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FOCUS ON SCIENCE READING

Навчально-методичний посібник з англійської мови
для студентів фізичних спеціальностей

Харків – 2009

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Затверджено на засіданні науково-методичної ради Харківського національного університету імені В.Н. Каразіна (протокол № від . . 2009 р.)

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Навчально-методичний посібник призначено для студентів фізичних спеціальностей. Посібник має за мету навчити студентів читати англійською мовою наукові тексти з фізики, знаходити корисну інформацію, аналізувати її, а також ознайомити студентів з основами наукового методу дослідження. Необхідність створення цього посібника обумовлена недостатністю англомовних учбових матеріалів вузько галузевого характеру.

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ПЕРЕДМОВА

Посібник призначено для навчання студентів фізичного та радіофізичного факультетів читанню та розумінню наукової літератури за фахом на англійській мові, знаходженню необхідної інформації та її наступному аналізу.

Основна увага сконцентрована на перекладі та обговорюванні англійських оригінальних текстів з загальної фізики, вивченню особливостей наукового мовного матеріалу.

Посібник має за мету:

1) розширення словникового запасу студентів з фізичних спеціальностей;
2) навчання мовним моделям сучасного наукового стилю;
3) ознайомлення студентів з основними етапами наукового методу дослідження;
4) активне оволодіння мовними навичками, необхідними для проведення науково-дослідницької роботи, анотування та реферування курсових робіт, виступів з доповідями на англійській мові на наукових конференціях;
5) закріплення найбільш типових для наукового стилю мовних структур.

Посібник складається з 13 уроків (Units). Усі уроки, окрім останнього, містять по два тексти (додатковий та основний) загально фізичного спрямування та розроблені до них завдання.

Завдання кожного уроку вміщують:

1) вправи з перекладу лексичного матеріалу та вправи, спрямовані на запам'ятовування лексики за фахом, словосполучень та виразів, типових для наукової мови;
2) питання, що мають за мету навчання оглядовому та аналітичному читанню, пошуку потрібної інформації та перекладу;
3) творчі вправи, які потребують змістового аналізу тексту та виразу особистої точки зору стосовно отриманої інформації;
4) граматичні вправи, необхідні для перекладу наукового матеріалу на рідну мову;
5) вправи на розвиток навичок читання наукової літератури з застосуванням технік наукового дослідження: вміння порівнювати, класифікувати, відрізняти факт від думки, виказувати гіпотези, описувати, складати ознаки, робити висновки, тощо;
6) мовні моделі комунікативних умінь з виразу особистого відношення до прочитаного: згоди, сумніву, спростування, здогадки, наміру, тощо.

Останній урок систематизує набуті знання з наукового методу досліджень та містить творчі вправи до кожного з етапів. Тексти уроків супроводжено посиланнями до деяких термінів та виразів, які в них зустрічаються.

Посібник може бути використано як для аудиторної роботи з викладачем, так і для самостійної роботи студентів. Структура посібника дозволяє студенту самостійно працювати з текстами для отримання інформації за фахом та розвитку навичок читання наукової літератури, а викладачеві дає можливість оптимально організувати аудиторну роботу з проведення контролю, аналізу та обговорення.

UNIT 1
THE COMPOSITION OF MATTER

Short Reading

Read the following passage and find out how matter may be classified.

Notes:

to take up –	займати, приймати
to consist of –	складатися з ...
to arrange –	влаштувати
either … or …–	або ... або
firm –	міцний, твердий
to melt –	топити, розчинятися, плавити
to soften –	пом'якшувати(ся)
gradually –	послідовно, поступово
to flow –	текти, лити(ся)
rigid –	жорсткий, негнучкий
loose –	вільний, просторий, широкий
to fit in –	пристосовувати

The Nature of Matter

Everything around us consists of matter: this book, your body, the air you breathe, and the water you drink. Matter is anything that has weight or mass and takes up space.

All matter may be classified as solid, liquid, or gas. Solids are firm and have a definite form.

Rubber, wood, glass, iron, cotton, and sand are all classified as solids. A considerable force would be needed to change the shape or volume of an iron bar, for example, because the atoms or molecules of a solid are densely packed and have very little freedom of movement.

Solids may be further divided into two classes: crystalline and amorphous. Rocks, wood, paper, and cotton are crystalline solids. Crystalline solids are made up of atoms arranged in a definite pattern. When these solids are heated, the change to a liquid, known as melting, is sharp and clear. Amorphous substances include rubber, glass, and sulfur. In these substances, the pattern of the atoms is not orderly, and when heated, they gradually soften.

Liquids, on the other hand, are not rigid. If water, milk, or oil is poured on a table, it will flow all over the surface. The atoms or molecules of liquids attract each other and thereby enable liquids to flow. But these atoms are loosely structured and do not keep their shape. Therefore a liquid will take the shape of any container in which it is poured. However, liquids have a definite volume; a quart of milk cannot fit in a pint container.

Gases, such as air, oxygen, and carbon dioxide, have no fixed shape or volume of their own. They diffuse or spread out to fill any container. If water is put into a tire, it will run to the bottom; if air is put into a tire, it fills the whole space inside the tire. The atoms or molecules of gases are widely spaced and move very rapidly. They either compress or expand to adapt to any area.

Everything we know is made of matter in solid, liquid or gaseous form.

Vocabulary in Context

A good vocabulary will help you to improve your reading in your profession. Reading will not automatically increase your vocabulary. At this stage of language development you must make a special effort to acquire new words. The vocabulary sections contain strategies for continuing to build your vocabulary and for making vocabulary growth a lifetime habit.

Mark the letter of the answer that best matches the meaning of the italicized word as it is used in each of these sentences.

1. Atoms are *infinitesimal* in size.
   a. tiny b. huge
2. Chemists study the composition of natural *substances.*
   a. materials b. machines
3. All matter is either liquid, solid, or gas, and solids may be *subdivided* into crystalline and amorphous.
   a. built up b. broken down
4. Plastic products are hard to dispose of because they are almost *indestructible.*
   a. unable to be destroyed b. unable to be constructed
5. At one time the atom was thought to be *indivisible.*
   a. unable to be divided b. unable to be seen
6. Einstein's ideas are too *abstract* for many people to understand,
   a. practical b. theoretical
7. The *reaction* of iron and oxygen produces rust.
   a. chemical activity b. separation
8. The airplane had to rely on radar in the *dense* fog.
   a. thick b. thin
9. The moon *revolves* around the earth.
   a. stretches b. circles
10. Some scientists suspect that the planet Uranus once *collided* with another object in space.
    a. crashed b. orbited

Finding Main Ideas

Scientific writing consists mainly of concepts and material that supports those concepts. The concept is usually stated in a topic sentence. The topic sentence is frequently but not always the first or the last sentence of the paragraph.

In the following passage find the topic sentence of each paragraph.

Reading

Notes:

infinitesimal –	безмежний, нескінченний
to emerge –	з'являтися, виходити
to equal –	зрівняти(ся)
indivisible –	неподільний
indestructible –	незруйнований
to be universally accepted –	бути загально прийнятим

to claim –	заявляти, твердити
to revolve –	обертатися
to surround –	оточувати
entire –	цілий, суцільний
to collide –	стикатися, зіткнутися

The Infinitesimal Atom

There are over four million substances known to man. (Yet it is one of the amazing facts of science that all these substances are made up of only about 100 different varieties of matter, which are called elements.) Oxygen, hydrogen, gold, aluminum, sulfur, carbon, and chlorine are all examples of elements that combine in different ways to make the more than four million substances. Elements are made of particles called molecules, too tiny to be seen even with a powerful microscope. Molecules are made of even smaller particles called atoms. All the world is made of atoms.

The concept of atoms first emerged in ancient Greece. In 400 BC the philosopher Democritus theorized that matter could be divided into smaller and smaller particles until a point was reached beyond which no further subdivision was possible. These indestructible particles were called *atomos,* a Greek word meaning indivisible. We know today that atoms are so small that it would take more than a million of them to equal the thickness of this sheet of paper. Democritus' theory, however, was not universally accepted in the ancient world, for many believed in Aristotle's theory that matter is composed of four elements: earth, fire, air, and water.

During the Middle Ages in Europe, the concept of atoms was considered too abstract and was accordingly rejected. Finally, in 1804 the Englishman John Dalton formulated an atomic theory based on his experimentation. He claimed that all matter is made of atoms; that all atoms of a single element have the same shape, size, weight, and behavior; and that atoms of each element are different from those of any other element. He said that atoms are not created or destroyed but rather form new combinations in chemical reactions.

Dalton thought that atoms were solid, but today atoms are believed to consist mainly of space, with a dense nucleus at the center. The size of the nucleus inside an atom is comparable to the size of an ant on a football field. Each nucleus contains protons, which have a positive electric charge, and neutrons, which have no charge. The nucleus is surrounded by electrons, which have a negative electric charge. The number of protons equals the number of electrons in each atom, and therefore the entire atom has no charge. In 1913, the Danish physicist Niels Bohr proposed a model of the atom in which the electrons revolved around the nucleus like the planets revolve around the sun. Today the movement of electrons is thought to be more like bees hovering around a hive. The force of attraction between the positive protons in the nucleus and the negative electrons whirling around keeps the electrons in their paths.

What is it that makes iron hard, oxygen a gas, and mercury a liquid? The properties of an element are determined by the number of electrons in an atom, which is called the atomic number. All atoms of the same element are alike. If you've seen

one atom of oxygen, you've seen them all. Hydrogen, the lightest element, has one electron and one proton. In fact, the hydrogen atom, the most common atom in the universe, is the basis on which our entire universe was formed. Oxygen has eight protons and eight electrons. Uranium, one of the heaviest elements, has 92 protons and 92 electrons.

All the world is made of atoms: everything we see and know of is made of the billions and billions of these infinitesimal specks of matter. All life exists because atoms are continually moving, combining, separating, colliding, giving off energy, and absorbing energy.

Understanding the Reading

Each of the following statements is inconsistent with the information in the previous passage.

Test your reading comprehension by finding and correcting each error.

Example: Molecules are even smaller than atoms.

Atoms are even smaller than molecules.

1. In ancient Greece everyone believed Aristotle's theory that matter is composed of four elements: earth, fire, air, and water.
2. During the Middle Ages the atomic theory was widely accepted.
3. John Dalton theorized that atoms are composed of electrons, protons, and neutrons.
4. Neutrons have a negative electric charge.
5. Each atom is neutral because the number of its protons equals the number of its neutrons.
6. Niels Bohr proposed a model of the atom with the electrons revolving around the planets.
7. Electrons are kept in their paths by the force of gravity.
8. The atomic number of an element is the total of the number of electrons and the number of protons.
9. All the atoms of a single element are different.
10. Atoms of hydrogen are identical to atoms of oxygen.

Transferring Information

Read the paragraph and find another way that matter may be classified.

Electrical Conductivity

Matter is frequently classified according to its electrical conductivity as a conductor, nonconductor, or semiconductor. Conductors have many electrons that are free to move and are useful in carrying, or conducting, electric current. All metals, particularly silver, copper, gold, and aluminum, are good conductors. Substances with few free electrons are called nonconductors, or insulators, because they do not carry electric charge and can be used to prevent electricity from flowing where it is not wanted. Air, wood, glass, and plastic are insulators. A few substances, like carbon,

silicon, and germanium, do not fall into either of these categories. They are classed as semiconductors and are used in such electronic devices as transistor radios.

Translating

Translate the following sentences from Ukrainian into English.

A

1. Загально відомо, що матерія – це те, з чого складається усе навколо нас.
2. Це обладнання займає багато місця, його треба або удосконалювати, або змінити.
3. Гума – це міцний матеріал, який класифікують як тверде тіло.
4. Усі питання мали бути урегульованими.
5. Ці речовини поступово пом’якшуються, коли їх нагрівають.
6. Вони пристосують старі контейнери під рідину, що залишилася після експерименту.
7. Атоми, що мають вільну структуру, не зберігають своєї форми.
8. Речовини мають здатність литися, тому що їх атоми та молекули притягують один одного.

B

1. Ми побачили безмежні можливості цього методу, коли нам показали дивовижні результати.
2. Вони завжди поєднують працю та відпочинок.
3. Незруйновані частки було названо атомами, що означає неподільні.
4. Ці частки мають дивовижні властивості.
5. Ми цілком згодні, що цифри повинні зрівнятися з універсально прийнятими.
6. Його завжди оточують його друзі.
7. Електрони обертаються навколо ядра, як планети навколо Сонця.
8. Група вчених вирішила відділитися від інших та повністю змінити напрямок своїх досліджень.

Discussion Points

Using English to Express Agreeing:

Here are some useful ways of agreeing with someone’s opinion.

I absolutely (completely) agree.
I entirely agree.
That's true (That is right).
Yes indeed!
I quite agree with ... .
Couldn't have put it better myself.
That's a wonderful idea.
That would be marvelous.
That's just what I was thinking.
That's exactly what I think.

Memorize the following expressions and use some of them to agree with the information obtained from the texts of this unit.

UNIT 2
THE ELEMENTS

Short Reading

Read the following passage and find as many comparisons as you can.

Notes: to search (for) – шукати, обшукувати, досліджувати
technique – техніка, технічний прийом, метод
to convert – перетворювати
to succeed in (doing) smth. – досягати мети, мати успіх
to extract – витягати, здобувати, вибирати
at least – принаймні
to occur – траплятися, спасти на думку
compound – суміш, сполука
durable – міцний, довговічний
to emerge – з'являтися, виходити
to withstand – вистояти, протистояти

The Wonder Metals

The study of metals began in the Middle Ages when alchemists searched for a technique to convert "base metals", like lead, to gold. They never succeeded in making gold but at least by experimenting with the metals (in contrast to the ancient Greeks, who only speculated about them) they made many discoveries.

All but 20 of the over 100 elements identified to date are metals but only 7 of these are common in the earth's crust. Iron, the most widely used metal, is rarely found in the free state (not combined with other metals) and must be extracted from naturally occurring compounds (ores) such as hematite, magnetite, and pyrite.

The beautiful colors of rocks are due almost entirely to these iron compounds. In fact, iron pyrite is often called fool's gold because of the similarity of its color to gold. Iron is very strongly magnetic, and the fact that the earth is a magnet itself tipped scientists off to the fact that iron is a major component of the earth's core, or center.

Pure iron is a relatively soft, silvery metal that is very active chemically (that is, it combines with oxygen to corrode or form rust). It is usually mixed with other elements or compounds to form alloys such as steel, stainless steel, or cast iron, which are more durable and rust resistant than pure iron.

Aluminum is the most abundant metal, but it was not used until a century ago because it is so active chemically and difficult to extract. Like iron it is soft, but in contrast to iron and steel, aluminum is very light and more resistant to corrosion. These qualities make it useful for airplanes, trains, automobiles, rockets, and house siding.

In the 1940s, magnesium emerged as an important metal. Although it is less abundant in the earth, more chemically active, and harder to extract than aluminum, it is present in sea water and that means there is almost an endless supply of it.

In the space age, the extraordinary properties of titanium have made it the new wonder metal. Lighter and stronger than steel, it is more resistant to corrosion and able to withstand heat.

The remaining major metals are sodium, potassium, and calcium, all too active chemically (they react violently with water) for use in construction.

Vocabulary in Context

Mark the letter of the answer that best matches the meaning of the italicized word as it is used in each of these sentences.

1. Silicon is a nonmetallic element that is inexpensive because it is so *abundant* in minerals.
   a. rare b. plentiful
2. When exposed to air and moisture, iron will *corrode*.
   a. rust b. shine
3. The *spontaneous* explosion caused a lot of damage.
   a. unplanned b. planned
4. The room got stuffy and warm due to improper *ventilation*.
   a. heating b. air circulation
5. There is oxygen in the *protoplasm* of all plants and animals.
   a. blood b. living matter
6. Water is *vital* to all living things.
   a. necessary b. useless
7. Larger vehicles *consume* more gasoline than smaller ones.
   a. use b. save
8. A *catalyst* speeds up a chemical reaction.
   a. chemical agent b. forest animal
9. Farmers *fertilize* their soil to make it more productive.
   a. enrich b. ruin
10. To obtain aluminum, metallurgists must *extract* it from bauxite.
    a. remove b. destroy

Skimming

Skimming for main ideas is a reading skill that is useful in a number of ways:

a) Always skim a textbook chapter before reading it closely. If you follow this procedure, you will read faster and with greater interest and comprehension.

b) When you need to write a research paper, skim the references you find in the library to see which contain the material you need.

c) Skim any passage that you find difficult. Once you have a general idea of the content and organization, you will be able to read it thoroughly with better understanding.

Skim the following passage to discover its main topic and the information it contains. Then answer the following questions.

1. The main topic of this reading is:
   a. the industrial uses of oxygen, nitrogen, and hydrogen
   b. how oxygen, nitrogen, and hydrogen differ from the other elements

c. the importance of oxygen, nitrogen, and hydrogen to living things
d. the differences between the three gases

2. All of the following topics are discussed in the passage *except:*
a. oxidation
b. a comparison of nitrogen and oxygen
c. the characteristics of hydrogen
d. the scientists who discovered each gas and the year of discoveries

Reading

Notes:

odour –	запах, аромат
nitrogen –	азот
hydrogen –	водень
to consume –	споживати
to harden –	ставати твердим; загартовувати
decay –	руйнування, розпад
fuel –	паливо, пальне
combustion –	згоряння
to kindle –	запалювати(ся), підпалювати
to inhale –	вдихати
fertilizer –	добриво
dilute –	розбавляти, розчиняти
to be highly flammable –	бути надзвичайно запальним

The Life-Supporting Gases

How long can a human being live without oxygen? What if there were no nitrogen in the air? Just how important is hydrogen?

Three of our most abundant and important elements are the gases oxygen, nitrogen, and hydrogen. Although they share many properties – all three are colorless, odorless, and tasteless at room temperature – each one is necessary to life in a unique way.

The same substance causes metals to corrode, wood to rot, apples to turn brown, paint to harden, gasoline to burn, and iron to rust. Fire cannot burn without it, and human beings cannot live without it. This substance is oxygen, an essential ingredient in air and water and the most abundant element in the earth's crust.

Oxygen is very active chemically, meaning that it readily combines with other substances in a process called oxidation. For example, iron combines with oxygen from the air to produce iron oxide, or rust. Food and water combine with oxygen to form decay. Vegetable oils used in paints combine with oxygen to harden. These are all examples of slow oxidation. The rapid oxidation of fuels causes combustion, or fire. Sometimes a fire starts spontaneously. If a substance with a low kindling temperature, such as oily rags, newspapers, or grain, is heated in the absence of proper ventilation, oxidation may occur so rapidly that the substance bursts into flames. This phenomenon is called spontaneous combustion.

