Instructor's Manual

English For Science

FRAN ZIMMERMAN

INSTRUCTOR'S MANUAL
English for Science

Министерството на образованието и науката препоръчва този учебник за учениците от гимназиите със засилено изучаване на английски език, с математически и природо-математически профил.

Учебникът ще подпомогне успешното усвояване на терминологията в областта на природо-математическите науки.

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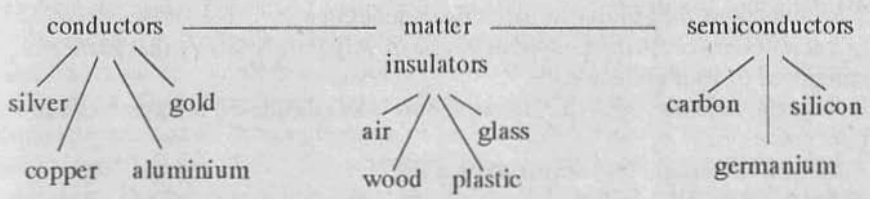
TABLE OF CONTENTS

CHAPTER 1
ANSWER KEY

Identifying General and Specific Ideas

1. copper, lead, mercury, silver; nonferrous substances
2. steel; alloy
3. compounds; acids, bases, salts, metallic oxides
4. deer; mammal
5. Carbon; graphite, diamond, amorphous
6. Rocks; igneous, metamorphic, sedimentary
7. Coffee, tea, paint; colloids
8. Coal, wood, oil; fuels
9. Salts; inorganic compounds
10. nucleic acids; deoxyribonucleic acid, ribonucleic acid

Transferring Information



Completing Sentences (Answers will vary)

1. categories
2. divided, classes
3. type
4. classed
5. grouped, classifications
6. classified
7. categorized
8. kind

Changing Active Voice to Passive Voice

1. Sulfur is extracted from volcanic rock.
2. The electric battery was invented by Luigi Galvani in 1786.
3. The American space shuttle program was temporarily suspended after the accident in 1986.
4. The Panama Canal was completed in 1914.
5. Many people were killed by the 1986 earthquake in Mexico City.
6. Nitrogen can be extracted from the air by liquefication.
7. Bacteria is destroyed by the white corpuscles in the blood.
8. The craters on the moon were probably caused by meteors.
9. Simple, one-celled plants and animals are sometimes classified together.
10. Artificial intelligence may be defined as the capacity of a computer to imitate human reasoning.

Using the Passive Voice

1. are expelled
2. were calculated
3. was discovered
4. was produced
5. is manufactured
6. is called, are needed
7. is controlled
8. was proposed

Vocabulary in Context (reading skills)

1. a
2. a
3. a
4. b
5. a
6. a
7. b
8. a
9. a
10. b
11. b
12. a

Understanding the Reading (Answers will vary)

1. Atoms are even smaller than molecules.
2. The concept of the atom originated in ancient Greece.
3. In ancient Greece, many people believed in Aristotle's theory that matter is composed of four elements.
4. During the Middle Ages, the atomic theory was considered too abstract and was rejected.
5. John Dalton thought that atoms were solid.
6. The size of the nucleus inside an atom is comparable to the size of an ant on a football field.
7. Atoms consist mainly of space with a densely packed nucleus.
8. Neutrons have no electric charge.
9. Each atom is neutral because the number of its protons equals the number of its electrons.
10. Niels Bohr proposed a model of the atom with the electrons revolving around the nucleus.
11. Electrons are kept in their paths by the force of attraction between the protons and the electrons.
12. The atomic number of an element is the number of electrons.
13. All the atoms of an element are the same.
14. The atoms of each element are unique.
15. The hydrogen atom is the most common atom in the universe.

Vocabulary in Context (listening skills)

1. a
2. a
3. a
4. b
5. a
6. b
7. b
8. a
9. b
10. b
11. a
12. a
13. a

Using Your Notes to Classify

1. M
2. C
3. C
4. E
5. C
6. M
7. M
8. E
9. C
10. E
11. C
12. E

LECTURE:

The Chemistry of Matter

We read earlier in this chapter that matter may be classified according to its physical state as solid, liquid, or gas. But there is another way to classify matter. Scientists classify matter on the basis of chemical composition as elements, compounds, and mixtures.

