wherever, whichever, however*. In some sentences, these words are actually noun-clause markers.

Examples:

Put that box *wherever* you can find room for it.
They stay at that hotel *whenever* they're in Boston.
However you solve the problem, you'll get the same answer.

Reduced adverb clauses

When the subject of the main clause and the subject of the adverb clause are the same person or thing, the adverb clause can be reduced (shortened). Reduced

Section 2. GUIDELINES FOR GRAMMAR TEST

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adverb clauses do not contain a main verb or a subject. They consist of a marker and a participle (either a present or a past participle) or a marker and an adjective.

Examples:

When astronauts are orbiting the Earth, they don't feel the force of gravity, (full adverb clause).

When orbiting the Earth, astronauts don't feel the force of gravity, (reduced clause with present participle).

Although it had been damaged, the machine was still operational, (full adverb clause).

Although damaged, the machine was still operational, (reduced clause with a past participle).

Although he was nervous, he gave a wonderful speech, (full adverb clause) *Although nervous,* he gave a wonderful speech, (reduced clause with an adjective).

You will most often see reduced adverb clauses with the markers *although, while, if, when, before, after,* and *until.* Reduced adverb clauses are NEVER used after *because.*

Mini-test

Identify and correct errors involving adverb clauses

_____, I don' think criminals and terrorists can be included.

(A) When human rights are the equal rights of everyone
(B) Even though human rights are the equal rights of everyone
(C) If human rights are the equal rights of everyone
(D) Because human rights are the equal rights of everyone

No one has less or more rights _____

(A) if the next person does.
(B) than the next person does.
(C) because the next person does.
(D) when the next person does.

It's not _____1_____ _____2_____ his or her rights, to torture, to silence, to indoctrinate.

1
(A) when someone committed a crime
(B) because someone committed a crime
(C) though someone committed a crime
(D) if someone committed a crime

2
(A) who are allowed to take away
(B) when we are allowed to take away
(C) that we are allowed to take away
(D) which we are allowed to take away

But all of the rights _____1_____ _____2_____to some extent and in some circumstances belong to criminals as well.

1
(A) to have
(B) which of all of us have

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(A) to have
(B) which of all of us have

(C) because of all of us have
(D) when of all of us have
2
(A) though limited
(B) when limited
(C) if limited
(D) because limited
We have freedom of movement _____1_____ entail the right to enter the private property _____2_____to our neighbors.
1
(A) although it does not
(B) when does not
(C) that it does not
(D) if it does not
2
(A) because it belongs
(B) that belongs
(C) if it who belongs
(D) that belongs
So the fact _____does not set them apart from ordinary citizens.
(A) when criminals' rights are limited
(B) of criminals' rights are limited
(C) that criminals' rights are limited
(D) as criminals' rights are limited
It does not mean _____are not equal anymore.
(A) whose human rights
(B) which human rights
(C) that human rights
(D) more than human rights
Human rights are equal _____the unconditional property of us all.
(A) as soon as they are
(B) with the purpose that they are
(C) because they are
(D) if they are
We do not have to fulfil certain conditions — such as respect_____1_____–_____2_____
(A) because we must have for the law
(B) though we must have for the law
(C) as we must have for the law
(D) we must have for the law
2
(A) wherever we have them.
(B) since that we have them.
(C) in order that we have them.
(D) because we have them.

(C) because of all of us have
(D) when of all of us have
2
(A) though limited
(B) when limited
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(D) because limited
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Section 1. GUIDELINES FOR ACADEMIC COMMUNICATION

Important presentation issues

Instruction: These are guidelines for presentation issues which usually pose a big problem for graduate students and young researchers. This is an adaptation of a text placed in the Internet without copyright limitations. You are sure to realize that, no matter how brilliant your ideas might be, they will fail to achieve their potential because of your failure to address presentation issues. On reading and understanding the following text your purpose will be to acquire the standard guidelines along which a presentation is built. This will be your goal as a researcher. However your goal as an examinee is to get ready to present the ideas through the vocabulary that you acquire in this section at your English candidate exam.

Part 1. Performance Adequacy

Many good research papers fail to achieve their potential because of the student's failure to address six important presentation issues: **(1) *Presentation Format*; (2) Syntax and Spelling; (3) Adequate Research and; (4) Citation; (5) Plagiarism; and (6) Field Component**.

(1)Presentation Format:
Each professor normally will indicate the type of presentation format preferred for a particular course. In general, all papers should be typed, double spaced (about 0.33» from one line to the following line), have 1» margins all around, and be printed in a clear, readable font style. The preferred font size usually is Courier or Times New Roman 12 cpi. Headings and subheadings should be used to indicate the major sections of the paper. You can ***center or left justify these headings***, with one line space above and below the heading. The first line of each paragraph should be indented five spaces, and there should be no line spaces left between paragraphs (except when introducing a heading or subheading). Some professors prefer a ragged right justification (as in this paragraph), while others accept full justification of both margins. Consult your professor on this issue.

A cover page ***setting out the title of the paper, the name of the course, and the name of the paper's author*** should be provided for all research papers. Consult with your professor for specific requirements on this issue.

(2) Syntax and Grammar:
There is nothing more frustrating than reading a research paper ***plagued with*** spelling and syntax ***errors***! Every student has campus access to word processing. Before you print out a final draft copy of your paper, USE THE SPELL CHECK AND THE GRAMMATIK programs!!! In a computerized environment, spelling errors and major syntax errors are totally unacceptable.

Unit 16

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Read over your paper carefully BEFORE you print out the final copy. Have a friend or relative read the paper back to you so you can listen to how it sounds. Watch out for simple grammar problems such as «its and it's,» «their and there,» «were and where,» and subject-verb agreement errors. Avoid common mistakes, such as «Australia is a democratic country and **their** government.....» This is WRONG! Countries are «it,» not «she» or «he» or «their.» The correct sentence would read «Australia is a democratic country and its government .....»

If you are unsure about any grammar or spelling issue, consult a writing aid, visit the University Writing Center, or ask your professor for help. Remember, it's not only important what you say, but how you say it! The key to a successful paper is to EDIT, EDIT, EDIT!!!

(3) Quality of Research:

A well written and researched paper should draw from accepted academic sources. What are academic sources? Primarily, these are books written by ***academics*** and other experts as well as professional journal articles. Geography, for example, has dozens of academic journals where geographers publish their research (Geographical Review, Professional Geographer, Annals of the AAG, Transactions, Journal of Transport Geography, etc.). You should endeavor to consult these journals in your research as they contain a rich and varied collection of articles.

Academic journal articles are those published in accepted professional journals, usually 10-15 pages in length, with a detailed bibliography, and are usually ***peer reviewed*** by other academics and professionals. Check with your professor if you are unsure about a particular journal source. Articles that are NOT considered academic in nature are those published in media magazines (Time, Newsweek, Beijing Review, Oil and Gas Journal, Economist, etc.) that are often anonymous in nature, short in length, and with no cited bibliography. Other NON-JOURNAL sources include statistical abstracts, encyclopedias, reference books, etc. Although these are valid and very useful sources, and should be used in your work, they do not fit the definition of «academic journal articles» for the purpose of a research paper.

Be extremely careful about material read and downloaded from the Internet or any world-wide web source. Most academic journal articles are not available on the web. If you find material on the Web, it must meet the criteria outlined above to qualify as a legitimate academic journal article. ALL material downloaded from the Web and used in a paper should ***be checked against other reputable sources***. ***DO NOT try and submit prepackaged research papers downloaded from the Web!*** You will be caught, you will receive an «F» for the course, and you will be charged with fraud!

Answer the following questions:

- Did your professors indicate the type of presentation format in your research field? If they did, when did you learn about it first?
- Are grammar and style criteria important in Ukrainian/Russian language papers?
- What academic sources do you regularly use?
- Do you often download from the Internet?
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Academic journal articles are those published in accepted professional journals, usually 10-15 pages in length, with a detailed bibliography, and are usually ***peer reviewed*** by other academics and professionals. Check with your professor if you are unsure about a particular journal source. Articles that are NOT considered academic in nature are those published in media magazines (Time, Newsweek, Beijing Review, Oil and Gas Journal, Economist, etc.) that are often anonymous in nature, short in length, and with no cited bibliography. Other NON-JOURNAL sources include statistical abstracts, encyclopedias, reference books, etc. Although these are valid and very useful sources, and should be used in your work, they do not fit the definition of «academic journal articles» for the purpose of a research paper.

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Prepare a 2 minute story about the framework of a good presentation format.

(4) Citation:

Your research paper will contain material gained from a variety of academic and non-academic sources. All sources must be clearly and correctly attributed in the text (see plagiarism in section 5) and listed in a Bibliography or Works Cited section at the end of your paper. Many different types of citation styles exist. Most researchers use the parenthetical or Harvard reference style (see e.g. .a current issue of Geographical *Review* or the Annals of the Association of American Geographers for examples of this style).

Example: World cities are connected by hierarchies of transport networks (Keeling 1995). Or: Brian Turton (1992:67) observed recently that «a problem-oriented approach is often used.»

If you use a source with multiple authors (three or more), cite as follows in the text -- (Keeling et al. 1995) -- but provide the full name of all the authors in the bibliography (i.e. Keeling, D., Hoffman, W., and Trapasso, M. (1995) Useless meetings I have attended. Journal of High-Pressure Research 75(4):25-30.

If citing material from the Internet, provide the full description of the http address (i.e. http://www.wku.edu) in the bibliography, along with the author's name (if there is one), the location of the material cited, the year of publication, and the page number or name.

Here are some examples of how to cite materials in the bibliography section of your paper.

Single-author book:

Keeling, D.J. (1996) Buenos Aires: Global Dreams, Local Crises. London and New York: John Wiley and Sons.

Multiple-author book:

Clinton, W.J., and Carter, J.E. (1995) Crises I Have Caused. Washington, DC: Republican Press.

Journal Article:

Trapasso, L.M. (1995) Water resource systems developed centuries B.C., Part II: The Dujianyan water works in the Peoples Republic of China. Proceedings of the Geography Section of the KAS 95:19-21.

Newspaper Article with no author:

New York Times (1996) Death to the left-wing Liberals, November 27, Section D, 15.Consult a good writing manual or your professor for further assistance with citation styles and formats.

(5) Plagiarism:

Plagiarism is a serious problem that is not very well understood by most students. Simply stated, plagiarism is the act of ***passing someone else's work off as your own*** or using someone's research without proper citation. **Direct plagiarism** occurs when a passage is ***quoted verbatim (word for word).***

Indirect plagiarism occurs when the student paraphrases the original work without giving credit to the original author. Paraphrasing means to substitute certain words and to alter some sentences while repeating all the main ideas. Even though the original work was not copied verbatim, the ideas and substance have been copied.

Part 2. Professional Adequacy

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The general rule here is that if something is considered very general knowledge it does not need citation.

For example, «China today has over 1 billion inhabitants and it is a very crowded country.» Most people know this so you don't need citation. However, if you have more specific data, such as «China had 1.31 billion inhabitants in 2001,» you will need a citation because this level of specificity is not ***common knowledge***.

However, if you use ANY piece of material from a published (or, in certain circumstances, unpublished) source, you MUST provide proper citation. The rules on how to avoid plagiarism can be quite confusing. Consult your professor or a good writing guide on tips to avoid this serious problem. Basically, you should have a citation in every paragraph where you have used material from a published source, including the Internet.

Moreover, EVERY map, table, graphic, or picture that you include from whatever source (even if it's your own material) must have a proper caption and a full citation (i.e. Source: Photograph by the author). DO NOT fill up the paper with lines of direct quotes from material. Put the material in your own words and cite the original source.

If you have more than four lines of direct quotation on any one page in your paper, you probably have too much direct quotation. If in doubt about this, talk to your professor!

Finally, every direct quote used in a research paper should be cited with the author's last name, date of publication, and PAGE NUMBER from the original source (i.e. Keeling 1997:105).

Acts of intentional plagiarism will result in an automatic «F» (bad grade) for the paper and for the course, along with appropriate action from the ***University Academic Complaint Committee***. In extreme cases, students have been expelled from the University for plagiarism. Learn the rules NOW!! DO NOT PLAGIARIZE.

(6) Your field Component of the Research Paper:

Finally, we ***come to the very heart of*** many research paper problems — the failure to include your field component in the paper. Having your field component does not mean throwing some table in at the end of the research paper!

Your discipline is concerned with definite relationships. Your research should be addressing some aspect of these relationships — an analysis of patterns, ***stream-flow processes***, implications of policy, ***diffusion patterns***, ***network changes***, etc., etc., etc.

Ask yourself at the beginning of the research project what the field component of your paper is going to be. What pattern or process are your investigating? How has it changed? How might it change as the result of some action or process?

Also important to this concept is the ***«SO WHAT?»*** question. You must have a good ***rationale*** for conducting the research. Why are you researching this topic or issue? Adding to the body of knowledge about a topic, exploring new methodological approaches to a problem or issue, evaluating policy implications for a specific problem, or helping us to understand more fully the complexity of human-environment relationships all are solid rationales for conducting research.

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Finally, and above all, you should enjoy your research. Choose issues or problems that really motivate you and challenge you professionally and intellectually. ***Don't opt for*** the already ***hashed-over approach*** that will ***bore you to distraction***. Address the serious and challenging issues--the reward and satisfaction will be much higher ***in the long run***.

Answer the following questions:

- Are local citation standards different from American/European citation standards?
- What is meant by indirect plagiarism?
- What is meant by direct plagiarism?
- What is meant by a field component of a research paper?
- How can you avoid plagiarism in your research paper?

Vocabulary and idiom notes to memorize and use

Presentation format

To *center-justify or left-justify these headings*

To set out the title of the paper, the name of the course, and the name of the paper's author

To be plagued with spelling and syntax ***errors***

Academics

To be checked against other reputable sources

To submit ***prepackaged research papers*** downloaded from the Web

Plagiarism is the act of ***passing*** someone else's work ***off*** as your own

Direct plagiarism

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In the long run

Incomplete noun clauses

Noun clauses are the third type of subordinate clause. They begin with **noun-clause markers.** Noun clauses that are formed from statements begin with the noun-clause marker *that.* Noun clauses formed from *yes/no* questions begin with the noun-clause markers *whether* or *if.* Those formed from information questions begin with *wh-* words: *what, where, when,* and so on.

Examples:

Dr. Hopkins' office is in this building, (statement).

I'm sure *that* Dr. Hopkins' office is in this building.

Is Dr. Hopkins' office on this floor? (yes/no question).

I don't know *if (whether)* Dr. Hopkins' office is on this floor.

Where is Dr. Hopkins' office? (information question).

Please tell me *where* Dr. Hopkins' office is.

Notice that the word order in direct questions is not the same as it is in noun clauses. The noun clause follows statement word order (subject + verb), not question word order (auxiliary + subject + main verb). Often one of the distractors for noun-clause items will incorrectly follow question word order.

Examples:

I don't know what *is her name,* (incorrect use of question word order).

I don't know what *her name is.* (correct word order) *She called him to ask what time *did his party start,* (incorrect use of question word order).

She called him to ask what time *his party started,* (correct word order).

Noun clauses function exactly as nouns do: as subjects, as direct objects, or after the verb *to be.*

Examples:

When the meeting will be held has not been decided, (noun clause as subject).

The weather announcer said *that there will be thunderstorms,* (noun clause as direct object).

This is *what you need,* (noun clause after *to be).*

Notice that when the noun clause is the subject of a sentence the verb in the main clause does not have a noun or pronoun subject.

In structure items, the noun-clause marker, along with any other part of the noun clause—subject, verb, and so on—may be missing from the stem, or the whole noun clause may be missing.

Examples:

was caused by breathing impure air was once a common belief.

(A) Malaria
(B) That malaria
(C) Why malaria
(D) Because malaria

Choice (A) is incorrect because there are two verbs (was caused and was) but only one subject. Choice (C) is incorrect because Why is not the appropriate noun-clause marker in this sentence; the noun clause is based on a statement, not on an information question. Choice (D) is incorrect because it forms an adverb clause, but the main clause lacks a subject. In the correct answer the noun clause

Section 2. GUIDELINES FOR GRAMMAR TEST

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itself (That malaria was caused by breathing impure air) is the subject of the verb was in the main clause.

One basic question psychologists have tried to answer is ___

(A) people learn
(B) how do people learn
(C) people learn how
(D) how people learn

Choice (A) is incorrect; there is no connector between the first clause and the second. Choice (B) incorrectly follows question word order. Choice (C) is incorrect because how is in the wrong position.

Exercise: Choose the one option—(A), (B), (C), or (D)—that correctly completes the sentences, then mark the appropriate blank

1. begin their existence as ice crystals over most of the earth seems likely.

(A) Raindrops
(B) If raindrops
(C) What if raindrops
(D) That raindrops

2. Scientists cannot agree on related to other orders of insects.

(A) that fleas are
(B) how fleas are
(C) how are fleas
(D) fleas that are

3. It was in 1875___ joined the staff of the astronomical observatory at Harvard University.

(A) that Anna Winlock
(B) Anna Winlock, who
(C) as Anna Winlock
(D) Anna Winlock then

Mini-test

Identify and correct errors involving noun clauses

_____both ineffective and hypocritical, doesn't help to promote ideas of linguistic equality and multilingualism in Europe.

A) Language policy in the European Union is
(B) If language policy in the European Union is
(C) When language policy in the European Union is
(D) That language policy in the European Union is

kept up for so long is obvious and clear.

A) Why have these illusions been
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(C) If these illusions have been
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The traditionally superior position of the French in Europe explains _____ of their own linguistic power.
A) what they cannot accept in the decline
(B) that they cannot accept the decline
(C) how they cannot accept the decline
(D) whether they cannot accept the decline

_____1_____of some sociolinguists, _____2_____the idea of English as a European lingua franca

1
(A) There is the politically-correct ideologies
(B) It is the politically-correct ideologies
(C) What are the politically-correct ideologies
(D) The politically-correct ideologies

2
A) constantly fuel opposition against
(B) that constantly fuel opposition against
(C) what if constantly fuel opposition against
(D) because they constantly fuel opposition against

(C) What if raindrops
(D) That raindrops

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Section 1. GUIDELINES FOR ACADEMIC COMMUNICATION

What is an abstract?

Instruction: These are guidelines for abstract writing which usually pose another big problem for young researchers who are writing their first articles. This is an adaptation of several texts placed in the Internet without copyright limitations. You are sure to realize that the quantity of scholarly articles published daily in your field is so huge that the only way to limit your search is to feed key words into a search system. An abstract is the right format to help you not to get list in the infinity of information. On reading and understanding the following text your purpose will be to acquire the standard guidelines along which an abstract is written. This will be your goal as an academic writer. Moreover your goal as an examinee will be to get ready to present the ideas through the vocabulary that you acquire in this section at your English candidate exam.

Part 1. Definition

An abstract is ***a condensed version*** of a longer piece of writing that ***highlights*** the major points covered, ***concisely describes*** the content and scope of the writing, and ***reviews*** the writing's contents in ***abbreviated*** form.

Abstracts are short statements that briefly summarize an article or scholarly document. Abstracts are like ***the blurbs*** on the back covers of novels. They entice someone to read further. With an abstract, you have to prove why reading your work ***is worthwhile***.

What types of abstracts are generally used?

Two types of abstracts are generally used:

Descriptive Abstracts

- tell readers what information the report, article, or paper contains.
- include the purpose, methods, and scope of the report, article, or paper.
- do **not** provide results, conclusions, or recommendations.
- are always very short, usually under 100 words.
- introduce the subject to readers, who must then read the report, article, or paper to find out the author's results, conclusions, or recommendations.

Informative Abstracts

- communicate specific information from the report, article, or paper.
- include the purpose, methods, and scope of the report, article, or paper.
- provide the report, article, or paper's results, conclusions, and recommendations.
- are short -- from a paragraph to a page or two, depending upon the length of the original work being abstracted. Usually informative abstracts are 10% or less of the length of the original piece.
- allow readers to decide whether they want to read the report, article, or paper.

Unit 17

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Informative Abstracts

- communicate specific information from the report, article, or paper.
- include the purpose, methods, and scope of the report, article, or paper.
- provide the report, article, or paper's results, conclusions, and recommendations.
- are short -- from a paragraph to a page or two, depending upon the length of the original work being abstracted. Usually informative abstracts are 10% or less of the length of the original piece.
- allow readers to decide whether they want to read the report, article, or paper.

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All abstracts include:
- A full ***citation of the source***, preceding the abstract.
- The most important information first.
- The same type and style of language found in the original, including technical language.
- Key words and phrases that quickly identify the content and focus of the work.
- Clear, concise, and powerful language.

Why are abstracts so important?

The practice of using key words in an abstract is vital because of today's electronic information ***retrieval systems***. Titles and abstracts are filed electronically, and key words are put in electronic storage. When people search for information, they enter key words related to the subject, and the computer prints out the titles of articles, papers, and reports containing those key words. Thus, an abstract must contain key words about what is essential in an article, paper, or report so that someone else can retrieve information from it.

Things You'll Need: Computer, Word Processor

Answer the following questions:

- Do you agree with the definition given above? Or would you like to add or take out anything?
- What are the generally used types of abstracts?
- How can you characterize the type of abstract you generally use?
- Why are abstracts so important?
- What do abstracts include?

Prepare a 2 minute story about the guidelines of writing a good abstract.

Part 2. Qualities of a Good Abstract

An effective abstract has the following qualities:

uses one or more ***well-developed paragraphs***: these are unified, coherent, concise, and able to stand alone.

uses an introduction/body/conclusion structure which presents the article, paper, or report's purpose, results, conclusions, and recommendations in that order.

follows strictly the chronology of the article, paper, or report.

provides logical connections (or transitions) between the information included.

adds **no** new information, but simply summarizes the report.

is understandable to a wide audience.

oftentimes uses passive verbs ***to downplay the author*** and emphasize the information. Check with your teacher if you're unsure whether or not to use the Passive Voice.

Parts of an Abstract

Despite the fact that an abstract is quite brief, it must do almost as much work as the multi-page paper that follows it. In a computer architecture paper,

All abstracts include:
- A full ***citation of the source***, preceding the abstract.
- The most important information first.
- The same type and style of language found in the original, including technical language.
- Key words and phrases that quickly identify the content and focus of the work.
- Clear, concise, and powerful language.

Why are abstracts so important?

The practice of using key words in an abstract is vital because of today's electronic information ***retrieval systems***. Titles and abstracts are filed electronically, and key words are put in electronic storage. When people search for information, they enter key words related to the subject, and the computer prints out the titles of articles, papers, and reports containing those key words. Thus, an abstract must contain key words about what is essential in an article, paper, or report so that someone else can retrieve information from it.

Things You'll Need: Computer, Word Processor

Answer the following questions:

- Do you agree with the definition given above? Or would you like to add or take out anything?
- What are the generally used types of abstracts?
- How can you characterize the type of abstract you generally use?
- Why are abstracts so important?
- What do abstracts include?

Prepare a 2 minute story about the guidelines of writing a good abstract.

Part 2. Qualities of a Good Abstract

An effective abstract has the following qualities:

uses one or more ***well-developed paragraphs***: these are unified, coherent, concise, and able to stand alone.

uses an introduction/body/conclusion structure which presents the article, paper, or report's purpose, results, conclusions, and recommendations in that order.

follows strictly the chronology of the article, paper, or report.

provides logical connections (or transitions) between the information included.

adds **no** new information, but simply summarizes the report.

is understandable to a wide audience.

oftentimes uses passive verbs ***to downplay the author*** and emphasize the information. Check with your teacher if you're unsure whether or not to use the Passive Voice.

Parts of an Abstract

Despite the fact that an abstract is quite brief, it must do almost as much work as the multi-page paper that follows it. In a computer architecture paper,

this means that it should in most cases include the following sections. Each section is typically a single sentence, although there is ***room for creativity***. In particular, the parts may be merged or spread among a set of sentences. Use the following as a checklist for your next abstract:

Motivation:
Why do we care about the problem and the results? If the problem isn't obviously «interesting» it might be better to put motivation first; but if your work is incremental progress on a problem that is widely recognized as important, then it is probably better to put the problem statement first to indicate which piece of the larger problem you are ***breaking off*** to work on. This section should include the importance of your work, the difficulty of the area, and the impact it might have if successful.

Problem statement:
What *problem* are you trying to solve? What is the *scope* of your work (a generalized approach, or for a specific situation)? Be careful not to use too much jargon. In some cases it is appropriate to put the problem statement before the motivation, but usually this only works if most readers already understand why the problem is important.

Approach:
How did you go about solving or ***making progress on the problem***? Did you use simulation, analytic models, prototype construction, or analysis of field data for an actual product? What was the ***extent of your work*** (did you look at one application program or a hundred programs in twenty different programming languages?) What important *variables* did you control, ignore, or measure?

Results:
What's the answer? Specifically, most good computer architecture papers conclude that something is so many percent faster, cheaper, smaller, or otherwise better than something else. Put the result there, in numbers. Avoid vague, ***hand-waving results*** such as «very», «small», or «significant.» If you must be vague, you ***are only given license to do so*** when you can talk about ***orders-of-magnitude improvement***. There is a tension here in that you should not provide numbers that can be easily misinterpreted, but on the other hand you don't have ***room for all the caveats***.

Conclusions:
What are the implications of your answer? Is it going to change the world (unlikely), ***be a significant «win», be a nice hack, or simply serve as a road sign indicating that this path is a waste of time*** (all of the previous results are useful). Are your results *general*, potentially generalizable, or specific to a particular case?

Answer the following questions:
- Do you agree that the qualities listed above are absolutely necessary?
- Do you always pursue these qualities in your abstracts??

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Answer the following questions:
- Do you agree that the qualities listed above are absolutely necessary?
- Do you always pursue these qualities in your abstracts??

- What are parts of an abstract?
- Did you know all these things about abstracts before?
- If you did, who told you first? Or did you acquire this knowledge by probe and error experience?

Vocabulary and idiom notes for discussing abstracts

Condensed = concise = abbreviated

To highlight = to describe = to review

Scholarly document — relating to science and/or academe, scientific, academic

Blurbs on the back cover of a novel

To be worthwhile

Citation of the source

Retrieval system

Well-developed paragraphs

Oftentimes = often

To downplay the author

Room for creativity

To break off = to separate, to single out

To make progress on the problem

Extent of one's work

Hand-waving results = vague, indefinite

To be given license to do = to be allowed to do

Orders-of-magnitude improvement.

Room for caveats = room for caution, warning

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Room for caveats = room for caution, warning

Errors with incomplete phrases

Incomplete participial phrases

Participial phrases generally occur after nouns. They are actually **reduced** (shortened) **relative clauses. Present participles** (which always end in *-ing)* are used to reduce adjective clauses that contain active verbs.

Example:

The Crimea, *which joined Ukraine in 1954,* became a Ukrainian oblast, (adjective clause with active verb) The Crimea, *joining Ukraine in 1954,* became a Ukrainian oblast, (participial phrase with a present participle).

Most **past participles** end in *-ed,* but there are also many irregular forms. Past participles are used to reduce adjective clauses with passive verbs.

Example:

Tavrida National University, *which was founded in 1918,* is the oldest university in the Crimea, (adjective clause with a passive verb).

Tavrida National University, *founded in 1918,* is the oldest university in the Crimea, (participial phrase with a past participle)

Participial phrases can also come before the subject of a sentence.

Examples:

Joining Ukraine in 1954, The Crimea became a Ukrainian oblast.

Founded in 1918, Tavrida National University is the oldest university in the Crimea,

Usually, the participle itself is missing from this type of structure item, but any part of a participial phrase as well as parts of a main clause may be missing.

Example:

Natural resources provide the raw materials___to produce finished goods

(A) needed, (B) are needed, (C) which need, (D) needing

Option (B) is a passive verb; the sentence cannot contain two main verbs *{are needed and provide)* in the same clause. Choice (C) creates an adjective clause, but the verb in the clause is active and a passive verb is needed. (However, a relative clause with a passive verb *{which are needed)* would be a correct answer. Choice (D) is a present participle and has an active meaning; a past participle is needed.

Incomplete appositives

An appositive is a noun phrase that explains or rephrases another noun phrase. It usually comes after the noun that it rephrases. It may also come before the subject of a sentence.

Example:

Yuri Nikulin, *a famous actor and clown,* operated his own Circus Show, (appositive following a noun).

A famous actor and clown, Yuri Nikulin operated his own Circus Show, (appositive before the subject).

Appositives are actually reduced adjective clauses that contain the verb *to be.* However, unlike adjective clauses, they do not contain a marker or a verb.

Section 2. GUIDELINES FOR GRAMMAR TEST

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Example:

Oak, *which is one of the most durable hard woods,* is often used to make furniture, (adjective clause).

Oak, *one of the most durable hard woods,* is often used to make furniture, (appositive).

Appositives are usually separated from the rest of the sentence by commas, but short appositives (usually names) are not.

Example:

Economist *Paul Samuelson* won a Nobel Prize in 1970.

In a test sentence, all or part of an appositive phrase may be missing. In addition, the noun that the appositive refers to or other parts of the main clause may be missing.

Example:

The Trolleybus Road, of the first such roads in Europe, connected Simferopol airport to Yalta. (A) which one, (B) it was one, (C) one, (D) was one

Choice (A) is incorrect; there is no verb in the relative clause. Choice (B) has no connecting word to join the clause to the rest of the sentence. Choice (D) is incorrect because a verb cannot be used in an appositive phrase. Note: *which was one* would also be a correct answer for this problem.

Incomplete/missing prepositional phrase

A prepositional phrase consists of a **preposition** *(in, at, with, for, until,* and so on) followed by a noun or a pronoun, which is called the **prepositional object.** Prepositional phrases often describe time and location, among others.

Examples:

In autumn maple leaves turn red.

Gaitshill is one of the most famous neighborhoods *in Boston*.

After that, there won't be any more problems.

The house was built *by John's grandfather.*

Prepositional phrases come at the beginning of sentences, but they may appear in other parts as well.

Remember, the preposition cannot correctly be the subject of a sentence, as in these examples:

In autumn is my favorite season.

Without a *pencil* is no way to come to a test.

Prepositional phrases with the same meaning as adverb clauses

There are also certain prepositions that have essentially the same meaning as adverb-clause markers but are used before noun phrases or pronouns, not with clauses.

Examples:

He chose that university *because of* its fine reputation. (because/since it has fine reputation).

The accident was *due to* mechanical failure. (because/since there was mechanical falure).

Visibility is poor today *on account of* air pollution. (because/since there is air pollution).

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He enjoys motorcycle riding *in spite of* the danger. (although/even though it is dangerous).

Despite its loss, the team is still in first place. (although/even though it has lost).

Her father lived in England *during* the war. (when/while there was the war).

In a sentence where the correct answer is an adverb-clause marker, one of these words often appears as a distractor

Examples:

1. No one knows what color dinosaurs were____no sample of their skin has survived.

(A) because of
(B) because that
(C) it is because
(D) because

Choice (A) is incorrect; because of can only be used before nouns or pronouns. In choice (B), that is unnecessary. In (C), the phrase it is used unnecessarily.

2. ____rises to the surface of the Earth, a volcano is formed.

(A) Liquid magma
(B) Whenever liquid magma
(C) Liquid magma, which
(D) That liquid magma

Choice (A) creates two clauses, but there is no connecting word to join them. Choice (C) creates a sentence with a main clause and an adjective clause, but the main clause has two subjects (liquid magma and a volcano). Choice (D) creates a noun clause. In a correct sentence, when a noun clause opens a sentence, the clause itself is the subject of the verb in the main clause, but this sentence already has a subject [volcano].

3. invisible to the unaided eye, ultraviolet light can be detected in a number of ways.

(A) Although is
(B) Despite
(C) Even though it
(D) Although

The best answer completes a reduced adverb clause. In choice (A), the adverb clause lacks a subject and is not a correct reduction because it contains a verb. In choice (B), despite cannot be used with an adjective (only with a noun phrase or a pronoun). Choice (C) does not supply a verb for the adverb clause and is not a correct reduction because it contains a subject.

4. Because alabaster can be easily carved.

(A) is soft
(B) softness
(C) of its softness
(D) of soft

Choice (A) lacks a subject in the adverb clause. Choice (B), a noun, could only be used with because of. In (D), because of is followed by an adjective; to be correct, it must be followed by a noun phrase or a pronoun.

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Mini-test

Identify and correct errors involving incomplete phrases

_____1_____in the name of the high ideal of linguistic equality, a time-consuming, and expensive translation machinery is maintained 2 to translate the illusion of equality into illusions of multilingualism.

1

(A) Despite powerful translators' lobbies fight
(B) Fghting powerful translators' lobbies
(C) Powerful translators' lobbies are fighting
(D) Powerful translators' lobbies fighting

2

(A) that is doing its best
(B) it is doing its best
(C) even thoughit is doing its best
(D) doing its best

The translations are taken as tokens for equality:

(A) what are produced in the world's largest translation bureau
(B) produced in the world's largest translation bureau
(C) producing in the world's largest translation bureau
(D) while produced in the world's largest translation bureau

No one can tell _____than ability to read the more reliable English and French originals.

(A) that the process of translation counts more
(B) though the process of translation counts more
(C) why the process of translation counts more
(D) why counts more the process of translation

_____1____in the EU is a relative one: some languages are _____2____

1

(A) The supposed linguistic equality
(B) Although the supposed linguistic equality
(C) Because the supposed linguistic equality
(D) Linguistic equality as supposed

2

(A) clearly more equal than others
(B) clearly more equal before others
(C) more clearly equal as others
(D) more clearly than others equal

Minority languages do not count at all.

(A) to use inside the member states
(B) inside the member states
(C) are used inside the member states
(D) there are inside the member states

these articles do not contain any valuable information.

(A) Though easily accessible for an Internet user
(B) Although it is easily accessible for an Internet user
(C) Despite easily accessible for an Internet user

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these articles do not contain any valuable information.

(A) Though easily accessible for an Internet user
(B) Although it is easily accessible for an Internet user
(C) Despite easily accessible for an Internet user

(D) Even though it easily accessible for an Internet user

.No one knows what race the Incas were no one of these people has survived.

(A) because of

(B) because that

(C) it is because

(D) because

John Glenn, , became a national hero immediately after his flight.

(A)he was the first American astronaut

(B) who was the first American astronaut

(C) the first American astronaut

(D) being the first American astronaut

(D) Even though it easily accessible for an Internet user

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Section 1. GUIDELINES FOR ACADEMIC COMMUNICATION

Steps for Writing Effective Abstracts

Instruction: Below are the guidelines for abstract writing continued. This is an adaptation of several texts placed in the Internet without copyright limitations. You are sure to realize that to write a good abstract you will have to gain experience of using all steps recommended in this unit. Your abstract must be in the right format to meet necessary requirements. On following the given steps and writing a good abstract your purpose is not only to acquire the standard guidelines along which an abstract is written but also to get ready to discuss abstract writing skills at your English candidate exam.

Part 1. Follow These Steps

Reread the article, paper, or report ***with the goal of abstracting in mind***.
Review your original article.
Outline its main themes and highlights to use for your abstract.
Look specifically for these main parts of the article, paper, or report: purpose, methods, scope, results, conclusions, and recommendation.
Re-read your original article and try ***to pinpoint*** any concepts you could use as keywords for an Internet search. Headings, titles or table of contents are usually good sources of keywords.
Use the headings, outline heads, and table of contents as a guide to writing your abstract.
If you're writing an abstract about another person's article, paper, or report, the introduction and the summary are good places to begin. These areas generally cover what the article emphasizes.
Write a rough draft.
After you've finished rereading the article, paper, or report, write a rough draft ***without looking back at*** what you're abstracting.
Summarize the article using new words.
Don't copy and paste from the original! This rough draft should be longer than your finished product so you can delete unnecessary words. Let yourself ***brainstorm*** while you edit.
Write an introductory sentence. This will be a statement of purpose for your article. It should introduce your central concept.
Write the body. This will be a brief description of ***the subject matter***, roughly one or two paragraphs.
Embed keywords into the first 20 words of the body. Make them inconspicuous so they don't break the reader's concentration.
Write a one or two sentence conclusion. This should entice someone to read more.
Edit and revise your abstract as needed. It is best ***to let a day pass before*** you return to it with fresh eyes. Edit unnecessary words. Be sure you clearly present your main points.

Unit 18

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Re-read your original article and try ***to pinpoint*** any concepts you could use as keywords for an Internet search. Headings, titles or table of contents are usually good sources of keywords.
Use the headings, outline heads, and table of contents as a guide to writing your abstract.
If you're writing an abstract about another person's article, paper, or report, the introduction and the summary are good places to begin. These areas generally cover what the article emphasizes.
Write a rough draft.
After you've finished rereading the article, paper, or report, write a rough draft ***without looking back at*** what you're abstracting.
Summarize the article using new words.
Don't copy and paste from the original! This rough draft should be longer than your finished product so you can delete unnecessary words. Let yourself ***brainstorm*** while you edit.
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Don't merely copy key sentences from the article, paper, or report: you'll put in too much or too little information.

Don't rely on the way material was phrased in the article, paper, or report: summarize information in a new way.

Revise your rough draft to correct weaknesses in organization:
improve ***transitions from point to point***,
drop unnecessary information,
add important information you left out,
eliminate wordiness,
fix errors in grammar, spelling, and punctuation.
Print your final copy and read it again to catch any glitches that you find.

Tips and Warnings

Embed keywords into the first 20 words of your abstract. This will make it visible to the major Internet search engines if you publish online.

Emphasize the information, not the author, unless the author has ***noteworthy credentials***.

Never introduce new information in the abstract. Reveal what's in the article.

Read it aloud to yourself or to a friend.

Make sure it sounds natural and coherent.

Keep it short — stick to one or two solid paragraphs/

Vocabulary and idiom notes for discussing abstracts

With the goal of doing smth
To abstract in mind
Without looking back at
.Let yourself ***brainstorm***
The subject matter
To let a day pass before you do smth
Transitions from point to point
Fix errors in grammar
Noteworthy credentials

Do the following tasks:

• Take any short (5-10 pages) Ukrainian/Russian language article. If it is preceded with an abstract, forget it. It would be best if you take your own new article.

• Prepare an abstract (in Ukrainian/Russian) diligently following all the steps given above.

Prepare a 2 minute story (in English) about the steps you have had to pass while preparing your abstract.

Part 2. Sample Science Abstracts

Read the following sample abstracts and select the one or the ones you like best. In the end of the Unit **Vocabulary and Idiom for Abstract Writing** offers words and phrases you re recommended to use while writing abstracts for your own articles.

Don't merely copy key sentences from the article, paper, or report: you'll put in too much or too little information.

Don't rely on the way material was phrased in the article, paper, or report: summarize information in a new way.

Revise your rough draft to correct weaknesses in organization:
improve ***transitions from point to point***,
drop unnecessary information,
add important information you left out,
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Luis Lehner, Ph.D. University of Pittsburgh, 1998. DAI-B 59/06. 279 p., Dec 1998

Abstract:

The problem of detecting gravitational radiation **is receiving considerable attention with the construction of** new detectors in the United States, Europe, and Japan. **The theoretical modeling of** the wave forms that would be produced in particular systems **will expedite the search for and analysis of** detected signals. **The characteristic formulation of** GR is **implemented to obtain** an algorithm capable of evolving black holes in 3D asymptotically flat spacetimes. **Using compactification techniques**, future null infinity **is included in** the evolved region, **which enables the unambiguous calculation of** the radiation produced by some compact source. **A module to calculate** the waveforms **is constructed and included in** the evolution algorithm. **This** code **is shown to be** second-order convergent **and to handle** highly non-linear spacetimes. **In particular, we have shown that** the code can handle spacetimes whose radiation is equivalent to a galaxy converting its whole mass into gravitational radiation in one second. **We further use the characteristic formulation to treat** the region close to the singularity in black hole spacetimes. The code carefully excises a region surrounding the singularity and accurately evolves generic black hole spacetimes with apparently unlimited stability.

Key words: gravitational radiation (GR), spacetimes, black holes.

2. Chemistry of acetyl transfer by histone modifying enzymes: structure, mechanism and implications for effector design

S C. Hodawadekar and R. Marmorstein

The Wistar Institute and The Department of Chemistry, University of Pennsylvania, Philadelphia, PA, USA

Abstract:

The post-translational modification of histones **plays an important role in** chromatin regulation, **a process that insures the fidelity of** gene expression and other DNA transactions. Of the enzymes that mediate post-translation modification, the histone acetyltransferase (HAT) and histone deacetylase (HDAC) proteins that add and remove acetyl groups to and from target lysine residues within histones, **respectively, have been the most extensively studied at both the functional and structural levels. Not surprisingly,** the aberrant activity of several of these enzymes **have been implicated in** human diseases such as cancer and metabolic disorders, thus making them important drug targets. **Significant mechanistic insights into the function of** HATs and HDACs have come from the X-ray crystal structures of these enzymes **both alone and in liganded complexes**, **along with** associated enzymatic and biochemical studies. **In this review, we will discuss what we have learned from** the structures and related biochemistry of HATs and HDACs and **the implications of these findings for** the design of protein effectors to regulate gene expression and treat disease.

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Abstract:
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4. Cooperation in Games with Forgetfulness
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UCLA Anderson School of Management, University of California, Los Angeles, Los Angeles, California 90095

Abstract:
Companies and managers **are apt to** forget information, yet **classic** game theory **analysis assumes that** all players **have perfect recall**. **This paper expands the literature by examining how** introducing forgetfulness into a multiplayer game-theoretic framework **can help or hinder** cooperative behavior. **We find that** forgetfulness **impacts the ability of** firms **to cooperate in countervailing directions**. **On one hand**, forgetfulness **can diminish the ability to** punish deviators, **making** cooperation **more difficult**. **On the other hand, under some conditions** forgetfulness **can make meting out** severe punishments—**even below-**(stage) **minimax** punishments—**credible** and **decrease the ability for** players **to** effectively deviate, **facilitating** cooperation **even in circumstances where** cooperation **cannot be sustained** under perfect recall. **We apply our model to a number of** strategic games that **commonly appear in the literature.**
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5. THE SOCIAL-PSYCHOLOGICAL OUTCOMES OF MARTIAL ARTS PRACTISE AMONG YOUTH: A REVIEW

Jikkemien Vertonghen and Marc Theeboom
Vrije Universiteit Brussel, Belgium

Abstract:

Martial arts involvement among the youth **has been described in controversial terms**. **Studies regarding the effects of** martial arts practise on youth **show** contrasting images. **While some refer to** enhanced personal and social opportunities for those that participate, **others warn against** increased levels of aggressiveness and antisocial behavior among its participants. **The aim of the present review is to provide, firstly, an overview of the major findings of studies concerning** the social-psychological outcomes of martial arts practise. **Secondly**, **the limitations of those studies are discussed. From more than 350 papers, collected during a two-year lasting literature study, 27 papers met all criteria to be included in this study**. **This review revealed that even though a considerable amount of research on** social-psychological **outcomes of** martial arts practise **has been conducted over the years**, **to date**, **it has not brought clarity in** the existing duality **regarding the possible effects of** martial arts involvement. **It is proposed that a better understanding can be provided if specific influential factors are taken into account in future research** (i.e., participants' characteristics, type of guidance, social context and structural qualities of the sport).

Key words: Martial arts, youth, personality traits.

6. Psychology as a Social Science

Nikolas Rose
London School of Economics and Political Science, London, UK

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This paper describes the social role of psychology as it took shape across the 20th century, **and argues** that it was, **in large part**, this social vocation that **provided the conditions for** psychology **establishing itself as an academic discipline**. **The development of** psychology in this period **was bound up with changes in the understanding** and treatment of distress, conceptions of normality and abnormality, techniques of regulation, normalization, reformation and correction; on child rearing and education, advertising, marketing and consumption technologies and the management of human behaviour in practices from the factory to the military. Psychological languages **entered common sense and professional discourse across** Europe and North America, in Australasia, in Latin America **and in many other countries.** Human beings **came to understand** themselves as inhabited by a deep interior psychological space, **to evaluate themselves and to act upon themselves and others in terms of this belief**. As we enter the 21st century, the deep psychological space that opened within us is beginning to flatten out, and our discontents are being mapped directly onto the brain. Will the 21st century still be the century of psychology?

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Keywords: normality, abnormality, individuality, group, attitudes, genealogy.

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Errors in word order

Most word order errors consist of two words in reverse order. Some of the most common examples of this type of error are given below.

Examples:

Goods such as flowers fresh and seafood are often shipped by air. The adjective *fresh* must come before the noun *flowers: fresh flowers.*

Visitors to Vancouver often comment on how beautiful its setting is and on how clean is it. The correct word order is subject + verb: *it is*

You may encounter errors with either **correlative conjunctions** or **coordinate conjunctions.**

All of the answer choices for a structure item involving **word order** contain more or less the same words, but they are arranged in four different orders. The word order is «scrambled» in three choices; one direct. Most items consist of three or four words.

(A) XYZ
(B) YXZ
(C) ZYX
(D) XZY

Word order problems are easy to identify because the answer choices are exactly—or almost :exactly—the same length, so the answer choices form a rectangle.

Examples:

Andromeda is a galaxy containing millions of individual stars, but it is____Earth that it looks like a blurry patch of light.

(A) so far away from
(B) away so far from
(C) from so far away
(D) away from so far

Only choice (A) involves the correct word order for this sentence. Choices (B) and (D) are incorrect word orders in any sentence. Choice (C) could be correct in certain sentences, but is not correct in the context of this sentence.

Alaska is sutuated the rest of the US that it takes three hours to go from Anchorage to Seattle by air.

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The correct choice is (A).

Many different types of structures are used in word order problems. One of the most common is a use with a superlative adjective or adverb.

Word order items are the only sentence structure items in which the distractors can be ungrammatical. In sentence structure problems, distractors are always correct in some context. However, at least two of the sentences may be grammatical. The correct choice depends on the context of the sentence.

It sometimes is easy to eliminate distractors in word order items by making sure they «fit» with the type of the sentence. If you are not sure which remaining answer is correct, use your «ear.» Say the :sentence to yourself (silently) to see

Section 2. GUIDELINES FOR GRAMMAR TEST

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which sounds best. Sometimes in word order problems, the answer which looks best doesn't always sound best. Don't, however, go just by the sound of the answer choices; you must consider them as part of the whole sentence.

A special type of word order problem involves inversions. This type of sentence uses question word order even though the sentence is not a question. When are inversions used?

When the negative words listed below are placed at the beginning of a clause for emphasis. E.g.:

not only, not until, not once, at no time, by no means, nowhere
never, seldom, rarely scarcely, no sooner

Examples:

Not only shade and beauty, but they also reduce carbon dioxide.
(A) do trees provide
(B) trees provide
(C) provide trees
(D) trees do provide

Only choice (A) correctly uses question word order after not only. Choices (B) and (C) do not use an auxiliary verb, which is required after not only. Choice (D) does not follow the correct word order: auxiliary + adjective + main verb

Not once *was he* on time.
Seldom *have I heard* such beautiful music.
Not only *did the company* lose profits, but it also had to lay off workers.

When the following expressions beginning with *only* occur **at the beginning of a sentence** (with these expressions, the subject and verb **in that clause** are inverted):

only in (on, at, by, etc.), only once, only recently

Examples:

Only in an emergency *should you use* this exit.
Only recently *did she return* from abroad.

When the following expressions beginning with *only* occur **at the beginning of a sentence** (with these expressions, the subject and verb **of the second clause** are inverted):

only if, only when, only because, only after, only until

Examples:

Only if you have a serious problem *should you* call Mr. Franklin at home.
Only when you are satisfied *is the sale* considered final.

When clauses beginning with the word so + an adjective or participle occur at the beginning of a sentence

Examples:

So rare *is this coin* that it belongs in a museum.
So confusing *was the map* that we had to ask a police officer for directions.

When clauses beginning with expressions of place or order occur at the beginning of a sentence (in these cases, the subject and main verb are inverted since auxiliary verbs are not used as they would be in most questions)

Examples:

In front of the museum *is a statue.*
Off the coast of California *lie the Channel Islands.*
First *came a police car,* then *came an ambulance.*

which sounds best. Sometimes in word order problems, the answer which looks best doesn't always sound best. Don't, however, go just by the sound of the answer choices; you must consider them as part of the whole sentence.

A special type of word order problem involves inversions. This type of sentence uses question word order even though the sentence is not a question. When are inversions used?

When the negative words listed below are placed at the beginning of a clause for emphasis. E.g.:

not only, not until, not once, at no time, by no means, nowhere
never, seldom, rarely scarcely, no sooner

Examples:

Not only shade and beauty, but they also reduce carbon dioxide.
(A) do trees provide
(B) trees provide
(C) provide trees
(D) trees do provide

Only choice (A) correctly uses question word order after not only. Choices (B) and (C) do not use an auxiliary verb, which is required after not only. Choice (D) does not follow the correct word order: auxiliary + adjective + main verb

Not once *was he* on time.
Seldom *have I heard* such beautiful music.
Not only *did the company* lose profits, but it also had to lay off workers.

When the following expressions beginning with *only* occur **at the beginning of a sentence** (with these expressions, the subject and verb **in that clause** are inverted):

only in (on, at, by, etc.), only once, only recently

Examples:

Only in an emergency *should you use* this exit.
Only recently *did she return* from abroad.

When the following expressions beginning with *only* occur **at the beginning of a sentence** (with these expressions, the subject and verb **of the second clause** are inverted):

only if, only when, only because, only after, only until

Examples:

Only if you have a serious problem *should you* call Mr. Franklin at home.
Only when you are satisfied *is the sale* considered final.

When clauses beginning with the word so + an adjective or participle occur at the beginning of a sentence

Examples:

So rare *is this coin* that it belongs in a museum.
So confusing *was the map* that we had to ask a police officer for directions.

When clauses beginning with expressions of place or order occur at the beginning of a sentence (in these cases, the subject and main verb are inverted since auxiliary verbs are not used as they would be in most questions)

Examples:

In front of the museum *is a statue.*
Off the coast of California *lie the Channel Islands.*
First *came a police car,* then *came an ambulance.*

Mini-test

Identify and correct errors involving word order

It is said that
(A) from the Pacific the first refugees of climate change will come.
(B) the first refugees of climate change from the Pacific will come.
(C) the first will come refugees of climate change from the Pacific.
(D) the first refugees of climate change will come from the Pacific.

In the midst of this ocean's tropical regions _____1_____ populated continents _____2_____, 8,000 of them inhabited.

1
(A) far away from
(B) away so far from
(C) from so far away
(D) away from so far

2
(A) small 50,000 islands are scattered
(B) are scattered 50,000 small islands
(C) 50,000 small islands are scattered
(D) scattered are 50,000 small islands

to the impacts of global warming.
(A) Particularly vulnerable they are
(B) Particularly vulnerable are they
(C) They are particularly vulnerable
(D). Vulnerable they are particularly

_____1_____ behind this fresh water lens formation on a coral island, IRD and its partners studied the structure and such parameters 2 .

1
(A) With the objective of understanding the processes
(B) To objectively understand the processes
(C) Understanding the processes with the objective of
(D). Should they understand the processes objectively

2
(A) as the the reservoir geometry of flow rates
(B) as the geometry of the reservoir and flow rates
(C) like the geometry of the reservoir and flow rates
(D) as the reservoir and flow rates geometry

in coastal and island reservoirs
(A) Unstable is the balance …….
(B) The balance unstable is ……
(C) Between fresh water and salt water the balance is unstable …….
(D) The balance between freshwater and salt water ……. is unstable

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Dissertations: Conducting Research

Instruction: These are guidelines for conducting a dissertation which usually pose a big problem for post graduate students. This is an adaptation of a text placed in the Internet without copyright limitations. You are sure to realize that, no matter how advanced you are in your field or how novel and promising your ideas might be for your research, it will take too much time for you to achieve your goal because of your failure to demonstrate your achievements in the selected field. On reading and understanding the following text your purpose will be to verify what you know about the standard guidelines of writing a dissertation. This will be your goal as a competitor for the candidate degree. However your goal as an examinee is to get ready to present these guidelines employing the vocabulary that you acquire in this section at your English candidate exam.

Writing a dissertation in your field is similar to writing a scientific report, in which the ***main goal is the demonstration of acquired knowledge in a selected field***. The research in dissertations is a difficult aspect as your field of science has many diverse directions.

Despite ***the diversity of subjects***, there are accepted methodological approaches in writing dissertations. This article will provide a guide on the important elements of dissertations, and the way they can be approached.

The Steps in Dissertations

The common steps that can be identified through the process of writing a dissertation are as follows:

Identifying a research problem — such step in dissertations implies asking questions regarding an identified problem, considering ***the feasibility of them being answered***.

A literature review - A review of literature will indicate ***the gaps in specific knowledge*** in the selected field. It should be highlighted that in terms of division to sections, it can be stated that the literature review is one of the largest sections in dissertations, serving two purposes, i.e. demonstrating the accumulated knowledge and identifying the gaps in it.

Formulating a hypothesis — basically, hypotheses are the assumptions made through the preliminary investigation. One or more are selected as the basis of the dissertation, and which are tested in the study.

Data collection — according to the established hypothesis, the type of data to be collected will be determined. At the same time, the nature of the requested data will require assessing the most effective ***methods of its collection***, e.g. quantitative or qualitative data. ***Accordingly,*** several aspects should be determined in dissertations such as the samples, the body of data, and the appropriate method of data measurement.

Unit 19

Section 1. GUIDELINES FOR ACADEMIC COMMUNICATION

Dissertations: Conducting Research

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Analysis of findings and presentation results.

Useful Tips:

The «thinking about it stage» is when you are finally ***faced with the reality of completing your degree***. Usually the early phases of a graduate program proceed in clear and very structured ways. The beginning phases of a graduate program proceed in much the same manner as an undergraduate degree program. There are clear requirements and expectations, and the graduate student moves along, step by step, getting ever closer to the completion of the program.

One day, however, the clear structure begins to diminish and now you're approaching the thesis/dissertation stage. This is a new and different time. These next steps are more and more defined by **you** and not your adviser, the program, or the department.

Be realistic about the time that you're willing to commit to your research project. If it's a 10 year project that you're thinking about admit it at the beginning and then decide whether or not you have 10 years to give to it. If the project you'd like to do is going to demand more time than you're willing to commit then you have a problem.

Research proposal. Assuming you've done a good job of «thinking about» your research project, you're ready to actually prepare ***the proposal***. ***A word of caution*** - those students who tend to have ***a problem in coming up with a viable proposal*** often are the ones that have tried to ***rush through the «thinking about it» part*** and move too quickly to trying to write the proposal. Here's a final check. Do each of these statements describe you? If they do you're ready to prepare your research proposal.

I am **familiar** with other research that has been conducted in areas related to my research project.

(___Yes, it's me)
(___No, not me)

I have a clear **understanding** of the steps that I will use in conducting my research.

(___Yes, it's me)
(___No, not me)

I feel that I have the **ability** to get through each of the steps necessary to complete my research project.

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I know that I am **motivated** and have *the **drive** to get through all* of the steps in the research project.

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Writing a dissertation. The major myth in writing a dissertation is that you start writing at Chapter One and then finish your writing at Chapter Five. This is seldom the case. The most productive approach in writing the dissertation is to **begin writing those parts of the dissertation that you are most comfortable with.**

Then move about in your writing by completing various sections as you think of them. At some point you will be able to spread out in front of you all of

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the sections that you have written. You will be able to sequence them in the best order and then see what is missing and should be added to the dissertation. This way seems to make sense and builds on those aspects of your study that are of most interest to you at any particular time. Go with what interests you, start your writing there, and then keep building!

Review two or three well organized and presented dissertations. Examine their use of headings, overall style, typeface and organization. Use them as a model for the preparation of your own dissertation. In this way you will have an idea at the beginning of your writing what your finished dissertation will look like. A most helpful perspective!

A simple rule - if you are presenting information in the form of a table or graph **make sure you introduce the table or graph in your text.** And then, following the insertion of the table/graph, make sure you discuss it. If there is nothing to discuss then you may want to question even inserting it.

Another simple rule - **if you have a whole series of very similar tables try to use similar words in describing each.** Don't try and be creative and entertaining with your writing. If each introduction and discussion of the similar tables uses very similar wording then the reader can easily spot the differences in each table.

We are all familiar with how helpful the Table of Contents is to the reader. What we sometimes don't realize is that it is also invaluable to the writer.

Use the Table of Contents to help you improve your manuscript. Use it to see if you've left something out, if you are presenting your sections in the most logical order, or if you need to make your wording a bit more clear. Thanks to the miracle of computer technology, you can easily copy/paste each of your headings from throughout your writing into the Table of Contents.

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If you are including a Conclusions/Implications section in your dissertation **make sure you really present conclusions and implications.** Often the writer uses the conclusions/implications section to merely restate the research findings.

Don't waste my time. I've already read the findings and now, at the Conclusion/Implication section, I want you to help me understand what it all means. This is a key section of the dissertation and is sometimes best done after you've had a few days to step away from your research and allow yourself to put your research into perspective.

If you do this you will no doubt be able to draw a variety of insights that help link your research to other areas. I usually think of conclusions/implications as the «So what» statements. In other words, what are the key ideas that we can draw from your study to apply to my areas of concern.

Potentially the silliest part of the dissertation is the Suggestions for Further Research section. This section is usually written at the very end of your writing project and little energy is left to make it very meaningful. The biggest problem with this section is that the suggestions are often ones that could have been made prior to you conducting your research.

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Read and reread this section until you are sure that you have made suggestions that emanate from your experiences in conducting the research and the findings that you have evolved. Make sure that your suggestions for further research serve to link your project with other projects in the future and provide a further opportunity for the reader to better understand what you have done.

Now it's time to write the last chapter. But what chapter is the last one? My perception is that **the last chapter should be the first chapter.** I don't really mean this in the literal sense. Certainly you wrote Chapter One at the beginning of this whole process. Now, at the end, it's time to «rewrite» Chapter One. After you've had a chance to write your dissertation all the way to the end, the last thing you should do is turn back to Chapter One.

Reread Chapter One carefully with the insight you now have from having completed Chapter Five. Does Chapter One clearly help the reader move in the direction of Chapter Five? Are important concepts that will be necessary for understanding Chapter Five presented in Chapter One?

Answer the following questions:

- Do you agree that writing a dissertation in your field is similar to writing a scientific report?
- Do you know the accepted methodological approaches in writing dissertations? If you do, where did you learn them?
- Are you taking all these steps in writing your dissertation?
- What stages have you already passed?
- What stage are you in currently? What t steps are to be taken yet?
- Do you see any difference between the steps described her and the Ukrainian standards?

Prepare a 2 minute story about the framework of the format of your dissertation.

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Errors in subject/verb agreement

If a subject is singular, the verb must be singular. If the subject is plural, the verb must be plural.

Minerals in seawater exists in the same proportions in all of the oceans of the world.

The plural subject *minerals* requires a plural verb, *exist.* You might have found this question tricky because the singular noun *seawater* comes between the subject and the verb, and you may have mistaken that word for the true subject.

Bowling, one of the most popular indoor sports, are getting popular all over the Crimea and in other areas of Ukraine.

The subject of the sentence is *bowling,* not *sports.* The singular verb form *is* should therefore be used.

There are some special rules about subject-verb agreement that you should be familiar with:

• A sentence with two subjects joined by *and* takes a plural verb. E.g.:The chemistry lab and the physics lab *are* . . .

• Some words end in *-s* but are singular in form. Many of these words are the names of fields of study *{economics, physics,* and so on). *News* is another word of this kind. E.g.:

Economics *is* . . . The news *was* . . .

Irregular plurals *(children, feet, mice,* and so on) take plural verbs. E.g.:

The women *were* . . . His feet *are* . . .

When a clause begins with the expletive *there,* the verb may be singular or plural, depending on the grammatical subject.

Subjects with *each* and *every* take singular verbs. (This includes compound words like *everyone* and *everything.*) E.g.:

Each state *has* . . .

Each of the representatives *was* . . .

Every person *was* . . .

Everyone *wants* . . .

The verb in relative clauses depends on the noun that the relative pronoun refers to. E.g.:

The house that *was* built . . .

The students who *were* selected . . .

The phrase *the number of* + plural noun takes a singular verb. The phrase *a number of* + plural noun takes a plural verb. E.g.:

The number of trees *is* . . .

A number of important matters *have* . . .

Singular subjects used with phrases such as *along with, accompanied by, together with, as well as,* and *in addition to* take singular verbs. E.g.:

The mayor, along with the city council, *is* . . .

Together with his friends, Mark *has* . . .

• Quantities of time, money, distance, and so on usually take a singular verb. E.g.:

Five hundred dollars *was* . . .

Section 2. GUIDELINES FOR GRAMMAR TEST

Errors in subject/verb agreement

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Five hundred dollars *was* . . .

Two years *has* . . .
Ten miles *is* . . .

Exercise: Problems involving subject-verb agreement.

Directions: Underline the form that correctly completes each sentence. Then circle the subject with which the underlined verb agrees. The first one is done as an example.

The first bridge to be built with electric lights (was/were) the Brooklyn Bridge. .

Ethics (is/are) the study of moral duties, principles, and values.

There (is/are) two types of calculus, differential and integral.

.George Gershwin, together with his brother Ira, (was/were) the creator of the first musical comedy to win a Pulitzer Prize.

.In a chess game, the player with the white pieces always (moves/move) first.

.The Earth and Pluto (is/are) the only two planets believed to have a single moon.

A number of special conditions (is/are) necessary for the formation of a geyser.

Each of the Ice Ages (was/were) more than a million years long.

The battery, along with the alternator and starter, (makes/make) up the electrical system of a car.

Teeth (is/are) covered with a hard substance called enamel.

The more-or-less rhythmic succession of economic booms and busts (is/are) referred to as the business cycle.

The number of protons in the nucleus of an atom (varies/vary) from element to element.

All trees, except for the tree fern, (is/are) seed-bearing plants.

Fifteen hundred dollars a year (was/were) the per capita income in the United States in 1950.

Everyone who (goes/go) into the woods should recognize common poisonous plants such as poison ivy and poison oak.

More items involving parallel structures

In certain structure items, the correct use of **parallel structures** is tested. Parallel structures have :the same grammatical form and function. Look at the following sentences:

She spends her leisure time *hiking, camping,* and *fishing.*

He *changed* the oil, *checked* the tire pressure, and *filled* the tank with gas.

Nancy plans to either *study* medicine or *major* in biology.

Nancy plans to study either *medicine* or *biology.*

All of the structures in italics are parallel. In the first, three gerunds are parallel; in the second, three main verbs; in the third, two simple forms; and in the fourth, two nouns. Many other structures must be parallel in certain sentences: adjectives, adverbs, infinitives, prepositional phrases, noun clauses, and others.

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A number of special conditions (is/are) necessary for the formation of a geyser.

Each of the Ice Ages (was/were) more than a million years long.

The battery, along with the alternator and starter, (makes/make) up the electrical system of a car.

Teeth (is/are) covered with a hard substance called enamel.

The more-or-less rhythmic succession of economic booms and busts (is/are) referred to as the business cycle.

The number of protons in the nucleus of an atom (varies/vary) from element to element.

All trees, except for the tree fern, (is/are) seed-bearing plants.

Fifteen hundred dollars a year (was/were) the per capita income in the United States in 1950.

Everyone who (goes/go) into the woods should recognize common poisonous plants such as poison ivy and poison oak.

More items involving parallel structures

In certain structure items, the correct use of **parallel structures** is tested. Parallel structures have :the same grammatical form and function. Look at the following sentences:

She spends her leisure time *hiking, camping,* and *fishing.*

He *changed* the oil, *checked* the tire pressure, and *filled* the tank with gas.

Nancy plans to either *study* medicine or *major* in biology.

Nancy plans to study either *medicine* or *biology.*

All of the structures in italics are parallel. In the first, three gerunds are parallel; in the second, three main verbs; in the third, two simple forms; and in the fourth, two nouns. Many other structures must be parallel in certain sentences: adjectives, adverbs, infinitives, prepositional phrases, noun clauses, and others.

The most common situation in which parallel structures are required is in a sequence in the first two sentences above. Parallel structures are also required with correlative conjunctions such as *either...or* or *not only...but also.*

Example:

Yalta has a pleasant climate, and many fascinating neighborhoods.

(A) exciting scenery,
(B) has exciting scenery
(C) that the scenery is exciting
(D) the scenery is exciting,

This sentence contains a series of three objects after the verb has: the first and third are noun phrases (a pleasant climate and many fascinating neighborhoods). To be parallel, the second object must also be a noun phrase. Therefore, choice (A) is the correct answer; (B), (C), and (D) are not parallel.

Mini-test

Identify and correct errors involving subject-verb agreement

The experimental site, islands off Noumea in New Caledonia,
(A) is remote from any human activity.
(B) are remote from any human activity.
(C) remote from any human activity.
(D) both are remote from any human activity.

Contrary to the results of the experiment 1 in the middle of the island rather than on its edges, 2 of sea water-freshwater interaction.
(A) fresh water prove to be intensively concentrated
(B) fresh water proves to be intensively concentrated
(C) fresh waters are intensively concentrated
(D) prove fresh water is to be intensively concentrated

2
(A) that is the usual zones
(B) which are the usual zones
(C) it are the usual zones
(D) there are the usual zones

Complementary _____derived from a hydrogeological model the importance of vegetation cover and the island's topography
(A) analyses….. have revealed
(B) analyses….. has revealed
(C) analyses….. is revealed
(D) analyses….. are revealed

The density of the vegetation and the greater degree of soil development.

(A) is maximal in the sand dunes near the sea.
(B) are maximal in the sand dunes near the sea.
(C) it is maximal in the sand dunes near the sea.
(D) they are maximal in the sand dunes near the sea.

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On the island margins_____, with dilution of the underground water.
(A) the phenomenon is observed
(B) are observed the phenomenon
(C) there are the phenomenon
(D) it is the phenomenon

A number of special conditions (is/are) necessary for the underground water sources to form.

There (is/are) two types of water reservoirs in the Crimea.

Two years (is/are) a long time when you have to wait.

The number of trees in the National Park is not great.

Each of the students (is/are) to submit their papers.

No news (is/are) good news.

The President along with his advisers (is/are) expected to arrive in an hour.

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Section 1. GUIDELINES FOR ACADEMIC COMMUNICATION

A dissertation defense

Instruction: These are some guidelines and tips to be taken into account at the defense procedure — the final part of your graduate study. This is an adaptation of S. Joseph Levine's text placed in the Internet without copyright limitations. You are sure to realize that, no matter how much you have done in the preparation of your dissertation, it will be indispensable for you to finish your degree requirements. On reading and understanding the following text your purpose will be to verify what you know about the standard guidelines of a dissertation defense procedure. This will be useful for you as a competitor for the candidate degree. However, at this stage your goal as an examinee is to get ready to present these guidelines employing the vocabulary that you acquire in this section at your English candidate exam.

It's not a war. It seems to suggest some sort of war that you're trying to win. And, of course, with 10 or 12 of **them** and only one of **you** it sounds like they may have won the war before the first battle is held. I wish they had called it a dissertation seminar or professional symposium. I think the name would have brought forward a much better picture of what should be expected at this meeting.

Try to remember that the purpose of the meeting is for you to show everyone how well you have done in the conducting of your research study and the preparation of your dissertation. In addition there should be a seminar atmosphere where the exchange of ideas is valued. You are clearly the most knowledgeable person at this meeting when it comes to your subject. And, the members of your committee are there to hear from you and to help you better understand the very research that you have invested so much of yourself in for the past weeks. Their purpose is to help you finish your degree requirements.

You are not alone. It's important that you have the feeling when entering your defense that you **aren't doing it alone.** As was mentioned earlier, your major professor should be seen as an ally to you and «in your corner» at the defense. Don't forget, if you embarrass yourself at the defense you will also be embarrassing your dissertation director. So, give both of you a chance to guarantee there is no embarrassment. Meet together ahead of time and discuss the strategy you should use at the defense. Identify any possible problems that may occur and discuss ways that they should be dealt with. **Try and make the defense more of a team effort.**

Don't be defensive at your defense (this sounds confusing!). This is easy to say but sometimes hard to fulfill. You've just spent a considerable amount of time on your research and there is a strong tendency for YOU to want to defend everything you've done.

Unit 20

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However, the committee members bring a new perspective and may have some very good thoughts to share. Probably the easiest way to deal with new input is to say something like «Thank you so much for your idea. I will be giving it a lot of consideration.» There, you've managed to diffuse a potentially explosive situation and not backed yourself or the committee member into a corner. Plus, you've not promised anything. Try and be politically astute at this time. Don't forget that your ultimate goal is to successfully complete your degree.

Presentation. The student prepares a 20-25 minute presentation that reviews the entire study. This is done through the help of a series of 10-12 large pieces of paper, wall charts that have been posted sequentially around the walls of the room. Each piece of paper contains key words regarding each of the different aspects of the study. Some pieces of paper contain information about the study setting, questions and methodology.

Other pieces of paper present findings and finally there are those pieces that present the conclusions and implications. By preparing these wall charts ahead of time the student is able to relax during the presentation and use the pieces of paper as if they were a road map toward the goal. The wall charts stay up for everyone to see and to help focus attention.

The committee. Following this structured presentation the committee begins to ask questions, but as can be expected the questions follow along with the wall charts and the whole discussion proceeds in an orderly manner. If guests are present at the defense, this form of presentation helps them also follow along and understand exactly what was accomplished through the research.

Enjoy it. Well that about does it. By following the above suggestions and ideas I hope it will be possible for you to finish your graduate degree program in a most timely and enjoyable manner. By looking ahead to the different aspects of this final part of your graduate study it becomes clear that you can do a number of things to insure your success. Good luck!

(Based on «Writing and Presenting Your Thesis or Dissertation» by S. Joseph Levine, Ph.D. Michigan State University, East Lansing, Michigan USA. http://a-pluss.com/article/dissertation)

Answer the following questions:

- Do you agree that the defense procedure is not a war, nor are members of the defense committee hostile?
- Do you agree that you are clearly the most knowledgeable person at the defense when it comes to your subject?
- Is the approach to defense different or the same in Ukraine?
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Prepare a 2 minute story about the framework of a good defense procedure.

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Items involving misplaced modifiers

A misplaced modifier is a participial phrase or other modifier that comes before the subject, but does NOT refer to the subject. Look at this sentence:

Driving down the road, a herd of sheep suddenly crossed the road in front of Liza's car. (INCORRECT;)

This sentence is incorrect because it seems to say that a herd of sheep—rather than Liza—was driving down the road. The participial phrase is misplaced. The sentence could be corrected as shown:

As Liza was driving down the road, a herd of sheep suddenly crossed the road in front of her. (CORRECT),

This sentence now correctly has Liza in the driver's seat instead of the sheep.

The following sentence structures are often misplaced.

Present participle.Walking along the beach, the ship was spotted by the men.

Correction: Walking along the beach, the men spotted the ship.

Past participle. Based on this study, the scientist could make several conclusions.

Correction: Based on this study, several conclusions could be made by the scientist.

Appositive. A resort city in Arkansas, the population of Hot Springs is about 35,000.

Correction: A resort city in Arkansas, Hot Springs has a population of about 35,000.

Reduced adjective clause. While peeling onions, his eyes began to water.

Correction: While he was peeling onions, his eyes began to water.

Adjective phrases. Warm and mild, everyone enjoys the climate of the Virgin Islands.

Correction: Everyone enjoys the warm, mild climate of the Virgin Islands.

Expressions with like or unlike. Like most cities, parking is a problem in San Francisco.

Correction: Like most cities, San Francisco has a parking problem

Structure items with misplaced modifiers are usually easy to spot. They generally consist of a modifying element at the beginning of the sentence followed by a comma, with the rest or most of the rest of the sentence missing. The answer choices tend to be long. To find the answer, you must decide what subject the modifier correctly refers to.

Examples:

Using a device called a cloud chamber,

(A) experimental proof for the atomic theory was found by Robert Millikin.

(B) Robert Millikin's experimental proof for the atomic theory was found.

(C) Robert Millikin found experimental proof for the atomic theory.

(D) there was experimental proof found for the atomic theory by Robert Millikin.

Choices (A) and (B) are incorrect because the modifier (*Using a device called a cloud chamber)* could not logically refer to the subjects *(experimental*

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proof and *RobertMiWikin's experimental proof).* (D) is incorrect because a modifier can never properly refer to the introductory words *there* or *it.*

1. Fearing economic hardship, _____
(A) many Ukrainians emigrated to other countries in the 1990s.
(B) emigration from Ukraine to other countries took place in the 1990s.
(C) it was in the 1990s that many Ukrainians emigrated to other countries.
(D) an emigration took place in the 1990s from Ukraine to other countries.

2. Rich and distinctive in flavor,
(A) there is in the United States a very important nut crop, the pecan
(B) the most important nut crop in the United States, the pecan
(C) farmers in the United States raise pecans, a very important nut crop
(D) pecans are the most important nut crop in the United States

3._____ orbiting from 2.7 to 3.6 billion miles from the sun.
(A) The astronomer Clyde Tombaugh discovered Pluto in 1930
(B) Pluto was discovered by the astronomer Clyde Tombaugh in 1930
(C) It was in 1930 that the astronomer Clyde Tombaugh discovered Pluto
(D) The discovery of Pluto was made by Clyde Tombaugh in 1930

4. A popular instrument, .
(A) only a limited role has been available to the accordion in classical music.
(B) there is only a limited role for the accordion in popular music.
(C) classical music provides only a limited role for the accordion.
(D) the accordion has played only a limited role in classical music.

Missing or incomplete comparisons

Many sentences contain comparisons, some of these involve the comparative forms of adjectives.

Examples:

Sea bass freshwater bass.
(A) are larger than (correct)
(B) are larger the
(C) are as large
(D) are larger

On the average, the Pacific Ocean is *deeper than* the Atlantic.
Rhonda is a *more experienced* performer *than* Theresa.
This show is *less interesting than* the one we watched last night.
Be sure that the sentence compares similar things or concepts.
The ears of African elephants are bigger than *Indian elephants.* (INCORRECT) *The ears of African elephants* are bigger than *those of Indian elephants.* (CORRECT)

The first sentence above is incorrect because it compares two dissimilar things: an African elephant's ears and an Indian elephant. In the second, the word *those* refers to ears, so the comparison is between similar things.

Another type of comparison involves the phrase *as...as; not so…as.*

Examples:

The lab lasted *as long as* the class did.
There weren't *as many people at the meeting as* I had thought there would be.
Wild strawberries are _____as cultivated strawberries.