Oxygen is found in the protoplasm of all living organisms and is essential to respiration. Human beings cannot live more than five minutes without oxygen. We

inhale oxygen, which passes into the bloodstream and is carried to the body tissues. There it combines with the food we consume, producing the energy we need to maintain our body temperature and to supply us with the strength for physical activity.

Nitrogen is also vital to living things. All plants and animals contain nitrogen compounds in which the nitrogen has been converted to its free state by a process called nitrogen fixation. Fertilizers contain nitrogen compounds to feed plants and help them to grow.

In contrast to oxygen, nitrogen is comparatively inactive; that is, it does not readily combine with other substances. Therefore, nitrogen does not support combustion. If there were no nitrogen to dilute the oxygen in the air we breathe, the combustion of fuel would be extremely fast, metals would corrode rapidly, and smoking would be impossible. When, however, with the help of high temperatures, electricity, and catalysts, nitrogen does react with other elements, it tends to be very powerful. Because many nitrogen compounds are unstable, they are used in explosives like TNT and gunpowder. Other compounds include drugs such as poisons, antibiotics, laughing gas (nitrous oxide), and anesthetics. Nitrogen can be extracted from the air by liquefying air.

Hydrogen is the most abundant element in the universe. The sun and stars are almost pure hydrogen. Our sun's source of energy is the conversion of hydrogen into helium. Hydrogen is also found in almost all plant and animal tissues. There are more atoms of hydrogen in our bodies than any other element because our bodies are about two-thirds water! Hydrogen is also found in most fuels and in all acids. It is the lightest known element and is highly flammable. Helium is almost as light as hydrogen but it is nonflammable.

Hydrogen and oxygen are the main constituents of the water we drink. Nitrogen and oxygen are the chief elements of the air we breathe. Our existence could not be possible without the presence of all three.

Understanding the Reading

Each of the following statements is inconsistent with the information in the previous passage.

Test your comprehension by finding the error in each statement and restating it correctly.

Example: Oxygen, nitrogen, and hydrogen have similar properties, but only oxygen is essential to life. *All three are essential to life.*

1. The substance that causes wood to rot is not the same as the one that causes apples to turn brown.
2. The decaying of food is an example of rapid oxidation.
3. Human beings can live up to 15 minutes without oxygen.
4. Nitrogen converts to a free state by a process called spontaneous combustion.
5. Compared to oxygen, nitrogen is very active.
6. Nitrogen is used in explosives because it is so stable.
7. Oxygen is the most abundant element in the universe.

8. Scientists do not know what the sun is made of.
9. In contrast to helium, hydrogen is nonflammable.
10. The essential ingredient in fertilizers is hydrogen.

Translating

Translate the following sentences from Ukrainian into English.

A

1. Вчені шукають відповідь на це питання на протязі багатьох років.
2. Новий метод пошуку ще ніде не застосовувався.
3. Здається неможливим перетворити свинець на золото.
4. Нарешті ми мали успіх в проведенні цього важливого експерименту.
5. Принаймні, ці речі трапляються навіть при звичайних температурах.
6. Такі сполуки відносно безпечні для людини.
7. Ми маємо утворити більш довговічні сплави, що протидіятимуть корозії.
8. Цей метал може з'явитися внаслідок праці талановитих вчених.
9. Мені спало на думку, що я вже чув щось подібне.
10. Він не мав наміру когось образити.

B

1. Кисень, азот та водень мають сходні властивості.
2. Невідомий аромат так вразив його, що він вирішив купити нові парфуми.
3. Ці гази не мають запаху, смаку та кольору.
4. Коли їжа поєднується з киснем, виформовується розпад.
5. Коли рослинні олії поєднуються з киснем, вони стають твердими.
6. Кисень, який ми вдихаємо, поєднується з їжею, що ми споживаємо, та дає нам життєву енергію.
7. Добрива містять азотні сполуки, що підпитують рослини та допомагають їх росту.
8. Багато типів пального містять водень, тому що він надзвичайно займистий.
9. Азот розчиняє кисень у повітрі, яким ми дихаємо.
10. Азотні сполуки нестабільні, їх часто використовують у вибухівках.

Discussion Points

Using English to Express Tentative Agreement:

Here are some useful ways of tentative agreeing with someone's opinion.

That could be right, but…
To a large extent it is right, but…
I agree with that to a certain extent, but…
Up to point I'd agree with that, but…
I take this point, but…
There is a point here, but…
I appreciate this point of view, but…
That's an interesting idea, but…

Memorize the following expressions and use some of them to agree to a certain extent with the information obtained from the texts of this unit.

UNIT 3
COLOR, LIGHT, SOUND

Short Reading

Read the passage below to discover what causes us to see different colors.

Notes:

to respond to the different wavelengths –	реагувати на різні довжини хвиль
to travel on different frequencies –	розповсюджуватись на різних частотах
to cause (smb.) to see –	змушувати (когось) побачити
either … or … –	або … чи …
to result from –	бути результатом, виникати з
a rainbow of colors –	райдуга кольорів
to produce ultraviolet (infrared) light –	створювати ультрафіолетове (інфрачервоне) світло
to measure energy –	вимірювати енергію
everyday experience –	щоденний досвід
to determine –	визначати

The Nature of Color

Why is the sky blue and the grass green? Why isn't the sky green and the grass blue? And why is a rose red instead of purple? What we see as color is the way our brains respond to the different wavelengths of light.

Light is a form of electromagnetic energy that travels very quickly on different frequencies, or wavelengths, which we see as different colors. For example, a wavelength of 400 nanometers (nm) causes us to see violet. A wavelength of 660 nm causes us to see red.

The color brown is induced by the mixing of wavelengths. Yellow can be produced by either its own wavelength or a mixture of the wavelengths for red and green. Our sky looks blue because molecules of oxygen and nitrogen in the air scatter more blue wavelengths than any other color.

White light results from a mixing of the wavelengths of all colors. Sir Isaac Newton discovered that when sunlight passed through a glass prism, the white light dispersed into a spectrum of colored light. Newton then allowed the spectrum to pass through a second prism and the colors recombined, producing a beam of white light.

This simple experiment demonstrated that white light contains all the colors of the spectrum. A beautiful and dramatic example of this occurs when sunlight falls on drops of water in the air after a rain. The beam of white sunlight spatters into a rainbow of colors.

Certain colors are invisible to human eyes. Wavelengths shorter than that of violet produce ultraviolet light that can damage skin cells. Wavelengths longer than that of the color red produce infrared light, radio waves, X-rays, and gamma rays. We cannot see colors produced by these wavelengths, but we can measure and use their energy.

Vocabulary in Context

A

Mark the letter of the answer that best matches the meaning of the italicized word as it is used in each of these sentences.

1. The best way to solve a problem is to find the *source.*
   a. origin b. effects
2. The space between the earth and the moon is a *vacuum.*
   a. empty b. full
3. The glass door was so *transparent,* we bumped into it.
   a. strong b. clear
4. Fleming *revealed* that his discovery of penicillin was occidental.
   a. made known b. kept hidden
5. The earth *absorbs* the water from the rain.
   a. drinks in b. gives off
6. Wood is *opaque;* no light passes through it.
   a. unclear b. clear
7. Air is the *medium* through which sound travels.
   a. process b. environment
8. The old building was *transformed* into an emergency hospital.
   a. enlarged b. changed
9. A microscope *magnifies* invisible objects so we can see them.
   a. enlarges b. reduces
10. All efforts were *concentrated* on landing the plane safely.
    a. centered b. scattered

B

Insert the following words in the sentences given below:

a. electromagnetic energy
b. brains
c. mixture
d. sunlight
e. spectrum
f. skin cells
g. rainbow
h. wavelengths

1. Our ____ respond to the different wavelengths of light.
2. ____ of wavelengths induce the color brown.
3. We see light which is the form of ____ .
4. White light contains all the colors of the ____ .
5. When ____ passed through a glass prism, the white light dispersed into a spectrum of colored light.
6. We can measure ____ which produce infrared light, radio waves, X-rays and gamma rays.
7. ____ can be damaged by ultraviolet light.
8. The beam of white sunlight spatters into a ___ of colors.

Scanning

When you need to search technical material for the answers to specific questions, you will want to locate the particular information without reading every word. This can be accomplished by scanning the passage.

Read the following questions. Then find the answers by scanning the passage for the key words.

1. What is the speed of light? (key words: a large number)
2. Who originated the wave theory of light? (key words: a proper name with capital letters)
3. What is silver bromide used for? (key words: silver bromide)

Reading

Notes:

to be reflected off objects –	відбиватися від об’єктів
transparent materials –	прозорі матеріали
to be the first to propose –	запропонувати першим
the rest of	решта
to diverge from a straight path –	відхилятись від прямої траекторії
to strike the surface –	потрапляти на поверхню
to pass from one medium to another –	переходити з одного середовища до іншого
to enable living things to grow –	дозволяти живим істотам рости
to verify ideas with experiments –	перевіряти уявлення експериментами
to move at a constant speed –	рухатися з постійною швидкістю
to conclude –	робити висновки
to be referred to as –	називатися
to keep in motion –	зберігати у стані руху
it was not until … that –	і тільки

Reflecting on Light

Most of what we know about the world comes to us through our ability to "see" with our eyes, our telescopes, and our microscopes. But how do we see? Sight is not something that reaches *out from* our eyes. Instead it is the light that travels *to* our eyes. You see this page, for example, because light, reflecting from the sun or an electric light, travels from the paper to your eyes.

Sometimes we see light as it comes from a direct source, such as the sun, fire, lightning, or a light bulb. The rest of the time we see light as it is reflected off objects.

Light travels at high speeds. It must have been a great leap in the intuition of scientists to realize that light actually "travels." It isn't just there! In the air light travels at a speed of 186,000 miles per second. It travels slightly faster in a vacuum and slower in other transparent materials such as water or diamonds. It takes light less than one minute to travel from the earth to the moon and about 15 minutes to go from the earth to the sun.

In 1678 the Dutch scientist Christian Huygens was the first to propose that light travels in waves. Since then the work of the American Albert Einstein and the Scottish James Maxwell has revealed that light actually consists of particles known as photons and travels in electromagnetic waves.

Light seems to travel in straight lines. If you shine a flashlight in the dark, for example, the beam of light appears to be straight. In contrast, sound waves travel in every direction. We can hear people on the other side of a wall but cannot see them.

In certain situations light diverges from a straight path. When it falls on an object, most is either absorbed (in the case of an opaque object such as wood or metal) or passes through (in the case of a transparent object such as water or glass). The remainder of the light is reflected. It is reflected light that changes direction. When light is reflected off a smooth surface, it changes direction in a regular way, that is, the angle that is reflected equals the angle at which it strikes the surface. If the surface is rough, light is reflected in many directions.

Certain silver compounds (like silver bromide) reflect almost all the light that falls on them and are accordingly used for mirrors. The image that is reflected in a flat mirror is identical to the original object, even in size, except that the image is reversed. This is because light on a flat surface changes direction.

When light passes from one transparent medium to another, it changes speed and direction. This process, called refraction, explains the apparent shortening of a person's legs or the bending of a stick in water.

Light is a form of energy that can be transformed into heat. You can prove this by using a magnifying glass to concentrate the sun's rays on a piece of paper and burn a hole in it. It is this light energy from the sun that warms the earth and enables living things to grow. Plants get light energy directly from the sun. Animals get it from the plants they eat.

Understanding the Reading

A scientist must be precise by reading and observing carefully and measuring and recording accurately.

Inaccurate information can result in incorrect conclusions.

Indicate whether each of the following statements is stated in the passage or not stated.

1. The speed of light is 186,000 miles per second.
2. Light travels slower through glass than through air.
3. Light travels faster than sound.
4. Moonlight is reflected light.
5. Light travels faster through water than sound does.
6. Scientists did not always know that light travels.
7. Light travels in the same way as sound.
8. Light travels at different speeds in different substances.
9. Sound waves do not travel in straight lines.
10. Most of the sound we hear is reflected.

Vocabulary in Context

A

Find synonyms to the verbs:

to realize, to reflect, to travel, to see, to propose, to reveal, to consist, to strike, to enable, to get, to diverge.

B

Find sentences with the following words and word combinations in the text and translate them:

ability to "see"; a great leap in the intuition; to travel in waves; to reveal; to shine a flashlight; to fall; to absorb; to be reflected off; flat mirror; to warm the earth.

C

Suggest antonyms to the following adjectives:

transparent; light; direct; fast; little; straight; equal; smooth; identical; short; accurate; correct.

Translating

Translate the following sentences from Ukrainian into English.

1. Чому довжина хвилі у 400 нм змушує нас бачити фіолетовий колір?
2. Як створити жовтий колір?
3. Чому небо здається блакитним?
4. Яке явище відкрив Ісак Ньютон?
5. Що ми бачимо, коли сонячне світло падає на краплю води після дощу у повітрі?
6. Чи можливо використовувати енергію інфрачервоного світла?

Discussion Points

Using English to Express Disagreeing:

Here are some useful ways of disagreeing with someone's opinion. Notice that you need to be very polite when disagreeing with someone in English.

I'm not sure I entirely agree.
I don't think I really like the idea.
No, I think you're mistaken here.
No, I'm sorry, there I have to disagree.
I disagree entirely. (I can't agree at all.)
I don't agree with that at all on that point.
That's not right I'm afraid.
That's quite wrong.
I really must object to that, you know.
That's quite a separate issue.
I don't think there's any point in that at all.
I can't see what that has got to do with the matter in hand.
That can't be taken that into account.
I can't really see the significance of that…

Memorize the following expressions and use several of them to disagree with some information obtained from the texts of this unit.

UNIT 4
MOTION AND GRAVITY

Short Reading

Read the passage below and find Aristotle's and Galileo's hypotheses about motion.

Some Notions about Motion

Which falls faster, a blade of grass or a stone? Anyone can see that a stone falls faster. And that is what the ancient Greeks believed. Based on everyday experience, Aristotle determined that heavy objects fall faster than light objects and that objects fall with a speed proportional to their weight.

Aristotle also studied horizontal motion. He observed that whenever he pushed a rock or other object, it always rolled for a while and then came to rest. He hypothesized that the natural state of an object is to be at rest and a force is necessary to keep an object in motion. Aristotle's hypotheses were accepted for two thousand years because they were consistent with logic and informal observation.

It was not until the early 1600s that these long-established beliefs were challenged. Galileo was not content to accept ideas without verifying them with experiments. He dropped various weights from a height and recorded the results. Disproving Aristotle's hypothesis, he determined that all bodies fall at equal rates, if you discount the air resistance. A blade of grass will fall more slowly than a stone only because it meets with more resistance from the air.

Galileo also disproved Aristotle's hypothesis about horizontal motion. He demonstrated that a body pushed on a smooth surface could go much further than one pushed on a rough surface. When a lubricant such as oil was used, almost no force was required to keep the object in motion. He concluded that if an object does not meet with resistance (friction), it will continue to move at a constant speed even if no force is applied.

Half a century later, Newton extended Galileo's ideas and formulated a theory that a body at rest will remain at rest and a body in motion will remain in motion unless some outside force acts on it. This theory is so universally accepted it is referred to as Newton's first law of motion.

Vocabulary in Context

A

Mark the letter of the answer that best matches the meaning of the italicized word as it is used in each of these sentences.

1. The structure is resting on four *vertical* posts.
   a. level b. up-and-down
2. His *inertia* was caused by hot weather and fatigue.
   a. activity b. inactivity
3. The students' names were listed in *inverse* alphabetical order.
   a. correct b. reverse
4. The *proportion* of hydrogen to oxygen in water is 2 to 1.

a. relationship b. distance

5. The researchers were pleased because the results of the experiment *were consistent* with their expectations.
   a. agreed b. disagreed
6. The design of the Taj Mahal in India is *symmetrical;* all sides are equal.
   a. regular b. irregular
7. We had to rest after *exerting* all our energy to push the car up the hill.
   a. using b. saving
8. Automobiles *expel* carbon monoxide, which pollutes the air.
   a. give off b. absorb
9. The humidity *altered* the results of the experiment and we had to redo it.
   a. changed b. improved
10. Water can be formed by the *synthesis* of hydrogen and oxygen.
    a. separation b. combination

B

Fill in the gaps in these sentences using the verbs in the box in the proper form.

to determine, to fall(2), to push, to base, to discount, to hypothesize, to accept, to act, to keep, to require, to conclude, to remain, to apply

1. They never ____ their ideas on their own experience.
2. We didn't know that the stone ____ already.
3. This rock cannot ____ with the help of this device.
4. The scientist ____ this theory recently.
5. He always ____ our invitation with pleasure.
6. It ____ many years ago that a force is necessary ____ an object in motion.
7. Almost no money ____ to repair the car.
8. He ____ my close friend after all.
9. We notice that all bodies ____ at equal rates if we ____ the air resistance.
10. When some force ____ on the body it begins to move.
11. The students ____ that the device was good after they ____ it for a while.

C

Complete the sentences:

1. Ancient Greeks believed that … .
2. Aristotle observed that objects always rolled for a while and then came to rest when … .
3. Galileo dropped various weights from a height and … .
4. Galileo had disproved Aristotle's hypothesis and determined that … .
5. It has been demonstrated that a body pushed on a smooth surface … .
6. When a lubricant is used, almost no force is required … .
7. If no force is applied … .
8. Newton extended Galileo's ideas and formulated a theory that … .

Finding Main Ideas

A good way to read a textbook is to highlight the topic sentence of each paragraph or section. Later to review the material you only need to read the topic sentences. Note that here the topic sentences are usually found toward the ends of the paragraphs because the information builds up to a conclusion.

Find the topic sentence of every paragraph in the following passage.