Elements are the basic substances that cannot be decomposed or broken down into simpler substances by ordinary chemical means. What are these basic substances?

Some of the earlier Greek philosophers, including Aristotle, believed that the four basic elements that all things are made of are earth, fire, air, and water. But these ancient Greeks were philosophers, not scientists, and as such they speculated but did not experiment. During the Middle Ages, the alchemists secretly experimented with metals. Finally in the 18th century, the early chemists disproved the theory of the four elements when they determined that water was composed of hydrogen and oxygen, and air composed of nitrogen and oxygen. After that, many other substances were determined to be elements, and they were categorized as metals and nonmetals. Metals include copper, silver, gold, iron, and lead. Nonmetals include solids, such as carbon and sulfur, and gases, such as oxygen, hydrogen, nitrogen, and helium.

The list of elements grew and scientists looked for a pattern in order to understand their behavior. In 1869, the Russian chemist Dmitri Mendeleev organized all the known elements, according to their weights and properties, into a table called the periodic table of the elements. To date, 92 natural elements have been identified. Several others, such as plutonium, have been produced artificially. Many of these are extremely rare. One of the interesting facts of science is that almost all matter - including the seas, people, plants, the earth - is created from about 20 common elements.

Most common substances are not elements, but compounds of elements. A compound is a substance that is made up of two or more elements that cannot be separated by mechanical means. For example, water can only be separated into hydrogen and oxygen by a process known as electrolysis. Salt, sugar, alcohol, benzene, and sulfuric acid are other examples of compounds. Each compound has more than one type of atom within each molecule, and a compound has characteristics that are distinct from the characteristics of its constituents. For example, when two atoms of hydrogen combine with one atom of oxygen, an entirely new substance is formed - H_2O, or water! Salt is a compound of sodium which is an active metal, and chlorine, which is a poisonous gas. Yet salt has none of the

characteristics of either of these two elements, fortunately. Compounds have a constant or invariable composition. For example, any sample of water contains the same proportion of hydrogen and oxygen. This is called the law of definition composition.

Substances which are not homogeneous, or uniform in composition, are called mixtures. Air is essentially a mixture of nitrogen and oxygen. Soil, cement, wood, rocks, and food products are categorized as mixtures. The constituents of a mixture may exist in different proportions. For example, a cake may be prepared with different proportions of flour, butter, eggs, and sugar. Also, each ingredient in a mixture retains its identity. If there is sugar in the cake, the cake will taste sweet.

CHAPTER 2
ANSWER KEY

Understanding Comparisons

1. chromium
2. platinum
3. copper
4. gold
5. zinc
6. sodium
7. mercury

Using a Table

1. b
2. b
3. a
4. b
5. a
6. a
7. a
8. b

Creating Sentences (Answers will vary)

1. The surface temperature of Mercury is lower than that of Venus.
2. The life span of kangaroo is less than that of cat.
3. An egg has almost the same amount of calories as an apple.
4. The diameter of the earth is about four times the diameter of the moon.
5. Elephants have a longer gestation period than giraffes.
6. The Pacific Ocean has more than twice as much water as the Atlantic Ocean.

Creating Comparisons (Answers will vary)

1. Telescopes and microscopes are instruments that are used to see objects not visible to the naked eye. Telescopes are used for distance and microscopes for things too small to see.
2. Submarines and dolphins both function underwater. Submarines are ships and must be controlled by human beings; dolphins are living things.
3. Computers and calculators are both electronic devices that process information. Computers can be programmed; calculators cannot. Calculators perform arithmetical processes. Computers are more complex and process all kinds of information.
4. Deserts and jungles are both found in hot climates. Deserts are arid regions with few living things. Jungles are wet, tropical regions that are dense with plants, animals, birds, and insects.
5. Photocopiers and x-ray machines both reproduce images. Photocopiers reproduce the surface of something; x-rays penetrate a solid substance and reproduce the inside.