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The words *like/alike* and *unlike/not alike* can also be used to express comparison:

Like A, B, …; A, like B, …; A is like B; A and B are alike.

Unlike X, Y, …; X, unlike Y…;. X is unlike Y; X and Y are not alike

In these sentences, similar-looking words such as *likely, likewise, dislike,* and *unlikely* may appear as distractors.

Other phrases can be used in making comparisons:

A is the same as B; A and B are the same; A is similar to B.

X is different from Y; X and Y are different; X differs from Y.

A special kind of comparison is called a proportional statement. A proportional statement follows this pattern: *The more A...the more B.*

Example:

The higher the humidity, *the more uncomfortable* people feel.

Mini-test

Identify and correct errors involving misplaced modifiers

_____air pollution is a big problem in Simferopol.
(A) Like in most Ukrainian cities
(B) Like most Ukrainian cities
(C) Alike most Ukrainian cities
(D) As most Ukrainian cities

, everyone wants to be friends with John.
(A) Kind and cooperative
(B) As he is kind and cooperative
(C) Being kind and cooperative
(D)Also kind and cooperative

for his exam his computer broke.
(A) While sitting
(B) While he was sitting
(C) On sitting
(D) He was sitting

_____is constantly growing
(A) The center of the Crimea, the population of Simferopol
(B) In Simferopol, the center of the Crimea, the population
(C) The center of the Crimea, Simferopol, the population
(D) Simferopol, the center of the Crimea, the population

he decided to drop his research.
(A) Resulting in a failure
(B) Resulting in a failure of his research
(C) As his research resulted in a failure
(D) Because a failure

a car accident happened.
(A) Walking down the street

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a car accident happened.
(A) Walking down the street

(B) When I was walking down the street
(C) I was walking down the street
(D) Walked down the street

_____can help assess the water resources of the Pacific coral islands

(A) Mapping the salinity distribution of the island's groundwater this analysis

(B) This analysis of mapping the salinity distribution of the island's groundwater

(C) Mapping this analysis of the salinity distribution of the island's groundwater

(D) When mapping the salinity distribution of the island's groundwater this analysis

_____1____ that family enterprises aim at humane objectives _____2_____ and at financial objectives 3 than non-family enterprises 4

1

(A) Based on the hypothesis
(B) Basing on the hypothesis
(C) It is based on the hypothesis
(D) There is based on the hypothesis

2

(A) to a greater extent
(B) on a greater extent
(C) with a greater extent
(D) at a greater extent

3

(A) to a lesser extent
(B) on a lesser extent
(C) with a lesser extent
(D) at a lesser extent

4

(A) the results of an empirical study for the region Upper-Austria are presented.

(B) are presented the results of an empirical study for the region Upper-Austria.

(C) an empirical study for the region Upper-Austria the results of are presented.

(D) the results are presented of an empirical study for the region Upper-Austria.

Tips for tactics in finding grammar errors

- Skim each sentence, looking for obvious errors.
- If you haven't found the error, read the sentence again carefully, concentrating on the underlined parts. Go through a mental checklist of the most common types of errors (those involving word form, word choice, parallelism, verbs, pronouns, and singular/plural nouns) to see if any of the underlined expressions seem to fall into those categories.
- If you are still unable to find an error, try eliminating options that seem to be correct.

(B) When I was walking down the street
(C) I was walking down the street
(D) Walked down the street

_____can help assess the water resources of the Pacific coral islands

(A) Mapping the salinity distribution of the island's groundwater this analysis

(B) This analysis of mapping the salinity distribution of the island's groundwater

(C) Mapping this analysis of the salinity distribution of the island's groundwater

(D) When mapping the salinity distribution of the island's groundwater this analysis

_____1____ that family enterprises aim at humane objectives _____2_____ and at financial objectives 3 than non-family enterprises 4

1

(A) Based on the hypothesis
(B) Basing on the hypothesis
(C) It is based on the hypothesis
(D) There is based on the hypothesis

2

(A) to a greater extent
(B) on a greater extent
(C) with a greater extent
(D) at a greater extent

3

(A) to a lesser extent
(B) on a lesser extent
(C) with a lesser extent
(D) at a lesser extent

4

(A) the results of an empirical study for the region Upper-Austria are presented.

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Functional module analysis in metabolomics Chokes

Shaily Mehta and Somnath Tagore. Department of Biotechnology & Bioinformatics

Abstract: Since recent years the work on biological and metabolic network has been increasing due to the new biological discoveries and essential metabolites. Metabolomics being a urgeoning field, which produces voluminous data that, like other 'omics' data, should be seen as a resource that contributes specifically to the former half of an iterative cycle of hypothesis-generating and hypothesis- testing phases. It is becoming increasingly apparent that our ability to generate large quantities of metabolomics or metabolic profiling data will help to open up many previously inaccessible areas of biology various high-throughput techniques are leading to an explosive growth in the size of biological databases and creating the opportunity to revolutionize our understanding of life and disease. Interpretation of these data remains, however, a major scientific challenge. With the study of enzymes and metabolites new pathways can be discovered, which can help in the analysis of the various process taking place in the organism. In order to identify potential drug targets the concept of choke points was used to find enzymes which uniquely consume or produce a particular metabolite. Hence the study of these choke are taken into consideration.

Keywords: Biological, metabolic network, metabolites, enzymes, choke points

1 INTRODUCTION

The present scenario tells us that network analysis is essential for the analysis of genetic, proteomics and metabolomics data [1, 2].

The present discovery of enzymes and metabolites has made the study of metabolomics very much in need. Since past couple of decades we have understood the basic idea of the formation of metabolites. It all starts with the process of ingestion were the organism takes the material such as food into their bodies. These material become compounds and energy necessary for sustaining the activity of the organism by various chemical reactions. The whole of such chemical reaction taking place in the body is called metabolism. Here the substrate is converted to a product i.e. one compound is converted to another and chain of reactions is generated which forms a large scale network. This network is known as Metabolic Pathway.

With the increase in research work large no of metabolic pathways are continuously being discovered and there activity is studied. Due to which large no of enzymatic databases were build to store in these data. Also the activity of each of these enzymes taking part in the metabolic pathways is studied carefully. Various graph theories, mathematical, computational and programming aspects

ЧАСТЬ II

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are taken into consideration for the verification of these metabolites and chemical reactions and to demonstrate the intrinsic hierarchical modularity of metabolic networks [3] and their robustness based on the shortest path analysis of the metabolic networks [4-6].

A typical metabolic network consists of reactions, metabolites and enzymes, which can be modeled using graph theory [7-11]. These representations lead from a simple graph consisting of edges (reactions) and nodes (metabolites) or vice versa to a complex bipartite graph where two nodes (metabolites) share a common node (reaction/enzymes) [12].

Enzyme-centric networks can be created by joining enzymes that share a common metabolite in a path. The enzyme-centric view [13] simplifies the representation of the metabolic network by removing loose ends in the network (metabolites at the periphery of the network) and forming clusters of interacting enzymes. The gene-centric view has been successfully used in determining co-regulated genes in the metabolic and regulatory networks [14-18].

Hence it becomes a necessity to understand the choke points which are enzymes which play a crucial role in the metabolic pathway. Understanding these enzymes will widen the scope of analyzing the pathway considerably. Choke points are those enzymes which uniquely consume and/or produce a certain metabolite. They are ranked by the number of k-shortest paths (in/out) passing through it and the load point (in/out) on it. Since it is a reasonable assumption that a large number of the biochemical reactions follow the shortest path, we assume that the shortest path count can good indicator of biochemical activities. Inactivation of choke points may lead to an organism's failure to produce or consume particular metabolites which could cause serious problems for fitness or survival of the organism hence they are considered crirtical points in the metabolic networks.

Chokepoint analysis has several advantages. First, it allows us to test the consistency between experimental data and assumptions about the organization and regulation of the biochemical pathway and of its interdependencies with other processes. Second, it can be used to predict the consequences of various mutations or inhibitors.The concept of choke points was used in our study to find potential drug targets in the metabolic network of Bacillus anthracis Sterne. The metabolites and enzymes are further ranked on the basis of their loads in the given network. A comparative study was performed between the human metabolic network and pathogen choke points to discriminate human choke points from the pathogenic bacterial choke points. A homology search was performed against human genome to find non-homologus potential drug targets from the pathogen choke points.

A new method to analyse choke points by screening the entire metabolic network of pathogens and report the probable choke points in the network was discovered by group of scientists [19].

This extended graph theory model ranks the choke points according to the k-shortest path passing through it and the load (in/out) on it. This ranking has a major advantage as this measure may help determine the biochemical essentiality of a metabolite/enzyme. For example, in Plasmodium falciparum—a parasite causing malaria in humans—a host cell enzyme 4.2.1.24 (d-aminolevulinate dehydratase; ALAD) involved in hemebiosynthesis was suggested as an antimalarial target.

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This enzyme is also a choke point enzyme and identifying such potential targets in the athogens can accelerate the drug discovery.

Also all three clinically validated drug targets for malaria are chokepoint enzymes. A total of 87.5% of proposed drug targets with biological evidence in the literature are chokepoint reactions.

2 CURRENT SCENARIO

In order to confer biological meaning to the graph-based approach of finding choke points, the present studies deal with the following steps:-

For building the biochemical network we used the LIGAND database from KEGG as this data model is the backbone for the Pathway Hunter Tool in addition to BRENDA. For the predicted choke points in the pathogen we performed a homology search against the human genome using BLAST.

Calculations of the top choke points which are ranked by number incoming shortest paths along with important load points are reported in the metabolic network of the organism. A network based comparative study of the important choke points between a model organism and Homo sapiens is performed using Pathway Hunter Tool (PHT). '+' implies that a particular enzyme acts as a choke point in the human biochemical network as well as in the pathogen whereas '–' indicates that this enzyme is only a choke point in the pathogen and not in the human biochemical network.

A homology search is performed between the human and model organism. Choke point enzymes using BLAST and chokepoints with a closest homologue with e-values <1.0e–02 are removed.

The above method was one of the techniques proposed by the scientist working in this field. There may be many more methods which have potential in identification of these choke points which are yet to be discovered or they are in the process to reach there out.

3 IMPLEMENTATION

Chokepoint analysis can be implemented in various pathway analysis.

First, it allows us to test the consistency between experimental data and assumptions about the organization and regulation of the biochemical pathway and of its interdependencies with other processes.

Second, it can be used to predict the consequences of various mutations or inhibitors.

The targeting of metabolic pathways has several advantages on its own. Each step in the pathway is well validated as an essential function for pathogen growth. The target enzymes from the pathogen which are discarded and which share a similarity with the host proteins ensures that the targets have nothing in common with the host proteins, thereby, eliminating undesired host protein–drug interactions. Metabolic pathway analysis is becoming increasingly important for assessing inherent network properties in reconstructed biochemical reaction networks. As of now, identifying choke point reactions, identification of enzymes has been done that are essential to the parasite's survival.

There is an enrichment of drug targets in chokepoints as compared with non-chokepoints.This leads to the conclusion that the classification of an enzyme as a chokepoint has some bearing on whether or not it would make a good drug target.

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Another approach could be combining Choke Point analysis with chemo-genomic profiling (micro-array data), Providing a complete and better annotation in vivo (thereby reducing the identification of false Choke Point enzymes and providing previously unreported Choke Point enzymes in the metabolic network) is one of the first steps in this direction.

4 CHOKE POINT ANALYSIS

Choke point analysis was successfully performed on large no of organisms to discover potential drug targets. e. g. Plasmodium falciparum, B.antracis, Corynebacterium glutamicum, E.histolytica.

If an enzyme catalyzes at least one chokepoint reaction, it is classified as a potential drug target. chokepoints and non chokepoints against proposed drug targets from the literature is compared to assess the usefulness of identifying chokepoint enzymes for proposing drug targets.

A complete literature search for proposed amoebiasis drug targets is attempted that were metabolic enzymes and met the criteria discussed above.

Chokepoints may not be essential. One reason could be that they create unique intermediates to an essential product which are not essential themselves and finally, there could be chokepoint reactions that are not essential due to other pathways that achieve the same metabolic goal within the organism. One example could be blocking the reaction that has no deleterious effects on the parasite. Due to the high percentage of enzymes identified as choke points, one additional criteria observed in addition to being a choke point enzyme for identifying potential metabolic drug targets is that an enzyme not having isozymes would make it more likely to be a good drug target.

An analysis of the top 10 choke points in B.anthracis, a pathogen, is presented. In a number of possible drug targets against infection of B.anthracis are identified. It was found that the enzymes tryptophan synthase (EC: 4.2.1.20) and anthranilate phosphoribosyltransferase (EC: 2.4.2.18) could be effective potential drug targets. Neither of these enzymes are choke points in the human metabolic network nor do they share a significant homology with the human genome. This means that blocking these enzymes might affect the pathogen but not the human as there exists an alternate pathway To identify potential drug targets, a chokepoint analysis of the metabolic network of E.histolytica is performed. A «chokepoint reaction» is a reaction that either uniquely consumes a specific substrate or uniquely produces a specific product in the Entamoeba metabolic network. It is expected that the inhibition of an enzyme that consumes a unique substrate result in the accumulation of the unique substrate which is potentially toxic to the cell and the inhibition of an enzyme that produces a unique product to result in the starvation of the unique product which potentially cripple essential cell functions [20]. Thus, it is believed that chokepoint enzymes may be essential to the parasite and are therefore potential drug targets.

5 CONTRIBUTION OF CHOKE POINTS IN THE HUMAN METABOLIC NETWORK

While treating disease like diabetes, obesity, cancer, HIV etc it is very important that the drug enables target specific action. This includes the fact that the drug wold act directly on the metabolic pathway in whole or he enzyme which is responsible for spreading the disease.

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A comparative study of choke points with the human metabolic network is essential to identify possible interference of the drugs with the human metabolism which might lead to side effects. It has to be kept in mind though, that presently a large number of genes have unidentified functions which could lead to erroneous prediction of choke points. For example, often drug targets are identified by a unique pathogen-specific metabolic activity, as in the case of reverse transcriptase in the case of HIV.

Hence, the study of theses choke points is very much in demand and had potential to act on large no of targets thereby giving favorable results.

6 CONCLUSION

Choke points are important points in a reaction; they are reaction which consumes/produces certain metabolites which play important role in a given reaction. In absence of these choke points an organism cannot survive. The current analysis includes only the completely annotated enzymes in each organism. Including all the available enzymes for the organisms, such as putative enzymes, may complete the analysis of the metabolic network. The extended graph-based choke point concept can facilitate drug discovery andranking choke points based on their load values may be a likely pointer to the lethality level of such potential drug targets in the network. Further study and comparative analysis of various metabolic networks based on our network model can be beneficial for in vivo and in vitro studies.

There are further aspects on which the list of potential drug targets can be narrowed down. The drug should adversely affect the parasite but not the human host which means that if the drug target has a homologous enzyme in human, it should not be essential or have differential inhibition in human. In other way, it can be said that potential drug targets should be expressed in the human stages of the parasite. The rapid emergence of multi-drug resistant strains of these potentially lethal pathogens calls for the identification of new targets. The discovery of new targets with help of choke point analysis may lead to a drug formulation that would be able to counteract the resurgence of these diseases.

Also with further studies we can prove choke points to be helpful in the discovery of important regions in the pathway along with a better approach towards understanding the system well.

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discovered. The two most promising concepts for pathway analysis focused here are closely related. Assessing metabolic systems by the set of extreme pathways can, in general, give misleading results owing to the exclusion of possibly important routes. A full assessment of the proposed listed steps will require intense further effort. It is to be expected that some experiments may be significant which will stimulate the next phase of amendments and refinements. As it stands, it is hoped to serve the scientific community as a starting point for further data collection and experimentation in concert with, and based on, pathway analysis. One of the most important step is to reduce the Probability of identifying false choke points which can be done by undergoing annotation. Studies say that, Choke Point analysis with chemo-genomic profiling (micro-array data), can Provide a complete and better annotation in vivo.

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Structural colour and iridescence in plants: the poorly studied relations of pigment colour

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Abstract
Background Colour is a consequence of the optical properties of an object and the visual system of the animal perceiving it. Colour is produced through chemical and structural means, but structural colour has been relatively poorly studied in plants.
Scope This Botanical Briefing describes the mechanisms by which structures can produce colour. In plants, as in animals, the most common mechanisms are multilayers and diffraction gratings. The functions of structural colour are then discussed. In animals, these colours act primarily as signals between members of the same species, although they can also play roles in camouflaging animals from their predators. In plants, multilayers are found predominantly in shade-plant leaves, suggesting a role either in photoprotection or in optimizing capture of photosynthetically active light. Diffraction gratings may be a surprisingly common feature of petals, and recent work has shown that they can be used by bees as cues to identify rewarding flowers.
Conclusions Structural colour may be surprisingly frequent in the plant kingdom, playing important roles alongside pigment colour. Much remains to be discovered about its distribution, development and function.
Key words Diffraction grating, flower colour, interference, iridescence, multilayer, photoprotection, pollinator attraction, structural colour

INTRODUCTION: WHAT IS COLOUR?

The bright colours of flowers attract pollinating insects by making the floral tissue stand out against a background of vegetation. Analyses of insect visual acuity have shown that vegetation is visually very similar to bark, soil and stone from an insect's point of view, because all these materials weakly reflect light across the whole range of the insect visual spectrum (Kevan *et al.*, 1996).

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Flowers are different — they appear as bright colours because they selectively reflect certain wavelengths of light, which are perceptible to pollinating animals, and, usually, to humans as well.

Colour is a property of both the coloured object and the perception of the animal observing it (Fig. 1). Light arriving at an object can be transmitted through it, absorbed by it or reflected back from it. If an object reflects or transmits all wavelengths of light equally, then it is perceived as white (Fig. 1, top). If an object strongly absorbs all wavelengths of light, then it is perceived as black (Fig. 1, centre). However, if it absorbs all light except one set of wavelengths, such as the red, which it instead reflects or transmits, then it can be said to have a colour. What that colour is depends on the visual system of an animal observing the object. If it has photoreceptors that are strongly activated by red light, as vertebrates do, then the object will appear red (Fig. 1, bottom left). If it has no photoreceptors that respond to red light, the object will appear black — to that animal the object is indistinguishable from an object that absorbs all wavelengths of light. Because photoreceptors are triggered by a curve of wavelengths the situation can be more complex. So, for insects that do not have red-light receptors but whose green-light receptors respond to a curve of wavelengths with the tail of the curve in the red part of the spectrum, the object in question would appear dull green.

Colour is a property of the light reflected by an object and the visual system of the animal observing it. If a flower reflects all wavelengths of light, it is perceived as white (top). If it absorbs all wavelengths then it appears black (centre). However, if it absorbs all wavelengths apart from one region of the spectrum, it has a colour. The flower shown in the bottom panel reflects red light. To the vertebrate eye, which has red-light receptors, the flower appears red. However, to the bee eye, which has no red-light receptors but whose green-light receptors are weakly stimulated by red light, the flower appears a dull green.

Plants, like animals, achieve colour in two main ways. First, they use chemical- or pigment-based colour. Pigments are compounds which absorb subsets of the visible spectrum, transmitting and reflecting back only what they do not absorb and causing the tissue to be perceived as the reflected colours. Chlorophyll absorbs light in both the red and the blue parts of the spectrum, reflecting only green light, and causes leaves to appear green to humans. Similarly, a flower that humans perceive as red contains pigments which absorb yellow, green and blue light, leaving red light as the only wavelength visible to us which is reflected. Plant pigments have been thoroughly studied from a biochemical perspective, and their synthesis and regulation have also been characterized by molecular genetics.

However, both plants and animals have also been shown to produce structural colours. A structural colour occurs when different wavelengths of light are selectively reflected from a substance, with the remaining wavelengths transmitted or absorbed. The famous blue butterflies of the genus *Morpho* have wing scales which selectively reflect a narrow bandwidth of blue light, allowing other wavelengths to be transmitted through the wing (Fig. 2A). The wings accordingly look intensely blue to humans, even though they contain no blue pigments (Vukusic *et al.*, 1999). Structural colour has been well characterized in animals, but very little studied in plants.

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Structural colour and iridescence. (A) The intense blue colour of the *Morpho* butterfly is due to reflection of light by multilayers. (B) Multilayers generate iridescence by reflecting different wavelengths of light at different angles at each boundary between layers. (C) Diffraction gratings consist of ordered parallel grooves at particular frequencies, like the cuticular striations on this tulip petal. (D) An iridescent beetle (rose chafer, *Cetonia aurata*) visits an artichoke flower.

IRIDESCENCE IS A UNIQUE PROPERTY OF STRUCTURAL COLOUR

Chemical and structural colours have several different properties. They differ first in the intensity of colour that they produce. Pigments are generally not very good at absorbing all but a very few wavelengths of light. Instead, they absorb most light of a number of wavelengths, but allow quite a broad range of wavelengths to be reflected or transmitted. This results in colours which can appear dull or muted, as they consist of a mixture of different colours of light. In contrast, structural colours can appear very intense, as reflective structures can be very precise in the bandwidths that they reflect.

Chemical and structural colours also differ in the patterns that they can produce. Chemical colours are diffuse, and look the same from all angles. To produce patterns of colour, different pigments must be localized to different cells or areas of a tissue. Commonly occurring pigment patterns in plants include different coloured venation on petals, and spots of dark pigment acting as targets at the bases of petals, near the nectaries. Structural colours have the potential to generate shifting patterns of colour as the viewer moves, rather than across different regions of the tissue. Reflective structures can reflect one particular peak wavelength of light at one angle, and another peak wavelength at a second angle. Thus, as an animal moves its position relative to the structure it will see the object change from the first colour to the second colour. The phenomenon of appearing different colours when viewed from different angles is called iridescence, and it is a unique attribute of structural colour. Iridescence can cover a few or many different colours, and can be in regions of the spectrum visible to a variety of animals, including in the ultraviolet (UV).

STRUCTURAL COLOUR AND IRIDESCENCE — MECHANISMS USED BY ANIMALS

The mechanisms capable of producing structural colour in animals were described by both Hooke and Newton in the 17th and early 18th centuries, and a large body of literature has subsequently been produced, much of which is covered in several recent reviews (Parker, 2000; Vukusic and Sambles, 2003; Doucet and Meadows, 2009). A very brief overview shows that structural colour can be produced by either incoherent or coherent light scattering.

Incoherent light scattering takes place when individual light-scattering structures are randomly separated from one another by an average distance that is large when compared with the wavelength of the light. The light-scattering structures differentially scatter different visible wavelengths, but in such a way that the phase relationship of the scattered wavelengths is random. Although most structural colour in animals is produced by coherent light scattering, the

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blue colouration in many amphibians is attributed to incoherent scattering (Bagnara *et al.*, 2007), as is the blue colour of the sky.

The majority of structural colour, and all iridescence, in animals is produced by coherent light scattering, which occurs when the distribution of light-scattering elements, and the resulting phase relationship of reflected light waves, is precisely ordered. An ordered distribution of light scatterers can result in either constructive or destructive interference. If the phase difference between two waves is a multiple of exactly one full wavelength then the two waves constructively interfere with each other and there is a strong reflection of light at that particular wavelength. By contrast, if the phase of the reflected waves differs by half a wavelength, or an odd multiple of half wavelengths, then destructive interference occurs such that reflection of this wavelength is weak or absent.

The simplest type of coherent light scattering is that of thin-film interference, which gives the colour to soap bubbles and oil-slicked puddles. Thin-film interference occurs when two transparent layers of materials with different optical densities meet. The optical density of a material determines the extent to which light waves are slowed down as they pass through it. Light is also reflected at each side of the boundary between the two materials — both before and after passing through each individual layer. Optical density, the thickness of the material layer, and the angle and wavelength of the light all help to determine if the light reflecting from the bottom of a layer is in phase or out of phase with the light reflected from the top of the layer, which will in turn determine whether constructive or destructive interference occurs for each wavelength. Constructive interference for one wavelength and destructive interference for others results in the reflected light being of one colour. Multilayer reflectors that produce structural colour consist of ordered layers of these pairs of thin films layered in series, producing even stronger constructive interference for specific wavelengths and resulting in very pure, intense colours (Fig. 2B). The classic example of multilayered structural colour in animals is shown by the blue *Morpho rhetenor* butterfly, in which the multilayered structure on its wing scales produces a vivid blue colour of such intensity that it is said to have a visibility of up to half a mile (Vukusic *et al.*, 1999; Vukusic and Sambles, 2003).

A diffraction grating consists of a reflective surface over which runs a series of ordered and precisely spaced parallel grooves (Fig. 2C). Some of the light that hits the surface is reflected as normal, but light that hits the grooves is diffracted — split into its component wavelengths — and each wavelength is reflected at a different angle. Light with longer wavelengths has a higher diffraction angle than light with shorter wavelengths, so the light separates into its component parts, producing the rainbow effect that can be easily seen over the surface of a CD. Several beetle and spider species have been found to produce iridescence through this mechanism (Parker and Hegedus, 2003; Seago *et al.*, 2009).

Iridescence can also result from the presence of photonic crystals, which are ordered three-dimensional structures. The classic example of a photonic crystal is opal, which consists of tiny spheres of silica packed together. The diffraction of light through opal is determined by the size and regularity of the spheres, which in turn determines the colours shown. Three-dimensional structures

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generating iridescence have been found in a wide range of animals, including comb-jellies, several butterfly species, the feathers of a number of bird species and in the annelid *Aphrodita* sp. (Parker *et al.*, 2001; Vukusic and Sambles, 2003; reviewed in Welch and Vigneron, 2007). The spines of *Aphrodita* species show a multicoloured iridescence that is caused by a structure of holes ordered in hexagonal crystal structure within the spines (Parker *et al.*, 2001). Biological photonic crystals can vary greatly in both form and method of function.

MECHANISMS OF PLANT STRUCTURAL COLOUR AND IRIDESCENCE

Structural colour and iridescence have arisen multiple times in the animal kingdom, so it is hardly surprising that they are also found in plants. All the general mechanisms used by animals to produce structural colour are also used by plants. Like animals, plants produce structural colour by both coherent and incoherent scattering. Incoherent 'Rayleigh' scattering (by particles smaller than the wavelength of light reflected) has been found in a number of plant species. The wax deposits on blue spruce (*Picea pungens*) and chalk dudleya (*Dudleya brittonii*) scatter shorter wavelengths of light preferentially, resulting in a blue colouration to the leaves (Vogelmann, 1993).

Iridescence has been shown to be produced by both multilayers (Fig. 2B) and diffraction gratings (Fig. 2C) in plants. The first example of multilayered iridescence in plants was found in the lycophyte *Selaginella*. Two species of *Selaginella*, *S. willdenowii* and *S. uncinata*, produce a vivid blue–green iridescence on their leaves when growing in shade. In the first detailed study into the mechanisms of plant iridescence, Hébant and Lee (1984) found that *Selaginella* leaves had two layers in the outer cell wall of their epidermal cells. These layers, visible under transmission electron microscopy, were each approx. 80 nm thick, the predicted thickness to cause multilayer interference that would result in the observed iridescence. These two layers were not found in ordinary green *Selaginella* leaves grown under higher light conditions and lacking iridescence (Hébant and Lee, 1984). Other plants with iridescent leaves are also found in low light environments, and all produce a similar blue–green iridescence. Although the multilayers in *Selaginella* appear to be relatively simple, with only a few layers producing the iridescence, other plant species produce more elaborate structures. The outer epidermal cell walls of the iridescent ferns *Danaea nodosa*, *Diplazium tomentosum* and *Lindsaea lucida* have many repeated dense layers alternating with arcs of cellulose microfibrils. The layers are of the correct thickness to cause iridescence through interference in the young iridescent leaves, but these layers are missing in the older leaves, which show no iridescence. The angle of the cellulose microfibrils changes gradually through the alternating layers up to a total 180 ° rotation (Graham *et al.*, 1993; Gould and Lee, 1996; Lee, 2007). The resulting helicoidal structure is remarkably similar to the helical stack of chitin microfibrils found in some iridescent beetle species and may therefore be an example of convergent evolution (Lee, 2007; Seago *et al.*, 2009). Leaf iridescence can also be caused by multilayers within the protoplast, not just within the cell wall. In the fern *Trichomanes elegans* and the angiosperms *Phyllagathis rotundifolia* and *Begonia pavonina*, specialized plastids called 'iridoplasts' are found in the

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iridescent leaves. These iridoplasts are much flatter than chloroplasts, and the thylakoid stacks within them are in such close contact that they form layers that cause the interference of light, resulting in the iridescent blue colouration (Graham *et al.*, 1993; Gould and Lee, 1996; Lee, 2007).

Multilayers generating iridescence are also found in the fruits of *Elaeocarpus angustifolius* and *Delarbrea michiana*, in this case arising from a structure called an 'iridosome'. This is secreted to the region outside the cell membrane of fruit epidermal cells, and consists of layers of cellulose that are of the predicted thickness to cause interference colouration (Lee, 1991; Lee *et al.*, 2000).

Diffraction gratings were identified in plants more recently, with the first report of their presence on the petals of species including *Tulipa* sp., *Hibiscus trionum* (Fig. 3A) and *Mentzelia lindleyi* (Fig. 3E) published in 2009. In these species the petal epidermal cells are elongated and flat and the overlying cuticle produces a series of long, ordered ridges with a periodicity that acts as a diffraction grating and splits the light reflecting from the surface into component wavelengths (Fig. 3B, C; Whitney *et al.*, 2009*a*). The iridescence produced is often predominantly in the UV wavelengths, which, although invisible to the human eye, are easily visible to many animal pollinators including bees and birds. The cuticular striations creating floral iridescence can also occur in patterns overlying those caused by pigment colour (Whitney *et al.*, 2009*a*, *b*).

Plant iridescence. (A) The inner part of the *Hibiscus trionum* petal has an oily iridescence overlying red pigmentation. (B) Scanning electron microscopy of this region shows that the cells overlying the red pigment are covered with a diffraction grating made from cuticular striations, although the cells over the white region are smooth. (C) When petal diffraction gratings are replicated in transparent optical epoxy, light reflected from the epoxy is not white but shows a range of colours. (D) The iridescent labellum of *Ophrys speculum* is thought to mimic the wings of female pollinators. (E) *Mentzelia lindleyi* is iridescent as a result of diffraction gratings, but the iridescence is only detectable in the bee-visible UV region of the spectrum.

Flowers are also the site of the one example of a three-dimensional photonic structure that has been found in plants. The elongated hairs that cover the attractive bracts surrounding edelweiss flowers (*Leontopodium nivale* subsp. *alpinum*) have an internal structure that acts as a photonic crystal (Vigneron *et al.*, 2005). The hairs are hollow tubes with a series of parallel striations around the external surface. Through diffraction effects, the hairs absorb the majority of the UV light, effectively acting as an efficient sun-block. A variety of other epidermal cell morphologies are also known to influence light capture and reflection in petals (Kevan and Backhaus, 1998).

FUNCTIONS OF ANIMAL IRIDESCENCE

Iridescence appears to have as varied a range of functions as it does methods of production in the animal kingdom. The recent review by Doucet and Meadows (2009) gives a clear overview of the functions of animal iridescence. The most frequent role of animal iridescence appears to be in visual communication. Iridescence can relay information about the animal's species (Silberglied and Taylor, 1978), about its age if iridescence changes or deteriorates over time (Kemp, 2006; Bitton and Dawson, 2008), about sex, as in

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many species only one sex has iridescence (Rutowski, 1977), and nutritional status, as individuals with poor nutrition may lack the resources to produce very vivid colouration (Kemp and Rutowski, 2007). Iridescence has also been found to play an important role in mate choice in birds, butterflies and fish (Kodric-Brown and Johnson, 2002; Sweeney *et al.*, 2003; Kemp, 2007), while the depth of the blue structural colour on the testicles indicates the degree of dominance within the troop of a male vervet monkey (Prum and Torres, 2004).

As well as providing information for other animals, structural colour has also been implicated in helping animals avoid detection by their predators, either by mimicry or by camouflage. Colourful reef fish are well camouflaged against the equally colourful corals, while tiger beetles blend a range of structural colours together to produce a matt camouflage (Schultz, 1986; Schultz and Bernard, 1989; Seago *et al.*, 2009).

FUNCTIONS OF PLANT IRIDESCENCE

As with animals, structural colour in plants is important in both display and defence. However, in plants the targets of the display are not other plants but pollinating insects, and the defence may be against potentially damaging levels of light as well as animal predators.

The primary function of flower and fruit iridescence is likely to be the attraction of animals, particularly those species whose visual systems are attuned to iridescence for animal–animal communication. The fruits of *Elaeocarpus* and *Delarbrea michiana* (Lee, 1991; Lee *et al.*, 2000) have an iridescence that is thought to enhance animal attraction. Iridescence has also been shown to attract pollinating insects. It has been believed for some time that iridescence is used by pseudocopulatory flowers (such as species of *Ophrys*, Fig. 3D) to mimic female insects visually, but we were able to show that iridescence can act as an ordinary, learnable cue, in the same way that flower colour or shape might (Whitney *et al.*, 2009*a*). Foraging bumblebees were trained that iridescent targets (generated by an artificial diffraction grating) contained a reward, whether they had a basic pigment colour of purple, blue or yellow, and that non-iridescent targets in the same pigment colours did not. The bees learned the iridescent cue, and were able to use it when presented with red targets to identify correctly the rewarding ones. The diffraction gratings generating floral iridescence often occur in patterns overlying those caused by pigment colour (Whitney *et al.*, 2009*b*), suggesting that they might enhance pigment-based learnable cues.

The ability of structural colour to reflect strongly in specific wavelengths is thought to provide photoprotection to leaves. The Rayleigh scattering shown by *Picea pungens* and *Dudleya brittonii* is thought to result in enhanced reflection of shorter wavelengths, and thus to give protection against UV damage (Vogelmann, 1993). Protection against UV is also thought to be the primary function of the photonic crystal hairs overlying the surface of the edelweiss bracts, which protect the reproductive tissues against the potentially mutagenic UV levels found at the altitudes where this plant grows (Vigneron *et al.*, 2005). Photoprotection may also be the function of the blue multilayer iridescence produced by understorey plants such as *Danaea nodosa*, *Diplazium tomentosum*, *Lindsaea lucida* and *Begonia pavonina*. These plants are all adapted to low light conditions, and so might be at risk of photodamage if they encountered sunflecks

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or other high-intensity light. The iridescent blue leaves of *Begonia pavonina* recovered significantly more rapidly from light exposure than green non-iridescent leaves, although no difference was found between the iridescent and non-iridescent leaves of *Diplazium tomentosum* (Lee, 2007).

In contrast, it has been hypothesized that the iridescence of *Selaginella* species might aid the capture of photosynthetically active wavelengths in low light conditions because the leaf iridescence may act as a natural anti-reflective coating. Such coatings (on glasses and cameras) use thin film structures, analogous to those found in the iridescent *Selaginella* leaf, to produce constructive interference for certain wavelengths, increasing transmission of those wavelengths, but a side-effect is that the wavelengths not transmitted are strongly reflected because of destructive interference. In the same way, the iridescence in *Selaginella* could enhance blue-light reflection while enriching red-light absorption (Hébant and Lee, 1984).

OUTLOOK

Our understanding of plant structural colour and iridescence lags some way behind the work in animals, perhaps because plant pigment biochemistry has been studied so successfully or perhaps because animal structural colours are so striking. It is not surprising that similar mechanisms to generate structural colour have evolved in both plants and animals, but it will be important in the years to come to establish the molecular mechanisms underlying the development of these structures, which are likely to be very different in organisms with such basic differences in body architecture. The identification of structurally coloured plant species that are amenable to a genetic or transgenic dissection of candidate genes will be necessary to allow such work to progress rapidly. Preliminary studies suggest that some members of the Compositae, a number of petaloid monocots and certain species of Solanaceae might represent good targets for molecular and developmental analysis. It is also apparent that plant structural colour has evolved to mediate plant responses to both biotic and abiotic factors. A primary role is for communication with animals, and structures are therefore likely to target colours visible to pollinating or predatory species. One immediate challenge is to investigate how many species show structural colour (or iridescence) restricted to the UV region of the spectrum, and therefore invisible to the human eye. Investigation of the UV reflectance of flowers pollinated by insects that are themselves iridescent might be fruitful, as the visual acuity of such animals is already entrained to shifting colours, rather than to static ones. Such a study will also provide an understanding of the evolutionary lability of structural colour, and of the extent to which it appears to have co-evolved in response to interactions with particular groups of insect. Given that we do not currently have a good understanding of which plants produce structural colour, how they produce it and what they produce it for, one of the most exciting aspects of plant structural colour is the amount that still remains to be learned.

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Calibrating the Tree of Life: fossils, molecules and evolutionary timescales

Félix Forest Jodrell Laboratory, Royal Botanic Gardens, Kew, Richmond, Surrey TW9 3DS, UK July 9, 2009.

Abstract

Background: Molecular dating has gained ever-increasing interest since the molecular clock hypothesis was proposed in the 1960s. Molecular dating provides detailed temporal frameworks for divergence events in phylogenetic trees, allowing diverse evolutionary questions to be addressed. The key aspect of the molecular clock hypothesis, namely that differences in DNA or protein sequence between two species are proportional to the time elapsed since they diverged, was soon shown to be untenable. Other approaches were proposed to take into account rate heterogeneity among lineages, but the calibration process, by which relative times are transformed into absolute ages, has received little attention until recently. New methods have now been proposed to resolve potential sources of error associated with the calibration of phylogenetic trees, particularly those involving use of the fossil record.

Scope and Conclusions: The use of the fossil record as a source of independent information in the calibration process is the main focus of this paper; other sources of calibration information are also discussed. Particularly error-prone aspects of fossil calibration are identified, such as fossil dating, the phylogenetic placement of the fossil and the incompleteness of the fossil record. Methods proposed to tackle one or more of these potential error sources are discussed (e.g. fossil cross-validation, prior distribution of calibration points and confidence intervals on the fossil record). In conclusion, the fossil record remains the most reliable source of information for the calibration of phylogenetic trees, although associated assumptions and potential bias must be taken into account.

Key words Calibration, fossil, incompleteness, molecular dating, rate heterogeneity, relaxed molecular clock, uncertainty

INTRODUCTION

The use of DNA sequences to estimate divergence times on phylogenetic trees (molecular dating) has gained increasing interest in the field of evolutionary biology in the past decade. The abundance of publications on the subject, the numerous alternative methods proposed and the often heated debates on various aspects of the discipline demonstrate the interest it generates. The molecular clock hypothesis was first proposed by Zuckerkandl and Pauling (1965); they proposed that differences in DNA (or protein) sequences between two species are proportional to the time elapsed since the divergence from their most recent common ancestor.

The subsequent inclusion of temporal frameworks in many evolutionary studies has influenced the way results are interpreted and significantly modified the way in which conclusions are drawn from these findings. Linking the

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evolution of particular morphological characters or key ecological innovations to geological, climatic or biotic events is much improved in the light of an evolutionary timescale. The development of molecular dating tools became particularly valuable to the discipline of historical biogeography; it added a temporal gauge to the directionality of events demonstrated by the topology of phylogenetic trees. Inferences on observed distribution patterns were rendered significantly more plausible under a temporal framework, even if only descriptive. Furthermore, new methods of biogeographical reconstruction have been developed such as *Lagrange*, which uses a likelihood framework to infer the evolution of geographical ranges and incorporates divergence times as well as constraining the connections between areas to specific times (Ree and Smith, 2008).

The rationale of the molecular clock hypothesis, that evolutionary rates are constant, was shown to be invalid in the majority of examined cases; the clock does not tick regularly. The heterogeneity of substitution rates among different lineages in a phylogenetic tree explains this irregularity (Britten, 1986) and is a result of species-specific factors such as generation time, metabolic rate, effective population size and mutation rates (see Rutschmann, 2006). The extent of influence of some such factors, however, remains in dispute (e.g. Whittle and Johnston, 2003).

Rutschmann (2006) classified the most commonly employed methods for estimating divergence times into three categories depending on how they handle rate heterogeneity, namely (1) assuming a global substitution rate (standard molecular clock); (2) correcting for rate heterogeneity (e.g. by deleting branches or incorporating several rates categories before the dating procedure), and (3) incorporating rate heterogeneity (i.e. integrating rate heterogeneity into the dating procedure using rate change models; relaxed molecular clock). The four most commonly used methods in the literature all fall into the third category; these are non-parametric rate smoothing (NPRS; Sanderson, 1997), penalized likelihood (PL; Sanderson, 2002), the Bayesian method implemented in the Multidivtime package (Thorne *et al.*, 1998) and Bayesian evolutionary analysis by sampling trees (BEAST; Drummond and Rambaut, 2007). The first three of these methods assume rate changes between ancestral and descendant lineages are autocorrelated, i.e. that substitution rates in descendant lineages are to an extent inherited from ancestral lineages; these methods differ in the way that rate autocorrelation is handled. BEAST does not assume rate autocorrelation; instead, it samples rates from a distribution. Additional flexibility is found in BEAST in its optional tree topology requirement that can incorporate phylogenetic uncertainty, and the possibility of assigning distributions to the calibration process *a priori* (see below). More details on these methods and several others are available elsewhere (Rutschmann, 2006, and references therein).

Two main topics have fuelled the controversy associated with molecular clocks: these are how to handle rate heterogeneity and calibration. At its outset, the field of molecular dating was focused on circumvention of rate heterogeneity among lineages. Meanwhile calibration, the process by which relative time is transformed into absolute age (e.g. million of years) using information independent of the phylogenetic tree and its underlying data, was somewhat

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trivialized. This situation has changed in recent years and many studies have now addressed the numerous difficulties associated with calibration. This paper is focused on molecular clock calibration (particularly based on palaeontological data), the potential problems and source of error associated with it, and the various methods proposed to incorporate these uncertainties in molecular estimates of divergence times.

SOURCES OF CALIBRATION INFORMATION

Information used to calibrate a phylogenetic tree is obtained from three principal sources: (1) geological events; (2) estimates from independent molecular dating studies; and (3) the fossil record. Information from palaeoclimatic data has also been used to calibrate trees (e.g. Baldwin and Sanderson, 1998), but its use is limited and will not be discussed further here. The fossil record is the most commonly employed source of information to calibrate phylogenetic trees and will receive most attention here.

Plate tectonics, the formation of oceanic islands of volcanic origin and the rise of mountain chains are examples of geological events that can be used to calibrate phylogenetic trees. The assignation of such calibration points to a given node assumes that the divergence at this node is the result of this new geographical barrier, through either vicariance (e.g. continental split) or dispersal (e.g. oceanic islands) events. This type of calibration must be used with care in studies examining biogeographical patterns to avoid circular reasoning. Despite appearing less prone to imprecision than the use of the fossil record, geological events have their own suite of potential and often intractable problems. The timings of continental splits are often reported as unique values, but the actual separation of two continental plates occurred over millions of years (and is a continuous process). Furthermore, as two land masses drift apart, biological exchanges between them are likely to continue for several million years depending on the dispersal abilities of the organisms involved. These two points render the use of continental splits as calibration points a choice rather difficult to justify. Similar problems can be attributed to the rise of mountain chains; these phenomena take place over a long period of time (several tens of millions of years in the case of the Andes; e.g. Garzione *et al.*, 2008) and exchanges between each side of a new geographical barrier will continue for some time.

Species endemic to oceanic islands of volcanic origin and therefore of known age can be used to apply a maximum age constraint on the divergence between the endemic species and their closest continental relatives. This approach accounts for the likelihood that the ancestor of the island endemic species arrived at an unspecified time after the formation of the oceanic island. Present-day oceanic islands, however, might only be the most recent element of a series of oceanic island formation over time in a particular region (Heads, 2005), which would invalidate their use as reliable calibration constraints. For example, molecular dating of Galapagos endemic iguanas shows that their dispersal to the archipelago pre-dates the age of the current islands (Rassmann, 1997). Submerged islands found in the vicinity of the present day islands suggest that the Galapagos archipelago is in fact much older (10–15 Mya to 80–90 Mya) than the extant islands (Hickman and Lipps, 1985; Christie *et al.*, 1992). A similar situation is observed in Hawaii, leading some to describe evolutionary history on this

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SOURCES OF CALIBRATION INFORMATION

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Plate tectonics, the formation of oceanic islands of volcanic origin and the rise of mountain chains are examples of geological events that can be used to calibrate phylogenetic trees. The assignation of such calibration points to a given node assumes that the divergence at this node is the result of this new geographical barrier, through either vicariance (e.g. continental split) or dispersal (e.g. oceanic islands) events. This type of calibration must be used with care in studies examining biogeographical patterns to avoid circular reasoning. Despite appearing less prone to imprecision than the use of the fossil record, geological events have their own suite of potential and often intractable problems. The timings of continental splits are often reported as unique values, but the actual separation of two continental plates occurred over millions of years (and is a continuous process). Furthermore, as two land masses drift apart, biological exchanges between them are likely to continue for several million years depending on the dispersal abilities of the organisms involved. These two points render the use of continental splits as calibration points a choice rather difficult to justify. Similar problems can be attributed to the rise of mountain chains; these phenomena take place over a long period of time (several tens of millions of years in the case of the Andes; e.g. Garzione *et al.*, 2008) and exchanges between each side of a new geographical barrier will continue for some time.

Species endemic to oceanic islands of volcanic origin and therefore of known age can be used to apply a maximum age constraint on the divergence between the endemic species and their closest continental relatives. This approach accounts for the likelihood that the ancestor of the island endemic species arrived at an unspecified time after the formation of the oceanic island. Present-day oceanic islands, however, might only be the most recent element of a series of oceanic island formation over time in a particular region (Heads, 2005), which would invalidate their use as reliable calibration constraints. For example, molecular dating of Galapagos endemic iguanas shows that their dispersal to the archipelago pre-dates the age of the current islands (Rassmann, 1997). Submerged islands found in the vicinity of the present day islands suggest that the Galapagos archipelago is in fact much older (10–15 Mya to 80–90 Mya) than the extant islands (Hickman and Lipps, 1985; Christie *et al.*, 1992). A similar situation is observed in Hawaii, leading some to describe evolutionary history on this

archipelago as on a 'volcanic conveyer belt'. Calibration based on species endemism to volcanic islands can be difficult to justify and caution is advised.

The use of estimates derived from independent molecular dating studies (also referred to as secondary or indirect calibration points) is the only source of calibration information for many groups, particularly for those in which the fossil record is scarce or non-existent. The primary problem with this approach is that sources of error generated by the first dating exercise remain and are propagated and likely to be magnified in subsequent analyses. The use of secondary calibration points should be a last resort and, when used, care should be taken to include error associated with the primary molecular estimate in the subsequent analysis (e.g. using confidence intervals or standard deviation as minimum and maximum values on a given node, or using a prior distribution; see below). Failure to take this error into account can result in estimates of divergence times with broader uncertainty, and thus of little use or scientific value. The use of substitution rates from independent studies to calibrate a phylogenetic tree also falls under this category of calibration (e.g. Richardson *et al.*, 2001) and suffers drawbacks similar to those described above.

There is general consensus that the fossil record provides by far the best information with which to transform relative time estimates into absolute ages (e.g. Magallón, 2004). As with other sources of calibration information, the use of fossilized remains has disadvantages and is subject to various sources of errors. Nevertheless, promising methods recently proposed attempt to tackle these issues. The focus of the following discussion is on calibration using palaeontological data, but many of the aspects addressed below are also applicable to geological events and secondary calibration points.

UNCERTAINTY AND THE FOSSIL RECORD

Sources of error in molecular inference of divergence time are numerous, including phylogenetic uncertainty, substitution noise and saturation, rate heterogeneity (among lineages, over time and between DNA regions), incomplete taxon sampling and incorrect branch length optimization (e.g. Sanderson and Doyle, 2001; Magallón and Sanderson, 2005). The calibration process is not exempt from potential sources of error either; these include erroneous fossil age estimates, the incompleteness of the fossil record and the placement of fossils on phylogenetic trees. Although often difficult to circumvent, much progress has recently been made in mitigating these factors.

Generally, a taxon's first appearance in the fossil record represents the time it became abundant rather than the time of its emergence (Magallón, 2004). Considering estimates from the fossil record as actual ages would underestimate the true age of the clade to which the fossil is assigned (Benton and Ayala, 2003; Conti *et al.*, 2004). Older fossils assigned to a given group are likely to be discovered and to push back in time the earliest occurrence of a lineage; thus the age of a fossil is generally treated as a minimum constraint in calibration procedures (e.g. Benton and Ayala, 2003; Near *et al.*, 2005). This means that the clade on which the constraint is applied cannot be younger than the fossil.

Fossil remains can be dated by use of stratigraphic correlations or radiometric dating. Uncertainty is introduced here as a result of any unreliability in the age assessment itself and the imprecision of the estimate when the fossil is

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assigned to a particular geological division (or stratum). For example, a fossil assigned to the Palaeocene can theoretically have any age between 55·8 and 65·5 Mya. Any time assigned to a calibration point within this epoch would be technically appropriate, but would result in significantly different estimates for the other nodes in the tree. To counter this, because the fossil represents a minimum age, it is preferable to use the upper boundary of the geological division (in this case 55·8 Mya) in a molecular dating study, once again as a minimum constraint. Some programs permit specification of a prior distribution on the age of a node which takes into account the uncertainty associated with the dating of a fossil (Drummond and Rambaut, 2007; see below).

The fragmentary nature of the fossil record and lineage extinction have important consequences for the accurate placement of fossil calibration points. Once a fossil has been accurately assigned to a group of extant taxa based on one or more synapomorphies, it is placed on the phylogenetic tree either with the stem group or with the crown group (Fig. 1). The crown group comprises all the extant taxa of a clade and their most recent common ancestor plus all the extinct taxa that diverged after the origin of the most recent common ancestor of the living taxa. The stem group comprises all the members of the crown group (extinct and extant) plus all the extinct taxa that diverged since the split of the crown group from its closest living relative (Fig. 1). In any rooted phylogenetic tree, all internal nodes are both stem group nodes and crown group nodes; the definition of stem and crown group nodes is relative to the other nodes in the tree (e.g. in Fig. 1, node 2 is the crown group node of clade B and the stem group node of clade A). Because the fossil record is fragmentary, one can never be certain that a given fossil will possess features that place it in the crown group rather than along the stem lineage leading to the crown group. Consequently, there can be large and difficult to quantify discrepancies between the time of divergence of a lineage, the time of appearance of a synapomorphy (a particular feature characterizing a clade) and the age of the oldest known fossil exhibiting this feature (Magallón, 2004; Fig. 1). This highlights the importance of taking the most conservative options (i.e. options resistant to subsequent changes that would invalidate the assumptions regarding the position of a fossil) in calibration by use of fossils as minimum constraints on the stem group node.

Ultrametric tree (in which branch lengths represent time) of extant taxa (solid branches) with the placement of fossil taxa (dashed branches). The designation of a node as either a crown group or stem group is relative; node 1 is the crown group node of clade A; node 2 is the stem group node of clade A, but also the crown group node of clade B; and node 3 is the stem group node of clade B. Fossil X has been assigned to the stem lineage leading to clade A based on one or more shared synapomorphies. If this fossil was to be used as calibration point, its age would be assigned as minimum constraint on the stem group node of clade A (node 2). Placing the calibration point on the crown group node of clade A (node 1) would result in an overestimation of molecular ages. The use of fossils as minimum constraints takes into consideration the incompleteness of the fossil record; should older fossils be discovered (such as fossil '?'), the minimum constraint placed on node 2 using this fossil would not be invalidated.

An exception to the rule of using fossils as minimum constraints can be applied to fossilized pollen grains. Pollen grains have a much higher fossilization

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An exception to the rule of using fossils as minimum constraints can be applied to fossilized pollen grains. Pollen grains have a much higher fossilization

potential than any other plant organs, but not all plant groups will have an extensive pollen fossil record or possess palynological features assigned with confidence to extant taxa. Tricolpate pollen grains (those with three apertures or colpi), for example, are unique to the eudicots in plants, and age estimates for these fossils place them in the Barremian and Aptian of the early Cretaceous (130–112 Mya; e.g. Doyle and Hotton, 1991); earlier occurrence is thought to be very unlikely. The abundance and widespread distribution of early tricolpate pollen fossils coupled to their easily identified features has led to their frequent use as a maximum constraint or fixed age in molecular dating of angiosperms (e.g. Anderson *et al.*, 2005; Magallon and Castillo, 2009). It is only in such rare cases that fossils can be used as maximum constraints or fixed ages without serious risk of underestimating molecular ages.

The incompleteness of the fossil record also leads inevitably to the underestimation of node ages in a phylogenetic tree (Springer, 1995), presenting significant discrepancies between estimates obtained from the fossil record and molecular dating (e.g. Benton and Ayala, 2003). The selectivity of fossilization is largely responsible for this situation. Different plant groups (e.g. deciduous anemophilous trees are better represented in the fossil record than entomophilous/zoophilous herbs) and structures (e.g. pollen is more easily preserved than flowers) have different preservation potential (Herendeen and Crane, 1995); thus the fossil record is biased towards groups and structures more conducive to fossilization.

Several methods have been developed by which to estimate the extent of incompleteness of the fossil record. Earlier studies proposed statistical approaches to calculate confidence intervals on stratigraphic ranges; the earliest occurrence of a given group in the fossil record is estimated by use of the number of known fossils and the number and size of gaps in the stratigraphic column (Strauss and Sadler, 1989; Marshall, 1990, 1994). Because these methods do not take into account the quality and density of the fossil record, Marshall (1997) proposed an additional function that allows for bias linked to collecting and preservation potential. Subsequently, Foote and colleagues (e.g. Foote, 1997; Foote *et al.*, 1999) estimated rates of extinction, origination and preservation from the fossil record to produce a measure of completeness [see Magallón (2004) for more details on these methods]. Tavaré *et al.* (2002) proposed a method based on an estimate of the proportion of preserved species in the fossil record and the diversification patterns of the group. More recently, Marshall (2008) developed a quantitative approach to estimate maximum age constraints of lineages using uncalibrated ultrametric trees (i.e. with relative branch length optimization) and multiple fossil calibration points. Assessing the fossil record of a group using the procedures outlined above would theoretically produce a realistic age estimate for this group. Furthermore, the resulting estimate of earliest occurrence can be used as a fixed age or maximum constraint in subsequent molecular dating studies, minimizing the uncertainty associated with the age of a given fossil.

NEW METHODS FOR FOSSIL CALIBRATION

Many early molecular dating studies used a single fossil as a calibration point; this practice is now believed to lead to strong bias in molecular age estimates (e.g. Graur and Martin, 2004; Reisz and Müller, 2004). Where possible, it is currently advocated that multiple fossils should be used in the

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calibration process (e.g. Conroy and Van Tuinen, 2003; Graur and Martin, 2004; Forest *et al.*, 2005; Near *et al.*, 2005; Benton and Donoghue, 2007; Rutschmann *et al.*, 2007), although an extensive and reliable fossil record is not always available. However, if the intrinsic accuracy of a fossil is questionable (i.e. doubtful age estimate assigned to an extant group or representing a lineage with a large gap between its divergence and the first appearance of remains in the fossil record), it is better excluded from the analysis (see above; Near *et al.*, 2005). Near *et al.* (2005) proposed a fossil cross-validation procedure that allows potentially inaccurate fossils to be identified when multiple fossils are used to calibrate a phylogenetic tree. This method compares the molecular age estimates produced by the calibration of the phylogenetic tree with one of the fossils with the age estimates from the fossil record for the other nodes used in the calibration procedure. Individual fossils that produce age estimates inconsistent with the remainder of the fossils used as calibration points are removed (Near *et al.*, 2005) and the analysis is repeated, but including only reliable fossils as calibration points. Rutschmann *et al.* (2007) built on the fossil cross-validation method of Near *et al.* (2005) to address another problem: the multiple potential positions of a given fossil on the phylogenetic tree. They assessed the effect of the alternative positions of each fossil on the consistency of the age estimates in a set of calibration points. This allows the selection of the best position on the phylogenetic tree for each fossil given an *a priori* selected set of assignment possibilities. By use of this approach, no calibration information is removed from the dating procedure (contrary to the method of Near *et al.*, 2005, in which ambiguous fossils are removed), and the method provides more precise estimates because the most coherent calibration sets produce lower standard deviation (Rutschmann *et al.*, 2007). Concern has been raised that such cross-validation methods might lead to the exclusion or repositioning of fossils that are not necessarily misleading, but rather misinterpreted (e.g. placement, dating) or victims of bias in the dating procedure itself (Hugall *et al.*, 2007; Parham and Irmis, 2008; Lee *et al.*, 2009).

Lee *et al.* (2009) recognize the usefulness of the two methods mentioned above, but note that the imprecision surrounding the phylogenetic position of a given calibration is not calculated in these methods. They propose a new method that integrates this uncertainty. This approach allows the inclusion of fossils in a combined matrix of morphological and molecular characters analysed under a Bayesian framework, and the assessment of estimates among sampled trees based on the position of the fossil in each particular tree as determined by the analysis (Lee *et al.*, 2009). They demonstrate that the uncertainty associated with the phylogenetic position of a fossil used as calibration point can result in molecular age estimates with large confidence intervals (Lee *et al.*, 2009).

While the three above methods deal with uncertainty associated with the phylogenetic position of fossil calibration points, another recent method implemented in the program BEAST (Drummond and Rambaut, 2007) allows the user to include in addition a level of uncertainty on the age of a given fossil using a prior distribution. The prior distribution of the age is assigned to the most recent common ancestor of a group of taxa circumscribed by the user (Drummond *et al.*, 2006); these prior distributions are various (e.g. normal, lognormal or uniform). Applying a normal distribution would assume that the age of this node is equally likely to be older or younger than the fossil, how

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much so being determined by the standard deviation specified. A normal prior distribution is more appropriate for calibration points based on estimates from independent molecular studies (secondary calibrations) and geological events such as oceanic islands, in which it can be argued that uncertainty is equally distributed on either side of the age used (the mean of the distribution). For a calibration point based on fossil remains, a lognormal prior distribution covering a longer period of time towards the past is more appropriate, allowing for uncertainty of the age estimate of the fossil and for error associated with the incompleteness of the fossil record. The method implemented in the program BEAST provides a significant improvement over other methods, particularly as it considers uncertainty associated with tree topology and calibration.

CONCLUSIONS

In recent literature, some authors have voiced their concerns regarding molecular dating methods in general and the calibration procedure in particular (e.g. Graur and Martin, 2004; Heads, 2005; Pulquério and Nichols, 2007). The importance of a carefully designed calibration scheme in a molecular dating study cannot be overemphasized; it is one of the most fundamental aspects of the methodology. The identification of reliable fossils is a crucial step in this procedure, but finding unequivocal fossils may prove to be a tedious task in some plant groups. The lack of fossils in a given group may prevent the use of molecular dating completely. However, fossils from closely related groups may be used as calibration points if taxa representing them are included in the phylogenetic tree, but the further the calibration point is positioned in relation to the node(s) of interest, the greater will be the uncertainty of the resulting age estimates. A good starting point in the search for fossil calibration points is the Plant Fossil Record online database maintained by the International Organisation of Palaeobotany (www.biologie.uni-hamburg.de/b-online/library/iopaleo/pfr.htm), which contains several thousand extinct taxa from both modern and extinct genera.

The development of methods addressing the potential problems affecting calibration, particularly based on fossil data, has elegantly addressed some of the criticisms mentioned above and provided new opportunities and tools for more reliable calibration of phylogenetic trees. The program BEAST (Drummond and Rambaut, 2007) is one of the most promising methods on account of its flexibility regarding uncertainty in fossil age estimates, mainly due to the dating of the fossil and the incompleteness of the fossil record. The next phase in software development for molecular dating would include programs allowing better estimation of uncertainty by incorporating fossil cross-validation procedures, taking into consideration fossil abundance data and integrating the calculation of confidence intervals on the fossil record.

The assumptions and bias inherent to aspects of the methodology are not the only obstacles to reliable and plausible timescales; dating results must be viewed in light of the information that was used to obtain them, and uncertainty around resulting age estimates must be considered. Molecular dating is a powerful tool and its use continues unabated because it offers a tantalizing and otherwise unavailable glimpse into the evolutionary history of a group.

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Changes Seen in Rainfall. Trends in March, June and October Since 1945 in Spain

ScienceDaily (Mar. 22, 2010) — An international team led by the University of Zaragoza (UNIZAR) has produced MOPREDAS, the most complete database to date on monthly precipitations in the Iberian Peninsula. This has been used to analyse monthly rainfall trends between 1945 and 2005 in the Spanish part of the Iberian Peninsula.

The aim of this study is «to respond to a request in the ministerial report about the impacts of climate change in Spain, which highlights the lack of detailed studies into rainfall in Spain or a database that covers the entire country,» José Carlos González-Hidalgo, lead author of the study and a tenured professor of Physical Geography in the Faculty of Geography at UNIZAR, said.

The study, which has just been published online in the International Journal of Climatology, shows that March, June and October are the months that show significant changes in precipitation trends across large areas of the Iberian Peninsula.

Precipitation has declined in quantity in March and June (above all in the centre, south and west of the country), but over large parts of the country in general, affecting more than 60% of the peninsula in March.

«We can't say categorically that annual precipitation has increased or decreased overall, but there are marked variations in different areas,» says the geographer.

For the period between October and March, rainfall has increased in October while there has been a widespread decrease in March, «which is important information for the management of water resources.»

Reconstruction of precipitation series over more than half a century

The scientists reconstructed and analysed 2,670 monthly precipitation series (average density 1/200 km2) over the peninsula between December 1945 and November 2005. To do this, they used the computerised documentary sources held by the Spanish Meteorological Agency (AEMet) in order to create details for different areas, «which had not been done until now,» says González-Hidalgo, adding that «we were able to carry out this work because the AEMet archives are the most useful of sources for research.»

In addition, the new database also includes information from above the 1000-1500 metre altitude range, «which had barely been analysed up until now,» the researcher stresses.

The results of the latest study «give a much more detailed image of precipitation behaviour over the second half of the century in peninsula Spain,» the scientist says.

The case of the Mediterranean coast

In previous studies, the group of scientists had analysed the same issue between 1950 and 2000 along the Mediterranean coast, covering the river basins of the eastern Pyrenees, the Ebro, Júcar, Segura rivers and eastern Andalusia, «an area in

География

Changes Seen in Rainfall. Trends in March, June and October Since 1945 in Spain

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According to these preliminary studies, published in 2009 in the International Journal of Climatology, «the only widespread and significant reduction in precipitation along the Mediterranean could be seen in March,» concludes the researcher.

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Continued Death of Forests Predicted in Southwestern US Due to Climate Change

ScienceDaily (Dec. 14, 2010) — If current climate projections hold true, the forests of the Southwestern United States face a bleak future, with more severe — and more frequent — forest fires, higher tree death rates, more insect infestation, and weaker trees. The findings by university and government scientists are published in this week's issue of the *Proceedings of the National Academy of Sciences (PNAS)*.

«Our study shows that regardless of rainfall going up or down, forests in the Southwest U.S. are very sensitive to temperature — in fact, more sensitive than any forests in the country,» said first author Park Williams, postdoctoral researcher in the Department of Geography at UC Santa Barbara. «Forests in the Southwest are most sensitive to higher temperatures in the spring and summer, and those are the months that have been warming the fastest in this area.»

Past forest studies have shown that warmer temperatures are associated with wildfires and bark beetle outbreaks. «We found that up to 18 percent of forest area in the Southwest — millions of acres — has experienced mortality due to severe wildfires and bark beetle outbreaks in the last 20 years,» said Williams.

Co-author Joel Michaelsen, a professor of geography at UCSB, said: «In order to carry out this research project, Park Williams assembled a very comprehensive data set of over 1,000 tree ring chronologies from all across the United States.» Michaelsen is a dendroclimatologist — a scientist who studies climate using analysis of tree rings.

«Instead of using the chronologies to reconstruct past climate patterns, as is usually done in dendroclimatic work, the relationships between growth and climate were used to study possible impacts of future climate change on forest health,» said Michaelsen. «One noteworthy finding was that tree growth throughout the Southwestern U.S., while quite sensitive to precipitation variations, is also negatively impacted by warmer temperatures. This is an important result, because predictions of future warming in the region are considerably more certain than any predictions of precipitation change.»

Researchers found that historic patterns of vegetation change, insect outbreaks, fire activity, runoff, and erosion dynamics show that landscapes often respond gradually to incremental changes in climate and land-use stressors until a threshold is reached, at which time there may be dramatic landscape changes, such as tree die-offs or episodes of broad-scale fire or erosion. They also found that the stressors that contribute to tree mortality tipping points can develop over landscape and even sub-continental scales.

Co-author Christopher Still, an associate professor of geography at UCSB, said: «These predicted large-scale changes in forest cover and composition (i.e.,

which water resources are placed under great consumption pressure and there is great social debate about the best way of managing them,» points out González-Hidalgo.

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Added co-author Craig D. Allen of the U.S. Geological Survey: «Such big, fast changes in Southwest forest vegetation could have significant effects on a wide range of ecosystem goods and services, from watershed protection and timber supplies to biodiversity and recreation. These emerging vulnerabilities present increasingly clear challenges for managers of southwestern forests to develop strategies to mitigate or adapt to the coming changes, in order to sustain these forested ecosystems and their benefits into the future.»

Forests help retain rainwater and keep it from flowing down mountains immediately, noted Williams in explaining the importance of forests to landscapes and rivers. «When forests disappear,» he said, «water runs downhill more quickly and takes the upper layers of soil with it.»

According to Williams, the erosion makes it harder for future generations of trees to establish themselves and makes it more difficult for people to capture storm water as it flows from the mountains. In addition, erosion increases the amount of sediment flowing in rivers and settling in lakes, and causes water to remain in the forest long after the rain.

The paper also points to the many implications of these changes for future management and use of Southwest forests.

The scientific article is part of a special PNAS feature edition called «Climate Change and Water in Southwestern North America.»

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Small Islands in the Pacific: Duel Between Freshwater and Sea Water

ScienceDaily (Dec. 15, 2010) — It is said that the first refugees of climate change will come from the Pacific. In the midst of this ocean's tropical regions are scattered 50,000 small islands, 8,000 of them inhabited. They are particularly vulnerable to the impacts of global warming. These effects include rising sea-water levels, drought and diminishing stocks of freshwater. Such water is essential for the life of the fauna and flora and for the human populations' food supplies. On the coral reef islands, freshwater occurs as underground reservoirs, as lenses in balance with the underlying sea water.

IRD scientists and their research partners have investigated the processes behind such lenses, the way they change and develops, their capacity and vulnerability. The team's geological, hydrogeological and geophysical surveys showed that the lens structure and internal processes depend strongly on the island's vegetation cover and topography. This work opens up ways towards assessing what will happen to this resource as a consequence of expected changes in the climate and sea level.

The balance between freshwater and salt water in coastal and island aquifers is unstable and the processes involved are difficult to characterize. With the objective of understanding the processes behind this lens formation on a coral island, IRD and its partners studied the structure and such parameters as the geometry of the reservoir and flow rates.

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Terrain untouched by human activity

The experimental sites, islands off Noumea in the South-West lagoon of New Caledonia, are remote from any human activity. The scientists used the geophysical imaging method, electrical resistivity tomography, to study the spatial distribution of the groundwater salinity, in particular on M'Ba island, 1,500 km east of Australia. With this imaging technique the groundwater conductivity can be measured along a vertical section and hence the salinity deduced. The data collected enabled the team to characterize the shape and structure of the underground freshwater reservoir, also to assess the rain-induced groundwater recharge, using a hydrological model based on IPCC climate data including information on cyclones.

Contrary to the results anticipated, this salinity proved to be intensively concentrated in the middle of the island rather than on its edges, which are the usual zones of sea water-freshwater interaction. Complementary analyses derived from a hydrogeological model have revealed the importance of vegetation cover and the island's topography in the spatial distribution of the salinity in the groundwater reservoir, located 3 or 4 m below the ground surface, and the mechanisms of this island aquifer.

Plant transpiration causes the saline water to evaporate from the roots. This process concentrates salt in the freshwater lens at the island's centre, as the plant cover is denser and longer established there. For example, a coconut palm draws up 300 L of water per day. Conversely, in the recent coastal sand dunes, the vegetation is much more sparse and the groundwater salinity remains less concentrated. Moreover, the freshwater lens recharge induced by rain is minimal in the island's centre, again owing to the density of the vegetation and the greater degree of soil development. However, it is maximal in the sand dunes near the sea. This explains an accentuation of the phenomenon, with dilution of the underground water on the island margins and concentration of salt in the central areas.

The island's morphology and internal structure also have a strong influence on the variable groundwater recharge rate along the island's transverse axis. This island was constructed by the piling-up of layers of material from sand-dominated reef formations, lying about 30 m above a complex substratum. It is geologically representative of many of the small islands or atolls in Noumea lagoon and, more generally, small coral reef islands of the Indo-Pacific region.

In conclusion, cross-validation of the geoelectrical models and the groundwater models is useful for 2D and 3D mapping of the salinity distribution of the island's groundwater aquifer. This analysis can help assess the water resources of the Pacific coral islands in the context of the search for indicators of vulnerability in the face of global climate change and bring significant evidence concerning future changes and developments in coral islands, which contributes to the survival and development of numerous terrestrial and marine species and of their inhabitants.

These investigations were conducted jointly by the teams of the research units LOCEAN (UMR IRD/Université Paris VI/CNRS/MNHN), CEREGE (UMR IRD/CNRS/Collège de France/Universités Aix-Marseille 1 and 3) and Université de la Réunion and Université d'Avignon, as part of the INTERFACE project subsidized by the French Agence Nationale de la Recherche (ANR) (programme *Vulnérabilité, Milieux, Climats*).

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PHYSICAL GEOGRAPHY RESEARCH QUARTERLY SPRING 2010; -(71):83-94.

QUANTITATIVE & QUALITATIVE ANALYSIS OF THE PAPERS PUBLISHED IN QUARTERLY GEOGRAPHICAL JOURNALS IN THE DURATION OF 10 YEARS (1998-2008)

MOVAHED A., IZADI PEGAH
SHAHID CHAMRAN UNIVERSITY

Introduction: Scientific and professional journals are assumed as ducts of scientific production and scientific communication and trying to play these two functions between scholars in different academic fields. Review of historical science shows that efficient factors have had a general role in formation, emergence, growth and development of science with a particular role in knowledge of geography in which we can consider the scientific and professional journals. Scientific and professional journals are specialized publications which are published in regular intervals and play two-function of scientific production and scientific communication. Published articles in professional journals because of the updated and (relatively) short content, transferring the results of writer to the readers speedily, low cost of journal (compared to books), relatively authentic and first-hand information, detailed analysis and effort in using known and logical methods, fast publication and distribution, introducing the past to today's textbooks and resources related to the topic, and removal of the marginal texts (due to observing a finite volume and a journal article) is so important.

The place of publications in addition to the role of enormous scientific findings resource in which used by most professional staff members of the community, is another important source assessment, including the level of countries or areas of science degree in special and the ability to assess the extent of scientific research and higher education for young people. Research Journal of Geographical Research (Journal of Geographical Research Institute University of Tehran) is a scientific research journals approved by the Commission reviews of the country — the Ministry of Science, Research and Technology and is the first specialized geography journal in the country in which from past 32 year till now 66 volumes have been published. The journal was named from the year 1988 as «Geographical Report» and after that till now (from 23 years onwards) as «Geographic Research,» has made available the latest scientific research and research studies from the geography of Iran for scholars.

Materials and methods: A descriptive- content analytic method is used as the research method. This article is about studying the process of published numbers of a geographical quarterly journal during the past 10 years, from no.36 of October 1998 to no.66 of the winter of 2008 in the form of an eight parameter frame of «thematic share of articles», «science-proficiency group association», «resources and origins», «dividing the articles based on the extracting resource», and «used methods and techniques .«

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Result and discussion:

1- Academic institutions participating:

In total, 53 scientific institutions as universities and academic research institutions — participated in 320 evaluated research articles; from 320 published articles in journal, 143 numbers of articles means 44.7 percent of them has allocated to University of Tehran and most of the remaining percent (29.4percent) are from other cities universities. Also, 62 number of articles means 19.4 percent of them were allocated to other universities of Tehran. Share of the rest of country's academic institutions (11 institutions) in total were 3.4 percent and nearly 3.1 percent of the published articles institutions are unknown.

2- Author scientific degree:

Reviewing the relevant data shows that scientific degree respectively, including : 10.9 percent Master's degree, 24.1 percent associate professor, 45.3 percent assistant professor, 1.9 percent instructor, 9.7 percent doctoral graduates and doctoral students, 1.6 percent the graduates and master's graduate student, 0.3 percent BA and in 4.7 percent of articles, scientific place of scientific academy members is not mentioned.

3- Articles issue share:

From 320 reviewed articles was respectively subject climatic geography: 17.5 percent, geomorphology 16.3 percent, hydrology 9.4 percent, rural geography 16.6 percent, urban geography 15.3 percent, geopolitics 8.4 percent, geography of tourism 2.8 percent, geographical area 0.9 percent and remote sensing and cultural geography 0.3 percent is allocated. Thus, the largest issue in these articles is dedicated to climate and geography articles and minimal contribution to remote sensing and geographic medicine.

4- Used techniques and methods:

Nearly 83.4 percent of published articles not mentioned the method used in writing research, 8.4 percent of the articles descriptive — analytical, 1 percent empirical, 0.9 percent comparative method and 6.6 percent used from other methods

5- Separating articles based on extractive resource

From 320 reviewed articles 21 articles means 6.6 percent of all articles extracted from previous resource and has been presented as article and separately 1.9 percent from published thesis, 0.9 percent from master's thesis and 3.8 three percent are extracted from the research project. Also 287 articles mean 93.4 percent of articles have not been extracted from the previous field of scientific research.

6- Participating of scientific– professional groups: In total, 20 scientific — specialist groups have been participating in 320 reviewed articles. However, this diversity is not so deep and 78.4 percent of articles are from the Department of Geography and this group has a general share in writing articles in this journal.

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7- Time of accepting articles:

Reviewing this issue is important to the arbitration process and journal organization for follow-up articles and have effective role in the satisfaction rate of applicants in publishing the magazine. From 320 articles of the time to get acceptance, 164 articles means 51.3 percent of the articles is not mentioned, and mainly are related to the first publishing decade of magazine, but in the other 157 articles the less time for acceptance of articles were 3 months and the maximum duration were 51 months.