Reading

Notes:

It was … who … –	саме … (підсилююча конструкція)
to verify –	перевіряти
to resist –	опиратися, чинити опір
a great deal of –	багато
to remain at rest / in motion –	залишатися у стані спокою / у русі
to be related (to) –	бути пов'язаним (з)
the ...er … the ...er –	чим …, тим …
(e.g. the larger the mass, the less the acceleration)–	(чим більше маса, тим менше прискорення)
moreover –	більше того
although –	проте, однак, хоч
to some extent –	в деякій мірі
to happen to –	відбуватися, траплятися з
to push off –	відштовхуватися (від)
to wear out –	зношувати (машину), спрацьовувати
to exert a force (on smb.) –	впливати силою (на кого-небудь)
both … and … –	і, та
according to –	згідно, відповідно
on the one hand … –	по-перше
on the other hand –	по-друге
to influence (smth.) –	впливати (на що-небудь)
in fact –	фактично

Newton Explains Motion

Although many scientists studied motion, it was the great Sir Isaac Newton who formulated the theories of motion, verifying and extending the earlier work of Galileo and Copernicus. Newton studied horizontal and vertical motion.

First Newton studied the quality of inertia, or the tendency of a body to resist change in its state of motion or direction. A tennis ball, for example, has little inertia; it is easy to get it to move, stop, or change direction. A truck, on the other hand, has a great deal of inertia. Newton concluded that a body at rest will remain at rest and that a body in motion will remain in motion unless some outside force acts on it. This principle is called the law of inertia, or Newton's first law of motion.

But Newton's curiosity was not satisfied. He wondered what causes a change in motion. Why does a body at rest begin to move or a body in motion change its direction? He determined that if a body is at rest, no force is acting on it; however, when a force acts on a body, the force will speed up, slow down, or change the direction of that body.

Moreover, Newton discovered that there is a relationship between force and acceleration. If you push a swing gently, it will move slowly. If you push it harder, it will go faster. Newton noted that if you discount the friction involved, the amount of force is directly related to the amount of acceleration.

The acceleration is also related to the mass of the object. Mass, which is the quantity of matter in a body, also determines the amount of inertia an object has. A truck has a great deal of mass, a bicycle has much less. If you use an equal amount of force to push a bicycle and a truck, the bicycle will go much faster than the truck. The larger the mass, the less the acceleration.

In fact, the acceleration of a body is inversely proportional to its mass. Newton's second law of motion states that the acceleration of a body is directly related to the force acting on it and inversely proportional to its mass. The direction of the acceleration is in the direction of the applied force.

Finally, Newton explored the question of the source of force. He observed that the force acting on a body comes from another body. But this idea by itself was not consistent with his view of a balanced and symmetrical universe. He therefore concluded that whenever there is a force pushing in one direction, there is another force pushing back. This concept may be difficult to imagine, but try pulling on a rubber band and you will feel it pulling back on you. Also notice what happens to your finger when you press it against a table.

Objects can exert a force because all materials are elastic to some extent, although the elasticity of walls and tables may be slight. When you push off against the wall of a swimming pool, for example, you start to move away from the wall. The wall is exerting a force on you that causes you to move in the opposite direction. And if you think the floor does not push back against your feet, why do your shoes wear out, and why do your feet hurt you after you have been on them for a long time? Why do automobile tires wear out? Thus Newton stated his third law: whenever one object exerts a force on a second object, the second object exerts an equal and opposite force on the first.

The movement of a rocket is also based on this law. The rocket expels gases, which then exert an equal and opposite force propelling the rocket forward. In space, a vehicle can alter its speed or direction by expelling rockets in the opposite direction.

Newton's laws are applicable everywhere in the universe and synthesize both vertical and horizontal motion. The concept that the universe functions according to logical orderly natural laws influenced not only the scientific world but also the social, political, and philosophical thinking of the Western world for two hundred years.

Understanding the Reading

Indicate whether each of the following sentences is true or false according to the information in the passage above.

1. Although many scientists studied motion, Newton was the first.
2. Galileo's ideas were based on Newton's work.
3. Newton's third law is the law of inertia.
4. Inertia is the tendency of a body to resist change.
5. Any change in motion is produced by a force.
6. The direction of acceleration is opposite to the direction of force.
7. Newton believed that the universe is symmetrical and balanced.
8. Every action produces an equal and opposite reaction.
9. A rocket functions on the principle of action and reaction.
10. Newton's ideas influenced world thinking in fields other than science.

Vocabulary in Context

A

Find sentences with the following words and word combinations in the text and translate them:

to get smth. to move; to cause a change in motion; to conclude; to discount; an equal amount of force; to be inversely proportional; to explore a question; to exert a force; to state a law; to be based on; to be applicable.

B

Fill in the gaps using the word in the box. Put the combinations verbs in the proper form.

according to; act on; a great deal of; to some extent; to be consistent with; to exert a force on; unless; wear out; to happen to; finally, although

1. They are certain to write the paper in time … some unpredicted circumstances prevent them from doing it.
2. This device functions … the laws of physics.
3. He is rather clever, but he is also absent-minded … .
4. If a body is at rest, no force … it.
5. The car had … mass and it couldn't be pushed so easily.
6. The shop assistant said that the new shoes were so good that they never … .
7. The results … our previous ideas.
8. It … me many years ago.
9. The object is at rest and it does not … another object.
10. … the scientists were not sure of it, the data obtained made them agree with us.
11. … he concluded that there was another force acting on the body.

C

Answer the following questions in writing using the word combinations given in the Notes.

1. Who formulated the theories of motion and extended the earlier work of Galileo and Copernicus?
2. What is inertia?
3. When does a body remain at rest?
4. Why will the bicycle go much faster then the truck if you use an equal amount of force to push them?
5. All materials are not elastic, aren't they?
6. What causes you to move in the opposite direction when you push off against the wall in a swimming pool?
7. What happens when one object exerts a force on a second object?
8. A vehicle in space cannot alter its direction, can't?
9. Does the concept of the universe functions according to magic laws?

Translating

Translate the following sentences from Ukrainian into English.

1. І тільки у двадцятому сторіччі ці уявлення були взяти під сумнів.
2. Завжди потрібна сила, щоб зберігати об'єкт у стані руху.
3. Він фіксував результати свого щоденного досвіду.
4. Ми не будемо робити якісь висновки, якщо наша теорія не буде деякий час перевірятися експериментально.
5. Скло має більший опір повітрю, ніж камінь при падінні.
6. Він спростував цю гіпотезу за допомогою своїх експериментів.
7. На рівній поверхні тіло, що штовхнули піде далі тіла, що рухається по необробленій поверхні.
8. Вчений зробив висновок, що тіло рухається з постійною швидкістю, якщо не зустрічає опору.
9. Вони поширюють ці ідеї та додають до них практичного досвіду.
10. Цю теорію називають першим законом руху.

Discussion Points

Using English to Express Different Points of View:

Here are some useful ways of expressing different points of view.

I'm not certain …
I think it's probably…
Well, I'm not sure.
It all depends on …
It's hard to tell from …
Well, I suppose it might be …
But on the whole …
I feel it's unlikely …
It's far more likely that …

Memorize the following expressions and use some of them to express your other opinion concerning the information obtained from the texts of this unit.

UNIT 5
ENERGY

Short Reading

Read the following passage to find definitions for types of energy.

Mind that Aristotle suggested that a good definition should include the general classification of a term plus the specific characteristics that differentiate the term from other members of its class.

Notes:	to strike a nail –	забивати цвях
	not only … but also … –	не тільки … але і …
	because of … –	через, з-за, із-за
	to release energy … –	вивільняти енергію
	to define –	визначати

The Many Forms of Energy

Energy is the ability to do work. When a hammer strikes a nail it exerts a force on the nail that causes it to move. The movement of the hammer has the ability to do work and therefore has a form of energy that we call kinetic energy. Kinetic energy is the energy of motion.

An object may have energy not only because of its motion but also because of its position or shape. For example, when a watch spring is wound, it is storing energy. When this energy is released, it will do the work of moving the hands of the watch. This form of energy is called potential energy. Potential energy is stored energy. Water in a dam is another example of potential energy.

There are many types of kinetic and potential energy, including chemical, thermal, mechanical, electrical, and nuclear energy. Chemical energy is potential energy that is stored in gasoline, food, and oil. Just as the watch spring needs to be released to do the work of moving the hands, the energy stored in food molecules needs to be released by enzymes or substances in the body, and the energy stored in gasoline must be released by the spark plug to do its work of propelling the car forward. Thermal energy may be defined as the kinetic energy of molecules. When a substance is heated, the molecules move faster, that causes that substance to feel hot. Mechanical energy is energy related to the movement of objects. Electric energy is energy that is produced by electric charges. Nuclear energy is the energy that is stored in the nucleus of certain kinds of atoms, like uranium.

Vocabulary in Context

A

Mark the letter of the answer that best matches the meaning of the italicized word as it is used in each of these sentences.

1. Frayed electrical wires are *potential* fire hazards.
   a. probable b. unlikely

2. The *velocity* of the wind increased during the storm.
   a. sound b. speed
3. Despite the head-on collision, the engine remained *intact.*
   a. whole b. broken
4. The *conservation* of natural resources, such as rivers and forests, is an important issue of our time.
   a. preservation b. observation
5. When the temperature dropped, *vapor* accumulated on the inside of the window.
   a. steam b. dust
6. Pasteur's germ theory proved to be *valid* and was a major breakthrough in the history of medicine.
   a. false b. true
7. When the bottle was uncapped, all the pressure inside was *released.*
   a. set free b. increased
8. Energy is released by *the fission* of atomic nuclei.
   a. splitting b. combining
9. The cold on top of the mountain got more *intense* later in the evening.
   a. extreme b. moderate
10. An alloy is *a fusion* of two or more metals that makes a stronger metal.
   a. combination b. separation

B

Find synonyms to the following words:

a) to cause, to call, kind, to propel, to produce, to suggest, substance, specific, to speed up, to store, to declare, precise, to occur.

b) to transform, to decrease, to lift, to discover, total, to remain, thus, to destroy, weight, valid, to split, rapidly, to take place, quantity, to release, to combine.

C

Find antonyms to the following words:

to release, potential, certain, to differentiate, tall, forward, ability, general, misunderstanding, narrow.

Scanning

When you need to search technical material for the answers to specific questions, you will want to locate the particular information without reading every word. This can be accomplished by scanning the passage.

Scan the following passage paying attention to the following.

1. A definition of work (key words: work, defined).
2. The name of the French chemist who studied chemical changes in 1785 (key

words: 1785, French).

3. The meaning of the letter *c* in the equation $E = mc^2$ (key words: $E = mc^2$).

Reading

Notes:

frequently –	часто
to lose (lost) –	втрачати, позбуватися
to decrease / to increase –	зменшувати / збільшувати
to gain –	здобувати
velocity –	швидкість
to measure –	вимірювати
the same amount of energy –	таж сама кількість енергії
to start with –	починати з
to destroy –	руйнувати
neither … nor … –	ні … ні …
to predict … –	передбачати, передрікати
to be split apart –	бути розщепленим
to take place –	відбуватися
to result in –	приводити до

$E = mc^2$

Energy can be transformed or changed from one type to another. For example, an apple hanging on a tree has potential energy, or the energy of position. As it falls, it loses potential energy because its height decreases. At the same time, it gains kinetic energy, or the energy of motion, because its velocity increases. Potential energy is being transformed into kinetic energy.

Frequently, the transfer of energy involves a transfer from one body to another. When you lift up a rock, you are changing the chemical energy of the food you have eaten into muscle energy. As you lift the rock high, your muscle energy is changing into the rock's potential energy.

When energy is transformed from one type to another or transferred from one body to another, no energy is lost. When we measure energy, we discover that the total amount remains intact. Suppose we prepared, cooked, and then ate some food. If we were to measure carefully all the energy that remains at the end of this process (such as potential, kinetic, and heat), we would always find exactly the same amount of energy as we started with (such as chemical and potential). Energy can thus be converted from one form to another but never created or destroyed. This is called the law of the conservation of energy.

Matter, like energy, can be converted from one form to another but neither be created nor destroyed. In 1785, the French chemist Antoine Lavoisier demonstrated that there is no gain or loss of mass in a chemical change. For example, when a piece of wood is burned, ashes remain. At the same time, the wood combines with oxygen in the air to form carbon dioxide and water vapor, which pass into the air. If the carbon dioxide, water vapor, and ashes are added together, the total weight will equal the original weight of the wood plus the oxygen in the air. Thus, there is no change in the total mass. This is called law of the conservation of mass.

Many years later, Albert Einstein theorized that the conservation of energy is not distinct from the conservation of mass, that is, that there is a single law, the law of conservation of matter and energy. He predicted that matter could be changed into energy and vice versa. This concept was expressed in his famous equation $E = mc^2$, where *E* represents the amount of energy, *m* is the amount of matter, and *c is a* constant equal to the speed of light.

Einstein's theory proved to be valid in 1939, when it was discovered that enormous amounts of energy could be released by splitting uranium atoms, a process called fission. When a uranium or plutonium atom is split apart, it gives up neutrons that in turn split other atoms. This chain reaction takes place very rapidly and releases a huge amount of energy, resulting in the explosion of an atomic bomb.

Although it may seem strange, a process that is the exact opposite of fission can also release great quantities of energy. Under conditions of intense heat, such as are found at the center of the sun, hydrogen atoms combine to form helium atoms. The transformation of hydrogen into helium is called fusion. When fusion takes place, the hydrogen atoms lose a small amount of mass, which is transferred into energy.

Fusion produced on the earth results in a hydrogen bomb, which is much more powerful than the original atomic bomb. But the principle of fusion can also be used to produce energy for peaceful purposes that can supply all of the needs of the human race for a long time.

Understanding the Reading

Each of the following statements is inconsistent with the information in the previous passage.

Test your reading comprehension by finding the error in each statement and restating it correctly.

Example: Energy can be transformed from one type to another, but it cannot be transferred from one body to another. *Energy can be transformed from one type to another or can be transferred from one body to another.*

1. Kinetic energy is the energy of position.
2. Unlike matter, energy cannot be created or destroyed.
3. Einstein said that the conservation of matter and the conservation of energy are unrelated.
4. Einstein's theory about the conservation of matter and energy was never proved.
5. The development of atomic energy demonstrates that energy can be converted into matter.
6. When an atom is split, it gives off electrons.
7. An atomic explosion occurs as a result of the slow chain reaction of splitting atoms.
8. Fusion takes place on the sun when two uranium atoms are combined.
9. Extreme heat or cold is required for fusion to take place.
10. Fusion produced on the earth results in an atomic explosion.

Translating

Translate the following sentences from Ukrainian into English.

A

1. Часто трапляється, що енергія трансформується з одного типу в інший.
2. Коли яблуко падає, воно витрачає потенційну та здобуває кінетичну енергію.
3. Якщо нам потрібно виміряти залишок енергії після того, як ми приготували та з'їли якусь їжу, ми завжди знайдемо ту саму кількість енергії, що була спочатку.
4. Альберт Ейнштейн стверджував, що існує єдиний закон збереження матерії та енергії.
5. Ця реакція може привести до вибуху атомної бомби.
6. Потенційна енергія – це коли ти знаходишся у ліжку, розмірковуючи про ті речі, що ти маєш зробити.
7. Це не повинно відбуватися ні за яких обставин.
8. Почнемо з того, що цей будинок не треба руйнувати.
9. Ні французький хімік, ні німецький фізик ще не дали відповідь на це питання.
10. Ми передбачали можливість зростання швидкості.

B

Translate the following questions from Ukrainian into English and answer them.

1. Енергія не може змінюватися з одного типу на інший, чи не так?
2. Що таке потенційна енергія?
3. Коли потенційна енергія стає кінетичною?
4. Коли не відбувається втрата енергії?
5. Чи можливо створювати енергію?
6. Що таке закон збереження енергії?
7. Коли теорія Ейнштейна виявилася справедливою?
8. Що трапляється, коли звільнюється велика кількість енергії?

Discussion Points

Using English for Making a Point:

Here are some useful ways of expressing a point of view.

I would like to say here that…
You should know (realize) that…
I would like to make one thing clear from the outset…
I think we have to consider that…
I think I should mention here that…
We should always remember that…
I believe you know that…
The point is that…

Memorize the following expressions and use some of them to make your points concerning the information obtained from the texts of this unit.

UNIT 6
HEAT

Short Reading

Read the passage below and underline examples of how heat affects the properties of matter.

Notes:	to affect (smth.) –	впливати (на що-небудь)
	to clarify a concept –	з'ясовувати поняття
	to turn red –	почервоніти
	to provide an example –	навести приклад
	for –	тому що
	to contract –	стискатися
	the rest –	залишок
	to collide –	зіштовхуватися
	living things –	живі істоти
	to serve –	служити
	to stand (smth.) –	витримувати (що-небудь)

Effects of Temperature

Temperature affects matter in many ways. As a substance gets hotter, its molecules move faster and its properties are altered. The physical state of a substance is affected by its temperature. For example, at a temperature of 0° C or below, water is a solid (ice); above 0° C it becomes a liquid; and at 100° C it turns to a gas (steam). Almost all other substances are similarly affected by temperature.

Temperature alters the color of matter. Iron, for example, turns red, then orange, and then white at increasingly high temperatures. (You have seen the iron burner on a stove turn red.) An incandescent light bulb provides another example of a color change, for its tungsten wire gives off a white light when it is hot.

The size of an object is affected by temperature. Most materials expand when they are heated and contract when they are cooled. A glass may break when boiling water is poured into it because part of the glass heats up and expands more rapidly than the rest.

Temperature also affects the pressure of a gas. As a gas is heated, its molecules begin to move rapidly, colliding with the walls of the container. If a closed glass tube is heated, the increased pressure inside will cause it to break.

The ability of a metal to resist electricity varies with its temperature. The increased movement of its molecules makes the molecules less resistant to electrical charge. Heated wires cause excess electrical movement, which can damage machines. Computers and other sensitive machines function best in air-conditioned rooms. Living things are very sensitive to comparatively small temperature changes. This is exemplified when we touch something very hot or cold and feel pain. The pain serves to protect us, because living things cannot stand extremes of temperature.

Using the same principle, we pasteurize milk and cook meat to kill harmful bacteria and other organisms that cannot tolerate the heat.

Vocabulary in Context

A

Mark the letter of the answer that best matches the meaning of the italicized word as it is used in each of these sentences.