Like and As

1. like
2. as
3. as, as
4. like
5. like
6. as, as
7. as

Vocabulary in Context (reading skills)

1. b	6. b	11. a	16. a
2. a	7. b	12. a	17. a
3. a	8. b	13. b	18. a
4. a	9. a	14. a	19. a
5. b	10. b	15. a	20. b

Skimming

1. c
2. d

Understanding the Reading (Answers will vary)

1. Oxygen, nitrogen, and hydrogen have similar properties and all three are essential to life.
2. The substance that causes wood to rot is the same as the one that causes apples to turn brown.
3. The decaying of food is an example of slow oxidation.
4. It is possible for the fire to start spontaneously.
5. Human beings cannot live more than five minutes without oxygen.
6. Nitrogen converts to a free state by a process called nitrogen fixation.
7. In contrast to oxygen, nitrogen is comparatively inactive.
8. If the air were pure oxygen, smoking would be impossible.
9. Nitrogen is used in explosives because it is unstable.
10. Hydrogen is the most abundant element in the universe.
11. The sun is almost pure hydrogen.
12. Hydrogen is the most abundant element in our bodies because our bodies are mostly water.
13. In contrast to hydrogen, helium is nonflammable.
14. The essential ingredient in fertilizers is nitrogen.

Vocabulary in Context (listening skills)

1. a	6. a	10. b
2. a	7. b	11. a
3. a	8. b	12. b
4. b	9. b	13. b
5. b		

Understanding the Lecture

1. T	6. T	10. F
2. F	7. T	11. F
3. F	8. T	12. T
4. F	9. T	13. F
5. F		

LECTURE:

The Precious Metals

Why are some metals so much more valuable than the others? Gold, silver, and copper are metals that have been valued for thousands of years for their beautiful luster, their scarcity, and their usefulness. During the Middle Ages, alchemists searched for a way to change base metals, like lead, into gold. They thought that if they could find the right formula, they could, for example, add a certain amount of mercury to lead and produce gold. Even the great Sir Isaac Newton believed it could be done! Why is gold so valuable?

Gold is the most malleable of all the metals. It can be hammered into sheets so thin that 250 of them would equal the thickness of a sheet of paper. It is also the most ductile metal. One gram of gold can be drawn into a wire 1.8 miles in length!

Gold is the least chemically active of all the metals and does not combine with oxygen to form rust. This ability to resist corrosion makes it very durable, i.e. it may last for centuries. Pure gold is too soft to be used in jewelry so it is usually alloyed with other metals. The proportion of gold in an alloy is measured in karats. Pure gold is 24 karats. A 14 karats gold ring is an alloy of about 58% gold and small percentages of copper and silver.

Silver is similar to gold in many ways. Like gold, it is very malleable and ductile and so it is also used for jewelry. Silver differs from gold in that it is more reactive and tarnished when exposed to the traces of sulfur in the air. (Silver sulfide, a black deposit, forms on its surface.) Pure silver is too soft and so it is usually alloyed with copper to increase its hardness and durability. Sterling silver is 92.5 percent silver and 7.5 percent copper. Silver is used for coins and for photographic film because certain compounds of silver, such as silver bromide, reflect light. Silver is the best conductor of electricity known.

Copper was one of the first metals to be widely used. The properties of copper resemble those of silver and gold. Copper is used for electric wiring because it is very malleable, extremely ductile, an excellent conductor, and less expensive than silver. One of the principle uses of copper is to produce alloys. Pure copper is inadequate for tools and machine parts because it is too soft. When alloyed with tin, however, it produces bronze which is harder than either copper or tin; when alloyed with zinc it produces brass; and when alloyed with steel, it increases the resistance of steel to corrosion. Copper, like gold and silver, is a beautiful and precious metal that has been used for ages to produce coins, jewelry and ornaments.