8- Sources: Generally in reviewed articles

5757 sources have been used in performing research that from this numbers 3594 means 62.2 percent are from Persian sources and 2163 sources means 37.5 percent are from Latin sources. Average resources used for the 320 articles, are equal 18 sources for each article that is satisfactory figure in the use of resources. Average of latin sources used in each paper is equal to 7 sources and for the Persian sources is about 11 sources for each article.

Conclusion:

The results and findings show the quantitative and qualitative progress of the 8 parameters. The articles with the subjects of «natural geography» have the most share of the topics of the articles, and «continental geography» was the most used subject in these articles with 17.5% percents. The editors with the educational degree of «faculty co-professor» have the biggest number of the studied authors. Different authors of 19 science-proficiency groups participated in giving the articles of this research. Only 6.6% percents of the studied articles had the results of previous science-proficiency works. In most of the articles, the methodology in not mentioned, and the mostly used research method of the articles was descriptive — analytic.

Keyword: QUANTITATIVE AND QUALITATIVE ANALYSIS, THEMATIC SHARE, ASSOCIATION OF ORGANIZATIONS, AUTHORS' RANK, GEOGRAPHICAL RESEARCHES

Geography Research and News Geography Research and News

Decline of West Coast fog brought higher coastal temperatures last 60 years (12/17/2010)

Fog is a common feature along the West Coast during the summer, but a University of Washington scientist has found that summertime coastal fog has declined since 1950 while coastal temperatures have increased slightly.

Fog formation appears to be controlled by a high-pressure system normally present off the West Coast throughout the summer, said James Johnstone, a postdoctoral researcher with the Joint Institute for the Study of the Atmosphere and Ocean at the UW.

«The behavior of that high-pressure cell is responsible for a lot of the weather phenomena we see on the coast,» he said. It can alter water temperature, ocean circulation, surface winds and other factors linked to coastal fog formation.

The fog decline could have negative effects on coastal forests that depend on cool and humid summers, but Johnstone, who presents his findings Monday

7- Time of accepting articles:

Reviewing this issue is important to the arbitration process and journal organization for follow-up articles and have effective role in the satisfaction rate of applicants in publishing the magazine. From 320 articles of the time to get acceptance, 164 articles means 51.3 percent of the articles is not mentioned, and mainly are related to the first publishing decade of magazine, but in the other 157 articles the less time for acceptance of articles were 3 months and the maximum duration were 51 months.

8- Sources: Generally in reviewed articles

5757 sources have been used in performing research that from this numbers 3594 means 62.2 percent are from Persian sources and 2163 sources means 37.5 percent are from Latin sources. Average resources used for the 320 articles, are equal 18 sources for each article that is satisfactory figure in the use of resources. Average of latin sources used in each paper is equal to 7 sources and for the Persian sources is about 11 sources for each article.

Conclusion:

The results and findings show the quantitative and qualitative progress of the 8 parameters. The articles with the subjects of «natural geography» have the most share of the topics of the articles, and «continental geography» was the most used subject in these articles with 17.5% percents. The editors with the educational degree of «faculty co-professor» have the biggest number of the studied authors. Different authors of 19 science-proficiency groups participated in giving the articles of this research. Only 6.6% percents of the studied articles had the results of previous science-proficiency works. In most of the articles, the methodology in not mentioned, and the mostly used research method of the articles was descriptive — analytic.

Keyword: QUANTITATIVE AND QUALITATIVE ANALYSIS, THEMATIC SHARE, ASSOCIATION OF ORGANIZATIONS, AUTHORS' RANK, GEOGRAPHICAL RESEARCHES

Geography Research and News Geography Research and News

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The fog decline could have negative effects on coastal forests that depend on cool and humid summers, but Johnstone, who presents his findings Monday

(Dec. 13) at the American Geophysical Union annual meeting in San Francisco, hasn't seen evidence of that yet.

In fact, climate models indicate that coastal fog should be increasing because of global warming, but he believes that is not happening because of strong influence exerted by regional circulation patterns related to the Pacific Decadal Oscillation. That climate phenomenon, centered in the North Pacific, has wide-ranging effects that last for years or even decades rather than for just a year or two.

«You would eventually expect to see significant effects on the coastal forests if the fog continues to decline,» he said.

Johnstone examined records from airports up and down the West Coast that have taken hourly readings on cloud height for the last 60 years. He looked closely at two stations in particular, Monterey on the central California coast and Arcata on the northern California coast, and found that their decline in fog and increase in temperature matched very closely despite being separated by about 300 miles. Both also reflected a great deal of variability.

«During a foggy summer you tend to have cool conditions along the coast and unusually warm temperatures in the interior,» Johnstone said, adding that during less foggy summers coastal areas tend to be warmer than usual and the interior is cooler.

Historically there have been stark temperature differences at times between the coast and areas just a short ways inland. But the differences have been shrinking in recent years, mostly because of rising coastal temperatures, he said. Cooler temperatures typically are located near sea level, and the warmer inland temperatures begin to show up at about 1,300 feet in elevation.

Johnstone found that the contrast between inland and coastal temperatures was much greater from 1900 to 1930 than during the last 60 years, indicating that summers on the coast were much foggier in the early 20th century.

But he notes that while coastal fog has generally declined, the data in general have shown consistent variability. For example, the Pacific Northwest, and Seattle specifically, had record fog frequency in the summer of 2010, and many places along the West Coast recorded their foggiest summer since 1991.

A next step in his work will be to understand the discrepancy between climate models and actual fog observations so that the factors involved in summer fog formation can be better understood.

Note: This story has been adapted from a news release issued by the University of Washington

Greenland ice sheet flow driven by short-term weather extremes, not gradual warming (12/13/2010)

Sudden changes in the volume of meltwater contribute more to the acceleration — and eventual loss — of the Greenland ice sheet than the gradual increase of temperature, according to a University of British Columbia study.

The ice sheet consists of layers of compressed snow and covers roughly 80 per cent of the surface of Greenland. Since the 1990s, it has been documented to be losing approximately 100 billion tonnes of ice per year — a process that most

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scientists agree is accelerating, but has been poorly understood. Some of the loss has been attributed to accelerated glacier flow towards ocean outlets.

Now a new study, to be published tomorrow in the journal *Nature*, shows that a steady meltwater supply from gradual warming may in fact slow down glacier flow, while sudden water input could cause glaciers to speed up and spread, resulting in increased melt.

«The conventional view has been that meltwater permeates the ice from the surface and pools under the base of the ice sheet,» says Christian Schoof, an assistant professor at UBC's Department of Earth and Ocean Sciences and the study's author. «This water then serves as a lubricant between the glacier and the earth underneath it, allowing the glacier to shift to lower, warmer altitudes where more melt would occur.»

Noting observations that during heavy rainfall, higher water pressure is required to force drainage along the base of the ice, Schoof created computer models that account for the complex fluid dynamics occurring at the interface of glacier and bedrock. He found that a steady supply of meltwater is well accommodated and drained through water channels that form under the glacier.

«Sudden water input caused by short term extremes — such as massive rain storms or the draining of a surface lake — however, cannot easily be accommodated by existing channels. This allows it to pool and lubricate the bottom of the glaciers and accelerate ice loss,» says Schoof, who holds a Canada Research Chair in Global Process Modeling.

«This certainly doesn't mitigate the issue of global warming, but it does mean that we need to expand our understanding of what's behind the massive ice loss we're worried about,» says Schoof.

A steady increase of temperature and short-term extreme weather conditions have both been attributed to global climate change. According to the European Environment Agency, ice loss from the Greenland ice sheet has contributed to global sea-level rise at 0.14 to 0.28 millimetres per year between 1993 and 2003.

«This study provides an elegant solution to one of the two key ice sheet instability problems identified by the Intergovernmental Panel on Climate Change in their 2007 assessment report,» says Prof. Andrew Shepherd, an expert on using satellites to study physical processes of Earth's climate, based at the University of Leeds, the U.K.

«It turns out that, contrary to popular belief, Greenland ice sheet flow might not be accelerated by increased melting after all,» says Shepherd, who was not involved in the research or peer review of the paper.

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Transcripts of the Institute of British Geography, NS 28. P. 133–141 2003.
Royal Geographical Society (with The Institute of British Geographers) 2003. Blackwell Publishing Ltd

Geography: a different sort of discipline?

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Abstract: Debate continues about the inter-relationships between human and physical geography and their different research and publication practices. Relatively little data about these are available, however. Using an analysis of all publications submitted by UK geographers to the 2001 Research Assessment Exercise, this paper identifies a substantial difference between human and physical geographers in their publication strategies. Most physical geographers place their research papers in specialized inter-disciplinary journals and make relatively little use of geography outlets: most human geographers, on the other hand, publish in geography journals. Comparisons with other disciplines — in the earth and environmental and social sciences respectively — also identify differences between geographers and their peers. The overall conclusion is that, with regard to research and publication at least, UK geography cannot be presented as a single academic community with strong internal ties, but rather as a conglomerate of separate communities writing for different audiences.

Key words**:** human and physical geography publications UK audiences

The institutionalization of disciplines

Growth in the number and size of research universities through the twentieth century was accompanied by an increasingly sharp academic division of labour, with the creation of separate disciplines, each offering their own degree courses and research agenda. Many of these had origins in earlier scientific practices, but their formalization as separate identities within universities did not occur until late in the nineteenth century at least, and even for those — like geography — with such roots, full institutionalization did not occur until well into the twentieth century.

The process of institutionalization involved a number of inter-related processes, among the most important of which were: the introduction of degree programmes in the named discipline; the establishment of separate departments named after the discipline and appointment to them of individuals — increasingly those trained in the discipline — to teach on its degree programmes and conduct research in aspects of its subject matter; the creation of professorial chairs in the discipline; and the foundation of learned societies to promote research in the discipline through meetings of various types and the publication of research findings, notably in journals whose contents had been subject to peer review.

For geography in the United Kingdom, these largely occurred in the twentieth century, with the first chairs in the subject, the first honours degree programmes, the creation of the IBG to hold the first conferences of academic geographers, and so forth (Johnston 2003).

Once disciplines have been created and recognized and have an institutional presence, they become the equivalent of defended territories (Becher and Trowler 2001; Johnston 1998). Individual members of the discipline identify with it — they take the title ‘geographer’, for example — and the departments compete for resources, including students, within and between universities. The discipline becomes part of an academic political system, and a major goal for its leaders — as in any bureaucracy — is to advance their discipline’s cause, with expansion frequently a major element in their strategy. In this way, the

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disciplinary academic division of labour becomes firmly embedded in institutional and intellectual practices and any proposed changes — especially those that may threaten a discipline's size and power, even its identity — will be resisted, particularly if they involve either nearby rival disciplines or the creation of new ones that appear to be invading the existing disciplinary territory.

Research and publication

Part of the claim to strength and power for any discipline is the quality of its members' research — a criterion that is also central to career advancement for individual members. Within a discipline's institutions, therefore, its publication outlets are crucial, since these offer the arena where individuals can report their research findings and win the recognition that is the foundation of career progression. In UK geography there were initially few such outlets, all published by learned societies — the Geographical Journal, Geography and the Transactions, Institute of British Geographers, plus the Scottish Geographical Magazine, the only 'regional' journal to flourish within the UK for a long period.

By the 1950s, these were offering insufficient opportunities for publishing the research of the growing number of research-active academics, and new journals were launched outwith the learned societies. The first such non-society journal — Geographical Studies — was a cooperative venture launched by a few 'dissatisfied' aspiring geographers: it failed after only five years (Steel 1983).

There were then no further launches until the late 1960s, from when a variety of new journals appeared, almost all of them produced by commercial publishers who realized the potential market opportunities. (The main exception was Area, which began as the IBG's Newsletter, and was then upgraded to a second refereed journal.)

Some of these new journals were aimed at multidisciplinary markets, in part to ensure market success but also linked to claims for cross-disciplinary interaction; others were aimed at subdisciplinary markets within the discipline, catering for the growing numbers of specialists that reflected the growth, specialization, fragmentation and compartmentalization of the discipline. (Some of the latter were launched by commercial publishers in collaboration with academic organizations, such as the IBG's Study Groups — as with Earth Surface Processes.)

By the 1990s, therefore, geography — like all large and buoyant disciplines — had a substantial number of journals in which its researchers could seek to publish their work: some were published by learned societies and edited by their appointees (usually through some relatively transparent process of application if not election); others were published by commercial publishing houses and edited by academics who were, in effect, 'employed' by them.

These journals soon became arranged in a form of hierarchy: some were considered more prestigious than others to publish in (and had the reputation of operating more stringent refereeing procedures). And citation data were deployed to show that some had more impact than others, in that the papers which were published there on average received more citations than those in other journals.

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One further feature characterized the last decades of the twentieth century — the growing internationalization of science, at least within separate language realms. Academic journals — especially those launched by commercial publishers — were aimed at as wide an audience as possible, largely to promote sales, and many of the new journals were international in their editorial arrangements.

Authors from any country were encouraged to submit their work to such journals, many of which were, however, clearly based in a single country or small group of countries.

By the end of the twentieth century, therefore, most academic disciplines in the English-speaking universities had a range of journals available in which their members' research findings were published. Some of those journals were considered more prestigious than others, and there- fore more desirable targets for publishing papers in. Each discipline had an informal, if far from universally-ascribed to, international ranking of journal prestige, and the goal of many researchers was to get their papers accepted by the journals seen as not only the most prestigious but also the most visible — which should therefore increase the number of both potential and actual readers of their work, and hopefully its influence too. Some of those journals may be multi-disciplinary because of their widespread reputation — Nature is the paradigm example in the UK, as is Science in the US. But most journals' reputation does not extend (far?) beyond their parent discipline, which means that most research papers are circulated within constrained, disciplinary audiences only. Knowledge production and circulation occurs through fragmented publcation media.

Quantifying knowledge circulation in the UK: the RAEs

But is that the case? Is the circulation of knowledge through academic journals largely confined within separate disciplinary containers? And is it the same for all disciplines, even different parts of those disciplines? In particular, does geography conform to the general paradigm, or is it in some ways different?

How might one answer such questions? One source of data for UK geography is the material submitted by individuals, through their departments, to the Research Assessment Exercises (RAEs).

Each 'research-active' individual nominates the four publications that he/she considers most representative of her/his highest quality work during the relevant period, and the great majority (certainly in geography and most other sciences and social sciences) nominate papers published in peer-reviewed academic journals.

This material submitted to the 2001 RAE is all now available on the web. Furthermore, it has been analysed — for all Units of Assessment (UoA: i.e. disciplines recognized in the RAE) — by a commercial firm (Evidence Ltd), which has added other data (notably from the ISI's citation count material). Relevant customized material for their own institution can be purchased by individual universities. One of the tables made available for every UoA lists the top journals by frequency of occurrence of nominated papers, for all institutions

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being assessed, and separately for those obtaining 5 and 5* grades. A second table lists the 20 journals with the highest ISI impact factors in which one or more papers from the relevant UoA was published.

Where did UK geographers publish?

In total, some 3870 journal articles were nominated by 'research-active' geographers included in their institutions' RAE submissions: these comprised 91.1 per cent of all of the items nominated (i.e. less than 10 per cent of the nominated items were books, monographs or other forms of publication).

Twenty-three journals received 20 or more nominations, with their total of 1227 accounting for some 31 per cent of all journal articles nominated. The number of nominations for any one journal ranged from 20 for Economic Geography to 141 for Environment and Planning A: only the latter and Transactions had more than 100 nominations. None had more than 100 nominations from just the 16 departments that were accorded a 5* or 5 grade according to the number of nominations from those departments. There is a significant negative relationship between the total number of nominations from grade 5*/5 departments and the percentage of the total number of nominations for a journal coming from those departments: the more prestigious the journal, the more likely that a scholar nominating a paper in it came from a grade 5* or 5 department. Other features of the journals not included there — such as whether they are commercially published, whether they are based in the UK etc.

1. Five of the journals are edited and produced by learned societies (even though they are published for the society by a commercial company): they are the three RGS(IBG) journals, plus Regional Studies (produced by the Regional Studies Association, in which geographers have always played major roles and for which they have provided several of the editors since publication started in 1969) and the Annals of the Association of American Geographers.

Of the other 18, 17 are produced and published commercially, a few of them (such as Earth Surface Processes and International Journal of Remote Sensing) being linked to a learned society (the BGRG and the Remote Sensing Society respectively): Economic Geography is published by Clark University.

2. Only three of the journals are based outside the UK — the Annals, the Journal of Hydrology and Economic Geography — although the lead editor of Environment and Planning D (which is published in the UK) has always been an academic at a North American university. Most of the commercially produced journals have editors based in a number of countries, however.

3. Of the nine journals which will have almost entirely attracted papers from physical geogra phers — only one, Progress in Physical Geography, is an explicitly geographical journal, though it publishes several papers every year from non-geographers, defined as those lacking an institutional affiliation with a university geography department: in 2001, Volume 25 contained 17 separate papers, 67 per cent of them authored by geographers; all but one of its 12 annual progress reports was authored by a geographer.

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Earth Surface Processes was established by an IBG Study Group — the British geomorphological Research Group — but geographers authored only 67 per cent of its papers in 2001 (Volume 26). The other six are explicitly multi-

disciplinary journals in which papers from geographers form a minority of the total published, even though several are edited from geography departments in the UK: in Hydrological Processes, for example, only 22 per cent of the papers published in Volume 15 (1–6), 2001, were authored by geographers; in the International Journal of Remote Sensing the comparable figure for Volume 22 (1–10), 2001, was 13 per cent of 130 papers; for the Journal of Hydrology (Volume 227, 2000) it was 8 per cent of 62; for Journal of Quaternary Science (Volume 16, 2001) it was 29 per cent of 64; and for Quaternary Science Reviews (Volume 19, 1–6, 2000) it was 19 per cent of 51.

4. Excluding the four journals published by geographical learned societies — in three of which the great majority of the papers will have been authored by human geographers (the exception is Geographical Journal) — there are ten the majority of whose papers are by human geographers. Of these, three serve a fairly broad constituency within that subdiscipline (Environment and Planning A, Geoforum, Progress in Human Geography), with only one — Environment and Planning A — attracting a substantial number of articles from outside geography; a further five are oriented largely towards more specialist research communities within human geography (Environment and Planning D, Journal of Historical Geography, Political Geography, Economic Geography and Applied Geography: only the first of these attracts a substantial number of papers from out with eography).

Just two — Regional Studies and Urban Studies — can definitely be described as multi-disciplinary, even though geographers provide substantial numbers of their papers and have edited both.

The last two of these points suggest a clear distinction between the publication strategies of British human and physical geographers, as illustrated by the journals in which they have placed their ‘best four’ papers over a five-year period. The majority of physical geography papers have been placed in multi-disciplinary journals — notably in hydrology and quaternary studies — where geographers are minority participants. Their authors seek peer approval outside their institutionalized discipline.

Most human geographers, on the other hand, are publishing their best work in journals aimed mainly at geographers alone, either all geographers (and, in effect, since few physical geographers publish in them, all human geographers) or subdisciplinary groups within human geography. Or, to put it another way, human geographers largely talk among themselves, it seems, while physical geographers prefer to talk to colleagues in other disciplines.

This conclusion is largely sustained by the data in Table II, which lists the 20 journals containing one or more nominated papers by geographers that have the highest impact factors of all journals nominated by geographers.

Only two of these — have more than three papers from geographers. The great majority of them are clearly journals that would be favoured by physical rather than human geographers: apart from some of the medical journals which publish social science material, the list predominantly comprises journals that are open to physical geographers only.

Geography compared: I — human geography and the social sciences

How does the situation in geography compare with that in other disciplines? For human geography I have looked at comparative data for the three

disciplinary journals in which papers from geographers form a minority of the total published, even though several are edited from geography departments in the UK: in Hydrological Processes, for example, only 22 per cent of the papers published in Volume 15 (1–6), 2001, were authored by geographers; in the International Journal of Remote Sensing the comparable figure for Volume 22 (1–10), 2001, was 13 per cent of 130 papers; for the Journal of Hydrology (Volume 227, 2000) it was 8 per cent of 62; for Journal of Quaternary Science (Volume 16, 2001) it was 29 per cent of 64; and for Quaternary Science Reviews (Volume 19, 1–6, 2000) it was 19 per cent of 51.

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Geography compared: I — human geography and the social sciences

How does the situation in geography compare with that in other disciplines? For human geography I have looked at comparative data for the three

‘mainstream’ large social science disciplines — economics with econometrics, sociology, and political science with international relations. Economics, like geography, is predominantly a journal-based discipline in its publishing, with 96 per cent of its nominated items being journal articles: sociology and political science are less journals-orientated, with 70 and 68 per cent articles, respectively. Each of the three disciplines is substantially smaller than geography: there were 2492 journal articles nominated in economics, 2246 in political science and 1844 in sociology compared to 3870 in geography.The full data are not repeated here, both to save space and because of commercial considerations: instead the main similarities are introduced.

The dominant feature of the 24 journals listed for economics is that all focus on that discipline alone, either generally (as with the Economic Journal and the American Economic Review) or for subdisciplinary communities (as with Econometrica, the Journal of Development Economics and the Journal of Political Economy). Economics, it seems, is a very ‘closed’ discipline — or, economists write only for other economists! — and only one of the 24 journals listed — World Development — can in any way be described as multi-disciplinary (it ranks 21st in the list). But that closure is not also parochial. Most of the journals are commercially produced (only five are published by learned societies, although several others involve collaboration between a commercial publisher and a single university department). Over half of them (14) are edited from the United States.

Economists may talk mainly to other economists, therefore, but very much within an international community. Of the top ten journals, five are US-based and another — the European Economic Review — has its focus outwith the UK. By way of contrast, the other two social science disciplines are much more parochial as well as closed. Of the 23 sociology journals listed, for example, only three are produced from the United States: two of them are relatively specialized and multi-disciplinary in their orientation (Science, Technology and Human Values and Research on Language and Social Interaction); the third is Sociological Theory, produced by the American Sociological Association. (The three are relatively low down the list, occupying 11th, 15th and 20th positions, respectively.) All but one of the top ten journals in the list is UK-produced and -focused (the exception is the European Sociological Review).

Almost half of the 23 journals are multi-disciplinary, reflecting the external interactions of specialist research communities within sociology (as with Theory, Culture and Society, Journal of Adolescence and British Journal of Criminology), but the top six are all explicitly sociological journals. Unlike the situation in both economics and geography, the top American journals (American Journal of Sociology and American Sociological Review) do not appear in the list. According to the data provided on papers published in high-impact journals, just four papers in American Journal of Sociology were nominated, all of them from grade 5*/5 departments.

The pattern in political science and international relations is very similar to that for sociology, except there is a slightly greater European focus.Of the 21 journals listed, only two — World Development and Research Policy — are US-based, though a further two are explicitly European in their coverage. Fewer of the political science journals nominated are commercially produced (perhaps indicative of a

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smaller market), and there are few explicitly multi-disciplinary journals. Again, none of the major US journals (American Political Science Review or Journal of Politics, for example) makes the most-nominated list: there were five papers in all published in the American Political Science Review (as indicated by the list of high-impact journals) along with one in the American Sociological Review and one in the Transactions of the Institute of British Geographers.

Human geographers, according to these comparative data, are less parochial than their colleagues in either sociology or political science, therefore: they are more likely to publish in journals with an international focus, and also more likely to place their 'best' papers in multi-disciplinary journals.

Economists, on the other hand, are much more international — but also much more of a closed community.

Geography compared: II — physical geography and the earth and environmental sciences

Turning to comparative materials for physical geography, data have been abstracted for two UoAs: Environmental Sciences and Earth Sciences. In both cases, the great majority of the journals listed are international in their scope, with editors (let alone editorial and advisory boards) drawn from several countries.

Earth and environmental scientists are writing for wide communities. US-based journals are clearly seen as highly prestigious, however.

Two of the top four journals nominated from environmental sciences departments are published by the American Geophysical Union (Journal of Geophysical Research — Oceans and Atmosphere, and Geophysical Research Letters), and the sixth and seventh in the list are published by the Geological Society of America and the American Meteorological Society, respectively. (Lower down the list are three more American Meteorological Society journals, and two further productions of the American Geophysical Union.)

The pattern for earth sciences is very similar, with some overlap of journals from the previous list. Of the 22 journals listed, three are published by the American Geophysical Union and two by the Geological Society of America. Both UoAs are explicitly multi-disciplinary, of course, although earth sciences is dominated by geology departments.

Physical geographers, therefore, are akin to their peers in earth and environmental sciences in focusing their publications on international journals that attract papers from a range of scholars. They conform to the norm of universality of science — at least within the English-language realm. Interestingly, however, none of the multi-disciplinary journals listed in Table I as physical geography appear in the lists for earth and environmental sciences. They are occupying different segments of the broad community of international environmental science.

Geography compared: III — geography and psychology

Finally, what of a comparison with the discipline that geography is frequently paired with because both cross the science–social science border (and

smaller market), and there are few explicitly multi-disciplinary journals. Again, none of the major US journals (American Political Science Review or Journal of Politics, for example) makes the most-nominated list: there were five papers in all published in the American Political Science Review (as indicated by the list of high-impact journals) along with one in the American Sociological Review and one in the Transactions of the Institute of British Geographers.

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Geography compared: III — geography and psychology

Finally, what of a comparison with the discipline that geography is frequently paired with because both cross the science–social science border (and

in many UK universities operate through both faculties) — psychology? The discipline is similar to geography in both size (4861 journal articles nominated) and preponderance of journal articles in the nominated items (96 per cent).

The pattern of journals (25 are listed) is very similar to the science model identified above for physical geography and also for earth and environmental sciences, concentrating on journals focused on specific subdisciplinary specialisms (some of which, such as cognition and perception, are also multi-disciplinary), the great majority of which are international in their focus. (Four of the listed journals are published by the American Psychological Association — including two of the top four listed — and another four by the British Psychological Society.)

So is geography different?

We already know the answer to this in a general sense: geography departments — and thus the institutionalized discipline in the UK — involve human and physical geographers working in a collective environment, offering degree courses that, to a greater or lesser extent, combine elements of the two, but at the same time the two groups differ in their research benchmarks and peers.

Physical geographers have increasingly organized their research and consequent publication according to what is seen as the norm for a scientific discipline: human geographers have come to dominate the general geography journals (notably those produced by learned societies such as the RGS(IBG)) as physical geographers have focused their work elsewhere. In addition, human geographers have sought outlets elsewhere, in other social science journals — though mainly in multi-disciplinary journals that they largely dominate — and in specialist journals oriented largely to sub-disciplinary communities within geography.

But how different are the two? Arguments such as that outlined in the previous paragraph have been made many times (much more frequently in discussion and debate than in print) but with little supporting evidence. The publications data from the 2001 RAE for the first time allow some evidence to be collated.

They have shown, very clearly, that the split within the discipline between human and physical geography in publication practices is substantial. Physical geographers seek the approval and interest of their peers in journals that are oriented to different aspects of environmental science, in most of which they are minority contributors only: for them, scientific reputation (and the career advancement that should follow) is largely sought outwith the discipline. This is much less the case with human geographers, whose peer group is very substantially other human geographers: they tend to publish in journals edited by their disciplinary colleagues and in which most of the papers come from geographers too. In this they operate similarly to their colleagues in other social sciences.

But they are much less constrained to a disciplinary territory (albeit subdivided into separate, more specialist cells) than the much more exclusive (though also much more international) economists; and they are much less constrained to writing for relatively parochial (i.e. UK-focused) journals than their colleagues in sociology and political science. Human geographers'

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conversations are more confined within their disciplinary territory than those of their physical geography colleagues, but have wider audiences (in several senses of that word) than is the norm elsewhere in UK social science.

In sum, whereas physical geographers tend to converse through their publications with other earth and environmental scientists, human geographers are much more likely to talk among them

selves — or among groups of themselves. Physical geographers are more scientifically extrovert than their human geography colleagues. But human geographers are not entirely isolated: many of their publications have bibliographies that range widely across the social sciences, so that at least some of their papers and books are connecting their discipline to wider intellectual currents.

But the balance of trade, I guess (I have no evidence), is not working in geographers' favour: they are much more likely, on average, to refer to work by non-geographers than non-geographers are to refer to their work. And does all this matter for the discipline? Much concern is being expressed about fragmentation and centrifugal tendencies within the discipline, however vibrant its various parts (see, for example, Thrift 2002; Clifford 2002; Johnston 2002), and the President of the RGS(IBG) raised concerns about the disappearance of geography as a specially identified discipline with its own department and degree programmes in a number of UK universities during his 2002 Presidential Address (Cooke 2002: a similar shift is almost complete in Australia: Holmes 2002). For those who wish to retain the current morphology of geography departments and degree programmes, and hence its separate identity within the UK's academic division of labour, there is a continuing need to sustain a political unity while recognizing the very different scientific practices — including publication — that characterize its various parts.

As it stands, geography in the UK is not an exemplar of the paradigm academic discipline, comprising a community occupying and defending a well-defined intellectual territory. It is a whole comprising a range of parts pulling in different directions — something that the data presented here suggest marks it out as substantially different from some of its neighbouring disciplines, especially in the social sciences. That may be a strength — but probably only a strength if the body is carefully managed. As geography researchers we have a wide range of different audiences: what holds us together? For those who defend the unity of geography as an intellectual project, the data presented here raise many difficulties: for those who see it as simply a political project — promoting the benefits, for both, of keeping the two disparate parts together — those data clearly set the parameters for their task.

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Naive Geography.

Max J. Egenhofer and David M. Mark
National Center for Geographic Information and Analysis. Report 95-8

Abstract

This paper defines the notion and concepts of Naive Geography, the field of study that is concerned with formal models of the common-sense geographic world. Naive Geography is the body of knowledge that people have about the surrounding geographic world. Naive Geography is envisioned to comprise a set of theories that provide the basis for designing future Geographic Information Systems that follow human intuition and are, therefore, easily accessible to a large range of users.

1. Introduction

Naive Geography is the field of study that is concerned with formal models of the common-sense geographic world. It comprises a set of theories upon which next- generation Geographic Information Systems (GISs) can be built. In any case, Naïve Geography is a necessary underpinning for the design of GISs that can be used without major training by new user communities such as average citizens, to solve day-to-day tasks. Such a scenario is currently a dream. Most GISs require extensive training, not only to familiarize the users with

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terminology of system designers, but also to educate them in formalizations used to represent geographic data and to derive geographic information. Naive Geography is also the basis for the design of intelligent GISs that will act and respond as a person would, therefore, empowering people to utilize GISs as reliable sources, without stunning surprises when using a system. This paper defines the notion and concepts of Naive Geography.

Although various aspects of Naive Geography have been studied for at least 40 years in a piecemeal fashion, Naive Geography has never been addressed comprehensively as a theory of its own. Occasionally, different terms have been used to describe certain aspects of it—Spatial Theory (Frank 1987) , Geographical Information Science (Goodchild 1992), Spatial Information Theory (Frank and Campari 1993), Environmental Psychology, or plain Artificial Intelligence. Aspects of Naive Geography have been also considered within academic geography, and can be found in books by Bunge (1962) or Abler et al.

(1971). By labeling Naive Geography, and distinguishing it from related areas in spatial information theory, geographic information science, and Naive Physics, we intend to catalyze and focus work on some very central issues for these fields, and for artificial intelligence and GIS in general.

Central to Naive Geography is the area of spatial and temporal reasoning. Many concepts of spatial and temporal reasoning have become important research areas in a wide range of application domains such as Physics, Medicine, Biology, and Geography. Particularly the field of Naive Physics (Hayes 1979; 1985a) addresses concerns that appear at a first glance to be very similar to Naive Geography. We will, however, be more specific on the domain, and the types of representation and reasoning by focusing on common-sense reasoning about geographic space and time; subsequently called geographic reasoning.

We argue that such a focus is necessary to treat appropriately the ontological and epistemological differences among the different application domains of spatio-temporal reasoning—their data and their reasoning methods, the way people use these data and interact with them.

Much of Naive Geography should employ qualitative reasoning methods. Note that this notion of qualitative reasoning is distinct from the notion of qualitativeness as it is occasionally used in geography to allude to descriptive rather than analytical methods. In qualitative reasoning a situation is characterized by variables that can only take a small, predetermined number of values (De Kleer and Brown 1984) and the inference rules use these values in lieu of numerical quantities approximating them. Qualitative reasoning enables one to deal with partial information, which is particularly important for spatial applications when only incomplete data sets are available. It is important to find representations that support partial information. Qualitative and quantitative approaches have significantly different characteristics. While quantitative models use absolute values, qualitative models deal with magnitudes, which can sometimes be seen as abstractions from the quantitative details; therefore, qualitative reasoning models can separate numerical analyses from the determination of magnitudes of events which may be assessed differently, depending on the contex in which the particular situation is viewed. This is not to be confused with fuzzy reasoning, which is frequently applied to dealing with

terminology of system designers, but also to educate them in formalizations used to represent geographic data and to derive geographic information. Naive Geography is also the basis for the design of intelligent GISs that will act and respond as a person would, therefore, empowering people to utilize GISs as reliable sources, without stunning surprises when using a system. This paper defines the notion and concepts of Naive Geography.

Although various aspects of Naive Geography have been studied for at least 40 years in a piecemeal fashion, Naive Geography has never been addressed comprehensively as a theory of its own. Occasionally, different terms have been used to describe certain aspects of it—Spatial Theory (Frank 1987) , Geographical Information Science (Goodchild 1992), Spatial Information Theory (Frank and Campari 1993), Environmental Psychology, or plain Artificial Intelligence. Aspects of Naive Geography have been also considered within academic geography, and can be found in books by Bunge (1962) or Abler et al.

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imprecise information (Zadeh 1974). Qualitative spatial reasoning is exact, as is its outcome; yet, the resulting qualitative spatial information may be underdetermined, i.e., there is a set of possible values, one of which is the correct result (Morrissey 1990). Qualitative information and qualitative reasoning are not seen as substitutions for quantitative approaches, they are rather complementary methods, which should be applied whenever appropriate. For many decision processes qualitative information is sufficient; however, occasionally quantitative measures, dealing with precise numerical values, may be necessary and that would require the integration of quantitative information into qualitative reasoning. Qualitative approaches allow the users to abstract from the myriad of details by establishing landmarks (Gelsey and McDermott 1990) when «something interesting happens»; therefore, they allow them to concentrate on a few but significant events or changes (De Kleer and Brown 1984).

The remainder of this paper continues with a brief review of Naive Physics (Section 2), and then defines Naive Geography in more detail (Section 3). Section 4 discusses an approach that promises progress toward the development of a Naive Geography. In Section 5, we lay out a sampling of ingredients of a Naive Geography. Section 6 presents

our conclusions and points out some directions for further research.

2. Naive Physics

«Naive Physics is the body of knowledge that people have about the surrounding physical world. The main enterprises of Naive Physics are explaining, describing, and predicting changes to the physical world.» (Hardt 1992, p. 1147). The term Naive Physics was coined by Patrick Hayes, and introduced in his Naive Physics Manifesto (Hayes 1978), a passionate and visionary statement that provided a catalyst for much research into qualitative methods for spatial and temporal problem solving. It was motivated by the recognition that Artificial Intelligence was—in the late 1970s—full of toy problems:

«Small, artificial axiomatizations or puzzles designed to exercise the talents of various problem-solving programs or representational languages or systems» (Hayes 1978, p. 242). To overcome this limitation, Hayes proposed that researchers should concentrate on

modeling common-sense knowledge.

Related terms and concepts include Intuitive Physics, Qualitative Physics, and Common- Sense Physics—some of these terms are more or less synonymous with Naive Physics, whereas others treat similar problems using different approaches. Intuitive Physics (McClosky 1983) addresses people's thinking about such tasks as dropping an object on a target while walking. Many people demonstrated poor performance in predicting when to release an object, which indicated that their intuitive models of physics may deviate from our current text-book examples of Newtonian Physics. Similarly, Naive Geography may follow Intuitive Physics as it may contradict many of our currently employed models for geographic space and time. Qualitative Physics (De Kleer and Brown 1984; De Kleer 1992) describes models of small-scale space in which objects undergo mechanical operations. A well-investigated example is

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the attempt to replicate the behavior of an analog clock (Forbus et al . 1991). While Qualitative Physics employs some methods that may be relevant to Naive Geography, it differs because Qualitative Physics usually focuses on the mechanics of a system and excludes human interaction.

Naive Physics by no means excludes geographic spaces. Indeed, Hayes's (1978) seminal paper on the topic contains examples of lakes and other geographic features; however, the great majority of the work in naive, common-sense, qualitative, and intuitive physics deals with spaces and objects manipulable by people, perceived from a single view point.

There is strong evidence, from a variety of sources, that people conceptualize geographic spaces differently from manipulable, table-top spaces (Downs and Stea 1977; Kuipers 1978; Zubin 1989; Mark 1992a; Montello 1993; Pederson 1993; Mark and Freundschuh 1995). Thus, we think the new term, Naive Geography, is appropriate as part of an attempt to focus the research efforts of theoretical geographers and other spatial information theorists, on formal models of common-sense knowledge of geographic spaces.

3. Naive Geography: the Notion

In this paper, we are using the notion and concepts of Naive Geography to refer to what might otherwise have been called the Naive Physics of Geographic Space. Modifying Hardt's (1992) definition of Naive Physics: Naive Geography is the body of knowledge that people have about the surrounding geographic world.

Naive Geography captures and reflects the way people think and reason about geographic space and time, both consciously and subconsciously. Naive stands for instinctive or spontaneous.

Naive geographic reasoning is probably the most common and basic form of human intelligence. Spatio-temporal reasoning is so common in people's daily life that one rarely notices it as a particular concept of spatial analysis. People employ such methods of spatial reasoning almost constantly to infer information about their environment, how it evolves over time, and about the consequences of changing our locations in space.

Naive geographic reasoning can be, and has to be, formalized so that it can be implemented on computers. As such Naive Geography will encompass sophisticated theories. Naive geographic reasoning may actually contain «errors» and will occasionally be inconsistent. It may be contrary to objective observations in the real, physical world.

These are properties that have been dismissed by the information systems and database communities. The principle of databases has been storage of non-redundant data to avoid potential inconsistencies. Information systems are supposed to provide one answer, one and only one. Naive Geography theories give up some of these restricted views of an information system.

3.1 The Essence of Naive Geography: Geographic Space

Geographic space is large-scale space, i.e., space that is beyond the human body and that may be represented by many different geometries at many different scales. Occasionally, geographic space has been defined as space that cannot be observed from a single viewpoint (Kuipers 1978; Kuipers and Levitt

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1988). The intention of this definition was to describe the fact that geographic space comprises more than what a person sees. Of course, this definition falls short the moment one considers hills, towers, skyscrapers, hot-air balloons, airplanes, and satellites from which one can gain a view of much larger portions of space than by standing in a parking lot. A better definition of geographic space might be the space that contains objects that we humans do not think of being manipulable objects.

Geographic space is larger than a molecule, larger than a computer chip, larger than a table-top. Its objects are different from an atom, a microscopic bacterium, the pen in your hand, the engine that drives your car. Geographic space may be a hotel with its many rooms, hallways, floors, etc. Geographic space may be Vienna, with its streets, buildings, parks, and people. Geographic space may be Europe with mountains, lakes and rivers, transportation systems, political subdivisions, cultural variations, and so on. Within such spaces, we constantly move around. We explore geographic space by navigating in it, and we conceptualize it from multiple views, which are put together (mentally) like a jigsaw puzzle. This makes geographic space distinct from small-scale space, or table-top space, in which objects are thought of as being manipulable and whenever an observer lacks some information about these objects, he or she can get this information by moving the object into such a position that one can see, touch, or measure the relevant parts.

3.2 Naive Geography for GIS Design

In addition to the scientific motivation of trying to get a better understanding of how people handle their environments, there is the need to incorporate naive geographic knowledge and reasoning into GISs. The concepts and methods people use to infer information about geographic space and time become increasingly important for the interaction between users and computerized GISs. While many spatial inferences may appear trivial to us, they are extremely difficult to formalize so that they could be implemented on a computer system. Current methods to derive spatial and temporal information about geographic space are limited; therefore, we see a big gap between what a human user wants to do with a GIS, and the spatial concepts offered by the GIS.

Today's GISs do not sufficiently support common-sense reasoning; however, in order to make them useful for a wider range of people, and in order to allow for prediction or forecasting, it will be necessary to incorporate people's concepts about space and time /nd to mimic human thinking; therefore, we will focus on common-sense geographic reasoning, reasoning as it is performed by people, reasoning whose outcome makes intuitive sense to people, reasoning that needs little explanation.

In the past, geographic reasoning has been limited to calculations in a Cartesian coordinate space; however, Euclidean geometry is not a good candidate for representing geographic information, since it relies on the existence of complete coordinate n-tuples. Likewise, pictorial representations are inadequate since they overdetermine certain situations, e.g., when drawing a picture representing a cardinal direction, a sketch also includes information about the sizes of the objects and some relative distances. Formalized spatial data models have been extensively discussed in the context of databases and

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GISs; however, to date there are, for instance, no models for a comprehensive treatment of different kinds of spatial concepts and their combinations that are cognitively sound and plausible. More flexible and advanced methods are needed to capture the results from cognitive scientists' studies, such as the fact that the nature of errors in people's cognitive maps is most often metrical and only rarely topological (Lynch 1960), or how topological structure (Stevens and Coupe 1978) or gestalt are used for spatial reasoning. Researchers have identified different types of spaces with related inference methods (Piaget and Inhelder 1967; Golledge 1978; Couclelis and Gale 1986).

GISs need to include such intelligent mechanisms to deal with often complex spatial concepts. If GISs can achieve geographic reasoning in a manner similar to a human expert, these systems will be much more valuable tools for a large range of users—family members who are planning their upcoming vacation trip, scientists who want to analyze their data collections, or business people who want to investigate how they performed in various geographic markets.

3.3 What Naive Geography is Not

Naive Geography is neither arm-chair science, nor does it employ Mickey-Mouse research. Likewise, Naive Geography is neither childish nor stupid geography, nor is it the geography of ignorant or simple-minded people. It is not geography by the uneducated nor for the uneducated. Despite the attempts to capture human performance, naive geographic reasoning does not aim at being descriptive, neither in its methodologies nor in its results and interpretations. And it is not just another term for fuzzy reasoning, nor is fuzzy reasoning a substitute for Naive Geography—it might have its value as one of several methods for naive geographic reasoning, though. Finally, Naive Geography is not a replacement for GIS.

3.4 Naive Geography and Related Disciplines Naive Geography is not a completely new discipline. Quite the opposite, it is closely related to several of our current scientific and engineering disciplines, and builds upon them. Geography is the most obvious discipline—it is part of the name Naive Geography. Geography is the science concerned with relationships, processes, and patterns of our surrounding world, and as such it addresses at a coarse level the kind of issues we are concerned with. At a more detailed level, the domain-specific fields contribute to Naïve Geography. They include geology, archeology, economics, and transportation as they describe particular domain knowledge that shapes the users' and analysts' mental models and therefore, often enable inference that is otherwise impossible.

These geographic disciplines are not the only relevant fields for Naive Geography. Naïve Geography has to employ concepts and principles of cognitive science and linguistics to ensure a linkage with the way people perceive geographic space and time, and the ways they communicate about them. Naive Geography is associated with anthropology as it has to accommodate regional and cultural particularities in how people deal with geographic space and time. There is the field of psychology upon which Naive Geography builds.

And philosophy may contribute to Naive Geography as Aristotle's, Kant's, or Leibnitz's views of space frame many of the discussions about the nature of Naive Geography.

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Finally, there are the fields that provide us the tools to express and formalize naïve geographic knowledge: engineering as it pertains to the modeling of geographic information, from measurements about the Earth to GIS user interface design, as well as computer science and mathematics. This scanning of relevant fields is certainly incomplete, and there may be many others whose findings and influences may be even more dramatic than those listed here. There are many who contribute—as there are many who will benefit.

4. Towards the Development of Naive Geography

Naive Geography has to bridge between different scientific perspectives; therefore, in order to investigate naive geographic concepts, researchers have to combine different research methodologies. It will be the interplay between the different approaches that will provide the exciting and useful results.

The framework for developing Naive Geography consists of two different research methodologies: (1) the development of formalisms of naive geographic models for particular tasks or sub-problems so that programmers can implement simulations on computers; and (2) the testing and analyzing of formal models to assess how closely the formalizations match human performance. For Naive Geography, the two research methods are only useful if they are closely integrated and embedded in a feedback loop to ensure that (1) mathematically sound models are tested (bridging between formalism and testing) and (2) results from tests are brought back to refine the formal models (bridging between testing and implementable formalisms). The outcome of such a complete loop

leads to refined models, which in turn should be subjected to new, focused evaluations. In an ideal scenario, this leads to formal models that ultimately match closely with human perception and thinking. From the refinement process we may gain new insight into common-sense reasoning and we may actually derive certain reasoning patterns. The latter—the generic rules—would manifest naive geographic knowledge. Research in the area of spatial relations provides an example in which the combination and interplay of different methods generates useful results. The treatment of spatial relations within Naive Geography must consider two complementary sources: (1) the cognitive and linguistic approach, investigating the terminology people use for spatial concepts (Talmy 1983; Herskovits 1986; Retz-Schmidt 1988) and human spatial behavior, judgments, and learning in general; and (2) the formal approach concentrating on mathematically based models, which can be implemented on a computer (Egenhofer and Franzosa 1991; Papadias and Sellis 1994; Hernández 1994). The formalisms serve as hypotheses that may be evaluated with human-subject testing (Mark et al. 1995).

5. Some Elements of Naive Geography

The mere identification of a comprehensive set of elements of Naive Geography comprises a major research task, and its completion would provide a big step towards the successful manifestation of Naive Geography. As a starting point, we present an ad hoc collection of elements that would contribute to a Naive Geography. The list is by no means exhaustive, and some of the following may turn out to be false, or at least uncommon and/or limited to specific cultures, primarily those of the authors. We present these elements to give the reader a flavor of what we intend should be included in Naïve Geography.

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5.1 Naive Geographic Space is Two-Dimensional

Manipulable objects on a table-top are essentially three-dimensional. Even a sheet of paper has a thickness. Furthermore, in everyday-object (manipulable) space, the three dimensions are all about equal. Objects are easily rotated about any axis, or obliquely.

When an object is moved, we expect its properties, spatial and non-spatial, to remain unchanged.

Geographic space under Naive Geography is, in contrast, essentially two-dimensional. There is considerable evidence that the horizontal and vertical dimensions are decoupled in geographic space. For example, people often grossly over-estimate the steepness of slopes, and the depths of canyons compared to their widths. So, instead of parsing a three-dimensional space into three independent one-dimensional axes, geographic spaceseems to be interpreted as a horizontal, two-dimensional space, with the third dimension reduced more to an attribute (of position) rather than an equal dimension. This is very much like the 2 1/2-D representations used in computational vision (Marr 1982). That GISs have succeeded in the marketplace with little or no capabilities to do three- dimensional analysis is testimony to the nature of geographic space. A two-dimensional system for CAD (computer-aided design) would not likely be successful.

5.2 The Earth is Flat

This is a different point than the one about two-dimensionality. In most of our large-scale reasoning tasks, this is a common simplification. It is not a discussion as to whether it is admissible, or not. People do it. When traveling from Boston to New York, one disregards the Earth's curvature. This is independent of the mode of transportation. Trans-Atlantic air travelers often ask why the flight path goes all the way up over Greenland, rather than going straight across—the great circle, shortest path between two points across the surface of a sphere, is not part of common-sense knowledge for most people.

5.3 Maps are More Real Than Experience

Perhaps this point should be, «Maps are more faithful to the reality of geographic space than are our direct experiences of such spaces.» Many times, we hear statements like, «When I get home, I want to look at the route on a map, to see where I went.» This seems to be based on a naive assumption that the truth about where one is in geographic space is better represented by a map-based, map-like, or configurational view of geographic space, than it is by our memories of our experiences with that space from within.

5.4 Geographic Entities are Ontologically Different from Enlarged Table-Top Objects

As geographic space differs from table-top space, so are the properties and the behavior of many entities in geographic space different from those on a table top. The issue is not just mere size. In his paper Ontology of Liquids, Hayes (1985b) gave an excellent example with a detailed discussion of how the ontology of lakes is different from that of many other objects composed of liquids. He showed how a

5.1 Naive Geographic Space is Two-Dimensional

Manipulable objects on a table-top are essentially three-dimensional. Even a sheet of paper has a thickness. Furthermore, in everyday-object (manipulable) space, the three dimensions are all about equal. Objects are easily rotated about any axis, or obliquely.

When an object is moved, we expect its properties, spatial and non-spatial, to remain unchanged.

Geographic space under Naive Geography is, in contrast, essentially two-dimensional. There is considerable evidence that the horizontal and vertical dimensions are decoupled in geographic space. For example, people often grossly over-estimate the steepness of slopes, and the depths of canyons compared to their widths. So, instead of parsing a three-dimensional space into three independent one-dimensional axes, geographic spaceseems to be interpreted as a horizontal, two-dimensional space, with the third dimension reduced more to an attribute (of position) rather than an equal dimension. This is very much like the 2 1/2-D representations used in computational vision (Marr 1982). That GISs have succeeded in the marketplace with little or no capabilities to do three- dimensional analysis is testimony to the nature of geographic space. A two-dimensional system for CAD (computer-aided design) would not likely be successful.

5.2 The Earth is Flat

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phenomenon/entity in geographic space has an ontology that is not simply an enlarged version of the table-top manipulable world.

5.5 Geographic Space and Time are Tightly Coupled

The linkage between space and time is an aspect of Naive Geography that deserves special attention. The term geographic space and time is understood such that geographic distributes over space and time—formalists would tend to write geographic (space and time). As there is geographic space, we want to argue that there is geographic time, i.e., time that is inherently linked to geographic concepts (Egenhofer and Golledge 1994). We select one of several examples to underline this claim:

Many cultures have pre-metric units of area that are based on effort over time (Kula 1983). The English acre (Jones 1963; Zupko 1968; 1977), the German morgen (Kennelly 1928), and the French arpent (Zupko 1978) all are based on the amount of land that a person with a yoke of oxen or a horse can plow in one day or one morning. There have been similar measures for distance, such as how far a person can walk in an hour, or how far an army can march in a day. We know of no such «effort-based» units of measure for manipulable (table-top) space.

5.6 Geographic Information is Frequently Incomplete

Another setting for geographic reasoning is given by the constraint that reasoning in geographic space must typically deal with incomplete information. Nevertheless, people can draw sufficiently precise conclusions, e.g., by completing information intelligently or

by applying default rules, frequently based on common sense. A number of cognitive studies have provided evidence that people may employ hierarchically organized schemes to reason in geographic space and to compensate for missing information (Hirtle and

Jonides 1985; McNamara et al . 1989).

5.7 People use Multiple Conceptualizations of Geographic Space

When thinking about geographic space, people typically employ several different concepts, and change between them frequently. Such conceptualizations of space may reflect the differences between perceptual and cognitive space (Couclelis and Gale 1986), or may be based on different geometrical properties, such as continuous vs. discrete (Egenhofer and Herring 1991; Frank and Mark 1991). The dependency on scale, or difference in the types of operations people would typically employ, has been raised as another motivation for distinguishing different types of spaces (Zubin 1989).

5.8 Geographic Space has Multiple Levels of Detail

This aspect of representing geographic space is orthogonal to multiple conceptualizations of geographic space. A conceptualization of geographic space may have several levels of granularity, each of which will be appropriate for problem solving at different levels of detail. In cartographic applications, this aspect has been considered to be part of scale (Buttenfield 1989). The naive view of geographic space implies that processing a query against a more detailed representation would not provide a more precise query result.

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5.9 Boundaries are Sometimes Entities, Sometimes Not

The fact that Naive Geography models geographic space as it is perceived by people, is strongly reflected in the way boundaries are represented. There is no uniform view of what a boundary is and how it is established—even if one could agree on a model for the physical entities. Such simple configurations as national boundaries may have diverse interpretations, even if the countries involved agree over the extent of their territories.

Conventionally, political subdivisions are modeled as a partition of space in which a boundary separates one nation's land from its neighbor. Each of the neighbors may actually have a different perspective, namely that the boundary belongs to their country.

As such, the boundary between two neighboring countries may be considered a pair of boundaries. Smith (1994) argues, from a philosophical point of view, that there may be geographic situations in which the boundary between two adjacent areas is even asymmetric. As examples he cites situations in which one country did not recognize the existence of a national boundary with its neighbor, while the other country considered it a valid boundary. Political subdivisions are certainly not the only cases in which such multiple views of boundaries may occur. The same case could be made for land parcels and the question as to who owns the boundary between two adjacent parcels.

5.10 Topology Matters, Metric Refines

In geographic space, topology is considered to be first-class information, whereas metric properties, such as distances and shapes, are used as refinements that are frequently less exactly captured. There is ample evidence that people organize geographic space such

that topological information is retained fairly precisely, capturing such relationships as inclusion, coincidence, and left/right (Lynch 1960; Stevens and Coupe 1978; Riesbeck 1980).

5.11 People have Biases Toward North-South and East-West Directions

People's mental maps of directions and distances are frequently quite gross simplifications, with particular preferences for alignments in North-South and East-West directions. Despite exposure to maps and satellite images, we often ignore geographic reality. For instance, at a global scale, South America often is considered to be due south of North America. Likewise, most people misjudge latitudes when trying to compare cities in North America and Europe (Tversky 1981). While such misconceptions are similar to those found by Stevens and Coupe (1978), they cannot be explained with a hierarchical conceptualization of geographic space. A potential source for some of these errors are climate comparisons, and the equation (for the Northern hemisphere) that colder means further North, and warmer equates to further South, may indicate that factors other than geographic location may influence estimations of directions.

Biases toward strict cardinal directions appear also in judgments about coastlines—the U.S. East coast is frequently believed to be due North-South (Mark 1992b). Such misconceptions may have surprising consequences when people interact with information systems. For example, most people requesting the satellite image South of the State of Maine from an image archive, would

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People tend to have similar biases towards North-South directions and right angles in navigation, where they may be irritated by slight deviations from the norm and consequently perform poorly in wayfinding.

5.12 Distances are Asymmetric

Euclidean geometry includes the axiom that a distance from point A to point B is equal to the distance from B to A. In naive geographic space, this premise is frequently violated. Distances are not only thought of as lengths of paths on the Earth's surface, but frequently seen as a measure for how long it takes to get from one place to another (Kosslyn et al. 1978). The shortest path may have multiple interpretations, e.g., in terms of distance, time, fuel consumption, or toll. Even if the same path, in opposite directions, is chosen between two points, the distance as people perceive it may not be the same (Golledge et al. 1969): terrain may influence how fast one can travel or traffic during rush hours may slow down travel in one direction.

While distance applies as a measure between positions in geographic space, it extends to abstract concepts where it captures conceptual closeness. For example, among water bodies, a pond is conceptually closer to a lake than to the sea, because one can find more conceptual differences between a pond and the ocean than between a pond and a lake.

The shorter the distance is, the more similar the instances are. Again, such distances among concepts are frequently asymmetric, implying that the induced similarity is asymmetric as well (Papadias 1995), i.e., if A is similar to B, then B is not necessarily similar to A.

5.13 Distance Inferences are Local, Not Global

Geographic distances are thought of as local, i.e., covering the neighborhood between the two points of interest, without involving locations remote to both objects. Common coordinate systems, however, have their origins at the equator, and distance differences are calculated as differences of lengths from the equator and from Greenwich. How far it is from Bangor, Maine to Orono, Maine is based on how distant Bangor and Orono are from the equator, and how remote Bangor and Orono are from Greenwich, U.K. (Goodchild 1994). In a similar way, any distinction about North, South, East, and West is related on the reference frame's (remote) origin. Despite the convenience of such coordinate calculations, alternative spatial reference systems are needed in support of Naive Geography. Such reference systems should pay attention to neighborhood relations, as demonstrated in measurement-based systems (Buyong et al . 1991), or use coordinate-based calculations as a last resort of inference, as supported by deductive geographic databases (Sharma et al . 1994).

5.14 Distances Don't Add Up Easily

Reasoning about distances along networks in geographic space underlies formalisms that differ considerably from standard calculus. Usually, one adds up lengths of segments along a path, irrespective of their values, to obtain the length of the entire path. This method provides unreasonable results in cases where the

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values to be added differ by large amounts. For instance, the distance between the airports in Bangor, Maine and Santa Barbara, California is approximately 5,000 kilometers. When computing the travel distance from the University of Maine to UC Santa Barbara, it would make little sense to add the relatively short legs between the campuses and the respective airports—10 kilometers and 1.5 kilometers—to the overall distance and claim that it took 5,011.5 kilometers to get from one campus to the other.

6. Conclusions

This paper described the notion and concepts of Naive Geography. Naive Geography establishes the link between how people think about geographic space and how to develop formal models of such reasoning that can be incorporated into software systems. Such intelligent GISs—one or two generations down the road—would be intuitive to use and would provide powerful reasoning capabilities and some limited methods to make predications of human behavior. Like Patrick Hayes in his Naive Physics Manifesto, we consider our framework as a start of a discussion, to be revised in the future.

Common-sense reasoning is difficult, and if there are formalizations that appear to be common-sensical, then they are excellent results. Unfortunately, our scientific communities frequently consider such formalizations as «too simplistic»—because everyone understands them, and science should have some complexity to be considered science. We disagree with this attitude at the level of common-sense reasoning. If it is simple and solves the problem, then it is good.

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What the Buddha Knew About Mathematics But Never Told You
By Joe Pagano
Article Source: http://EzineArticles.com/?expert=Joe_Pagano

Form is emptiness, emptiness is form.» ***---Heart Sutra***

At the heart of Buddhism is the concept that stillness reigns supreme, that by virtue of stilling the mind and emptying it of its contents, one can become enlightened. What is mind-startling about this premise is the truth that rings loudly from its core. What we shall see here through a mathematical example is how the Buddha was indeed right: form does arise from emptiness and emptiness is actually form. It is all in the perception.

The famous mathematician, John von Neumann, created a method, known as *von Neumann hierarchy*, of generating the set of *Natural* numbers {1,2,3,...} from...essentially *nothing*. From this example, we see how form arises out of emptiness, and thus reinforces the precept of the *Heart Sutra* quoted above. To carry out this example, all we need is some basic knowledge of set theory.

A set is a group of objects. Thus the set **A** = {3, 5, 7, 9} comprises the odd numbers from 3 through 9 inclusive. We can also talk about the set {}, which is called the *empty* set. The empty set is the set which contains no elements; this set is sheer «*emptiness*.» Now sets can contain sets as elements. For example, take the set **A** above and now add the element {12} which is the set which contains the element 12. Form the set **B** = {3, 5, 7, 9, {12}}. The set **B** contains five elements, one of which is *itself* a set.

When we talk about the *union* of two sets, we simply merge the elements of each set into one, not repeating any common elements. Thus if **C** = {1, 2, 3} and **D** = {3, 4, 5} then **C** *union* **D**, or **CUD**, in which the symbol «**U**» means union, is the set **E** = {1, 2, 3, 4, 5}. Now the example that follows is going to show how we create something from nothing, or *form* from emptiness. We have the following steps:

Step 0**:** {} Empty Set
Step 1: { {} } Set containing the empty set
Step 2: { {}, { {} } } Set containing the previous two sets
Step 3**:** { {}, { {} }, { {}, { {} } } } Set containing the previous three sets

Iterating in this way, we create a sequence in which the next element is the union of the two previous sets. Now at *Step 1*, we have a set with one element; at *Step 2*, we have a set with two elements, and so on. In this way, we can generate the set of *Natural* numbers {1, 2, 3,...}

Thus from emptiness, namely the empty set, which contains nothing, we have created *form*, that is the *Natural* numbers, which contain an infinity of numbers. The only difference is how we look at the two sets: *our perspective*. In mathematics, there is a very special word for what we have just done between the sequence generated by the empty set and the *Natural* numbers. We say the two sets are *isomorphic*, which basically means that the elements of each set are the same except in the way we perceive them. This is much the same as the *isomorphism* that would exist between the numbers 1,2,3... in English and the

Математика

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same numbers called by another name in a foreign language such as French or German, or even Macedonian, if you will.

Thus emptiness is *form*, depending on our perspective of course; and *form*, the *Natural* numbers, is emptiness, again depending on our perspective. Indeed the Buddha did know something about mathematics that he never told us; but now even we know some of his ancient secrets. Now maybe if we apply them to everyday living, everybody will be a lot better off.

Music and Mathematics — There Are Many Connections

By Joe Pagano

Article Source: http://EzineArticles.com/?expert=Joe_Pagano

If you thought music was not a mathematical language, then think again. In fact, music and mathematics are very much intertwined, so much so that I guess you could say one could not live without the other. Here we examine a relationship that clearly demonstrates the strength of this tie. Let the music begin.

For those with a rudimentary knowledge of music, the diatonic scale is something quite familiar. To understand why certain pairs of notes sound good together and others do not, you need to look into the sinusoidal wave patterns and the physics of frequencies. The *sine wave* is one of the most basic wave patterns in mathematics and is depicted by smoothly alternating crest-trough regularity. Many physical and real-world phenomena can be explained by this basic wave pattern, including many of the fundamental tonic properties of music. Certain musical notes sound well together (musically this is called *harmony* or *consonance*) because their sinusoidal wave patterns reinforce each other at select intervals.

If you play the piano, then how each of the different notes sounds to you is dependent on how your instrument is tuned. There are different ways to tune instruments and these methods depend on mathematical principles. These tunings are based on multiples of frequencies applied to a given note, and as such, these multiples determine whether groups of notes sound well together, in which case we say such notes are in harmony, or poorly together, in which case we say such notes are out of harmony or dissonant.

Where these multiples come from depend on criteria set by the instrument maker and today there are certain standards that these fabricators follow. Yet criteria notwithstanding, the multiples are inherently mathematical. For example, in more advanced mathematics, students study series of numbers. A series is simply a pattern of numbers determined by some rule. One famous series is the ***harmonic series***. This comprises the reciprocals of the whole numbers, that is 1/1, 1/2, 1/3, 1/4...The harmonic series serves as one set of criteria for certain tunings, one notably called *Pythagorean Intonation*

In Pythagorean intonation, notes are tuned according to the «*rule of the perfect fifth*.» A perfect fifth comprises the «*musical distance*» between two notes, such as C and G. Again without trying to turn this article into a treatise on musical theory, the notes between C and G are C#, D, D#, E, F, F#, and G. The «*distance*» between each of these notes is called a half-step. Thus a perfect fifth comprises 7 half-steps, C-C#, C#-D, D-D#, D#-E, E-F, F-F#, and F#-G. When we number the notes in a musical harmonic series, the number ascribed to the C

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Thus emptiness is *form*, depending on our perspective of course; and *form*, the *Natural* numbers, is emptiness, again depending on our perspective. Indeed the Buddha did know something about mathematics that he never told us; but now even we know some of his ancient secrets. Now maybe if we apply them to everyday living, everybody will be a lot better off.

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note and that ascribed to the G note will always be in the ratio of 2:3. Thus the frequencies of these notes will be tuned so that their ratios correspond to 2:3. That is the C-note frequency will be 2/3 the G-note frequency, or vice versa, the G note frequency will be 3/2 the C note frequency, in which frequency is measured in cycles per second or Hertz.

Now, continuing by tuning according to perfect fifths, the fifth above G is D. Applying the *perfect fifth ratio*, the D note will be tuned to a frequency which is 3:2 the G frequency, or looking at this from below, the G note is 2/3 the frequency of the D note. We can continue in like manner until we complete what is called the ***Circle of Fifths***, bringing us back to a C note by applying successive ratios of 3/2 to the previous note in the cycle. This takes twelve steps and when complete, the frequency of the second C, or the higher octave C note should be exactly ***twice*** the frequency of the lower C note. This is a requirement of all octaves. However this does not happen by applying this ratio of 3/2.

Musicians have rectified this problem by resorting to none other than the field of *irrational numbers*. Recall that those numbers are such that they cannot be expressed as fractions, that is, their decimal representations, like the number pi or the square root of two, do not end and do not repeat. Thus as a result of the failure of the Pythagorean tuning method to produce *perfect* octaves, tuning methods have been developed to obviate this situation. One is called «*equal temperament*» tuning, and this is the standard method for most practical applications. Believe it or not, this tuning method incorporates rational powers of the number two. That is correct: *fractional powers of the number two*. So if you thought you were learning rational exponents for nothing in algebra class, here is one example of where such a topic is used in real life

The way equal temperament tuning works is as follows: each note throughout its octave has its frequency multiplied by successive *twelfth roots* of two to get to the next higher note. That is, if we start with the standard A note, which vibrates at 440 Hertz, let us say, to get to A#, we multiply this 440 by 2^(1/12). Since the twelfth root of two is equal to 1.05946 to five decimal places, A# would be tuned to 440*1.05946 or 464.18 Hertz. And thus the tuning continues with the next note B obtained by taking 2^(2/12)*440. Note that we increment the *twelfth power of 2* by 1 each time, obtaining powers of 2 which are 1/12, 2/12, 3/12, etc.

What is *nice* about this method is its exactness, unlike the inexactness of the Pythagorean intonation method discussed earlier. Thus when we arrive at the octave note, the next A above the standard A, which should vibrate at twice the frequency of the original 440 Hertz A, we get ***A octave*** = 440*2^(12/12) which is 440*2 = 880 Hertz, as it should be---exactly. As we stated earlier, when tuning by the Pythagorean method, this does not happen because of the repetitive use of the ratio 3/2, and therefore accommodations must be made to bring in line the inexactness of this approach. These accommodations result in perceptible dissonances between certain notes and in certain keys.

This tuning exercise demonstrates that mathematics and music are well intertwined, and indeed one could say that these two disciplines are inseparable. Music is truly mathematical and mathematics is, well, yes musical. Since many people think of musical talent coming from the «*creative*» types and mathematics ability coming from the «*nerdy*» or non-creative types, this article

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in some part helps disabuse these same people of this notion. Yet the question remains: If two ostensibly different fields as music and mathematics are happily married, how many other fields out there, which at first seem to have nothing to do with mathematics, are just as intricately linked to this most fascinating subject. *Meditate on that for awhile.*

Advanced Mathematics — Can Someone Please Help Me!?
By Joe Pagano
Article Source: http://EzineArticles.com/?expert=Joe_Pagano

For those adventurous souls out there who try to plumb the depths of more advanced mathematics, I certainly give you credit for your efforts. Studying advanced mathematics can be very humbling, to say the least. You feel good about yourself because you think you are smart, and then you read something on advanced mathematics and you realize how little you understand. At least that is the way I usually feel. The sad thing is though, it may not be that you and I are not bright enough but that the teachers and writers of this particular subject fail terriby at what they do. Thus the cry should be, «*Can someone please help me!*»

Because I love a challenge, I decided to make my major mathematics in college. This was by no means my strongest subject. English and foreign languages certainly came very easily to me and could have been *slam-dunk* choices as majors. I probably would have suffered a lot less than I did from studying things like *advanced calculus*, *real* and *complex analysis*, *mathematical statistics* and *set theory*. This study was further compounded by professors who, for the most part, failed to elucidate the subject matter. Consequently, I got my degree, although with not perfect grades, good grades, and am certainly proud of my accomplishment. The irony in all this is that after all that suffering, I now relish the subject and have written extensively on many facets of this discipline.

What I have found in my study of mathematics, particularly advanced mathematics, is that there are so few good teachers of it. When I was a graduate student — yes I actually decided to punish myself more by studying this subject at the graduate level — I remember sitting in my *complex analysis* course, listening to my Indian professor go off on tangents about exotic realms of this subject. What he was talking about, I can hardly say. I know I would catch an idea here or there, but none of what he said had any relevance, and I just sat there for the most part and pretended to understand. After all, nobody wanted to look foolish.

Now that I am a bit older, and hopefully wiser, I realize the foolhardiness of it all. The purpose of going to school and attending lectures or classes is to ask questions and learn. Material should be presented in a way so that students, willing to put in the time and effort, should understand — at least at a superficial level. What I found from most of the lectures I attended and most of the textbooks I used is that I understood very little — if anything. One could say that I could not discern the forest from the trees; but the real truth is that I could not discern *even one tree from another*. How sad.

Unfortunately, things have not changed since those days in the 80's. When I try to plumb the depths of advanced mathematics I encounter the same outdated, stale, methods of pedagogy that just do not serve. Why can't anyone produce books on advanced mathematics, or even articles on the subject, so that willing

in some part helps disabuse these same people of this notion. Yet the question remains: If two ostensibly different fields as music and mathematics are happily married, how many other fields out there, which at first seem to have nothing to do with mathematics, are just as intricately linked to this most fascinating subject. *Meditate on that for awhile.*

Advanced Mathematics — Can Someone Please Help Me!?
By Joe Pagano
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learners like me or you, could understand? Certainly the men who understand this subject are smart enough to be able to do this, no? Then again, there might be an agenda: that of not letting too many into this select circle of prominent mystique. This is much like the master karate instructor's inner circle of disciples. These masters are not too quick to teach their secret methods, which took a lifetime to acquire and understand, to some neophyte, until that person has proven his loyalty, and even sanity. Indeed you would not want such killer techniques in the wrong person's hands.

Such easy dissemination of enlightenment might serve a purpose in the martial arts, yet I argue that such in a discipline as advanced mathematics should be freely available. Even with my background and experience, I find it enormously frustrating that I cannot teach myself to master the theory of, let us say, *partial differential equations*, because there is not one book that tries to teach this subject without quickly throwing the student into the forest without a roadmap. Yes I know that the subject is comprehensive and depends on other branches of mathematics, and that if the author were to break everything down, the book might have to be three thousand pages; yet the alternative is that very little if anything is learned by the student, and thus the realm of advanced mathematics remains untouched but by a select few, leaving out many potential bright students, who perhaps, before being daunted and quitting the pursuit of such subject, would make great contributions to the subject and even world. After all, mathematics is the language of the universe, and a comprehensive understanding of this subject can lead to all kinds of useful applications.

Thus I scream, «*Can anyone please help!*» I want to be able to learn Einsteinian mathematics and all about tensors. Could someone please break this down so that a person with my intelligence might glimpse this awesome domain. Alas. No one answers; and therefore, I have to be content to trudge through such readings with the labors of childbirth. But I stay hopeful that one day this might change. Anyone out there?

Mathematician Uses Topology To Study Abstract Spaces, Solve Problems
ScienceDaily (Aug. 16, 2010)

Studying complex systems, such as the movement of robots on a factory floor, the motion of air over a wing, or the effectiveness of a security network, can present huge challenges. Mathematician Robert Ghrist at the University of Illinois at Urbana-Champaign is developing advanced mathematical tools to simplify such tasks.

Ghrist uses a branch of mathematics called topology to study abstract spaces that possess many dimensions and solve problems that can't be visualized normally. He will describe his technique in an invited talk at the International Congress of Mathematicians, to be held Aug. 23-30 in Madrid, Spain.

Ghrist, who also is a researcher at the university's Coordinated Science Laboratory, takes a complex physical system — such as robots moving around a factory floor — and replaces it with an abstract space that has a specific geometric representation.

«To keep track of one robot, for example, we monitor its x and y coordinates in two-dimensional space,» Ghrist said. «Each additional robot requires two

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«To keep track of one robot, for example, we monitor its x and y coordinates in two-dimensional space,» Ghrist said. «Each additional robot requires two

more pieces of information, or dimensions. So keeping track of three robots requires six dimensions. The problem is, we can't visualize things that have six dimensions.»

Mathematicians nevertheless have spent the last 100 years developing tools for figuring out what abstract spaces of many dimensions look like.

«We use algebra and calculus to break these abstract spaces into pieces, figure out what the pieces look like, then put them back together and get a global picture of what the physical system is really doing,» Ghrist said.

Ghrist's mathematical technique works on highly complex systems, such as roving sensor networks for security systems. Consisting of large numbers of stationary and mobile sensors, the networks must remain free of dead zones and security breaches.

Keeping track of the location and status of each sensor would be extremely difficult, Ghrist said. «Using topological tools, however, we can more easily stitch together information from the sensors to find and fill any holes in the network and guarantee that the system is safe and secure.»

While it may seem counterintuitive to initially translate such tasks into problems involving geometry, algebra or calculus, Ghrist said, that doing so ultimately produces a result that goes back to the physical system.

«That's what applied mathematics has to offer,» Ghrist said. «As systems become increasingly complex, topological tools will become more and more relevant.»

Funding was provided by the National Science Foundation and the Defense Advanced Research Projects Agency.

Mathematical Problem Solved After More Than 50 Years: Chern Numbers Of Algebraic Varieties ScienceDaily (June 11, 2009)

A problem at the interface of two mathematical areas, topology and algebraic geometry, that was formulated by Friedrich Hirzebruch, had resisted all attempts at a solution for more than 50 years. The problem concerns the relationship between different mathematical structures. Professor Dieter Kotschick, a mathematician at the Ludwig-Maximilians-Universität (LMU) in Munich, has now achieved a breakthrough.

As reported in the online edition of the journal *Proceedings of the National Academy of Sciences* (PNAS), Kotschick has solved Hirzebruch's problem. Topology studies flexible properties of geometric objects that are unchanged by continuous deformations. In algebraic geometry some of these objects are endowed with additional structure derived from an explicit description by polynomial equations. Hirzebruch's problem concerns the relation between flexible and rigid properties of geometric objects. (PNAS, 9 June 2009)

Viewed topologically, the surface of a ball is always a sphere, even when the ball is very deformed: precise geometric shapes are not important in topology. This is different in algebraic geometry, where objects like the sphere are described by polynomial equations. Professor Dieter Kotschick has recently achieved a breakthrough at the interface of topology and algebraic geometry.

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«I was able to solve a problem that was formulated more than 50 years ago by the influential German mathematician Friedrich Hirzebruch», says Kotschick. «Hirzebruch's problem concerns the relation between different mathematical structures. These are so-called algebraic varieties, which are the zero-sets of polynomials, and certain geometric objects called manifolds.» Manifolds are smooth topological spaces that can be considered in arbitrary dimensions. The spherical surface of a ball is just a two-dimensional manifold.

In mathematical terminology Hirzebruch's problem was to determine which Chern numbers are topological invariants of complex-algebraic varieties. «I have proved that — except for the obvious ones — no Chern numbers are topologically invariant», says Kotschick. «Thus, these numbers do indeed depend on the algebraic structure of a variety, and are not determined by coarser, so-called topological properties. Put differently: The underlying manifold of an algebraic variety does not determine these invariants.»