1. To open the door, first *insert* the key in the lock.
   a. turn b. enter
2. The submarine was completely *submerged* in the water and could not be seen.
   a. sunk b. uncovered
3. Sound cannot be *conducted* in a vacuum because there are no air waves to transmit it.
   a. carried b. absorbed
4. Wires were *insulated* to prevent the transfer of electricity or heat.
   a. covered b. exposed
5. *Fluids* are not rigid and can flow from one container to another.
   a. solids b. liquids and gases
6. *Germs arc invisible* without the aid of a microscope.
   a. unable to be seen b. unable to be divided
7. After the fire, the nuclear reactor was *emitting* radiation.
   a. giving off b. absorbing
8. The sun *radiates* heat and light.
   a. takes in b. gives off
9. When there is a *disparity* between test results, the test should be repeated.
   a. similarity b. difference

B

Match English and Ukrainian equivalents:

to give a definition –	змінювати колір
to be affected –	почервоніти
to alter the color –	визначати
to turn red –	знаходитись під впливом
to serve to protect –	впливати на тиск
to affect the pressure –	спричиняти рух
to expand –	опиратися електриці
to cause movement –	витримувати екстремальні
to stand extremes of temperature –	температури
to resist electricity –	служити для захисту
	поширюватись

C

Find sentences with the word combinations and translate them in writing:

the physical state of a substance; the color of matter; to pour water; the increased pressure; to vary with temperature; to function best; living things; to tolerate the heat.

Scanning

Scan the following passage keeping in mind that examples usually come directly after definitions and find the following examples:

1. one example of conduction,
2. one example of convection,
3. one example of radiation.

Reading

Notes:	transfer of energy –	передача енергії
	thus –	таким чином
	an ideal insulator –	ідеальний ізолятор
	to rise (rose, risen) –	здійматися
	dense –	густий
	to replace –	заміняти
	to be dependent (on) –	бути залежним (від ...)
	to be invisible –	бути непомітним
	to reach the earth –	досягати землі
	to pass through –	проходити через
	to give off –	випромінювати, випускати
	to emit –	випромінювати, випускати

How Heat Is Transferred

Heat is the energy that warms our houses and cooks our food. It is the transfer of energy from a warmer body to a cooler body. How does this heat transfer take place?

Conduction is one method of heat transfer that takes place when there is a difference in temperature between two objects. For example, if a silver spoon is inserted into a pot of hot tea, the handle of the spoon will immediately become hot. This is because the molecules at the submerged end speed up, which causes the slow-moving molecules at the cold end to move faster. Energy is thus transferred or conducted.

Heat flows from a warmer object to a cooler one until the temperatures are equal. Substances like metals are good conductors because heat transfers readily from one molecule to another. All substances conduct some heat, but substances like glass, plastic, and wood act as insulators because their molecules transfer energy so slowly. Gases and liquids are poor conductors because the molecules make very little contact with which to pass on the energy. The warmest materials are those that trap pockets of air, such as wool, fiberglass, asbestos, and down. A vacuum would make an ideal insulator because it has no molecules to transfer the heat.

Although molecules in a fluid do not conduct heat very well, they do transfer heat by convection. Convection is the upward flow of masses of liquid or gas molecules as they are heated from below. The hot air rising above a radiator is an example of convection. As the heat causes the air to expand, it becomes less dense and rises. Convection is used in hot air furnaces, in which air is heated and then

forced into a room to replace the cold air, which is then drawn into the furnace to be heated. Winds and ocean currents are examples of convection found in nature.

Radiation is the third method of heat transfer. All life on earth is dependent on the radiation of the sun's heat and light energy. One fascinating aspect of the sun's radiation is that the electromagnetic rays that carry warmth and light to the earth are themselves invisible and without heat. We know this because the space between the earth and the sun is dark and cold, but when the rays reach the earth, they light the atmosphere and warm our world. In contrast to conducted and converted heat, radiated heat passes through a vacuum.

All objects emit, or give off, radiation. For example, when two objects are near each other, the one that is warmer will give off more energy than the cooler one, thus transferring energy from one to the other. Usually, objects do not absorb all the energy but reflect some of it. Light colors reflect more energy than dark colors. Highly polished surfaces reflect more energy than dull ones.

Drawing Conclusions

A scientist must be able to draw conclusions from the available facts. For example, if it is true that wood is a better insulator than metal, it is a logical conclusion that wood would make a better pot handle than metal.

After reading the previous passage carefully, indicate what conclusions can be drawn from the information it contains by marking the letter of the answer that best completes each of these sentences.

1. If the molecules in your tea are moving very rapidly, your tea is ... .
   a. hot b. cold
2. Opening the door between a warm room and a cold one will cause the temperature in the two rooms to ... .
   a. equalize b. increase
3. Oxygen is a ... conductor of heat.
   a. good b. poor
4. A double-glass window that traps air is a ... insulator.
   a. good b. poor
5. Since cork has air pockets, it is a ... insulator.
   a. good b. poor
6. An air conditioner that causes hot air to rise operates on the principle of ... .
   a. conduction b. convection
7. On a trip from the earth to the moon you would pass through ..temperatures.
   a. cold b. hot
8. The earth absorbs heat ... .
   a. and radiates it b. but does not radiate it
9. The most comfortable clothing on a hot, sunny day is ... .
   a. light colored b. dark colored
10. A house with white walls will be ... than one with dark walls.
    a. cooler b. warmer

Translating

A

Find English equivalents in the text:

зігрівати будинки; відбуватися; змушувати рухатись скоріше; діяти як ізолятор; підніматися над нагрівачем; залежати від; випромінювати більш енергії; відбивати енергію; три типа передачі енергії.

B

Translate the following sentences from Ukrainian into English:

1. Якщо срібну ложку покласти у гарячий чай, її ручка швидко нагріється.
2. Ця передача енергії все ж таки відбувається.
3. Усі речовини передають деяку кількість тепла.
4. Найтепліші матеріали – це такі матеріали, як асбест, скловолокно та дерево.
5. Коли тепло змушує повітря розширюватися, воно стає менш щільним та підіймається.
6. У протилежність переданому теплу, тепло, що випромінювалося, іде через вакуум.
7. Світлі кольори відбивають більше енергії, ніж темні.

Discussion Points

Using English to Express Hesitation and Uncertainty:

Hesitation is a natural part of using a language. But most people have to hesitate now and then. Silence is not a good way to hesitate as it causes embarrassment and confusion.

Here are some useful expressions you can use to fill the silence in order to collect your thoughts and decide how to express them.

Well, let me see…
Oh, let me think for a moment…
You know
The thing is...
How can I put it?

Here are some useful expressions you can use when you are *hesitating*.

I need some time to think it over, I'm afraid.
I really don't think I can give a firm decision on that.
I doubt.
There are certain points I'd like clarifying before I give my word.
I agree in principle, but there are certain points...
That point needs careful consideration.

Here are some useful ways of expressing *uncertainty* about some facts.

I'm not certain but I think…
Yes, I'm not sure ...I think.
Well, I'm not quite (absolutely, a hundred percent) sure.

Memorize the expressions and use some of them to express your uncertainty or hesitation concerning some information.

UNIT 7
SMOKING, DRUGS AND ALKOHOL

Short Reading

Read the following passage to discover evidence that smoking is harmful.

Notes: beyond a doubt –	безсумнівно, безперечно
to shake (shook, shaken) everybody up –	потрясти усіх
to get closer to the truth –	наблизитися до істини
to announce –	оголошувати, повідомляти
to contribute (to smth.) –	сприяти (чому-небудь)
thereby –	таким чином
to indicate –	вказувати
to attempt –	намагатися
onset –	початок, настання
despite –	незважаючи на
due to –	завдяки (чому-небудь)

Where There's Smoke, There's Fire

It was not too long ago that smoking by adults was not viewed as dangerous. Its long-term effects were not visible and had not been conclusively demonstrated. Then, in 1964 the Surgeon General of the United States announced that smoking had been proven by scientific research to be detrimental, or harmful, to health.

Since then, more and more evidence has accumulated to indicate that smoking is harmful. Smoking is related to many heart and circulatory ailments. The tobacco plant contains nicotine, a chemical that is poison in its pure form. It has been demonstrated that nicotine increases the rate of the heart, intensifies the effects of high blood pressure, and causes the constriction or tightening of the blood vessels, thus contributing to heart disease.

Smoking is the most significant factor in respiratory diseases. It can damage the tiny hairs (cilia) that line the breathing passages, thereby causing emphysema or chronic bronchitis. Research also confirms that the tar in cigarette smoke is carcinogenic, that is, it can produce cancer in any tissues it comes in contact with, such as the mouth, the throat, and the lungs.

There is also a correlation between smoking and birth defects. The evidence indicates that pregnant women who smoke a pack of cigarettes a day have a greater likelihood of having a miscarriage, a premature baby, a smaller-than-normal baby, or a baby with mental retardation or heart defects.

Smokers often become physically and psychologically dependent on their habit and suffer withdrawal symptoms if they attempt to stop. Even the onset of a smoking-related illness is not always sufficient to enable heavy smokers to quit. Despite all the information made available to the public since 1964, only in 1985 the American Lung Association estimated that there were 250,000 premature deaths due to smoking in the United States per year.

Vocabulary in Context

A

Mark the letter of the answer that best matches the meaning of the italicized word as it is used in each of these sentences.

1. The drought *altered* conditions for the farmers.
   a. improved b. changed
2. Poor physical condition will make you more *susceptible* to illness.
   a. sensitive b. resistant
3. Virus *infections* cannot be cured with antibiotics.
   a. diseases b. organisms
4. The accident victim did not know what happened because he was *in a coma.*
   a. unconscious b. awake
5. Calcium is *obtained* from the electrolysis of calcium chloride.
   a. destroyed b. gotten
6. Coffee *stimulates* the nerve centers.
   a. quiets b. excites
7. The view from the mountain produced a *sensation* of dizziness.
   a. fear b. feeling
8. He retired from his job when he developed a *chronic* illness.
   a. long lasting b. brief
9. The needle was sterilized before the *injection.*
   a. insertion b. removal
10. The *initial* research was inconclusive, so a second experiment was planned.
    a. last b. first

B

Fill in the gaps using the words in the box. Use the verbs in the proper form.

to cause, to enable, to become dependent, to announce, to contain, to attempt, to confirm, beyond any doubt, to intensify, correlation

1. ____ there are much more phenomena to be investigated in this field.
2. There is ____ between smoking and lung disease.
3. Smoking can ____ the harmful processes in a human body.
4. It was ____ that smoking is unhealthy.
5. Nicotine ____ the constriction of the blood vessels.
6. He ____ to stop smoking every week.
7. The tobacco plant ____ nicotine.
8. The data given here ____ us to understand the problem better.
9. They ____ on their habits and had withdrawal symptoms.
10. Results ____ that the tar in cigarette smoke is dangerous to health.

Skimming

Skimming for main ideas is a reading skill that is useful in a number of ways:

a) Always skim a textbook chapter before reading it closely. If you follow this procedure, you will read faster and with greater interest and comprehension.
b) When you need to write a research paper, skim the references you find in the library to see which contain the material you need.
c) Skim any passage that you find difficult. Once you have a general idea of the content and organization, you will be able to read it thoroughly with better understanding.

Skim the following passage and then answer these questions:

1. Which of the following is the main idea?
    a. Drugs are always potentially harmful.
    b. Drugs are not harmful.
    c. Drugs are occasionally harmful but usually beneficial.

2. Which of the following drugs are discussed in the passage: cocaine, narcotics, PCP, amphetamines, inhalants, caffeine marijuana, barbiturates, and hashish?

3. Answer the questions in writing or make up dialogues using your notes (you may work in pairs).
    a. What data shook everybody up in 1964?
    b. What are detrimental effects which smoking may produce?
    c. Tar in cigarette smoke is very good for health, isn't?
    d. A correlation between smoking and birth defects does not exist, does it?
    e. Why is smoking so harmful for babies?
    f. Withdrawal symptoms do not develop even when you are a heavy smoker, do they?
    g. How many premature deaths are caused by smoking every year?

Reading

Notes:

to assume –	припускати
to weigh –	зважувати
to relieve pain –	полегшувати біль
to be highly susceptible (to) –	бути дуже схильним (до)
to lead (led) –	вести
bursts of energy –	спалахи енергії
to reduce anxiety –	знижувати хвилювання
to stay awake –	залишатися бадьорим, залишатися без сну
to suppress –	пригнічувати
to be addictive –	спричиняти звикання
to be aware of –	усвідомлювати
consequence –	наслідок

The Danger of Drugs

Drugs are substances that alter the body chemistry. The pleasing effects of any drug should be weighed carefully against its serious dangers.

Marijuana is a drug that has been much discussed and debated. It relaxes the mind and body and produces a pleasant, happy feeling in many users. At the same time, it can alter functions that may affect the memory, coordination, motivation, and attention span of the user. Although its effects may be less harmful than alcohol, it should not be assumed that it, or any drug, is harmless.

Narcotics (codeine, heroin, opium and morphine) are considered "hard drugs" and are addictive, or habit forming. They act as depressants on the nervous system, relieving pain and decreasing alertness and vigor.

Heroin makes the user lethargic and highly susceptible to infection, coma, and even death from overdose. Because heroin is addictive, it often leads the user to crime to pay for the high cost of obtaining the drug. Another narcotic, morphine, is used by hospitals as a pain reliever. Occasionally, patients receiving morphine become addicted.

Cocaine (or "coke") is a drug that stimulates the nervous system, producing a feeling of well-being and strong sensations. *Sniffing cocaine* powder over a long period can cause paranoia, hyperactivity, and chronic insomnia. "Crack," a form of cocaine that is smoked, is especially dangerous because the user can become intensely addicted in a very short period of time. Like heroin, it frequently leads the user to crime.

Amphetamines (called "speed" or "uppers") include Benzedrine, Dexedrine, and Methedrine. These drugs increase the blood pressure and stimulate the nervous system to give the user great bursts of energy. In small amounts, they are used by students and drivers to stay awake, by athletes to improve their physical performance, and by dieters to decrease their appetite. However, injections of amphetamines bring on initial feelings of energy and well-being that are followed by low periods of depression, exhaustion, irritability, and aggressiveness. An overdose of amphetamines can be fatal.

Barbiturates, or "downers" (sleeping pills), act on areas of the brain to reduce anxiety and cause sleepiness. The effects include loss of muscle coordination, slurred speech, and mental confusion. The use of barbiturates and alcohol together can suppress the breathing centers and be fatal.

Psychedelics, or hallucinogens (including LSD and mescaline), are drugs that produce hallucinations and other mental disorders. Their effects are somewhat unpredictable. Psychedelics can cause changes in mood, thinking, and behavior and distortions of time and space. Effects include dizziness, nausea, anxiety, and tremors.

With the exception of marijuana, research indicates that most of the above drugs are addictive. Users build up a tolerance for the drug, requiring increasing doses to achieve the same effects. Sometimes an addict's tolerance may be dangerously high, and a fatal amount is taken accidentally. Anyone considering using any drug should be aware of the potentially serious consequences.

Understanding the Reading

Indicate whether each of the following statements is true or false according to the previous passage.

1. Only certain drugs alter the body's chemistry.
2. There is no correlation between the use of marijuana and a decrease in motivation.
3. Marijuana is less dangerous than alcohol and therefore is probably harmless.
4. Morphine cannot become addictive when used by hospitals as a pain reliever.
5. A significant danger of heroin is that it is so addictive.
6. Cocaine has no long-term harmful effects.
7. Cocaine is one drug that is not addictive.
8. Some students use amphetamines because they provide temporary bursts of energy.
9. Even an overdose of amphetamines will probably not be fatal.
10. Barbiturates are particularly dangerous when taken with alcohol.

Answer the questions in writing. Make up dialogues using your notes.

1. What data shook everybody up in 1964?
2. What are detrimental effects which smoking may produce?
3. Tar in cigarette smoke is very good for health, isn't it?
4. A correlation between smoking and birth defects does not exist, does it?
5. Why is smoking so harmful for babies?
6. Withdrawal symptoms do not develop even when you are a heavy smoker, do they?
7. How many premature deaths are caused by smoking every year?

Vocabulary in Context

A

Give synonyms for the following words:

to alter, carefully, to cause, to receive, to act, to obtain, use, mental, disorder, anxiety, occasionally, to assume, to be aware of.

B

Give antonyms for the following words:

to increase, pleasant, happy, to suppress, harmful, frequent, to improve, predictable, accidentally, short, loss.

C

Give Ukrainian equivalents and use the following words and word combinations in the sentences given below (put the verbs in the proper form):

a. to affect coordination
b. to be susceptible
c. to lead
d. to produce a feeling of well-being
e. to be aware of

f. to be considered
g. to be weighed carefully
h. to alter the body chemistry
i. distortions of time and space
j. in a short period of time

1. Doctors agree that drugs ____ .
2. Heroine ____ to be ″hard drug″ .
3. The substance ____ and the person moved too slowly.
4. They refused to take the medicine after the harmful effects ____ .
5. Drugs ____ him to crime and he had been a prisoner for 5 years.
6. The users ____ to death from overdose.
7. One can become intensely addicted ____ .
8. Cocaine is a stimulator and it ____ .
9. Hallucinogens often cause ____ .
10. He ____ the potential consequences.

Vocabulary Building

Find derivatives for the following words:

V ─ N e.g. demonstrate ─ demonstration
estimate ─ …
indicate ─ …
attempt ─ …
announce ─ …

N ─ A e.g. danger ─ dangerous
conclusion ─ …
harm ─ …
significance ─ …
evidence ─ …

Discussion Points

Using English for Stating Your Position:

Here are some useful ways of stating your own position.

Perhaps I could begin by saying that…
I think I should make it clear right from the outset that…
If you would allow me to give you a brief outline of my position on this matter...
I think I ought to say right from the start that…
What I'm getting at is that…
The point I'm trying to make is that…
The crux of the matter is that…
What I'm driving at is that…
I want to make it clear that…
I would like to say here that…
I feel I should point out to you that…

Memorize the following expressions and use some of them to express your position concerning the information obtained from the texts of this unit.

UNIT 8
ELECTRICITY AND MAGNETISM

Short Reading

Read the following passage to find directions for performing an experiment.

Notes:

to pick up –	підбирати
amber –	бурштин
to perform –	проводити, виконувати, здійснювати
to arrange –	розміщати, розташовувати
to sustain –	підтримувати
capacity –	ємність, місткість
magnetic capacity –	магнітна проникність
charge –	заряд
to repel –	відштовхувати
unlike –	несхожий
unlike	на відміну від
therefore –	тому, отже
similarly –	також
to remove –	пересувати, знімати

Lightning Strikes

You know that lightning is actually electricity. But how does lightning occur? The ancient Greeks noticed that when they rubbed a piece of amber with wool or fur, the amber would attract or pick up small pieces of leaves or dust. This was called the amber effect.

The English word *electricity* comes from the Greek word *electron*, which means amber.