CHAPTER 3
ANSWER KEY

Identifying Cause and Effect

1. copper is heated to 1083°C, it melts
2. Changes occur in plants, they absorb energy from the sun
3. The rotation of a compass needle, the earth's magnetic field
4. Ashes, the burning of wood
5. Acids, turn litmus paper red
6. Rubbing a comb with a cloth, a negative electric charge
7. Fast moving charged particles, the ionization of atoms
8. The ocean's tides, the gravitational pull of moon
9. The more iron is exposed to moist air, the more it rusts
10. Color, the reflection of light.

Understanding Paraphrases

1. b
2. b
3. a
4. a
5. a
6. b

Recognizing Subordination

1. No one was killed, because
2. When, iron becomes rust resistant
3. Even when, water will not decompose
4. The gas pressure increased, because
5. When, the earth's magnetic field may have been reversed
6. As, the rate of a chemical reaction increases
7. Neon gives off light, when
8. If, it condenses directly to a solid

Using Subordination (Answers will vary)

1. When mercury is heated to -38.9°C, it melts.
2. No sound can be heard if a bell is struck in a vacuum.
3. Chlorophyll disintegrates, causing leaves to turn red, yellow, and orange.
4. An echo is heard when a sound wave reflects off a mountain.
5. Ions are formed as an acid is dissolved in water.
6. If a lens is too thin or an eyeball is too short, a person becomes farsighted.

Recognizing Cause and Effect in a Paragraph

1. Dissolving the pellets in water caused them to break up.
2. Stirring the pellets speeded up the reaction.
3. The breaking of the chemical bonds of sodium hydroxide caused the release of energy.
4. The rise of the temperature of the water was brought about by the release of energy.
5. They broke into sodium and hydroxide ions.
6. It speeded the reaction.

7. A release of energy resulted.
8. It raised the water temperature.

Prefixes

1. c
2. b
3. e
4. g
5. i
6. j
7. k
8. a
9. d

Vocabulary in Context (reading skills)

1. a
2. a
3. a
4. b
5. a
6. b
7. a
8. a
9. a
10. b
11. b
12. b
13. a
14. a

Making Inferences

1. S
2. I
3. N
4. I
5. N
6. I
7. N
8. S
9. S
10. N
11. I
12. N
13. S
14. S
15. I

Vocabulary in Context (listening skills)

1. b
2. a
3. a
4. b
5. b
6. a
7. b
8. a
9. b
10. b
11. a
12 a

Understanding the Lecture

1. T
2. F
3. T
4. T
5. F
6. F
7. T
8. F
9. T
10. F
11. T
12. F

LECTURE:

The Music of Sound

Why does a guitar sound different from a clarinet? And why do both sound different from a trumpet or a piano even when the note is sounded on all four instruments? The answer can be found in an explanation of how sound is produced.

Sound is produced by vibrations in the air and it travels in waves. When a hammer strikes a nail, they both begin to vibrate. The vibrations push the molecules in the air and produce waves. These sound waves move in every direction in increasingly larger circles. When the waves reach the ear, the ear drum vibrates and nerves send a message to the brain that we hear as sound.

The speed at which sound travels is determined by the medium through which it passes. Sound travels very fast in a solid substance, slower in a liquid, and the slowest in the air. Sound travels in the air at 330 meters per second, much slower than the speed of light. That is why we see lightning before we hear thunder. There is no sound in a vacuum because there are no air molecules to vibrate. Next time you're in a vacuum, don't bother to turn on the radio! There is no sound without movement.

Sound is characterized by its pitch, volume, intensity, and quality. Pitch refers to whether the sound is high or low. Pitch is determined by the frequency of a sound wave (or how fast the wave vibrates). For example, a violinist produces a high pitch by shortening the violin string and causing it to vibrate rapidly. A clarinetist does the same by shortening the column of air. A long string or column of air vibrates slowly, inducing a low sound.

The volume of a sound is determined by the amplitude, or size of the sound waves. The greater the amplitude, the louder the sound. For example, when the head of a large drum is struck, it produces large sound waves which create a loud sound.