The solution to Hirzebruch's problem is announced in the current issue of *PNAS Early Edition*, the online version of PNAS.

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Mathematicians Find New Solutions To An Ancient Puzzle
ScienceDaily (Mar. 18, 2008)

Many people find complex math puzzling, including some mathematicians. Recently, mathematician Daniel J. Madden and retired physicist, Lee W. Jacobi, found solutions to a puzzle that has been around for centuries. Jacobi and Madden have found a way to generate an infinite *number of solutions for a puzzle known* ***as 'Euler's Equation of degree four.'***

The equation is part of a branch of mathematics called number theory. Number theory deals with the properties of numbers and the way they relate to each other. It is filled with problems that can be likened to numerical puzzles.

«It's like a puzzle: can you find four fourth powers that add up to another fourth power» Trying to answer that question is difficult because it is highly unlikely that someone would sit down and accidentally stumble upon something like that,» said Madden, an associate professor of mathematics at The University of Arizona in Tucson.

Equations are puzzles that need certain solutions «plugged into them» in order to create a statement that obeys the rules of logic.

For example, think of the equation x + 2 = 4. Plugging «3» into the equation doesn't work, but if x = 2, then the equation is correct.

In the mathematical puzzle that Jacobi and Madden worked on, the problem was finding variables that satisfy a Diophantine equation of order four. These equations are so named because they were first studied by the ancient Greek mathematician Diophantus, known as 'the father of algebra.'

In its most simple version, the puzzle they were trying to solve is the equation: (a)(to the fourth power) + (b)(to the fourth power) + (c)(to the fourth power) + (d)(to the fourth power) = (a + b + c + d)(to the fourth power)

That equation, expressed mathematically, is: $a^4 + b^4 + c^4 + d^4 = (a + b + c + d)^4$.

Madden and Jacobi found a way to find the numbers to substitute, or plug in, for the a's, b's, c's and d's in the equation. All the solutions they have found so far are very large numbers.

In 1772, Euler, one of the greatest mathematicians of all time, hypothesized that to satisfy equations with higher powers, there would need to be as many variables as that power. For example, a fourth order equation would need four different variables, like the equation above.

Euler's hypothesis was disproved in 1987 by a Harvard graduate student named Noam Elkies. He found a case where only three variables were needed. Elkies solved the equation: (a)(to the fourth power) + (b)(to the fourth power) + (c)(to the fourth power) = e(to the fourth power), which shows only three variables are needed to create a variable that is a fourth power.

Inspired by the accomplishments of the 22-year-old graduate student, Jacobi began working on mathematics as a hobby after he retired from the defense industry in 1989.

Fortunately, this was not the first time he had dealt with Diophantine equations. He was familiar with them because they are commonly used in physics for calculations relating to string theory.

Jacobi started searching for new solutions to the puzzle using methods he found in some number theory texts and academic papers.

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He used those resources and Mathematica, a computer program used for mathematical manipulations.

Jacobi initially found a solution for which each of the variables was 200 digits long. This solution was different from the other 88 previously known solutions to this puzzle, so he knew he had found something important.

Jacobi then showed the results to Madden. But Jacobi initially miscopied a variable from his Mathematica computer program, and so the results he showed Madden were incorrect.

«The solution was wrong, but in an interesting way. It was close enough to make me want to see where the error occurred,» Madden said.

When they discovered that the solution was invalid only because of Jacobi's transcription error, they began collaborating to find more solutions.

Madden and Jacobi used elliptic curves to generate new solutions. Each solution contains a seed for creating more solutions, which is much more efficient than previous methods used.

In the past, people found new solutions by using computers to analyze huge amounts of data. That required a lot of computing time and power as the magnitude of the numbers soared.

Now people can generate as many solutions as they wish. There are an infinite number of solutions to this problem, and Madden and Jacobi have found a way to find them all.

«Modern number theory allowed me to see with more clarity the implications of his (Jacobi's) calculations,» Madden said.

«It was a nice collaboration,» Jacobi said. «I have learned a certain amount of new things about number theory; how to think in terms of number theory, although sometimes I can be stubbornly algebraic.»

The article, ««On $a^4 + b^4 + c^4 + d^4 = (a + b + c + d)^4$» is published in the March issue of The American Mathematical Monthly.

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Mathematicians Solve 140-Year-Old Boltzmann Equation
ScienceDaily (May 14, 2010)

Pennsylvania mathematicians have found solutions to a 140-year-old, 7-dimensional equation that were not known to exist for more than a century despite its widespread use in modeling the behavior of gases.

The study, part historical journey but mostly mathematical proof, was conducted by Philip T. Gressman and Robert M. Strain of Penn's Department of Mathematics. The solution of the Boltzmann equation problem was published in the *Proceedings of the National Academy of Sciences*. Solutions of this equation, beyond current computational capabilities, describe the location of gas molecules probabilistically and predict the likelihood that a molecule will reside at any particular location and have a particular momentum at any given time in the future.

During the late 1860s and 1870s, physicists James Clerk Maxwell and Ludwig Boltzmann developed this equation to predict how gaseous material distributes itself in space and how it responds to changes in things like temperature, pressure or velocity.

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The equation maintains a significant place in history because it modeled gaseous behavior well, and the predictions it led to were backed up by experimentation. Despite its notable leap of faith — the assumption that gases are made of molecules, a theory yet to achieve public acceptance at the time — it was fully adopted. It provided important predictions, the most fundamental and intuitively natural of which was that gasses naturally settle to an equilibrium state when they are not subject to any sort of external influence. One of the most important physical insights of the equation is that even when a gas appears to be macroscopically at rest, there is a frenzy of molecular activity in the form of collisions. While these collisions cannot be observed, they account for gas temperature.

Gressman and Strain were intrigued by this mysterious equation that illustrated the behavior of the physical world, yet for which its discoverers could only find solutions for gasses in perfect equilibrium.

Using modern mathematical techniques from the fields of partial differential equations and harmonic analysis — many of which were developed during the last five to 50 years, and thus relatively new to mathematics — the Penn mathematicians proved the global existence of classical solutions and rapid time decay to equilibrium for the Boltzmann equation with long-range interactions. Global existence and rapid decay imply that the equation correctly predicts that the solutions will continue to fit the system's behavior and not undergo any mathematical catastrophes such as a breakdown of the equation's integrity caused by a minor change within the equation. Rapid decay to equilibrium means that the effect of an initial small disturbance in the gas is short-lived and quickly becomes unnoticeable.

«Even if one assumes that the equation has solutions, it is possible that the solutions lead to a catastrophe, like how it's theoretically possible to balance a needle on its tip, but in practice even infinitesimal imperfections cause it to fall over,» Gressman said.

The study also provides a new understanding of the effects due to grazing collisions, when neighboring molecules just glance off one another rather than collide head on. These glancing collisions turn out to be dominant type of collision for the full Boltzmann equation with long-range interactions.

«We consider it remarkable that this equation, derived by Boltzmann and Maxwell in 1867 and 1872, grants a fundamental example where a range of geometric fractional derivatives occur in a physical model of the natural world,» Strain said. «The mathematical techniques needed to study such phenomena were only developed in the modern era.»

The study was funded by the National Science Foundation.

Quasicrystals: Somewhere Between Order And Disorder
ScienceDaily (May 29, 2008)

Professionally speaking, things in David Damanik's world don't line up — and he can prove it.

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colleague Serguei Tcheremchantsev offer a key proof in the study of quasicrystals, crystal-like materials whose atoms don't line up in neat, unbroken rows like the atoms found in crystals. Damanik's latest work focused on a popular model mathematicians use to study quasicrystals. The research, which was 10 years in the making, proves that quasicrystals in the model are not electrical conductors and sheds light on a little-understood corner of materials science.

«This is the first time this has been done, and given the broad academic interest in quasicrystals we expect the paper to generate significant interest,» said Damanik, associate professor of mathematics at Rice University.

Until 1982, quasicrystals weren't just undiscovered, they were believed to be physically impossible. To understand why, it helps to understand how atoms line up in a crystal.

In literature dating to the early 19th Century, mineralogists showed that all crystals — like diamond or quartz — were made up of one neat row of atoms after another, each row repeating at regular intervals. Mathematicians and physical chemists later showed that the periodic, repeating structure of crystals could only come in a few fixed arrangements. This was elegantly revealed in the early 20th Century when crystals were bombarded with X-rays. The crystals diffracted light into patterns of spots that had «rotational symmetry,» meaning that the patterns looked exactly the same when they were spun partway around. For example, a square has four-fold rotational symmetry because it looks exactly the same four times as it is spun a full turn.

X-ray crystallography reinforced what physicists, chemists and mathematicians already knew about crystals; they could yield patterns of spots with only two-, three-, four- or six-fold rotational symmetry. The physics of their lattices permitted nothing else.

All was well until 1982, when physicist Dan Shechtman did an X-ray diffraction study on a new alloy he'd made at what is now the National Institute of Standards and Technology. The pattern of spots looked like those made by crystals, but it had five-fold rotational symmetry, like a pentagon — something that was clearly forbidden for a periodic structure.

The alloy — which was quickly dubbed quasicrystal — attracted intense scientific interest. Dozens of quasicrystals have since been made. Though none of their structures have yet been solved, scientists and mathematicians like Damanik are keen to understand them.

«Mathematically speaking, quasicrystals fall into a middle ground between order and disorder,» Damanik said. «Over the past decade, it's become increasingly clear that the mathematical tools that people have used for decades to predict the electronic properties of materials will not work in this middle ground.»

For example, Schrödinger's equation, which debuted in 1925, describes how electrons behave in any material. But for decades, mathematicians have been able to use just one of the equation's terms — the Schrödinger operator — to find out whether a material will be a conductor or an insulator. In the past five years, mathematicians have proven that that method won't work for quasicrystals. The upshot of this is that it is much more complex to actually run the numbers and find out how electrons behave inside a quasicrystal.

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Supercomputers have been used to actually crunch the numbers, but Damanik said computer simulations are no substitute for a mathematical proof.

«Computer simulations have shown that electrons move through quasicrystals — albeit very slowly — in a way that's markedly different from the way they move through a conductor,» Damanik said. «But computers never show you the whole picture. They only approximate a solution for a finite time. In our paper, we proved that electrons always behave this way in the quasicrystal model we studied, not just now or tomorrow but for all time.»

Damanik's research was funded by the National Science Foundation.

Europe's Leading Scientists Urge Creation of a CERN for Mathematics
ScienceDaily (Dec. 1, 2010)

Europe needs an Institute of Industrial Mathematics to tighten the link between maths and industry as an enabler of innovation — putting maths at the heart of Europe's innovation, according to the European Science Foundation in a report launched in Brussels at the «Maths and Industry» Conference.

Such an Institute would help not only to overcome the fragmentation that currently characterises mathematics research in Europe, but also to act as a magnet for excellence and innovation much like Europe's Centre for Nuclear Research (CERN) gave the world both the world wide web and the Large Hadron Collider to investigate the big bang.

«It may often be invisible in the final product or to the final consumer, but mathematics is the fundamental ingredient to many innovations that help us respond to a rapidly changing economic landscape,» said Andreas Schuppert from Bayer Technology Services GmbH who contributed to the report. «Creating a 'CERN for mathematics', the European Institute of Mathematics for Innovation, will promote industry and academic collaboration, stimulating innovation, growth and job creation. As such, it could help achieve Europe's 2020 objectives of sustainable growth through a knowledge-based economy.»

The Institute would be designed as a vast network of world-class mathematicians, making them easily accessible for collaboration with companies seeking novel solutions. The institute would connect hubs of academic excellence, as well as resources such as databases and libraries. As a centralised resource, this Institute would be particularly useful for small and medium enterprises (SMEs) that often struggle to tap into the continent-wide pool of industrial mathematicians, but which represent Europe's main driver of innovation and a major source of job creation.

«Bringing together mathematicians in one organisation will make it easier for companies to access the expertise they need, while at the same time facilitating access to funds by eliminating overlap at national level,» said Mario Primicerio from Universita degli Studi di Firenze, Italy who chaired the ESF report, «Maths and Industry.» In addition to setting up the Institute, the report also recommends allocating EU funds for a specific industrial and applied mathematics project under the upcoming 8th R&D Framework Programme, the

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next EU-wide funding initiative for science. In addition, it advises for the implementation of an industrial policy that includes an EU-wide 'Small Business Act in Mathematics' which would fund spin-off companies based on mathematics as is already the case in Germany and Sweden.

The ESF's Forward Look report «Maths and Industry» results from a partnership with the European Mathematical Society and close collaboration by academia, industry and policy makers. It is available online at: www.esf.org/publications

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European Group Aims To Make Maths Teaching More Rigorous And Inspiring ScienceDaily (Aug. 29, 2008)

An attempt to re-energise mathematics teaching in Europe is being made in a new project examining a range of factors thought to influence achievement. Mathematics teaching is as vital as ever both in support of key fields such as life sciences, alternative energy development, or information technology, and also through its unique ability to develop widely applicable problem solving skills. It should be highly relevant not just for the elite few but for all people in education.

The new project was discussed at a recent workshop organised by the European Science Foundation (ESF), which brought together experts in different areas of mathematics education. «It was agreed that we would begin the process of developing a comparative project, involving between fifteen and twenty European countries, to examine the interrelatedness of the mathematics-related beliefs of teachers and students, teacher practices and student cognition,» said Paul Andrews, the workshop's convenor and Senior Lecturer in Education at the Faculty of Education of Cambridge University in the UK.

Andrews pointed out that the solution to the mathematics teaching conundrum was complex and multi-dimensional, just like many of the great problems in the field itself. On the one hand, enthusiasm needed to be balanced with rigour in order to motivate students while also teaching skills and knowledge worth acquiring. «To assume that the development of enthusiasm is sufficient to guarantee achievement would be naïve as there are countries in which students have little enthusiasm for mathematics but achieve relatively highly and, of course, vice versa,» pointed out Andrews.

There has also been a tension between immediate vocational objectives in response to the needs of employers, and the higher ideal of teaching logical thinking and deeper mathematical problem solving. European countries have to date resolved this tension in different ways, with the UK being at the vocational end of the spectrum, while Hungary has taken the purest approach with its traditions for mathematical rigour.

«One of the problems of English education is that students experience a fragmented and procedural conception of mathematics, due to underlying notions of vocationalism, and so rarely come to see the subject as a coherent body of concepts and relationships which can be worth studying for the intrinsic satisfaction it can yield,» said Andrews. «The situation in countries like Hungary

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is almost the complete opposite — all students experience an integrated and intellectually worthwhile mathematics taught by teachers with little explicit interest in the applications of the subject but an enthusiasm for logical thinking and the problem-solving opportunities that mathematics can provide.»

But the issue of mathematics teaching is not just about content, but also attitude, on the part both of pupils and teachers. One significant finding to emerge from the workshop was that the common practice of dividing pupils into sets defined by ability, which, in the UK context, is applied more for mathematics teaching than any other subject, can be counterproductive, even for the most able pupils. «Where teachers do not necessarily expect to teach students in ability groups but expect to work with the full ability range, achievement is generally higher across the board,» said Andrews.

Another finding that perhaps contradicted common wisdom was that students often progressed best when taught to approach problem solving collectively instead of in isolation. This runs counter to the perception, manifested regularly in UK schools, that mathematics is a lonely endeavour pursued by individuals in competition rather than cooperation.

It remains to be seen whether the ESF project will lead to a radical shake up in mathematics teaching comparable to the introduction of the so called «new maths» in the 1980s in the place of the previous more arithmetically based approach. More likely it will lead to rebalancing of teaching, bringing greater consistency and rigour to deliver a more wholesome curriculum.

The workshop «The Relevance of Mathematics Education» was held in Cambridge, UK in January 2008. Each year, ESF supports approximately 50 Exploratory Workshops across all scientific domains. These small, interactive group sessions are aimed at opening up new directions in research to explore new fields with a potential impact on developments in science.

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US Needs Better-Trained Math Teachers to Compete Globally, Study Finds
ScienceDaily (Apr. 19, 2010)

Math teachers in the United States need better training if the nation's K-12 students are going to compete globally, according to international research released by a Michigan State University scholar.

William Schmidt, University Distinguished Professor of education, found that prospective U.S. elementary and middle-school math teachers are not as prepared as those from other countries. And this, combined with a weak U.S. math curriculum, produces similarly weak student achievement, he said.

The Teacher Education Study in Mathematics, or TEDS-M, is by far the largest of its kind, surveying more than 3,300 future teachers in the United States and 23,244 future teachers across 16 countries. Schmidt led the U.S. portion of the project.

«We must break the cycle in which we find ourselves,» said Schmidt, who presented his findings at a Washington news conference.

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«A weak K-12 mathematics curriculum in the U.S., taught by teachers with an inadequate mathematics background, produces high school graduates who are

at a disadvantage. When some of these students become future teachers and are not given a strong background in mathematics during teacher preparation, the cycle continues.»

More rigorous K-12 math standards, which are part of the Common Core State Standards Initiative, will be completed soon by the National Governors Association and the Council of Chief State Officers. The standards are expected to be adopted by a majority of the 48 states considering them.

But the new standards will require U.S. math teachers to be even more knowledgeable, Schmidt said. His study found that while nearly all future middle-school teachers in the top-achieving countries took courses in linear algebra and basic calculus, only about half of U.S. future teachers took the fundamental courses.

To attack the problem, Schmidt laid out a three-fold approach:

Recruit teachers with stronger math backgrounds.

Implement more rigorous state certification requirements for math teachers.

Require more demanding math courses in all teacher preparation programs.

Schmidt, who studied the performance of 81 public and private colleges and universities, said the real issue is how teachers are prepared — the courses they take and the experiences they have. The quality and type of programs in the United States varies widely by state and by institution.

TEDS-M revealed that differences in middle school teacher certification programs, for example, have a great impact on math-teaching capabilities. Future teachers prepared in programs focused on secondary schools (grades 6 and above) had significantly higher mathematics knowledge scores than those prepared in other types of programs, including those focused only on middle school teacher preparation.

«Teacher preparation curricula are critical, not only for our future teachers, but also for the children they will be teaching,» Schmidt said. «The problem isn't simply the amount of formal math education our future teachers receive. It also involves studying the theoretical and practical aspects both of teaching mathematics and teaching in general.»

TEDS-M expands on previous research to include elementary teachers and draw comparisons across more countries. The international headquarters for the project also is MSU, with Maria Teresa Tatto, John R. Schwille and Sharon Senk serving as principal investigators in collaboration with the International Association for the Evaluation of Educational Achievement.

The U.S. study is sponsored by Boeing Co., Carnegie Corp. of New York, the Bill & Melinda Gates Foundation and the GE Foundation.

The full report, Breaking the Cycle: An International Comparison of U.S. Mathematics Teacher Preparation, is available at http://usteds.msu.edu.

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Few Gender Differences in Math Abilities, Worldwide Study Finds
ScienceDaily (Jan. 6, 2010)

Girls around the world are not worse at math than boys, even though boys are more confident in their math abilities, and girls from countries where

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Girls around the world are not worse at math than boys, even though boys are more confident in their math abilities, and girls from countries where

gender equity is more prevalent are more likely to perform better on mathematics assessment tests, according to a new analysis of international research.

«Stereotypes about female inferiority in mathematics are a distinct contrast to the actual scientific data,» said Nicole Else-Quest, PhD, a psychology professor at Villanova University, and lead author of the meta-analysis. «These results show that girls will perform at the same level as the boys when they are given the right educational tools and have visible female role models excelling in mathematics.»

The results are reported in the latest issue of *Psychological Bulletin*, published by the American Psychological Association. The finding that girls around the world appear to have less confidence in their mathematical abilities could help explain why young girls are less likely than boys to pursue careers in science, technology, engineering and mathematics.

Else-Quest and her fellow researchers examined data from the Trends in International Mathematics and Science Study and the Programme for International Student Assessment, representing 493,495 students ages 14-16 from 69 countries. Both studies' results were released in 2003, and not all countries participated in both assessments. The TIMSS focuses on basic math knowledge, while the PISA test assesses students' ability to use their math skills in the real world. The researchers felt these two tests offered a good sampling of students' math abilities.

While these measures tested different math abilities, there were only small gender differences for each, on average. However, from nation to nation, the size of the gender differences varied a great deal.

The two studies also assessed students' level of confidence in their math abilities and how important they felt it was to do well in math in order to have a successful career. Despite overall similarities in math skills, boys felt significantly more confident in their abilities than girls did and were more motivated to do well.

The researchers also looked at different measures of women's education, political involvement, welfare and income in each country. There was some variability among countries when it came to gender differences in math and how it related to the status and welfare of women. For example, if certain countries had more women in research-related positions, the girls in that country were more likely to do better in math and feel more confident of those skills.

«This meta-analysis shows us that while the quality of instruction and curriculum affects children's learning, so do the value that schools, teachers and families place on girls' learning math. Girls are likely to perform as well as boys when they are encouraged to succeed,» said Else-Quest.

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Computers Effective In Verifying Mathematical Proofs
ScienceDaily (Nov. 7, 2008)

New computer tools have the potential to revolutionize the practice of mathematics by providing far more-reliable proofs of mathematical results

gender equity is more prevalent are more likely to perform better on mathematics assessment tests, according to a new analysis of international research.

«Stereotypes about female inferiority in mathematics are a distinct contrast to the actual scientific data,» said Nicole Else-Quest, PhD, a psychology professor at Villanova University, and lead author of the meta-analysis. «These results show that girls will perform at the same level as the boys when they are given the right educational tools and have visible female role models excelling in mathematics.»

The results are reported in the latest issue of *Psychological Bulletin*, published by the American Psychological Association. The finding that girls around the world appear to have less confidence in their mathematical abilities could help explain why young girls are less likely than boys to pursue careers in science, technology, engineering and mathematics.

Else-Quest and her fellow researchers examined data from the Trends in International Mathematics and Science Study and the Programme for International Student Assessment, representing 493,495 students ages 14-16 from 69 countries. Both studies' results were released in 2003, and not all countries participated in both assessments. The TIMSS focuses on basic math knowledge, while the PISA test assesses students' ability to use their math skills in the real world. The researchers felt these two tests offered a good sampling of students' math abilities.

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than have ever been possible in the history of humankind. These computer tools, based on the notion of «formal proof», have in recent years been used to provide nearly infallible proofs of many important results in mathematics.

When mathematicians prove theorems in the traditional way, they present the argument in narrative form. They assume previous results, they gloss over details they think other experts will understand, they take shortcuts to make the presentation less tedious, they appeal to intuition, etc. The correctness of the arguments is determined by the scrutiny of other mathematicians, in informal discussions, in lectures, or in journals. It is sobering to realize that the means by which mathematical results are verified is essentially a social process and is thus fallible. When it comes to central, well known results, the proofs are especially well checked and errors are eventually found.

Nevertheless the history of mathematics has many stories about false results that went undetected for a long time. In addition, in some recent cases, important theorems have required such long and complicated proofs that very few people have the time, energy, and necessary background to check through them. And some proofs contain extensive computer code to, for example, check a lot of cases that would be infeasible to check by hand. How can mathematicians be sure that such proofs are reliable?

To get around these problems, computer scientists and mathematicians began to develop the field of formal proof. A formal proof is one in which every logical inference has been checked all the way back to the fundamental axioms of mathematics. Mathematicians do not usually write formal proofs because such proofs are so long and cumbersome that it would be impossible to have them checked by human mathematicians. But now one can get «computer proof assistants» to do the checking. In recent years, computer proof assistants have become powerful enough to handle difficult proofs.

Only in simple cases can one feed a statement to a computer proof assistant and expect it to hand over a proof. Rather, the mathematician has to know how to prove the statement; the proof then is greatly expanded into the special syntax of formal proof, with every step spelled out, and it is this formal proof that the computer checks. It is also possible to let computers loose to explore mathematics on their own, and in some cases they have come up with interesting conjectures that went unnoticed by mathematicians. We may be close to seeing how computers, rather than humans, would do mathematics.

Four new articles in the December 2008 issue of Notices of the American Mathematical Society explore the current state of the art of formal proof and provide practical guidance for using computer proof assistants. If the use of these assistants becomes widespread, they could change deeply mathematics as it is currently practiced. One long-term dream is to have formal proofs of all of the central theorems in mathematics. Thomas Hales, one of the authors writing in the Notices, says that such a collection of proofs would be akin to «the sequencing of the mathematical genome».

The four articles are:

1. Formal Proof, by Thomas Hales, University of Pittsburgh
2. Formal Proof---Theory and Practice, by John Harrison, Intel Corporation
3. Formal proof---The Four Colour Theorem, by Georges Gonthier, Microsoft Research, Cambridge, England

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Free Software Brings Affordability, Transparency To Mathematics
ScienceDaily (Dec. 7, 2010)

Until recently, a student solving a calculus problem, a physicist modeling a galaxy or a mathematician studying a complex equation had to use powerful computer programs that cost hundreds or thousands of dollars. But an open-source tool based at the University of Washington won first prize in the scientific software division of Les Trophées du Libre, an international competition for free software.

The tool, called Sage, faced initial skepticism from the mathematics and education communities.

«I've had a surprisingly large number of people tell me that something like Sage couldn't be done — that it just wasn't possible,» said William Stein, associate professor of mathematics and lead developer of the tool. «I'm hearing that less now.»

Open-source software, which distributes programs and all their underlying code for free, is increasingly used in everyday applications. Firefox, Linux and Open Office are well-known examples.

But until recently, nobody had done the same for the everyday tools used in mathematics. Over the past three years, more than a hundred mathematicians from around the world have worked with Stein to build a user-friendly tool that combines powerful number-crunching with new features, such as collaborative online worksheets.

«A lot of people said: 'Wow, I've been waiting forever for something like this,'» Stein said. «People are excited about it.»

Sage can take the place of commercial software commonly used in mathematics education, in large government laboratories and in math-intensive research. The program can do anything from mapping a 12-dimensional object to calculating rainfall patterns under global warming.

The idea began in 2005, when Stein was an assistant professor at Harvard University.

«For about 10 years I had been really unhappy with the state of mathematical software,» Stein said. The big commercial programs — Matlab, Maple, Mathematica and Magma — charge license fees. The Mathematica Web page, for example, charges $2,495 for a regular license. For another program, a collaborator in Colombia was quoted about $550, a special «Third World» discount price, to buy a license to use a particular tool, Stein said.

The frustrations weren't only financial. Commercial programs don't always reveal how the calculations are performed. This means that other mathematicians can't scrutinize the code to see how a computer-based calculation arrived at a result.

«Not being able to check the code of a computer-based calculation is like not publishing proofs for a mathematical theorem,» Stein said. «It's ludicrous.»

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So Stein began a year and a half of frenzied work in which he created the Sage prototype, combining decades' worth of more specialized free mathematical software and filling in the gaps.

«I worked really, really hard on this, and didn't sleep much for a year. Now I've relaxed. There are a lot more people helping out,» Stein said. «It seems like everyone in the field has heard of Sage now, which is surreal.»

Among those helping is a team of five UW undergraduate students who work part-time on the code — everything from writing new formulas to improving the Google-ish graphical interface. (Even when Sage runs on an individual computer, not over the Internet, you use a Web browser to enter commands.)

Regular meetings, named «Sage days,» bring together volunteer developers. The fourth Sage day, held in Seattle in June, drew about 30 people. The sixth Sage day was held last month in Bristol, England. Forty-one people attended talks and many participated in coding sprints. Dozens of other people around the world contribute through Sage's online discussion boards.

Last month, Stein and David Joyner, a mathematics professor at the U.S. Naval Academy in Annapolis, Md., published a letter in the Notices of the American Mathematical Society in which they argue that the mathematical community should support and develop open-source software.

Soon Sage will face off against the major software companies in physical space. In early January, thousands of mathematicians will gather in San Diego for the joint meeting of the American Mathematical Society and the Mathematical Association of America. In the exhibition hall, Stein has paid the first-timers' rate of $400 to rent a booth alongside those of the major mathematical software companies, where he and students will hand out DVDs with copies of Sage.

«I think we can be better than the commercial versions,» he said. «I really want it to be the best mathematical software in the world.»

Sage research and student support is made possible by grants from the National Science Foundation. The Sage meetings are supported by various mathematical associations. The project has also received several thousand dollars in private donations.

'Combinatorial' Approach Squashes Software Bugs Faster, Cheaper
ScienceDaily (Dec. 17, 2010)

A team of computer scientists and mathematicians from the National Institute of Standards and Technology (NIST) and the University of Texas, Arlington is developing an open-source tool that catches programming errors by using an emerging approach called «combinatorial testing.» The NIST-Texas tool, described at a recent conference,* could save software developers significant time and money when it is released next year.

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than complex ones.** Even for Web browsers containing hundreds of different variables, most failures were caused by interactions between just two variables. Nonetheless, in the applications that the researchers studied, additional failures could result from interactions of up to six variables.

Based on that insight, the NIST-Texas team went beyond the popular practice of «pairwise testing,» or exploring interactions between only two variables at a time, and designed a method for efficiently testing different combinations of settings in up to at least six interacting variables at a time. Their technique resembles combinatorial chemistry in which scientists screen multiple chemical compounds simultaneously rather than one at a time.

For example, imagine a word-processing program that features 10 different text formats. Certain combinations of settings (such as turning on superscript, subscript and italics at the same time) could cause the software to crash. Trying all possible combinations of the 10 effects together would require 1,024 tests. However, testing all possible combinations of any three effects requires just 13 different tests, thanks in part to the fact that if the tests are selected judiciously the 10 different variables allow you to explore 120 combinations of «triples» simultaneously.

The new tool generates tests for exploring interactions among the settings of multiple variables in a given program. Compared to most earlier combinatorial testing software, which has typically focused on testing interactions between just two variables, the tool excels at quickly generating efficient tests for 6-way interactions or more.

The researchers plan to release the tool early next year as open-source code. They currently are inviting developers to participate in beta testing of the tool before release. This new approach for finding bugs to squash may be particularly useful for increasing the reliability of e-commerce Web sites, which often contain many interacting variables, as well as industrial process controls, such as for robotic assembly lines of high-definition televisions, which contain many interacting software-controlled elements that regularly turn on and off.

* Y. Lei, R. Kacker, D. R. Kuhn, V. Okun and J. Lawrence, IPOG: A general strategy for t-way software testing. IEEE International Conference on Engineering of Computer-Based Systems March 26-29, 2007, pp 549-556, Tucson AZ, USA.

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Researchers at North Carolina State University have developed a software tool that will make it faster and easier to translate video games and other software into different languages for use in various international markets — addressing a hurdle to internationalization that has traditionally been time-consuming and subject to error.

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If you want to sell or promote a software application in a foreign market, you have to translate it into a new language. That used to mean programmers would have to pore over thousands of lines of code in order to identify every little string that relates to what appears on a user's screen. This could be incredibly time consuming and, even then, there was always room for human error. Programmers have to be certain they are not replacing code that governs how the program actually works.

But now researchers from NC State and Peking University have created a software tool that identifies those pieces of software code that are designed to appear on-screen and communicate with the user (such as menu items), as opposed to those pieces of code that govern how the program actually functions. Once those «on-screen» pieces of code have been identified, the programmers can translate them into the relevant language — for example, translating the tabs on a toolbar from English into Chinese.

«This is a significant advance because it saves programmers from hunting through tens of thousands of lines of code,» says Dr. Tao Xie, an assistant professor of computer science at NC State. «Productivity goes up because finding the 'need-to-translate' strings can be done more quickly. The quality also goes up, because there is less chance that a programmer will make a mistake and overlook relevant code.»

As an example of how the software tool can identify errors and oversights made by human programmers, Xie says, the researchers found 17 translation omission errors when they applied the software tool on a popular online video game. The errors were then corrected.

The research was supported in part by the National Science Foundation and the U.S. Army Research Office. The research will be presented in May at the International Conference on Software Engineering in Vancouver, Canada, and will also be published in the proceedings of the conference.

Software Development: Speeding From Sketchpad To Smooth Code
ScienceDaily (Aug. 11, 2009)

Creating error-free software remains time consuming and labour intensive. A major European research effort has developed a system that speeds software development from the drawing board to high-quality, platform-independent code.

According to Piotr Habela, technical coordinator of the VIDE (for VIsualize all moDel drivEn programming) project, software developers have many good ideas about how to visualise, develop, debug and modify software, plus standards to guide them. The problem is that the design and development process has always been fragmented.

He explains that methods for visualising or flowcharting how a program should work do not lead directly to computer code.

Software written in one programming language may be difficult to translate into another. No matter how carefully programmers work, complex software almost always includes errors that are difficult to diagnose and fix. Because of

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the lack of precise links between a program's features and the software that implements them, updating or modifying a program often turns out to be time-consuming and costly.

«What we attempted that was quite distinct,» says Habela, «was to make the development of executable software a single process, a single toolchain, rather than a sequence of separate activities.»

It took two-and-a-half years of intensive effort by VIDE's ten academic and industrial research partners, funded by the European Union, but the result is a software design and development toolkit that promises to make creating well-functioning, easily-modified software — for example for small businesses — significantly smoother, faster, and less expensive.

Model driven architecture

A key part of VIDE's approach was to build on the idea of Model Driven Architecture, a programming methodology developed by an international consortium, the Object Management Group.

The idea is that each stage of software development requires its own formal model. The VIDE team realised that by creating and linking those models in a rigorous way, they could automate many of the steps of software development.

A software developer might start by working with a domain expert — for example a business owner — to determine what a new program needs to do. Those inputs, outputs and procedures would be formalised in what is called a computation independent model (CIM), a model that does not specify what kinds of computation might be used to carry it out — it lays out what the program will do rather than how it will do it.

«Models are usually considered just documents,» says Habela. «Our goal was to make the models serve as production tools.»

In the case of VIDE, much of that modeling is visual, in the form of flowcharts and other diagrams that are intuitive enough for the domain expert to understand, but which are sufficiently formalised to serve as the inputs to the next stage of the software development process.

To carry out these first modeling steps, the researchers created a domain analysis tool and a programming language called VCLL, for VIDE CIM Level Language.

From CIM to PIM to program

Once they have produced a formal CIM of the program they want to implement, it's time to move a step closer to a functioning program by translating it into a platform independent model, or PIM.

For the VIDE team, a PIM is a model that specifies precisely what a program needs to do, but at an abstract level that does not depend on any particular programming language.

The researchers developed several software tools to produce a usable, error-free PIM. These include an executable modelling language and environment, a defect-detection tool, and finally a program that translates their final model into an executable Java program.

Luckily, the researchers did not have to build their system from the ground up. They were able to rely to a large extent on a pre-existing modeling language

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A software developer might start by working with a domain expert — for example a business owner — to determine what a new program needs to do. Those inputs, outputs and procedures would be formalised in what is called a computation independent model (CIM), a model that does not specify what kinds of computation might be used to carry it out — it lays out what the program will do rather than how it will do it.

«Models are usually considered just documents,» says Habela. «Our goal was to make the models serve as production tools.»

In the case of VIDE, much of that modeling is visual, in the form of flowcharts and other diagrams that are intuitive enough for the domain expert to understand, but which are sufficiently formalised to serve as the inputs to the next stage of the software development process.

To carry out these first modeling steps, the researchers created a domain analysis tool and a programming language called VCLL, for VIDE CIM Level Language.

From CIM to PIM to program

Once they have produced a formal CIM of the program they want to implement, it's time to move a step closer to a functioning program by translating it into a platform independent model, or PIM.

For the VIDE team, a PIM is a model that specifies precisely what a program needs to do, but at an abstract level that does not depend on any particular programming language.

The researchers developed several software tools to produce a usable, error-free PIM. These include an executable modelling language and environment, a defect-detection tool, and finally a program that translates their final model into an executable Java program.

Luckily, the researchers did not have to build their system from the ground up. They were able to rely to a large extent on a pre-existing modeling language

called UML, for Unified Modeling Language. UML provides a systematic way to visualise and describe a software system.

«We now have a kind of prototyping capability built into the development process,» says Habela. «You can design a model, specify its behavioural details, run it with sample data to see how it behaves, and then check with the domain expert to see if it is in fact the behaviour they expected.»

Several of the consortium members are implementing the VIDE toolkit in specific areas, for example web services, database management, and a variety of business processes.

Habela cautions that reaching VIDE's goal of smoothly automating the entire software design and development process requires more work. Because of the broad scope of the project and the fundamental changes they are making, they are not yet ready to deploy the complete system.

However, he says, they have gone a long way towards clearing up «the muddy path from requirements to design.»

The VIDE project received funding from the ICT strand of the EU's Sixth Framework Programme for research.

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EVIDENCE OF SHIFTING STANDARDS IN JUDGMENTS OF MALE AND FEMALE PARENTS' JOB-RELATED ABILITY

Kathleen Fuegen
Northern Kentucky University
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Ohio State University

ABSTRACT

We tested the hypothesis, derived from the shifting standards model of stereotyping, that parenthood would polarize judgments of men's and women's job-related ability. One hundred thirty-five attorneys evaluated the résumé of a recent law school graduate. The résumé depicted the graduate as male or female and as either single or married with two young children. We found that a mother was held to a stricter standard for hiring than either a father or a woman without children. Results suggest earlier research conducted with undergraduates generalizes to professionals (Correll, Benard, & Paik, 2007; Fuegen, Biernat, Haines, & Deaux, 2004).

INTRODUCTION

Women comprise 49% of the recipients of law degrees (NCES, 2005) but only 17% of partners in law firms (Samborn, 2005). Gender stereotyping and discrimination account for at least some of this gap (Agars, 2004; Eagly, 2005; Lyness & Heilman, 2006; Martell, Lane, & Emrich, 1996; Powell, Butterfield, & Parent, 2002; Schein, 2001). Women who become mothers face negative stereotypes about their workplace competence and commitment (Crosby, Williams, & Biernat, 2004; Hebl, King, & Glick, 2007; King, 2008). The purpose of this research is to examine how gender stereotypes affect standards for inferring job-related competence and hiring and promotion decisions for mothers and fathers. Russo (1976) and Williams (2001) have argued that there exists a cultural stereotype that a «good» mother bears primary responsibility for the care of children. A mother who works full-time is seen as deviating from gender roles, though a father is not (Etaugh & Folger, 1998). Women receive more criticism than men for spending too little time at home (and too much at work). In contrast, men receive more criticism than women for spending too much time at home (and too little at work) (Deutsch & Saxon, 1998).

A growing body of literature suggests that mothers who violate gender roles by seeking full-time employment are negatively stereotyped and discriminated against. Cuddy, Fiske, and Glick (2004) asked undergraduate participants to read vignettes describing a consultant who was either female or male and either a parent

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or not a parent. Participants requested and recommended the consultant less when she was a mother than a woman without children, though fatherhood did not affect a man's chances of being requested and recommended. Consistent with predictions derived from the stereotype content model (Fiske, Cuddy, Glick, & Xu 2002), participants rated a mother more communal (warm) but less agentic (competent) than a woman without children. Heilman and Okimoto (2008) asked undergraduate (Study 1) and graduate (Study 2) participants to evaluate a job applicant depicted as male or female and with or without children. Similar to Cuddy et al. (2004), participants recommended a mother less often than a woman without children. Fatherhood had no effect on a man's chances of recommendation. Consistent with predictions derived from the lack of fit model (Heilman, 1983), lower ratings on agentic traits predicted lower expectations of a mother's competence. These studies suggest that women are uniquely disadvantaged in terms of perceived job-related competence when they become mothers.

Higher Standards for Mothers than Fathers

We argue that negative outcomes for mothers reflect the setting of more stringent standards for inferring job-related competence in mothers relative to fathers and women and men without children. Testing predictions derived from the shifting standards model of stereotyping (Biernat, 2003), Fuegen, Biernat, Haines, and Deaux (2004) asked undergraduate participants to judge the level of ability (e.g., test scores and rankings on letters of recommendation) they would require of an applicant for an attorney position in order to hire him or her. Participants held a mother to higher standards than a father, and a father was held to lower standards than a man without children. Furthermore, a mother was somewhat less likely to be hired and significantly less likely o be promoted than a woman without children. Fatherhood did not affect a man's chances of being hired or promoted, consistent with Cuddy et al. (2004) and Heilman and Okimoto (2008).

The premise of the shifting standards model is that stereotypes activate standards according to which individual members of stereotyped groups are judged. To the extent that motherhood highlights gender stereotypes (i.e., that women are warm, gentle, and caring; Spence & Buckner, 2000), mothers may be judged according to lower job-related competence standards for women in general, relative to fathers and women without children (Bridges, Etaugh, & Barnes-Farrell, 2002). Precisely because of lower expectations of competence, a mother must demonstrate more skill than a father or a woman without children to be judged equally competent.

Generalizing to a Non-student Population

One may question whether students' judgments are similar to professionals' judgments of job-related ability. Students are unlikely to have experience evaluating job applicants. Professionals who are parents may be more likely to hold egalitarian gender beliefs (Etaugh & Moss, 2001).

Two studies have assessed perceptions of parent and non-parent job applicants among non-student professionals. Firth (1982) mailed application letters to accounting firms in which the applicant's gender and parental status were

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Predictions

We predicted that parenthood would polarize judgments of men's and women's job-related ability such that mothers would be held to higher standards than fathers. We base this prediction on the assumption that motherhood makes salient stereotypes that suggest that women are warm, gentle, and caring—attributes not thought to facilitate success in the workplace. To the extent motherhood makes gender stereotypes and the cultural role of care-giver salient, a female job applicant with children will be judged according to a stricter standard than a female job applicant without children. To the extent fatherhood makes the cultural role of breadwinner salient and suggests maturity, responsibility, or leadership, a male applicant with children will be judged according to a more lenient standard than a male without children.

Our predictions are unique in suggesting that men may benefit in terms of perceived job-related ability when they become fathers. Predictions derived from the stereotype content model (Cuddy et al., 2004), the lack of fit model (Heilman, 1983; Heilman & Okimoto, 2008), and expectation states theory (Correll et al., 2007; Ridgeway & Correll, 2004) suggest that parental status has no effect of judgments of men's job-related ability. Rather, mothers are uniquely disadvantaged in the workplace because they are perceived as warm but not competent (Cuddy et al., 2004), notagentic (Heilman & Okimoto, 2008), or because motherhood is a status characteristic implying reduced performance capacity (Correll et al., 2007). We suggest that fathers are uniquely advantaged in the workplace because they are perceived as both competent and warm (Cuddy et al., 2004; Fuegen et al., 2004) and because paid employment is consistent with gender roles (Etaugh & Folger, 1998). Indeed, research has shown that fathers are held to lower standards than even the «ideal» worker (Fuegen et al., 2004), fathers are offered a higher starting salary than men without children (Correll et al., 2007), and fathers' work hours and wages increase when mothers temporarily leave the workforce (Lundberg & Rose, 2000).

METHOD

Participants and Procedure

Participants were 135 law school graduates (74 women, 61 men). We randomly selected equal numbers of males and females from an alumni directory. Of the 588 participants contacted, 36 had undeliverable addresses, resulting in 552 potential participants. Eighty females and 68 males responded

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(response rate = 27%). Due to clerical error, we had to omit the responses of seven males and six females. Our sample had considerable professional experience, though males had more experience than females: males reported having an average of 21 years of experience (SD = 14.47), compared to 9 years (SD = 7.47) for females, $t(83.14) = 5.55$, $p < .0001$.

We mailed participants a recruitment script with a dollar bill attached, one of four résumés, a questionnaire, and a self-addressed stamped envelope. In the recruitment script, we stated that we were interested in how experienced decision makers evaluate job applicants. We assured participants that participation in the study was voluntary and that their answers were anonymous. We asked participants to review the résumé, complete the questionnaire, and return the completed questionnaire in the self-addressed stamped envelope. The dollar was theirs to keep regardless of whether they chose to participate.

The résumé was that of an actual law school graduate with some relevant work experience. We manipulated applicant gender via the name on the résumé («Kenneth» or «Katherine»). We chose these names because they suggest roughly equal intellectual competence and a nonspecific age (see Biernat & Fuegen, 2001). We manipulated parental status under the résumé heading «Personal information.» We indicated the applicant was either single with no children or married with two young children (ages 5 and 3).

Dependent Measures

On the questionnaire, participants indicated what score in percentile ranking the applicant would need on a standardized ability test, letters of reference, and the Law School Admissions Test (LSAT) as well as in what percentage of his or her law school class the applicant would need to be ranked (e.g., the top 10%) to be hired as a first-year associate. These four items were standardized and combined to form the standards index (alpha = .75). Participants also indicated whether they would hire the applicant and whether the applicant would be a good candidate for promotion.

RESULTS

Standards

An Applicant Gender X Parental Status ANOVA on the standards index revealed only the predicted interaction, $F(1, 97) = 8.75$, $p < .01$, partial eta squared = .08 (see Table 1). A female applicant was held to higher standards when she was a parent than when not a parent, $p < .02$.

Standards were also higher for a mother than a father, $p < .01$. A father tended to be held to lower standards than a man without children, though this simple comparison was not significant, $p = .10$

Table 1. Standards for Hiring as a Function of Applicant Gender and Parental Status Female parent Male parent Female non-parent Male non-parent N 25 22 31 25

Mean standard for hiring 0.35 -0.27 -0.16 0.09

Standard deviation 0.37 0.77 0.96 0.64

Note. Means reflect standardized values; higher numbers indicate the setting of a stricter standard.

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Hiring and Promotion Decisions

Hiring and promotion decisions were recoded as no = 0 and yes = 1. A logistic regression on hiring revealed no significant effects. Thus, there was no evidence that a mother was hired less frequently than a father or a woman without children. Regarding promotion, there was only a main effect of Parental Status, chi-square (1, N = 84) = 4.42, $p < .04$. Unexpectedly, a parent was more likely to be recommended for promotion than a non-parent (Ms 71.43% and 48.98%, respectively). The odds that a parent would be recommended for promotion were 2.66 times greater than the odds that a nonparent would be recommended for promotion, Wald (1, N = 84) = 4.22, $p < .04$ (beta = 0.98; 95% confidence interval for odds ratio = 1.05, 6.79). This effect did not depend on Applicant Gender, $p = .57$.

GENERAL DISCUSSION

To our knowledge, this is the first study to vary the gender and parental status of a job applicant and to assess standards, hiring, and promotion decisions among professionals. Consistent with prior research, we found that mothers are negatively stereotyped in terms of job-related competence (Correll et al., 2007; Cuddy et al., 2004; Etaugh & Kasley, 1981; Firth, 1982; Fuegen et al., 2004; Heilman & Okimoto, 2008). We hypothesized that, to the extent motherhood highlights gender stereotypes, a mother will be held to higher standards than a female non-parent applicant. We found that a mother was held to higher standards than a woman without children and higher standards than a father. These findings support the shifting standards model of stereotyping. This model is unique in suggesting that because fathers are presumed to exhibit maturity, responsibility, or leadership (characteristics thought to facilitate success in the workplace), a father will be held to lower standards than a male non-parent. Also consistent with shifting standards, we found that a father tended to be held to (non-significantly) lower standards than a man without children. In contrast to earlier research showing that parental status had no effect on judgments of men's job-related competence (Correll et al., 2007; Cuddy et al., 2004; Heilman & Okimoto, 2008), we found that parenthood benefited men (see also Haines & Bragger, 2007).

We anticipated that being held to high (or low) standards would result in a lower (or higher) likelihood of being hired. If this pattern had borne out, a mother would have been unlikely to be hired, and a father would have been likely to be hired. Instead, we found that parenthood did not harm a woman's chances of being hired, nor did it help a man's chances of being hired. These null effects for hiring suggest that standards do not predict decisions in a straightforward way, at least among a professional sample. Whereas Fuegen et al. (2004) found that undergraduate participants were marginally less likely to hire a mother than a woman without children, we did not find that effect in this sample. This difference in results may reflect reluctance among professionals to make decisions based on limited information. Indeed, many participants

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spontaneously commented that they would need more information to make a hiring decision. The same was true regarding promotion decisions: several participants reported that they would need more information to make a recommendation regarding promotion. Thus, although parents were judged as especially good candidates for promotion, caution should be exercised in interpreting this finding. The analyses for promotion are based on a smaller sample size (N = 84) than the analyses for standards (N = 101).

Future Directions

A topic in need of investigation is whether decision-makers who are parents are any more or less likely to hire a job applicant who is also a parent, relative to non-parent decision-makers. Future research examining how attitudes about work/family conflict affect standards and hiring among decision-makers with and without children is needed. Also, the ages of children may affect perceptions of job-related ability. The association between women and care-giving may be stronger for mothers of infants than mothers of school-aged children. Third, the sex-typing of the job may affect perceptions of ability. A job emphasizing communal traits (e.g., schoolteacher) may be less subject to maternal bias than a job emphasizing agentic traits.

CONCLUSION

This research contributes to a growing body of literature on the barriers mothers face as they enter or attempt to advance in the workplace. This research also highlights the value of testing hypotheses in a non-college population and increases the external validity of earlier research findings. We show that negative stereotypes of mothers' job-related ability are no less likely to affect judgment standards among experienced than naïve observers.

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INDIVIDUALISM, COLLECTIVISM, AND PERCEPTIONS OF CONTROL ASSOCIATED WITH CONTROL AND CHOICE

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Univeristy of Windsor

ABSTRACT

To examine participants ratings of perceived control, a partial-replication was conducted with the addition of culture-based covariates (horizontal/vertical, individualism/collectivism). Participants believed they would perform an undesirable task for either a short (2 minutes) or long (20 minutes) time period. Proofreading length was determined by the contents of an envelope selected either by the researcher's coin flip (no choice) or directly by the participant (choice). Participants were told the envelopes contained either the same time periods (no control), or different time periods (control). Results indicated an illusory control effect with the provision of choice, with no impact from the cultural covariates. Implications are discussed.

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INTRODUCTION

It is well documented that people strive for control and mastery of their environment, and the benefits of control have received much attention (Seligman, 1975; Schulz, 1976). Much of the research in the area of control has focused on prediction, and maintained that control and prediction are nested together (Geer & Maisel, 1972; Burger & Arkin, 1980; Wortman, 1975). In other words, if one feels control over an important outcome, it also means that outcome is predictable (Schulz, 1976) — that to change the occurrence or duration of electric shocks is to also anticipate when they will occur. The resulting confound implies that one could not know whether higher perceived control was due to controllability of the outcome, predictability of the outcome, or some combination of the two.

Unconfounding Prediction and Control

Nickels et al. (1992) attempted to unconfound prediction and control, but had to reconceptualize the two. Under the reconceptualization, «prediction refers to knowing which outcome will likely occur before it occurs; control refers to exerting an influence over which outcome will likely occur» (p. 160). Under the reconceptualization, one could present controllable outcomes without prediction as «blind responses which make a difference in outcomes» (p.160). Across two experiments, the separation of prediction and control was successfully demonstrated. Participants in both prediction/control and no-prediction/control conditions provided higher scores on control-associated measures (control, influence, and responsibility) and lower helplessness ratings compared to participants in no-control conditions. The results supported the reconceptualization and the theoretical separation of control and prediction.

Control/Choice Confound

Although the aforementioned study rectified the control and prediction confound, a new confound arose. Specifically, the manipulation of control was confounded with choice as participants given controllability over the outcome also made a choice between options. This implies that one could not know whether higher perceived control was due to controllability of the outcome, choice between options, or some combination of the two (Langlois et al. 2002). Langer's (1975) seminal work on the illusion of control demonstrated that the provision of choice alone was sufficient to produce control-related feelings. Therefore, when people are given a choice, even between options that make no difference (e.g., selecting your own lottery number before the draw), people can still report enhanced perceived control.

In an effort to disentangle controllability from choice, Langlois et al. (2002) hypothesized that participants with controllability will report higher control-related feelings than participants without controllability — even without being able to predict the outcome. The presence of an illusory control effect would be evident however if participants with choice (regardless of controllability) will report higher control-related feelings than participants without choice, regardless of prediction. In a two-experiment study, participants were told they would proofread medical papers for either two minutes or 20 minutes, a time period determined based on the contents of one of two envelopes (marked 'left' and 'right'). Although no proofreading was actually done, participants believed they

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would proofread for either a more (2-minutes) or less (20-minutes) desirable time period. The envelopes were selected either by the participant (choice) or by the experimenter's coin-flip (no-choice). The independent variables were choice and control, so that participants were randomly assigned to one of three levels therein: choice/control, choice/no-control, and no-choice/no-control. In these conditions, choice-participants selected between envelopes, wereas no-choice-participants received the envelope determined by the experimenter's coin flip. Conditions with control involved different outcomes (e.g., different time periods), whereas conditions with no control involved the same outcomes (i.e., identical time periods in the envelopes).

The dependent variables for this study were participants' self-reported feelings of prediction, control, responsibility, and helplessness. The dependent measures questionnaire was completed after the experimental manipulation. In order to hold prediction of the outcome constant at no-prediction, knowledge of the outcome was withheld from participants until they had completed the questionnaire. Results indicated that to render higher feelings of perceived control, one's choice must make a difference in the outcome (i.e., outcomes must be different). Specifically, participants in the control/choice condition felt more control and responsibility than the other two conditions, which did not differ significantly from each other. Moreover, participants with control (different outcomes) felt more influence than participants without control (same outcomes). Helplessness did not vary significantly among the groups. Overall, the illusory control hypothesis of elevated feelings of perceived control with simply the provision of a choice (where control and choice were no longer confounded) was disconfirmed.

Control across Cultural Dimensions

The present study is a replication of Langlois et al. (2002) with the consideration of cultural variables, namely the Western-based individualist (personal achievement) vs. Eastern-based collectivist (group accomplishment) dimension. Individualism involves a self-concept that is both autonomous and unbound by one's in-group (e.g., close family and friends). The individualistic person's goals do not necessarily overlap with the group's goals and relationships are only maintained if the benefits and costs are balanced. A collectivistic orientation involves a self-concept that is bounded to the group. Goals typically overlap with the group and when a discrepancy exists, group goals are a priority. Relationships are of the utmost importance and are maintained at all costs (Singelis, Triandis, Bhawuk, & Gelfand, 1995; Triandis, 1995).

Triandis, McCusker, and Hui (1990) described attributes they called pure individualistic and collectivistic types. Collectivistic people pay more attention to their in-group and behave differently in regards to that group compared to those who are individualistic. The most important in-group is the family. For those who are individualistic, the in-group and the out-group are less defined and therefore, they do not behave as differently between these groups. As previously described, when personal goals are discrepant with group goals, collectivistic people place emphasis on group goals whereas individualistic people place emphasis on personal goals.

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Triandis, McCusker, and Hui (1990) described attributes they called pure individualistic and collectivistic types. Collectivistic people pay more attention to their in-group and behave differently in regards to that group compared to those who are individualistic. The most important in-group is the family. For those who are individualistic, the in-group and the out-group are less defined and therefore, they do not behave as differently between these groups. As previously described, when personal goals are discrepant with group goals, collectivistic people place emphasis on group goals whereas individualistic people place emphasis on personal goals.

Given the importance of the in-group for those who are collectivistic, norms are largely derived from one's in-group. For individualistic cultures, personal likes and dislikes are more important.

Triandis et al. infer that group norms largely determine social behaviour in collectivistic cultures whereas attitudes are more important in individualistic cultures.

Indeed, differences in control related feelings between collectivistic and individualistic participants seem plausible. Ji, Peng, and Nisbett (2000, p. 944) state that Westerners place so much importance on control «they often fail to distinguish between objectively controllable and uncontrollable events, tend to perceive more control than they actually have, and report mistakenly high levels of predictability of events.» Furthermore, Iyengar and Lepper (1999) demonstrated that American children were more motivated to perform a task when they chose that task themselves. In contrast, Asian American children were more motivated to solve a task that their mother chose. In a study on decision-making, Kim and Drolet (2003) investigated the effects of cultural assumptions of choice and uniqueness on the tendency to seek variety in choices. The results showed cultural differences in the likelihood of variety-seeking in regards to choice rules. Those from individualistic cultures demonstrated a tendency to vary choice rules whereas those from collectivistic cultures did not. In short, people from different cultures may respond differently when given control over a choice.

However, Triandis and Gefland (1998) further distinguish the individualist-collectivist dimension according to both horizontal and vertical subcategories. In general, horizontal cultures value equality among members, status is fairly even, and members are seen as similar to one another. Vertical cultures demonstrate inequality and status hierarchy; members are seen as different from one another. This creates four possible types based on the two cultural dimensions. In horizontal collectivist cultures, the self is viewed as merged with the in-group; members of the in-group are viewed as similar, and equality is emphasized. For vertical collectivist cultures, the self is viewed as an aspect of the in-group, where members are seen as different from one another; inequality is both accepted and expected. For horizontal individualist cultures, the self is viewed as autonomous but equal to other members of the group. Finally for vertical individualist cultures, members are viewed as different, status inequality is expected, and competition remains important (Singelis, et al., 1995).

In the present study, whereas no specific hypotheses were made with respect to culture, it was expected that each of the four cultural covariates would influence the extent to which the three from one another. That is, after accounting for the cultural covariates of horizontal/vertical and individualist/collectivist, that the mean differences — expected to be highest among participants with both control and choice — would alter significantly.

METHOD

Participants

Eighty-seven University of Windsor undergraduate students (65 women and 22 men) volunteered to participate in order to attain partial course credit. The mean age was 21.54 years.

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METHOD

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Eighty-seven University of Windsor undergraduate students (65 women and 22 men) volunteered to participate in order to attain partial course credit. The mean age was 21.54 years.

The sample consisted of 34 Caucasians, 21 Asians, 13 Middle Easterners, 9 African Americans, and 10 participants of mixed or other ancestry. All participants were Canadian-born.

Materials

Two white envelopes with «LEFT» printed on one and «RIGHT» printed on the other contained index cards with the time periods «2 minutes» or «20 minutes» printed on the back in light pencil so as not to be revealed through the envelope. Medium-sized signs (8.5 x 11 inch) were used to provide control- and choice-relevant information to participants. Signs indicating control-relevant information read either «THE ENVELOPES CONTAIN THE SAME TIME PERIOD» or «THE ENVELOPES CONTAIN DIFFERENT TIME PERIODS.» Signs indicating choice-relevant information read either «YOUR TIME PERIOD WILL BE DETERMINED BY THE ENVELOPE YOU SELECT» or «YOUR TIME PERIOD WILL BE DETERMINED BY THE THE ENVELOPE SELECTED FROM AN EXPERIMENTER-FLIPPED COIN.» These group-relevant signs were placed in the room with the participant, and the experimenter ensured that participants could read and understand them.

A two-dollar Canadian coin — with the words «LEFT» and «RIGHT» affixed to each side on white paper — was used. A sheet of paper contained a list of medical verbiage under the heading «Commonly Misspelled Medical Terms.» Under the list was an excerpt from a medical paper.

Two large medical textbooks with clearly visible titles were placed on the table in front of the participants.

Design and Procedure

For the present study, participants were led to believe they were participating in a study designed to investigate the effects of personality on proofreading accuracy. All participants received the same instructions from the researcher based on their experimental condition. Upon arrival, participants completed a consent form, and were advised they would proofread medical papers for either a short (2-minute) or long (20-minute) time period. They were then presented with a list of fictitious medical terms and several sentences from a sample medical paper. Prior to the experimental manipulation, participants completed a horizontal/vertical and individualism/collectivism measure (Triandis & Gelfund, 1998). This 32-item questionnaire asked participants to rate their level of agreement or disagreement with several statements on a scale from one to nine (1-strongly agree, 9-strongly disagree). Triandis and Gelfund (1998) report adequate internal consistency and supportive validity for these constructs. Addition of these covariates represents an extension of the replicated study.

Participants were tested individually in a private room. An experimental design with random assignment to three conditions was used. Each condition involved selecting one of two envelopes, and participants were told that they would proofread medical papers for the amount of time indicated in the chosen envelope (either 2 or 20 minutes). In these conditions, participants with control over the outcome were presented with envelopes containing different time periods (outcome); participants with no control were presented with envelopes

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containing identical time periods (outcomes). Participants in choice conditions selected an envelope themselves whereas participants in no-choice conditions had the envelope selected for them by the experimenter's coin-flip. Thus, participants were randomly divided into three independent groups: Participants in the control/choice condition (n = 31) chose between two envelopes which contained 2 and 20 minute time cards and they did not know which envelope contained which time period. In the no-control/choice condition (n = 27), participants chose between the envelopes and were told that both contained the same amount of time (either 2 or 20 minutes) but they did not know which.

In the no-control/no-choice condition (n = 29), participants were told both envelopes contain the same time period but selection was made by the experimenter's coin flip. Participants were deliberately not told what time period they received in order to hold prediction constant at no-prediction.

After experimental manipulations and prior to opening the envelope, participants completed a dependent measures questionnaire. Participants rated their levels of perceived control, responsibility, influence, and helplessness on a scale from 1 to 5 (1-not at all, 5-to a great extent). This questionnaire also included demographic questions as well as manipulation checks to assess

their knowledge of their prediction, control, and choice in their given experiemental group; participants who incorrectly answered any of the main manipulation checks were disgarded from analysis. One final check assessed whether participants wanted to proofread for the short (2-minute) time period. The entire process took approximately 30 minutes. After the experiment was completed, participants were fully debriefed by the researcher and informed they would not be proofreading any papers.

RESULTS

A bivariate correlation indicated the dependent variables of perceived control, influence, and responsibility were all negatively correlated with helplessness and positively correlated with each other (see Table 1). An ANOVA with group (choice/control, choice/no control, no choice/no control) as the independent variable indicated nonsignificant group differences for both influence, $F(2, 84) = 2.580$, $p = .082$, and helplessness, $F(2, 84) = 1.702$, $p = .189$, but significant group differences for responsibility, $F(2, 84) = 3.748$, $p = .028$, and perceived control, $F(2, 84) = 8.252$, $p = .004$. Ryan-Einot-Gabriel-Welsch F multiple comparison tests were conducted to investigate the specific differences between the three levels of the independent variable (choice/control, choice/no control, no choice/no control) for control and responsibility. Results indicated that participants with both choice and control reported higher feelings of perceived control ($M = 2.90$, $SD = 1.14$) and responsibility ($M = 3.13$, $SD = 1.28$) than the no-control groups. In addition, participants with choice but no control reported higher feelings of both perceived control ($M = 2.52$, $SD = 1.4$) and responsibility ($M = 2.74$, $SD = 1.48$) than participants with no choice and no control ($M = 1.86$, $SD = 1.03$; $M = 2.17$, $SD = 1.31$, respectively). This would suggest the presence of an illusion of control, produced by choice without control.

In an assessment of the covariates, the bivariate correlation matrix revealed nonsignificant correlations between each of perceived control, influence, and helplessness for all four cultural covariates (horizontal/vertical and individualism/

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DISCUSSION

The results of the present study did not fully replicate those of Langlois et al. (2002). They hypothesized that «even without prediction of outcome, participants with choice of option will report higher-control associated measures than participants with no choice of option» (p. 168).

Participants with both choice and control felt more control and responsibility than participants with choice but no control and participants with neither choice nor control. Furthermore, participants with control felt more influence than those without control. These findings disconfirmed the hypothesis that simply making a choice will result in control-related feelings.

They concluded that «to feel control, one's actions (e.g., choice of envelope) should make a difference in one's outcome (e.g., proofreading time)» (p. 170). That is, in order to render feelings of perceived control, simply making a choice was not sufficient; one's choice had to make a difference in the desired outcome.

Finally, the present results disconfirmed the hypothesis that inclusion of cultural dimensions of horizontal/vertical, individualism/collectivism would alter the resulting group differences.

Although one of the cultural covariates (horizontal-collectivism) was significantly related to one of the control-associated dependent measures (responsibility), its consideration as a covariate did not significantly alter the group differences.

In the present study, although we similarly found the highest ratings of perceived control and responsibility among those with both control and choice, and the lowest ratings among those with both no-control and no-choice, we also uncovered a unique effect. That is, participants with choice but no control perceived less control and responsibility than those with control but more than those without. In short, we identified an illusory control effect wherein the presence of choice without control can significantly enhance feelings of control and responsibility among participants (Langer, 1975). Although Ji et al. (2002) would contend that Westerners are more susceptible to illusory control due to the importance placed on personal control in Western Society, past research has shown that choice alone does not necessarily produce those feelings (Cramer & Perrault, 2006; Langlois et al., 2002).

Further research is needed to investigate the effects of choice on illusory control. Specifically, conditions under which choice alone leads to illusory control can be investigated. Also, research can investigate differences in susceptibility to illusions of control based on cultural differences (for example, individualism and collectivism). A limitation exists concerning the crossing of choice with control.

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Without implementing a no-choice/control condition, choice and control are not completely crossed (Langlois et al. 2002). This condition poses methodological difficulties and thus was not included in the study. Future research can investigate situations in which participants feel control without making any choices.

When considering the sample for this study, it is important to note that it was collected at a Canadian university. Although the majority of this sample was non-Caucasians, Western values and belief systems could be internalized by these participants. Perhaps a cross-cultural sample consisting of participants currently from different cultures will yield different results. Furthermore, there is a potential limitation concerning the experimental manipulation. Although it was assumed participants prefer to proofread for a short period (e.g., 2 minutes), perhaps this sample did not have a vested interest in that particular outcome.

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THE EFFECT OF COMMUNICATIVE IMPEDIMENTS ON INTERPERSONAL ATTACHMENT AND DEVIANCE

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ABSTRACT

This article introduces a theory describing the relationship between factors that increase social isolation and deviance. The theory is examined in the context of virtual visitation. We integrate social exchange, anomie, and strain theories to argue that as communication is impeded between two actors, the less satisfied either will be with the communication and thus, the more alienated they may become. Social alienation, in turn, may make actors more inclined to commit deviance. Findings have important implications for a broad set of applied settings including correctional facilities that have replaced in-person contact visits with virtual visits.

INTRODUCTION

America’s prison and jail population is rapidly increasing. Currently, well over two million adults are incarcerated in federal, state and local correctional facilities (BJS, 2008). For nearly all these inmates, face-to-face contact with the

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THE EFFECT OF COMMUNICATIVE IMPEDIMENTS ON INTERPERSONAL ATTACHMENT AND DEVIANCE

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ABSTRACT

This article introduces a theory describing the relationship between factors that increase social isolation and deviance. The theory is examined in the context of virtual visitation. We integrate social exchange, anomie, and strain theories to argue that as communication is impeded between two actors, the less satisfied either will be with the communication and thus, the more alienated they may become. Social alienation, in turn, may make actors more inclined to commit deviance. Findings have important implications for a broad set of applied settings including correctional facilities that have replaced in-person contact visits with virtual visits.

INTRODUCTION

America’s prison and jail population is rapidly increasing. Currently, well over two million adults are incarcerated in federal, state and local correctional facilities (BJS, 2008). For nearly all these inmates, face-to-face contact with the

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outside world is significantly restricted. Consequently, inmates are isolated from their families and friends and must rely on periodic visits to maintain personal contact. In recent years however, a growing number of America's correctional facilities have replaced in-person contact visits with virtual visits. For inmates in these institutions, meetings are no longer face-to face, but instead take place over a video screen.

The impact of this virtual form of visitation on the emotional attachment between inmates and their visitors has not been studied and is not currently known. It is understood however, that virtual communication lacks «media richness» in comparison to face-to-face interaction (de Pillis & Furumo, 2007). Communication using a video screen diminishes the visibility of non verbal cues including subtle facial expressions, body posture or faint olfactory signals. It also eliminates the possibility of interpersonal contact. Research has shown that the consequences associated with these deficits include misinterpreted messages, decreased trust and commitment as well as diminished satisfaction wih the interaction (Straus & McGrath, 1994; Watson-Manheim & Belanger, 2002).

In what follows, we introduce a theory describing the relationship between factors that increase social isolation and deviance. We argue that over time, any feature of a social exchange setting hat creates impediments to interaction, including aspects of communication that isolate actors by decreasing the fulfillment of the interaction between them and significant others, also diminishes the strength of social bonds between actors and their visitors. It is well understood that people who experience weakened bonds or attachments with others are more likely to engage in antisocial behavior than their counterparts (Hirschi, 1969). Consequently, impediments to interaction contribute to increases in behavior that violates accepted mores. We believe that virtual visitation is one such impediment, and use it to illustrate this process. In the following sections, we review the relevant literature and present our theory.

RELEVANT LITERATURE

Exchange Theory

The genesis of social exchange theory can be traced to the works of several early contributors including, Homans (1961), Thibaut and Kelley (1959), Blau (1964), and Emerson (1962, 1972). These works blended rational choice and reinforcement processes to explain how actors in a social setting exchange valued items.

Social exchange differs from purely economic theory in a fundamental way. Traditionally, micro economic theory assumes that sequential exchanges are independent events. Social exchange theory, however, takes the recurring exchange relation as its subject matter (Molm & Cook, 1995). Exchange is a joint activity that is often built up over time. The perspective assumes that self interested actors exchange with other self interested actors in order to reach goals they could not achieve alone (Lawler & Thye, 1999). The outcomes of exchange serve as reinforcement contingencies that foster the connection. Consequently, the exchange relationship is the smallest unit of analysis.

Recently, Lawler (2001) proposed an affect theory of social exchange. The theory moves beyond current theorizing that conceptualizes rational choice and

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reinforcement as the primary processes that mediate structural exchange opportunities. Instead, the theory argues outcome of exchange produces global emotions which are involuntary, primitive and nonspecific feelings that are not immediately attached to particular social objects (Lawler, Thye & Yoon, 2000). If the outcome of exchange is successful, actors feel good; if the outcome is unsuccessful, they feel bad (Lawler & Thye, 1999). The emotions generated by exchange function as internal self reinforcing or punishing stimuli. Actors try to reproduce positive global feelings and avoid negative global emotions. These emotions also trigger cognitive efforts to explain their source. Actors involved in joint exchange tasks attribute these emotions to their exchange relations or groups. Lawler (2001) notes that the fundamental implication of these assumptions is that successful exchange increases group cohesion and unsuccessful exchange reduces it. Cohesion is defined as the strength and durability of person to person and person to group relations.

Anomie

A long tradition of work in sociology describes and explains the association between social integration and antisocial behavior. Durkheim specifies how deviance is mediated by two social processes. Egoism is a feeling of purposelessness due to a lack of social integration and anomieis negative emotion and cognition generated by weak normative regulation of behavior. Although there is slippage related to the meanings of these terms, (see Bearman, 1991), several theorists argue that egoism and anomie are two sides of the same coin (Gibbs & Martin, 1964; Johnson, 1965). For them, social integration is a precondition for regulation. The latter cannot exist without the former. Durkheim felt that the more individuals interact in social systems subsumed by strong social relationships, the more likely they are to become attached to others and the less likely they are to carry out antisocial behavior (Stockard & O'Brien, 2002).

Although the study of homicides and suicides has developed in different sub-disciplines and & O'Brien, 2002), Durkheim believed the causes of suicide and homicide in complex modern societies are «parallel» and stem from anomie or egoism (Stockard & O'Brien, 2002). Durkheim specified four sources or factors that lead to suicide. Egoistic suicide results from excessive individualism and occurs when the ties connecting the individual to society or others are weak. In essence, there are so few bonds linking the person to society that nothing is left to prevent the person from self destructive behavior. Altruistic suicide is caused by too much social integration. These people are so firmly connected to society that they are willing to sacrifice their lives for the good of the collective. Durkheim specified several categories of anomic suicide. Although somewhat varied, each of these categories share the common assumption that suicide occurs when a sense of normlessness generates a disjunction between goals and means until finally, people discover they lack the wherewithal to fulfill their needs. Fatalistic suicide results from excessive regulation of norms. Durkheim believed this was a rare phenomenon that occurred when the individual perceived no hope of relief from the oppressive regulation brought on by society. Although Durkheim's discussion of homicides is somewhat indistinct and ambiguous, his core argument specifies that (at least for modern social systems),

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the more strongly individuals are integrated into and regulated by society, the less likely they will be to experience any type of lethal violence whether it be suicide or homicide (Stockard & O'Brien, 2002).

Strain Theory

This tradition traces its roots to Durkheim and holds that delinquency and deviance occur when individuals experience strain because they are unable to achieve their goals through legitimate means (Merton, 1938; Cohen, 1955; Cloward & Ohlin, 1960). Early formulations, including Merton, argued that deviance resulted from anomie or normlessness produced by a disjunction between economic goals and structurally determined channels for achieving these outcomes.

When faced with this disjunction, people may choose non-normative methods for achieving the culturally accepted goal of becoming wealthy. These «innovators» resort to crime or deviance to manage strain. More recently, Agnew (1992) extends these ideas by suggesting first, that negative experiences are key in generating deviant behavior because, among other things, strain or the failure to achieve positively valued outcomes produces negative emotion which leads to deviant behavior (Kaufman, Rebellon, Thaxton & Agnew, 2008). And second, that individuals who are subject to repetitive strain are more likely to commit deviance or crime than others (Agnew, 1992).

Social Control Theory

It is well understood that the social control theoretical tradition (Hirschi, 1969) also builds upon Durkheim's work in explaining deviant criminal behavior (Stockard & O'Brien, 2002). Both traditions argue that weakened attachment is fundamental in generating antisocial behavior. Following Durkheim, Travis Hirschi, in his landmark work Causes of Delinquency (1969), argued that the more people are connected to society and other social institutions by social bonds, the less likely they will be to engage in criminal behavior.

According to Hirschi, four types of social bonds keep individuals from antisocial behavior. Involvement is the extent of participation in «conventional activities» such as school, work and sports. The more people are involved in these activities, the less time they have for deviant acts. Commitment is the investment of time and energy in conventional activities. An increase in commitment is inversely related to criminal or deviant behavior. Belief is the idea that the rules, laws, and norms of society should be obeyed. The strength of belief in conformity partially determines whether an individual commits a criminal act. Attachment is an enduring, strong, affective relationship between two or more people. This association is characterized by a sense of caring and respect for the opinions and feelings of the other person or group. An inverse relationship exists between attachment and criminality.

Research indicates that of the four types of bonds, attachment is the strongest predictor of criminal behavior (Bernard, Snipes, & Gerould, 2010; Agnew, 1991; Empey & Stafford, 1991; Jensen & Rojek, 1992; Junger-Tas, 1992). For example, Hirschi (1969) found that attachment, measured as communication between child and caregiver, or attachment measured as affinity to school and peers, was important for control. In family relationships distinguished by a lack

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of communication, children worry less about their parents' disapproval than in more communicative family units. This indifference increases chances for deviance. Likewise, juveniles who do not like school, their teachers, or peers tend to commit more delinquent acts than other children. Simply put, this research suggests that people are less likely to commit crime if they believe it may jeopardize the affection and respect of those people in their lives who are important to them.