To demonstrate this concept, you may perform the following experiment: arrange tiny pieces of paper on a table, rub a plastic comb with some woolen fabric, hold the comb over the pieces of paper and observe what happens. The paper should be attracted to the comb. (The comb must be rubbed again to sustain its magnetic capacity.)

In the eighteenth century, scientists discovered that there are two types of electric charge. The American Benjamin Franklin named these charges positive and negative. It was noted that like charges repel each other and unlike charges attract each other.

In the experiment above, the magnetic effect occurs because rubbing the comb causes some electrons from the cloth to run on to the comb. The cloth then has fewer electrons (which are negative) and thus becomes positively charged. The comb therefore has additional electrons, giving it a negative charge. The comb attracts the paper because opposite charges attract. Similarly, you have probably experienced an electric shock when you removed synthetic clothing from a clothes dryer, combed your hair, or touched a metal doorknob after walking across a thick rug.

A spectacular example of this phenomenon occurs during a storm. Inside a cloud, currents of air rub against the raindrops. As the electrons are rubbed off, one

cloud becomes positively charged and another negatively charged. The opposite charges attract each other, and an enormous spark of electricity jumps from one cloud to another or from a cloud to the ground. Thus, lightning is produced.

Vocabulary in Context

Mark the letter of the answer that best matches the meaning of the italicized word as it is used in each of these sentences.

1. Oil and water *repel* each other.
   a. attract b. resist
2. The possibility of life existing elsewhere in the universe is *intriguing* to many scientists.
   a. ridiculous b. interesting
3. Marie and Pierre Curie were able to *isolate* a new radioactive element, radium.
   a. separate b. create
4. The bridge was *suspended* from cables supported by towers at either end.
   a. hung b. separated
5. The hands on the dial *pivoted* as the gas pressure was raised and lowered.
   a. rotated b. reversed
6. The blueprint for the machinery was *accurate* except for one error.
   a. correct b. incorrect
7. To make sure the names were chosen by chance, the computer was programmed to list them *at random.*
   a. without order b. in order
8. During the eclipse, the earth, sun, and moon were *aligned.*
   a. in a line b. out of line
9. The experiments were conducted *simultaneously* in London and Rome.
   a. in the same place b. at the same time

Scanning

When you need to search technical material for the answers to specific questions, you will want to locate the particular information without reading every word. This can be accomplished by scanning the passage.

Scan the following passage and give the answers to these questions.

1. Who was William Gilbert?
2. Where is the magnetic North Pole?
3. What did Michael Faraday and Joseph Henry both discover?

Reading

Notes:

rubber –	гума
to some degree –	у деякій мірі
steel –	сталь
to manifest oneself –	виявлятися, проявлятися

to draw (drew, drawn) –	тягти, привертати, притягувати
to push away –	відбивати, відштовхувати
to suspend –	підвішувати
to pivot –	обертатися, вертітися
to speculate –	роздумувати, припускати
exactly –	точно; саме, якраз
from time to time –	час від часу
to reverse –	повністю змінювати, перевертати
orderly –	охайно, акуратно
to align –	ставити в ряд
simultaneously –	одночасно
to attach –	прикріплювати

The Magic of a Magnet

What is the magic that enables a magnet to pick up an iron nail but not a wooden pencil, a rubber eraser, or a copper penny? Magnetism, named for the ancient Greek town of Magnesia, is a force of nature that manifests itself differently in different materials. Although every substance is magnetic to some degree, magnetic effects are much more powerful with iron and steel than with materials such as wood, rubber, copper and glass.

If you have ever played with two magnets, you know the powerful force with which certain ends are drawn toward each other and other ends push away from each other across space. The magnets two north poles repel each other and their two south poles attract each other

Physicists have always been intrigued by the fact that when a magnet is cut in half, two new magnets are formed, each with a north and South Pole. If we were to cut these two magnets, we would have four magnets, each with a north and South Pole. The North Pole cannot be isolated from the South Pole. Magnetic poles never exist alone.

The ability of magnetic iron ores, or lodestones, to attract iron and other substances was known to the ancient Greeks. Later, around the year 1100, the Chinese discovered that if a splinter of lodestone were suspended from a thread, it would pivot and point north and south, thus making a very accurate compass. This phenomenon was explained in 1600 by William Gilbert, Queen Elizabeth's doctor, who speculated that the earth itself was a gigantic magnet.

The earth's magnetism is one of the great mysteries of science which no one has been able to explain. Although the earth has an iron core, that core cannot be a magnet because at great heats (over 1000° C at the center of the earth) iron loses its magnetism.

Another mystery is the fact that the magnetic poles are actually located over a thousand miles from the North and South Poles and they are not even at exactly opposite sides of the earth. In addition, by studying the age of rocks, scientists have discovered that from time to time in the history of the earth, the earth's magnetic field actually reverses itself as the magnetic South Pole becomes the magnetic North Pole and vice versa.

When viewed under an electron microscope, a piece of iron can be seen to be made up of many tiny magnetic areas called domains. When these domains are orderly arranged, the iron is magnetized. When these domains are randomly arranged, the iron will not act as a magnet. This explains why a magnet will pick up unmagnetized pieces of metal such as a steel paper clip. The force of the magnet causes all the tiny magnetic domains of the paper clip to align themselves. Then the north pole of the paper clip is attracted to the south pole of the magnet, and the south pole of the paper clip is attracted to the north pole of the magnet.

In 1832, the connection between magnetism and electricity was simultaneously discovered by the Englishman Michael Faraday and the American Joseph Henry. They found that when a magnet is passed through a coil of wire, it produces an electric current in the wire. This occurs because the wire contains unattached electrons. A magnetic field moving near the wire pulls these free electrons along the wire, creating an electric current.

Not only does a moving magnetic field induce electricity, but the opposite is also true. Electric currents produce magnetism. When a current of electricity is passed through a conductor, a magnetic field is formed around it. Thus a magnetic field may be induced by an electric current. Scientists believe that all magnetic fields are produced by electric currents. This is the true magic of a magnet.

Understanding the Reading

Indicate whether each of these sentences is true or false according to the previous passage.

1. All substances are somewhat magnetic.
2. Magnetic poles that are alike attract each other.
3. A magnet can exert its force across an open space.
4. A north pole of a magnet cannot exist separately from a south pole.
5. Compasses were used by the ancient Greeks.
6. William Gilbert suggested that a compass needle points north and south because the earth is a magnet.
7. We know that the earth is a magnet because it has an iron core.
8. The magnetic poles of the earth are located precisely at the geographical North and South Poles.
9. The earth's magnetic field reverses itself periodically.
10. A piece of iron is magnetized when its domains are scattered in different directions.
11. Metals are good electrical conductors because they contain many loose electrons.
12. Magnets can produce electricity but electricity cannot produce magnetism.

Vocabulary in Context

Complete the following sentences. Consult the text above. Use the verbs in brackets as key words.

1. Magnetism is a force of nature that ____ (to manifest oneself).
2. When you play with two magnets, there is the powerful force with which certain ends ____ (to draw toward each other).
3. The ancient Greeks knew that magnetic iron ores or lodestones ____ (to attract).
4. If a splinter is suspended from a thread, it ____ (to pivot; to point).
5. The earth's magnetic field ____ (to reverse oneself) from time to time.
6. The force of the magnet causes all the tiny magnetic domains of the paper clip ____ (to align oneself).
7. Michael Faraday and Joseph Henry simultaneously ____ (to discover).
8. Scientists believe that magnetic fields ____ (to produce).

Translating

A

Match English and Ukrainian equivalents:

1. actually	a) також
2. therefore	b) по суті
3. similarly	c) певно, мабуть
4. tiny	d) схожий
5. opposite	e) наступний
6. probably	f) протилежний
7. following	g) тому
8. ancient	h) додатковий
9. enormous	i) стародавній
10. additional	j) величезний
11. like	k) крихітний

B

Translate the following sentences from Ukrainian into English:

1. Бурштин, коли його натирають, звичайно притягує чи підбирає маленькі частки пилу чи листя.
2. Вчитель вже проводив цей експеримент.
3. Цей експеримент проводили, коли студенти увійшли до лабораторії.
4. У цьому випадку ми маємо протилежні заряди.
5. Тому наступний ефект спостерігають, коли присутні додаткові електрони, що утворюють негативний заряд.
6. Подібні заряди завжди відштовхують один одного, а несхожі притягуються.
7. Не треба було розміщувати зброю біля вогнища.
8. Неможливо підтримувати електричний струм в стародавніх приладах.

C

Translate the following sentences from Ukrainian into English:

1. У деякій мірі ці ефекти значно сильніші у металевих, ніж у гумових та скляних виробах.
2. Ці явища спостерігалися одночасно деякими вченими.
3. Лікар припустив, що сама земля і є величезний магніт.
4. Наука ще не змогла пояснити, чому магнітне поле землі час від часу повністю змінюється.
5. Коли ці частки розміщуються випадково, залізо не діє як магніт.
6. Наші вчені виконували ці дослідження одночасно з американськими колегами.
7. Вільні електрони витягуються магнітним полем уздовж провідника і таким чином утворюється електричний струм.
8. Якщо б ми мали розрізати ці два магніти, ми б отримали чотири магніти з північними та південними полюсами.

Discussion Points

Giving Verbal Directions

Plan your instructions carefully so that all necessary steps are included. As you prepare your talk:

a. List all the steps in the procedure.
b. Make sure that each step is separate and distinct and that nothing has been omitted.
c. Arrange the steps in chronological order.
d. A good way to conclude is to explain how this information might be used.

Using English for Making Suggestions:

Here are some useful ways of making suggestions.

Maybe it would be a good idea to…
I think it would be a good idea if …
Wouldn't it be possible to …?
Surely it would be possible to…?
I don't see why we can't (just)…
Is there any possibility of …-ing?
It might be worth looking into…
Have you thought about …-ing?
Have you considered …-ing?
What would you think if…?
What if…?
Let's…
Why don't we…?
I think we should…
How about …-ing?
What about …-ing?

Memorize the following expressions and use some of them to make your suggestions concerning the information obtained from the texts of this unit.

UNIT 9
LIQUIDS AND GASES

Short Reading

Read the following passage to find sentences that express mathematical relationships.

Notes:

to attach –	прикріплювати, приєднувати, прикладати (до чогось)
to bump –	ударяти(ся), стукати(ся)
to drum –	вибивати, бити в барабан
to be familiar with –	бути знайомим з
to wonder –	дивуватися (чому – at); цікавитися, бажати знати
actually –	насправді, фактично
to exhale –	видихати
to breathe –	дихати
breath –	дихання
to slip –	ковзати, пересуватися плавно
to slide (slid) –	ковзати, ковзатися (на льоду), зісковзувати
depth –	глибина
gravitation –	сила ваги, тяжіння

Pressure: As Molecules Collide

Everything around us is made of atoms — the earth, our bodies, the sea, the air. Small groups of atoms form molecules. In gases, the molecules are loosely attached and move about bumping into each other and into any surface they touch. This constant drumming of the molecules on a surface is called pressure.

The gas we are most familiar with is air. Since gases expand to any container you might wonder why our air does not escape into outer space. The answer is simple that gravity holds the atmosphere close to the earth. In fact, due to the gravitational pull, the gases of our atmosphere accumulate near the surface of the earth. Air gets progressively thinner the higher you go, until it gradually disappears into space. Because the air is so thin at very high elevations, such as the Himalaya Mountains, climbers take oxygen to help them breathe.

The ancient Greeks knew that air had substance, that is, that it was not merely empty space, because they could feel the wind or their exhaled breath. Galileo proved that air actually has weight. Under normal climatic conditions, the weight of the air at sea level is equal to 14.7 pounds per square inch.

This means that the air in a medium-sized room may weigh more than one hundred pounds! Why don't we feel this enormous pressure on our bodies? The reason is that atmospheric pressure is universal; it acts in all directions on all surfaces so that everything on the earth is in balance.

The pressure inside your body equals the pressure outside. When you go up in an elevator or airplane, you feel your ears popping because as the air gets thinner, the number of molecules "hammering" inside your ear exceeds the number "hammering" outside, until the molecules have a chance to equalize.

Because the molecules are closer together in a liquid than in a gas, they slip and slide over and around each other, exerting pressure on the walls of their container. You feel this pressure when you dive beneath the surface of the water. The pressure of the water is directly proportional to the depth. The pressure on a diver is thus equal to the weight of the atmospheric pressure plus the water pressure.

Vocabulary in Context

Mark the letter of the answer that best matches the meaning of the italicized word as it is used in each of these sentences.

1. The temperature on a Fahrenheit fever thermometer *ranges* from 94° to108°.
   a. extends b. contracts
2. Swimmers feel more *buoyant* in salt water than in fresh water.
   a. floatable b. sinkable
3. The television viewers *observed* the explosion of the space shuttle.
   a. watched b. heard
4. Word processors have *displaced* typewriters in many offices.
   a. taken the place of b. damaged
5. The *volume* of air in a room can be measured in cubic feet.
   a. quality b. quantity
6. The *density* of the fog gave us poor visibility.
   a. thickness b. coolness
7. Newton *computed* the weights of the planets.
   a. measured b. calculated
8. Water contains hydrogen and oxygen in a *ratio* of two to one.
   a. proportion b. size
9. The *degree* of gravitational pull depends on the size of the objects involved.
   a. quality b. amount
10. Ten *minus* four equals six.
    a. less b. plus

Scanning

When you need to search technical material for the answers to specific questions, you will want to locate the particular information without reading every word.

This can be accomplished by scanning the passage.

Scan the following passage and answer these questions:

1. What is Archimedes' principle?
2. What type of water has a density of 64 pounds per cubic foot?

3. What is the specific gravity of people?

Reading

Notes: to notice – помічати, звертати увагу
to float – плавати (на поверхні); нестися (за течією)
to range – ставити в ряд; коливатися (в певних межах); простиратися
buoyancy – плавучість
to immerse – занурювати
to exert a force – прикладати силу
to push upward – штовхати у гору; натискати
density – густота; щільність; концентрація; питома вага
dense – густий, щільний

What Makes Objects Float?

As a child, you may have played with objects in the bathtub, noticing that the bar of soap sank to the bottom of the water while the plastic soap dish floated on top. Why is it that many objects, ranging from a piece of cork to an ocean liner, will float, while others will not?

The force that makes objects float is called buoyancy. This concept was established by the great Greek mathematician Archimedes, who also played in the bathtub. Archimedes observed that when he got into his bathtub, water was displaced, or pushed out. He determined that any object immersed in a liquid is buoyed up by a force equal to the weight of the fluid displaced by the object.

This is known as Archimedes' principle. For example, suppose a rock weighs 100 pounds and has a volume of 1 cubic foot. When that rock is submerged in water, it displaces 1 cubic foot of water, which weighs 62 pounds. Therefore, the gravitational pull on the rock is 100 pounds downward and the buoyant force is 62 pounds upward. Out of the water, you would need to exert a force of 100 pounds to lift the rock. In the water you would have to exert a force of 100 minus 62 pounds (or 38 pounds).

The buoyant force of a liquid, or how much it pushes upward, depends on the density of the liquid. A body will float if its density is less than that of the liquid in which it is immersed; it will sink if its density is greater. Ice is less dense than water, so icebergs float on the surface of the ocean. Steel ships are designed with many spaces filled with air so that their density is less than that of water.

Density is computed by dividing the weight of the liquid by its volume. Saltwater has a density of 64 pounds per cubic foot, while fresh water has a density of 62 pounds per cubic foot. Hence the buoyant force of saltwater is greater than that of fresh water, which explains why it is easier for a swimmer to float in the ocean than in a lake.

Similarly, an ice cube will float in a glass of water. That same ice cube would sink in pure alcohol, because alcohol has a lower density than ice. The tendency of an ice cube to sink or float in a drink depends on the proportion of water to alcohol. Be on *y*our guard if you put an ice cube in a drink and it sinks to the bottom.

Specific gravity is the ratio of the density of a substance to the density of water. Human beings have a specific gravity of approximately 1.0, which is the same as that of water. This is not surprising, considering that our bodies are two-thirds water. However, a fat person has less specific gravity than a thin person and therefore will have an easier time floating.

Drawing Conclusions

After reading the previous passage carefully, indicate what conclusions can be drawn from the information it contains by marking the letter of the answer that better completes each of the following sentences.

1. A small rock will ... .
   a. float better than a large one b. not float better than a large one
2. If a ship weighs more than 64 pounds per cubic foot, it will ... .
   a. sink b. float
3. If a ship weighs more than 64 pounds per cubic foot, it will ... .
   a. sink b. float
4. Since cork floats in water, we know that its density is ... .
   a. more than that of water b. less than that of water
5. It is easier to float if you are ... .
   a. thin b. fat
6. It is easy to lift someone in the water because of the ... .
   a. buoyant force b. specific gravity
7. Archimedes must have been .
   a. a clever Greek mathematician b. very clean
8. The best place to make a scientific discovery is ... .
   a. in the bathtub b. not stated in the passage
9. *A* ship will float higher in ... .
   a. lake water b. ocean water

Translating

Translate the sentences from Ukrainian into English:

A

1. Вчені, що працюють у цій галузі, знайомі з явищами, які фактично не мають пояснення.
2. Коли хворий видихав, його дихання було хрипким.
3. У цьому лісі дуже приємно дихати свіжим повітрям.
4. Завдяки силі тяжіння, гази атмосфери збираються біля поверхні землі.
5. Цікаво, що дійсно довів Галілей?
6. Вважають, що Азовське море має невелику глибину.
7. Молекули вільно скріплені у газах та рухаються, ударяючись одна об одну.

Translate the sentences from Ukrainian into English:

B

1. Архімед помітив це явище, коли грався у ванні.
2. Тенденція льоду плавати на поверхні або тонути залежіть від пропорцій води та алкоголю у напоях.
3. Ми не повинні прикладати силу, щоб не зламати нове обладнання.
4. Сила, що дозволяє речам плавати на поверхні, є плавучість.
5. Густота рідини вказує на силу плавучості.
6. Вчений визначив, що ці речі не були занурені у воду.
7. Він мав багато улюблених занять, що простиралися від шахів до гри у гольф.
8. Густоту можна підрахувати, поділивши вагу рідини на її об'єм.

Discussion Points

Drawing Conclusions:

A short paragraph does not require a concluding statement, but a longer paper should have a conclusion instead of just ending abruptly.

A conclusion is important because it is the final thought given to the reader and thus has the strongest impact. Therefore, the conclusion should contain the main things to remember.