The intensity of the sound refers to the amount of energy the sound wave is carrying. Intensity is related to amplitude; the greater the intensity, the louder it seems.

The quality of the sound refers to differences in the type of sound such as the variations in the sounds of musical instruments. These are determined by the mixtures of the vibrations. Different instruments produce different combinations of vibrations. The result is that each instrument has its own tone quality. The string on a violin produces a different mixture of vibrations that the column of air on a clarinet which, in turn, produces different vibrations than the head of a drum.

Today, computers are being used, not only to recognize and simulate human voices, but even to "play" music. To synthesize a human voice, the computer vibrates a speaker cone to try to simulate the acoustical wave patterns produced by the human voice. To play a particular piece of music, the computer is programmed for the precise pitch and duration of each note. There have even been attempts to have a computer "compose" melodies by programming it to randomly select notes that follow rules of harmony and melody. So far, Mozart and Beethoven don't have to worry.

CHAPTER 4
ANSWER KEY

Identifyng Hypotheses in Sentences

1. b
2. b
3. a
4. a
5. b
6. b
7. a

Identifying Hypotheses in Paragraphs

Time, like space and motion, is relative; there is no real or absolute time.

Identifying Probability

1. seems
2. could be
3. are thought ... to be
4. suggests
5. appears
6. as far as we know
7. there is a theory
8. may

Using Models of Probability (Answers will vary)

1. The "greenhouse effect" may be warming our earth.
2. The pandas in China may be becoming extinct.
3. The ocean's tides may be slowing the rotation of the earth.
4. Quasars may be violently exploding galaxies.
5. The continents may be drifting or moving on the surface of the earth.
6. The radioactive fallout from nuclear test explosions may be harmful to the atmosphere.
7. The population of the world may be increasing at a dangerous rate.
8. Computers may be revolutionizing industry around the world.

Prefix: trans -

1. transparent
2. translate
3. transfusion
4. transistor
5. transmitted
6. transferred
7. transplants
8. transformed

Vocabulary in Context (reading skills)

1. b
2. a
3. a
4. b
5. b
6. b
7. b
8. b
9. b
10. a
11. a
12. a
13. a
14. a
15. a
16. b
17. a
18. b
19. b

Understanding the Reading

1. F
2. F
3. F
4. T
5. T
6. F
7. F
8. F
9. T
10. T
11. T
12. F
13. T

Vocabulary in Context (listening skills)

1. a
2. a
3. a
4. b
5. a
6. a
7. a
8. a
9. a
10. a
11. a

Understanding the Lecture

1. F
2. T
3. F
4. F
5. T
6. T
7. T
8. F
9 T
10. T

LECTURE:

Obeying the Law of Gravity

Earlier in the chapter, we read about Newton's studies of horizontal motion. But Newton was also interested in vertical motion. He was looking for an explanation for what holds the moon in its orbit. He reported that one day, while sitting in his garden, he noticed an apple fall from the tree. He began to speculate about how the force of gravity extends to the top of trees and even to the tops of mountains. If it extends that far, perhaps it extends all the way to the moon.

Newton had already established that an object tends to move in a straight line if no outside force acts on it. The moon does not move in a straight line, however; the moon revolves around the earth. Newton concluded that the gravitational force of the earth holds the moon in its orbit around the earth. This same gravitational pull holds the sun and the planets in their places.

Newton determined that weight is the gravitational force or pull acting on an object. If you travel to the moon, the mass of your body will be precisely the same but your weight

will be less, due to the proportionally smaller size of the moon. Similarly, if you travelled to different planets, your weight would vary with the mass of each planet in our solar system.

Newton was able to calculate the relative weights of the sun, the earth, and the planets by comparing their relative gravitational strength. The greater the mass of two bodies, the greater is the force of attraction between them. Thus, the force of attraction between the earth and a 200-pound person is greater than the force of attraction between the earth and a 100-pound person.