THEORY

In this section we introduce our theory. The theory consists of three logically connected assumptions and a set of scope conditions. Each assumption is supported by relevant theory and research.

Scope Conditions:

(1) All assumptions apply from the perspective of a focal actor designated as 'P.' (2) The interaction occurs in social exchange settings where (3) a focal actor perceives an opportunity to repeatedly exchange with at least one same specific other and where (4) the outcome of the exchange is uncertain. (5) Finally, the focal actor and another are exchanging tangible items such as money or non-tangible, socially valued items such as friendship and esteem. Assumptions: The theory is expressed through three logically related assumptions that explain how the structural features of exchange generate emotions that lead to the development of deviance under the scope conditions.

Assumption 1: The more communication is impeded between actors 'P' and 'O', the less 'P' will be satisfied with the outcome of interaction with 'O'.

An impediment to communication is anything that blocks, delays, strains, or reduces the frequency of, or interferes with, the interaction. Communication researchers have found that these factors are often associated with lower satisfaction (de Pillis & Furumo, 2007). Researchers comparing virtual to face-to-face interaction (for example in business teams or classrooms) have found that virtual communication is generally equally effective in accomplishing goals, but members of face-to-face interaction report significantly higher levels of satisfaction with the interaction (Warkentin, Sayeed, & Hightower, 1997; Arbaugh, 2000).

Assumption 2: The less 'P' is satisfied with the outcome of interaction with 'O,' the more P experiences alienation from O.

Alienation is defined as emotional detachment or withdrawing personal affection from a social relation. Support for this assumption comes principally from Lawler's (2001) affect theory of social exchange. This approach argues that three fundamental processes occur in exchange settings: (i) the act of exchange generates emotions among participants, (ii) actors attribute these emotions to the exchange relationship itself and (iii) these emotions serve as internal reinforcement contingencies that either increase or reduce group cohesion. Unsuccessful exchange generates negative emotion and a hedonistic or self serving bias that reduces cohesion between exchange partners.

Assumption 3: the more P experiences alienation from O, the more P is inclined to commit deviance.

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occurs when an actor breaks an accepted normative standard of the setting. Norms include formally enacted rules such as laws and regulations and informal behavioral standards that are not codified into law. Deviance ranges from offenses against rules that are severely sanctioned, such as personal violence against others, to infractions of informal norms that are not officially punished, such as cheating during a casual game of golf.

When actors are detached or withdrawn from social relations, social control theory and research suggests that deviance is likely to occur. Weakened bonds reduce the degree that people care about the thoughts and opinions of others, which increases the probability of normative rule violations. Informal social control by friends, family and neighbors is weakened in these circumstances because the offender is less likely to experience a feeling of shame (Braithewaite, 1989). Consequently, any social characteristic that decreases interdependency among people is likely to increase the probability of deviance (Hamilton & Rauma, 1995).

The theory generates several derivations which are logical consequences of the assumptions of the theory. The following one is of particular interest. Primary Derivation: The more communication is impeded between P and O, the more P is inclined to commit deviance.

This derivation follows from assumptions 1 and 3 and stems primarily from ideas found in strain theory. This tradition holds that delinquency and deviance occurs when individuals are unable to achieve their goals through legitimate means (Merton, 1938; Cohen, 1955; Cloward & Ohlin, 1960). In this context, individuals are unable to achieve satisfaction from interaction. Agnew (1992) extends these ideas by suggesting that negative experiences generate deviant behavior because the failure to achieve positively valued outcomes produces negative emotion which leads to deviant behavior (Kaufman, Rebellon, Thaxton & Agnew, 2008).

CONCLUSIONS

Social exchange theory, control theory and strain theory each successfully account for responses to emotional reactions generated by social structure. However, the theories take different explanatory routes. Social exchange focuses on responses to exclusion from exchange, control theory directs attention towards emotions generated by alienation and strain theory examines how anomie affects behavior. Integrating elements of each of these theories opens an array of potential new applications without subverting the theory's basic assumptions. Our integrated theory argues that impeded communication disrupts the exchange process, and this in turn leads to deviance that is a result of strain and alienation. Our theory allows for an array of new predictions that have important implications for applied settings, including one of the most important: an increasing number of correctional facilities that have replaced in-person contact visits with virtual visits.

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Career Counseling: Increased Stress Due to Job Insecurity
Carole M. Saylor, MC, NCC, LAC, DCC, LISAC

In today's world, we are more and more defined, not by who we are, but by what work we do. Work plays a powerful and increasing role in people's lives. As it makes more and more demands on our time and energy, our chosen work or career path impacts every facet of our lives. A strong relationship develops between our work and our mental and physical health. Stress in any of these areas, especially work, will affect all other areas of our lives and this is when career counseling can be helpful.

Stress is an interaction between individuals and any source of demand (stressor) within their environment. A stressor is the object or event that the individual perceives to be disruptive. Stress results from the perception that the demands exceed one's capacity to cope. Different people react differently to the same stressors because of their backgrounds, experiences and values. Elevated stress levels in employees are associated with increased turnover, absenteeism; sickness, reduced productivity, and low morale.

Work stressors are related to depression, anxiety, general mental distress, heart disease, ulcers, and chronic pain. Many people are distressed by efforts to juggle work and family demands, such as caring for sick or aging parents or children. Any exploration of the relationship between work conditions and mental distress, which is the hallmark of career counseling, must take into account individual factors such as sex, age, race, income, education, marital and parental status, personality, and ways of coping.

Although the rewards of work can offset some of its stressful aspects, the physical environment and the psychosocial conditions of employment can have adverse effects on a worker's mental and physical well-being. Lack of control over work, the work place, and employment status have been identified both as sources of stress and as a critical health risk for some workers. Employees who are unable to exert control over their lives at work are more likely to experience work stress and are therefore more likely to have impaired health. Many studies have found that heavy job demand, and low control, or decreased decision latitude, lead to job dissatisfaction, mental strain, and cardiovascular disease.

Today, stress and its resulting illnesses impact workers in almost every comer of the world. In Australia, stress claims by government workers increased by 90% between 1990 and 1993. A French survey showed 64% of nurses and 61% of teachers were upset over the stresses associated with their jobs. Another study found that stress-related diseases such as high blood pressure and heart attacks cost the U.S. economy $200 billion a year in absenteeism, compensation claims and medical expenses.

In today's economic upheavals caused by downsizing, layoffs, mergers, and bankruptcies have cost hundreds of thousands of workers their jobs. Millions more have been shifted to unfamiliar tasks within their companies and wonder how much longer they will be employed. Adding to the pressures that workers face are new bosses, computer surveillance of production, fewer health and

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retirement benefits, and the feeling they have to work longer and harder just to maintain their current economic status. Workers at every level are experiencing increased tension and uncertainty, and are updating their resumes, hoping to find jobs, that in many cases, no longer exist.

The loss of a job can be devastating, putting unemployed workers at risk for physical illness, marital strain, anxiety, depression, and even suicide. Loss of a job affects every part of life, from what time you get up in the morning, to whom you see, and what you can afford to do socially. Until the transition is made to a new position, stress is chronic.

In many instances it has been found that the restructuring, reengineering, layoffs, outsourcing, and offshoring performed by companies did little to improve productivity and nothing to improve morale. A review of 52 studies of corporate restructuring involving several thousand companies found that on an average, organizational downsizing had little if any positive impact on earnings or stock market performance. And regrettably, 70% of U.S. companies report serious morale problems caused by years of upheaval and restructuring.

Workers who survive corporate downsizing also find their lives impacted by the vast changes sweeping their work environments. The Lancet, a British medical journal, recently reported increased illness among employees who survive job reductions. Mark Braverman, the founder of Crisis Management Group in Newton, Massachusetts, states «Often times, the people who remain after the cuts are made, wind up feeling demoralized, overworked, stressed, and fearful that they will be targeted the next time around.»

A feeling of powerlessness is a universal cause of job stress. When you feel powerless, you're prey to depression's traveling companions, helplessness and hopelessness. You feel you cannot alter or avoid the situation because you feel nothing can be done.

Many employees find themselves worrying about survival rather than a new car or new home. People's dreams are fading fast with the reality that they could be jobless at any time in today's workplace. What was once taken for granted now leads to worry and insecurity. Troubling thoughts flood some people's minds such as: the loss of their home, retirement, pensions, and health benefits, leading to greater insecurity.

Workers are struggling to adjust to downsizing. In a poll conducted in 1995, workers said they would work more hours, take fewer vacations, or accept less benefits in order to keep their jobs. Desperate for some job security, people are willing to work harder and longer with fewer benefits to maintain their occupational status.

Loss of control over one's future work role can lead to mental health issues along with devastating consequences to other life roles including family life, friends, and societal relationships. It can also lower self-esteem, which often leads to depression. This loss of job control can have devastating effects on every aspect of not only the individual but of their family's lives.

In general, job control is the ability to exert influence over one's environment so that the environment becomes more rewarding and less threatening. Individuals who have job control have the ability to influence the planning and execution of work tasks. Research has found that it is the influence resulting from participation, rather than participation itself, which affects job stress and health.

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The following strategies for reducing work-related stress may assist you in gaining a feeling of job control.

1. Alter the working conditions so that they are less stressful or more conducive to effective coping. This strategy is most appropriate for large numbers of workers working under severe conditions. Examples include altering physical annoyances such as noise levels, or changing organizational decision-making processes to include employees. These alterations could be attempted by large numbers of employees working together such as a labor or union group. It could also be addressed by upper management in corporations who truly have a regard for their employees.

2. Help individuals adapt by teaching them better coping strategies for conditions that are impossible or difficult to change. A limitation to this strategy is that it is costly to deal with each individual's unique transaction with the environment. Intervention strategies could include individual counseling services for employees, Employee Assistance Programs, or specialized stress management programs, such as cognitive behavioral interventions (Long, 1988). Many Employee Assistance Programs address these issues within the company, however, some employees are reluctant to participate for fear of being labeled as trouble makers or have their names appear at the top of the next layoff list. If an individual is feeling inordinate stress at work, it would be advised to seek counseling on an individual basis or find stress reduction classes outside the corporate environment.

3. Identify the stressful relationship between the individual or group and the work setting. Intervention strategies might include changes in worker assignment to produce a better person-environment fit, or it could involve teaching coping strategies for individuals who share common coping deficits (e.g., training in relaxation skills). Again these interventions would require support from upper management in the Company. Or an individual would have to pursue learning coping strategies on their own time and at their own expense in order to insure confidentiality.

4. A good tactic to make you feel you are in control and being proactive about the situation is to re-evaluate what is truly important in your life. Decide what status level, economic level, and comfort level you have to maintain to be able to survive and be happy within yourself. When people do this evaluation, they frequently discover they can make much less money and live much differently than they do currently and still be happy. Take a look at other careers where you might be as happy or happier and pursue the education or training necessary to work in that field. It would be advisable to obtain this training while you are still employed at your old job, before looking for a new job becomes imperative.

Conclusion:

Work stress is constantly affecting us and our families and seems to be growing in leaps and bounds. This stress can be the harbinger of job dissatisfaction, mental strain, and physical maladies. If you find yourself experiencing increased levels of job stress due to job insecurity, you need to take action and prepare for the future. You must be your own safety net, you cannot depend on your company to have your best interests at heart. You cannot be an ostrich with your head stuck in the sand. You need to see the handwriting on the wall and prepare accordingly, especially if that handwriting is saying you will probably be unemployed within a few years.

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Differences in Management accounting between family enterprises and non-family enterprises: A Statistical Approach

Christine Duller

Abstract

Management accounting deals with the subject family enterprises rather little in spite of its high economical relevance. This paper questions, weather general objectives of family enterprises differ from those of non-family enterprises. Based on the hypothesis that family enterprises aim at humane objectives to a greater extent and at inancial objectives to a lesser extent than non-family enterprises the results of an empirical study for the region Upper-Austria are presented. The conclusion is that apart from the extent of return on equity objectives of family enterprises do not differ much from those of non-family enterprises. The second point of interest is to analyse differences in objectives between medium and large sized enterprises.

Keywords: Business administration, empirical research, correspondence analysis

1. Introduction

According to the deinition for SME (small and medium sized enterprises) given by the European Union only 0.5 % of the Austrian enterprises are classiied as large enterprises (Commission of the European Communities, 2003, p. 39). Therefore the vitality, custom ization and competitiveness of the national economy are borne by small and medium sized enterprises. Moreover these enterprises are of special importance for the national labour market, because 65.5 % of the Austrian employees are part of those enterprises.

Most of the small and medium sized enterprises costitute family enterprises simultaneously. In Austria about 75% of all enterprises are family enterprises, and approximately 70% of all employed persons are working in family enterprises (Pichler, Bornett, 2005, p. 125; Feldbauer-Durst müller et al., 2007, p. 428; Hasch et al., 2000, p. 62).

In spite of the high economical relevance management accounting deals with the subject family enterprises in empirical research rather little. Theoretical research in management accounting in family enterprises is focused either on foundations or successions of enterprises or on the special socio-economic aspects given by the combination of enterprise and owner family (Feldbauer-Durstmüller et al., 2007, p. 428; Klein, 2004, p. 54 f.).

This paper questions, weather general objectives of family enterprises differ from those of non-family enterprises. Based on the hypothesis that family enterprises aim at humane objectives to a greater extent and at inancial objectives to a lesser extent than non-family enterprises the results of an empirical study for the region Upper-Austria are presented.

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dealing with the topics small and medium sized enterprises, management accounting and family enterprises simultaneously.

This work is based on following theoretical approaches: Hahn argues that due to serious changes in business environment more coordination and management in medium-sized family enterprises is needed. Controller ship — seen as management assistance — is suitable to perform this task (Hahn, 1994, p. 125 f.). Horváth uses the Three-Circle Model built up by Tagiuri & Davis, developed by Gersick et al., to describe the management system in medium sized family enterprises as an extensive interaction of business, family and ownership (Tagiuri, Davis, 1992, p. 49; Gersick, Davis, McCollom Hampton, 1997, p. 5 f.; Horváth, 1999, p. 121 f.). Based on Horváth's conception for controller ship Feldbauer-Durstmüller and Haas elaborated a system for information, planning and controlling in medium sized family enterprises (Horváth, 2009, p. 91 f.; Feldbauer-Durstmüller, Haas, 2008, p. 107 f.).

Neither Hahn nor Horváth have conducted empirical research to verify their theoretical work, but empirical research on this topic is published for Germany (e.g. Ossadnik, et al., 2004, p. 622 f; Berens, Püthe, Siemes, 2005, p. 186 f.).

For Anglo-American countries empirical research usually deals either with objectives of enterprises in general or micro and small enterprises (e.g. Upton et al., 2001; Peel, Bridge, 1999; Gibson, Cassar, 2002; Stonehouse, Pemberton, 2002), but there is no empirical research in the special context of management accounting in small and medium sized family enterprises so far (Duller, Haas, 2009, p. 33f.).

3. Hypothesis Development

Previous research indicates that business objectives in family enterprises are less infuenced by monetary objectives, but more determined by interests of stakeholders and human objectives (Fröhlich, Pichler, 1988, p. 95 f.). Moreover, descriptive empirical research for Germany indicates that in family enterprises liquidity protection, employee satisfaction and entrepreneurial independence are more important objectives than in non-family enterprises (Günther, Gonschorek, 2006, p. 7).

Using exploratory qualitative empirical methods Spence and Rutherfoord looked at social responsibility and proit maximisation in small irms in UK. One result out of twenty face-to-face interviews was the conclusion, that most small irms are likely to be dominated by objectives concerning subsistence or social issues (Spence, Rutherford, 2002, p. 137 f.).91

Due to the fact, that the distinction between family and non-family enterprises differs and the classiication concerning size is ambiguous, research results from other countries and samples are possibly not adequate for Austria.

Therefore, the following hypotheses will be tested in this survey: Family enterprises aim at humane objectives to a greater extent than non-family enterprises.

Family enterprises aim at inancial objectives to a lesser extent than non-family enterprises.

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Furthermore, Fröhlich and Pichler argue that family enterprises' biggest interest is to survive (Fröhlich, Pichler, 1988, p. 98). For this reason it is indicated that family enterprises aspire to a smaller return of equity than non-family enterprises. This will be tested with the hypotheses:

Family enterprises aspire to a smaller return of equity than non-family enterprises.Medium sized enterprises aspire to a smaller return of equity than large sized enterprises.

4. Research method and results

The research method is based on a standardized questionnaire, which was available via internet. All enterprises in Upper Austria with 50 or more employees (1180 enterprises) were invited to take part in the survey. Each enterprise got an individual link, which ensured that the completion of the questionnaire was possible for interesting enterprises exclusively. After completion the individual link was locked automatically to guarantee once-only participation.

The usable return was 236 enterprises or 20%, 189 of them declared themselves as family enterprises (80.1%). Due to the fact that the proportion of family enterprises in Austria is about 70-80%, the sample can be treated as representative.

The main point for further discussions is how a family enterprise is deined. There are many different approaches to deine it. Some of the popular criterions are the following (Feldbauer-Durstmüller et al., 2007, p. 430):

Level of equity held by a single family

Degree of implication of the family in the management structure

More than 50% of ownership is held by a family

A family group controls the business

In this survey the enterprises had to decide themselves weather they are a family enterprise or not according to (at least one of) the following criteria:

Arbitrary legal structure More than 50% ownership is held by family members or family close foundations

Family members are part of management

Syndications of families or branches of families

In order to verify the given hypotheses concerning management accounting classical statistical tests were used (Chi-squared-Test, Fisher Exact Test). Family enterprises are more often than not small and medium enterprises, too. Therefore, each of the above hypotheses was tested with respect to structure and size.

Testing the given hypotheses with respect to structure (family versus non-family enterprises) and size (medium enterprises versus large enterprises) had the following results:

There was no signiicant difference in human objectives, neither for structure nor for size.

The same result was found for inancial objectives in general. Only the aspired return on equity showed signiicant differences for structure ($p = 0.023$) and size ($p = 0.007$).

This means that there is a signiicant difference in the aspired return of equity between medium sized and large enterprises (Figure 1 and Table 1) and also between family and non-family enterprises.

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The correspondence analysis extracted two factors, the irst factor was mainly determined by size (number of employee), the second factor was less important and was mainly determined by size (turnover of enterprise). The structure (family business or non family business enterprise) was nearly completely determined by the irst factor. So the most important variable for prediction of the aspired equity rate is the size of an enterprise expressed by the number of employee.

5. Conclusions

Apart from the extent of the aspired return on equity the objectives of responding family enterprises do not differ from those of non-family enterprises. Moreover multi-variate analyses showed that for the aspired return of equity the determining factor is not structure, but size.

This result does not verify common theoretical research. Assuming the correctness of the theoretical statements at least two possible explanations can be given for the mismatch:

The situation for family enterprises has changed, because nowadays their owners are better educated in business administration than some years ago. Therefore more and more family enterprises act in a similar manner like non-family enterprises to keep up their chances in the market.

The sample size in this work is very small, especially for multivariate analyses.

Splitting the sample according to structure and size causes small frequencies in some categories, in particular large family-enterprises are very rare in the sample (and in Austria). So it is hard to ind evidence for any complex statement. More and even more detailed results could be found in a bigger sample.

To clarify the results a second survey has started in August 2009. This time the population is given by all medium and large enterprises in Austria. Moreover in cooperation with universities in Germany data for some federal states of German will be compared with Austrian data.

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Outsourcing: The Advantages And Disadvantages Of Outsourcing
By F. John Reh**,** About.com Guide

Outsourcing occurs when a business secures (purchases) products and/or services from a third party, as opposed to producing them in-house. There are several advantages and disadvantages to outsourcing.

Advantages of Outsourcing

One of the biggest advantages can be lower personnel costs. By outsourcing job duties to non-employees, a business does not have to pay consistent wages or offer additional employee benefits. The company may pay lower taxes because independent contractors, the people who complete the outsourced projects, pay their own withholding, social security, and other taxes. This can add up to substantial savings.

Some businesses choose to take their outsourcing one step further by choosing a vendor, located in another part of the world. Doing so typically saves them more money because they end up paying a much lower wage than would be necessary in their home country. The disadvantage is that these vendors may not understand English and communication is more difficult

Many times, outsourcing speeds up production time. Since the third-party vendor will only be concentrating on one specific task, instead of numerous office duties, actual production time can be greatly increased.

Outsourcing gives a business the flexibility to change third-party vendors whenever necessary. This process is not as time-consuming as the normal employee hiring process, because they are not screening individuals, they are considering established companies with proven track records.

An excellent example of this is customer service. When a business outsources its customer service department, it does not have to hire and oversee thirty individual operators. Instead, it can hire one call center, which will perform all needed tasks.

Recent studies show that information technology-related tasks are outsourced more than anything else. Other common department functions that are outsourced include: human relations, training, accounting and supply management.

Whether a business chooses to outsource on a temporary basis or permanently, the advantages are well worth the decision to do so. Most businesses, which set out to outsource temporarily end up making an ongoing commitment.

Disadvantages of Outsourcing

One of the biggest disadvantages of outsourcing is undesirable results. This is especially true when a company hires a third-party vendor to mass produce a

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Disadvantages of Outsourcing

One of the biggest disadvantages of outsourcing is undesirable results. This is especially true when a company hires a third-party vendor to mass produce a

product. In the event that the finished products do not meet quality standards, the manufacturing process must be repeated by a different vendor.

Not only is this a waste of time and materials, it can also be very costly for the company who outsourced the project. They are essentially paying twice for the same job. In addition there is always the possibility that the company may lose sales, during this same period because of the lack of available product.

Another disadvantage of outsourcing is a loss of jobs. Many times work is outsourced simply as a means to save money. Outsourcing to a foreign country typically saves a company a great deal in wages. So, the choice is made to reduce their local workforce, at the expense of the laid-off employees.

In turn, it can cause community uproar and even a decrease in business and profits. This happens when local consumers make the decision to shop elsewhere, as a way to voice their disdain.

Outsourcing customer service jobs, to foreign countries, is on the rise. Many large corporations including credit card companies, shopping networks and computer manufacturers are making this change.

The problem with this is a lack of communication. It can be very frustrating for a consumer who is calling in with a customer service issue. When this individual cannot understand the customer service representative they are speaking with, it just causes more frustration and does little to solve the problem.

Management 101
By F. John Reh, About.com Guide

What is management? What do managers do? How do I manage?

These are standard questions that most of us in the management profession have been asked more than once. And questions we asked once in our careers too. Here, then, is a basic look at management, a primer, Management 101 from my perspective.

Art and Science

Management is both art and science. It is the art of making people more effective than they would have been without you. The science is in how you do that. There are four basic pillars: plan, organize, direct, and monitor.

Make Them More Effective

Four workers can make 6 units in an eight-hour shift without a manager. If I hire you to manage them and they still make 6 units a day, what is the benefit to my business of having hired you? On the other hand, if they now make 8 units per day, you, the manager, have value.

The same analogy applies to service, or retail, or teaching, or any other kind of work. Can your group handle more customer calls with you than without? Sell higher value merchandise? Impart knowledge more effectively? etc. That is the value of management — making a group of individual more effective.

Basic Management Skill #1: Plan

Management starts with planning. Good management starts with good planning. And proper prior planning prevents… well, you know the rest of that one.

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Figure out what your goal is (or listen when your boss tells you). Then figure out the best way to get there. What resources do you have? What can you get? Compare strengths and weaknesses of individuals and other resources. Will putting four workers on a task that takes 14 hours cost less than renting a machine that can do the same task with one worker in 6 hours? If you change the first shift from an 8 AM start to a 10 AM start, can they handle the early evening rush so you don't have to hire an extra person for the second shift?

Look at all the probable scenarios. Plan for them. Figure out the worst possible scenario and plan for that too. Evaluate your different plans and develop what, in your best judgement, will work the best and what you will do if it doesn't.

TIP: *One of the most often overlooked management planning tools is the most effective. Ask the people doing the work for their input.*

Basic Management Skill #2: Organize

Now that you have a plan, you have to make it happen. Is everything ready ahead of your group so the right stuff will get to your group at the right time? Is your group prepared to do its part of the plan? Is the downstream organization ready for what your group will deliver and when it will arrive?

Are the workers trained? Are they motivated? Do they have the equipment they need? Are there spare parts available for the equipment? Has purchasing ordered the material? Is it the right stuff? Will it get here on the appropriate schedule?

Do the legwork to make sure everything needed to execute the plan is ready to go, or will be when it is needed. Check back to make sure that everyone understands their role and the importance of their role to the overall success.

Basic Management Skill #3: Direct

Now flip the «ON» switch. Tell people what they need to do. I like to think of this part like conducting an orchestra. Everyone in the orchestra has the music in front of them. They know which section is playing which piece and when. They know when to come in, what to play, and when to stop again. The conductor cues each section to make the music happen. That's your job here. You've given all your musicians (workers) the sheet music (the plan). You have the right number of musicians (workers) in each section (department), and you've arranged the sections on stage so the music will sound best (you have organized the work). Now you need only to tap the podium lightly with your baton to get their attention and give the downbeat.

Basic Management Skill #4: Monitor

Now that you have everything moving, you have to keep an eye on things. Make sure everything is going according to the plan. When it isn't going according to plan, you need to step in and adjust the plan, just as the orchestra conductor will adjust the tempo.

Without a plan you will never succeed. If you happen to make it to the goal, it will have been by luck or chance and is not repeatable. You may make it as a flash-in-the-pan, an overnight sensation, but you will never have the track record of accomplishments of which success is made.

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Now that you have a plan, you have to make it happen. Is everything ready ahead of your group so the right stuff will get to your group at the right time? Is your group prepared to do its part of the plan? Is the downstream organization ready for what your group will deliver and when it will arrive?

Are the workers trained? Are they motivated? Do they have the equipment they need? Are there spare parts available for the equipment? Has purchasing ordered the material? Is it the right stuff? Will it get here on the appropriate schedule?

Do the legwork to make sure everything needed to execute the plan is ready to go, or will be when it is needed. Check back to make sure that everyone understands their role and the importance of their role to the overall success.

Basic Management Skill #3: Direct

Now flip the «ON» switch. Tell people what they need to do. I like to think of this part like conducting an orchestra. Everyone in the orchestra has the music in front of them. They know which section is playing which piece and when. They know when to come in, what to play, and when to stop again. The conductor cues each section to make the music happen. That's your job here. You've given all your musicians (workers) the sheet music (the plan). You have the right number of musicians (workers) in each section (department), and you've arranged the sections on stage so the music will sound best (you have organized the work). Now you need only to tap the podium lightly with your baton to get their attention and give the downbeat.

Basic Management Skill #4: Monitor

Now that you have everything moving, you have to keep an eye on things. Make sure everything is going according to the plan. When it isn't going according to plan, you need to step in and adjust the plan, just as the orchestra conductor will adjust the tempo.

Problems will come up. Someone will get sick. A part won't be delivered on time. A key customer will go bankrupt. That is why you developed a contingency plan in the first place. You, as the manager, have to be always aware of what's going on so you can make the adjustments required.

This is an iterative process. When something is out of sync, you need to Plan a fix, Organize the resources to make it work, Direct the people who will make it happen, and continue to Monitor the effect of the change.

Is It Worth It

Managing people is not easy. However, it can be done successfully. And it can be a very rewarding experience. Remember that management, like any other skill, is something that you can improve at with study and practice.

Performance Management is NOT an Annual Appraisal

A Performance Management System That Makes a Difference
By Susan M. Heathfield**, About.com Guide**

Performance Management System Defined

Performance management begins when a job is defined. Performance management ends when an employee leaves the company. Between these points, the following must occur for a working performance management system.

Develop clear job descriptions.

Job descriptions are the first step in selecting the right person for the job, and setting that person up to succeed. I do not mean traditional job descriptions that ended with «and whatever else you are assigned by the manager.» I believe job descriptions provide a framework so the applicants and new employees understand the expectations for the position. I much prefer to see these expressed as outcomes.

Select appropriate people with an appropriate selection process.

People have different skills and interests. Jobs have different requirements. Selection is the process of matching the skills and interests of a person to the requirements of a job. Finding a good job «fit» is exceptionally important. Use a selection process that maximizes input from potential coworkers and the person to whom the position will report. See *What Great Managers Do Differently* for more discussion about selection.

Negotiate requirements and accomplishment-based performance standards, outcomes, and measures.

Ferdinand F. Fournies, in his long-lasting book, *Why Employees Don't Do What They're Supposed to Do and What to Do About It*, clearly states the first reason why people sometimes fail to meet your expectations. He says employees don't know what they're supposed to do.

Provide effective orientation, education, and training.

Before a person can do the best job, he or she must have the information necessary to perform. This includes job-related, position-related, and company-

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related information; an excellent understanding of product and process use and requirements; and complete knowledge about customer needs and requirements.

Provide on-going coaching and feedback.

People need ongoing, consistent feedback that addresses both their strengths and the weaker areas of their performance. Effective feedback focuses more intensely on helping people build on their strengths. Feedback is a two-way process that encourages the employee to seek help. Feedback is usually more effective when requested. Create a work environment in which people feel comfortable asking, «How do you think I'm doing?»

Conduct quarterly performance development discussions.

If supervisors are giving employees frequent feedback and coaching, performance reviews can change from negative, evaluative, one-sided presentations to positive, planning meetings. Held quarterly, employees always know how they are performing and their next goals and challenges.

Design effective compensation and recognition systems that reward people for their contributions.

The power of an effective compensation system is frequently overlooked and downplayed in some employee motivation-related literature. I think this is a mistake. It is often not so much about the money as it is about the message any reward or recognition sends to an individual about their value. Money has become a metaphor for value.

Provide promotional/career development opportunities for staff.

The supervisor plays a key role in helping staff develop their potential. Growth goals, changing and challenging job assignments and responsibilities, and cross-training contribute to the development of a more effective staff member. Help to create an environment in which people feel comfortable to experiment and make mistakes.

Assist with exit interviews to understand WHY valued employees leave the organization.

When a valued person leaves the company, it is necessary to understand why the person is leaving. This feedback will help the company improve its work environment for people. An improved work environment for people results in the retention of valued staff. If your environment truly encourages discussion and feedback, you will learn nothing new in an exit interview.

The impact of the Human Resources professional on this performance management system is powerful.

You can encourage managers and supervisors to take responsibility for managing performance in their work area and cooperating for performance improvement across the organization.

You can promote the understanding that even if one individual's work area, shift, or department is successful, this will not result in a well-served customer. Because all components of your organization are part of a system that creates value for your customer, all components must be successful.

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So, too, in your performance management system, all components must be present and working to create value for each employee and the organization.

How To Be A Better Manager
By F. John Reh, About.com Guide

Need For Good Managers Increasing

The need for good managers is not going away. It is intensifying. With ‘flatter’ organizations and self-directed teams becoming common; with personal computers and networks making information available to more people more quickly; the raw number of managers needed is decreasing. However, the need for good managers, people who can manage themselves and others in a high stress environment, is increasing.

I believe anyone can be a good manager. It is as much trainable skill as it is inherent ability; as much science as art. Here are some things that make you a better manager:

As a person:

You have confidence in yourself and your abilities. You are happy with who you are, but you are still learning and getting better.

You are something of an extrovert. You don’t have to be the life of the party, but you can’t be a wallflower. Management is a people skill — it’s not the job for someone who doesn’t enjoy people.

You are honest and straight forward. Your success depends heavily on the trust of others.

You are an includer not an excluder. You bring others into what you do. You don’t exclude other because they lack certain attributes.

You have a ‘presence’. Managers must lead. Effective leaders have a quality about them that makes people notice when they enter a room.

On the job:

You are consistent, but not rigid; dependable, but can change your mind. You make decisions, but easily accept input from others.

You are a little bit crazy. You think out-of-the box. You try new things and if they fail, you admit the mistake, but don’t apologize for having tried.

You are not afraid to «do the math». You make plans and schedules and work toward them.

You are nimble and can change plans quickly, but you are not flighty.

You see information as a tool to be used, not as power to be hoarded.

Take a look at yourself against this list. Find the places where you can improve and then get going. And , if you need help, remember that’s what this site is all about —

Helping new managers get started and experienced managers get better.
Management Pros Share Their Secrets
By F. John Reh**,** About.com Guide

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Who better to offer tips and insight to someone just starting their management career than the seasoned professional manager. We are fortunate to have such a group of management professionals frequent the Management Forum on this site. Recently, I asked them this question:

«Remember way back when — when you got your first management job. What do you wish someone had told you then? What would be the one tip you would give to a manager just starting out?»

Their answers reflect the character and style of these individuals; their wisdom; their experience.

Here's a list of Ten Top Tips:

(M) Consult, consult, consult.

(A) You are managing people, not projects or product development or customer service or any other departmental mission. People are complicated and messy. They aren't machines any more than you are; they won't be the same every day, no matter how much you'd like them to be. So stay alert to what's going on with them.

(K) For the first couple of days, sit down and get to know your staff. Find out what they do, what their goals are, what they like to do in their free time, etc. Several years ago, I watched a new manager start with a company and for the first month or so, didn't talk to any of his staff. A month later, he wondered why people were handing in their two week notices.

Get to know your staff!!

(R) Learn how to deal with problem or resentful employees. I was promoted into my position over a longer-term employee. She was made my assistant. (Before everyone raises the sexism issue, I was the ONLY male manager and was promoted on performance.) She had a great deal of resentment and worked against me at every turn. After floundering around for a while, I finally took her into the office and calmly explained the facts of life to her, that I was the manager and if she couldn't work with me one of us would be leaving and it wouldn't be me. She straightened out after that and we eventually developed a good relationship.

Avoid re-inventing the wheel.

Everything doesn't require your unique hand-print. Some things probably work just fine already. Also don't think or act like you know everything, nothing breeds resentment more than arrogance. You may be smart, but there's always someone smarter.

(MC) You are responsible for everything that happens in your scope of authority. Don't ever think that just because you may not be doing the actual work, you are not responsible---you *are*. Unless you are comfortable with this basic fact, management is *not* for you.

The rewards come at a price. You will have to make decisions that will benefit the company as well as your staff....and quite often they are in direct conflict with each other. (You cannot be all things to all people....)

You do have a right to be human. Just because you are now management, does not mean that you can (or should) throw emotion out the window.

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Laugh with your people....let them know that you are not a humorless troll

Be honest with your people...you expect the same from them. Even if it's bad news, honesty does help lessen the blow.

Defend your people! They will reward you with their loyalty.

As exciting and as insightful as these tips for new managers are, there is one more we should add. Management is not for everybody. As (A2) put it «it's never too late to say thanks but no thanks....I'm happy where I am.»

David Ruth

Low-status leaders are ignored

How a leader is picked impacts whether others will follow

People who are deemed social misfits or «losers» aren't effective leaders, even if they are crusading for a cause that would benefit a larger group, according to new research from Rice University, the University of Texas and Universitat de Valencia.

The study's authors observed the contributions of 80 participants in a repeated public-goods game and found that players were more likely to mimic the actions of a leader they perceived as a high-status individual; they ignored leaders perceived as low-status and, when they had a chance, punished them for trying to lead.

«In a team, naming someone a leader is not sufficient to create effective leadership,» said Rick Wilson, co-author of the study and professor of political science and statistics and psychology at Rice. «The status of the leader — the way in which the leader is chosen — determines the extent to which the rest of the subjects will follow.»

In each round of the research experiment, players were given 50 experimental currency units (ECUs) and had to decide what portion to keep for themselves and how much to contribute to a group account. Whatever was put into the group account was doubled and then split equally by the group of four. For any individual, this meant that it was better to retain everything for their private account, since each ECU put into the group account would yield only a .5 ECU return. However, if everyone in the group put in everything, they would each double their ECUs — hence the public-goods problem.

Each group had a leader whose contributions everyone could see. The leader was determined by scores on an arbitrary trivia quiz. In half the experiments, the leader was the player who had the highest score (high status); in the other half, the player who had the lowest score (low status) was designated as the leader. The group members were told how their leader was chosen.

At the end of each of the 20 rounds, each follower observed his or her own earnings and the leader's contributions. The leader observed the contributions of each of the followers. On average, players allocated between 40 and 50 percent of their ECUs to the public pot, whether they had a high- or low-status leader. However, contributions from followers with low-status leaders dropped off in later rounds even though their leaders began giving more and more, crusading for followers to make greater contributions to the public pot that could benefit everyone in the group.

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300

Groups with high-status leaders showed greater stability, and the followers were more likely to imitate their leaders — even though those leaders maintained the amount of their initial contributions.

«In teams with high-status leaders, followers are more likely to go along with them, even though the leader does not necessarily set a good example,» Wilson said. «A high-status leader should be willing to risk making unilaterally high contributions to the public good, because the followers will do the same.»

Wilson and his co-authors, Catherine Eckel of the University of Texas and Enrique Fatas of the Universitat de Valencia, also studied the effect of punishment. In the 21st round of the game, followers were given the option to punish the leader by issuing points that decreased a player's profits in the experiment, and vice versa. Punishment was costly both for the person initiating the punishment and for the person punished.

Once punishment was introduced, contributions increased significantly for the groups with a low-status leader and only slightly for those with a high-status leader. However, low-status leaders punished others and, in turn, were punished more. They made significantly less money in the experiment than any other player.

«Punishment, while important to enforcing cooperative norms in many social dilemmas, does not boost contributions in all instances,» Wilson said. «The bottom line is that high-status leaders don't need to punish because they are followed. Low-status leaders need to rely on punishment to motivate followers, but it is costly for everyone. It's like they are the Rodney Dangerfields of the world — they get no respect. When they use punishment to boost contributions to the public good, their followers retaliate.»

Managing the Holiday Season
By F. John Reh, About.com Guide

Does it seem like everyone around you is getting into the Holidays, but you are too busy to join in? Do you feel like you are the only one doing any work anymore. Would you like some help getting through the Holiday season?

(Note: Retail business have their own special situation at this time of the year, so many of the thoughts below won't apply to them. Instead, here's a list of holiday management tips for the Retail Industry.)

Concentrate on what is important

The first rule of getting through the year end craze, without seeming like Ebenezer Scrooge and without losing your mind, is to concentrate your efforts on the important tasks.

What really has to be done? Do you have production deadlines to meet. What customer satisfaction issues require attention? Does a specific project need to be completed this year or would you get more creative work if it slips into January?

Focus your management effort on those things that have to get done this year. Encourage as much production as you can get, but make sure you are applying that effort to the issues where it will make a difference. This is a classic case of the 80/20 rule. (If you don't know that rule or how to apply it, read Pareto's Principle — The 80-20 Rule.)

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Make last minute fiscal «adjustments»

Think about your financials. Should you accelerate income for this year to meet stakeholder expectations, or should you defer it into next year to reduce taxable income for this year. You plan your financials all year long, but this is your last chance to «buff them up».

Plan and budget

If you haven't already done your planning and prepared your budgets for next year you had better get busy. (Here's some help on building your annual budget.) It's hard, especially in smaller companies, to take time away from more immediate issues in order to deal with planning, but it is essential.

If your budget planning cycle is done already, this is still a good time to review your plan. Have your secretary block out all your appointments for half an hour and just sit and think. Are we heading in the right direction? Do we know how to get there?

Reflect on the good things

This is also a great time to think back on all the good things you have accomplished this year. Take the time to congratulate yourself for these successes, whether they are financial successes or inter-personal successes.

Reward Key Employees

This is also another good time to recognize key employees and reward them for their contributions during the past year. Remember, that the behaviors and accomplishments for which you reward these employees are the behaviors you are encouraging for all your employees for next year.

If you pay holiday bonuses to the employees with the highest production you encourage everybody to produce. If you acknowledge those with the fewest errors, people will focus next year on reducing their errors. And if you praise the employees who excelled at customer service,... well you get the idea.

Thank all employees

Finally, thank all your employees. They all contributed in some measure to your success. Depending on your position in the organization, and your budget, this recognition may vary. It can be a hand-written note, a small gift, or a company party.

Set Specific Goals to Increase Success
Small Business Success Program: Business Success Lesson 2
By Susan Ward**,** About.com Guide

What one change can you make to increase your success ten fold? Learn how to set specific goals when goal setting and use specific goals in all your business planning. Goals need to be specific if we have any chance of accomplishing them. Setting specific goals when we're goal setting sets us up for success rather than failure.

Make last minute fiscal «adjustments»

Think about your financials. Should you accelerate income for this year to meet stakeholder expectations, or should you defer it into next year to reduce taxable income for this year. You plan your financials all year long, but this is your last chance to «buff them up».

Plan and budget

If you haven't already done your planning and prepared your budgets for next year you had better get busy. (Here's some help on building your annual budget.) It's hard, especially in smaller companies, to take time away from more immediate issues in order to deal with planning, but it is essential.

If your budget planning cycle is done already, this is still a good time to review your plan. Have your secretary block out all your appointments for half an hour and just sit and think. Are we heading in the right direction? Do we know how to get there?

Reflect on the good things

This is also a great time to think back on all the good things you have accomplished this year. Take the time to congratulate yourself for these successes, whether they are financial successes or inter-personal successes.

Reward Key Employees

This is also another good time to recognize key employees and reward them for their contributions during the past year. Remember, that the behaviors and accomplishments for which you reward these employees are the behaviors you are encouraging for all your employees for next year.

If you pay holiday bonuses to the employees with the highest production you encourage everybody to produce. If you acknowledge those with the fewest errors, people will focus next year on reducing their errors. And if you praise the employees who excelled at customer service,... well you get the idea.

Thank all employees

Finally, thank all your employees. They all contributed in some measure to your success. Depending on your position in the organization, and your budget, this recognition may vary. It can be a hand-written note, a small gift, or a company party.

Set Specific Goals to Increase Success
Small Business Success Program: Business Success Lesson 2
By Susan Ward**,** About.com Guide

What one change can you make to increase your success ten fold? Learn how to set specific goals when goal setting and use specific goals in all your business planning. Goals need to be specific if we have any chance of accomplishing them. Setting specific goals when we're goal setting sets us up for success rather than failure.

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Setting Specific Goals

A specific goal is a goal that incorporates an action plan that outlines how you will achieve the goal, and a performance measure that tells you how you will evaluate the goal.

This is the goal setting formula for ensuring that you're setting a specific goal:

«I will (goal + performance measure) BY (specific actions).»

The performance measure in the goal is often a date or a length of time, but it could be any objective criteria that you can use to determine whether or not you've accomplished the specific goal that you've set.

Suppose you're goal setting because you want to lose weight. An example of a specific goal to help you meet this objective is:

«I will lose 10 pounds in two months BY running on a treadmill for half an hour six days a week.»

Setting Goals For Business Success

Before you can set specific goals designed to increase your business success, you need to know what you mean by success. I personally think that success means enjoying what you do, to the point that your work energizes you and creates happiness that spills over to your personal life. But what does «increased business success» mean to you?

Is it working less hours so you have more time to spend with your family? Is it having more energy to tackle your many tasks? Is it developing more confidence so you can sell your product or service more successfully or try something new?

Examples of Specific Success Goals

Depending on what the purpose of your goal setting exercise is, you might decide to set specific goals such as:

«One month from now, I will spend entire weekends with my family BY reorganizing my work schedule and learning how to delegate.»

«I will develop enough confidence to present my business plan to the bank BY faithfully completing every assignment in the «Increase Your Business Success in 10 Weeks» program.»

Goal Setting Tips

Success isn't just a matter of a healthy bank account; think about what you really want to accomplish, no matter how outlandish it seems at first thought and set your goals accordingly.

A goal doesn't have to be sweeping to be valuable; small goals are worth working on, too, because they can lead to big changes. For instance, «One month from now, I will work three hours less a week BY becoming better organized», is a perfectly acceptable specific goal.

Use this same specific goal setting formula in all your business planning, and you'll quickly see an increase in the number of goals you accomplish!

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Online Management Science PhD: Career Info

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An Online Management Science PhD is an ideal option for mid-level and senior managers who wish to advance their careers and become leaders in their chosen field. Professionals working in government and higher education can also help their career advancement opportunities with an Online Management Science PhD.

Basics of an Online Management Science PhD

Online Management Science PhD programs are often self-directed research programs or online courses which focus on such subjects as mathematical modeling, forecasting, operational analysis and evaluation models. Other skills taught in these programs include detecting management fads, evaluating proposals and learning methods.

What Can I do with an Online Management Science PhD?

Graduates with an Online Management Science PhD are prepared for upper-level positions in a variety of for-profit, non-profit and government organizations. Graduates are also qualified to enter the field of management and operations research. First developed by the military, operations research analysts use mathematics, science and engineering to find solutions for project goals and define problems.

Job Outlook for Careers Relating to an Online Management Science PhD

While the highest ten percent of management and operations analysts earn above $128,000 annually, the median wage is approximately $69,000 per year. The Bureau of Labor and Statistics (*www.bls.org*) estimates that job prospects will increase, but so will the competition.

Master of Network and Communications Management

A Master of Network and Communications Management program deals with advanced practices in networks, wireless devises and telecommunications. During your program you will study advanced techniques and theories for information security, telecommunication law, operation and management of networks, and communication systems for wireless components. Upon receiving your Master of Network and Communications Management degree you can go on to advanced levels in management as a network systems analyst, communications systems analyst or a computer software engineer. Please read on to find out more.

Reasons to Earn a Master of Network and Communications Management

Technology within networks and communications are increasingly changing. If your interest lies in being able to plan and coordinate network technologies, including voice and data communications, for different levels of organizations, a Master of Network and Communications Management program is for you. Upon graduating, you have the potential to become a leader as it relates to planning and designing networks, budget development and analysis of new technology trends.

Master of Network and Communications Management Career Opportunities.
Occupational Outlook

With rapid changes in technology, those in the network and communications industry should see good job opportunities. According to the Bureau of Labor Statistics, the field of network systems and data communications is said to be one of the top 10 fastest growing fields over the next five years.

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Salary Information

According to the Occupational Outlook Handbook of the Bureau of Labor Statistics, the average salary for network systems and data communication analysts was a little over $60,000 in 2004.

Master of Network and Communications Management Degree Specifics

Required Courses

Much of what you will learn in your Master of Network and Communications Management program will be theory-based. It is assumed that you will have basic knowledge of techniques, though some Master programs will build on those skills as well. Specific coursework that you will learn through may include:

- Information Security
- Telecommunication Law
- Operation and Management of Networks
- Communication Systems for Wireless Components

Skills You Will Learn

You will develop skills in a variety of networking and communications scenarios. These skills will help you on your way to becoming a leader in your field. Upon completing a Master of Network and Communications Management program, you should be able to:

- Design communication networks
- Develop budgets and maintain finances for relevant equipment and services
- Maintain security for networks and have an understanding of trends in the industry

Bachelor of Management and Leadership

A Bachelor of Management and Leadership teaches students the communication, organizational, and business skills they will need to begin working in the fulfilling world of management leadership. Individuals with a Bachelor of Management and Leadership go on to work in a variety of fields, including personnel recruitment, management analysis, and engineering management. Read on to find out more about how Bachelor of Management and Leadership degree programs work.

Why Earn a Bachelor of Management and Leadership?

If you're looking for a way to use your leadership skills to create an efficient work environment and are interested in the management aspect of business, a career in management leadership could be for you. A Bachelor of Management and Leadership degree program sets the stage for success in the field by teaching students how to analyze and resolve conflicts, negotiate and communicate in a business setting, and make effective financial plans. Individuals with a Bachelor of Management and Leadership can choose from jobs in virtually any industry, including engineering, electronics, pharmacy, and mass communications.

Career Possibilities

Occupational Outlook and Demand for These Careers

The outlook for individuals in the management leadership field is good. According to the Occupational Outlook Handbook, employment of financial analysts and personal financial advisors, management analysts, and human resources

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managers is expected to increase faster than the national average through 2014. In addition to this growth, many opportunities will come about from the need to supplant employees who transfer to other professions or leave the work force.

Salary Information

According to the U.S. Department of Labor, *www.dol.gov*, the median yearly income of operations research analysts was $60,190 in May 2004. Engineering managers averaged $97,630, while office and administrative supervisors earned $41,030 in 2004.

Degree Specifics

Coursework Requirements

In order to become eligible for graduation, students must complete coursework designed to help them succeed in their careers in the management leadership industry. While course names vary, classes typical of a Bachelor of Management and Leadership degree program include the following:

- Conflict Resolution
- Interpersonal Communication
- Budget Planning
- Ethics of Management
- Human Resources and Leadership

Skills You Will Learn

Individuals seeking a Bachelor of Management and Leadership must master certain skills before obtaining their degrees. In addition to an understanding of basic communication skills and management methods, students will also acquire knowledge and skills in the following areas:

- Interpretation of data
- Information synthesis and evaluation
- Appropriate usage of media
- Team building with diversity and equality
- Theory of accounting and budget planning

The Management Myth

Most of management theory is inane, writes our correspondent, the founder of a consulting firm. If you want to succeed in business, don't get an M.B.A. Study philosophy instead

By Matthew Stewart

During the seven years that I worked as a management consultant, I spent a lot of time trying to look older than I was. I became pretty good at furrowing my brow and putting on somber expressions. Those who saw through my disguise assumed I made up for my youth with a fabulous education in management. They were wrong about that. I don't have an M.B.A. I have a doctoral degree in philosophy—nineteenth-century German philosophy, to be precise. Before I took a job telling managers of large corporations things that they arguably should have known already, my work experience was limited to part-time gigs tutoring surly undergraduates in the ways of Hegel and Nietzsche and to a handful of summer jobs, mostly in the less appetizing ends of the fast-food industry.

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The strange thing about my utter lack of education in management was that it didn't seem to matter. As a principal and founding partner of a consulting firm

that eventually grew to 600 employees, I interviewed, hired, and worked alongside hundreds of business-school graduates, and the impression I formed of the M.B.A. experience was that it involved taking two years out of your life and going deeply into debt, all for the sake of learning how to keep a straight face while using phrases like «out-of-the-box thinking,» «win-win situation,» and «core competencies.» When it came to picking teammates, I generally held out higher hopes for those individuals who had used their university years to learn about something other than business administration.

After I left the consulting business, in a reversal of the usual order of things, I decided to check out the management literature. Partly, I wanted to «process» my own experience and find out what I had missed in skipping business school. Partly, I had a lot of time on my hands. As I plowed through tomes on competitive strategy, business process re-engineering, and the like, not once did I catch myself thinking, *Damn! If only I had known this sooner!* Instead, I found myself thinking things I never thought I'd think, like, *I'd rather be reading Heidegger!* It was a disturbing experience. It thickened the mystery around the question that had nagged me from the start of my business career: Why does management education exist?

Management theory came to life in 1899 with a simple question: «How many tons of pig iron bars can a worker load onto a rail car in the course of a working day?» The man behind this question was Frederick Winslow Taylor, the author of The *Principles of Scientific Management* and, by most accounts, the founding father of the whole management business.

Taylor was forty-three years old and on contract with the Bethlehem Steel Company when the pig iron question hit him. Staring out over an industrial yard that covered several square miles of the Pennsylvania landscape, he watched as laborers loaded ninety-two-pound bars onto rail cars. There were 80,000 tons' worth of iron bars, which were to be carted off as fast as possible to meet new demand sparked by the Spanish-American War. Taylor narrowed his eyes: there was waste there, he was certain. After hastily reviewing the books at company headquarters, he estimated that the men were currently loading iron at the rate of twelve and a half tons per man per day.

Taylor stormed down to the yard with his assistants («college men,» he called them) and rounded up a group of top-notch lifters («first-class men»), who in this case happened to be ten «large, powerful Hungarians.» He offered to double the workers' wages in exchange for their participation in an experiment. The Hungarians, eager to impress their apparent benefactor, put on a spirited show. Huffing up and down the rail car ramps, they loaded sixteen and a half tons in something under fourteen minutes. Taylor did the math: over a ten-hour day, it worked out to seventy-five tons per day per man. Naturally, he had to allow time for bathroom breaks, lunch, and rest periods, so he adjusted the figure approximately 40 percent downward. Henceforth, each laborer in the yard was assigned to load forty-seven and a half pig tons per day, with bonus pay for reaching the target and penalties for failing.

When the Hungarians realized that they were being asked to quadruple their previous daily workload, they howled and refused to work. So Taylor found a «high-priced man,» a lean Pennsylvania Dutchman whose intelligence he compared to that of an ox. Lured by the promise of a 60 percent increase in

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wages, from $1.15 to a whopping $1.85 a day, Taylor's high-priced man loaded forty-five and three-quarters tons over the course of a grueling day—close enough, in Taylor's mind, to count as the first victory for the methods of modern management.

Taylor went on to tackle the noble science of shoveling and a host of other topics of concern to his industrial clients. He declared that his new and unusual approach to solving business problems amounted to a «complete mental revolution.» Eventually, at the urging of his disciples, he called his method «scientific management.» Thus was born the idea that management is a science—a body of knowledge collected and nurtured by experts according to neutral, objective, and universal standards.

At the same moment was born the notion that management is a distinct function best handled by a distinct group of people—people characterized by a particular kind of education, way of speaking, and fashion sensibility. Taylor, who favored a manly kind of prose, expressed it best in passages like this:

… the science of handling pig iron is so great and amounts to so much that it is impossible for the man who is best suited to this type of work to understand the principles of this science, or even to work in accordance with these principles, without the aid of a man better educated than he is.

From a metaphysical perspective, one could say that Taylor was a «dualist»: there is brain, there is brawn, and the two, he believed, very rarely meet.

Taylor went around the country repeating his pig iron story and other tales from his days in the yard, and these narratives formed something like a set of scriptures for a new and highly motivated cult of management experts. This vanguard ultimately vaulted into the citadel of the Establishment with the creation of business schools. In the spring of 1908, Taylor met with several Harvard professors, and later that year Harvard opened the first graduate school in the country to offer a master's degree in business. It based its first-year curriculum on Taylor's scientific management. From 1909 to 1914, Taylor visited Cambridge every winter to deliver a series of lectures—inspirational discourses marred only by the habit he'd picked up on the shop floor of swearing at inappropriate moments.

Yet even as Taylor's idea of management began to catch on, a number of flaws in his approach were evident. The first thing many observers noted about scientific management was that there was almost no science to it. The most significant variable in Taylor's pig iron calculation was the 40 percent «adjustment» he made in extrapolating from a fourteen-minute sample to a full workday. Why time a bunch of Hungarians down to the second if you're going to daub the results with such a great blob of fudge? When he was grilled before Congress on the matter, Taylor casually mentioned that in other experiments these «adjustments» ranged from 20 percent to 225 percent. He defended these unsightly «wags» (wild-ass guesses, in M.B.A.-speak) as the product of his «judgment» and «experience»—but, of course, the whole point of scientific management was to eliminate the reliance on such inscrutable variables.

One of the distinguishing features of anything that aspires to the name of science is the reproducibility of experimental results. Yet Taylor never published the data on which his pig iron or other conclusions were based. When Carl Barth, one of his devotees, took over the work at Bethlehem Steel, he found

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Taylor's data to be unusable. Another, even more fundamental feature of science—here I invoke the ghost of Karl Popper—is that it must produce falsifiable propositions. Insofar as Taylor limited his concern to prosaic activities such as lifting bars onto rail cars, he did produce propositions that were falsifiable—and, indeed, were often falsified. But whenever he raised his sights to management in general, he seemed capable only of soaring platitudes. At the end of the day his «method» amounted to a set of exhortations: Think harder! Work smarter! Buy a stopwatch!

The trouble with such claims isn't that they are all wrong. It's that they are too true. When a congressman asked him if his methods were open to misuse, Taylor replied, No. If management has the right state of mind, his methods will always lead to the correct result. Unfortunately, Taylor was right about that. Taylorism, like much of management theory to come, is at its core a collection of quasi-religious dicta on the virtue of being good at what you do, ensconced in a protective bubble of parables (otherwise known as case studies).

Curiously, Taylor and his college men often appeared to float free from the kind of accountability that they demanded from everybody else. Others might have been asked, for example: Did Bethlehem's profits increase as a result of their work? Taylor, however, rarely addressed the question head-on. With good reason. Bethlehem fired him in 1901 and threw out his various systems. Yet this evident vacuum of concrete results did not stop Taylor from repeating his parables as he preached the doctrine of efficiency to countless audiences across the country.

In the management literature these days, Taylorism is presented, if at all, as a chapter of ancient history, a weird episode about an odd man with a stopwatch who appeared on the scene sometime after Columbus discovered the New World. Over the past century Taylor's successors have developed a powerful battery of statistical methods and analytical approaches to business problems. And yet the world of management remains deeply Taylorist in its foundations.

At its best, management theory is part of the democratic promise of America. It aims to replace the despotism of the old bosses with the rule of scientific law. It offers economic power to all who have the talent and energy to attain it. The managerial revolution must be counted as part of the great widening of economic opportunity that has contributed so much to our prosperity. But, insofar as it pretends to a kind of esoteric certitude to which it is not entitled, management theory betrays the ideals on which it was founded.

That Taylorism and its modern variants are often just a way of putting labor in its place need hardly be stated: from the Hungarians' point of view, the pig iron experiment was an infuriatingly obtuse way of demanding more work for less pay. That management theory represents a covert assault on capital, however, is equally true. (The Soviet five-year planning process took its inspiration directly from one of Taylor's more ardent followers, the engineer H. L. Gantt.) Much of management theory today is in fact the consecration of class interest—not of the capitalist class, nor of labor, but of a new social group: the management class.

I can confirm on the basis of personal experience that management consulting continues to worship at the shrine of numerology where Taylor made his first offering of blobs of fudge. In many of my own projects, I found myself

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compelled to pacify recalcitrant data with entirely confected numbers. But I cede the place of honor to a certain colleague, a gruff and street-smart Belgian whose hobby was to amass hunting trophies. The huntsman achieved some celebrity for having invented a new mathematical technique dubbed «the Two-Handed Regression.» When the data on the correlation between two variables revealed only a shapeless cloud—even though we knew damn well there had to be a correlation—he would simply place a pair of meaty hands on the offending bits of the cloud and reveal the straight line hiding from conventional mathematics.

The thing that makes modern management theory so painful to read isn't usually the dearth of reliable empirical data. It's that maddening papal infallibility. Oh sure, there are a few pearls of insight, and one or two stories about hero-CEOs that can hook you like bad popcorn. But the rest is just inane. Those who looked for the true meaning of «business process re-engineering,» the most overtly Taylorist of recent management fads, were ultimately rewarded with such gems of vacuity as «BPR is taking a blank sheet of paper to your business!» and «BPR means re-thinking everything, everything!»

Each new fad calls attention to one virtue or another—first it's efficiency, then quality, next it's customer satisfaction, then supplier satisfaction, then self-satisfaction, and finally, at some point, it's efficiency all over again. If it's reminiscent of the kind of toothless wisdom offered in self-help literature, that's because management theory is mostly a subgenre of self-help. Which isn't to say it's completely useless. But just as most people are able to lead fulfilling lives without consulting Deepak Chopra, most managers can probably spare themselves an education in management theory.

The world of management theorists remains exempt from accountability. In my experience, for what it's worth, consultants monitored the progress of former clients about as diligently as they checked up on ex-spouses (of which there were many). Unless there was some hope of renewing the relationship (or dating a sister company), it was *Hasta la vista*, baby. And why should they have cared? Consultants' recommendations have the same semantic properties as campaign promises: it's almost freakish if they are remembered in the following year.

In one episode, when I got involved in winding up the failed subsidiary of a large European bank, I noticed on the expense ledger that a rival consulting firm had racked up $5 million in fees from the same subsidiary. «They were supposed to save the business,» said one client manager, rolling his eyes. «Actually,» he corrected himself, «they were supposed to keep the illusion going long enough for the boss to find a new job.» Was my competitor held to account for failing to turn around the business and/or violating the rock-solid ethical standards of consulting firms? On the contrary, it was ringing up even higher fees over in another wing of the same organization.

And so was I. In fact, we kind of liked failing businesses: there was usually plenty of money to be made in propping them up before they finally went under. After Enron, true enough, Arthur Andersen sank. But what happened to such stalwarts as McKinsey, which generated millions in fees from Enron and supplied it with its CEO? The Enron story wasn't just about bad deeds or false accounts; it was about confusing sound business practices with faddish management ideas, celebrated with gusto by the leading lights of the management world all the way to the end of the party.

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We were very much of the moment. In the 1990s, the gurus were unanimous in their conviction that the world was about to bring forth an entirely new mode of human cooperation, which they identified variously as the «information-based organization,» the «intellectual holding company,» the «learning organization,» and the «perpetually creative organization.» «R-I-P. Rip, shred, tear, mutilate, destroy that hierarchy,» said über-guru Tom Peters, with characteristic understatement. The «end of bureaucracy» is nigh, wrote Gifford Pinchot of «intrapreneuring» fame. According to all the experts, the enemy of the «new» organization was lurking in every episode of *Leave It to Beaver*.

Many good things can be said about the «new» organization of the 1990s. And who would want to take a stand against creativity, freedom, empowerment, and—yes, let's call it by its name—love? One thing that cannot be said of the «new» organization, however, is that it is new.

In 1983, a Harvard Business School professor, Rosabeth Moss Kanter, beat the would-be revolutionaries of the nineties to the punch when she argued that rigid «segmentalist» corporate bureaucracies were in the process of giving way to new «integrative» organizations, which were «informal» and «change-oriented.» But Kanter was just summarizing a view that had currency at least as early as 1961, when Tom Burns and G. M. Stalker published an influential book criticizing the old, «mechanistic» organization and championing the new, «organic» one. In language that eerily anticipated many a dot-com prospectus, they described how innovative firms benefited from «lateral» versus «vertical» information flows, the use of «ad hoc» centers of coordination, and the continuous redefinition of jobs. The «flat» organization was first explicitly celebrated by James C. Worthy, in his study of Sears in the 1940s, and W. B. Given coined the term «bottom-up management» in 1949. And then there was Mary Parker Follett, who in the 1920s attacked «departmentalized» thinking, praised change-oriented and informal structures, and—Rosabeth Moss Kanter fans please take note—advocated the «integrative» organization.

If there was a defining moment in this long and strangely forgetful tradition of «humanist» organization theory—a single case that best explains the meaning of the infinitely repeating whole—it was arguably the work of Professor Elton Mayo of the Harvard Business School in the 1920s. Mayo, an Australian, was everything Taylor was not: sophisticated, educated at the finest institutions, a little distant and effete, and perhaps too familiar with Freudian psychoanalysis for his own good.

A researcher named Homer Hibarger had been testing theories about the effect of workplace illumination on worker productivity. His work, not surprisingly, had been sponsored by a maker of electric lightbulbs. While a group of female workers assembled telephone relays and receiver coils, Homer turned the lights up. Productivity went up. Then he turned the lights down. Productivity still went up! Puzzled, Homer tried a new series of interventions. First, he told the «girls» that they would be entitled to two five-minute breaks every day. Productivity went up. Next it was six breaks a day. Productivity went

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up again. Then he let them leave an hour early every day. Up again. Free lunches and refreshments. Up! Then Homer cut the breaks, reinstated the old workday, and scrapped the free food. But productivity barely dipped at all.

Mayo, who was brought in to make sense of this, was exultant. His theory: the various interventions in workplace routine were as nothing compared with the new interpersonal dynamics generated by the experimental situation itself. «What actually happened,» he wrote, «was that six individuals became a team and the team gave itself wholeheartedly and spontaneously to cooperation … They felt themselves to be participating, freely and without afterthought, and were happy in the knowledge that they were working without coercion.» The lessons Mayo drew from the experiment are in fact indistinguishable from those championed by the gurus of the nineties: vertical hierarchies based on concepts of rationality and control are bad; flat organizations based on freedom, teamwork, and fluid job definitions are good.

On further scrutiny, however, it turned out that two workers who were deemed early on to be «uncooperative» had been replaced with friendlier women. Even more disturbing, these exceptionally cooperative individuals earned significantly higher wages for their participation in the experiment. Later, in response to his critics, Mayo insisted that something so crude as financial incentives could not possibly explain the miracles he witnessed. That didn't make his method any more «scientific.»

Mayo's work sheds light on the dark side of the «humanist» tradition in management theory. There is something undeniably creepy about a clipboard-bearing man hovering around a group of factory women, flicking the lights on and off and dishing out candy bars. All of that humanity—as anyone in my old firm could have told you—was just a more subtle form of bureaucratic control. It was a way of harnessing the workers' sense of identity and well-being to the goals of the organization, an effort to get each worker to participate in an ever more refined form of her own enslavement.

So why is Mayo's message constantly recycled and presented as something radically new and liberating? Why does every new management theorist seem to want to outdo Chairman Mao in calling for perpetual havoc on the old order? Very simply, because all economic organizations involve at least some degree of power, and power always pisses people off. That is the human condition. At the end of the day, it isn't a new world order that the management theorists are after; it's the sensation of the revolutionary moment. They long for that exhilarating instant when they're fighting the good fight and imagining a future utopia. What happens after the revolution—civil war and Stalinism being good bets—could not be of less concern.

Between them, Taylor and Mayo carved up the world of management theory. According to my scientific sampling, you can save yourself from reading about 99 percent of all the management literature once you master this dialectic between rationalists and humanists. The Taylorite rationalist says: Be efficient! The Mayo-ist humanist replies: Hey, these are people we're talking about! And the debate goes on. Ultimately, it's just another installment in the ongoing saga of reason and passion, of the individual and the group.

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In the case of my old firm, incidentally, the endgame was civil war. Those who talked loudest about the ideals of the «new» organization, as it turned out, had the least love in their hearts. By a strange twist of fate, I owe the long- evity of my own consulting career to this circumstance. When I first announced my intention to withdraw from the firm in order to pursue my vocation as an unpublishable philosopher at large, my partners let me know that they would gladly regard my investment in the firm as a selfless contribution to their financial well-being. By the time I managed to extricate myself from their loving embrace, nearly three years later, the partnership had for other reasons descended into the kind of Hobbesian war of all against all from which only the lawyers emerge smiling. The firm was temporarily rescued by a dot-com company, but within a year both the savior and the saved collapsed in a richly deserved bankruptcy. Of course, your experience in a «new» organization may be different.

My colleagues usually spoke fondly of their years at business school. Most made great friends there, and quite a few found love. All were certain that their degree was useful in advancing their careers. But what does an M.B.A. do for you that a doctorate in philosophy can't do better?

The first point to note is that management education confers some benefits that have little to do with either management or education. Like an elaborate tattoo on an aboriginal warrior, an M.B.A. is a way of signaling just how deeply and irrevocably committed you are to a career in management. The degree also provides a tidy hoard of what sociologists call «social capital»—or what the rest of us, notwithstanding the invention of the PalmPilot, call a «Rolodex.»

For companies, M.B.A. programs can be a way to outsource recruiting. Marvin Bower, McKinsey's managing director from 1950 to 1967, was the first to understand this fact, and he built a legendary company around it. Through careful cultivation of the deans and judicious philanthropy, Bower secured a quasi-monopoly on Baker Scholars (the handful of top students at the Harvard Business School). Bower was not so foolish as to imagine that these scholars were of interest on account of the education they received. Rather, they were valuable because they were among the smartest, most ambitious, and best-connected individuals of their generation. Harvard had done him the favor of scouring the landscape, attracting and screening vast numbers of applicants, further testing those who matriculated, and then serving up the best and the brightest for Bower's delectation.

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decision modeling, and so forth—and these can prove quite useful to students, depending on their career trajectories. But the «value-add» here is far more limited than Mom or Dad tend to think. In most managerial jobs, almost everything you need to know to succeed must be learned on the job; for the rest, you should consider whether it might have been acquired with less time and at less expense.

The best business schools will tell you that management education is mainly about building skills—one of the most important of which is the ability to think (or what the M.B.A.s call «problem solving»). But do they manage to teach such skills?

I once sat through a presentation in which a consultant, a Harvard M.B.A., showed a client, the manager of a large financial institution in a developing country, how the client company's «competitive advantage» could be analyzed in terms of «the five forces.» He even used a graphic borrowed directly from guru-of-the-moment Michael Porter's best- selling work on «competitive strategy.» Not for the first time, I was embarrassed to call myself a consultant. As it happens, the client, too, had a Harvard M.B.A. «No,» he said, shaking his head with feigned chagrin. «There are only three forces in this case. And two of them are in the Finance Ministry.»

What they don't seem to teach you in business school is that «the five forces» and «the seven Cs» and every other generic framework for problem solving are heuristics: they can lead you to solutions, but they cannot make you think. Case studies may provide an effective way to think business problems through, but the point is rather lost if students come away imagining that you can go home once you've put all of your eggs into a two-by-two growth-share matrix.

Next to analysis, communication skills must count among the most important for future masters of the universe. To their credit, business schools do stress these skills, and force their students to engage in make-believe presentations to one another. On the whole, however, management education has been less than a boon for those who value free and meaningful speech. M.B.A.s have taken obfuscatory jargon—otherwise known as bullshit—to a level that would have made even the Scholastics blanch. As students of philosophy know, Descartes dismantled the edifice of medieval thought by writing clearly and showing that knowledge, by its nature, is intelligible, not obscure.

Beyond building skills, business training must be about values. As I write this, I know that my M.B.A. friends are squirming in their seats. They've all been forced to sit through an «ethics» course, in which they learned to toss around yet more fancy phrases like «the categorical imperative» and discuss borderline criminal behavior, such as what's a legitimate hotel bill and what's just plain stealing from the expense account, how to tell the difference between a pat on the shoulder and sexual harassment, and so on. But, as anyone who has studied Aristotle will know, «values» aren't something you bump into from time to time during the course of a business career. All of business is about values, all of the time. Notwithstanding the ostentatious use of stopwatches, Taylor's pig iron case was not a *description* of some aspect of physical reality—how many tons *can* a worker lift? It was a *prescription*—how many tons *should* a worker lift? The real issue at stake in Mayo's telephone factory was not *factual*—how

decision modeling, and so forth—and these can prove quite useful to students, depending on their career trajectories. But the «value-add» here is far more limited than Mom or Dad tend to think. In most managerial jobs, almost everything you need to know to succeed must be learned on the job; for the rest, you should consider whether it might have been acquired with less time and at less expense.

The best business schools will tell you that management education is mainly about building skills—one of the most important of which is the ability to think (or what the M.B.A.s call «problem solving»). But do they manage to teach such skills?

I once sat through a presentation in which a consultant, a Harvard M.B.A., showed a client, the manager of a large financial institution in a developing country, how the client company's «competitive advantage» could be analyzed in terms of «the five forces.» He even used a graphic borrowed directly from guru-of-the-moment Michael Porter's best- selling work on «competitive strategy.» Not for the first time, I was embarrassed to call myself a consultant. As it happens, the client, too, had a Harvard M.B.A. «No,» he said, shaking his head with feigned chagrin. «There are only three forces in this case. And two of them are in the Finance Ministry.»

What they don't seem to teach you in business school is that «the five forces» and «the seven Cs» and every other generic framework for problem solving are heuristics: they can lead you to solutions, but they cannot make you think. Case studies may provide an effective way to think business problems through, but the point is rather lost if students come away imagining that you can go home once you've put all of your eggs into a two-by-two growth-share matrix.

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can we best establish a sense of teamwork? It was *moral*—how much of a worker's sense of identity and well-being does a business have a right to harness for its purposes?

The recognition that management theory is a sadly neglected subdiscipline of philosophy began with an experience of déjà vu. As I plowed through my shelfload of bad management books, I beheld a discipline that consists mainly of unverifiable propositions and cryptic anecdotes, is rarely if ever held accountable, and produces an inordinate number of catastrophically bad writers. It was all too familiar. There are, however, at least two crucial differences between philosophers and their wayward cousins. The first and most important is that philosophers are much better at knowing what they don't know. The second is money. In a sense, management theory is what happens to philosophers when you pay them too much.

The idea that philosophy is an inherently academic pursuit is a recent and diabolical invention. Epicurus, Descartes, Spinoza, Locke, Hume, Nietzsche, and most of the other great philosophers of history were not professors of philosophy. If any were to come to life and witness what has happened to their discipline, I think they'd run for the hills. Still, you go to war with the philosophers you have, as they say, not the ones in the hills. And since I'm counting on them to seize the commanding heights of the global economy, let me indulge in some management advice for today's academic philosophers:

■**Expand the domain of your analysis!** Why so many studies of Wittgenstein and none of Taylor, the man who invented the social class that now rules the world?

■**Hire people with greater diversity of experience!** And no, that does not mean taking someone from the University of Hawaii. You are building a network—a team of like-minded individuals who together can change the world.

■**Remember the three Cs: Communication, Communication, Communication!** Philosophers (other than those who have succumbed to the Heideggerian virus) start with a substantial competitive advantage over the PowerPoint crowd. But that's no reason to slack off. Remember Plato: it's all about dialogue!

With this simple three-point program (or was it four?) philosophers will soon reclaim their rightful place as the educators of management. Of course, I will be charging for implementation.

Matthew Stewart is the author, most recently, of *The Courtier and the Heretic: Leibniz, Spinoza, and the Fate of God in the Modern World*.

June 2006 ATLANTIC MAGAZINE
http://www.theatlantic.com/magazine/archive/2006/06/the-management-myth/4883/

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Physics Post 03/30/2010 http://www.physicspost.com/science-article-241.html
What are Quantum Computers?

Quantum computers are not that different from normal computers outwardly, but they are in the sense that quantum theory is the basis on which these computers operate. The end result is that they are put together in a completely different way.

A normal computer operates on the basis of units known as bits. Each byte in a normal computer can only be one of 0 or 1 and nothing else. No matter how many bytes you have, each computer at a single point in time can only occupy one combination of these bytes in order for the programming to actually work.

A quantum computer is different from this because of a principle in quantum mechanics known as superposition. If you think back to your high school science courses, you may have learned about superposition when looking at how waves like light and sound waves move from one point to another. Quanta can also be in superposition with respect to each other and the end result is that the quantum bits that make up the computer can actually be 0, 1 and any superposition of the two.

The more quantum bits (also known as qubits) that you have, the more possibilities they are. Because you are dealing with superposition, it also means that the different positions can be occupied simultaneously. Whereas a simple 8-bit computer can only occupy one of the 256 positions generated by those 8 bits at once, the same 8-bit quantum computer could occupy all 256 qubit positions at once.

The end result is that quantum computers can be much more efficient than their conventional computer counterparts. Although quantum computers are still in their infancy, as the technology improves eventually it will become true that these computers will be able to calculate faster than the computers we have today. When that happens, the 3.0 GHz speed of a personal computer that we brag about now will be nothing in comparison to the new quantum computer models that become available on the market.