A concluding sentence may do one of the following:

1. Restate the main point for emphasis. This involves paraphrasing the topic sentence.
2. Summarize the information to review or clarify it. In a short paper a summary may not be different from the main point.
3. Relate the significance of your conclusion. Why is it important? What effect will it have?

Making up a Paragraph with a Conclusion:

The hypothesis is your topic sentence. The rest of the paragraph should support the hypothesis, that is, give reasons for your opinion.

A concluding statement relates the significance of what you have stated.

Using English for Summarizing:

Here are some useful ways of summarizing (recapping) the points.

So, let's just summarize.
Maybe we could just run over the main points again.
Can we just stop here a moment and summarize the points so far?
Let just recap for a moment.
We can draw a conclusion that....
Perhaps it would be useful if we just summarized said so far.

Memorize the following expressions and use some of them to summarize the information obtained from the texts of this unit.

UNIT 10
THE ORIGIN OF LIFE

Short Reading

Read the following passage and notice the different verb tenses that are used to report events of the past.

Notes:

fossil –	скам’янілість
remains –	рештки, останки
imprint –	відбиток, слід
trace –	слід, знак
miraculous –	загадковий
to evolve –	розвивати(ся)
minute –	дрібний, крихітний; незначний, неістотний
to grow (grew, grown) –	рости, збільшуватися; ставати
to respond to surroundings–	реагувати на оточення, на середовище
to spread (spread) –	поширювати(ся); розкинутися, простягатися, розстилати(ся)
to be alike –	бути схожими
advance –	рух уперед; успіх, прогрес
eventually –	зрештою

How Life Began

To discover how life began, archaeologists study fossils. Fossils are the remains or imprints of plants and animals of long ago that have been preserved in the earth's crust. The simplest forms of life appear in the lowest or oldest rocks. Although scientists can calculate that the earth is 4.6 billion years old, the oldest rocks that show any trace of life are less than 2 billion years old. Therefore, about 2.5 billion years had passed on the earth when life originated. Since the oldest forms of life were all sea life, many scientists believe life began in the sea.

We do not know exactly how, but in some miraculous way, the right kind of molecules happened to combine in the ocean or in clay to form a minute organism. All life has probably evolved from that single original cell, which may have been something like the bacteria of today. This one-celled organism ate, grew, responded to its surroundings, reproduced itself, and spread throughout the oceans.

Probably those first tiny organisms were not all alike. Some were better able to obtain food or adapt to colder waters. The stronger cells survived and their characteristics were passed on to the next generation.

The early cells reproduced simply by dividing in two. After a long time, single cells became attached to one another, and each cell became specialized in a different function. Gradually organisms became more and more complex. Today, many living things are made up of a combination of cells; our bodies are composed of skin cells, blood cells, muscle cells, brain cells, and so on.

The gradual migration of life from the ocean to the land was another major step that made many advances possible. Eventually plants and animals divided into males

and females, and possibilities increased for developing new and varied species or types. To date, more than 400,000 species of plants and 1,200,000 species of animals have developed. Gradually, the senses of sight and hearing improved in animals and brains grew and developed. Finally, intelligence progressed, leading to the development of human beings.

The Cell

It is one of the amazing facts of science that all living organisms, from simple plants and animals to human beings, are made of cells, and that these cells are remarkably similar in structure. Cells are composed of a jellylike substance called cytoplasm, with a nucleus that is the control center.

The nucleus contains a large amount of nucleic acid: DNA (deoxyribonucleic acid) and RNA (ribonucleic acid). For years biologists studied the nature of nucleic acid. By 1953 a theory- regarding the structure of the DNA molecule had been formulated by James Watson and Francis Crick. They said that DNA is the information-storing molecule and that RNA is the information-carrying molecule.

Cells reproduce by dividing in half to form two identical daughter cells in a process called mitosis. Every living thing ─ a dolphin, an ant, a daisy, or a human body ─ has begun life as a single cell with a few molecules of DNA.

Vocabulary Building

Study the following list of word roots and then match the terms at the left below with their meanings at the right.

1. photon	a. machine that produces electric energy
2. photoelectric cell	b. instrument for measuring time
3. chronometer	c. particle of light
4. chronic	d. relating to the center of the sun
5. dynamo	g. high energy explosive
6. heliocentric	f. continuing for a long time
7. dynamite	e. vacuum tube with electrical properties modified by light
8. helium	i. device for measuring the sun

Vocabulary in Context

Mark the letter of the answer that best matches the meaning of the italicized word as it is used in each of these sentences.

1. Efforts are being made to *preserve* dean air in the cities.
   a. protect b. destroy
2. The factory *generates* electricity for the entire surrounding area.
   a. produces b. obtains
3. Although Aristotle's theories of motion were believed to be true for centuries, they were *discredited* by Galileo's experiments.
   a. supported b. disproved
4. Numerous *species* of animals are in danger of becoming extinct.
   a. classes b. habitats

5. The *evolution* in computer technology has accelerated since 1980.
   a. development b. decline
6. After the bombing, the city was rebuilt by those who *survived.*
   a. lived b. died
7. It started to rain when the air was *saturated* with moisture.
   a. filled b. cleaned
8. Galileo discovered the *existence* of Jupiter's moons.
   a. presence b. disappearance
9. The camel is *adapted* to desert life and can go without water for long periods.
   a. unsuited b. adjusted
10. Einstein's theories have *prevailed* throughout the twentieth century.
   a. failed b. dominated
11. A butterfly *evolves* from a caterpillar.
   a. escapes b. develops
12. The subject of abortion has been *controversial* for a long time, and there will probably never be complete agreement.
   a. interesting b. disputed
13. Newton performed experiments to *confirm* what Galileo had proposed about motion.
   a. verify b. disprove

Skimming

Skimming for main ideas is a reading skill that is useful.

Skim the following passage to discover its main topic and the information it contains. Then answer the following questions.

1. The main topic of this passage is ... .
   a. the search to discover how human life evolved
   b. Aristotle's view of evolution
   c. the life of Charles Darwin
   d. the sex life of an oyster

2. You will find information about all of the following *except* ... .
   a. how Darwin formulated his theory
   b. why Darwin's theory was so controversial
   c. the biblical story of the origin of man
   d. the meaning of "survival of the finest"

Reading

Notes*:*		
	offspring –	нащадок
	a living thing –	жива істота
	to resemble smb. –	бути схожим на когось
	to hatch –	висиджувати (пташенят); вилуплюватися
	abrupt –	раптовий; різкий, уривчастий
	it was not until …that …	і тільки

species –	біол. вид; рід; різновид
to be struck –	бути враженим, приголомшеним
evidence –	доказ; свідчення; підстава
to prevail –	переважати; перемагати
to compete –	змагатися; конкурувати
controversial –	дискусійний, спірний

Evolution

Life comes only from other life. The offspring of a living thing resembles its parents. A bird is hatched from an egg produced by parent birds. A flower grows from seeds created by a parent flower. One organism passes the flame of life to another in a continuing cycle, thus preserving life on the earth.

This concept is relatively new to mankind. The folklore of many parts of the world includes tales of abrupt transformations of men into animals and vice versa. In the fourth century BC even the great Greek philosopher Aristotle believed in the spontaneous generation of certain living creatures. It was not until 1668 that the Italian scientist Francesco Redi performed experiments that discredited his theory.

Then, in the mid-nineteenth century, biologists began to explore the question of how so many different species of plants and animals had developed. A young English naturalist named Charles Darwin traveled to the Galapagos Islands off the coast of South America. There he observed many types of creatures that he had never seen, including swimming lizards, giant land turtles that weighed several hundred pounds, and a type of penguin that lived in tropical weather. Darwin was struck by the fact that many of the animals that he saw lived nowhere else in the world. Then, on neighboring islands, he studied many different species of a group of birds called finches.

As a result of his observations, Darwin formulated a theory of the evolution of human life. He knew that many organisms produce more offspring than can actually survive. For example, an oyster can spawn 100 million eggs at a time! If all these eggs survived, the ocean would be saturated with oysters! Since all cannot survive, there is competition among the individuals in a species for food, water, warmth, and space. In the struggle for existence, only the fittest, or the ones that are best able to adapt, will prevail.

Darwin called his theory "natural selection," or the "survival of the fittest." He argued that those species that are the most fit, or the best able to compete with other species in the environment, will survive. The process of natural selection has occurred innumerable times. Animals with the warmest fur survive in cold areas. Plants that require the least amount of water survive in the desert. Fish that could adopt to life on land became the first land animals.

In 1859 Darwin published his findings in *The Origin of Species.* He claimed that man has evolved from a lower form of life and that in fact all life on the earth has developed from a single, original cell. Over millions of years, through gradual change, development, and natural selection, all the different species of life that we

know today have evolved. Darwin's ideas were very controversial, partly because they were in conflict with many religious views about the origin of mankind.

In addition, many people were shocked at the idea that humans are animals and related to other forms of life. Particularly upsetting was the concept that the ancestors of human beings were related to apes or monkeys millions of years ago. But all the evidence we have today confirms Darwin's hypothesis.

Distinguishing Fact from Opinion

It is very important to recognize the difference between fact and opinion when reading scientific material or listening to a scientific lecture.

It may be an educated opinion, that is, one based on past statistics and current trends, but it remains an opinion until it can be proved.

Indicate whether each of these sentences represents a fact or an opinion. If you are unsure, try to determine whether the concept can be proved.

1. Life comes only from other life.
2. There is no spontaneous generation of life.
3. Aristotle should have realized that there is no spontaneous generation.
4. Darwin was a genius.
5. Darwin stirred up a great deal of controversy.
6. Aristotle was a dummy.
7. The Galapagos Islands are near South America.
8. There were many unusual creatures on the Galapagos Islands.
9. Some lizards can swim.
10. Oysters produce many offspring.
11. Oysters are good to eat.
12. Human beings are animals.
13. The world would be a better place without oysters.
14. Creatures on earth will continue to evolve for many centuries.
15. We will never know how life began.

Translating

Translate the sentences from Ukrainian into Russian:

A

1. Зрештою він з’ясував природу скам’янілостей.
2. Рештки цієї цивілізації були помічені вченими у ряді країн Східної Азії.
3. Наш загадковий світ стає ще більш цікавим для археологів.
4. Ці характеристики є незначними, коли ми говоримо про сліди та відбитки минулих століть.
5. Одноклітинні організми зростали, реагували на оточення, відтворювалися та поширювалися усюди в океані.
6. Клітини, які ми бачили учора, дуже схожі.
7. Цивілізація розвивається, коли є належні механізми її поступового прогресу.

8. Ми зробили важливий крок, що дозволяє поліпшити успіх та прискорити рух уперед.

В

1. Вони запитали нас, як з'явилися живі істоти.
2. Ця дівчинка дуже схожа на свою бабусю.
3. Раптове поліпшення економічного стану було дивовижним.
4. І тільки у минулому році вчені-біологи провели це дослідження.
5. Ми не мали наміру ставити під сумнів вашу гіпотезу.
6. Усі були вражені перемогою молодої команди.
7. Нові прилади мають конкурувати зі своїми закордонними аналогами.
8. Це спірне питання буде обговорюватися пізніше.
9. Вони не мали доказів, щоб підтвердити свою думку.
10. Теорія Дарвіна залишається відносно спірною.

Discussion Points

Making a Report

Make a report of a scientific discovery or event. Begin by a topic sentence that answers the questions *who, what, when,* and *where.* The paragraph can explain *how, why*. Your concluding sentence might tell the significance of the discovery or event. You might choose one of these:

1. the first human heart transplant or test-tube baby
2. the discovery of penicillin, x-rays, radium
3. the development of the atomic theory or the theory of relativity
4. the invention of the telephone, the computer, the airplane

Using English to Give Opinions:

Here are some useful ways of giving opinions. When you take part in a discussion it is useful to have techniques for getting people to listen to you and to give yourself thinking time while you arrange your ideas. Here are some useful opening expressions which get more and more formal as you go down the list.

Expressing an opinion weakly:

I'm inclined to think that…
I tend to think that… (I rather think…)

Expressing an opinion:

I'd like to point out that…
I think… (I consider…)
In my opinion… (My point of view is…)

Expressing an opinion strongly:

I'm sure that…
I'm certain that… (I'm absolutely convinced that…)
I definitely think that…
There's no doubt in my mind that…

Memorize the following expressions and use some of them to express your opinion concerning the information obtained from the texts of this unit.

UNIT 11
THE UNIVERSE

Short Reading

Read the following passage to determine which properties of the sun and stars are described (for example, size, position).

Notes:	to turn smth. to smth. –	перетворювати що-небудь на що-небудь
	relatively –	відносно
	mostly –	головним чином
	tremendous –	жахливий; величезний
	to convert –	перетворювати, обертати (на, у – into)
	enormity –	жахливість; величезність
	fusion –	сплавлення
	to be beyond comprehension –	бути за межами розуміння

The Sun and Other Stars

The sun is a star. It is a flaming ball of extremely hot gases. The surface temperature is about 11,000° F, hot enough to turn every solid to vapor, but relatively cool compared to the intense heat at the center.

Located about 93 million miles from the earth, the sun has a diameter that is approximately equal to 109 of our earths lined up like a row of beach balls, and a mass that is about 330,000 times the mass of the earth.

The sun is the original source of nearly all our energy. It is mostly made of hydrogen, although it also contains nearly every other kind of atom that exists on the earth.

The sun derives its energy from a process of fusion in which hydrogen atoms are converted into helium atoms under extreme heat and pressure. This process creates a tremendous noise, but we cannot hear it because sound does not travel through empty space.

Our sun is not even especially large or bright compared to other stars. Stars vary in size from smaller than the earth to large enough to hold a good part of our solar system! The color of a star indicates its temperature. A star may be red (the coolest), yellow (like our sun), white, or blue (the hottest).

The nearest star is 4.3 light-years from the earth. A light-year is the distance light travels in one year, or about 6 million million miles (6,000,000,000,000 miles). The farthest stars are billions of light-years away. Some are so far away that if they were to blow up today, their light would continue to be seen from the earth for a million years!

Our sun is part of an enormous galaxy of 30 billion stars, called the Milky Way. In addition there are billions of galaxies within range of our telescopes and countless billions beyond. The enormity of space is quite beyond human comprehension. How exciting it is to live in an age when human beings have begun to explore that space.

Vocabulary Building

Study the following list of prefixes (aqua-water, terra-earth, pyro-fire, astro-star) and then match the terms at the left below with their meanings at the right. You will not use all the meanings listed.

1. aqueous solution	a. poison capable of producing fever
2. rugged terrain	b. enormously large
3. extraterrestrial	c. outside the earth
4. pyrometer	d. structure for conveying water
5. pyrotoxin	e. rough land
6. astrophysics	f. watery liquid
7. astronomical	g. device for measuring high temperatures
8. aqueduct	h. inside the earth
9. aquarium	i. study of the constitution of celestial bodies
	j. tank for plants and animals that live in water

Vocabulary in Context

Mark the letter of the answer that best matches the meaning of the italicized word as it is used in each of these sentences.

1. Few rivers in industrialized areas are *devoid of pollution.*
   a. full of b. without
2. Until the roof is fixed, it will continue to *leak.*
   a. drip water b. absorb water
3. Asian elephants may become extinct due to insufficient *vegetation* in areas that were once green.
   a. rainfall b. plant life
4. *Cosmic* rays are dangerous to human beings.
   a. space b. earth
5. The sun's rays *are filtered* through the atmosphere so that we don't receive their full strength.
   a. concentrated b. screened
6. In warm climates, water is sometimes heated by *solar* energy.
   a. sun b. electric
7. The earth's shadow *eclipsed* the sun's light, so it suddenly grew dark on the moon.
   a. blocked b. absorbed
8. In a desert, the temperature *alternates* between extreme heat and extreme cold.
   a. varies b. rises
9. The fog *diffused* the lights from the street so that visibility was poor.
   a. spread b. concentrated
10. Some *lunar* mountains and craters can be seen from the earth.
    a. moon b. sun
11. The planet Mercury has no *satellite.*

a. moon b. atmosphere

12. The space flight was postponed due to *adverse* weather conditions.
a. favorable b. unfavorable

Skimming

A good technique for textbook reading is to read the titles and subtitles and turn each into a question. For example, from the title of the passage below, you would formulate the question "Is the moon a nice place to visit?" and then read to find the answer. This method will help you to focus on the main points, maintain your concentration, and read more rapidly.

Skim the following passage to find its main idea and the kind of information it contains and then answer these two questions.

1. What is the main point of the passage?
   a. The moon is a nice place to visit, but you wouldn't want to live there.
   b. The moon is not a nice place to visit, and you wouldn't want to live there.
   c. Poets don't know anything about the moon.
   d. Scientists don't know anything about the moon.

2. Which of these topics is covered in the article?
   a. the first landing on the moon
   b. the phases of the moon
   c. the climate on the moon
   d. how the moon affects the earth's tides

Reading

Notes:

hostile environment –	вороже оточення, середовище
to be devoid of water –	бути позбавленим води
to leak –	протікати, просочуватися, пропускати воду
to retain –	утримувати, зберігати
accordingly –	таким чином, отже, відповідно
striking –	вражаючий, дивовижний
solar eclipse –	сонячне затемнення
to blot out –	викреслювати
to dip –	занурювати(ся), спускати(ся)
lack –	брак
to emerge –	з’являтися, виявлятися
to diffuse –	розповсюджувати, поширювати, розсівати
to view –	оглядати, дивитися; оцінювати, роздивлятися
to shield –	захищати, прикривати
adverse conditions –	несприятливі умови
to contract –	скорочувати, стискати

The Moon: A Nice Place to Visit?

The moon has been described by songwriters and poets as a place for a romantic escape. We know of course that the moon is actually a very hostile environment for human beings.

The moon is completely devoid of water because the force of gravity on the moon is much less than on the earth. (The moon is much smaller; its surface is about as large as Africa.) The lack of a strong gravitational pull has caused any water the moon may have had to leak out into space over the 4.6 billion years that it has been in existence. Of course since there is no water, there is also no vegetation. So if you go, bring your lunch.

There is no air on the moon because its gravity is insufficient to retain an atmosphere. Accordingly, travelers to the moon require not only oxygen and water but also protection against cosmic rays that are unfiltered by an atmosphere. No atmosphere also means no weather – no wind, no rain, no clouds.