Gravitational force depends not only on the masses of the two bodies, but also on the distance between them. Thus, astronauts experience weightlessness on the way to the moon because they are not close enough to be affected by the gravitational pull of the earth or the moon.

Newton extended his law even further. He said that every object in the universe exerts a gravitational pull on every other object. This means that you are exerting a force on a person sitting next to you, your desk is exerting a force on your pencil, etc. If you are wondering why we don't feel this force, it is because gravity is only a strong force when a huge body, such as the earth, is involved.

Newton also explained the tides of the ocean. For thousands of years, it was noticed that there was a correlation between the ocean's tides and the phases of the moon, but no one was able to explain it. He reasoned that just as the earth pulls on the moon, the moon pulls on the earth. The gravitational pull of the moon has little effect on our land masses but it pulls on the oceans which are free to move. Thus, the law of gravity applies everywhere in the universe. The concept of universal gravity was the greatest contribution of Isaac Newton, the man many consider to be one of the greatest thinkers of all time.

CHAPTER 5
ANSWER KEY

Analyzing Definitions

1. an inert gas, that is light and nonflammable
2. one-celled, organisms
3. device, that transforms energy from one form to another
4. part of the brain, that is the center of reasoning
5. substance, that does not conduct heat and electricity
6. cloud, that forms on the ground
7. study, of the environment
8. celestial body, that orbits another celestial body

Correcting Definitions

1. Circular definition.
   Better: A scientific theory is a proposed explanation of why something occurs.
2. Lacks a classification.
   Better: An apple is a fruit that is round, red, and about the size of a fist.
3. Tells how you feel about it but not what it is.
   Better: Calculus is a system of calculation developed by both Newton and Leibniz.
4. Definition is more difficult than term being defined.
   Better: An ear is an organ of hearing.
5. Negative definition, that is, it tells what it is not, doesn't tell what it is.
   Better: A unicorn is a fictional horse with one horn in the center of its forehead.
6. Lacks both classification and characteristics.
   Better: A tornado is a type of storm with high, circular winds.
7. Lacks distinguishing characteristics.
   Better: Radium is a metallic element that is highly radioactive.
8. Describes a compass but doesn't define it.
   Better: A compass is an instrument that determines direction by means of a rotating magnetized needle.
9. Gives examples but does not define.
   Better: An amphibian is a creature that can live either on land or in the sea.
10. Circular definition.
    Better: A supernova is a star that suddenly explodes, becoming much brighter and then gradually fading.

Relative Clauses

1. Protons are positively charged particles that are contained in the nucleus of the atom.
2. A black hole is an area in space that has gravitational pull so powerful that nothing, not even light, can escape.
3. Marine biologists are scientists who study the animals and plants that live in the sea.
4. The stratosphere is the portion of the atmosphere that is over seven miles high.

5. Insulin is a hormone produced by the pancreas that is used in the treatment of diabetes.
6. Bacteria are simple forms of plant life that are the most abundant form of life on earth.
7. Oxidation is a chemical reaction that involves the loss of one or more electrons by an atom or ion.
8. Nitrogen is a colorless, odorless gas that makes up 80 percent of the air.

Formulating Definitions

1. An amoeba is a one-celled animal that constantly changes its shape.
2. An antibiotic is a drug that cures bacterial diseases.
3. A lung is an organ of breathing.
4. Acoustics is the science of sound.
5. Photosynthesis is the process by which plants manufacture food.
6. A catalyst is a substance that speeds up, but is not changed by a chemical reaction.
7. A calorie is a unit for measuring heat.
8. A cyclotron is an apparatus that bombards the nuclei of atoms.

Creating Definitions (Answers will vary but should have a classification plus distinguishing characteristics.)

1. A camera is a device for taking photographs.
2. A bridge is a structure that allows passage over a river, road, or the like.
3. An x-ray is a photograph taken through a solid substance using electromagnetic radiation.
4. A butterfly is an insect with large and frequently colorful wings.
5. Geology is the study of the physical history of the earth.
6. A diamond is a precious stone that is made of almost pure crystallized carbon.
7. An echo is the repetition of a sound caused by the reflection of sound waves.
8. A virus is a submicroscopic agent that causes disease.
9. Caffeine is a drug found in coffee, tea, and cola drinks, that acts as a stimulant.
10. An aquarium is a glass tank where aquatic plants and animals are grown.