Physics, Math and Mental Gymnastics
Author: **David Mcmahon**
Added: **06/21/2006**
Mental Gymnastics

While we enter physics to study the fascinating world of black holes, quarks and the quantum, the brutal truth is that mathematics is the central tool of the physicist. Gauss called mathematics the «Queen of the Sciences», and with good reason. If you don’t have a solid grasp of mathematics, you aren’t going to get very far.

One thing I noticed when getting my degrees in physics was that many of the students found math to be a painful «aside». In one case that really stands out in

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my memory, I was in a mechancs course and one of the homeworks required the calculation of a brutal integral. I worked very hard by myself over the weekend and managed to get the calculation out with a couple of pages of work. When I returned to class, I was surprised to find that the vast majority of the students had not even attempted to work out the integral. One student had obtained the answer-so he thought-using Mathematica. I looked at it carefully and saw that he had gotten the wrong answer. He argued with me-asserting that the computer cannot make a mistake-but we brought the TA over and it turned out he had entered the integral incorrectly. I had obtained the right answer by working it out by hand

The student in question had thought he was interested in physics but didn't want to bother with the work of physics-which involves diving into the mathematics. But to become a good physicist-or a solid engineer-you need to bite the bullet and become a master of mathematics. It doesn't matter if you're going to be an astronomer, experimentalist, or engineer-in my view if you want to be the best at what you do in these fields, you should have a solid command of math. So if you are interested in physics but aren't a mathematical hot shot, how can you pull yourself to the top of the field? In my view, the answer is to view mathematics the way you would athletics. A friend of mine who shared this view coined the term «mental gymnastics» to characterize his outlook and study habits.

We all aren't Math Genuises

While for some students thinking mathematically comes natural, most of us aren't ready to master the intricacies of studying proofs when we're college freshmen. This article is written for those of us who aren't automatic math whiz kids. If you are a mere mortal who finds math a bit of work, don't be discouraged. It's my belief that average people can raise themselves up to become very good mathematicians with a little bit of hard work. What we need is some training--we need to train our minds to think mathematically. The best way to think about how you can get this done is to draw an analogy between math and athletics.

To master a sport you have to build your muscles and train your body to react in certain ways. For example, if you want to become a great basketball player, you could be lucky enough to be born Michael Jordan. But more likely, you'll have to work at building a basic skill set, and the truth is even players like Michael Jordan put extra work into their craft. Some activiities you might consider that could make you a better basketball player are

- Lifting weights to build muscle mass
- Run sprints to improve your ability to run up and down the court without getting tired
- Spend a large amount of time shooting free throws, doing layups and practicing basic skills like passing

It turns out that becoming a successful physicist or engineer is in many ways similar to athletics. OK, so suppose you want to study Hawking radiation and string theory, but you are not a hot shot mathematician and weren't the best student. Instead of just reading a bunch of books or lamenting the fact we aren't an Einsteinian genius, what are the mathematical equivalents to lifting weights

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or running sprints we can do to improve our mathematical ability? In my view, we can begin by following two steps

- Learn the basic rules first-and don't focus on trying to learn proofs or do the hardest problems.
- Repeat, repeat, repeat. Do similar types of problems over and over until they are second nature. Only after a topic becomes second nature calculationally do we consider reading the proofs or theorems in detail.

That is do tons of problems. In my view a student should start off simple. Don't try to understand the proofs. For example, in my recent book, «Calculus In Focus», I take the perspective that students need to learn math by following the formula: show, repeat, try it yourself. That is

- Show the student a given rule, like the product rule for derivatives
- Focus on mastering calculational skills first. Do this by showing the student how to apply the rule with multiple examples.
- Repeat, repeat, repeat. Do a given type of problem multiple times so that it becomes second nature.

Once the «how» to solve problems is second nature, then go back for a deeper look at the material. Then learn the «why» and start learning the formality of mathematics through proofs and theorems. I use this approach to drill the central ideas of calculus in my book Calculus in Focus. More information can be found at http://www.quantumphysicshelp.com/calculus.htm.

Key Topics

In addition to the basic approach, a certain baseline has to be established if you want to build yourself up for a formal career in math, physics, or engineering. Let's build up a fundamental skill set that is going to build your fundamental math skills and help you master any subject. A few key areas I think students should focus on are outlined below

The Importance of Algebra

If you study physics or engineering, algebra never goes away. So the first step on the road to becoming the next Stephen Hawking is to master this tedious yet fundamental subject. Do yourself a favor and pick up a decent algebra book and work through it. Do every problem so that by the end of the book, factoring equations, logarithms and other math basics are second nature for you. In the same way that lifting weights is going to make a football or basketball a better athlete when the games are actually played, mastering algebra will pay off later when you're doing your homework in dynamics or quantum theory.

Trigonometry

If you go on to become an electrical engineer and study circuit analysis or decide to master black hole physics, one fundamental area of business you'll have in common with your colleagues is trigonometry. Make sure you know your trig inside and out, learn what the trig functions really mean and master those pesky identities. Also **don't over look this one crucial fact-trigonometry also provides a simple arena where you can learn how to prove and/or derive results.**

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We all know that later, when you take advanced physics courses, you're going to see the words «show that» pop up frequently in your homework problems. This is sure to cause headaches among the mere mortals amongst us, but it turns out you can improve your skills in this area in a non-threatening way by deriving trig identities. Instead of viewing the derivation of trig identities as a tedious obstacle, start to look at this as an opportunity. All trig books have homework problems where you have to derive an identity so pick up a trig book and do it until your blue in the face. Take it seriously and write up each proof as if you were submitting a short paper to a major journal. This will teach you how to go from point A to point B mathematically and how to write up a derivation in a formal way that will allow someone else to understand what's going on. If you do, later it will be easier to get through homework in advanced classes, you'll get better grades, and you'll develop a good foundation for writing up theoretical derivations for research papers.

Graphing Functions

While any function can be graphed easily on the computer or on a graphing calculator, it is very important to be able to graph a function on the fly with nothing more than a pencil and paper. The key abilities you want to focus on are developing an intuitive sense for how functions behave and learning how to focus on how functions behave in various limits. That is, how does a function look when the argument is small? How does it behave as the argument goes to infinity? Dig out your calculus book and review techiques that use the first and second derivative to graph a function. I review these extensively in my recent book «Calculus in Focus».

Series and Complex Numbers

In my opinion, understanding the series expansion of functions and the behavior of complex numbers can't be underestimated. If you want to understand physics, you need to master the use of series. Start by learning how to expand a function in a series. Some series should be second nature ('oh yeah, that's cosine»). Learn about convergence. Get a copy of Arfken and review the solution of differential equations using series. Try to get an intuitive feel for cutting a series off at a given term while retaining the essential behavior of the function. These are tools that are important when studying theoretical physics or advanced engineering.

David McMahon is a physicist who consults at Sandia National Laboratories and is the author of Calculus In Focus.

Does spooky action at a distance allow faster than light communication?
Author: David Mcmahon
Added: 03/21/2006

Does spooky action at a distance allow faster than light communication

It is often said that scientists do their best work while young. With Albert Einstein this certainly seems to have been the case. Before the age of 40 he developed special relativity, laid the groundwork for quantum theory by

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explaining the photoelectric effect and in his greatest achievement, developed his elegant theory of gravity, general relativity. However, it was a paper he wrote with two colleagues in 1935-when Einstein was nearly 56 years old-which stands out as his most cited scientific paper. In fact, it may well turn out to be one of the most significant scientific papers of all time.

This is of course the «EPR» paper, written with his colleagues Boris Podolsky and Nathan Rosen. Following a decade of vehement arguments with the great Neils Bohr about the meaning of quantum theory, this paper stands out as Einstein's «parting shot» in the debate-his last ditch effort to prove that quantum mechanics could not be a fundamental theory. The paper-titled «Can quantum mechanical description of reality be considered complete?»-uses quantum mechanics to demonstrate that particles which interact in someway become *entangled*, in a loose sense meaning that their properties become correlated. As we'll see in a moment, this is not an ordinary correlation in any sense of the word. It implies that there exists a strange connection between the particles that persists even when they are separated by great distances. In some sense, this connection is instantaneous, putting it in direct conflict with the special theory of relativity. It was this strange connection that led Einstein to the phrase «spooky action at a distance».

Quantum Entanglement

The EPR paper is based on the following thought experiment. Two particles interact and then separate. Furthermore, we imagine that they separate such that they are a great distance apart at a time when measurements on the particles can be made. EPR focused on two properties in particular-the position and momentum of each particle. These properties or variables were chosen because of the Heisenberg uncertainty principle. The uncertainty principle tells us that the position and momentum of a particle are *complimentary,* meaning that the more you know about one variable, the less you know about the other. If you have complete knowledge of a particles position, then the particles momentum is completely uncertain. Or if instead you have complete knowledge of the particles momentum, then its position becomes completely uncertain. Intermediate ranges of accuracy are possible, the lesson to take home is that you cannot measure one variable without introducing some uncertainty into the value of the corresponding complimentary variable. The amount of uncertainty is quantified precisely by the uncertainty principle. The uncertainty of quantum mechanics never sat well with Einstein, he felt the theory, which is statistical in nature, is statistical because there exist some unknown or «hidden» variables in the microscopic world we are not yet aware of.

We now imagine that two particles interact and then move off in different directions. Because they have interacted, they become entangled. When two particles are entangled, the state of each particle alone has no real meaning-the state of the system can only be described in terms of the whole. In terms of elementary quantum mechanics, there is a wavefunction which describes the two particles together as a single unit. The wavefunction, being a superposition of different possibilities, exists in a ghostly combination of possible states. The Copenhagen interpretation tells us that the properties of the particle, position or momentum, don't exist in definite values until a measurement is made.

explaining the photoelectric effect and in his greatest achievement, developed his elegant theory of gravity, general relativity. However, it was a paper he wrote with two colleagues in 1935-when Einstein was nearly 56 years old-which stands out as his most cited scientific paper. In fact, it may well turn out to be one of the most significant scientific papers of all time.

This is of course the «EPR» paper, written with his colleagues Boris Podolsky and Nathan Rosen. Following a decade of vehement arguments with the great Neils Bohr about the meaning of quantum theory, this paper stands out as Einstein's «parting shot» in the debate-his last ditch effort to prove that quantum mechanics could not be a fundamental theory. The paper-titled «Can quantum mechanical description of reality be considered complete?»-uses quantum mechanics to demonstrate that particles which interact in someway become *entangled*, in a loose sense meaning that their properties become correlated. As we'll see in a moment, this is not an ordinary correlation in any sense of the word. It implies that there exists a strange connection between the particles that persists even when they are separated by great distances. In some sense, this connection is instantaneous, putting it in direct conflict with the special theory of relativity. It was this strange connection that led Einstein to the phrase «spooky action at a distance».

Quantum Entanglement

The EPR paper is based on the following thought experiment. Two particles interact and then separate. Furthermore, we imagine that they separate such that they are a great distance apart at a time when measurements on the particles can be made. EPR focused on two properties in particular-the position and momentum of each particle. These properties or variables were chosen because of the Heisenberg uncertainty principle. The uncertainty principle tells us that the position and momentum of a particle are *complimentary,* meaning that the more you know about one variable, the less you know about the other. If you have complete knowledge of a particles position, then the particles momentum is completely uncertain. Or if instead you have complete knowledge of the particles momentum, then its position becomes completely uncertain. Intermediate ranges of accuracy are possible, the lesson to take home is that you cannot measure one variable without introducing some uncertainty into the value of the corresponding complimentary variable. The amount of uncertainty is quantified precisely by the uncertainty principle. The uncertainty of quantum mechanics never sat well with Einstein, he felt the theory, which is statistical in nature, is statistical because there exist some unknown or «hidden» variables in the microscopic world we are not yet aware of.

We now imagine that two particles interact and then move off in different directions. Because they have interacted, they become entangled. When two particles are entangled, the state of each particle alone has no real meaning-the state of the system can only be described in terms of the whole. In terms of elementary quantum mechanics, there is a wavefunction which describes the two particles together as a single unit. The wavefunction, being a superposition of different possibilities, exists in a ghostly combination of possible states. The Copenhagen interpretation tells us that the properties of the particle, position or momentum, don't exist in definite values until a measurement is made.

When a measurement is made, and we can choose to make a measurement on one particle or the other, the wavefunction «collapses» and each particle is found to be in a definite state. The measurement results obtained for entangled particles are correlated. So if we make a measurement result on particle A and find its momentum to be a certain value, we know-without making a measurement on particle B-what its momentum is with absolute certainty. As EPR put it, by making a measurement of momentum on particle A, using momentum conservation tells us that $p_A + p_B$ is an element of physical reality. In other words the wavefunction has collapsed and the variables have definite values-the ghostly superposition of possibilities is gone. The crucial point is that even though no measurement has been made on the distant particle B, the observer at the location of particle A has learned the value of B's momentum. Somehow the wavefunction has collapsed instantaneously across a spatial distance-presumably in violation of the speed of light limit set by relativity.

The situation can be made even more interesting by noting that we can choose instead to measure the position of particle A. Again, using conservation principles, we will learn the value of the position of particle B, and the quantity q_A — q_B assumes physical reality.

Notice that the observer at position A can *choose*, by making different measurements that he or she desires, which properties of particle B assume definite values-or assume physical reality in the terminology of EPR. They can make this choice at a later time without any prior agreement with an observer in possession of particle B. This is another aspect of spooky action at a distance. The observer at A makes a measurement choice-presumably chosen using the free will of the mind-and forces particle B into a definite value instantaneously.

The interpretation of these results is still in debate, some believe that the wavefunction only represents our state of knowledge about the system. However it seems that it would be difficult for anyone who believes this to examine diffraction images from electron scattering and deny that the wavefunction is a real physical entity.

In summary, it appears that the position or momentum of each member of the EPR pair is determined by measurements performed on the other, distant member of the EPR pair. The effect seems to be instantaneous, leading Einstein and his colleagues to refer to the phenomenon as «spooky action at a distance». The effect is non-local and appears to be instantaneous, but can anything useful come out of it? Can we exploit this to communicate faster than the speed of light? It turns out that as things are currently understood, the answer is no.

Teleportation

In recent years, it was shown that quantum entanglement could be exploited to transmit the state of a quantum particle from one place to another without having that state propagate through the space that separates the two locations. This certainly sounds magical enough-perhaps like something out of Star Trek-and is the reason that the investigators who discovered this phenomenon denoted it by the term *teleportation*. As we'll see in a moment, teleportation demonstrates that despite the spooky action at a distance, special relativity is saved because the ability to communicate is limited in an unexpected way. A fundamental observation that should be made this is true even though teleportation is described

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using *non-relativistic* quantum mechanics-a theory where as long as no electromagnetic fields are involved, there is no ultimate speed limit.

We imagine two parties who wish to communicate with each other. In the quantum computing literature they are identified by the overused corny labels of Alice and Bob. It works like this. First, Alice and Bob meet. They create an entangled EPR pair. Then each party takes one member of the pair. Alice stays home, while Bob travels off somewhere, perhaps to Las Vegas.

In teleportation, the quantum particles used can have one of two states, so measurement results can be labeled by a 0 or a 1

Since Alice and Bob each have in their possession one member of an entangled EPR pair, a spooky action at a distance connection exists between them. Alice can exploit this connection to send Bob the state of a quantum particle. The process is quite simple and Alice just follows these steps.

First, Alice gets the particle she wants to send with Bob, and she allows it to interact with her member of the EPR pair. Then she makes measurements on her member of the EPR pair and the particle that she wants to send to Bob. Since she is making measurements of two particles, her possible measurement results are the two-bit combinations 00, 01, 10, and 11.

Since Alice has allowed her half of the EPR pair to interact with another particle, the state of Bob's half of the EPR pair must have changed. It's at this point that special relativity peaks its head in-through the back door. Although the state of Bob's particle has changed, any measurement results he makes on his half of the EPR pair would be completely random. Bob has no information in his possession about the state of the unknown particle Alice wants to send him. Spooky action at a distance has occurred but at this point it's completely useless. To get something out of the situation-Alice has to call Bob-on an ordinary telephone say-and tell him her measurement results. If Alice gets the measurement result 00, Bob doesn't have to do anything-he now has the state of the particle Alice wanted to send him in his possession. However, that only happens 25% of the time, since Alice can get measurement results 00, 01, 10, and 11. If Alice gets measurement results 01, 10, or 11, Bob must make some measurements of his own on his half of the EPR pair in order to obtain the state of the particle Alice wants to send. We won't get into the technical details, but in each case a different set of operations must be performed by Bob. Alice has to communicate which set of operations to use-based on the measurement result she obtained in the past-using a classical communications channel. Therefore the «instantaneous» nature of the interaction cannot be exploited until a classical communications channel is used.

The interesting thing about teleportation in my view is that it seems to say that special relativity has a major role to play in the transfer of information. In a way this is a fitting cap off to Einstein's intellectual legacy. Einstein and Bohr both come out winners. Quantum mechanics stands on its own using the standard theory without hidden variables, yet what you can do with it is constrained by Einstein's special theory of relativity.

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An Introduction to Black Hole Thermodynamics
Author: Sridhar Narayanan
Added: 10/28/2003

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An Introduction

Black Holes are and have been an anomaly since their prediction. They are not new to the world of Physics, infact it was Laplace who first predicted them

«A luminous star, of the same density as the Earth, and whose diameter should be two hundred and fifty times larger than that of the Sun, would not, in consequence of its attraction, allow any of its rays to arrive at us; it is therefore possible that the largest luminous bodies in the universe may, through this cause, be invisible.» — Pierre Laplace, **The System of the World**, Book 5, Chapter VI (1798).

The existence of Black Holes was later Mathematically Formulated as a solution of the GR equations. Since then many Astronomers have been trying to point out Black Holes in our Universe. Theoreticians have been playing with the Mathematics of Black Holes to find elegant solutions to many problems like the beginning and ending of the Universe, Time Travel etc… . What is so exciting about Black Holes that makes them controversial? In this article, we shall see a brief introduction to the Thermodynamic Laws that govern Black Holes…

How are Black Holes Formed?

A Star exists because the pressure developed inside the star due to Fusion of the Hydrogen in the star balances the Gravitational Attraction of the core of the star. Since these 2 balance each other the star maintains its size until the Hydrogen is present in it… **Only until the Hydrogen is present in it**. After all the Hydrogen in the star has been converted to Helium, the pressure inside the star is no longer able to compensate the Gravitational Attraction and hence the star reduces in size. This contraction further increases the temperature inside the star, that the Fusion of Helium begins and this develops so much pressure that the Pressure exceeds the Gravitational Attraction and the star expands. This stage when the star is huge is called a Red Giant stage. After this stage, when all the Helium is used up, the Star again collapses and now there are 2 possibilities that can happen:

a) If the mass of the Star < 1.2 times Mass of the Sun**:** now, the mass content of the star is not sufficient to start another Fusion and thus the star cools down to a White Dwarf star that emits radiation to wear of its internal Energy.

b) If the mass of the Star > 1.2 times the Mass of the Sun**:** now, the Star has enough mass to overcome the White Dwarf stage and thus another fusion starts and it proceeds until…

(i) If the mass of the star is < 3 times and > 1.2 times the Mass of the Sun, then, the Star at one point of time explodes to excess pressure inside the star (Supernova Explosion) and a Rotating Neutron Star (Pulsar) is left.

(ii) If the mass of the star > 3 times and > 1.2 times the Mass of the Sun, then there is so much matter that Gravity dominates every inch of the Star and the Star collapses into itself. i.e. it undergoes successive contractions, upto a stage when there is so much concentration of mass in that region of space that a very high gravitational field is set up that is so powerful that not even light can escape from it.

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This radius where the Gravitational Potential Energy of the Collapsed Star equals the Kinetic Energy possessed by light such that not even Light can't escape beyond this region is called **Schwarzschild Radius (r_{bh})**.

At the Schwarzschild Radius,

Let the Kinetic Energy possessed by light = **K = (p*c)/2** [Mass equivalent for light = p/c]

p is the momentum of a Photon.

The Gravitational Potential Energy at $\mathbf{r_{bh} = P = [GM(p/c)]/ r_{bh}}$ where, M is the Mass of the Star

Thus, when **K = P,**

$\mathbf{r_{bh} = (2GM)/c^2}$

Below this radius, Light an never escape and above this radius the Gravitational Field of the Collapsed Star can be experienced. This effect due to which even Light cannot escape the gravity of the star makes it invisible to us, thus appearing invisible to us. Hence the name Black Hole (coined by John Archibald Wheeler).

We saw in the previous page, how a Black Hole evolved and the nature of its strong gravitational field. A Black Hole sucks in anything that comes near it!. Which means that there is so much of energy involved with a Black Hole, especially energy in the form of a heat. Curiosity, though may want to equate the disorderliness of the Black Hole to have an infinite process seeing it to be such a chaotic system, but, surprisingly, it is not (As shown by Prof. Stephen Hawking.). To understand the Thermodynamic Laws governing a Black Hole, we must first consider the following:

a) The realization from Quantum Mechanics that we can think of all matter-energy as waves.

b) The statement of Classical Physics that a wave in a confined region exits as a standing wave.

c) The realization from thermodynamics that the *entropy* can be viewed as a measure of the number of combinations or permutations of an ensemble that are equivalent. This is equivalent to viewing the entropy more conventionally as a measure of the heat divided by the temperature of a body. According to the Second Law of Thermodynamics, in a closed system the entropy never decreases.

c) The realization from Heisenberg's Uncertainty Principle that when a sufficient amount of energy transfer takes place in a very short amount of time, then the energy transfer cannot be measured. This permits the violation of Law of Conservation of Energy for a very short amount of time.

d) The Classical Statement that any body that is above zero degree Kelvin will radiate energy as Electromagnetic Radiation.

e) Feynman's Theory of Antimatter as regular matter going backwards in Time.

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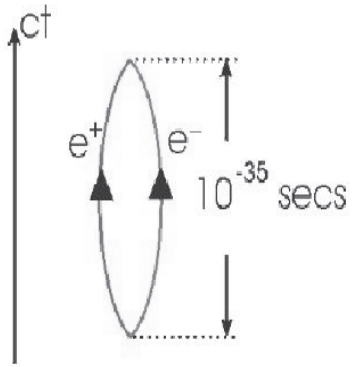
Virtual Pair Production:

In order to understand the concept of entropy related to a Black Hole, we must first understand the Phenomenon of Virtual Pair Production. The uncertainty relation between Time and Energy states that if the energy transfer in a system takes place in a very short time, then, the energy transfer cannot be measured. i.e. Energy Transfer and Time taken for the energy transfer cannot be simultaneously measured. According to this relation, one can extract energy out of no-where for a short amount of time to be distributed to its surroundings. This concept is applied to the phenomenon of Virtual Pair Production, where, a particle and an antiparticle are transformed from one to another every 10^{-35} seconds.



This is evident from the diagram on the left. i.e. The pair can only exist for 10^{-35} seconds. This is called the ***Planck Time.*** We believe virtual pairs of proton-antiprotons, neutron-antineutrons etc. are continually being formed and disappearing everywhere in the universe. Wheeler, then, characterizes the vacuum at a scale of very small distances as being ***quantum foam***.

THE BLACK HOLE HAS NO HAIR THEOREM

A Black Hole is created by a collapsing neutron star when all the neutrons are crushed out of existence. However, how can mass be crushed out of existence? The Total Mass-Energy of the system remains. In other words, if we define the event horizon to be the sphere surrounding the Schwarzschild Radius, then outside the event horizon, all the properties of matter that formed it are gone except for the total mass-energy, rotation and electric charge. This is called the ***Black Hole Has No Hair Theorem***. We know that since Space-Time is like a fabric, it is curved by the existence of mass-energy. The total mass-energy from the Black Hole is manifested as the curvature of Space-Time around the singularity. Singularity is that point in a Black hole where R→0, R being the

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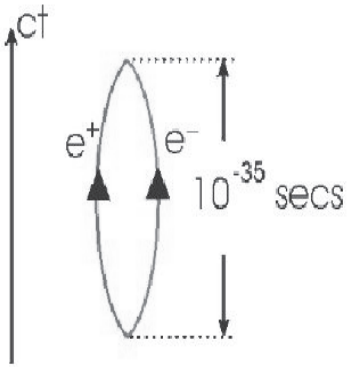

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radius. It is that point of a Black Hole that is most chaotic in nature and where the behavior of Space-Time is unpredictable. This Matter-Energy at the singularity is going to be considered as a wave trapped in a closed domain and the Entropy of the Black Hole studied Quantum Mechanically.

STANDING WAVES IN A BLACK HOLE

We know that all matter has a wave aspect, and Quantum Mechanics describes the behavior of these waves. So, we shall think about representing the mass-energy inside the event horizon as waves.

Now, what kinds of waves are possible inside the black hole? The answer is *standing waves*, waves that «fit» inside the black hole with a *node* at the event horizon. The possible wave states are very similar to the standing waves on a circular drumhead; they aren't exactly the same because the waves exist in three dimensions instead of just the two of the drumhead, but they are very close to the same.

Note that I just said «three dimensions.» This is correct; we are using non-relativistic quantum mechanics. The energy represented by a particular wave state is related to the frequency and amplitude of its oscillation. As we saw for the standing waves on a drumhead, the higher «overtones» have a higher frequency and thus these Quantum Mechanical waves contain more energy. Assume that the total mass-energy inside the event horizon is fixed. So, we have various standing waves, each with a certain amount of energy, and the sum of the energy of all these waves equals the total mass-energy of the black hole.

There are a large number of ways that the total mass-energy can distribute itself among the standing waves. We could have it in only a few high-energy waves or a larger number of low energy waves. It turns out that all the possible standing wave states are equally probable.

Thus, we can calculate the *probability* of a particular combination of waves containing the total mass-energy of the black hole the same way we calculated the probability of getting various combinations for dice. Just as for the dice, the state with the most total combinations will be the most probable state. But we have seen that the *entropy* is just a measure of the probability. Thus we can calculate the entropy of a black hole. We have also know that the entropy measures the heat divided by the absolute temperature.

The «heat» here is just the total mass-energy of the black hole, and if we know that and we know the entropy, we can calculate a *temperature* for the black hole. So, as Hawking realized, we can apply all of *Thermodynamics* to a black hole. Any body with a temperature above absolute zero will radiate energy. And we have just seen that a black hole has a non-zero temperature. Thus thermodynamics says it will radiate energy and evaporate.

We can calculate the rate of radiation for a given temperature from classical thermodynamics. How is this possible? Nothing can get across the event horizon so how can the black hole radiate? The answer is via virtual pair production.

Consider a virtual electron-positron pair produced just outside the event horizon. Once the pair is created, the intense curvature of space-time of the black hole can put energy into the pair. Thus the pair can become non-virtual; the electron does not fall back into the hole. There are many possible fates for the pair.

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Now, what kinds of waves are possible inside the black hole? The answer is *standing waves*, waves that «fit» inside the black hole with a *node* at the event horizon. The possible wave states are very similar to the standing waves on a circular drumhead; they aren't exactly the same because the waves exist in three dimensions instead of just the two of the drumhead, but they are very close to the same.

Note that I just said «three dimensions.» This is correct; we are using non-relativistic quantum mechanics. The energy represented by a particular wave state is related to the frequency and amplitude of its oscillation. As we saw for the standing waves on a drumhead, the higher «overtones» have a higher frequency and thus these Quantum Mechanical waves contain more energy. Assume that the total mass-energy inside the event horizon is fixed. So, we have various standing waves, each with a certain amount of energy, and the sum of the energy of all these waves equals the total mass-energy of the black hole.

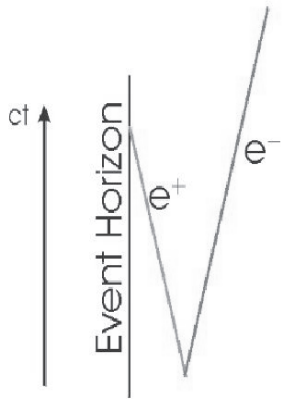
There are a large number of ways that the total mass-energy can distribute itself among the standing waves. We could have it in only a few high-energy waves or a larger number of low energy waves. It turns out that all the possible standing wave states are equally probable.

Thus, we can calculate the *probability* of a particular combination of waves containing the total mass-energy of the black hole the same way we calculated the probability of getting various combinations for dice. Just as for the dice, the state with the most total combinations will be the most probable state. But we have seen that the *entropy* is just a measure of the probability. Thus we can calculate the entropy of a black hole. We have also know that the entropy measures the heat divided by the absolute temperature.

The «heat» here is just the total mass-energy of the black hole, and if we know that and we know the entropy, we can calculate a *temperature* for the black hole. So, as Hawking realized, we can apply all of *Thermodynamics* to a black hole. Any body with a temperature above absolute zero will radiate energy. And we have just seen that a black hole has a non-zero temperature. Thus thermodynamics says it will radiate energy and evaporate.

We can calculate the rate of radiation for a given temperature from classical thermodynamics. How is this possible? Nothing can get across the event horizon so how can the black hole radiate? The answer is via virtual pair production.

Consider a virtual electron-positron pair produced just outside the event horizon. Once the pair is created, the intense curvature of space-time of the black hole can put energy into the pair. Thus the pair can become non-virtual; the electron does not fall back into the hole. There are many possible fates for the pair.



Consider one of them: the positron falls into the black hole and the electron escapes. According to Feynman's view we can describe this as follows: The electron crosses the event horizon traveling backwards in time, scatters, and then radiates away from the black hole traveling forwards in time.

Using the field of physics that calculates virtual pair production etc., called *Quantum Electrodynamics*, we can calculate the rate at which these electrons etc. will be radiating away from the black hole. The result is the same as the rate of radiation that we calculate using classical thermodynamics. The fact that we can get the radiation rate in two independent ways, from classical Thermodynamics or from Quantum Electrodynamics, strengthens our belief that black holes radiate their energy away and evaporate.

This how Prof. Stephen Hawking argued that a Black Hole does radiate energy and evaporates at some point of time.

This proves that the Black Hole does not have an infinite value for its entropy, but, infact its value is finite and is equal to:

$$\mathbf{S_{bh} = C_n \times A_h^2}$$

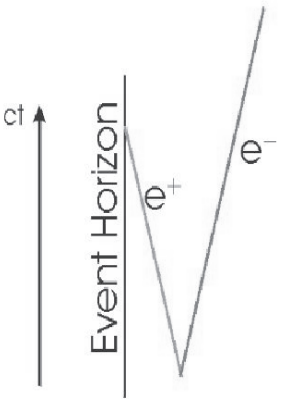
Where,

$\mathbf{S_{bh}}$ = Entropy of the Black Hole, $\mathbf{C_n}$ is a constant and $\mathbf{A_h}$ is the area of the Event Horizon. This Law was proposed by Stephen Hawking and is called ***BHAL — Bekenstein-Hawking Area Law***.

A BONUS

Thermodynamics of the Universe

Consider the universe. It has a size of about 15 billion light years or so. It also has a total amount of mass-energy. If we represent this mass-energy as quantum mechanical standing waves, just as we did for black holes, we can calculate the total entropy of the universe.



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It turns out that the entropy of either a black hole or the universe is proportional to its size squared. Thus for a given amount of total mass-energy, the larger the object the higher the entropy. But the universe is expanding, so its size is increasing. Thus the total entropy of the universe is also increasing.

This leads us to the idea that the Second Law of Thermodynamics may be a consequence of the expanding universe. Thus cosmology explains this nineteenth century principle. Put another way, we have realized that the direction of time, «time's arrow,» can come either from the fact that the universe is expanding or from the Second Law of Thermodynamics.

We have now found a relationship between these two indicators of the direction of time. It is amusing to speculate about what will happen to the Second Law of Thermodynamics if the universe is closed, so that at some point the expansion stops and reverses.

Even more wild is the idea that if the expansion of the universe determines the direction of time's arrow, then if the universe starts to contract the direction of time will also reverse. However, common sense tells us that this is not possible, for nature is intelligent enough to enforce the constraint upon us that Time will always move in the increasing direction and that whatever may be the case, our age will always keep increasing.

Whatever may be the case, one thing is for sure, Nature will always come out the way she wants to and so while dealing with her, we should go about without any pre determination of her characteristics...

She may not like it...and may never show up!!!!

Hope you enjoyed reading this article...

Energy Redshift Paradox
Author: Erich Schoedl
Added: 11/13/2003

This is assumes the reader understands time dilation from gravitational redshift, and has a basic understanding of mechanics. First, let me throw a thought experiment at you...

Set Up:

My UFO is *extremely* powerful, powerful enough to pull or push planets and even stars. One day I found a dead star system with a small non-rotating black hole that has an event horizon radius of 1,000 km. The system has two planets, A and Z. In the outer orbit (r(Z) ~ 1.5 x 10^8 km), planet Z is aging at the same rate as an Earth clock. Planet A is orbiting the black hole very closely (r(A) ~ 2700 km), and clocks on planet A age at only ½ the rate of a clock on planet Z due to time dilation from gravitational redshift predicted by the Schwarzschild solution. I'll use gamma=2 for this relative redshift throughout this post only for simplicity.

I use my UFO to pull planet Z, and accelerate it with a given thrust 1 m/s^2. I fly in with my UFO and pull to accelerate planet A, also 1 m/s^2 with the same engine thrust I used on Z, so it is almost exactly the *same mass* as planet Z the

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way I see them locally. So as measured locally, mass of Z = mass of A (Say both are 6 x 10^24 kg). Now to simplify what is observed, I'm only pulling the planets in a perpendicular direction to the orbit radius (to avoid arguments regarding the radial contraction in the metric). And to avoid relativistic complications from velocity, let's slow the orbit velocities to a stop just before running each experiment.

At planet A, me and my saucer age *slower* relative to Z (by General Relativity's gravitational redshift), and the whole acceleration process then appears to occur slower to observers on Z because of time dilation. No big deal right? But when I leave a line attached to A, fly out to Z, and then try to pull A: I can only accelerate it about 0.5 m/s^2 with the same engine thrust I used before. Planet A *feels* twice as heavy (accelerates half as fast) to my UFO when I'm pulling it from the Z orbit! Why?

The Paradox:

If we break down acceleration, we find it is dv/dt, or a change in velocity over a change in time (the differential limit is where the changes approach infinitely small). And velocity is just dx/dt, or a change in distance x, over a change in time, so acceleration is dx/dt^2. Now the *units* are what are important.

Since the change in time at Z is *twice* the change in time at A because of time dilation, the acceleration at A when viewed from Z appears to be only 1/4 of the local acceleration, assuming the distortion of the Schwarzschild geometry (in time only). To paraphrase: When viewed from planet Z, the UFO is near planet A and appears to pull it only a quarter of the acceleration that is measured locally.

So what does this thought experiment *mean*? The paradox comes into play not with measures of force directly, but with energy. If I pull planet A *locally* with the force 6 x 10^24 (N) for 10 meters, this equals 6 x 10^25 Joules of work done on planet A.

Assuming my really long UFO cable is inextensible with negligible mass, I pull on the cable attached to planet A with the *same* force until I move 10 meters, but this time from the orbit radius of Z. The work done by my UFO should be the same in both instances: it is equal to the energy burned by the spacecraft fuel. Here's the problem. The force felt at planet A when the UFO pulls from the Z orbit, would be 4 times as strong as the force the UFO exerts at the Z end of the cable.

All of the energy is spent in half the time as measured by clocks on planet A (assuming only the redshift time dilation from the Schwarzschild geometry). The force is 4 times as strong because the acceleration is 4 times as much, the 10 meter pull distance does not change from one frame to the other (in the tangent coordinate mentioned above x = x' in the Schwarzschild metric). This would mean we did 4 times the work on A, where W' = 4W or W = 1/4W', just by pulling from the orbit radius of planet Z, while burning *the same amount of fuel*. See the diagram below on the left.

This is a paradox, because we could then devise a mechanical method to do this work on A from Z, go to A to collect this added energy, then return to Z with more energy than we *started* with! The extra energy isn't surrendered by the mass of the system, or balanced out somehow, because it's totally

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mechanical in nature. It violates the conservation of energy principle — a big no-no.

Solution:

Changing one simple thing can resolve the energy paradox. Since work = force times distance, generally, and force is mass times acceleration, we can put the equation for work done on A locally into the form: W = m (dx / dt^2) x. Now for the work done on A by the UFO acting from Z, we just use the form W' = m' (dx' / dt'^2) x'.

The primes simply mean we are looking at a potentially different value from a different frame of reference (not all of the variables need to be different). Looking at the equation components strictly for the units, we can see that the square of time is in the denominator, and the square of distance is in the numerator along with mass.

Next let's assume a few things. First, we should assume W = W', or else there will be a violation of energy conservation as discussed. Next, let's assume the gravitational time dilation is accurate: dt = 2dt' in our case. Here dt is the rate of aging of a local clock on Z, and dt' is the time dilated rate of a clock on planet A observed at planet Z (gamma = 2) that tics only half as fast in comparison. In Expanded Relativity, the dimensions of observed length also change (see «Unified Relativity» at http://www.physicspost.com/articles.php?articleId=125, for more on Expanded Relativity). In the tangent direction that we're pulling the planets, the observed length is dilated in conjunction to the time dilation. So to pull planet A one meter, we would need to pull 2meters at planet Z, or dx = 2dx'. So the relativity factors of space dilation / time dilation cancel and W' = m' (dx / dt^2) x. For W' = W, m' would simply be equal to m. See the diagram above on the right.

The energy is conserved if we just consider that the dimensions of length are *dilated* in the metric, or stretched out (the radial dimension is complicated and contracted by mapping the coordinate system, so this experiment only considers the tangent dimensions as shown). By separating factors, the acceleration felt at A would be twice the acceleration experienced at Z, but the distance pulled at A would be only half the distance the cable was pulled at Z. If we pull planet A while in the Z orbit radius, and we *suppose* that the acceleration along the cable is constant, then we might assume the mass of planet A is twice its proper mass from the vantage of Z since we pull with a given thrust, but it only accelerates half as fast. This apparent increase in inertia is what was measured in the UFO thought experiment.

If you've read the «Unified Relativity» post, you've noticed an assumption was made that m' = ãm because of the appearance of this extra inertia. This isn't such a crazy mistake since the accelerations are redshift dependent. But you can see in the above treatment of work, the actual mass stays constant in order to stay consistent with the conservation of energy. The size of a mass appears to change, as well as the apparent inertia relative to a reference frame. Even the gravitational curvature caused by the mass is distorted relatively.

But as a mass is lowered toward the large gravity source, the actual rest mass, *and the energy contained in the mass*, must stay constant to maintain the conservation of energy principle. The potential energy argument made in «Unified Relativity» that mass *is* relative, is not exactly a valid contention in the

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The observed *effects* of mass, however, are completely relative as described. This includes a relativistic increase in the Newtonian gravitational attraction for greater distances from the sun by relativity of acceleration described above.

In truth, when I began writing this assertion, I was hoping to fit the relativity of gravitational acceleration from the Sun to the anomalous observations of the velocities of the Pioneer 10 & 11, Galileo, and Ulysses spacecraft (there was an article on this in *Discover* magazine offering the MOND theory of gravity as an explanation to resolve the issue). The discrepancy involves an apparent slowing down of the velocity beyond that predicted by current theory (See Anderson's paper for more on this measured discrepancy at http://www.arXiv.org/abs/gr-qc/0104064). Even the effects of Expanded Relativity that diverge from the Schwarzschild geometry are, however, orders of magnitude shy of explaining this particular discrepancy. Still, the dispute of the subtle energy paradox outlined above is very important, though difficult to measure without the UFO, to the foundation of conservation of energy in Relativity.

Employment in Physics
Author: Guest Writer
Added: 02/14/2006
Author: ZapperZ (PF)

Employment in Physics — Part 1

There have been frequent questions on the kinds of employment that are available for physicists. That question is very difficult to answer, because it depends on a number of factors, such as where you are, what degree you obtained, what area of specialization you went into, and what skill you have acquired.

I think it is best to start by simply pointing out the kind of job advertisements that most physicists in the market actually read. As far as I know, these are the two most popular sources of job listings aimed at physicists and others in similar fields such as astronomy, astrophysics, biophysics, chemistry, etc. Keep in mind that these job listings changes often, even weekly, and the number of listings also fluctuate during different times of the year. So sample them a few times to get a good idea of the kinds of jobs that are available.

A few of the items in the list are also for «studentship», or schools offering assistantships for students to pursue a Ph.D degree, sometime for a specific field of study. So not all of them are only for job-seekers.

Maybe this might influence you in the area of study you want to go into..
http://aip.jobcontrolcenter.com/search.cfm http://physicsweb.org/jobs/
Zz.

Employment in Physics — Part 2

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A new statistics on the salary increase of physics Ph.D's working in the industrial sector in the US has just been released.

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http://www.tipmagazine.com/tip/INPHF...iss-6/p10.html

I am bringing this up because I want to make two important points:

1. That if you have the needed skills and specialities, your employability as a physics Ph.D transcends beyond just the typical academic boundaries, and that you CAN be employed in many industrial sector of the economy. This I have tried to emphasize in my «So You Want To Be A Physicist» essays;

2. That compared to many other areas of science and engineering, a physics degree holder in the industrial sector still makes a «comfortable», if not lucrative, living.

Zz.

Employment in Physics — Part 3

Once again, we hear «horror stories» based on anecdotal evidence of the difficulties in finding jobs in with a physics degree. While this is certainly can be true, the employability or desirability of a physics graduate depends HEAVILY on (i) the area of physics that that person specialized in (ii) whether it was theoretical or experimental (iii) the skills that the person acquired (iv) pedigree (i.e. who was his/her mentor).

Because of this, you can have someone (like Jonathan Katz) who sees people going into dispair due to not having a good career in physics, versus people like me who sees Ph.D's in Medical Physics and Condensed matter physics being offered $70,000 upwards jobs in industries even before they graduate! Let's get this VERY clear — what you choose to do in graduate school has a huge impact on your ability to get a job upon graduation! It can be the difference between having your options being narrowed to only employment in the academic institutions or research labs, and having a wider option to also be employable in industries.

This topic will certainly be a major part of a future installment of «So You Want To Be A Physicist» essay. But for now, if you want a good snapshot of the employment in physics, at least in the US, go past all of these anecdotal evidence and look at the statistics that have been compiled by the AIP.

http://www.aip.org/statistics/trends/emptrends.html

Zz.

Employment in Physics — Part 4

This time I'm making a reference to a recent article on the job market for a specific speciality — MRI Physicists.

http://www.tipmagazine.com/tip/INPHF.../iss-1/p22.pdf

While this article focuses on a particular field, it also gives a broad feel to the job outlook in medical physics as a whole. In any case, the advice being given in this article echoes what I have been trying to get across in this series of essay, and in my «So You Want To Be A Physicist» essay — the ability to adapt to changing situations. To be able to do that, one must have as wide of a training and experience as possible to increase one's changes of having the necessary skill.

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Employment in Physics — Part 3

Once again, we hear «horror stories» based on anecdotal evidence of the difficulties in finding jobs in with a physics degree. While this is certainly can be true, the employability or desirability of a physics graduate depends HEAVILY on (i) the area of physics that that person specialized in (ii) whether it was theoretical or experimental (iii) the skills that the person acquired (iv) pedigree (i.e. who was his/her mentor).

Because of this, you can have someone (like Jonathan Katz) who sees people going into dispair due to not having a good career in physics, versus people like me who sees Ph.D's in Medical Physics and Condensed matter physics being offered $70,000 upwards jobs in industries even before they graduate! Let's get this VERY clear — what you choose to do in graduate school has a huge impact on your ability to get a job upon graduation! It can be the difference between having your options being narrowed to only employment in the academic institutions or research labs, and having a wider option to also be employable in industries.

This topic will certainly be a major part of a future installment of «So You Want To Be A Physicist» essay. But for now, if you want a good snapshot of the employment in physics, at least in the US, go past all of these anecdotal evidence and look at the statistics that have been compiled by the AIP.

http://www.aip.org/statistics/trends/emptrends.html

Zz.

Employment in Physics — Part 4

This time I'm making a reference to a recent article on the job market for a specific speciality — MRI Physicists.

http://www.tipmagazine.com/tip/INPHF.../iss-1/p22.pdf

While this article focuses on a particular field, it also gives a broad feel to the job outlook in medical physics as a whole. In any case, the advice being given in this article echoes what I have been trying to get across in this series of essay, and in my «So You Want To Be A Physicist» essay — the ability to adapt to changing situations. To be able to do that, one must have as wide of a training and experience as possible to increase one's changes of having the necessary skill.

Nature of the Work

All organizations rely on computer and information technology to conduct business and operate more efficiently. The rapid spread of technology across all industries has generated a need for highly trained workers to help organizations incorporate new technologies. The tasks performed by workers known as computer systems analysts evolve rapidly, reflecting new areas of specialization or changes in technology, as well as the preferences and practices of employers.

Computer systems analysts solve computer problems and apply computer technology to meet the individual needs of an organization. They help an organization to realize the maximum benefit from its investment in equipment, personnel, and business processes. Systems analysts may plan and develop new computer systems or devise ways to apply existing systems' resources to additional operations. They may design new systems, including both hardware and software, or add a new software application to harness more of the computer's power. Most systems analysts work with specific types of systems—for example, business, accounting, or financial systems, or scientific and engineering systems—that vary with the kind of organization. Some systems analysts also are known as *systems developers* or *systems architects*.

Systems analysts begin an assignment by discussing the systems problem with managers and users to determine its exact nature. Defining the goals of the system and dividing the solutions into individual steps and separate procedures, systems analysts use techniques such as structured analysis, data modeling, information engineering, mathematical model building, sampling, and cost accounting to plan the system. They specify the inputs to be accessed by the system, design the processing steps, and format the output to meet users' needs. They also may prepare cost-benefit and return-on-investment analyses to help management decide whether implementing the proposed technology will be financially feasible.

When a system is accepted, systems analysts determine what computer hardware and software will be needed to set the system up. They coordinate tests and observe the initial use of the system to ensure that it performs as planned. They prepare specifications, flow charts, and process diagrams for computer programmers to follow; then, they work with programmers to «debug,» or eliminate, errors from the system. Systems analysts who do more in-depth testing of products may be referred to as *software quality assurance analysts*. In addition to running tests, these individuals diagnose problems, recommend solutions, and determine whether program requirements have been met.

In some organizations, *programmer-analysts* design and update the software that runs a computer. Because they are responsible for both programming and systems analysis, these workers must be proficient in both areas. (A separate statement on computer programmers appears elsewhere in the *Handbook*.) As this dual proficiency becomes more commonplace, these analysts are increasingly working with databases, object-oriented programming languages, as well as client server applications development and multimedia and Internet technology.

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One obstacle associated with expanding computer use is the need for different computer systems to communicate with each other. Because of the

importance of maintaining up-to-date information—accounting records, sales figures, or budget projections, for example—systems analysts work on making the computer systems within an organization, or among organizations, compatible so that information can be shared among them. Many systems analysts are involved with «networking,» connecting all the computers internally—in an individual office, department, or establishment—or externally, because many organizations rely on e-mail or the Internet. A primary goal of networking is to allow users to retrieve data from a mainframe computer or a server and use it on their desktop computer. Systems analysts must design the hardware and software to allow the free exchange of data, custom applications, and the computer power to process it all. For example, analysts are called upon to ensure the compatibility of computing systems between and among businesses to facilitate electronic commerce.

Job Outlook

Employment of computer systems analysts is expected to grow much faster than the average for all occupations through the year 2014 as organizations continue to adopt and integrate increasingly sophisticated technologies. Job increases will be driven by very rapid growth in computer system design and related services, which is projected to be among the fastest growing industries in the U.S. economy. In addition, many job openings will arise annually from the need to replace workers who move into managerial positions or other occupations or who leave the labor force. Job growth will not be as rapid as during the previous decade, however, as the information technology sector begins to mature and as routine work is increasingly outsourced to lower-wage foreign countries.

Workers in the occupation should enjoy favorable job prospects. The demand for networking to facilitate the sharing of information, the expansion of client server environments, and the need for computer specialists to use their knowledge and skills in a problem-solving capacity will be major factors in the rising demand for computer systems analysts. Moreover, falling prices of computer hardware and software should continue to induce more businesses to expand their computerized operations and integrate new technologies into them. In order to maintain a competitive edge and operate more efficiently, firms will keep demanding system analysts who are knowledgeable about the latest technologies and are able to apply them to meet the needs of businesses.

Increasingly, more sophisticated and complex technology is being implemented across all organizations, which should fuel the demand for these computer occupations. There is a growing demand for system analysts to help firms maximize their efficiency with available technology. Expansion of electronic commerce—doing business on the Internet—and the continuing need to build and maintain databases that store critical information on customers, inventory, and projects are fueling demand for database administrators familiar with the latest technology. Also, the increasing importance being placed on «cybersecurity»—the protection of electronic information—will result in a need for workers skilled in information security.

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businesses, for example, has resulted in a growing need for specialists who can develop and support Internet and intranet applications. The growth of electronic commerce means that more establishments use the Internet to conduct their business online. The introduction of the wireless Internet, known as WiFi, creates new systems to be analyzed. The spread of such new technologies translates into a need for information technology professionals who can help organizations use technology to communicate with employees, clients, and consumers. Explosive growth in these areas also is expected to fuel demand for analysts who are knowledgeable about network, data, and communications security.

As technology becomes more sophisticated and complex, employers demand a higher level of skill and expertise from their employees. Individuals with an advanced degree in computer science or computer engineering, or with an MBA with a concentration in information systems, should enjoy favorable employment prospects. College graduates with a bachelor's degree in computer science, computer engineering, information science, or MIS also should enjoy favorable prospects for employment, particularly if they have supplemented their formal education with practical experience. Because employers continue to seek computer specialists who can combine strong technical skills with good interpersonal and business skills, graduates with non-computer-science degrees, but who have had courses in computer programming, systems analysis, and other information technology subjects, also should continue to find jobs in computer fields. In fact, individuals with the right experience and training can work in computer occupations regardless of their college major or level of formal education.

How to Become a Computer Systems Analyst

Virtually all organizations in the U.S. are dependent on computer and information technology to perform specific functions and manage data and business aspects. In order to run efficiently, organizations must use technology and to integrate new evolving technologies prudently. Computer systems need updating and customizing on a regular basis. This is where the computer systems analyst comes in.

What does a computer systems analyst do?

Computer systems analyst is a blanket term for a computer professional that solves computer issues and uses technology to meet the needs of the company. These professionals might be employed under different titles: IT consultant, IT specialist, programmer analyst, business systems analyst, system architect and computer specialist, to name a few. These highly-trained professionals plan, design and expand new computer systems as well as configure software and hardware. They update/upgrade current computer systems and modify them for new or expanded functions. They are frequently charged with preparing cost reports for management.

Computer systems analysts usually collaborate with other professionals in the information technology field, such as programmers, network security specialists, and software engineers, and will sometimes specialize in specific systems such as accounting, business, engineering, financial, or scientific systems. Click here to find out how to become a computer systems analyst.

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What kind of training does a computer systems analyst need?

Computer systems analysts are typically required to have a degree of at least bachelor level. Many employers may require a higher graduate level degree, as well as experience in the field for more complicated jobs and senior-level positions. Computer systems analysts have many different degrees, but typically, they have degrees in computer science, information technology, and management information systems. Click here to get a list of programs to get your management information systems degree online.

Qualifications vary by employer, but general qualifications include: broad computer systems knowledge, experience in employer's field, specific computer system knowledge, logical thinking skills, great communication and interpersonal skills, and sound problem-solving and analytical skills. Internships are appropriate for students ready to graduate, as they do not usually require any experience.

What are the prospects for a career in computer systems analysis?

Computer systems analyst jobs are projected to increase much faster than average for all occupations. There are new job opportunities expected in most related career fields. As companies and organizations continue to upgrade their technologies, excellent job prospects for computer systems analysts are expected. Employment for computer systems analysts is projected to increase by 29% from 2006 to 2016 with 146,000 new jobs. Computer systems analysts will be in high demand as companies and organizations continue to implement and incorporate new advanced technology. (1)

How much do computer systems analysts make?

According to the Bureau of Labor Statistics, the median annual salary for computer systems analysts was $75,890 in May 2007. The middle 50% earned between $56,590 and $92,420 annually. The lowest 10% earned less than $43,930 and the highest 10% earned above $113,670. (1) Computer systems design and related services, management companies and enterprises, insurance carriers, and professional and commercial equipment and supplies merchant wholesalers had the largest median yearly salaries.

A career in computer systems analysis is a great choice for you if you enjoy working in a comfortable environment in an office or laboratory and spending long periods of time working on a computer. Click here to find your path to a computer systems analyst career.

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Sports Science, 2010. http://www.pponline.co.uk/
Sports science: What have the sport scientists done for us? Craig Sharp on the interface between knowledge and p *Craig Sharp*
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Sportscience 14, 29-35, 2010 (sportsci.org/2010/wghBMS.htm)erformance

In 1990 Craig Sharp, recently described (in the BASES journal 2002) as ‘arguably the founder of sports science in the UK’, was heading up the British Olympic Medical Centre, which he had co-founded in 1987. In 1992 he was appointed to the first chair of sports science at the University of Limerick and is currently professor of sports science at Brunel University, with honorary posts at Stirling and Exeter Universities and at the International Equine Institute at Limerick. He is planning to retire soon, partly to concentrate on his life-long interest in Scottish, scientific and sports poetry.

When I first entered the world of sports science at the University of Birmingham in 1971, it was the only British university offering a degree in physical education (later sports science) in Britain. Then came Glasgow, Loughborough and Liverpool. Clyde Williams was appointed to Loughborough soon after, and for some years he and I gave lectures to packed audiences all over the country on aspects of sports physiology. The trouble was that we had to give virtually the same lecture each time, as the knowledge base of each audience at the time was quite low. I well remember Clyde saying to me after one such double act: ‘Craig, we really should stop inventing the wheel every month!’

Because I came from another profession (veterinary medicine), in which I had had some experience of racehorses and racing greyhounds, and because I had been a national runner and a professional squash player, I was especially interested in sports physiology, which I took to be the application to sport of what was known at the time about exercise physiology. A lot was known even then, researched by such famous physiologists as Nobel prizewinner AV Hill onwards, in a succession which included Roger Bannister’s 1950s work on oxygen aspects of running.

Practical application of science

Clyde Williams, Ron Maughan in Aberdeen, Bruce Davis in Salford and some others were more fundamental scientists than I was. They sought to create a good base of published research, while I was more interested in the practical application of that science to competitors and coaches.

I had co-founded the Birmingham Human Motor Performance Laboratory in the early 70s, gradually persuading a series of national squads to visit for testing and advice. These included the GB men’s artistic gymnastics squad, the sprint and slalom canoe squads, the England volleyball squad, the GB judo squad, the GB women’s and men’s squash squads and some of the GB rowers. In addition, a number of individual international competitors from track and field athletics, tennis, shooting and archery came regularly, with their coaches, for testing.

Физкультура и спорт

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However, until the mid-80s, most elite track and road runners went to the superb labs of Bruce Davis, Clyde Williams and John Humphreys (the latter working in Leeds), where the genuine expertise for running was concentrated. At the same time, Tom Reilly was making a name for himself in a variety of sports at Liverpool John Moores, as were Ed Winter at Bedford and Tudor Hale at Chichester.

Because of my involvement with Olympic squads (I had helped take 90 competitors to altitude train at St Moritz just before the 1972 Olympics and had been on the British Olympic Association's Medical Committee since 1972), I was invited in 1987 to set up the British Olympic Association's physiology laboratories at Northwick Park Hospital, whose Clinical Research Centre was one of the great medical research institutes of Europe.

My five years at the British Olympic Medical Centre (BOMC) coincided with an almost exponential growth in sports science teaching in universities throughout the country, and there are now some 150 sports science courses of various kinds in institutions around the UK.

From around 1990, when PP was founded, sport in general, but especially competition sport, came under a variety of influences all pointing the same way — towards an increasing use of sports science, first physiology but later psychology and biomechanics. In addition to the BOMC, other influences included:

- The National Coaching Foundation, especially under the brilliant guidance of Sue Campbell;
- The then British Association of National Coaches, under Geoff Gleason and John Atkinson;
- Great athletics coaches such as John Anderson, Harry Wilson and Peter Coe;
- Peter Radford and Neil Spurway with their 'physiology and sports science' course in Glasgow;
- John Brewer at Lilleshall.

Gold standards for lab testing

These and other influences, including the BASES gold standards for laboratory testing and interpretation, paved the way for a massive grassroots increase in the application of science to sport. This was paralleled by the growth and development of the British Association of Sport and Exercise Medicine, together with a major increase in diploma and masters courses in sports medicine in Scotland, England and Ireland.

In the old days, the governing bodies of various sports would send just their squads with their coaches to an accredited laboratory for appropriate testing. Now, however, increasing numbers of governing bodies employ their own sports scientists, who accompany the squads and provide even better liaison between the laboratory and the competitor and coach. At the highest elite level, some individual competitors employ their own personal sports scientists, such as the hugely experienced Joe Dunbar and Leo Faulmann.

What effect has this explosion of interest in sports science had on the sporting world itself? In sport in general, and running in particular, from club level upwards the level of knowledge is very much greater than ever before. Training has been put on a genuinely sound basis, as has nutrition and fluid

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balance before, during and after various events. Injuries can be managed and treated so that athletes stay in their sport for very much longer than, for example, in the Bannister days.

Professor Tim Noakes' book Lore of Running, in its fourth (paperback) edition last year, is an unsurpassed source of wisdom on the science and medicine of running, which should be read by every runner from the 800m distance upwards. There are also excellent books, financed by the International Olympic Committee, on the major fitness parameters and on a growing number of individual sports.

But what of the effect on performance? By comparison with the mid-80s, British running above 400m, with the astounding exception of Paula Radcliffe, has been not been notably successful. Partly, of course, this is because much of the rest of the world has latched onto very good training and sports science as well. But it is also because grass-roots athletics has withered away to a considerable extent in Britain, with the elite tending to cut themselves off from club events. For it is a sad paradox that an unprecedented explosion in knowledge about how to push the boundaries in sport has been accompanied by a parallel explosion in sedentary leisure pursuits (home computers, video, DVDs etc) that has made young people less and less eager to explore those boundaries.

Where do all the sport and exercise science graduates go? Before the second world war a classics degree was seen as a basic education, which few students ever thought to make their life's work. Sport science degrees have, to some extent, filled part of that general educational niche. A degree course with a spectrum ranging from statistical analysis and biomechanics through psychology and physiology to sports philosophy and sociology certainly offers an excellent general education, reflected in the very broad range of occupations such graduates enter.

Nevertheless, a substantial proportion of those graduates go on to work in sport or fitness, while growing numbers are absorbed into the various areas of health science. But herein lies a real problem for sport science. University departments are powerfully research driven these days in order to stay afloat financially and attract good staff and students. But the grant money for research into sport is very limited, partly because it tends to fall between stools, being perceived as too medical for the science funding bodies and too scientific for their medical equivalents. Money is available primarily for the application of sporting disciplines to health and medicine. Not for nothing did the original British Association of Sports Science become Sport and Exercise Science and the British Association of Sport and Medicine morph into Sport and Exercise Medicine.

My dream of a National Sports University for the UK

Excellent and relevant research into sport is being carried out — but not nearly as much as one would like. I used to dream of a National Sports University — Loughborough, Birmingham, Borough Road or Stirling on a grand scale, where genuine critical mass would be achieved within the major laboratory-based disciplines of physiology, psychology and biomechanics. But I don't know whether it will ever be realised.

What have been the main trends in research, and what are the outstanding challenges? In terms of running, physiological research has gradually been

balance before, during and after various events. Injuries can be managed and treated so that athletes stay in their sport for very much longer than, for example, in the Bannister days.

Professor Tim Noakes' book Lore of Running, in its fourth (paperback) edition last year, is an unsurpassed source of wisdom on the science and medicine of running, which should be read by every runner from the 800m distance upwards. There are also excellent books, financed by the International Olympic Committee, on the major fitness parameters and on a growing number of individual sports.

But what of the effect on performance? By comparison with the mid-80s, British running above 400m, with the astounding exception of Paula Radcliffe, has been not been notably successful. Partly, of course, this is because much of the rest of the world has latched onto very good training and sports science as well. But it is also because grass-roots athletics has withered away to a considerable extent in Britain, with the elite tending to cut themselves off from club events. For it is a sad paradox that an unprecedented explosion in knowledge about how to push the boundaries in sport has been accompanied by a parallel explosion in sedentary leisure pursuits (home computers, video, DVDs etc) that has made young people less and less eager to explore those boundaries.

Where do all the sport and exercise science graduates go? Before the second world war a classics degree was seen as a basic education, which few students ever thought to make their life's work. Sport science degrees have, to some extent, filled part of that general educational niche. A degree course with a spectrum ranging from statistical analysis and biomechanics through psychology and physiology to sports philosophy and sociology certainly offers an excellent general education, reflected in the very broad range of occupations such graduates enter.

Nevertheless, a substantial proportion of those graduates go on to work in sport or fitness, while growing numbers are absorbed into the various areas of health science. But herein lies a real problem for sport science. University departments are powerfully research driven these days in order to stay afloat financially and attract good staff and students. But the grant money for research into sport is very limited, partly because it tends to fall between stools, being perceived as too medical for the science funding bodies and too scientific for their medical equivalents. Money is available primarily for the application of sporting disciplines to health and medicine. Not for nothing did the original British Association of Sports Science become Sport and Exercise Science and the British Association of Sport and Medicine morph into Sport and Exercise Medicine.

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shifting towards more detailed treadmill testing for running economy, *lactate* thresholds and 'lactate minimum' levels. A major problem in assessing runners is that about 50% of the energy of each running stride is stored and released as '*elastic energy*' in tendons and ligaments, yet we are only able to measure the other 50%, which is delivered by muscle. The development of simple accurate systems for measuring elastic energy would represent a real breakthrough in running science.

Runners' fluid balance, glucose and salt requirements are reasonably well understood, thanks to Ron Maughan inter alia. Heat acclimatisation strategies are good, and there are some regimens to help athletes resist pollution.

Strategies to combat the effects of jet lag have been well researched by Tom Reilly; the principles of carbohydrate-loading are very well established; there is a growing research on creatine, and the 'new creatine' may well turn out to be carnosine, ingested to help the muscle cells buffer lactic acid internally, which is being researched by Roger Harris of Chichester.

From nutrients to supplements

Sports nutrition in general is moving on from study of the major nutrients — carbohydrate, protein and fat — to research into specific chemicals, such as glutamine to assist immune cells, and 'branched chain amino acids' to lessen central fatigue. And this is where one begins to enter the confusing realm of supplements, with all their attendant doping hazards for competitors.

Thus, the last 35 years have witnessed an accelerating groundswell of knowledge applied to sport. And in the 14 years of Peak Performance's life there has been an exponential increase in all aspects of sports knowledge in general and running in particular — of which the very existence of PP is living testimony.

Although I began this piece by listing a number of elements of 'expert input' into sport, I have focused mainly on just one of them — physiology. In their varying ways, all the other elements have made progress which is as great, or even greater, and will continue to do so.

But when it comes to factors that enhance performance, knowledge is not necessarily the most important. A major factor in the everincreasing performance in running, for example, is that the more people who run, from all nations of the world (and some parts have hardly begun to compete yet) the greater the chance of throwing up what are known in statistics as 'outliers' — those freakishly talented individuals who set world records.

Horses, through a century-old breeding programme, have exposed their species' outliers and are now being limited by physiology itself. But humans are still a very long way from reaching their physiological limits. We have by no means fully trawled the running genes of our species — let alone set about improving them!

Biomechanics and Medicine in Swimming XI: the 2010 International Symposium in Midsummer Oslo

Will G Hopkins, Tom J Vandenbogaerde

Institute of Sport and Recreation Research NZ, AUT University, Auckland 0627, New Zealand; Email. Reviewer: Kari Keskinen, Finnish Society of Sport Sciences, Olympic Stadium, FI — 00250 Helsinki, Finland.

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Abstract:
This quadrennial conference was hosted in 2010 by the Norwegian Sport University, NIH. Amongst the best performance-related presentations were a case study of a change in butterfly kicking style and large-scale longitudinal studies of talent identification and overtraining in swimmers. Novel Technologies and Analyses: pressure across the hand, active drag, computational fluid dynamics, markerless video analysis, beat the bubbles, frontal cross-sectional area, data-loggers/accelerometers, controlled trials with competitions, free simulation software. Starts and Turns: gliding, starting blocks, step starts, entry styles, underwater turn, start-time feedback, relay changeover, other starts and turns. Strokes and Kicking: limb coordination, freestyle/front crawl, butterfly. Training: reducing volume, overtraining, imagery, altitude, taper, strength. Water Polo: tests, offensive strategies. Miscellaneous: talent identification, trends and performance trajectories, skill acquisition, tests, lactate, swim suits, mushrooms. KEYWORDS: elite athletes, psychology, skill, technology, tests, training.

The 2010 quadrennial BMS conference in Oslo was memorable for the midnight twilight, the mainly wonderful summer weather, the nearby Nordic forests and lakes, the mayoral reception at the town hall, where one wall was a vast painting of Norwegians in an idyllic natural setting, and the amazing Vigeland Sculpture Park, featuring many more natural Norwegians. Is the Scandinavian attitude to nudity an evolutionary adaptation to the need for vitamin D? Also memorable and much appreciated was the thorough and thoughtful planning by our hosts at the Norwegian Sport University (Norges idrettshøgskolen, NIH), who provided an opening fanfare by a brass quartet of student musicians, a closing flute solo, free wi-fi, classy conference backpacks, and highest-quality espresso coffee throughout the conference.

And there were some great presentations! Here we report only on those with practical application to competitive swimming performance or to research thereon. If your interest is the clinical, safety, adapted, or educational aspects of swimming, peruse the book of abstracts (see below) to find the many relevant presentations.

Prizes for the best oral, poster and student presentation (the Archimedes Award) went to topics related to health and mechanisms. We had to wait for nearly the last poster on the last day for our choice of the best performance-related presentation: a case study by the coach of a top butterfly swimmer, who persevered with a change in kicking style for two years before his swimmer «got it» (to use his words) and went on to a personal best at age 30. See below. Runners-up were massive longitudinal studies of talent identification and overtraining.

Although this conference is focused on one sport, it is organized under the auspices of the World Commission of Science and Sports. WCSS is dedicated to bringing science to sport and to bridging gap between scientists and practitioners. There's a lot to be said for such specialty conferences, and this one was also just the right size: ~300 delegates (most of whom gave at least one presentation), nine unopposed keynote presentations, 125 oral presentations in three or four streams that didn't clash too badly, and 125 poster presentations. A

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To mark the 40 years since the inception of BMS, João Paulo Vilas-Boas included in his opening address a quantitative review of the contents of the previous and current conferences. The main topics have always been biomechanics, physiology and «evaluation», with medicine and other disciplines playing roles similar to those at any sport-science conference. So whether or not you are a biomechanist or a medic, if you are interested in swimming research, come to the 2014 conference. The venue was announced at the closing ceremony: the Australian Institute of Sport, Canberra, and it will be sometime near Easter.

Videos of the **keynote presentations** are now available at the Coaches Info website. The **conference abstracts** can be downloaded as a PDF from the conference website. A welcome difference from the ACSM meeting, along with the incomparable coffee, is the availability of abstracts for *all* presentations. Even more welcome, and for the first time, the volume of **full papers** will also be available free as a 10-MB PDF, the aim being to get more recognition and citations of the published work. For access to a particular paper before the password-protection is removed from the PDF, contact us. To make the most of the abstracts, we suggest you get a small group together (no more than five) with an interest in a specific stroke or topic, set up the PDF of the abstracts on a big monitor, then use the Search window (not the Find form) to link to each abstract containing an appropriate keyword. It's great fun, and you will learn things from each other, as well as from the abstracts.

In what follows, use the code number shown in brackets (…) to search the abstracts PDF for the given abstract. Text after the number represents the first few words of the title that will take you uniquely to the paper when you search for it in the full volume. *Abstract only* implies either that the authors did not submit a full paper or that the submitted paper was rejected in the peer-review process.

In evaluating effects on performance, it's important to keep in mind the changes that will improve or impair the medal prospects of a top athlete. The smallest important such change is 0.3 of the amount of variation (expressed as a standard deviation) that a typical top athlete shows from competition to competition (Hopkins et al., 1999; Hopkins et al., 2009). An elite swimmer's time varies in this way by only 0.8% (Pyne et al., 2004), so the smallest important change in swim time is 0.3 of 0.8%, or about 0.25%. Use this value even for research on subelite competitive swimmers, in the hope that the findings will apply to elites. For research on youth swimmers aimed at team selection or talent identification, the smallest effect may be better defined via standardization: 0.20 of the between-swimmer standard deviation. See Magnitude Matters for more.

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Novel Technologies and Analyses

An Italian group think they have developed the best technology yet for measuring **thrust** developed by the hand via **pressure differences** across the

hand (O-002, abstract only). Another group has developed algorithms to analyze the data from 12 pressure sensors on the hand (O-005, Prediction of Propulsive…).

You can detect left-right asymmetry and wide swings in instantaneous stroke force by measuring «**active drag**»: the tension in a line used to drag a swimmer through the water at slightly above maximum swimming speed while the swimmer swims all out (O-004, Measuring Active Drag…). This technique is not particularly new, and you can get the same information from an **instrumented tether**: synchronize it with video analysis and you can see what's going wrong. There was a good trade display of the latest version, the Torrent E-Rack, which for US$10,000 incorporates resisted training, assisted training, and synchronized video. The much simpler passive tether costs US$3000.

Bruce Mason gave only an average account of the biomechanics of **active drag** (O-006, A Method to Estimate Active…), but he redeemed himself completely in a keynote address about the biomechanical services provided to swimmers and their coaches at the **Australian Institute of Sport** in Canberra (KL-004, Biomechanical Services…). He presented a series of case studies of starts, turns, and swim strokes, where the high-tech equipment in the new pool at the AIS has been used to improve performance.

Most promising of the recent wizardry is the use of **computational fluid dynamics** (CFD) to combine the swimmer's anthropometry (from laser scan) with the swimmer's current swimming style (from video analysis) to develop a computerized mathematical model of the swimmer actively swimming through water, complete with simulations of the vortices and waves that limit speed. The model can then be used to predict ways to improve the swimmer's technique, and you try out the most promising in the pool. The method has been around for some years now, and although we got the impression that one more level of model development and computer power is needed to fully realize the potential of this approach, it was rumored that the Russians might already be there. Swimming at the next Olympics may be partly a contest between nations with the most money to spend on computers and computer programmers.

A CFD analysis of **finger positions** of an elite male swimmer reached the following conclusion (O-076, abstract only): «For hand positions in which lift force plays an important role (e.g., insweep phases), abduction of the thumb may be better, whereas at higher angles of attack… the adduction of the thumb may be preferable... Fingers [should be] slightly spread… to create more propulsive force.»

Development of **markerless automated video analysis** appears to be close to practical implementation (O-050, abstract only), the main breakthrough apparently being a statistical approach to dealing with the obscuring action of **bubbles**. Another group beat the bubbles by using a regression technique to identify limb-segment midlines in an analysis of the **dive** of 16 male elite swimmers (P-014, abstract only). Faster starters used a dolphin kick and performed deeper dives.

It's now possible to get a reasonable estimate of frontal **cross-sectional area** (responsible for drag) from an analysis of movements in the sagittal plane recorded from a single side-on camera (O-053, abstract only). We're not sure how this approach will «provide new practical insights into swimming analysis protocols».

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Apparently successful merging of video with the data stream from a 3-D accelerometer-gyroscope **data-logger** was made possible by addition of a **depth gauge** with a resolution of 10 cm to the device (O-055, Whole Body Observation…). «Wavelet analysis» also helped, but it was difficult to understand the presenter on this point. Another author claimed that «the feasibility to use **inertial sensors** [accelerometer-gyroscopes] to characterize turning, gliding and stroke resumption in swimming was verified» in eight elites doing various swim movements (O-123, Analysis of Swim Turning…). We are skeptical about the current practicality and bulk of these devices.

You can get a swimmer's **position** down to an accuracy of one frame of a 25-Hz video if you use 2-D **direct linear transformation** (DLT) analysis of footage from three cameras (O-056, The Validity and Reliability of a Procedure…).

If your team competes often in a season, and there are plenty of other teams in the competitions, and your coach wants to try some new strategy with the whole team, and the coach hasn't done anything else substantially different so far in the season, you can **use competition results** to estimate the effect of the strategy (O-073, abstract only). The uncertainty of the estimate is typically about one third of what you get from the usual controlled trials, and the outcome is as valid as it is possible to get: the effect on competitive performance. It's best done with mixed modeling.

It was demonstrated at the last BMS meeting, but the authors have updated their free **swimming simulation software** (Swumsuit), and it looks very cool indeed, at least for teaching (O-126, P-029, Advanced Biomechanical Simulations…) and possibly for research (P-030, abstract only). Downloads and more at the SWUM website.

Starts and Turns

Kinetic analysis of **gliding** combined with planimetry to determine cross-sectional area in six national-level males led the authors to recommend more emphasis on control of body position during the glides to reduce drag (O-078, Hydrodynamic Characterization…).

A new FINA-sanctioned **starting block** with side grips and a steeper angle (9° rather than 5°) appears to produce starts that would represent a substantial small effect for 50- and 100-m events in seven male swimmers (P-004, abstract only) and in 14 elite swimmers (O-083, A Biomechanical Comparison of Elite…). The authors of the latter study concluded that «coaches and athletes should spend time adapting to the new block and the new starting technique».

Step starts were statistically significantly faster than no-step starts in repeated trials of relay changeovers (O-084, Comparison among Three…), but this is one of those occasions where statistical significance of a trivial effect practically guarantees the effect isn't worth worrying about. The swimmers also made more «missed trials» (bad changeovers?) with step starts.

A randomized controlled trial of 5+5 elite swimmers compared outcomes of instruction on **pike vs flat entry** (O-086, abstract only). Both groups changed their entry style significantly, but whether the changes would have substantial effects on swim time was unclear.

Does a new «apnea» **underwater turn** (O-119, An Analysis of an Underwater…) offer any advantages for the butterfly and breaststroke? The mean

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Does a new «apnea» **underwater turn** (O-119, An Analysis of an Underwater…) offer any advantages for the butterfly and breaststroke? The mean

gain in time for the 10 swimmers was 0.07 s on average, which is not worthwhile, but apparently the swimmers had practiced the turn for only a few sessions (not stated in the abstract or full paper). So it might be worthwhile with enough practice, but only for 50- or 100-m events: the presenter mentioned that the reduction in breathing would probably impair performance in races with more than one turn.