Temperatures on the moon are quite extreme, ranging from 110° C to — 173° C. This occurs because there is no atmosphere to filter the sun's rays when it is shining and then to blanket in warm air when the sun goes down. These extremes of temperature are particularly striking during a solar eclipse, when the earth passes directly between the sun and the moon, temporarily blotting out the sun's light. At such times the temperature on the moon dips very rapidly and then rises immediately as the sun emerges from the earth's shadow. The change in temperature may be as much as 200° C in one hour! This sudden change can cause rocks to shatter due to the alternate expanding and contracting. Thus if you visit the moon, deciding what to wear could be a problem.

There is no twilight or dawn on the moon. Like the earth, the moon does not shine by its own light; it reflects the light of the sun. Unlike the earth, however, there is no atmosphere to diffuse the light as day becomes night and night turns into day. Changes from light to dark and dark to light occur suddenly.

The lunar sky is black. (Blue sky on the earth is produced by the scattering of blue light in the spectrum by particles of air.) On the moon stars are visible in the daytime, but you would have to shield your eyes from the unfiltered sunlight to view them.

There is no sound on the moon. Sound travels on waves of air molecules. Since there is no air, there is nothing to transmit sound. Leave your transistor home. Also, the moon is not a magnet the way the earth is. You can leave your compass home too.

The moon is a satellite of the earth, revolving around the earth once every twenty-nine and a half days. The moon itself rotates, but it does so very slowly. Therefore the same side of the moon is always visible to us. To get to the moon, you would have to travel 240,000 miles, a distance that is about the same as circling the earth at the equator ten times.

It is clear that if you were making a trip to the moon, you would need to pack more than a toothbrush and a change of underwear. Its adverse conditions would make it very difficult for a visitor from the earth.

Making Inferences

Indicate whether each of the following statements is stated in the passage, implied by other information in the passage or not stated.

1._ The force of gravity on the moon is less than that on the earth.
2. The tides on the earth are caused by the moon.
3. A person would weigh less on the moon than on the earth.
4. The moon has no water or atmosphere because it does not have enough gravity.
5. It would be difficult to have an argument with someone on the moon.
6. The moon orbits the earth about once a month.
7. We always see the same side of the moon.
8. The earth is 4.6 billion years old.
9. The temperature on the moon goes up to 200° C.
10. Human beings could not live on the moon.
11. Plants could not grow on the moon.
12. The moon has more extremes of temperature than the earth has.

Translating

Translate the sentences into English:

A

1. Ми не можемо бути впевнені остаточно, але вважаємо, що ці комп'ютери відносно дешеві.
2. Сонце є джерелом майже всієї енергії.
3. Головним чином, Сонце складається з водню.
4. У процесі сплавлення атоми водню перетворюються на атоми гелію під впливом тиску та надзвичайної теплоти.
5. Навіть чаклун не міг перетворити пар на живу істоту.
6. Нас здивувала величезність задач, які треба було вирішувати.
7. Цей вчений зробив величезний внесок у галузі розробки нових технологій енергозбереження.

B

1. Якщо ви бажаєте вдень дивитися на зірки з Місяця, ви вимушені захищати очі від нефільтрованого сонячного світла.
2. На Місяці немає атмосфери, що розповсюджує світло.
3. Кажуть, що їх відмову приймати участь в експедиції викликали несприятливі умови навколишнього середовища цього регіону.
4. Швидкі зміни змушують скелі руйнуватися завдяки стисканню та розширюванню.
5. Ця планета позбавлена води, таким чином ми не будемо мати можливість прийняти душ.
6. Здається, що Місяць – це вороже оточення для людини.
7. Вивчаючи нову тему ми помітили вражаючі факти щодо сонячного затемнення.
8. Вона завжди викреслює найважливіші речі та зберігає малоцікаві.

Discussion Points

Describing

A scientific description of a substance or object will usually answer some of the following questions:

a. What are its physical characteristics? (How does it look, feel, smell, taste? What happens to it when heated?)
b. What are its chemical characteristics? What is it made of?
c. Where is it found in nature? How abundant is it?

Using Precise Descriptions

Science demands objectivity and precision in its descriptions. To describe a comet as fantastic or long and beautiful tells very little. Scientists need to be specific. Adjectives must be objective and concrete. Dimensions should be quantitative.

Making up Extended Definitions

A definition may consist of a sentence or a paragraph. When a concept is too complex to be defined in one or two sentences, an extended definition is needed. An extended definition includes the basic parts of a formal definition (class + characteristics) as well as additional information that may include description, examples, classification, comparison, explanation, or other details. For example, an extended definition of a natural phenomenon (such as an eclipse, earthquake, or hurricane) would probably include causes and effects. An extended definition of a machine would probably include its functions and uses. An extended definition of a celestial object (such as a planet or comet) might include its location in respect to the earth and a comparison with another heavenly object. An extended definition of a disease would probably include its symptoms, prevention, and cure.

Using English for Emphasizing a Point:

Here are some useful ways of emphasizing a point. We need them to stress a certain fact or a piece of information which we consider to be of importance.

a) I want to make it clear that…
   I must emphasize that…
   I want to underline the fact that…
   Let's get this straight.
b) There's no doubt that…
   I don't have to spell it out.
   I think the figures (facts) speak for themselves.
   You don't need me to tell that…
c) Everyone should know by now that…
   I thought I'd made myself clear when I said that…
   At the risk of repeating myself, I should say that…
   I can't make this point strongly enough.
d) I don't want to leave anyone in any doubt about the fact that…
   I hope I've made myself clear.
   I think it would help if I gave a little background information on this matter.

Memorize the following expressions and use several of them to emphasize some information obtained from the texts of this unit.

UNIT 12
THE WEATHER

Short Reading

Read the following passage and find three predictions

Notes:

explorer (n.) –	дослідник
to descend –	спускатися, сходити
lunar eclipse –	місячне затемнення
to spin (spun) –	крутити(ся), вертіти(ся)
to tilt –	нахиляти(ся); перекидати(ся)
to blow out (blew, blown) –	(за)гасити

The World Turns

The earth is round; fifteenth- and sixteenth-century explorers like Columbus and Magellan proved it. But there were ancient Greeks who had known that two thousand years earlier. They saw ships descend over the horizon and observed the curved shadow of the earth on the moon during a lunar eclipse.

Then, in 200 BC, the Greek astronomer Eratosthenes noted that at noon on the first day of summer, when the sun was at its highest, its rays shone to the bottom of a vertical well in Syene, Egypt. Yet, on the same day in Alexandria, five hundred miles to the north, it was reported that a vertical post cast a shadow. If the earth had been flat, the post could not have cast a shadow at noon. The earth spins, or rotates on its axis, once every twenty-four hours, causing us to have day and night. At any given time, the side of the earth facing the sun will have daylight, and the side turned away from the sun will have night.

Although the earth is spinning at a speed of over one thousand miles an hour, we do not feel the movement or the wind because everything around us, including the atmosphere, is moving at the same speed. The effect is similar to riding in an airplane. The air moves with you. If you light a match on an airplane, no wind will blow it out.

The earth also revolves around the sun once every year. This yearly revolution, plus the tilting of the earth on its axis, causes the seasons. When the sun's rays are nearly overhead (*not* when the earth is closest to the sum and the days are long), great amounts of the sun's radiation are absorbed and the weather is hot. For example, from April through September, the North Pole tilts toward the sun and the northern hemisphere experiences summer while the southern hemisphere has winter. Then the North Pole tilts away from the sun and the seasons are reversed. On March 23 and September 21, the North Pole is not leaning toward or away from the sun. If you traveled around the earth on these two dates, you would find the days and nights equal every place you went.

Vocabulary Building

Study the following list of word roots (cardio-heart; geo-earth; -mit; -send; psycho-mind; -duct; –to lead) and use them to complete the missing words in the following sentences.

1. Weather information is *trans...* by satellite.
2. In ancient times water was transported over an *aque...* .
3. Aluminum is used for pots because it is a good *con...* of electricity.
4. A muscular action caused by the mind is a *...motor* activity.
5. A condition in which the heart stops beating is called *...ac* arrest.
6. In the spring the high school seniors *sub...* their applications to colleges.
7. A device that measures heart movements is a *...graph*.
8. The theory that the earth is the center of the universe is the *...centric* theory.
9. The branch of mathematics that deals with measuring and surveying the earth is *...metry*.
10. A metal that can be stretched into wire is described as *...ile*

Vocabulary in Context

Mark the letter of the answer that best matches the meaning of the italicized word in each of these sentences.

1. Madame Curie *inspired* many twentieth-century women to conduct scientific research.
   a. stimulated b. required
2. Birds and airplanes seem to *defy* the law of gravity when they fly away from the earth's surface.
   a. obey b. resist
3. The forecast was for dark clouds that would bring *precipitation.*
   a. heat b. rain
4. The experiment was *monitored* for errors.
   a. designed b. observed
5. Weather *forecasts* are more accurate today than ever before.
   a. predictions b. descriptions
6. There is no *infallible* cure for cancer.
   a. perfect b. partial
7. The rag was *saturated with* oil.
   a. full of b. emptied of
8. The seasons of the year recur in *cycles.*
   a. regular periods b. irregular periods
9. The storm caused *irreversible* damage.
   a. unchangeable b. changeable
10. The *depletion* of our resources is a twentieth-century problem.
    a. exhaustion b. increase
11. Mineral *concentrations* in the Dead Sea make aquatic life impossible.
    a. accumulations b. losses
12. Early storm warnings *averted* disaster.
    a. prevented b. caused

Scanning

A number of exercises in this book have provided opportunities to practice scanning. Scanning is a reading skill that is useful when looking up information in a reference book. To locate specific information, select possible key words and scan the table of contents in the front of the book, which lists all the chapters in the order in which they appear. Look for the same words in the index at the back of the book. Indexes are made up of key words arranged in alphabetical order.

Scan the following passage and find answers to these questions. (Choose key words for each question.)

1. What are two indicators of the weather?
2. What does a barometer measure?
3. What is the stratosphere?

Reading Notes:

to inspire –	надихати; вселяти почуття
to gather information –	збирати інформацію
precipitation –	опади
to dissolve –	розчиняти
moisture –	волога; сирість
to hold (held) –	тримати, держати, стримувати, містити
irreversible –	необоротний
depletion –	вичерпувати (запаси)
greenhouse effect –	тепличний ефект
to screen out –	відбивати
to prevent smth. from –	перешкоджати чому-небудь
to avert –	відводити; запобігати

Weather or Not

Weather has always intrigued human beings and inspired them to defy nature and try to predict the unpredictable. For centuries farmers watched clouds to determine whether rain was on its way. Mariners studied the changing sky and the drift of the clouds to predict wind directions and storms. Today, the science of meteorology is very complex. It involves gathering information from instruments that measure temperature, air pressure, wind velocity, degree of sunshine, cloudiness, and precipitation. Satellites and electronic computers make it possible to monitor weather information around the world. By studying all the information that is accumulated, the meteorologist determines the general weather pattern over the past few days and makes a prediction about the next few. Weather forecasting, of course, is still not infallible, and may never be.

All weather changes are brought about by temperature changes in different parts of the atmosphere. The sun controls our lives and our weather as it radiates energy to the earth. The areas of the earth near the equator get more heat from the sun than do those near the North and South Poles. The warm air near the equator expands and rises, moving toward the poles. As it cools, it sinks, replacing the cool air on the surface that has moved toward the equator to replace the rising warm air. This

unequal heating of the earth causes north and south winds. East-west winds are caused by the rotation of the earth.

Atmospheric pressure, as measured by a barometer, is another indicator of the weather. The amount of water vapor in the air is another predictor. Warm air can dissolve more water than cold air, just as hot tea dissolves more sugar than iced tea. The point at which the air cannot hold any more water is called the saturation point. On a warm day, if the air is saturated with moisture and the temperature drops, the excess water is squeezed out of the air. We see this moisture appearing as dew, fog, or clouds. If sufficient water it, squeezed out, we have rain or, at temperatures below the freezing point, snow.

Today there is a threat to the earth's climate from man-made chemical wastes. Meteorologists have known for a long time that the earth passes through cycles of warming and cooling. The earth has been gradually warming since the last ice age occurred about 18,000 years ago. Recently, however, scientists have become aware of the fact that our technical/industrial civilization may be causing changes in the earth's atmosphere that could alter the weather and that these changes could be very dangerous and irreversible.

One problem is ozone depletion. The stratosphere, or upper atmosphere of the earth, contains a layer of ozone gas that protects the earth from the sun's harmful ultraviolet rays. Recently, ozone concentrations over Antarctica have been dropping at an alarming rate. Researchers have determined that a group of man-made chemicals called chlorofluorocarbons are rising from the earth and destroying the ozone.

A second problem is the so-called greenhouse effect. Carbon dioxide in the atmosphere functions like the glass in a greenhouse, screening out excessive infrared rays and acting as an insulator to prevent heat from escaping at night. Without the protection of the atmosphere, temperatures on the earth could reach the extremes they do on the moon. If we continue to burn fossil fuels, the level of carbon dioxide in the air may increase to the point where it will blanket the earth and cause it to warm to a dangerous level.

It remains to be seen whether this warming trend will continue and, if so, whether scientists will be able to do something about it in time to avert disaster in the next century.

Distinguishing Fact from Opinion

Indicate whether each of these sentences represents a fact or an opinion.

1. Weather has always been of interest to men and women.
2. Mariners used to forecast the weather by studying the sky.
3. The science of meteorology is fascinating.
4. Weather forecasts are a waste of time because they are usually wrong.
5. Weather forecasting will never be infallible.
6. The sun controls our lives.
7. The earth's rotation causes winds.
8. Atmospheric pressure is an indicator of the weather.
9. The earth passes through warming and cooling cycles.
10. Scientists will never be able to control the weather.

11. Human beings will never be able to eliminate ozone pollution.
12. Once the earth's climate changes, it cannot be reversed.

Translating

Translate into English:

A

1. Дослідники довели, що Земля кругла, ще у 15–16 сторіччі.
2. Античні греки спостерігали, як кораблі сходили за горизонт.
3. Як крутиться Земля?
4. Усе навколо нас рухається з однаковою швидкістю.
5. Коли буває день, а коли – ніч?
6. Вітер не загасить сірник у літаку, якщо його запалити.
7. Що викликає різні пори року?

B

1. Погана погода надихала вчених на спроби передректи те, що передбачати неможливо.
2. Нам потрібно зібрати інформацію про тепличний ефект.
3. Вимірювання температури та тиску треба здійснити негайно.
4. Прогнозування погоди повинно здійснюватися за допомогою точного обладнання.
5. Тепле повітря розчиняє більш води, ніж прохолодне повітря.
6. Крапка насичення – це межа, за якою повітря не може тримати більше води.
7. Зміни погоди, що викликані технічним прогресом, бувають необоротні.
8. Шар озону захищає Землю від ультрафіолетових променів.
9. Ця речовина перешкоджає теплоті зникати вночі.
10. Вчені матимуть зробити щось, що відведе екологічну катастрофу.

Discussion Points

Using English to Express Incredulity:

Here are some useful ways of expressing incredulity of some facts.

Is there any proof that…?
I find that very hard to believe.
You don't honestly believe that…
You can't really expect me to believe that…?
That's incredible!
Oh, come on!
It is unbelievable!
Oh, come off it!
That's amazing!
They must be joking!

Memorize the following expressions and use some of them when you refuse to believe some information obtained from the texts of this unit.

UNIT 13
INTRODUCTION TO THE SCIENTIFIC METHOD

The material you have studied was focused on science language to prepare you to understand college-level science material and to participate in scientific research and in basic scientific courses. Let us summarize the *basic stages of any scientific research*.

1. Classifying

The early stages of scientific research involve making observations and gathering information. However, merely collecting facts is not enough. The scientist needs to arrange and classify the facts and to find relationships among them.

The word *classification* comes from the word *class* – meaning a group of things that all have one important element in common. Scientists group related information into an array. Chemists, for example, cannot study every element, but can make generalizations by arranging all the elements into groups with related properties. Thus, if iodine is identified as belonging to the same group as chlorine and bromine, its properties can be predicted. Similarly, since there are several million kinds of plants and animals on earth, it is clearly impossible to study each one. However, by classifying an animal as a member of a particular group, or species, a biologist can predict its characteristics. Classification is thus very basic to scientific thought and expression.

A classification includes:

a. a general class,
b. a specific item,
c. a basis for classification

2. Comparing

Scientists try to organize information by seeking relationships. Classification is one way of arranging information. Comparing is another. Comparisons not only arrange information but also expand it. When prehistoric human beings noticed that wood burns and stone does not, they were making an important step toward advancing scientific knowledge. Often comparisons enable us to solve problems. For example, to determine which substance to use for electrical wiring, various metals are compared for electrical conductivity, cost, availability, and the like.

Comparisons provide a new perspective on information. For example, the fact that an ant can carry a crumb of bread only becomes impressive when the crumb is discovered to be three times the weight of the ant. The fact that water expands when it becomes solid is more interesting when comparisons show that all other liquids contract, or take up less space, as they solidify. It was a comparison of the habits of lung cancer victims with those of the general population that led to the discovery of a link between smoking and lung cancer. Comparisons are thus a part of every aspect of science.

3. Cause and Effect

The process of seeking relationships among scientific facts includes looking for cause and effect. The fifth-century BC Greek philosopher Leucippus suggested that there is causality in nature, that is, that every natural event has a natural cause.

All science is based on this assumption. For example, something causes apples to fall, planets to stay in their orbits, the sun to emit energy, and a baby to be born with a defect.

Scientists must be careful, however, not to assume that one event caused another just because they happened in sequence. If there is an earthquake the day a comet passes near the earth, it cannot be assumed that the two events are related.

Sometimes the effect of one occurrence becomes the cause of a second event, and the effect of the second becomes the cause of a third. A nuclear reaction is an example of this kind of causal link. As one uranium atom is split, it releases neutrons that in turn split other uranium atoms. The result is a continuous chain reaction of causes and effects. It is the job of science to connect situations and events and thereby discover the how's and why's of our world.

4. Hypothesizing

When a scientist discovers a relationship that seems to hold true without exception, he or she formulates a *hypothesis.* A hypothesis is a tentative or temporary solution to a scientific problem or an explanation for why something happens. Although a hypothesis usually develops from the intuition of the scientist, it is based on observations or facts. For example, Charles Darwin's hypothesis about evolution came to him while he was riding in a carriage (he wrote, "I can remember the very spot in the road"), but the idea was the product of many years of study and experimentation.