Prefixes

1. d	4. b	7. c
2. e	5. i	8. h
3. f	6. g	9. a

Vocabulary in Context

1. a
2. b
3. a
4. a
5. a
6. b
7. a
8. a
9. a
10. a

Understanding the Reading (Answers will vary)

1. Energy can be transformed from one type to another or transferred from one body to another.
2. Kinetic energy is the energy of motion.
3. Like matter, energy cannot be created or destroyed.
4. Potential energy is the energy of position.
5. Einstein said that the conservation of matter and the conservation of energy are related.
6. Einstein's theory about the conservation of matter and energy was proved.
7. The development of atomic energy demonstrates that matter can be converted into energy.
8. When an atom is split, it gives off neutrons.
9. An atomic explosion occurs as a result of the rapid chain reaction of splitting atoms.
10. Fusion takes place on the sun when two hydrogen atoms are combined.
11. Extreme heat is required for fusion to take place.
12. Fusion produced on the earth results in a hydrogen bomb.

Vocabulary in Context (listening skills)

1. a
2. b
3. a
4. a
5. a
6. b
7. b
8. a
9. a

Understanding the Lecture

1. b
2. b
3. b
4. a
5. a
6. a
7. a
8. b
9. b
10. b

LECTURE:

The End of the Universe

We have already read that energy cannot be created or destroyed. This law of conservation of energy is also referred to as the first law of thermodynamics. However, we should never assume that we have an inexhaustible supply of energy. We constantly need more energy because whenever we use energy, we degrade that energy into some less useful form.

Energy continually runs downhill from a higher to a lower grade. This is called the second law of thermodynamics. Although energy is always conserved, it usually winds up as heat energy. For example, if you rub your hands together, they will get warm. Your muscle energy has changed to heat energy.

Heat energy is a lower form of energy. Consider what happens when you drop a rock. In your hand, the rock has a potential energy which changes into kinetic energy as it falls. When it hits the ground, its kinetic energy changes to heat energy. Heat energy is a lower form of energy because it cannot readily be transformed into useful work. When the rock was in the air, it had potential energy to do work, such as driving a stick into the ground. After the rock hits the ground, it is no longer capable of doing any work. Energy was preserved in the process, but since heat energy is a lower form of energy than potential or kinetic energy, energy is running downhill.

One sign of the degrading of energy is that heat always flows from a warmer object to a cooler one; it never does the reverse. If you put an ice cube in a hot drink, heat flows from the hot liquid to warm and melt the cube. Heat energy never flows from a cold object to a hot one, making the cold object colder and the hot object hotter. Heat energy is a low grade of energy and the lower the temperature of the object, the lower the grade of energy it contains.

The downgrading of energy is manifested in another way. Natural processes tend to proceed toward a state of greater disorder. Nothing goes from disorder to order. When you open a bottle of perfume, the molecules of the perfume rush out into the air in disorderly fashion. They never go back into the bottle and return to an orderly state! Similarly, if you shook some salt and pepper together, they would become mixed. There is no way you could mix, stir, or shake the mixture to extract the salt from the pepper and restore two orderly piles of distinct substances. The disorder of the universe continually increases.

If this condition exists everywhere, the natural outcome will be that everything in the universe will degenerate into disorder, all energy will be depleted, and all life will come to an end. This running down of energy is referred to as "entropy" or the "heat-death" of the universe. However, you don't need to worry about it, unless you plan to be around in a billion years or so.