A controlled trial of the effect of giving feedback about **start times** produced a statistically significant improvement in start time in the experimental group (O-121, abstract only), but it was done with regional-level swimmers and physed students, and in any case the gains would probably translate into a trivial effect in 50-m swim time. Inferring significance apparently via a comparison of P values in the two groups is also forbidden, although the presenting author said that this was a mistake in the abstract.

In the first of two controlled trials aimed at improving **relay changeovers** (O-122, abstract only), both groups of 13 junior elites received video feedback for the 4 d of training, but one group was given additional feedback on horizontal take-off force while the other received feedback on changeover time. The group receiving force feedback made bigger reductions in changeover time that would probably translate into medals (not enough data presented to be sure), and they made less false starts. In the other trial, eight elites practiced the traditional arm-swing start while another eight learned a single-step start. Both groups improved by a similar amount, but it's unclear from the ambiguous abstract whether the step start was better.

There was no immediate application to race times, but the following analyses may be of interest nevertheless: **backstroke start** (P-009, Biomechanical Characterization…); **flat, pike or Volkov starts** (O-085, Influence of Swimming Start…); and **gliding** (P-036, Evaluation of the Gliding…) .

Several **correlational studies** of starts or turns and performance time suffered from woefully inadequate sample sizes. Unless the relationships are very strong and therefore obvious anyway (for example, when there are novice and expert swimmers in the sample), you need hundreds of subjects to do the job properly. The only way correlation can work with samples of 10-20 is when the correlated variables are change scores derived from repeated measurements, in which the subjects spontaneously vary their technique substantially and there are substantial differences in the change in performance–see, for example, the paper on effects of tapering (P-072) reported in more detail below. It's even better when you make multiple observations on each subject, derive a slope representing the relationship between the movement and performance for each subject, then process the slopes with a simple t statistic. (See within-subject modeling for more.) Anyway, here's a quick list of the studies: kinematic analysis of **grab start** in 12 national level (and this involved stepwise regression, which is right out of the question with this sample size) (P-020, Kinematics Analysis of Undulatory…); kinematic analysis of **water-entry skill** in 14 college elites (P-024, abstract only); and kinematic and kinetic analysis of **tumble turns** in eight elite females (P-033, Biomechanical Factors Influencing…).

Strokes and Kicking

In a keynote and original-research presentation on **limb coordination** (KL-002, Inter-Limb Coordination in Swimming), Ludovic Seifert mentioned *complex systems, dynamical system theory, self-organization*, and various

gain in time for the 10 swimmers was 0.07 s on average, which is not worthwhile, but apparently the swimmers had practiced the turn for only a few sessions (not stated in the abstract or full paper). So it might be worthwhile with enough practice, but only for 50- or 100-m events: the presenter mentioned that the reduction in breathing would probably impair performance in races with more than one turn.

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constraints, although you don't have to understand these concepts to appreciate his main finding: the best swimmers achieve overlap of the propulsion phase of each arm at race pace, presumably by shortening the recovery phase of each stroke. Is there an application to performance enhancement here? Seifert also presented several original-research studies on coordination (O-044, Arm Coordination, Active Drag…; P-037, Modelling Arm Coordination…).

A string of **light-emitting diodes** down each arm facilitated automatic digitizing (P-127, Preliminary Results of…). Combined with high-speed video of four elite **freestylers**, the technique revealed that forward thrust (as determined by hip forward velocity) is maximum midway through the stroke rather than towards the end, as traditionally taught, and that these swimmers adopted an elbow angle of ~130° rather than the recommended 90°. The authors are getting a bigger sample size.

The findings were inconclusive with respect to race times, but you may have an interest in video analyses of **front-crawl** (P-005, P-035, abstracts only), and the **freestyle** in the previous paragraph.

Analysis of pressure difference across the hand combined with video of 23 varsity-level butterfly swimmers revealed **patterns of hand-force** development that led to the following conclusions: coaches can adjust entry angle to eliminate time wasted when the hands are above the shoulders, and coaches can also encourage swimmers to begin elbow flexion as soon as the entry is complete (O-111, Quantitative Data Supplements…).

The most inspirational presentation for us was the case study presented by the coach of the 100-m butterfly Asian record holder, who took two years to change his **kicking** style, then went on to set a personal best as a 30-year old (P-077, Effects of Reduced Knee-bend…). The swimmer was taught to keep his legs straight in the upbeat and to delay bending the knees until the downbeat was initiated. The presentation of the longitudinal monitoring was almost exemplary, lacking only an inferential statistic for the uncertainty in the change in performance (but the effect was so clear that it didn't matter).

Training

Continuing the long tradition initiated by Dave Costill, a group from Denmark reported on the effect of **halving training volume** and increasing training intensity for 12 weeks in a randomized controlled trial of 16+15 elite swimmers (20 male, 11 female) (O-026, P-078, abstracts only). VO2max dropped significantly by 3.8% in the experimental group compared with control. It was also apparent in the presenter's slide that performance in an all-out 200-m test also declined by about 1.5%, but it was non-significant and it was presented as no change. On the other hand, 100-m sprint performance apparently improved, but the comparison of the changes in the two groups is not in the abstract. Amazingly, the coach allowed this 12-week study to straddle the Danish national championships, but the group had not investigated the effect of the first 6 wk of the program on change in competitive performance since the previous competition. Hopefully they will, and report it using chances of benefit and harm with respect to a smallest important change of 0.25%.

In a sometimes overwhelming keynote lecture, Pierre-Nicolas Lemyre told us all about one of the biggest and best studies yet of **overtraining/burnout** (KL-006, The Psycho-Physiology of Overtraining…), involving psychometrics,

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Means and standard deviations were reported for a new **test battery** (P-094, abstract only), but there were no statistics for validity (e.g., correlation with ability of players) or reliability (e.g., test-retest correlation). The same group reported a correlational study of muscle strength and **throwing speed** with 15 players (O-038, abstract only). See our earlier comments about inadequate sample size.

Looking for patterns of play in games using sophisticated modeling may be the way of the future. Here a group used Markov chains to analyze **offensive play** in 11 games between the same two teams at a world league final (O-041, A Markov Chain Model). Their conclusion: fast breaks and intense activities of the back players are important.

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In a spectacular study of **talent identification** (O-071, Talent Prognosis…), 21 measures of fitness and anthropometry were taken on over 700 children of

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By our calculations from the full paper, **Olympic swim times** in the 2008 games were faster than predicted from the trend over previous Olympics by a large 1.7 ± 0.7 % (mean ± SD) (P-088, Identification of a Bias…). Swimsuits were surely the main reason?

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Exercise Science and Sports Studies Department, Springfield College, Springfield, MA, USA.

Abstract

The purpose of this investigation was to determine if creatine supplementation assisted with reducing the amount of exercise induced muscle damage and if creatine supplementation aided in recovery from exercise induced muscle damage. Two groups of subjects (group 1 = creatine; group 2 = placebo) participated in an eccentric exercise protocol following 7 and 30 days of creatine or placebo supplementation (20 $g.d^{-1}$ for 7 d followed by 6$g.d^{-1}$ for 23 d = 30 d). Prior to the supplementation period, measurements were obtained for maximal dynamic strength, maximal isometric force, knee range of motion, muscle soreness, and serum levels of creatine kinase (CK) and lactate dehydrogenase (LDH). Following 7 days of creatine supplementation, on day 8, subjects began consuming 6 $g.d^{-1}$ of creatine for 23 days. Additionally on days 8 and 31, subjects performed an eccentric exercise protocol using the knee extensors to

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induce muscle damage. Indirect markers of muscle damage, including maximal isometric force, knee range of motion, muscle soreness, and serum levels of CK and LDH, were collected at 12, 24, and 48 hours following each exercise bout. The results indicated that acute bouts of creatine have no effect on indirect markers of muscle damage for the acute (7 days) bout. However, maximal isometric force was greater for the creatine group versus placebo for the chronic (30 days) bout. This suggests that the ergogenic effect of creatine following 30 days of supplementation may have a positive impact on exercise induced muscle damage.

Key words: Soreness, isometric force, eccentric

Introduction

Creatine supplementation has been widely studied as an ergogenic aid relative to performance in high-intensity activities (Burke et al., 1996; Casey et al., 1996; Greenhaff et al., 1993; Harris et al., 1992; Kreider, et al., 1998; Odland et al., 1997; Terjung, et al., 2000; Volek, et al., 1999; Willoughby and Rosene, 2001). Others have examined clinical aspects of creatine supplementation such as potential adverse effects in muscle injury (Krieder, et al., 1998), thermoregulation (Kern et al., 2001; Rosene et al., 2004; Volek, et al., 2001), and renal complications (Boswell et al., 2003). These studies have led investigators to examine potential clinical benefits of creatine supplementation such as with recovery from exercise induced muscle damage (Rawson et al., 2001

Exercise-induced muscle damage has been shown to result from strenuous, unaccustomed exercise. The damage that occurs is primarily due to eccentric muscle actions and affects the structural composition of muscle leading to impairments in performance. These structural changes in muscle include mechanical factors, alterations in calcium homeostasis due to sarcoplasmic reticulum disruption, and the inflammatory response (Clarkson and Sayers, 1999).

As part of the repair process, protein synthesis is enhanced via several mechanisms including the stress proteins which have been found to be up-regulated following a bout of eccentric exercise (Willoughby et al., 2003). Creatine supplementation has also been shown to impact protein synthesis resulting in alterations in skeletal muscle composition. Twelve weeks of creatine supplementation ($25g.d^{-1}$ for 1 wk; followed by $5g.d^{-1}$ for 12 wks) resulted in increased muscle fiber cross sectional area when compared to placebo for type I (35% vs 11%), type IIa (36% vs 15%), and type IIb fibers (35% vs 6%) (Volek et al., 1999). Additionally, greater increases were found for type I, type IIa, and type IIx MHC mRNA expression for creatine supplemented individuals compared to placebo. For these changes in MHC mRNA expression, subjects were supplemented with $6g.d^{-1}$ for 90 days with no loading phase (Willoughby and Rosene, 2001).

Rawson et al., 2001 reported that 5 days of creatine supplementation ($20g.d^{-1}$) did not reduce indirect markers of muscle damage or reduce recovery time following eccentric exercise. Increased muscular strain as a result of the eccentric exercise was believed to have caused structural damage within the muscle thereby limiting creatine's effects on cellular membrane stability. As

induce muscle damage. Indirect markers of muscle damage, including maximal isometric force, knee range of motion, muscle soreness, and serum levels of CK and LDH, were collected at 12, 24, and 48 hours following each exercise bout. The results indicated that acute bouts of creatine have no effect on indirect markers of muscle damage for the acute (7 days) bout. However, maximal isometric force was greater for the creatine group versus placebo for the chronic (30 days) bout. This suggests that the ergogenic effect of creatine following 30 days of supplementation may have a positive impact on exercise induced muscle damage.

Key words: Soreness, isometric force, eccentric

Introduction

Creatine supplementation has been widely studied as an ergogenic aid relative to performance in high-intensity activities (Burke et al., 1996; Casey et al., 1996; Greenhaff et al., 1993; Harris et al., 1992; Kreider, et al., 1998; Odland et al., 1997; Terjung, et al., 2000; Volek, et al., 1999; Willoughby and Rosene, 2001). Others have examined clinical aspects of creatine supplementation such as potential adverse effects in muscle injury (Krieder, et al., 1998), thermoregulation (Kern et al., 2001; Rosene et al., 2004; Volek, et al., 2001), and renal complications (Boswell et al., 2003). These studies have led investigators to examine potential clinical benefits of creatine supplementation such as with recovery from exercise induced muscle damage (Rawson et al., 2001

Exercise-induced muscle damage has been shown to result from strenuous, unaccustomed exercise. The damage that occurs is primarily due to eccentric muscle actions and affects the structural composition of muscle leading to impairments in performance. These structural changes in muscle include mechanical factors, alterations in calcium homeostasis due to sarcoplasmic reticulum disruption, and the inflammatory response (Clarkson and Sayers, 1999).

As part of the repair process, protein synthesis is enhanced via several mechanisms including the stress proteins which have been found to be up-regulated following a bout of eccentric exercise (Willoughby et al., 2003). Creatine supplementation has also been shown to impact protein synthesis resulting in alterations in skeletal muscle composition. Twelve weeks of creatine supplementation ($25g.d^{-1}$ for 1 wk; followed by $5g.d^{-1}$ for 12 wks) resulted in increased muscle fiber cross sectional area when compared to placebo for type I (35% vs 11%), type IIa (36% vs 15%), and type IIb fibers (35% vs 6%) (Volek et al., 1999). Additionally, greater increases were found for type I, type IIa, and type IIx MHC mRNA expression for creatine supplemented individuals compared to placebo. For these changes in MHC mRNA expression, subjects were supplemented with $6g.d^{-1}$ for 90 days with no loading phase (Willoughby and Rosene, 2001).

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such, sarcolemmal and sarcoplasmic reticulum damage may have been too extensive for a 5-day supplementation protocol to have any impact (Rawson et al., 2001).

The symptoms of delayed onset muscle soreness which include strength loss, pain, muscle tenderness, stiffness, and swelling, have been reported to occur within 48 hours of damage and last beyond 5 days. Degradation of contractile proteins appears to contribute to decreases in muscular force 5-28 days post eccentric exercise (Ingalls et al., 1998). Therefore, reductions in force output immediately following a bout of eccentric exercise and up to 5 days may be related to the inflammatory response associated with cellular membrane damage (Connelly, Sayers et al., 2003). Any effects of creatine supplementation impacting myofibrillar protein content would not be evident until between the 5 and 28 day time period.

Athletes have also anecdotally reported decreased fatigue, decreased muscle soreness, and decreased recovery time while supplementing with creatine. With evidence to support increased myofibrillar protein synthesis, muscular hypertrophy, and muscular strength with creatine supplementation it is possible that creatine supplementation will have positive effects on indirect markers of exercise-induced muscle damage (Willoughby and Rosene, 2001; Volek, et al., 1999). Based on previous reports of enhanced creatine uptake with exercise and positive effects on skeletal muscle composition, (Burke et al., 1996; Casey, et al., 1996; Greenhaff, et al., 1993; Harris et al., 1993; Kreider, et al., 1998; Odland, et al., 1997; Terjung, et al., 2000; Volek, et al., 1999; Willoughby and Rosene, 2001) longer supplementation protocols may also be helpful in decreasing exercise-induced muscle damage. Therefore the purpose of this investigation was to determine the effects of 7 and 30 days of creatine versus placebo supplementation on indirect markers of muscle damage following a bout of eccentric exercise.

Methods

Subject

Twenty males, were randomly assigned to a creatine (CR) or placebo (P) group (CR = 10; P = 10). For the CR group subjects were 21.6 ± 1.65 yrs, 1.77 ± 0.07 m, 84.0 ± 8.3 kg, and 12.95 ± 4.76% body fat. For the P group subjects were 21.60 ± 0.70 yrs, 1.753 ± 0.06 m, 84.0 ± 13.4 kg, and 11.75 ± 4.72% body fat. The subjects were physically active (consistent physical activity for 6 months prior to beginning the study) and free of creatine supplementation for at least 60 days prior to beginning the study. All subjects were required to read and complete a medical history form to ensure that eligibility criteria were met. All subjects were informed of the purpose and possible risks involved in the investigation and were required to read and sign an informed consent prior to participation. All procedures were approved by the University Institutional Review Board.

Blood sampling

For serum creatine kinase (CK) and lactate dehydrogenase (LDH), blood was drawn from the antecubital vein into a 10 mL collection tube via a Vacutainer apparatus. The blood samples stood for 10 min, were centrifuged to extract the

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serum and frozen at -20°C for later analysis. Blood samples were obtained prior to each eccentric exercise bout and also at 12, 24, and 48 hours post-exercise. Serum CK and LDH were analyzed via reflectance spectrophotometry with the dry-chemistry technique utilizing the DT60 II Chemistry System (Orthoclinical Diagnostics, Raritan, NJ) at 680 nm (CK) and 340 nm (LDH) following manufacture's guidelines.

Muscle strength assessment

Maximal dynamic strength (MDS) of the dominant (acute) and non-dominant (longer-term) thigh was assessed using a Body Masters (Rayne, LA) seated leg extension machine via a standard one repetition maximum (1-RM) test prior to the eccentric exercise protocol. The concentric 1-RM measure was used to determine the eccentric load of 150% of the concentric 1-RM. A maximum of four sets was used to determine the 1-RM in order to counteract muscle fatigue (Willoughby and Pelsue, 1998; Willoughby and Rosene, 2001).

Maximal isometric force (MIF) was determined using the Biodex System 2 (Shirley, NY) isokinetic dynamometer. Subjects were seated with the leg positioned at approximately 45° of knee flexion. The Biodex was set at 0° per second or in isometric mode and the subject performed 3 maximal isometric contractions with 1 minute rest between trials. The average score was used as the criterion.

Knee range of motion and muscle soreness

Knee range of motion (KROM) was assessed using standard goniometric techniques with the subject in the prone position (Norkin and White, 1995). The evaluator passively moved the involved knee into the flexed position (heel moving towards the buttocks) while the hips were maintained in neutral. The position of the knee at which the subject attempted to lift the hips off the table or indicated maximal knee motion was used as the measurement

Perceived muscle soreness (SOR) was assessed by each subject placing a mark along a 25.4 cm continuum, with 0 indicating no muscle soreness and 25.4 cm indicating very, very sore (Willoughby et al., 2003)

Testing protocol

Two groups of subjects (group 1 = creatine; group 2 = placebo) participated in an eccentric exercise protocol following 7 and 30 days of creatine or placebo supplementation. Prior to the supplementation period, baseline measures were obtained for MDS, MIF, KROM, SOR, and serum levels of CK and LDH.

Following the 7 days of creatine supplementation (20 $g.d^{-1}$), on day 8 (acute effect), subjects began consuming 6 $g.d^{-1}$ of creatine for 29 days. Additionally on day 8, subjects performed a knee extension eccentric exercise protocol to induce muscle damage of the knee extensors. The eccentric exercise protocol consisted of a warm- up bout of 1 set of 10 repetitions at 50% of the previously determined concentric 1-RM. Subjects then performed 7 sets of 10 repetitions at 150% of the concentric 1-RM using eccentric contractions, with each repetition lasting 2-3 seconds and 15 seconds rest between each repetition. A 3 min rest was employed between each set (Willoughby et al., 2003). Subjects were required to refrain from strenuous exercise 3 days prior to the exercise bout. Indirect markers of

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muscle damage including MIF, KROM, SOR were assessed at 12 hours post-eccentric exercise and every 24 hours thereafter for 5 days (Rawson et al., 2001). Blood samples were obtained prior to each eccentric exercise bout and also at 12, 24, and 48 hours post-exercise. After 30 days of supplementation, on day 31 (longer-term effect), subjects repeated the knee extension eccentric exercise protocol on the non-dominant leg to counteract the repeat bout effect. To determine the correct eccentric load, the concentric 1-RM of the non-dominant leg was assessed on day 21 of the supplementation period, in addition to all other measures, following procedures previously described. Measurements for indirect markers of muscle damage on the non- dominant leg were repeated at 12 hours post-eccentric exercise and every 24 hours thereafter for 5 days (Rawson et al., 2001). Blood samples were obtained prior to each eccentric exercise bout and also at 12, 24, and 48 hours post-exercise. Subjects were instructed to consume a normal mixed diet throughout the duration of the study. During the 36 day study period, subjects completed four, 3-day dietary recalls for analysis of nutrient intake. Additionally, subjects were required to refrain from any additional strenuous activity (increasing exercise duration, intensity, beginning a new exercise regimen, etc). Normal daily activities and/or exercise were permitted.

Statistical analysis

Before analyses of the dependent variables, independent group t-tests were performed to ensure that the creatine and placebo groups were similar across diet. Analyses were preformed individually for the acute and chronic conditions. For both conditions, 2 X 7 ANOVAs with time as the repeated factor were computed to examine interactions or differences among the independent variables. The independent variables included the treatment groups (creatine or placebo) and time (pre to day 5). The dependent variables were MIF, KROM, and SOR. In addition, 2 X 4 ANOVAs with time as a repeated factor were computed for LDH and CK for both acute and chronic phases. The levels for time included pretest up to 48 hr. The alpha level was set at 0.05 and when post hoc analyses were performed, the Bonferroni adjustment was used to adjust for multiple analyses. Results

Results

The independent group t-tests for dietary intake of carbohydrate, protein and fat was not significantly different ($p > 0.05$) for the two groups. It was therefore determined that the groups were similar for dietary intake

Acute condition: No significant ($p > 0.05$) difference or interaction was found for KROM. For MIF and SOR only significant ($p < .05$) time differences were found. With respect to MIF, 12 hr was significantly less than days 3, 4, and 5. For SOR, pre test scores were significantly less than hr 12, 24 and 48; 12 hr was significantly greater than days 4 and 5. In addition, 48 hr was significantly greater than days 3, 4, and 5; and lastly, day 3 was significantly greater than days 4 and 5. LDH and CK were not significantly different across time or group ($p > 0.05$

Chronic condition: KROM, and LDH were not significantly ($p > 0.05$) different with respect for group or time. SOR was significantly ($p < 0.05$) different across time. Pre test scores were significantly less than hours 12, 24, and 48. Hour 24 was significantly greater than day 5; and hr 48 and day 3 were

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significantly greater than days 4 and 5. CK was significant ($p < 0.05$) across time. Pre test scores were significantly less than hours 12, 24, and 48.

For the chronic MIF data, one subject was eliminated for the analyses. Values for the subject were not considered within normal values for MIF. For MIF there was a significant ($p < 0.05$) time and treatment effect. For the time effect, MIF scores were significantly lower at 12 hours versus hours 24 and 48 and days 3, 4, and 5. Hour 24 MIF scores were significantly lower than days 3, 4, and 5. At 48 hours MIF scores were significantly greater than at 12 hours and days 4 and 5. On day 3 MIF scores were significantly greater than at 12 and 24 hours. On days 4 and 5 MIF scores were significantly greater than 12, 24, and 48 hours. For the treatment effect, MIF scores for the creatine group were significantly greater versus the placebo group.

Discussion

This investigation examined the acute and longer-term (chronic) effects of creatine supplementation on exercise-induced muscle damage. Anecdotal reports have indicated that individuals supplementing with creatine have a decreased recovery time during and following exercise, subsequently these individuals report greater/more effective exercise sessions. The consequences of exercise-induced muscle damage particularly that of eccentric exercise, include a myriad of events that lead to reductions in muscle force, increased soreness, and impaired muscle function (Thompson et al., 2001). Therefore strategies utilized to reduce the negative effects of exercise-induced muscle damage would have great benefit to those wishing to maximize performance.

As a result of exercise- induced muscle damage, there is injury to the cell membrane which triggers the inflammatory response leading to the synthesis of prostaglandins and leukotrines (Connolly et al., 2003). Additionally, alterations in sarcolemmal and sarcoplasmic reticulum membranes are evident. This damage may result in increased intracellular calcium levels which may be associated with muscle degradation. As such, ingestion of exogenous creatine may provide protective effects via increased phosphocreatine synthesis which may aid in stabilizing the sarcolemmal membranes and thereby reducing the extent of damage (Rawson et al., 2001).

In the current investigation only MIF following the chronic condition resulted in creatine having greater MIF versus placebo. This suggests that the creatine supplementation may reduce the extent of muscle damage when supplementing for more than 30 days. However, since no other indices of muscle damage resulted in differences between creatine and placebo, it is plausible that since these subjects were active males, that an ergogenic effect of creatine supplementation may have occurred. Previous investigators have reported increases in muscle fiber size and molecular changes with 12 weeks of creatine supplementation (Volek et al., 1999; Willoughby and Rosene, 2001). These investigations incorporated a resistance training program that contributed to the resultant changes. In the present investigation subjects were not required to refrain from training, therefore there was the potential for similar ergogenic effects. The resultant muscle force differences in the chronic condition support an ergogenic benefit, while the results from the acute condition are similar to previous reports with short-term supplementation (Rawson et al., 2001).

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Neural factors such as enhanced neural recruitment patterns, enhanced motor unit synchronization and increased excitability of the ?-motor neuron have been attributed to strength gains early in a training program, the first 6-8 weeks. In addition, there appear to be intramuscular structural adaptations, including muscular hypertrophy and fiber type conversion (type IIb converts to type IIa) that occurs during 6 weeks of training (Staron et al., 1994). Creatine supplementation has been found to enhance intramuscular adaptations to strength training both at the fiber and molecular level (Volek et al., 1999; Willoughby and Rosene, 2001

In the present investigation, it is plausible to expect that increased MIF scores resulted in part due to neural adaptations. However, the creatine group exhibited a greater increase in MIF versus the placebo group in the chronic condition. Therefore an ergogenic benefit of creatine supplementation is the most plausible explanation for differences in MIF. Ingalls, Warren, and Armstrong (1998) reported that decreased muscle force following muscle damage is a result of proteolysis at days 14 and 28 post damage. Early decrements in force (within 5 days of damage) were not attributed to proteolysis. The MIF differences between Cr and P conditions at 30 days post damage may be explained by enhanced protein synthesis versus degradation, most likely within the MHC as previously reported (Ingalls et al., 1998; Willoughby and Rosene, 2001

Previous research has shown positive effects of creatine supplementation on muscle protein synthesis (Willoughby and Rosene, 2001). In the event that there is increased protein synthesis, and therefore reduced proteolysis, then creatine supplementation may have a positive influence on performance when muscle damage occurs. Traditional supplementation protocols have been utilized to rapidly increase muscle creatine levels (Harris et al., 1992; Hultman et al., 1996) and then maintain these levels (Robinson, 2000). Therefore, the protocols have been divided into a loading and maintenance phase. The loading phase is incorporated to rapidly increase muscle creatine levels by as much as 20%.(Harris et al., 1992). The maintenance phase allows for these increased muscle creatine levels to remain for the duration of supplementation. Any positive effects of creatine on the attenuation of muscle damage may be found under such supplementation conditions.

Indices of muscle damage, other than MIF, did not differ between the creatine and placebo conditions. However, the resultant time effects were consistent with the progression of recovery from muscle damage. It has been shown that muscle creatine levels show increases in just 2 days (Vandenderghe et al. 1999) and that signs and symptoms of muscle damage present within 48 hours of the event (Connolly et al., 2003). In the present investigation under both acute and chronic conditions there was evidence of symptoms of muscle damage within the 48 hour period, particularly SOR. These findings are similar to Rawson et al., 2001 who reported symptoms of muscle damage however, no difference between creatine and placebo groups following 5 days of creatine supplementation at 20 $g.d^{-1}$.

The elevations of CK during the chronic condition may be indicative of using the non-dominant leg for the subsequent muscle damage bout. Increased CK in blood is a result of eccentric exercise which is unfamiliar to the muscle or muscle group, (Clarkson and Tramblay, 1992; Rawson et al., 2001) therefore CK

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elevations in the non-dominant compared to the dominant leg would be expected. Additionally, the CK elevations in the chronic condition suggest increased sarcolemmal or sarcoplasmic reticulum membrane damage. Since the non-dominant leg was used to induce muscle damage in the chronic condition, increased CK is most likely due to greater sarcolemmal and sarcoplasmic reticulum membrane instability as a result of mechanical stress from the eccentric exercise (Rawson et al., 2001).

Conclusion

In summary, short-term creatine supplementation did not appear to attenuate the effects of exercise induced muscle damage when compared to placebo treatments. However, the long-term effects appeared to have had an ergogenic effect on muscle when muscles were subjected to isometric force development. Anectdotal reports of attenuation of muscle damage and decreased recovery time may be associated with the increased energy availability of PCr associated with creatine supplementation, as well as the possible molecular changes in muscle. The eccentric protocol utilized in the current investigation and that of Rawson et al., 2001 were designed to create situations of significant muscle damage. Therefore the possibility exists that creatine's ergogenic effects on muscle may require greater than 7 days to positively impact muscle damage. Future studies may need to focus on lesser amounts of exercise induced muscle damage, such as may occur with regular weight-bearing athletic type activity, for short-term creatine supplementation protocols to see a potential benefit of creatine supplementation in decreasing recovery time and attenuating exercise induced muscle damage. In addition, longer-term supplementation protocols should investigate additional muscle performance measures, such as dynamic strength, to determine if muscle damage is attenuated or is recovery time decreased due to the ergogenic effects of creatine supplementation.

Acknowledgments

The creatine and placebo supplements were provided by AST Sports Science, Golden, CO, USA. All experimental procedures comply with the current laws of the United States.

Key points

- Eccentric muscle actions highly associated with exercise induced muscle damage.
- Creatine supplementation has ergogenic effect to increase protein synthesis.
- Creatine supplementation does not attenuate exercise induced muscle damage with short term supplementation (7 days).
- Increased maximal isometric force seen with creatine supplementation after 30 days following exercise induced muscle damage.
- Ergogenic effect of creatine supplementation may contribute to reduced exercise induced
- muscle damage.

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Recovery training: the importance of recovery and various recovery strategies you should implement

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The importance of recovery for sportsmen and women of all disciplines

James Marshall MSc, CSCS, ACSM/HFI, runs Excelsior, a sports training company

http://www.pponline.co.uk/encyc/recovery-training-the-importance-of-recovery-and-various-recovery-strategies-you-should-implement-42448

When planning training programmes for athletes, it is easy to write down sets, reps, times, volumes, intensities and loads. However, structuring a recovery programme to effectively allow adaptation to take place between training sessions is a lot trickier, as James Marshall explains

Before we look at how recovery can be optimised, it's important to understand why it's important. This is crucial for both coaches and athletes; coaches because they are going to have to plan time and resources to assist recovery, and athletes because they are going to have to implement the strategies. According to 'supercompensation theory' (see figure 1), after the body has been exposed to a stressful situation, providing that adequate recovery has taken place, it will adapt and become stronger(1). Without further exposure to this stimulus, the body will soon return to its previous state. However, if further training takes place during the supercompensation phase, then more work or higher intensities can be tolerated. But if training takes place too soon, recovery is incomplete, less work can be done and the athlete risks fatigue, injury or burnout

Fatigue comes in different forms, including central, peripheral neural, hormonal and psychological; the recovery process therefore needs to target all these different areas. Different aspects of fatigue require different amounts of recovery, and it is very difficult to balance these recoveries. For example, competing in a final of a competition may actually be physically easier than a training session, but the emotional, psychological and hormonal stress will be much greater and this should be taken into account when planning post-competition training.

Where recovery is useful is in trying to reduce the time between training stimulus and supercompensation. Inadequate recovery strategies will mean that you're not prepared to train at the next session; instead of enhancing training status, another session actually puts you back. There are some times when inadequate recovery might be planned, such as on a training camp for a few days, but this must then be followed by a few easier days to allow supercompensation to take place. However, during hard competitive phases of the season, time might be one thing the coach doesn't have, so enhancing the recovery becomes crucial.

Comparing recovery strategies

Which recovery strategies are best in a realistic training environment? Researchers from Australia looked at recovery interventions on netball players following a simulated netball circuit training session(2). The players performed the same circuit on two consecutive days and followed one of four recovery interventions:

- Passive recovery;
- Active recovery;
- Cold water immersion (CWT);
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- Passive recovery;
- Active recovery;
- Cold water immersion (CWT);
- Contrast water therapy.

All four of the interventions were performed for 15 minutes, with the passive recovery group sitting still for all that time. The active recovery group performed low intensity exercise at 40% of their maximum oxygen uptake (*VO2max*), while the cold water immersion subjects sat in a cold bath (9.3C) up to the top of their hip bone for 5 minutes, followed by 2.5 minutes out of the bath — repeated twice. The contrast water therapy group also sat in a similar temperature bath, but this time for 1 minute, then had a warm shower (39.1C) for 2 minutes and did this five times in total.

Recovery was assessed by subsequent performance (20m sprints, vertical jumps and total circuit time) as well as measurements of *lactate*, heart rates, ratings of perceived exertion and muscle soreness. The results showed that there was no difference statistically in performance on the two circuits or on the physical measurements for any of the recovery interventions (the fact that there was a whole 24 hours of recovery time between the two sessions may account for this, and that the circuit was challenging, but not maximal).

However, there was a difference in perceptions of recovery; the subjects who did cold water immersion and contrast water therapy perceived themselves as better recovered. This may be important as it shows the relevance of mental recovery in the process. It also highlights the need to keep recovery strategies tuned to the individual.

Compression clothing

Another study on netball players also found no difference in performance following an intervention — this time using compression tights(5). The subjects did five sets of 20 drop-jumps from a 60cm height, followed by an immediate jump up as high as they could, with a 2-minute rest between sets. The two recovery interventions were either wearing compression tights for 48 hours afterwards or just wearing normal clothing.

The results showed that there was no difference in performance between the groups in subsequent sprint tests; both groups ran slower 48 hours after the drop jumps than before. However, perceived muscle soreness was lower in the compression garment group compared to the *control* group after 48 hours. There was also a slight reduction in CK levels (see box 2, below) in the female compression garment group after 24 hours compared to the controls, but no difference after 48 hours. Moreover, subjects who used compression tights reported that the tights were uncomfortable at night, as they raised their body temperature and disrupted their sleep.

By contrast, a study on New Zealand provincial rugby players found that compression garments did help reduce CK levels compared to passive recovery(7). Contact sports such as rugby and boxing have been shown to produce higher levels of CK following the match, than in similar training sessions with no contact(8,9) so CK is definitely a useful marker of measuring fatigue in these sports.

The rugby players followed one of four recovery protocols post match:

- Passive recovery (sitting on the bench for 9 minutes);
- Active recovery (7 minutes' cycling on a stationary bike at 80-100 rpm);
- Contrast water therapy (CWT — 3 sets of sitting in a bath of cold water [8-10C] for 1 minute followed by hot water [40-42C] for 2 minutes);
- Compression garments — wearing compression pants for 12 hours post-match.

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CK levels were measured immediately post match and then subsequently at 36 and 84 hours post match. A comparison between peak levels and the levels at 84 hours was then made. The fastest recovery was found in the active group, with the CWT and compression groups also showing fast levels of recovery. The passive condition showed the slowest level of recovery by some degree.

The nature of science investigations is to isolate one intervention at a time and to compare each intervention against a control group. However, it's interesting to speculate if a combination of active recovery and CWT or compression garments worked better than one intervention alone. What is clear in this study was the short duration of all the post-match interventions; it could be surmised that a longer active recovery session would have resulted in an even further reduction in CK levels at 36 and 84 hours post match.

Implementing a recovery strategy

Coaches and athletes tend to fall into one of two camps: the 'throw every resource we have at this, and implement everything together' camp or the 'let them get on with it' camp. If you are a recreational athlete who trains on a Tuesday and Thursday, and competes on a Saturday, then you will have about 48 hours between sessions to recover naturally. Muscle *glycogen* can be restored through normal eating and most indicators of muscle damage such as creatine kinase will probably have returned to normal levels before your next training session. In short, recovery will likely take care of itself!

However, if you train or compete more frequently, then you'll need to do something to aid the recovery process. If you're a coach, it is probably best to have some 'non negotiable' recovery processes in place for the whole team:

- An active warm-down immediately after competition/practice has finished;
- Fluid and fuel replacement within 15 minutes of finishing the session;
- Some form of water therapy such as showers, contrast showers, contrast bathing, depending on facilities;
- A proper meal within two hours of finishing.

Depending on budget and the distance to travel home, compression garments could also be useful. Wearing compression tights is easy enough (although there is an initial cost) and many athletes like the comfort of wearing them. However, they shouldn't be worn at night because they can potentially disrupt sleep, which will hinder recovery. Table 1 shows the pros and cons of different recovery strategies.

Other factors

The importance of nutrition in recovery is beyond the remit of this article (this topic has been covered extensively in previous issues of PP). However, it's important to understand that carbohydrate, fluid and protein replacement is critical for speedy recovery. So, when looking at the physical aspects don't forget that they will be more effective with fuel and fluid intake. The importance of sleep should also not be overlooked; if all else fails, getting a good night's sleep should be first in the athlete's mind!

Remember, too, that the psychological and social aspects of recovery are also important in the recovery process. The individual's social and psychological preferences when recovering need to be taken into account. For example, some athletes might relax by taking a trip to the park as a group. For others, spending even more time with teammates could be an additional stressor and hinder the recovery process, so quiet time with a book or listening to music may be more

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appropriate. So-called ‘team building’ sessions maybe counterproductive for some athletes; stress can be created if these sessions take them away from their home environment for too long, causing relationship stresses, or placing them with teammates for longer than usual!

The use of CWT is also interesting, as plunging into a cold bath may not be to everyone’s tastes and could add to the stress of post-match trauma. The sudden immersion into cold water stimulates the sympathetic nervous system and actually invigorates the athlete. Gradual cooling may be more suitable for some because it stimulates the parasympathetic system and will calm the athlete down(10). It’s also worth adding that although other forms of heat therapy, such as saunas and jacuzzis, may feel relaxing if used a few hours after training, they should not be used immediately afterwards as they encourage dehydration.

Adaptation and personal preferences

As with any other form of training, adaptation to the recovery strategies will take place. The more you use a form of recovery, the more likely it is that after a certain amount of time, you will adapt, which will reduce the response and benefits. Instead, coaches should get their athletes familiar with recovery strategies such as CWT, but only in small doses. Then at the time of most need, such as in a tournament phase, you can use it much more intensely so that it stimulates the recovery process.

However, it’s important to emphasise that a successful recovery strategy needs to consider the athlete’s personal preferences, with the athlete being involved in planning their recovery strategies throughout the season and off-season. Of course this has to be done in conjunction with the coach and other support staff, but the athlete has to be familiar with and 100% comfortable with the choices made. If a coach introduces new methods the day before a competition, it will only lead to more stress for the athletes.

Summary

Recovery is essential in order to allow the body to adapt to the stresses of training and competition. Simply doing nothing may be okay for those who train two or three times a week, but for more serious athletes and those involved in contact sports, a recovery plan has to be put into place. The other tools here are important, but without good nutrition, sleep and relaxation they will be of limited value.

References

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http://www.liv.ac.uk/Chemistry/Links/links.html
The Basics of Organic Chemistry

Introduction
What is Organic Chemistry?

The word **Organic** is one of the most overused in the English language.

People use it as a derogatory term in phrases like **Don't eat that; it's not organic**. Of course, there is a precise scientific definition of the word. In science, Organic can be a biological or chemical term. In Biology it means any thing that is living or has lived. The opposite is Non-Organic. In Chemistry, an Organic compound is one containing **Carbon** atoms. The opposite term is **Inorganic**.

It's the Chemical meaning I want to explore in this essay.

Molecules

All substances are made up of **molecules** which are collections of atoms. All the molecules in existence are made up of about a hundred different kinds of atoms.

For example, a **water** molecule is composed of two atoms of Hydrogen and one atom of Oxygen. We write its formula as $\mathbf{H_2O}$.

A molecule of **Sulphuric Acid** contains two atoms of Hydrogen, one atom of Sulphur and four atoms of Oxygen. Its formula is $\mathbf{H_2SO_4}$.

These are simple molecules containing only a few atoms. Most Inorganic molecules are small. Below are a few common inorganic substances with their formulas.

Name of Substance	**Formula**
Carbon Dioxide	CO2
Salt	NaCl
Nitric Acid	HNO3
Laughing Gas	N2O
Ammonia	NH3
Saltpetre (used in gunpowder)	KNO3
Carbon Monoxide	CO
Potassium Permanganate (used in labs)	KMnO4
Calcium Carbonate (chalk)	CaCO3

All of these molecules have less than a dozen atoms.

The symbols Ca, K, Mn, Na and Cl stand for calcium, potassium, manganese, sodium and chlorine.

Molecules With Carbon

Most atoms are only capable of forming small molecules. However one or two can form larger molecules.

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Molecules With Carbon

Most atoms are only capable of forming small molecules. However one or two can form larger molecules.

By far and away the best atom for making large molecules with is **Carbon**. Carbon can make molecules that have tens, hundreds, thousands even millions of atoms! The huge number of possible combinations means that there are more Carbon compounds that those of all the other elements put together!

A single Carbon atom is capable of combining with up to four other atoms. We say it has a valency of 4. Sometimes a Carbon atom will combine with fewer atoms.

The Carbon atom is one of the few that will combine with itself. In other words Carbon combines with other Carbon atoms.

This means that Carbon atoms can form **chains** and **rings** onto which other atoms can be attached.

This leads to a huge number of different compounds. Organic Chemistry is essentially the chemistry of Carbon

Carbon compounds are classified according to how the Carbon atoms are arranged and what other groups of atoms are attached.

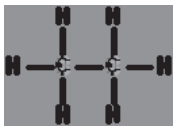
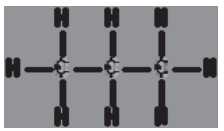
Hydrocarbons

The simplest Organic compounds are made up of only **Carbon** and **Hydrogen** atoms only. Even these run into thousands! Compounds of Carbon and Hydrogen only are called **Hydrocarbons**.

Please note that the molecule structure images below show the structure of three dimensional molecules in two dimensional format.

Alkanes

The simplest Hydrocarbon is methane, **CH_4**. This is the simplest member of a series of hydrocarbons. Each successive member of the series has one more Carbon atom than the preceeding member. This is shown in the table below.

Formula	Structure	Name / Uses
CH_4		**Methane** — gas used for cooking.
C_2H_6		**Ethane**
C_3H_8		**Propane** — heating fuel.

By far and away the best atom for making large molecules with is **Carbon**. Carbon can make molecules that have tens, hundreds, thousands even millions of atoms! The huge number of possible combinations means that there are more Carbon compounds that those of all the other elements put together!

A single Carbon atom is capable of combining with up to four other atoms. We say it has a valency of 4. Sometimes a Carbon atom will combine with fewer atoms.

The Carbon atom is one of the few that will combine with itself. In other words Carbon combines with other Carbon atoms.

This means that Carbon atoms can form **chains** and **rings** onto which other atoms can be attached.

This leads to a huge number of different compounds. Organic Chemistry is essentially the chemistry of Carbon

Carbon compounds are classified according to how the Carbon atoms are arranged and what other groups of atoms are attached.

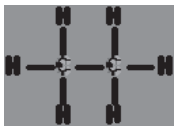
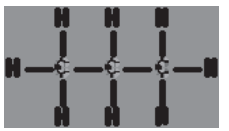
Hydrocarbons

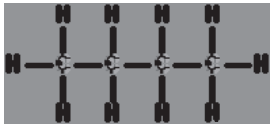
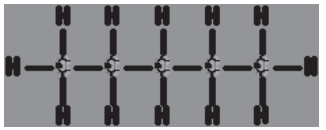
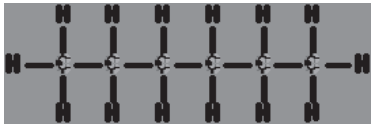
The simplest Organic compounds are made up of only **Carbon** and **Hydrogen** atoms only. Even these run into thousands! Compounds of Carbon and Hydrogen only are called **Hydrocarbons**.

Please note that the molecule structure images below show the structure of three dimensional molecules in two dimensional format.

Alkanes

The simplest Hydrocarbon is methane, **CH_4**. This is the simplest member of a series of hydrocarbons. Each successive member of the series has one more Carbon atom than the preceeding member. This is shown in the table below.

Formula	Structure	Name / Uses
CH_4		**Methane** — gas used for cooking.
C_2H_6		**Ethane**
C_3H_8		**Propane** — heating fuel.

C_4H_{10}		**Butane** — lighter / camping fuel.
C_5H_{12}		**Pentane**
C_6H_{14}		**Hexane**

As the reader can see, there is a series of these compounds with this general formula:

C_nH_{2n+2}

This series of compounds are called **alkanes**. The lighter ones are gases and used as fuels. The middle ones (7 Carbons to 12 Carbons) are liquids used in petrol (gasoline). The higher ones are waxy solids. Candle wax is a mixture of alkanes.

After **Butane**, the names of these compounds are from the Greek for the number of Carbon atoms followed by the suffix **-ane**. So, **Decane** would have the formula

$C_{10}H_{22}$.

Polythene is a very large alkane with millions of atoms in a single molecule. Apart from being flammable, alkanes are stable compounds found underground.

In the alkanes, all four of the Carbon valency bonds are taken up with links to different atoms. These types of bonds are called **single bonds** and are generally stable and resistant to attack by other chemicals. Alkanes contain the maximum number of Hydrogen atoms possible. They are said to be **saturated**.

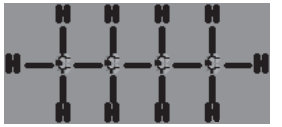
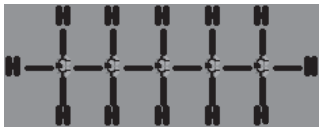
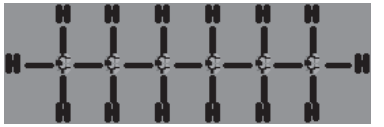
The alkanes are not the only hydrocarbons.

Alkenes

Another series of compounds is called the **alkenes**. These have a general formula:

C_nH_{2n}.

Alkenes have fewer hydrogen atoms than the alkanes. The extra valencies left over occur as **double bonds** between a pair of Carbon atoms. The double bonds are more reactive than single bonds making the alkenes chemically more reactive.

C_4H_{10}		**Butane** — lighter / camping fuel.
C_5H_{12}		**Pentane**
C_6H_{14}		**Hexane**

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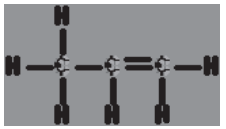
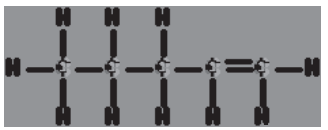
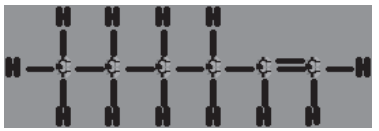
The simplest alkenes are listed in the table below:

Formula	Structure	Name / Uses
C_2H_4		**Ethene** — used as an industrial starter chemical.
C_3H_6		**Propene**
C_4H_8		**Butene**
C_5H_{10}		**Pentene**
C_6H_{12}		**Hexene**

These compounds are named in a similar manner to the alkanes except that the suffix is **-ene**.

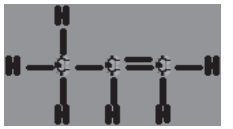
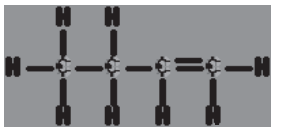
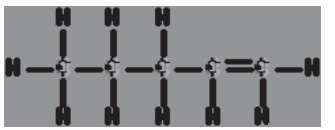
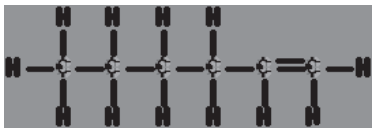
Alkynes

A third series are the **alkynes**. These have the following formula:
(C_nH_{2n-2}).

Alkynes have two carbon atoms joined by a tripple bond. This is highly reactive making these compounds unstable.

Examples of alkynes are:

The simplest alkenes are listed in the table below:

Formula	Structure	Name / Uses
C_2H_4		**Ethene** — used as an industrial starter chemical.
C_3H_6		**Propene**
C_4H_8		**Butene**
C_5H_{10}		**Pentene**
C_6H_{12}		**Hexene**

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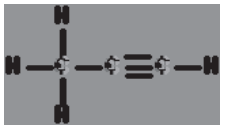
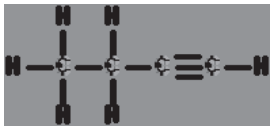
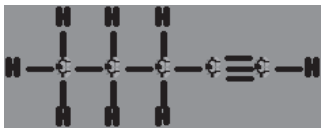
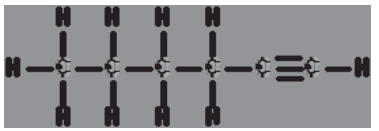
(C_nH_{2n-2}).

Alkynes have two carbon atoms joined by a tripple bond. This is highly reactive making these compounds unstable.

Examples of alkynes are:

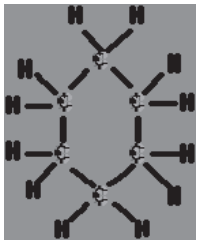
Formula	Structure	Name / Uses
C_2H_2		**Ethyne** — better known as **acetylene** which is used for welding underwater.
C_3H_4		**Propyne**
C_4H_6		**Butyne**
C_5H_8		**Pentyne**
C_6H_{10}		**Hexyne**

These highly reactive substances have many industrial uses.

Again the naming of these compounds is similar to the alkanes except that the suffix is **-yne**.

Carbon Rings

Alkanes, alkenes and alkynes all contain Carbon atoms in linear chains. There are also hydrocarbons arranged in rings. Some examples follow:

Formula	Structure	Name / Uses
C_6H_{12}		**Cyclohexane** — a saturated hydrocarbon with the atoms arranged in a hexagonal ring. In organic chemistry, the presence of Hydrogen atoms is often assumed and this compund can be reprsented by a hexagonal ring: 

Formula	Structure	Name / Uses
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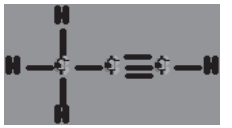
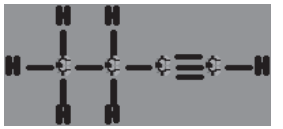
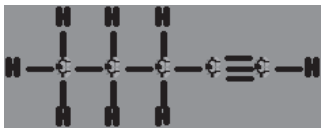
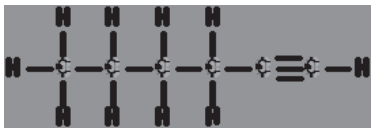
C_3H_4		**Propyne**
C_4H_6		**Butyne**
C_5H_8		**Pentyne**
C_6H_{10}		**Hexyne**

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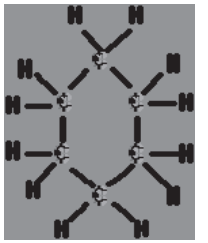
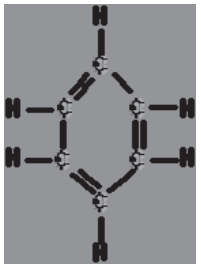
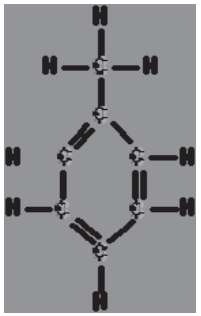
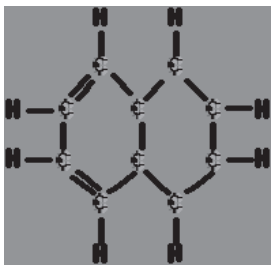
C_6H_{12}		**Cyclohexane** — a saturated hydrocarbon with the atoms arranged in a hexagonal ring. In organic chemistry, the presence of Hydrogen atoms is often assumed and this compund can be reprsented by a hexagonal ring: 

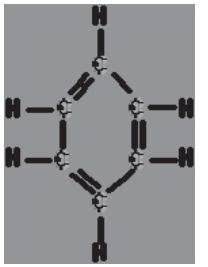
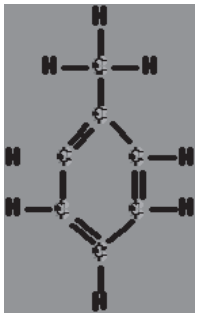
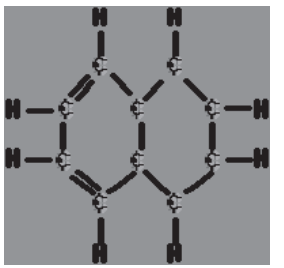
C_6H_6		**Benzene** — an industrial solvent. The Benzene Ring is one of the most important structures in organic chemistry. In reality, its alternate double and single bonds are «spread around» the ring so that the molecule is symetrical. This structure is represented by a hexagon with a circle: 
C_7H_8		**Toluene** — an important solvent and starter chemical. Using the Benzene Ring, this molecule can also be depicted as: 
$C_{10}H_8$		**Naphthalene** — used in moth balls. This can be depicted as two fused Benzene Rings: 

When rings are combined with chains, the number of hydrocarbons is virtually infinite.

And we are still using only two types of atoms (Carbon and Hydrogen). We will now add a third.

Carbon, Hydrogen and Oxygen

When Oxygen atoms are added, the variety of compounds grows enormously. In the table, each row discusses a series of compounds.

C_6H_6		**Benzene** — an industrial solvent. The Benzene Ring is one of the most important structures in organic chemistry. In reality, its alternate double and single bonds are «spread around» the ring so that the molecule is symetrical. This structure is represented by a hexagon with a circle: 
C_7H_8		**Toluene** — an important solvent and starter chemical. Using the Benzene Ring, this molecule can also be depicted as: 
$C_{10}H_8$		**Naphthalene** — used in moth balls. This can be depicted as two fused Benzene Rings: 

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See this table in: http://www.liv.ac.uk/Chemistry/Links/links.html

In the examples (http://www.liv.ac.uk/Chemistry/Links/links.html), each molecule has a single functional group.

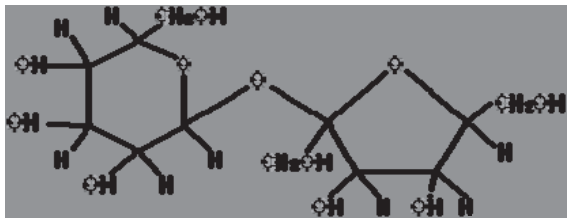
It is possible to have two or more functional groups on a molecule. These can be the same group (as in Oxalic Acid — a poison found in rhubarb leaves — which has two fatty acid groups) or different (as in Hydroxymethanoic Acid — which has a hydroxyl group and a fatty acid group):

$(COOH)^2$: Oxalic Acid

$CH_2OHCOOH$: Hydroxymethanoic Acid

The most famous compounds containing Carbon, Hydrogen and Oxygen are the Carbohydrates. An example is the common sugar, Sucrose ($C_{12}H_{22}O_{11}$).

This shows how varied and complex even simple organic compounds can be. Sucrose has a pair of rings: one hexaganol, the other pentaganol. Each ring contains an Oxygen atom. The rings are joined by an Oxygen (Ether) link. The entire compound contains several Hydroxyl (OH) groups.



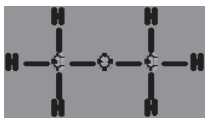
Sucrose

Isomerism

An interesting phenomenon with organic molecules is called isomerism. Let us look at two compounds introduced earlier.

Dimethyl Ether: **$(CH_3)_2O$** and **Ethanol**: **C_2H_5OH**.

The first is a gas which will knock you out if inhaled. The second is common alcohol drunk in spirits. The two molecules are shown below.



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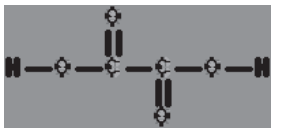

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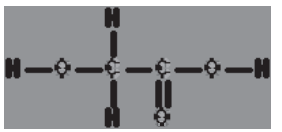

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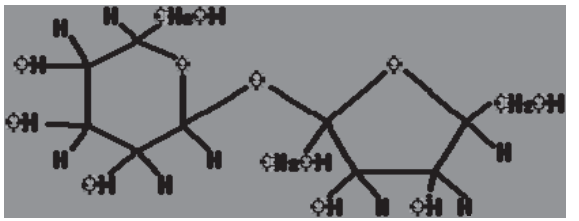

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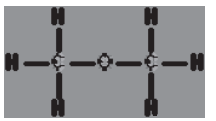
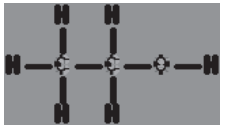


Dimethyl Ether



Ethanol

Notice that both compounds contain 2 Carbon atoms, 6 Hydrogen atoms and 1 Oxygen atom.

Even though the atoms are the same, they are arranged differently. This yields two different compounds with the same number of atoms. These compounds are **isomers** and the phenomenon is called Isomerism.

In this example, the two molecules have different functional groups. They are structural isomers. Other types of isomers exist.

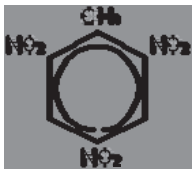
Isomerism increases the number of Organic compounds. The more Carbon atoms in a compound, the more ways of arranging the atoms and the larger number of isomers.

Adding Nitrogen

Many very important organic compounds contain Nitrogen. This produces more series of compounds.

See compounds in: http://www.liv.ac.uk/Chemistry/Links/links.html

A famous compound containing Nitrogen is Trinitro Toluene ($C_6H_2CH_3(NO_2)_3$ — usually abbreviated to TNT). This is an artificially made explosive. Its structure is shown below:



Trinitro Toluene (TNT)

There are six isomers of this compound as the three NO_2 groups can be placed in six different arrangements on the ring. These are known as positional isomers**.**

Other Atoms

The vast majority of organic compounds contain Carbon, Hydrogen, Oxygen and Nitrogen. Other types of atoms can be included to form even more compounds. These can contain atoms like **Phosphorus**, **Sulphur** (e.g. Thiamine, Vitamin B_1), **Magnesium** (e.g. Chlorophyll) and **Iron** (e.g. Haemoglobin).

As can be imagined, these additions increase the number of compounds. Apart from the naturally occurring Organic compounds, millions more can be synthesised. These can include atoms like **Chlorine** (used in pesticides). Examples of organic compounds containing Chlorine are shown below.

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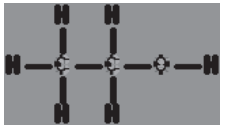

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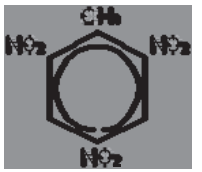

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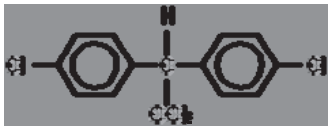
There is no difference between the same substance extracted from living organisms and made in a laboratory.

Formula	Structure	Name / Uses
$CHCl_3$		**Chloroform** — a human-made anaesthetic.
$C_{14}H_9Cl_5$		**Dichloro Diphenyl Trichloro Methane** — DDT an insecticide.

I hope this introduction to Organic Chemistry indicates just how vast and interesting the subject is.

The study of *organic chemistry* — which focuses on carbon molecules — is central to all living organisms.

The ability to convert ingested fuel to usable energy is what differentiates a living organism from a dead one. The ingested fuel contains a variety of large molecules (macromolecules) that get broken down. When the macromolecules have been broken down into their smallest parts, they can enter the cells, which contain more macromolecules, which are involved in more processes.

The Basics of Organic Chemistry

What is organic chemistry?

In organic chemistry, the focus is on the element carbon. Carbon is central to all living organisms; however, thousands of nonliving things (such as drugs, plastics, and dyes) are made from carbon compounds. Diamonds are carbon atoms in a crystal structure. Diamonds are so hard because the atoms of carbon are so closely bonded together in the crystal form. That same ability to pack closely together makes carbon an excellent structural element in its other forms as well.

One atom of carbon can combine with up to four other atoms. Therefore, organic compounds usually are large and can have several atoms and molecules bonded together. Organic molecules can be large, and they comprise the structural components of living organisms: carbohydrates, proteins, nucleic acids, and lipids.

Carbon is key

In their outer shells, carbon atoms have four electrons that can bond with other atoms. When carbon is bonded to hydrogen (which is common in organic molecules), the carbon atom shares an electron with hydrogen, and hydrogen likewise shares an electron with carbon. Carbon-hydrogen molecules are referred to as *hydrocarbons*. Nitrogen, sulfur, and oxygen also are often joined to carbon in living organisms.

Long carbon chains = low reactivity

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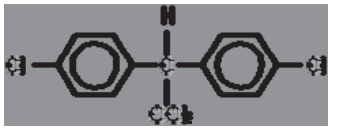
$C_{14}H_9Cl_5$		**Dichloro Diphenyl Trichloro Methane** — DDT an insecticide.

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Large molecules form when carbon atoms are joined together in a straight line or in rings. The longer the carbon chain, the less chemically reactive the compound is. However, in biology, other measures of reactivity are used. One example is enzymatic activity, which refers to how much more quickly a certain molecule can allow a reaction to occur.

One key to knowing that a compound is less reactive is that its melting and boiling points are high. Generally, the lower a compound's melting and boiling points, the more reactive it is. For example, the hydrocarbon methane, which is the primary component of natural gas, has just one carbon and four hydrogen atoms. Because it is the shortest carbon compound, it has the lowest boiling point (-162°C) and is a gas at room temperature. It is highly reactive.

On the other hand, a compound made of an extremely long carbon chain has a boiling point of 174°C (compared to water, which has a boiling point of 100°C). Because it takes so much more for it to boil, it is much less reactive and is not gaseous at room temperature.

Forming functional groups based on properties

In organic chemistry, molecules that have similar properties (whether they are chemical or physical properties) are grouped together. The reason they have similar properties is because they have similar groups of atoms; these groups of atoms are called *functional groups*.

Chemical properties involve one substance changing into another substance by reacting. An example of a chemical property is the ability of chlorine gas to react explosively when mixed with sodium. The chemical reaction creates a new substance, sodium chloride (table salt). *Physical properties* refer to different forms of a substance, but the substance remains the same; no chemical reaction or change to a new substance occurs.

Some of the properties that the functional groups provide include polarity and acidity. For example, the functional group called carboxyl (-COOH) is a weak acid. *Polarity* refers to one end of a molecule having a charge (polar), and the other end having no charge (nonpolar). For example, the plasma membrane has hydrophilic heads on the outside that are polar, and the hydrophobic tails (which are nonpolar) form the inside of the plasma membrane.

What Is the Role of Nucleic Acids in Living Things?

Nucleic acids are large molecules that carry tons of small details: all the genetic information. Nucleic acids are found in every living thing — plants, animals, bacteria, viruses, fungi — that uses and converts energy. Every single living thing has something in common.

People, animals, plants, and more all are connected by genetic material. Every living thing may look different and act different, but deep down — way deep down in the nucleus of cells — living things contain the same chemical «ingredients» making up very similar genetic material.

There are two types of nucleic acids: DNA (which stands for deoxyribonucleic acid) and RNA (which stands for ribonucleic acid). Nucleic acids are made up of strands of *nucleotides*, which are made up of a base containing nitrogen (called a *nitrogenous base*), a sugar that contains five-carbon molecules, and a phosphoric acid.

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Your entire genetic composition, personality, maybe even intelligence hinges on molecules containing a nitrogen compound, some sugar, and an acid. The *nitrogenous bases* are molecules either called *purines* or *pyrimidines.*

Purines include

- Adenine
- Guanine

Pyrimidines include

- Cytosine
- Thymine (in RNA)
- Uracil (in DNA)

Deoxyribonucleic acid (DNA)

DNA contains two strands of nucleotides arranged in a way that makes it look like a twisted ladder (called a *double helix*). The nitrogenous bases that DNA builds its double-helix upon are adenine (A), guanine (G), cytosine (C), and thymine (T). The sugar that is in the composition of DNA is 2-deoxyribose.

Adenine is always paired with thymine (A-T), and guanine is always paired with cytosine (G-C). These bases are held together by hydrogen bonds, which form the «rungs» of the «twisted ladder.» The sides of the ladder are made up of the sugar and phosphate molecules.

Certain sections of nitrogenous bases along the strand of DNA form a *gene*. A gene is a unit that contains the genetic information or codes for a particular product and transmits hereditary information to the next generation.

But genes are not found only in reproductive cells. Every cell in an organism contains DNA (and therefore genes) because DNA also codes for the proteins that the organism produces. And proteins control cell function and provide structure. So, the basis of life happens in each and every cell.

Whenever a new cell is made in an organism, the genetic material is reproduced and put into the new cell. The new cell can then create proteins within itself and also pass on the genetic information to the next new cell.

The order of the nitrogenous bases on a strand of DNA (or in a section of the DNA that comprises a gene) determines which amino acid is produced. And the order that amino acids are strung together determines which protein is produced. Which protein is produced determines what structural element is produced within your body (such as, muscle tissue, skin, or hair) or what function can be performed (such as if hemoglobin is being produced to transport oxygen to all the cells).

Ribonucleic acid (RNA)

The nitrogenous bases that RNA uses are adenine, guanine, cytosine, and uracil (instead of thymine). And, the sugar in RNA is ribose (instead of 2-deoxyribose). Those are the major differences between DNA and RNA.

In most animals, RNA is not the major genetic material. Many viruses — such as the human immunodeficiency virus (HIV) that causes AIDS — contain RNA as their genetic material. However, in animals, RNA works along with DNA to produce the proteins needed throughout the body.

For example, RNA has three major subtypes: messenger RNA (mRNA), transfer RNA (tRNA), and ribosomal RNA (rRNA). All three of those subtypes are involved in protein synthesis

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How Cell Substances Transport through the Plasma Membrane

The plasma membrane surrounding animal cells is where the exchange of substances inside and outside of cells takes place. Some substances need to move from the extracellular fluid outside cells to the inside of the cell, and some substances need to move from the inside of the cell to the extracellular fluid.

Some of the proteins that are stuck in the plasma membrane help to form openings *(channels)* in the membrane. Through these channels, some substances such as hormones or ions are allowed to pass through. They either are «recognized» by a *receptor* (a protein molecule) within the cell membrane, or they attach to a carrier molecule, which is allowed through the channels. Because the plasma membrane is choosy about what substances can pass through it, it is said to be *selectively permeable*.

Permeability describes the ease with which substances can pass through a border, such as a cell membrane. *Permeable* means that most substances can easily pass through the membrane. *Impermeable* means that substances cannot pass through the membrane. *Selectively permeable* or *semipermeable* means that only certain substances are able to pass through the membrane.

Transporting substances across the plasma membrane can require that the cell use some of its energy. If energy is used, the transport is called *active*. If molecules can pass through the plasma membrane without using energy, the molecules are using *passive* transport.

Helping the molecules across: Active transport

Sometimes, the molecules are just too big to easily flow across the plasma membranes or dissolve in the water so that they can be filtered through the membrane. In these cases, the cells must put out a little energy to help get molecules in or out of the cell.

Embedded in the plasma membrane are protein molecules, some of which form channels through which other molecules can pass. Some proteins act as *carriers* — that is, they are «paid» in energy to let a molecule attach to itself and then transport that molecule inside the cell.

Passive transport of molecules

A membrane can allow molecules to be passively transported through it in three ways: diffusion, osmosis, and filtration.

- **Diffusion:** Sometimes organisms need to move molecules from an area where they are highly concentrated to an area where the molecules are less concentrated. This transport is much more easily done than moving molecules from a low concentration to a high concentration. To go from a high concentration to a low concentration, in essence the molecules need to only «spread» themselves, or *diffuse,* across the membrane separating the areas of concentration.

In the human body, this action occurs in the lungs. You breathe in air, and oxygen gets into the tiniest air sacs of the lungs, the *alveoli.* Surrounding the tiniest air sacs of the lungs are the tiniest blood vessels — *capillaries.* The capillaries in the lungs, called *pulmonary capillaries,* contain the lowest concentration of oxygen in the body, because by the time the blood gets to the tiniest vessels, most of the oxygen has been used up by other organs and tissues.

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So, the tiniest air sacs of the lungs have a higher concentration of oxygen than do the capillaries. That means that the oxygen from the alveoli of the lungs can spread across the membrane between the air sac and the capillary, getting into the bloodstream.

- **Osmosis:** This term is used when talking about water molecules diffusing across a membrane. Basically, the diffusion of water (osmosis) works as described in the preceding bullet. However, with osmosis, the concentration of substances in the water is taken into consideration. If a solution is *isotonic*, that means the concentrations of the substances *(solutes)* and water *(solvent)* on both sides of the membrane are equal. If one solution is *hypotonic*, there is a lower concentration of substances (and more water) in it when compared to another solution. If a solution is *hypertonic*, there is a higher concentration of substances in it (and less water) when compared to another solution.

For example, the blood in your body contains a certain amount of salt. The normal concentration is isotonic. If suddenly there is too high a concentration of salt, the blood becomes hypertonic (too many salt molecules). This excess of salt forces water out of the blood cells in an attempt to even things out. But the effect this action has is actually that of shrinking the blood cells.

This shrinking of cells is called *crenation* (not cremation). If too much fluid is in the bloodstream, the blood cells have too few molecules of salt in comparison, making them hypotonic. Then, the blood cells take in water in an attempt to normalize the blood and make it isotonic. However, if the blood cells need to take in too much water to bring everything back into balance, they can swell until they burst. This bursting of cells is called *hemolysis* (*hemo* = blood; *lysis* = break apart).

- **Filtration:** The last form of passive transport is used most often in the capillaries. Capillaries are so thin (their membranes are only one cell thick) that diffusion easily takes place through them. But remember that animals have a blood pressure. The pressure at which the blood flows through the capillaries is enough force to push water and small solutes that have dissolved in the water right through the capillary membrane. So, in essence, the capillary membrane acts as filter paper, allowing fluid to surround the body's cells and keeping large molecules from getting into the tissue fluid.

Inorganic chemistry

What are acids? What are bases? How do they react together? What causes neutralization?

Acids and bases are fundamental chemicals in chemistry. In organic chemistry, the carboxylic acids have acidic properties, but in inorganic chemistry there is a wide range of acids with a variety of properties.

Definition of Acids and Bases

The word *acid* comes from the Latin word which means sour or sharp to the taste, and liquids like vinegar and lemon juice are well-known acids. Other properties of acids are that they are corrosive to some metals and turn a material called litmus, which is an indicator extracted from moss, red. Some common acids are citric acid — found in fruit juice, ethanoic acid — found in vinegar,

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sulfuric acid — found in car batteries, and carbonic acid, which is also known as soda water.

There are other chemicals which, when added to a mixture of acid and litmus, will turn it blue. These chemicals are called bases (alkalis when they are soluble) and their reaction with acid is called neutralisation. Common bases are calcium hydroxide (lime), sodium hydrogencarbonate (baking soda), magnesium hydroxide (milk of magnesia) and ammonia.

Acidity Depends on Hydrogen Ions

The behaviour of acids and bases is related to the presence of hydrogen ions (H+) in the solution. When an acid dissolves in water, it releases hydrogen ions, which cause the acidic properties. A *strong acid,* like sulfuric or hydrochloric acid, is an acid which is completely ionised in solution (Important: it has nothing to do with the concentration of the solution). A *weak acid,* like ethanoic or citric acid, is an acid which is not completely ionised.

The activity of a base is explained by its reaction with hydrogen ions. So, a base is able to react with hydrogen ions, reducing the acidic nature of the solution. Some bases are metal hydroxides, and the hydroxide part reacts with the hydrogen ion to make water. Other bases are carbonates or hydrogen carbonates which react with the hydrogen ions to make carbon dioxide and water. This explanation of how acids and bases work is called the Brønsted-Lowry definition of acids and bases, after the two scientists who first proposed it in 1923.

The pH Scale

A scale to demonstrate how acidic or basic a solution is has been developed, called the pH scale. It ranges from 1 to 14, in which the lowest numbers are for the most acidic and the higher numbers are the most alkaline, with pH 7 being neutral. The formula to work out the pH value is:

pH = -log [H+]

where [H+] is the concentration of hydrogen ions in the solution.

Some example of pH values:

- pH1: stomach acid
- pH3: vinegar
- pH5: rainwater
- pH7: pure water
- pH9: baking soda
- pH12: mineral lime
- pH14:s odium hydroxide (Caustic Soda)

Properties and Uses of the Alkaline Earth Metals

Oct 2, 2010 Rochelle Joseph

Alkaline Earth Metals — *Timothy Ismael (with permission)*

The alkaline earth metals are the elements found in group two of the periodic table. The properties of these metals allow them to be classed together.

The alkaline earth metals are the elements referred to as group two metals because they are found in group two of the periodic table. These metals have distinct properties that allow them to be grouped together. The metals which

sulfuric acid — found in car batteries, and carbonic acid, which is also known as soda water.

There are other chemicals which, when added to a mixture of acid and litmus, will turn it blue. These chemicals are called bases (alkalis when they are soluble) and their reaction with acid is called neutralisation. Common bases are calcium hydroxide (lime), sodium hydrogencarbonate (baking soda), magnesium hydroxide (milk of magnesia) and ammonia.

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make up the group of alkaline earth metals are, from top to bottom, beryllium, magnesium, calcium, strontium, barium and radium.

Natural Occurrences Alkaline Earth Metals

Beryllium is only found combined with other elements in nature. Among its compounds are the gems: aquamarine, which is the turquoise variety of beryl; bixbite, also known as red beryl and emerald, which is green beryl. Beryllium is also a constituent of the gemstones chrysoberyl and phenacite. Beryllium is present in bertrandite, which is one of the main ores of beryllium.

Magnesium is found in over sixty minerals on earth. Among these, only dolomite, magnesite, brucite, carnallite, talc and olivine are of commercial importance.

Magnesium is the forth most abundant element in the earth's crust where it constitutes only two per cent by mass. Magnesium is the eleventh most abundant element by mass in the human body, playing a major role in the manipulation of phosphate compounds such as ATP.

Magnesium is too reactive to occur naturally in is elementary state.

Calcium occurs naturally in sedimentary rocks such as calcite, dolomite and gypsum. Calcium can also be found in igneous rocks among which is plagioclase and in metamorphic rock such as garnets.

Calcium is a very abundant metal in the earth's crust as well as the human body. Like the other Group Two metals, pure, uncombined calcium does not occur naturally because the metal is too reactive.

Read on

Strontium occurs mainly in the form of its carbonate and sulfate naturally. It is more commonly known to exist as a product of nuclear fall out.

Barium, like strontium occurs mainly in the form of its carbonate and sulfate. Barium is also a constituent of the rare blue gemstone, benitoite.

Radium is a radioactive element. It is a decay product of uranium, and so, can be found in uranium ores.

Physical Properties of Alkaline Earth Metals

Alkaline earth metals are silvery, soft, low density metals which tarnish in air. They are so soft that they can be cut with a knife. Compared to other metals further in the periodic table, group two metals have low boiling and melting points. All alkaline earth metals have two valence electrons.

Alkaline earth metals burn in oxygen giving characteristic flames which are unique to each alkaline metal. Beryllium burns with a colorless flame, magnesium with a bright white flame and calcium with a brick red flame. Strontium burns with crimson flame while barium's flame is colored apple green.