A hypothesis does not always prove to be correct, and it may have to be rejected altogether or at least revised. Progress involves continually refining hypotheses as new information comes to light. For example, since no one has ever seen the structure of an atom, scientists continually revise their hypothesis about what it looks like.

As evidence is gathered to support a hypothesis and it becomes accepted in the scientific world, it is referred to as a *theory* (for example, the theory of relativity). When a theory explains or unifies a great deal of information, it becomes known as a *principle,* or *natural law* (for example, Archimedes' principle of water displacement or the law of gravity).

5. Defining

When making a hypothesis or other statement, scientists must make sure they are understood by other researchers. Misunderstandings occur when there are different concepts of what is being discussed.

A definition answers the question, "What is it?" Sometimes a definition is necessary because a word or concept has more than one meaning. For example, whether carbon is a metal or nonmetal depends on how you define carbon. At other times, a definition is required because a term is being used in a special way. For example, physicists use the terms *work* and *energy* in ways that are more specific than their common meanings. A definition should be complete enough to include all the items in the category yet narrow enough to eliminate items that do not belong. The Greek philosopher Plato once defined man as a two-legged creature that has no feathers. His critic Diogenes left the room and brought back a bird without feathers, declaring, "Here is Plato's man!" The problem with Plato's definition was that it did

not distinguish a man from other two-legged creatures without feathers. Communication between researchers is dependent on precise definitions of substances, concepts, processes, and ideas.

6. Exemplifying

After giving a definition or making any general statement, the best way to clarify a point is to give an example of it. A Chinese proverb says that a picture is worth a thousand words. It might also be said that one example is worth a thousand explanations. An example brings the general or abstract statement down to a specific or concrete image. For example, it is one thing to say that smoking is bad for your health and another to say that a regular smoker loses about five and a half minutes of life expectancy for each cigarette smoked. The example adds impact, making the statement more memorable, more interesting, and more persuasive, as well as providing evidence for it.

Scientists use examples to explain or clarify a concept and to give evidence to support it. Examples can sometimes serve to test the validity of a point. If no example can be found to illustrate a point, there may not be a point.

***7.* Giving Evidence**

Once a hypothesis has been proposed, the question is always asked, "Where is the evidence?" The British scientist Sir Humphry Davy once burned diamonds into graphite, ignoring the expense, to demonstrate that diamonds and graphite are both crystallized carbon. He made his point.

Proof or evidence is usually the result of observation or experimentation, combined with reasoning. The theories that are accepted are those with the most supporting evidence. In the second century, Claudius Ptolemy proposed that the planets and the sun revolved around the earth. His theory was accepted because it predicted the position of the planets with some accuracy. But all "proofs" are tentative, to be discarded when another theory emerges that explains more facts. Thirteen centuries later, the Polish scientist Nicolas Copernicus "proved" that the planets revolve around the sun by demonstrating that his theory explained things that Ptolemy's theory could not, like the seasons of the earth and the retrograde or backward motion of the planets. Then, in 1905 Albert Einstein shook everyone up by saying that motion is relative and that whether the sun is moving or the earth is moving depends on your point of view! And on and on we go, always striving to get closer and closer to the truth. But scientific theories can seldom be proven beyond a doubt. After all, no one can stand far enough out in space to observe the planets revolving around the sun!

8. Experimenting

The ancient Greek philosophers obtained their knowledge about the universe from reasoning and logic. But Galileo's experiments proved that Aristotle's reasoning was not always valid. Since then, no scientific concept is accepted unless there is evidence to support it.

When testing a hypothesis, every effort is made to eliminate subjective or biased ideas. If experiments do not support a hypothesis, the hypothesis must be rejected or modified. The twentieth-century writer-scientist Isaac Asimov wrote that

even though billions of observers tend to bear out a generalization, a single observation that contradicts or is inconsistent with it must force its modification.

Sometimes an experiment proves something other than what the researcher intended. Many great discoveries were accidents of an experiment. In 1929, for example, the Scottish researcher Sir Alexander Fleming noticed that some bacteria had been destroyed by a mold. He had accidentally discovered penicillin. In 1895, the German scientist Wilhelm Roentgen noticed that cathode rays penetrated black paper. Thus X-rays were discovered. While experimenting, the scientist needs to keep a sharp eye and an open mind.

9. Calculating

To a large extent, mathematics is the language of science. The accuracy of predictions depends on the accuracy of the measurements and computations used in experimentation. We have come a long way since *ancient times, when mathematics* was regarded by some, like Plato, as mysterious or supernatural; when numbers like seven or thirteen were thought to have magical powers for good or bad luck; and when members of certain brotherhoods were put to death for revealing mathematical "secrets" that are common knowledge today.

Mathematics gives precision to science. Our calculations tell us, for example, not merely that light travels fast but that it travels at a speed of 186,000 miles per second. We know not just that bacteria are so small that they are invisible but also that several hundred thousand bacteria could fit on the period at the end of this sentence. Scientists calculate everything from the number of atoms in a gram of hydrogen to the heat of the sun; from the width of a galaxy of stars to the number of calories in a granola bar; and from the date when living things first appeared on the earth to the time when our sun will expire.

10. Describing

A description serves to introduce a scientist's view of the world. It may describe conditions, results of an experiment, chemical changes, physical movements, or what is seen through a telescope or microscope. A description may also tell the characteristics or distinctive features of an object – how it looks, sounds, tastes, smells, works, or is produced.

The nature of something can be explained by describing it. For example, the concept of an atom is difficult to grasp from a definition alone, but a description of its appearance, detailing its structure and function, makes it easier to visualize.

11. Predicting

The goal of all scientific investigation is to predict the future, and is based on the assumption that what we can predict, we can protect ourselves against. Consider, for example, the number of lives that could be saved by the prediction of natural disasters such as hurricanes, earthquakes, and volcanic eruptions.

Prediction is a part of every field of science. The chemist who develops a new drug must be able to predict its effects – both good and bad – on the human body. The engineer who designs a rocket must be able to predict the effects of adverse weather on the vehicle. The astronomer needs to predict the orbit of a comet, and the biologist must predict the likelihood of a particular child inheriting hemophilia or another genetically linked disease.

Some events can be predicted quite accurately; an eclipse can be calculated to a fraction of a second. Others can only be predicted in terms of probability; the forecast may announce a 25 percent chance of rain tomorrow. However, no prediction of the future behavior of nature is 100 percent certain. The scientist must always be ready to adjust and refine predictions based on new observations.

Discussion Points

Speaking Activities:

Revise the basic stages of scientific research:

1. Classifying:

Answer the following questions:

a. How might you classify the students in your group?
b. What are of some ways you could classify books, people, academic subjects, music, cars?
c. What types of classification might interest a biologist, a physicist, a chemist?

2. Comparing:

a. Compare a computer and the human brain. Computers have been programmed to translate from one language to another, to play chess, and to solve complex mathematical problems. Will they ever be able to think? Will they be able to analyze, evaluate, make decisions, and make judgments? Will they be able to design, imagine, create?
b. Compare a sport game that is popular in your country with one that is popular in another one.
c. Compare the foods of two countries you know. Why are they different?
d. Compare an American car with one from another country. Consider their power, reliability, comfort, cost, appearance, and workmanship.

(Notes: to compare items begin with the similarities and then point out the differences. In what specific ways are they different?)

3. Cause and Effect:

Answer the following questions:

a. What are some of the beneficial effects of the technological advances in science in this century?
b. What are some of the harmful effects of modern technology?
c. What are some of the effects of space exploration?
d. What causes people to travel into space?
e. What might be the effects on earth of the discovery of life on another planet?
f. What are the possible effects of a continued expansion of world population?
g. What are some possible effects of a fuel shortage?
h. What are the effects of the computer on your life?

4. Hypothesizing:

a. Form a hypothesis to explain why some students succeed in their school work while others, with equal ability, fail.
b. Form a hypothesis to explain why some students experiment with drugs.
c. Form a hypothesis to explain why some people do not wear seat belts in their cars.
d. Form a hypothesis to explain why many drivers go faster than the speed limit.
e. Form a hypothesis to explain why some students although honest will cheat on a test.
f. Form a hypothesis to explain why some students seem to make friends easily while others do not.

(Notes: your conclusion might be a topic sentence; the rest of the paragraph should support the hypothesis giving reasons for your opinion; a concluding statement relates the significance of what you have stated.)

5. Defining:

a. Give an extended definition of a simple instrument or device such as a compass, fever thermometer, electric fan, pencil sharpener, flashlight, calculator, or toaster.
b. Your topic sentence should be a formal definition – the class plus distinguishing characteristics (for example, *a thermometer is a device for measuring temperature)*.
c. The rest of the paragraph should include additional characteristics such as
    a. a description of its appearance, such as its shape, size and color.
d. A description of what it is made of.
e. An explanation of its principle of operation or how it works.
f. A good way to conclude this type of definition is to describe its uses.

6. Exemplifying:

Give one or two examples of the following. Explain your answers.

a. Scientific facts that still amaze you.
b. Machines you would not want to live without.
c. Machines you wish had never been invented.
d. Scientific discoveries you would like to have witnessed.
e. Things you would like someone to invent.
f. Places you would like to explore.
g. Things you think scientists will never know.

7. Giving Evidence:

Be prepared to give your opinion on one of these topics. Offer evidence for why you think so.

a. Should advertising for alcohol be banned?
b. Should students be expelled from high school for using drugs on campus?
c. Should people convicted of drunken driving have their licenses taken away?
d. Should marijuana be legalized?
e. Should the minimum age for drinking be changed?

f. Should smoking be banned from public places?

8. Experimenting:

Give verbal directions to complete some procedure. You might want to choose from the following suggestions:

a. Play a game from another country.
b. Cook a dish from another country.
c. Perform an experiment not discussed in this class.
d. Make something by hand.
e. Perform an activity such as repairing a radio or developing film.

(Notes: plan your talk carefully so that all necessary steps are included)

9. Calculating:

Answer the following questions:

a. What are some things that a biologist needs to calculate? an astronomer? a chemist? a physicist? a geologist?
b. What could you measure or calculate in your classroom? (Think beyond linear measurements to such things as weight, volume, temperature, size and humidity.)
c. Some people have suggested that we use the decimal system because we have ten fingers. Suppose we had the same number of limbs as an octopus or a three-toed sloth? What kind of numbering system do you think we might have?
d. The ancient Hindus developed the concept of zero, which was later adopted by the Arabs. Why was that concept so important?
e. Why do you think some ancient people believed mathematics to be mysterious? Why do you think certain numbers were considered magical?

10. Describing:

Identify each item from these brief descriptions:

a. a nonmetallic element used to make computer chips,
b. a poisonous gas produced by the incomplete burning of gasoline that pollutes the air,
c. a drug-stimulant found in coffee and cola drinks,
d. a natural fiber, comes from a four-legged animal,
e. a metal that is liquid at room temperature,
f. black, soft, crystalline, a form of carbon (look at your pencil),
g. a plant, the most abundant form of life, some are harmful, some are harmless, invisible without a microscope, your body is full of them,
h. called the red planet, it has polar caps and seasons, located between the earth and Jupiter,
i. elastic substance, comes from the latex of trees, vulcanized (or heated with sulfur) to make it tougher

11. Predicting:

Use your imagination to make some predictions about the twenty-first century:

a. scientific discovery that will be made;
b. something that will be invented;
c. the transportation will be different;
d. the communication will be different;
e. the clothes men and women will wear;
f. the buildings will be different;
g. the way of getting education will be different

Using English to State Intention:

Here are some useful ways of stating our intentions and showing how firmly we intend to do something. Nothing is totally certain about the future. We can try to foresee events and make plans, state our intentions but we can never be sure what will actually happen

a. ***Yes, definitely:*** Nothing's going to stop me from … -ing…
I'm sure going to…
I'm certainly going to…
I'm going to…, that's for sure.

b. ***Yes, probably:*** I think I'll…
I may…
I'm hoping to…
I'd like to…

c. ***Perhaps:*** I'm thinking of…-ing…
I thought I'd…
I thought I might…
I haven't made up my mind if I'm going to…or…

d. ***No, probably not:*** I don't think I'll…
I don't really feel like…-ing…
I'm not really planning to…

e. ***No, definitely not:*** I'm certainly not going to…
You won't catch me…-ing…
I'm not going to… if I can help it.
I'm definitely not going to…

Memorize the following expressions and use some of them to express your intentions concerning your participation in scientific research courses in future.

ДОДАТКИ

Sentence Pattern 1

CLASSIFYING FROM GENERAL TO SPECIFIC

Matter	<	is/are may be can be could be	< classified grouped divided arranged categorized	> into	>	divisions groups types classes categories classifications

	<	classified categorized classed grouped	> as	>	solid liquid or gas

There are three	<	types kinds classes categories	>	of matter

.

CLASSIFYING FROM SPECIFIC TO GENERAL

Oxygen	<	may be can be could be is/are	>	classified classed categorized	>	as a gas.

Oxygen is	<	an example of a a type of a kind of a form of a	>	gas

Note: These sentence patterns are only samples, not a comprehensive list of all possible patterns.

ДОДАТКИ

Sentence Pattern 2

COMPARING SIMILARITIES

Magnesium is < like / similar to / comparable to / as important as > aluminum.

Magnesium < resembles / parallels > aluminum in many ways.

CONTRASTING DIFFERENCES

Iron < is unlike / is different from / differs from > aluminum. Unlike iron, / In contrast to iron, / Compared to iron, / In comparison to iron, > aluminum is light.

Iron is < heavier than / less abundant than / not as soft as > aluminum.

Iron is a < comparatively / relatively > soft metal.

CAUSE/EFFECT

A mixing of all wavelengths < causes / results in / produces / induces > a white light.

White light is < caused by / due to / induced by / a result of / produced by > a mixing of wavelengths.

When / If / As > all the wavelengths are mixed, a white light is produced.

A white light is produced < if / when / as > all the wavelengths are mixed.

ДОДАТКИ

Sentence Pattern 3

DEFINING

TERM = GENERAL CLASS WORD + SPECIFIC CHARACTERISTICS

An astronomer < is >	a scientist >	who >	studies the universe,
A barometer	an instrument	that	measures air pressure,
Conduction	a process	by which	heat is transferred,
A laboratory	a place	where	experiments are performed.

Physics < is > the study > of matter and energy.
A volt a unit for measuring electrical pressure.

TERM = SPECIFIC CHARACTERISTICS + GENERAL CLASS WORD

Mercury	< is a >	liquid >	metal.
A triangle		three-sided	plane figure.
Asbestos		fire-resistant	mineral.
A dinosaur		prehistoric	reptile.
A monkey		small, long-tailed	primate.

EXEMPLIFYING

For example, > iron turns red when it is heated.
For instance,
To be specific,
To illustrate,

Iron, < for example, > turns red when heated.
for instance,

Iron is < an example > of a substance that turns red when heated.
a case
an instance
an illustration

Iron < exemplifies > the concept of heat affecting color.
illustrates

The concept of heat affecting color is < exemplified > by iron.
illustrated

Solids < such as > iron and copper turn red when heated.
like

ДОДАТКИ

Sentence Pattern 4

REPORTING

REPORTING A COMPLETED ACTION IN PAST (SIMPLE PAST TENSE)

Darwin < published / announced / proposed > his theory of evolution in 1859.

REPORTING A COMPLETED ACTION (PRESENT PERFECT TENSE)

Biologists / He/She < already > made / just > new discoveries.

REPORTING AN UNCOMPLETED OR RECENT ACTION
(PRESENT PERFECT TENSE)

Biologists / He/She < have / has > recently / not yet / still not / often > made > new discoveries.

REPORTING AN ACTION COMPLETED BEFORE A GIVEN TIME
(PAST PERFECT TENSE)

By the time we < arrived >, the bomb < had exploded >.
By 1957 Russia < had launched > the first Sputnik.

REPORTING A CONTINUOUS ACTION
(PAST CONTINUOUS, PRESENT PERFECT CONTINUOUS, AND PAST PERFECT CONTINUOUS TENSES)

Darwin < was working > on his theory while in the Galapagos.

The universe < has been expanding > for 15 billion years. / since its inception.

Darwin < had been riding > in his carriage, when the idea came to him.

NOTE: When reporting, remember that the continuous past tenses do not frequently occur in scientific writing.

ДОДАТКИ

Sentence Pattern 5

DESCRIBING CHARACTERISTICS

The Nile River	>	is	<	4,145 miles	>	long.
Mount Everest				8,848 meters		high.
The Dead Sea				11 miles		wide.
The pipe				3 centimeters		thick.

The Nile	>	has	a <	length	>	of	<	4,145 miles.
The sun				surface temperature				11,000° F.
The Grand Canyon				depth				5,500 feet.
Lead				specific gravity				11.3.
An elephant				life span				about 75 years.

The	<	length	>	of	<	the Nile	>	is/are < 4,145 miles.
		color				iodine		purplish black.
		texture				sand		rough and granular.
		orbits				planets		elliptical.
		shape				earth		spherical.

Pluto	>	is/are	<	relatively	>	< small.
Glass				somewhat		brittle and transparent.
Zinc and cadmium				rather		reactive and silvery.
Blue stars				extremely		hot.
Copper salts				slightly		blue in aqueous solutions.

Note: The present simple tense is used most frequently when describing because descriptions in science are usually universals. The most commonly used verbs are to be and to have.

ДОДАТКИ

Sentence Pattern 6

PREDICTION

Active: There < will be > an eclipse tomorrow.

Passive: The eclipse < will be hidden > by the clouds.

PROBABLE PREDICTION

Active: If it rains, we < will get wet >.

Passive: If the eclipse is hidden, the photos < will be ruined. >.

HYPOTHETICAL PREDICTION

Active: If I studied, I < could / would / might > pass.

Passive: If the eclipse were hidden, the photos < could / would / might > be ruined.

IMPOSSIBLE PREDICTION

Active: If I had studied, I < would / could / might > have passed.

Passive: If the eclipse had been hidden, the photos < would / could / might > have been ruined.

Notes: The future tense with <u>will</u> is used for predictions that are likely to occur. The modals <u>would</u>, <u>could</u>, or <u>might</u> are used for hypothetical or impossible predictions. With <u>if</u> clauses the subjunctive form <u>were</u> is used instead of <u>was</u> (for example, <u>If</u> <u>I</u> <u>were</u> <u>rich</u> . . .). Any prediction that is based on a past condition cannot be fulfilled (for example, If the war had ended a year earlier, many lives would have been saved.).

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