Major Uses of Alkaline Earth Metals

Beryllium

Beryllium is primarily used in alloys. Its low densities allows it to add strength to other metals without adding much weight. A very important alloy of beryllium is beryllium copper which is, as expected, a mixture of beryllium and copper, Beryllium copper is used to make tools which are to be used in hazardous environments. Its non-sparking and non magnetic properties allow this. Beryllium copper is also used in the production of some musical instruments such as the tambourine and triangle. Furthermore, Beryllium copper

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is used in the production of bullets, precision measurement devices and in aerospace.

Magnesium

Like beryllium, magnesium is also used in alloys because it lends strength without adding much weight. Duralumin, an alloy of magnesium, aluminum and copper, is used in the production of air crafts and small boats. Other magnesium alloys are used in the production of household material.

Magnesium is used as flares and distress signals. This use is attributed to the bright white light produced when burning magnesium in oxygen.

Magnesium compounds are also very useful. These include magnesium oxide which is used as a refractory lining material, magnesium sulfate which is used as epson salts, as artificial snow and in fertilizers and magnesium hydroxide which is used as an antacid.

Calcium

Calcium's usefulness is found mainly in its compounds. However, calcium in its elemental form is used in alloys and as a de-oxidizer in steel.

Calcium compounds are especially important to a healthy body. They are involved in the strengthening of bones and teeth and in the transfer of nerve impulses. Calcium compounds are also involved in the control of fertilization in the human body permitting only one sperm to enter the egg.

Plaster of Paris which is used in casts is made of calcium sulfate. Gypsum wallboard, often called plasterboard, is also made of calcium sulfate.

Calcium carbonate, which exists as limestone, chalk, and marble is very important in the construction industry.

Barium

Barium is used in alloys with calcium and lead. Barium sulfate is used in medicine as a 'barium meal'. Patients swallow the sulfate which is relatively opaque to X-Rays and shows particularly well on X-Ray photographs.

Group Two metals, called the alkaline earth metals, have similar properties which allow them to be grouped together. These metals are very useful both in their elemental form and in compounds.

The Chemistry, Properties and Uses of Hydrogen

Apr 9, 2010 Simon Davies

Hydrogen Rocket Fuel — Mike Gieson

Hydrogen is the smallest, lightest, most abundant element in the universe, and the foundation of the Hydrogen Economy.

The element hydrogen is believed to be the most abundant element in the universe. It is the first element in the Periodic Table, containing just one proton in its nucleus. As an element, hydrogen exists as a diatomic molecule: H2 and is a gas at standard temperature and pressure.

Properties of Hydrogen

Hydrogen is a colourless, odourless, flammable gas. It is also much lighter than air, so a large proportion of elemental hydrogen produced on earth is lost from the atmosphere. Hydrogen has three common isotopes: Protium has one proton and no neutrons in its nucleus, so it has a mass number of 1; it makes up 99.985% of all hydrogen. Deuterium (D) has one proton and one neutron in its

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nucleus, and is sometimes called ‘heavy hydrogen’. Tritium has one proton and two neutrons in its nucleus, and is a radioactive isotope.

Compounds of Hydrogen

On earth, hydrogen is the third most abundant element in terms of number of atoms (behind oxygen and silicon), but ninth in terms of mass. Virtually all of this hydrogen is found combined in molecules, the most abundant being water (H2O). Hydrogen forms a large number of other compounds, however, being assigned an oxidation number of +1 or -1 depending on the electronegativity of the element to which it is bound.

Covalent Hydrogen Compounds

In its +1 oxidation state, hydrogen is found in binary compounds such as hydrogen chloride (HCl), hydrogen sulphide (H2S), and ammonia (NH3) in which it is covalently bonded to a more electronegative atom. Other compounds of hydrogen include acids like sulphuric acid (H2SO4) and nitric acid (HNO3); basic hydroxides like sodium hydroxide (NaOH) and calcium hydroxide (Ca(OH)2); and acid salts like sodium hydrogen phosphate (NaH2PO4) and sodium hydrogen carbonate (NaHCO3). Additionally it is present in many organic compounds, covalently bonded to carbon (CH4, C2H6 etc).

Metal Hydrides

In its -1 oxidation state, hydrogen is found in compounds with metals, called hydrides. These are ionic when hydrogen is combined with alkali or alkaline-earth metals like sodium or potassium. It also forms covalent bonds with elements silicon and antimony. With transition metals, lathanides or actinides, the hydrogen seems to dissolve into the structure of the metal, giving a more brittle substance which is still a conductor or semiconductor.

Uses of Hydrogen

Large quantities of hydrogen are used in the Haber Process, which turns nitrogen from the air into ammonia used in fertilizers. It is also used in the hydrogenation of fats and oils, the production of methanol, hydrocracking and metal refining. It is also an important rocket fuel, used by NASA to launch the space shuttles. Deuterium is used in nuclear power stations as a moderator to slow neutrons down.

Read on

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Preparation of Soluble Metal Salts in the Lab
Reactions Between Acids and Metals or Bases Makes Ionic Compounds
Jan 11, 2010 Adrienne Larocque

Adding iron filings to test tube with acid — *Photo by Adrienne Larocque*

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An acidic solution can be neutralized by reacting it with a base, a metal or a carbonate. The products of these neutralization reactions are called salts.

Salt, also known as sodium chloride, is a dietary mineral. Salts, on the other hand, are ionic compounds consisting of a metal cation (positively-charged ion) bonded to a simple or polyatomic anion (negatively-charged ion). High school chemistry courses typically require students to prepare metal salts in the laboratory by mixing various dilute acids with bases or certain metals.

An acid may be defined as any substance that dissociates and donates a hydrogen ion (H+) to a base. A base may be defined as any substance that contains a hydroxide ion (OH-) or produces it in solution (by reacting with water, for example). Not all bases are soluble in water; those that are soluble are called alkalis.

Laboratory Methods for Preparing Soluble Metal Salts

In high school laboratory settings, dilute acids should be used to ensure student safety. There are 4 standard methods for the preparation of metal salts:

- Mixing an acid with a base
- Mixing an acid with a metal
- Mixing an acid with a metal oxide
- Mixing an acid with a carbonate

Because the salts are soluble, it is necessary to gently heat the resultant solution to drive off the water. Eventually, the solution will become saturated and the metal salt will crystallize.

Reaction of an Acid with a Base

Sodium hydroxide (NaOH) is an example of an alkali, that is, a soluble base. Combining an aqueous solution of sodium hydroxide with dilute hydrochloric acid neutralizes the acid:

HCl(aq) + NaOH(aq) --> NaCl(aq) + H2O(l)

The hydrogen ion from the acid combines with the hydroxide ion from the base to produce water, and the cation from the base combines with the anion from the acid to produce the salt. The reaction seems unremarkable as the production of gas bubbles observed in some of the following reactions does not occur here. Students may observe some small degree of immiscibility, apparent as «squiggly» lines in the solution. The product of the reaction of this strong acid and strong base is simple salt water.

Reaction of an Acid with a Metal

In school laboratories it is necessary to use less reactive metals such as magnesium (Mg), aluminum (Al), zinc (Zn), iron (Fe) and tin (Sn) as a safety precaution. As an example, consider the addition of iron filings to a test tube containing sulfuric acid. The reaction equation can be written as follows:

H2SO4(aq) + Fe(s) --> FeSO4(aq) + H2(g)

Bubbles of hydrogen gas will be observed as the reaction proceeds. The test to confirm that hydrogen is produced is to place a lit splint near the mouth of the test tube. A popping sound will be heard.

Reaction of an Acid with a Metal Oxide

Metal oxides also are bases. They may be soluble or insoluble, depending on the cation species. Water-soluble oxides (oxides of alkali and alkaline earth metals) form metal hydroxides in solution. Oxides of transition metals generally are insoluble. Consider the following reaction between insoluble copper oxide and sulfuric acid:

H2SO4(aq) + CuO(s) --> CuSO4(aq) + H2O(l)

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H2SO4(aq) + CuO(s) --> CuSO4(aq) + H2O(l)

The reactant copper oxide will slowly dissolve in the acid. Because the product copper sulphate is dissolved, the solution will have a characteristic blue colour.

Reaction of an Acid with a Carbonate

Carbonates are also considered to be bases, even though they do not contain OH- groups. In any case, the reaction between an acid and a carbonate produces an obvious reaction in which carbon dioxide (CO2) gas is produced. For example:

2HCl(aq) + CaCO3(s) --> CaCl2(aq) + CO2(g) + H2O(l)

The test for CO2 involves bubbling the unknown gas through limewater (a saturated solution of calcium hydroxide). If the solution turns milky, the gas is carbon dioxide.

Summary of Acid-Neutralizing Reactions

To summarize, there are 4 standard reactions that neutralize acids and produce metal salts:

- Acid + base --> a salt + water
- Acid + metal --> a salt + hydrogen gas
- Acid + metal oxide --> a salt + water
- Acid + carbonate --> a salt + carbon dioxide gas + water

The common factor amongst these reactions is that they all produce a salt dissolved in water. Two of the reactions also produce gas which bubbles out of the solution

African Journal of Pure and Applied Chemistry Vol. 4(9), pp. 177-182, October 2010

The ground state structure and properties of erythritol in gas phase and in different solvents: A DFT / SC-IPCM approach

D. De, S. Dalai and B. R. De*

Department of Chemistry and Chemical Technology, Vidyasagar University, Midnapore-721102, West Bengal, India. Accepted 27 July, 2010

Abstract

Quantum mechanical study of the ground state structure and properties of erythritol was carried out in gas phase and in different solvents at the hybrid B3LYP DFT level with complete geometry optimization and varying basis sets [6-311G (d,p) and 6-311++G (d,p)] in order to provide detailed information of the model molecule in solvents of low, medium and high dielectric constant. It was found that the molecule is stabilized by solvation in all cases, the order of stability being water > DMSO > carbontetrachloride.

The dipole moment was increased. The charge density on O-atoms were increased almost as per above order indicating that there are two types of O-H groups in the molecule in agreement with the reported experimental findings. Carbon skeleton were planar in water and DMSO by 6-311++G (d,p) basis set gave non planar structure in CCl4. The geometries in water and DMSO were in excellent agreement with the experiment. The calculated IR frequencies are well when compared with the experimental results. The HOMO-LUMO gap remained almost same on solvation.

Key words: B3LYP DFT, GAUSSIAN, erythritol, charge distribution, gas phase.

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INTRODUCTION

The rapid development of both theory and software makes it possible to have detailed studies of the structure and properties of different molecules in gas phase and in solution. There is a growing interest in the study of important bio-molecules both theoretically (Ladik, 2004) and experimentally. Among the bio-molecules, carbohydrates are very important as they coordinate with various metal ions like Cu+2, Mn+2, Fe+2, Zn+2 etc. in playing vital role in versatile metabolic activities. Why these metal ions do so is to be answered. Carbohydrate research is a challenging field and its progress is much slower experimentally.

Recently, single crystals of co-ordinated complexes of neutral erythritol (C4H10O4) with various metal ions were synthesized and studied using FT-IR and single crystal X-ray diffraction analysis (Yang et al., 2004a and b). There are several theoretical (gas phase and water phase) and experimental reports (Jesus et al., 2005a and b; 2006; Ceccarelli et al., 1980; Shimada et al., 1959; Hao et al., *Corresponding author. E-mail: brdranjan@yahoo.com. 2005) on the erithritol molecule. In reference to Jesus et al. (2005a), a detailed study of the molecule has been done in gas phase using DFT method using 6-311++G (d,p) basis set and in reference to Jesus et al. (2005b), enthalpy of sublimation of erythritol in solid state has been determined and some terms have been calculated in gas phase by DFT method using 6-311++G(d,p) basis set. In reference to Jesus et al. (2006), a beautiful study of the same molecule in water phase has been done using CPCM model. Ceccarelli et al. (1980) and Shimada et al. (1959) have reported the crystal structure of the erythritol molecule been and Hao et al. (2005) has reported the solubility of erythritol in different solvents and solvent mixture (water, methanol, ethanol, acetone). Structure and properties of erythritol in its ground state and first excited state in gas phase without the solvent effects have been reported theoretically using lower basis set (De et al., 2006). In the present work, we have undertaken the detailed systematic and comprehensive theoretical investigation on the structure and properties of the simplest representative of the carbohydrates, that is erythritol in its ground state both in gas phase and in different solvents of low, medium and high dielectric constant by the hybrid B3LYP DFT method (Gaussian 03W Program,(Gaussian, Inc., Wallingford, CT) 2004; Lee, 1988; Becke et al., 1993) using [6-311G (d,p) and 6-311++G (d,p)] basis set in order to have detailed information about the model molecule because the higher basis sets are more reliable in this respect. This theory (DFT) has recently become popular in quantum chemistry because present day approximate functionals provide a useful balance between accuracy and computational cost, allowing much larger systems to be treated than traditional ab initio methods, retaining much of their accuracy. This theory is the way of approaching any interacting problem, by mapping it exactly to a much easier-to-solve non-interacting problem using higher basis set. Three solvents [carbon tetrachloride (= 2.228), DMSO (= 46.7) and water (= 78.39)] were chosen as the case study.

COMPUTATIONAL DETAILS

Complete geometry optimizations for the ground state in the gas phase were carried out with B3LYP DFT method with 6-311G (d,p) and 6-311++G (d,p)

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basis sets using GAUSSIAN 03W program (Gaussian 03W Program,(Gaussian, Inc., Wallingford, CT) 2004; Lee, 1988; Becke et al., 1993). In case of solution the optimized energies were computed using the SCIPCM SCRF model and B3LYP DFT method with the same basis set. The iso-density PCM (IPCM) model defines the cavity as an iso-density surface of the molecule. This iso-density is determined by an iterative process in which an SCF cycle is performed and converged using the current iso-density cavity. The resultant wave function is then used to compute an updated iso-density surface, and the cycle is repeated until the cavity shape no longer changes upon completion of the SCF.

An iso-density surface is a very natural, intuitive shape for the cavity since it corresponds to the reactive shape of the molecule to as great a degree as is possible (Rather than being a simpler, pre-defined shape such as a sphere or a set of overlapping spheres).

However, a cavity defined as an iso-surface and the electron density are necessarily coupled. The Self-consistent iso-density Polarized Continuum Model (SCI-PCM) was designed to take this effect fully into account. It includes the effect of solvation in the solution of the SCF problem. This procedure solves the electron density which minimizes the energy, including the solvation energy- density. In other words, the effects of solvation are folded into the iterative SCF computation rather than comprising an extra step afterwards. SCI-PCM thus accounts for the full coupling between the cavity and the electron density and includes coupling terms that IPCM neglects.

In the frequency calculation we specified, scf = tight, criteria and the basis set is 6-311G (d,p) only for all the solvents, because of computation time problem.

RESULTS AND DISCUSSION

Calculated equilibrium geometry of erythritol in its ground state both in gas phase and in different solvents are given in Table 1 along with the numbering scheme of the atoms of the molecule. Some important properties of the molecule are listed in Table 2. Mulliken atom electron density is recorded in Table 3. Atomic charge is not an observable quantum mechanical property. All methods for computing the atomic charges are necessarily arbitrary. Electron density among the atoms in a molecular system is being partitioned. Mulliken population analysis computes charges by dividing orbital overlap equally between the two atoms involved. Therefore the values are non-unique and depend on the basis set used.

Still, it is widely used. Figures 1 to 8 show the three dimensional structure of erythritol molecule with atom numbering at the calculated equilibrium geometry in gas phase, water, DMSO and carbon tetrachloride respectively. The significance of the figures is that it shows the complete three dimensional structures which are not completely reflected from the selected geometrical parameters given in the table. From Table 1, it is seen that the geometrical parameters do not change significantly between the basis sets but the chemical properties change a lot.

In the gas phase the torsion angle, C1-C4-C5-C6 of the molecule calculated by both basis sets shows non planarity of the carbon skeleton as expected. In water and DMSO this angle comes out to be 173.9 and -174.6 respectively only by 6-311++G (d,p) basis set calculation showing planarity of the carbon skeleton supporting the chemical expectations whereas

basis sets using GAUSSIAN 03W program (Gaussian 03W Program,(Gaussian, Inc., Wallingford, CT) 2004; Lee, 1988; Becke et al., 1993). In case of solution the optimized energies were computed using the SCIPCM SCRF model and B3LYP DFT method with the same basis set. The iso-density PCM (IPCM) model defines the cavity as an iso-density surface of the molecule. This iso-density is determined by an iterative process in which an SCF cycle is performed and converged using the current iso-density cavity. The resultant wave function is then used to compute an updated iso-density surface, and the cycle is repeated until the cavity shape no longer changes upon completion of the SCF.

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the other results show non planarity. In carbon tetrachloride, the skeleton remains non planar as in the gas phase indicating that solvent polarity has marked influence on the structure of the molecule.

This is further revealed in other results of torsion angles like O-C-C-O, C-C-C-O where the experimental results are well reproduced in water and DMSO but not in carbon tetrachloride. Regarding the C-O and C-C distances, they are in excellent agreement with the experimental results [7, 8, and 12] in all calculations and in all solvents. The same is true for the C-C-H, C-C-O and C-C-C angles. From Table 2 it is clear that the molecule is stabilized in all solvents by all calculations because of the less nuclear repulsion in each case. The solvation energy is of the order water > DMSO > carbon tetrachloride as obvious from chemical expectation arising out of the dielectric constant of the solvents. The dipole moment is increased in all solvents indicating that the charge separation is higher in the solution as is expected for a polar molecule. This is supported by the data from Table 3 where it is seen that the charge density on O-atoms are much more increased than that in the gas phase. Among the four oxygen atoms in the molecule the O13 carries the highest negative charge in all calculations and in all solvents with the exception of water by 6-311G (d, p). This indicates that O13-H18 group may behave differently from the other three O-H groups of the molecule showing that the molecule can behave as a bidentate ligand. This is in excellent agreement with the experimental findings (Yang et al. 2004a and b). From Table 3 it is also seen that all the carbon atoms are negatively charged both in gas phase and in solvated phase by 6-311++G (d, p) set as expected by electro-negativity rule whereas 6-311G (d, p) set shows C1 to be negatively charged both in gas phase and in solution phase and C5 to be negatively charged in solution phase with the exception of DMSO where it is positively charged which is unusual according to the electro negativity rule.

The H-atoms attached to O-atoms contain almost equivalent positive charges whereas those attached to C-atoms are less positively charged than the former both in gas phase and in solution phase and in all calculations as expected from the general electro negativity rule. The HOMO-LUMO gap increases on solvation and remains almost equivalent in all solvents. The calculated O-H frequencies using a scale factor 0.8439 is generated in the present study. In Yang et al. (2004a), the IR spectra were measured on a Nico-plan IR microscope attached on a Nicolet Magna-IR 750 FT-IR spectrometer. Four O-H vibrations have beencomputed to see whether there is any difference between them. The results show that there are two types of O-H frequencies.

The results are well compared with theexperimental findings (Yang et al., 2004a). The O13-H18 frequency is highest among the four O-H bonds both in gas and solution phase. The value is little decreased from the gas phase value in water and in DMSO, but remains almost same in carbon tetrachloride as expected from the solvent polarity point of view.

Conclusion

From the present study it can be concluded that neutral erythritol can coordinate with various transition metal ions through O-H groups in the ground state both in gas and solution phase, the complexation being better in solvents of

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International Caux Conferences 2009. Caux, 23rd of July 2009
Trust and Integrity in the Global Economy
George Katito

Good morning.

I am George Katito and I am a researcher for the South African Institute of International Affairs (SAIIA) based in Johannesburg. The SAIIA was established in 1934 with the goal of stimulating public discourse on key global issues. 75 years later, the institute continues to develop research into international affairs from a uniquely Sub Saharan perspective on themes ranging from the emerging role of Brazil, Russia, India and China in global affairs, transparency and accountability in Extractive Industries — and over the past few years, we have also generated extensive research into the role of trade in promoting development and into the state of Political and Democratic Governance in Sub Saharan Africa.

More recently, however, the implications of the global economic recession particularly on Sub Saharan Africa have become a critical component of our research — and I am privileged to be one of the institute's point people on the implications of the recession on aid flows to Sub Saharan Africa; the recession's impact on the health of civil society in the region and on what the global economic slump bodes for the implementation of the policies designed to improve the lives of people in our region.

I am deeply humbled by this opportunity to offer a few opening remarks on where our global economy stands today. However, from the onset, I would like to make it clear that what I bring to the table tonight really is not a sermon on the global recession — I would be the first to point out that I certainly do not have the moral authority to preach on the recession, but more than that many would be hard pressed to speak with authority on the sheer gravity of the problems that we face. But what I do offer to bring is food for thought. It's my hope that the next few minutes will present each one of us with a few morsels of insight to digest and a perhaps fresh perspective on where we all find ourselves today.

(Pause)

Well, that our global economy faces a formidable array of crises is not news. Climate change, food, and energy insecurity needs have established themselves as a trinity of challenges that our generation and those to come will contend with: Indeed, over 1 billion people globally — a sixth of the world's population — lack access to nourishing and regular intake of food. More worryingly, the global economy will need to produce enough affordable food to feed in excess of 2 billion more mouths over the next 15 years and a further billion within the next forty.

Fluctuating food prices have already spawned widespread social unrest in several parts of the developing world.

With regards to climate change, compelling scientific evidence increasingly points to a warmer planet. As many of us would be aware, what is especially

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worrying about shifts in climatic patterns is the human impact. The International Organisation on Migration predicts that roughly 200 million people will be forced to migrate as a direct consequence of climate change.

Frequent droughts and floods could also severely compromise food security and increase malnutrition which is responsible for 3.5 million deaths each year. The implications of climate change on public health are also worrisome. As a consequence of shifts in climate , the World Health Organisations predicts that the geographical spread of insect vectors that spread diseases such as malaria will increase — as will diarrhoeal diseases which are already the second largest cause of childhood mortality.

Added to these concerns, we have witnessed the emergence of a new crop of frapidly developing economies — notably among them China and India — whose pace and extent of growth will present significant strain upon a global economy already struggling to distribute it's economic and other resources equitably.

More recently, we have all been witnesses to what several leading economists have tagged the most serious financial crisis since the 1930s. While the epicentre of the crisis was and is indeed in our more developed markets where we saw key financial institutions, consumer spending and public governments take severe blows as a result of the crisis — it is increasingly clear that the effects of the crisis will be felt most strongly in developing regions that are not necessarily intimately tied to the most affected financial markets.

The World Bank and the International Monetary Fund project that an addition 90 million people living in the developing world will slip into extreme poverty as a direct consequence of the global economic slump. Sub Saharan Africa alone will likely suffer a 250 billion dollar decline in export revenue in 2009, and a similar dip of 277 billion in 2010. More worryingly, the prospects of achieving the global community's Millennium Development Goals looks increasingly bleak: As a case in point, an additional 700,000 new mothers in the developing world will not have the joy of celebrating their children's first birthday according to research emerging out of the United Nations Economic Commission for Africa on the human impact of the financial crisis.

These are all sobering statistics that we should not shrink from or dismiss as overwhelming and too daunting to tackle. Indeed, if there is one clear lesson to be gleaned from the progress of human civilization through the centuries — it is that we are sufficiently equipped to inspire and effect change when needed.

At various points, faced with debilitating economic depression, large scale wars, formidable threats to human freedom in the form of communism, religious fanaticism, and so for the, men and women of diverse backgrounds, means and resources have always risen to the challenges of their time, articulated new visions for the world beginning with themselves, their communities, countries and the world at large — and it is through the energy and leadership of our forebears that we have consistently pushed through the darkest points of our human history.

However, the imperative of creating a new vision for our global economy's rests with young women and men like myself everywhere, but perhaps more so for our young professionals present here at Caux.

Yes, achieving the necessary change required to tackle the global economy's most pressing challenges will not come easily or cheaply. But, the sure hope is in

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These are all sobering statistics that we should not shrink from or dismiss as overwhelming and too daunting to tackle. Indeed, if there is one clear lesson to be gleaned from the progress of human civilization through the centuries — it is that we are sufficiently equipped to inspire and effect change when needed.

At various points, faced with debilitating economic depression, large scale wars, formidable threats to human freedom in the form of communism, religious fanaticism, and so for the, men and women of diverse backgrounds, means and resources have always risen to the challenges of their time, articulated new visions for the world beginning with themselves, their communities, countries and the world at large — and it is through the energy and leadership of our forebears that we have consistently pushed through the darkest points of our human history.

However, the imperative of creating a new vision for our global economy's rests with young women and men like myself everywhere, but perhaps more so for our young professionals present here at Caux.

Yes, achieving the necessary change required to tackle the global economy's most pressing challenges will not come easily or cheaply. But, the sure hope is in

this, our generation of young people whose capacity, wherewithal and determination will be crucial to redefine the rules, conventions and values that have served our global economy poorly.

Unlike any other generation before us, we have at our disposal phenomenally efficient access to information, a markedly deeper appreciation and understanding of science and technology that — if harnessed well — could mean a markedly brighter future for humanity. Indeed, something as a simple as mobile phone technology has revolutionised how we tackle the global economy's most pressing challenges such as poverty. In some of the World's poorest countries such as Kenya, Uganda and Tanzania where I recently sat with women of modest means: it is encouraging to see how access to simple mobile technology has shortened the gap between marginalised communities and their local economies.

The remarkable progress that humanity has made in Science and Technology and our limitless potential in our present should give us hope that the challenges that we face collectively are neither insurmountable or permanent. The spiritual resources that millions have drawn upon through the ages and that we have access to should encourage us that a different, more sustainable, values-driven world is possible — one in which a fairer and more effective approach to trade, global financial regulation and global economic governance is the rule rather than the exception.

As we kick off 2009's Trust and Integrity in the Global Economy Conference, let us remain conscious of the fact that while the challenges that the global economy faces today are formidable, the potential to overcome them through a principled approach is equally strong.

May the next few days not only be an opportunity to take stock of where we are but may they also be a crucial turning point for all of us to be forces for change in our cities, countries and beyond.

Thank you

International Journal of Economic Sciences and Applied Research, 2009, 2 (2). P. 87-94

Cost Effectiveness of Paying Value Added Tax from the Viewpoint of Businesses

Sopková Eva

Abstract

Value added tax has been part of the economic reality in the business environment of the Slovak Republic for more than 16 years. It is a tool of general indirect taxation of the final consumption. The aim of this paper is to present partial results of the value added tax complex analysis in terms of cost ratio. The object of this research involves the share of incurred cost of businesses and the amount of tax liability in case of value added tax.

The classification of questionnaire research respondents is done according to the division of businesses into small, medium-sized and large businesses in Slovakia.

Keywords: Value Added Tax, Incurred Costs, Small, Medium-Sized, Large Businesses.

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Introduction

From the historical perspective, indirect taxes are considered younger than direct taxes. From the very beginning these taxes burdened end consumers and did not take into account their incomes and property. Since its establishment on 1 January 1968 (the first country to introduce value added tax was France), value added tax has been considered unfair due to its rate equal for all subjects irrespective of the amount of income. On the other hand, businesses as registered taxpayers serve as unpaid collectors of this tax. Besides paying the tax (at the level of businesses), value added tax incurs, above all, macroeconomic effects as indirect taxes make a significant part of budget incomes in European countries. Every year the revenue from indirect taxes makes approximately 60 % of tax revenue of the Slovak state budget.

1. Value added tax in the Slovak Republic and other countries of the European Union

There are a number of sources that bring different opinions and definitions of value added tax. Summarizing these opinions we can characterize this statutory, non-equivalent payment to the state in certain periods and amounts as a multi-phase excise tax of general character, which can be connected with the process of taxing the added value. Through the prices of goods and services it is a burden for the end consumer (Sopkova, Spisiakova, 2007). The payers of this tax are subjects that supply, import and export goods and services and that collect value added tax from customers.

The tax is indirect in the sense that the taxpayer (bearer of tax burden) and the tax collector are independent subjects, which is a characteristic feature of excise taxes. The European Commission (2000, p.13) defines this tax as ‘a general consumption tax, which is directly proportional to the price of goods and services. It is collected fractionally, i.e. on each transaction in the economic chain, and is neutral’.

Compared to other turnover taxes, this tax has a great advantage in its final share of the price of outputs being set as a statutory rate and not discriminating commodities with several stages of processing.

1.1. International context of value added tax

Besides the mentioned economic effects, value added tax has also an international dimension. The on-going discussion within the European Union is whether the harmonized system of this tax is efficient. The EU market consists of a number of economies with different legal systems and structures. The important instruments to harmonize value added taxes are various regulations and directives. The most important directive before 31 December 2006 was the Sixth Council Directive of 17 May 1977 harmonizing legal regulations of the member states for turnover tax — a common system of value added tax, a single base for its setting No. 77/388/EEC. Its main goal was to harmonize and exactly define notions related to value added tax. In order to make it simpler and more rational this directive was replaced by Directive 2006/112/EC on the common system of value added tax. It came into effect on 1 January 2007 and includes the rules on value added tax applied in the whole European Union. They are

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clearly formulated: the lowest base of value added tax must not go below 15%; member states can apply one or two lowered tax rates for exactly specified goods and services. Nevertheless, the rate must not be lower than 5%, and meeting the requirements, the countries can use the lowered rate with particular personal services. Yet, these rules are too complicated due to a number of exemptions allowed to some countries at their admission to the Union. These exemptions lead to a lack of consistency of the taxation system.

2. The base rate of value added tax

Currently, the base rate of value added tax in EU countries ranges from 15% to 25%. The average rate of the tax is 19.7%. The highest rate is levied in Sweden and Denmark and the lowest in Cyprus and Luxembourg. The so-called 'parking' rate can be 12% and more. At present, this rate is applied in four countries of the European Union, and these are: Belgium, Ireland, Luxembourg and Austria. Another exception is super lowered tax, which allows to levy a tax lower than 5% on some goods and zero rate completely exempts some goods and services from tax. Tax specialists from individual European countries search for optimum indirect taxes at different levels (Nerudova, 2007) and there are continuing discussions on tax harmonization in relation to the sources of finance. Implicit from this analysis is the fact that in spite of the effort to unify tax systems in Europe, it will not be an easy task.

In the Slovak language incurred cost is also translated as 'cost of adapting to the tax system' on the level of the private sector. Effectiveness is an economic category encompassing the main aspects of the economic activity of businesses (Elexa, 2007). This notion has several meanings and is used in different contexts. Effectiveness is related to economizing, efficiency and quality. The indicator of cost or cent indicator expresses the proportion of inputs and outputs. The most reasonable expression of effectiveness is the ratio of cost and revenue. In our research we took the ratio of incurred cost of taxation of businesses and paid tax as a criterion of effectiveness.

Due to a limited space we do not give details of the methods we used in calculating the economic efficiency of the process of applying value added tax. We chose effectiveness as the main indicator of the cost.

3. The effectiveness of value added tax scheme from the point of view of businesses

In order to ensure objectiveness and content validity of the results of our research we used the method of standardized questionnaire.

3.1. The content and structure of the questionnaire

The questionnaire was divided into an introduction and four main parts (I — IV).

Out of 29 questions in total, 14 were closed and 7 open. Eight questions with scaling answers were referring to numerical values (e.g. number of employees, amount of tax, amount of incurred cost, etc.).

The first part of the questionnaire (I) contained 5 questions and its aim was to obtain identification data on businesses, in particular:

- the legal form of the business

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- the legal form of the business

- the object and place of the business
- total number of employees
- yearly turnover.

In the second part (II) the questions focused on the value added tax and accounting of businesses. The 5 questions of this part were asking about type of accounting, who completes the VAT file and type of VAT registration (on a monthly, quarterly, optional, single basis, etc). The questions were also asking about the yearly amount of the paid VAT (exorbitant VAT allowances) for 2003 and 2004.

The third part of the questionnaire contained two sets of questions about the cost of taxation: The aim of part III.A (questions 11 — 19) was to obtain data on the cost of taxation in internal processing of value added tax in a business with precisely defined types of incurred cost. The respondents could also add other types of incurred cost and give their absolute value.

3.2. Results and discussion

Quantitative assessment of the results was based on the criterion of diligence and therefore we chose the year of the least changes in legislation and taxes in Slovakia, the year 2003, as the year of processing.

The resulting cost of paying value added tax by small businesses can be interpreted as follows: 10 Slovak crowns of paid tax incurred 4.40 crowns of social cost of paying value added tax. In medium-sized businesses 10 Slovak crowns meant 1.96 crowns of incurred cost of paying value added tax. In big companies — payers of value added tax — 10 Slovak crowns of paid tax incurred 0.83 crown of the cost of paying the tax. On the whole, in all responded businesses 10 Slovak crowns incurred 0.96 crown of the cost. The research continued also in the year of profound changes in taxation and legislative conditions. As it was expected, in that year the incurred cost increased and the most significant increase was recorded in the category of small businesses — by 5.31 percentage points. In medium-sized and large companies the increase of incurred cost of paying value added tax was 3 %. It is obvious that this development resulted in lower economic effectiveness of applying value added tax on the side of businesses (increase of 2.96%).

The indicator of cost was a quantitative synthetic output of the research. The primary data from the questionnaire were processed so they can be used to make further conclusions and initiate discussions and proposals of measures in value added taxation. From other theoretical and practical conclusions we have chosen the following: more than half of respondents (58) considered the legislation as difficult to understand, complicated and time and material demanding, as the most positive change the payers reported flat-rate tax scheme, which was applied in Slovakia from 1 January 2004 till 2006; at the same time they expressed a requirement to lower the marginal tax rate to 15%, only 4 respondents (3.51%) considered value added tax as a financial means of running a business (in terms of cash flow), an overwhelming majority of responded businesses (84.21%) do not particularly follow or calculate the effect of VAT taxation.

We have made recommendations and proposals to optimize the process of VAT taxation for different categories of businesses, in particular domestic businesses that produce for end-users, exporters, and/or suppliers within intra-

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community trading, customers within intra-community trading and for newly-established businesses. The recommendations should help businesses to make decisions about joining the value added tax scheme, i.e. either to register or not as a VAT payer.

Conclusion

Our research on value added tax encompassed a wider range of issues of general indirect taxation in the Slovak Republic. We have come to an important conclusion that businesses are not able to quantify the real incurred cost of VAT taxation and do not follow the effects of taxation (e.g. as hidden financial reserves). They lack any procedure to follow, register and quantify them in spite of the fact that they are part of everyday economic reality. In terms of the quantified cost of the process of VAT taxation small businesses' administrative burden was five times as much as that of large companies and three times higher in comparison with medium-sized businesses. The results show that despite the long-lasting effort to simplify the taxation process in the Slovak

Republic, its legislation should also consider other (simplifying) schemes of applying value added tax, especially with small businesses.

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The International Trading System and Its Future

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This article describes the evolution and structure of the international trading system, focusing on the tension between the fundamental GATT/WTO principle of most-favored-nation (MFN) treatment and the proliferation of discriminatory trading arrangements, including regional agreements as well as new versions of special and differential treatment of low-income countries. It also discusses the increasing pressure to use the enforcement power of the GATT/WTO system to achieve member compliance with social norms in the areas of labor and environment. The chapter concludes by considering some significant challenges that currently face the international trading system and possible directions of the system's evolution in response to these challenges.

I. Introduction

The international trading «system» comprises many thousands of unilateral, bilateral, regional, and multilateral rules and agreements among more than two hundred independent nations. Atop this complex and rapidly evolving mass of political and economic arrangements is the World Trade Organization (WTO), with 153 members that together account for nearly all of world trade.

Created in the Uruguay Round of multilateral negotiations as a successor to the General Agreement on Tariffs and Trade (GATT), the WTO provides a legal and institutional framework for national policies that directly or indirectly affect international trade among its members. Like the GATT, the primary goal of the WTO is to promote freer and more predictable conditions of trade.

However, practice has gradually moved away from the principles that shaped the original GATT. In the WTO, nondiscrimination among trading partners remains a fundamental principle, as laid out in the original GATT (now known as GATT 1947) and also in the updated GATT 1994 produced in the Uruguay Round. Yet GATT rules also allow for preferential (i.e., discriminatory) policies, and these have become an increasingly important feature of the international trading system. Likewise, although reciprocity has always played a key role in GATT/WTO procedures for multilateral trade negotiations and dispute settlement, the scope of non-reciprocal arrangements intended to benefit poorer countries has steadily expanded.

The WTO is the latest embodiment of multilateral efforts to promote cooperation among trading nations that began even before the end of World War II.

An overwhelming majority of the 153 members are developing countries, with 32 of the poorest classified as least developed countries (LDCs); 29 additional «observer» nations are working toward WTO membership. http://www.wto.org/english/thewto_e/whatis_e/whatis_e.htm (accessed 3/8/2010). Significant nonmembers include the Russian Federation and several other major oil exporters.

At the 1944 Bretton Woods Conference, which created the International Monetary Fund (IMF) and International Bank for Reconstruction and Development (World Bank), participating

nations also recognized the need for a third institution, to be called the International Trade Organization (ITO). The ITO was designed to prevent a resurgence of the protectionism of the pre-war period and continue the efforts toward reciprocal trade liberalization that were already in progress before the onset of the war. In addition to trade policies, the new organization‟s authority

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An overwhelming majority of the 153 members are developing countries, with 32 of the poorest classified as least developed countries (LDCs); 29 additional «observer» nations are working toward WTO membership. http://www.wto.org/english/thewto_e/whatis_e/whatis_e.htm (accessed 3/8/2010). Significant nonmembers include the Russian Federation and several other major oil exporters.

At the 1944 Bretton Woods Conference, which created the International Monetary Fund (IMF) and International Bank for Reconstruction and Development (World Bank), participating

nations also recognized the need for a third institution, to be called the International Trade Organization (ITO). The ITO was designed to prevent a resurgence of the protectionism of the pre-war period and continue the efforts toward reciprocal trade liberalization that were already in progress before the onset of the war. In addition to trade policies, the new organization‟s authority

was to include national policies toward foreign investment and business practices. However, plans for the ITO were derailed when the U.S. Congress failed to ratify its ambitious draft charter. In its place, the more limited 1947 GATT treaty emerged as a «temporary» solution, one for which U.S. participation did not require Congressional approval.

The GATT was an agreement rather than a full-fledged international organization and had «contracting parties» rather than members. It came into effect during the ITO negotiations, with the goal of achieving immediate tariff reductions among the 23 participating countries (Hudec 1998).

Despite its limited scope and resources, the GATT endured for nearly 50 years, its membership (formally, contracting parties or signatories) growing from an initial 23 to 128 by 1994.

[http://www.wto.org/english/thewto_e/gattmem_e.htm (accessed 3/8/2010)]

Prior to the Uruguay Round, which began in 1986, the GATT had already sponsored seven rounds of multilateral trade negotiations. These had achieved a significant cumulative reduction in tariff rates. By 1986, the trade-weighted average of tariffs on manufactured goods had been reduced to about 6.4 per cent, from about 35 per cent in 1947. [Crowley (2003) quoting Hoekman and Kostecki (1995).]

The GATT has thus been credited with a key role in facilitating the massive growth in the volume of world trade during the post-war era (Irwin 2002, 165-170).

Yet the GATT left some critical issues unresolved (Crowley 2003). Although average tariff rates had been reduced substantially, stubborn peaks for individual products remained. Some major industries, notably agriculture and textiles and apparel, had been excluded from normal GATT guidelines. Even in covered sectors, importing nations were making extensive use of «administered» protection—such as antidumping actions, countervailing measures, and voluntary export restraints—to limit competition from abroad. Moreover, GATT rules pertained mainly to trade in tangible goods, a significant limitation with international trade in services growing at a rapid rate. Other issues closely linked to trade but not covered by GATT rules included national policies toward foreign direct investment and intellectual property. And perhaps most central, the GATT provided no effective way to resolve disputes among the contracting parties.

Concerns about these shortcomings of the GATT provided much of the agenda for the ambitious Uruguay Round (1986-1994), which culminated in establishment of the WTO. Yet despite the fanfare surrounding the WTO‟s birth in 1995, doubts regarding the new organization soon began to materialize. These doubts were heightened by lack of progress in the Doha Round begun in 2001, the first round of multilateral negotiations sponsored by the WTO. Some critics have called for a new Bretton Woods conference to reconfigure the three major international economic organizations and reallocate responsibilities among them. The goal would be to increase their overall effectiveness in addressing problems in global governance not anticipated in the 1940s, including huge bilateral trade imbalances and national efforts to limit climate change.

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GATT/WTO principle of most-favored-nation (MFN) treatment, i.e., nondiscrimination among trading partners, and the trend toward discriminatory trading arrangements, including the proliferation of regional agreements as well as new versions of special and differential treatment of low-income countries. Section 4 focuses on participation of developing countries in the system and the effort to use special treatment to promote development objectives.

Section 5 discusses the pressure to use the enforcement power of the GATT/WTO system to achieve member compliance with social norms in the areas of environment and labor.

Section 6 assesses some significant challenges that currently face the international trading system. Section 7 concludes by considering possible directions of the system's evolution in response to these challenges.

2. The World Trade Organization

Notwithstanding repeated threats of its imminent collapse over nearly eight years

of negotiations, the Uruguay Round made remarkable headway in addressing some of the most important shortcomings that had plagued the GATT 1947. While negotiators continued the traditional GATT-era work of reducing tariff and non-tariff barriers to manufactured goods trade (average tariff rates were reduced by 40 per cent), they also broke new ground with agreements to bring trade in services, textiles and apparel, and agricultural products into greater conformity with GATT norms. The Round‟s significant achievements included negotiation of commitments to reduce agricultural subsidies, to phase out the Multifibre Arrangement (over a ten year period) and thus apply the same rules to trade in textiles and apparel as to trade in other manufactured goods, and to strengthen protection of intellectual property rights (with phase-in periods based on members‟ level of economic development). Other agreements improved rules and procedures dealing with a variety of non-tariff measures, including subsidies, technical barriers to trade, and sanitary and phytosanitary measures. The goal of these agreements was to balance member governments‟ acknowledged need to address domestic concerns against the potential for abuse of such policies as a disguised form of import protection or discrimination among trading partners.

The Uruguay Round also departed from precedent in a fundamental respect. With minor exceptions, all WTO members agreed to comply with the obligations spelled out in all the agreements, which were included in the «Single Undertaking.» This need for consensus among all participants was in contrast to the approach used in the Tokyo Round, in which various «codes» governing use of non-tariff barriers were endorsed by only some members, primarily the most advanced countries. Rules in the Tokyo Round codes then applied only to trade among signatories. However, there has recently been discussion of reverting to a system that does not require all members to move toward WTO goals at the same rate.

The most significant departure from the system created by GATT 1947 was a revamping of procedures for settling disputes among trading nations. The WTO Dispute Settlement Understanding (DSU) introduced a systematic rules-based approach to resolving disputes concerning members‟ alleged failure to meet their WTO obligations.

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This system is usually described as self-enforcing, in that the WTO itself has no power to police national trade policies. Rather, an affected member must initiate each dispute.

Hoekman and Kostecki (2009, 529-530). An approach in which common policies are implemented at different rates is often called «variable geometry,» a phrase due to Jacques Delors. However, because it refers to differences in speed of convergence to common policies, it leaves aside the more difficult situations in which there is no agreement on what the common policy should be.

Under the current system, any dispute that cannot be resolved through direct negotiation among affected countries is referred to a panel of three experts, almost always specialists in international commercial relations, e.g., diplomats and trade lawyers. The panel report is intended to provide a neutral judgment as to whether the member has violated GATT/WTO rules.

If the panel affirms that the contested policy is inconsistent with the member‟s WTO obligations, the member can appeal the decision, amend its policies, or face authorized retaliation from trading partners that have lost market access as a result of the violation. Authorized retaliation (and often merely the threat of retaliatory action)—in the form of partners‟ increased barriers designed to reduce the member's market access by an amount commensurate with the effect of the contested policy—provides the enforcement mechanism that maintains adherence to WTO rules and thus protects members‟ export market access. The DSU is an important improvement over the GATT system, in which any country could in effect veto a panel decision that was contrary to its political or economic interests.

Similar to the role played by the GATT until the end of the Uruguay Round, the WTO serves as a forum for multilateral trade liberalization negotiations among its members. The current Doha Round, initiated in 2001, is the first round of multilateral negotiations to be held under WTO sponsorship and is thus seen as a test of the new organization‟s ability to maintain forward momentum in trade liberalization. The stalled round therefore brings the WTO framework into question. But the WTO has important functions separate from its role as the facilitator of multilateral trade negotiations.

More precisely, the panel report indicates whether the challenged policy is WTO-inconsistent. This broader category also includes «non-violation complaints.» In contrast to the more common disputes involving an allegation that a member has violated a WTO rule, these refer to situations in which the complainant has not received the anticipated benefit even though no rule has been violated. Such complaints aim at preserving the balance of benefits intrinsic to reciprocal bargaining.important is its role discussed above as neutral arbitrator of trade disputes, i.e., in helping to assure that members actually receive the anticipated trade benefits of reciprocal liberalization. The WTO also serves a monitoring and information-dissemination function, again building on its GATT roots. The WTO collects and publishes data on trade flows as well as changes in trade policy undertaken by members between negotiating rounds (members are required to notify the WTO of certain policy changes, such as antidumping actions). Under the Trade Policy Review Mechanism (TPRM), the WTO carries out periodic reviews of each member‟s trade policy regime; scheduled frequency of review is highest for the largest trading economies.

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The results of the reviews, including the responses of member country officials, are made available on the WTO website. Finally, as discussed in section 4 below, the WTO has also continued to expand the role gradually taken on by the GATT in promoting the trade interests of developing countries.

3. GATT/WTO principles and discriminatory trading

At the start, the primary goal of the GATT was to promote nondiscriminatory trade liberalization. The fundamental guidelines were nondiscrimination (most-favored-nation treatment among signatories), reciprocity, and transparency. MFN treatment was deemed important enough to be the subject of Article I of the GATT 1947, This timing scheme is the opposite of what might be recommended, given that it dedicates most resources to the major countries, for which other agencies and organizations already provide ample and often more timely information. Moreover, the review process is influenced by political as well as economic considerations. To avoid controversy, reviewers may fail to emphasize the kinds of information that would be most helpful in ensuring members‟ adherence to their WTO commitments (Bown 2009, 219-220).

In the early decades, poor countries were termed «less-developed» countries (LDCs). Since adoption of the more optimistic but often inaccurate current terminology, LDC has become the acronym used to designate the least developed countries, i.e., the poorest of the poor agreement‟s preamble called for members to enter into «reciprocal and mutually advantageous arrangements directed to the substantial reduction of tariffs and other barriers to trade» and Article XXVIII required «compensatory adjustment» when previously agreed concessions were modified. The need for increased transparency was expressed in several GATT articles, especially Article X, requiring prompt publication by signatories of new laws and regulations affecting trade, and Article XI, calling for general elimination of quantitative restrictions on trade. The underlying goal was to ensure that foreign suppliers would face known and constant barriers, ones that could be overcome by sufficiently competitive producers. The strong preference specifically for the use of tariffs over quantitative restrictions or other types of trade policies also temmed from the view that reliance on tariffs would simplify the future process of reciprocal liberalization.

The early GATT priorities reflected the negotiating nations‟ desire to undo the harm to the international trading system that had occurred during the 1930s. The Smoot-Hawley tariffs enacted by the U.S. Congress in 1930 had soon been followed by similar «beggar-thy-neighbor» actions by other countries, as well as discriminatory arrangements such as the United Kingdom‟s imperial preferences, which entailed lower tariffs on imports from its colonies and dominions. With the United States and England taking the leading roles, negotiators resumed efforts begun before World War II to lower barriers to trade through reciprocal reductions in bound tariff rates (reciprocity), to replace quantitative restrictions and other nontariff barriers by tariff protection (transparency), and to eliminate discriminatory arrangements (most-favored-nation treatment).

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In the United States, the 1934 Reciprocal Trade Agreements Act authorized the President to conduct bilateral negotiations with major trading partners to

reverse the protectionist Smoot-Hawley tariffs on a reciprocal basis. U.S. tariff cuts achieved through these negotiations were then extended to other trading partners through most-favored-nation treatment. Negotiated reductions required no enabling legislation by Congress.

The initial success of the GATT in achieving these goals reflected mutual gains to the participating nations, but, given the overwhelming dominance of the United States in the world economy, the key factor was U.S. willingness to abide by GATT principles.

Cuts in the first GATT round (1947) reduced U.S. average bound tariff rates by 26 percent (Martin and Messerlin 2007). However, changing conditions gradually diluted U.S. commitment, pushing the contracting parties toward a multi-tier system of responsibilities. The first change was the surge in exports of manufactured goods from Japan and then from four even newer suppliers (Hong Kong, Singapore, Taiwan, and South Korea) collectively termed the Newly Industrializing Economies (NIEs) or Four Tigers. To manage the increase in competing imports, the United States and the European Union used discriminatory policies involving extra-GATT bilateral agreements with individual exporters rather than the GATT‟s own safeguard procedures (Article XIX), which are meant to be applied on an MFN basis. The result was the spread of negotiated quantitative restrictions, first from Japan to the NIEs, and then, especially for textiles and apparel, to many additional exporters. By 1974, worldwide trade in textiles and apparel was controlled by the Multifibre Arrangement (MFA), a system of bilateral quotas limiting trade between most of the world's rich importers and most of the world's poor exporters of these products.

At the same time, the list of contracting parties gradually expanded to include more of the world‟s poor countries. The new signatories were often former colonies of the original participants. Perhaps inevitably in an organization operating on the basis of unanimity, provision for «special and differential treatment» of nations at an earlier stage of economic development expanded far beyond the initial vague commitment in GATT

The United States had already negotiated bilateral trade restraints with Japan for textiles prior to World War II.

Part IV, which had been added in 1964. Attention to the trade concerns of less-developed nations increased further during the «New International Economic Order» crusade of the 1970s. The issues raised by the increasing majority of poor countries among participants in the GATT/WTO system are discussed below in section 4.

A final important change in the GATT/WTO system has been the surge in negotiation of preferential trade agreements (PTAs) among subsets of participating nations. From the start, the GATT made provision for PTAs in Article XXIV, even though such arrangements represented an explicit departure from the GATT/WTO guiding principle of nondiscriminatory trade among signatories, i.e., most-favored-nation treatment. In the WTO, Article XXIV of the GATT 1994, together with the Uruguay Round «Understanding on the Interpretation of Article XXIV of the General Agreement on Tariffs and Trade,» set rules governing PTAs for goods; Article V of the GATS contains corresponding rules for services.

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The GATT/WTO position on PTAs recognizes the desirability of increasing trade through voluntary agreements between two or more members. However, there is also the concern that such agreements should facilitate trade among the partner countries without raising barriers to trade with non-partner countries.

Article XXIV therefore places some significant restrictions on the common external tariffs applied by members of a customs union as well as the required product coverage, which is supposed to include «substantially all trade.» In practice, however, the GATT/WTO system has taken a laissez-faire attitude, with virtually no effort to ensure that agreements are consistent with the guidelines. Moreover, almost all the new PTAs—the notable exception is the European Union—have been free-trade agreements (FTAs) rather than customs unions with common external tariffs. The result has been what Jagdish Bhagwati termed a «spaghetti bowl» of PTAs, with selective product coverage, lengthy phase-in periods, and complex rules of origin (ROOs).

WTO documents refer to these as Regional Trade Agreements (RTAs), even when partner countries are on separate continents.

Even in the absence of higher MFN tariffs, the preferential margin created by a PTA in effect raises barriers to trade with non-partner countries, resulting in trade diversion, i.e., the substitution of partner imports for lower-cost imports from non-partners. Some economists have suggested that countries forming free trade areas should be

Beyond an expectation that new PTAs will be notified to the WTO, the rules on preferential trading appear to exercise little if any discipline over such arrangements. In practice, no preferential agreements among GATT or WTO members, whether developed or developing, have ever been challenged by other members. This laissez-faire posture has given rise to increasing concern about the effects of proliferating free trade agreements on progress toward multilateral trade liberalization. This deleterious effect could arise for either of two reasons (Krueger 2007). First, the limited capacity of many countries to conduct international trade negotiations may be taxed by efforts to form PTAs. Second, WTO members‟ incentives to engage in multilateral liberalization may be lessened to the extent that the benefits derived from current PTA membership would thereby be eroded. However, these concerns do not seem to be discouraging members from pursuing new PTAs

More lenient rules on preferential trading between developing countries are contained in the Tokyo Round agreements signed in 1979.

Moreover, some theoretical and empirical research suggests that formation of free trade areas may actually stimulate rather than retard multilateral liberalization, i.e., that PTAs can act as building blocks rather than stumbling blocks (McCulloch and Petri 2007; Estevadeordal, Freund, and Ornelas 2008).

4. Developing countries in the international trading system

Although the 23 nations participating in the negotiations that produced the original GATT in 1947 included 12 developing countries, in its early days the GATT was disparaged as a «rich man‟s club.»

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WTO documents refer to these as Regional Trade Agreements (RTAs), even when partner countries are on separate continents.

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Beyond an expectation that new PTAs will be notified to the WTO, the rules on preferential trading appear to exercise little if any discipline over such arrangements. In practice, no preferential agreements among GATT or WTO members, whether developed or developing, have ever been challenged by other members. This laissez-faire posture has given rise to increasing concern about the effects of proliferating free trade agreements on progress toward multilateral trade liberalization. This deleterious effect could arise for either of two reasons (Krueger 2007). First, the limited capacity of many countries to conduct international trade negotiations may be taxed by efforts to form PTAs. Second, WTO members‟ incentives to engage in multilateral liberalization may be lessened to the extent that the benefits derived from current PTA membership would thereby be eroded. However, these concerns do not seem to be discouraging members from pursuing new PTAs

More lenient rules on preferential trading between developing countries are contained in the Tokyo Round agreements signed in 1979.

Moreover, some theoretical and empirical research suggests that formation of free trade areas may actually stimulate rather than retard multilateral liberalization, i.e., that PTAs can act as building blocks rather than stumbling blocks (McCulloch and Petri 2007; Estevadeordal, Freund, and Ornelas 2008).

4. Developing countries in the international trading system

Although the 23 nations participating in the negotiations that produced the original GATT in 1947 included 12 developing countries, in its early days the GATT was disparaged as a «rich man‟s club.»

The GATT initially focused almost entirely on trade in manufactured goods, i.e., goods that were then exported mainly by the developed countries, and

GATT rules for poor countries were mostly the same as those for rich countries. However, developing countries were accorded special treatment through exemptions from some rules, e.g., permission under Article XVIII to use tariffs and quotas to promote an infant industry or to deal with balance of payments problems (Dam 1970, Chapter 14). Developing countries also benefited via most-favored-nation treatment from the liberalization commitments of the advanced nations without being required to engage in reciprocal opening of their own markets.The principle of special treatment for developing countries was formalized by the addition in 1966 of Part IV, «Trade and Development,» to the GATT. The Tokyo Round went even further with adoption of the Enabling Clause (officially, «Differential and More Favorable Treatment of Developing Countries») in 1979. The Enabling Clause allows advanced countries to discriminate in favor of poorer countries, and especially the least developed countries—as had already been done through the enactment of the Generalized System of Preferences (GSP). The Enabling Clause also allows developing countries to negotiate preferential trade agreements that do not satisfy the usual GATT criteria as spelled out in Article XXIV.

Pomfret (2007) argues that the extent of PTA formation has been exaggerated by use of faulty measures. He also notes that the most important PTAs in terms of trade volume affected, notably the European Union, coordinate policies in many areas in addition to trade, thereby achieving «deep integration» among their members. Such agreements have complex implications for the health of the multilateral trading system going far beyond the usual trade creation/trade diversion analysis.

Beginning in 1964, the United Nations Conference on Trade and Development (UNCTAD) provided a forum where concerns of poor countries could be aired. The UNCTAD agenda included issues such as one-way trade preferences for manufactured exports of poor countries, stabilization of commodity export prices—primary commodities had accounted for about 80 percent of export earnings of these countries and a non-fuel commodity was the leading export for many—and unconditional grant aid. However, much of the agenda required the cooperation of rich countries for funding or market access. Some parts of the agenda became reality, including the Generalized System of Preferences enacted by most industrialized countries and export-earnings stabilization schemes implemented by the International Monetary Fund and the European Economic Community (EEC).

Notwithstanding their special status, most of the poor countries remained poor, and those that prospered—mainly the NIEs and other East Asian countries—did so through export-oriented growth strategies. Yet these new exporters were soon subjected to discriminatory trade restrictions, and the GATT did little to shield them from policies that violated at least the spirit of its rules. Moreover, even after successive rounds of GATT-sponsored multilateral trade negotiations, labor-intensive manufactured products like shoes and especially textiles and apparel remained highly protected, while world prices of many agricultural products were depressed by generous subsidies in the United States and European Union.

For example, such agreements may cover only a limited range of products rather than «substantially all trade» as specified in Article XXIV.

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The GATT‟s special treatment of developing countries turned out to be at best ineffective and perhaps even counterproductive.

To begin with, it was predicated on the assumption now largely discredited that trade liberalization is less desirable for developing countries than for developed countries. Facing less external pressure to open their markets to trade, the developing countries obtained less of the potential benefits to be derived from integration into world markets. Moreover, relieving the developing countries of the requirement for reciprocity meant that these countries remained on the sidelines in shaping multilateral negotiations. The developing countries thus lost the opportunity to exchange access to their own domestic markets (whether as a group or, for some larger countries, individually) for desired liberalization commitments from developed countries. By remaining nonparticipants in the successive rounds of GATT tariff reductions, they also lost the opportunity to contest disadvantageous exceptions to basic GATT rules for specific sectors, especially textiles and apparel and agriculture.

Finally, because MFN liberalization reduces the benefits enjoyed by countries with preferential access to important markets, the existence of one-way preferences may retard progress toward global free trade.

By September 1986, when the Uruguay Round negotiations began, the total number of GATT contracting parties had grown to 91, and the majority of the additions were developing countries, including newly independent nations in Africa and elsewhere.

More developing nations joined the GATT during the negotiations that eventually produced the WTO, which commenced operation on January 1, 1995 with 128 members.

Jones (2010, 24-27). Some analysts foresaw the problematic outcome of the Tokyo Round‟s emphasis on «special treatment» of developing countries. See McCulloch (1983).

In the Doha Round, some beneficiary countries have requested compensation for the erosion of benefits from preferential market access as MFN protection is negotiated downward.

But despite ongoing efforts to provide benefits for poor countries, the operation of the GATT system was still dominated by the concerns of the developed nations, and those concerns continued to play an important role in the Uruguay Round. By 2008, an overwhelming majority of the 153 WTO members were developing countries, with 32 of the poorest classified as least developed countries (LDCs). Yet even with the rapid increase in their numbers, many observers, and especially those representing the interests of poor countries, judge that participation in the Uruguay Round and in the WTO have so far yielded few benefits for these countries.

Of the accomplishments from the Uruguay Round, the eagerly sought dismantling of the Multifibre Arrangement (MFA) proved to be a major disappointment to most developing countries, as China‟s share of export markets for textiles and apparel exploded and competition among suppliers dissipated quota rents. The Agreement on Trade-Related Aspects of Intellectual Property Rights (TRIPS) has been criticized as causing, at least potentially, an adverse movement in the terms of trade of poorer countries, which are overwhelmingly importers of proprietary technologies created mainly in a few rich countries.

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Promised elimination of U.S. and European Union agricultural subsidies has stalled, disappointing middle-income developing countries with comparative advantage in sugar, rice, cotton, soybeans, and other agricultural products. And the Doha Development Round, aimed specifically at addressing post-Uruguay-Round concerns of poor countries, has been declared dead on numerous occasions.

But laments regarding lack of progress in the Doha Round have tended to overshadow the increasing benefits already being derived by many developing countries from another achievement of the Uruguay Round: creation via the Dispute Settlement Understanding (DSU) of an enhanced process that allows members to self-enforce the market access to which their trading partners have agreed. Data on disputes brought to the WTO show a steady stream of WTO self-enforcement actions undertaken by developing countries throughout the WTO era, in contrast to the declining trend of self-enforcement actions undertaken by the developed countries over the same period (Bown and McCulloch 2010). These actions have allowed at least some developing countries to maintain the market access to which they are entitled in situations when trading partners have failed to uphold their WTO commitments

In practice, implementation delays and favorable pricing practices, especially for pharmaceuticals, have so far minimized the feared effects.

Yet the ability of developing countries to engage in successful self-enforcement actions remains limited by two important factors. First, most developing countries have small markets for imports. This is partly due to small total demand but also to significant import barriers, which on average are still much higher than those of the developed countries. Since the self-enforcement process relies on the threat of WTO-authorized retaliation, its potency is limited by import market size. Thus, only larger developing countries are in a position to take advantage of the self-enforcement process. In addition, information about foreign actions that reduce market access may be difficult to obtain, especially when the actions in question are less easily observed than new trade barriers. Developing countries have therefore focused their self-enforcement actions on types of WTO violations that are directly observable by exporting firms and governments, especially unjustified application of antidumping measures, rather than on subtler domestic measures that also limit imports.

Although WTO litigation costs of developing countries‟ self-enforcement actions are already heavily subsidized by the Advisory Center on WTO Law, the significant informational costs of determining when such an action is justified remain a significant deterrent (Bown 2009).

The preponderance of cases involving antidumping may also reflect the global proliferation in this particular form of import protection.

5. Trade sanctions as a means of enforcing socioeconomic norms

The WTO is unique among international organizations in possessing an effective system by which its rules can be enforced. As a result, there has been continuing pressure going back to the GATT era to use the WTO to enforce socioeconomic norms shared by a significant number of participating countries. The justification for involving the GATT/WTO is that failure to honor social norms usually confers a cost advantage. A country‟s failure to meet such norms

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may therefore be regarded as «social dumping» and treated in an analogous way. The main areas of domestic policy potentially affected are those concerned with environmental protection and labor standards, although as discussed in section 6.2 below, there has been recent discussion of using trade sanctions as a way to force macroeconomic «rebalancing.»

Underlying the controversy regarding use of WTO-authorized trade sanctions to enforce socioeconomic norms is that national attitudes regarding environmental protection and labor standards are strongly affected by per capita income—these norms tend to be «luxury goods» whose demand rises along with citizens‟ incomes. Expecting poor countries to meet the same standards as rich ones may place poor countries at an important competitive disadvantage and may also be economically inefficient. For example, to the extent that labor productivity is higher in rich countries, mutually beneficial two-way trade between rich and poor countries may require similar differences in wages.

Poor countries argue that norms should be adjusted to take into account differences in stage of development, pointing out that present labor and environmental conditions in their economies are no worse, and in some cases far better, than those that prevailed in the now-industrialized nations during an earlier era. Although actual GATT/WTO links between market access and social norms have so far been minor, the issue is poised for greater significance as many developed countries begin to impose broad restrictions on carbon emissions and pressure developing countries, especially large ones like China and India, to make corresponding commitments.

6. Emerging issues

It is easy to point to shortcomings in the world trading system that bode ill for the future. The Doha Round had stalled repeatedly even before the onset of the global financial crisis of 2008-9. Despite a trimmed-down agenda, many observers have grown pessimistic about completion of the round. But on the positive side, even the extreme economic disruptions accompanying the global crisis did not give rise to the feared surge in protectionism and defection from WTO disciplines. Although many countries implemented some new protection, this was done almost entirely in ways that did not violate their WTO commitments, i.e., through antidumping and safeguard actions, or by raising applied tariffs that were initially lower than the corresponding bound rates (Bown and Kee, 2010).

Meanwhile, the development of an unprecedented bilateral imbalance between the United States and China has placed an increasing strain on a system based on reciprocity, and a continuing surge of new preferential, i.e., discriminatory, trading arrangements has increased the tension between the GATT/WTO‟s key MFN principle and trade realities.

Consider a simple Ricardian model in which labor productivity in the richer country is four times as high in the export industry and twice as high in the import-competing industry as in the poorer country. Two-way trade is then possible only if the richer country‟s wage rate is at least twice but no more than four times as high as that of the poor country, when both are measured in the same currency.

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MFN has now come to mean least-favored-nation treatment, i.e., paying the «list price» at the border. Beneficiaries of one-way preferences argue that fairness requires compensation for erosion of benefits when successful MFN liberalization cuts the preferential margin they now enjoy. And finally, the perceived need to reverse the growth of carbon emissions will pose an important new challenge for the WTO, as participating countries seek trade policy measures to deal with «carbon leakage» from countries not willing to join in these efforts. How are these situations likely to play out in terms of evolution of the world trading system?

6.1 The Doha Round.

As of late 2010, the stalled Doha Round, which was initiated in November 2001 as the Doha Development Round, had already exceeded the length of any of its predecessors, and with no end in sight. In contrast, even the ambitious and protracted Uruguay Round had required «only» seven years and seven months from inception to signing. Economists and public officials are divided on both the feasibility of completing the round and the importance of doing so.

Some see the lack of progress as a reflection of the problems inherent in achieving consensus among such a large and diverse group of nations and even question whether there is any future for multilateral trade liberalization along the lines of the GATT rounds of the past. This view gains some credence from the heightened pace at which new preferential agreements have been initiated and concluded over the same period. Moreover, the recent economic woes of the advanced countries have further reduced domestic political support for any new concessions to developing countries.

Martin and Messerlin (2007) review the history of previous rounds of multilateral negotiations in order to evaluate alternative explanations for the Doha Round‟s lack of progress. In the end they remain cautiously optimistic about the round‟s eventual success. Baldwin (2009) likewise draws parallels with past rounds, pointing out that the history of past negotiations is also «littered with lengthy stalemates.»

Even those who argue for completing the round are divided on what is to be gained by doing so. Some see the fate of the Doha Round as significant mostly for what it implies about global support for the WTO as an institution. In this view, a failed round could undermine the WTO‟s authority in setting and enforcing guidelines for national policies toward trade (Hoekman, Martin, and Mattoo 2009). However, others see a Doha failure mainly as a missed opportunity to continue the GATT/WTO‟s progress in promoting a more open and transparent trading system. In direct contrast to proposals to further limit the scope of the negotiations as a way to facilitate agreement, Hufbauer, Schott, and Wong (2010) argue for a more ambitious package that would increase anticipated gains for major parties and thus justify the political effort required to bring the round to a successful conclusion. Whether this approach is feasible remains to be seen, but it is certainly true that progress can only be made if each participant perceives a net benefit from going forward; raising the stakes could energize the moribund process.

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However, with world leaders already challenged by more urgent priorities, it is not obvious where the necessary leadership for a step in this direction can be found.

6.2 Reducing bilateral imbalances.

As the world emerges from the global financial crisis, the need for «rebalancing» supply and demand across countries and continents has become evident. But where does the responsibility for rebalancing lie, and how should it be achieved? Accomplishing this goal during a still-fragile recovery beset with other important international dilemmas, such as the fate of the Euro, poses a formidable challenge.

Many believe that a major appreciation of China‟s currency is a necessary condition for sustained shrinkage of its bilateral surplus with the United States. If so, is it appropriate for the WTO to become the enforcer of this prescription? Mattoo and Subramanian (2009) argue for joint action by the International Monetary Fund and the WTO—the latter‟s participation required because the IMF has no ability to enforce its policy prescriptions on a member such as China that is not requesting IMF loans.

However, use of trade restrictions to force an exchange-rate appreciation would represent a major shift in the mission of the GATT/WTO, which normally focuses on measures that affect the composition of trade flows rather than aggregate imbalances (Bown and McCulloch, 2009). Moving in this direction would open the door to further actions whenever a country‟s exports seemed «too large» or imports «too small»—according to criteria still to be determined.

Some argue that by maintaining a low international price for the yuan, China is in effect subsidizing its exports, and that a countervailing duty equal to the extent of yuan undervaluation would be appropriate under WTO rules. However, there is no consensus among economic experts on the extent of yuan undervaluation. Moreover, an analysis by Staiger and Sykes (forthcoming) raises analytical doubts concerning this approach.

Staiger and Sykes conclude that the difficulty of determining the trade effects of China's currency practices «calls into question the wisdom and legitimacy of countermeasures that have been proposed….» In any case, even a large revaluation of the yuan in terms of the dollar would not be enough to restore bilateral balance between China and the United States unless accompanied by a substantial, sustained increase in national saving in the United States and a corresponding reduction in China and other surplus countries.

6.3 The trend toward preferential trading.

Sharply contrasting with the absence of progress in multilateral trade negotiations is continued momentum in the negotiation of new preferential agreements. The attraction of moving in this direction is obvious—with a small number of participants it is much easier to craft terms that are mutually beneficial. While excluded countries as a group may be harmed, this effect is usually sufficiently dispersed to avoid any major fallout. Yet even the most ardent supporters of the preferential approach see it as a complement to multilateral liberalization rather than a substitute. The real challenge is to avoid creating a thicket of inconsistent policies that further complicate the task of achieving liberalization multilaterally (Baldwin 2006).

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Staiger and Sykes conclude that the difficulty of determining the trade effects of China's currency practices «calls into question the wisdom and legitimacy of countermeasures that have been proposed….» In any case, even a large revaluation of the yuan in terms of the dollar would not be enough to restore bilateral balance between China and the United States unless accompanied by a substantial, sustained increase in national saving in the United States and a corresponding reduction in China and other surplus countries.

6.3 The trend toward preferential trading.

Sharply contrasting with the absence of progress in multilateral trade negotiations is continued momentum in the negotiation of new preferential agreements. The attraction of moving in this direction is obvious—with a small number of participants it is much easier to craft terms that are mutually beneficial. While excluded countries as a group may be harmed, this effect is usually sufficiently dispersed to avoid any major fallout. Yet even the most ardent supporters of the preferential approach see it as a complement to multilateral liberalization rather than a substitute. The real challenge is to avoid creating a thicket of inconsistent policies that further complicate the task of achieving liberalization multilaterally (Baldwin 2006).

Plummer (2007) advocates a multi-layered liberalization process in which regional agreements are based on «best practices» (the lasagna bowl). These might include a requirement that PTAs accept new members, perhaps after an initial waiting period. Kawai, Petri, and Sisli Ciammara (2009) and Lawrence (2008) envision the evolution of the WTO into a host organization for regional «clubs» formed by subsets of its members.

In contrast to the current laissez-faire approach toward PTAs, the WTO could develop and enforce guidelines for club actions and also serve as a neutral arbiter of disputes arising among club members.

The tension between preferential trading and multilateral liberalization is greatest in the case of poor countries that are the beneficiaries of one-way preferences. While it may be laudable to bend WTO rules in a way that ensures gains for even the poorest participants, there may be other ways to achieve this goal without creating built-in opposition to multilateral liberalization (which reduces the value of trade preferences).

One approach that has received increasing attention in recent years is aid for trade—provision of resources that help poor countries achieve gains from trade, through measures ranging from expert assistance in identifying areas of comparative advantage to improvements in port facilities and customs procedures. Measures of this kind facilitate mutually beneficial trade by accelerating the integration of poor countries into world markets, rather than creating an artificial advantage for a particular group of exporters. Another approach is to maintain the model of a single undertaking, but, as in the Uruguay Round, allow developing countries a longer period in which to achieve compliance. A third option is to focus MFN tariff-cutting efforts on the goods of greatest interest to developing country exporters.

6.4 Trade and climate change.

Reconciling WTO rules with national policies to limit greenhouse gas emissions is sure to pose a major challenge for the world trading system. Countries contemplating across-the-board action to reduce emissions face strong domestic political opposition, especially from industries whose costs will rise significantly as a consequence. Unless all countries adopt comparable measures, national policies raise obvious concerns about lost international competitiveness in the short run and migration of high-emissions industries to other countries in the longer run—in either case severely undermining the effectiveness of national actions in reducing global emissions. Policy proposals have therefore typically included border measures (taxes and subsidies intended to neutralize the impact on trade competitiveness) as well as government subsidies intended to reduce the private cost of complying with new standards or to spur innovation.

Hufbauer, Charnovitz, and Kim (2009) identify the areas in which national climate-change policies currently under review are most likely to conflict with WTO principles and thus result in a surge of new WTO disputes. These authors argue for negotiating a Code of Good WTO Practice on Greenhouse Gas Emissions Controls that would create a «green policy space» within which WTO members could take appropriate measures to limit emissions. In principle, the green space would allow countries some leeway within WTO rules to maintain the competitiveness of their own industries while raising environmental

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standards. At the same time, the Code would prevent the misuse of environmental policies to discriminate against goods and services produced abroad or to favor imports from preferred source countries. A related and more immediate issue concerns trade policies toward green goods and services—the inputs used to reduce greenhouse gas emissions. Negotiations on trade in green goods and services are on the Doha Round agenda, and Pascal Lamy, Director-General of the WTO, argues that WTO members have a strong interest in opening their markets to such goods as a way to improve the efficiency of their economies.

But Lamy's argument applies equally to liberalizing imports of almost any type of industrial input, and it thus ignores the need to overcome opposition from competing domestic producers. In practice, such a negotiation is likely to be complex and protracted, beginning with the determination of exactly which goods and services should be included.

Reuters, «WTO's Lamy sees trade pact boosting green goods,» May 20, 2010, http://www.reuters.com/article/idUSLDE64J13F20100520 (accessed 5/26/2010).

Compared to other environment-related policies that have generated past WTO disputes (e.g., protection of dolphins and turtles), both costs and benefits associated with efforts to limit climate change are likely to be very large, and their effects experienced over many economic sectors. For these reasons, such a negotiation is urgent. However, finding the necessary common ground for agreement in a large and diverse group of nations is sure to be difficult—perhaps the largest challenge yet for the international trading system.

7. Looking ahead

This chapter has reviewed the evolution and structure of the GATT/WTO system s well as several emerging issues likely to affect its performance in achieving its various goals. However, the current state of the international trading system provides good reasons for optimism. Most important, the system has survived more or less unscathed the worst global economic conditions since the Great Depression and the inevitable resurgence of protectionist sentiment worldwide. WTO disciplines, backed by the dispute settlement mechanism, remain a potent safeguard against unchecked unilateral measures to limit foreign competition. Despite some increase in (GATT-legal) temporary protection, trade flows have rebounded vigorously as world economic growth has revived. But as discussed in the previous section, the system has yet to deal with some pressing issues. Thus, the status quo, while representing an important achievement in terms of multilateral cooperation, will not be enough to maintain the open and predictable market access that WTO members have come to expect. Can the necessary progress be made? In the past, U.S. hegemony played a key role in shaping international institutions, but the United States does not appear ready to assume anything beyond shared responsibility for the provision of global public goods.

New problems have also been raised by the emergence of large and economically powerful developing countries, such as China, India, and Brazil. Still poor relative to the United States and other industrialized countries, these countries are reluctant to participate in international agreements on the same terms as their much richer counterparts, yet their impact on the global economy

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