CHAPTER 6
ANSWER KEY

Analyzing Exemplification

1. Carbohydrates are organic compounds. Organic compounds contain carbon in combination with hydrogen and oxygen.
2. Some birds travel enormous distances without resting. The ruddy turnstone flies nonstop from Alaska to Hawaii every year.
3. Parasites are living things that feed off other living things. The mistletoe plant lives off apple, maple, or poplar trees, causing them to die from malnutrition.
4. Several theories have been proposed to explain the nature of light. Christian Huygens suggested that light travels in waves. Albert Einstein proposed that light is transmitted as tiny particles, or photons.
5. Symbiosis is the coexistence of living things for their mutual benefit. Plant lice or aphids live with ants in a symbiotic relationship.
6. Atomic research has led to the development of artificially prepared elements. Einsteinium, fermium, californium, and berkelium are all manmade elements.

Recognizing Examples

1. a, c
2. b
3. a, c
4. a, c
5. a, b

Using Modals of Necessity

1. must only be administered
2. must be prepared
3. must be produced
4. must always be turned off
5. must not be inhaled
6. must be fertilized
7. must never be allowed
8. must never be released

Formulating Sentences with Necessity

1. The electricity should be shut off.
2. The blood donors should be tested for anemia.
3. The radiation monitoring devices should be calibrated regularly.
4. A fire extinguisher should be available in the laboratory.
5. The explosive devices should be properly insulated.
6. The technicians should be protected from excessive radiation.
7. The needles should be sterilized before the injections.
8. The patients should be immunized against the flu.

Suffixes

1. shorten
2. broaden
3. deepen
4. darken
5. widen
6. weaken
7. soften
8. blacken
9. tighten
10. loosen
11. brighten
12. frighten
13. strengthen
14. lengthen
15. sharpen
16. straighten

1. to identify
2. to solidify
3. to liquefy
4. to purify
5. to exemplify
6. to humidify
7. to electrify
8. to clarify

1. identification
2. solidification
3. liquefication
4. purification
5. exemplification
6. humidification
7. electrification
8. clarification

Vocabulary in Context

1. b
2. a
3. a
4. a
5. b
6. a
7. a
8. b
9. b

Drawing Conclusions

1. a
2. a
3. b
4. a
5. a
6. b
7. a
8. a
9. a
10. a

Vocabulary in Context (listening skills)

1. b
2. a
3. a
4. b
5. b
6. a
7. b
8. a
9. a
10. b
11. b
12. b

Understanding the Lecture

1. T
2. F
3. F
4. F
5. F
6. T
7. F
8. F
9. T
10. T
11. T.
12. F

LECTURE:

The Changing State of Matter

We read earlier in this chapter about how temperature affects matter. One of the most important effects of heat is that it can change the state of a substance from solid to liquid to gas. In fact, heat is a requirement in any change of physical state. We know that water can be cooled to form ice, or heated so that it boils and changes to steam or vapor. With the addition or subtraction of heat, almost all substances can be converted from one physical state to another.

Melting is the conversion of a solid to a liquid. If we heat a block of ice, when the temperature of the ice reaches 0°C, the molecules of ice start to move so fast that their order breaks down and they tumble all over each other. Gradually, the ice begins to melt. Substances convert from one state to another at fixed temperatures. For example, gold melts at 1063°C and iron at 1535°C. Frozen oxygen will melt at -219°C.

The reverse of the melting process is freezing. Freezing is lowering the temperature of a liquid sufficiently to change it to a solid. The freezing point of a substance is the same as its melting point. For example, liquid gold will solidify at 1036°C, iron at 1535°C, and oxygen at -219°C.

If a liquid is heated sufficiently, it will boil and convert to a gas. The process of converting from a liquid to a gas, or a vapor, is called evaporation. When water is heated, the molecules become increasingly violent so that some lose their attraction to the other molecules. They try to escape into the air and bubbles are formed. Eventually, all the molecules disperse into the air and the water gradually turns to steam or vapor. You have seen an example of this when water was left boiling in a pot. Liquids can evaporate without boiling. Liquids that evaporate easily, that is at low temperatures, are described as being volatile. Alcohol and perfume are volatile liquids. You have probably noticed how quickly they disappear when left uncovered.

The reverse of evaporation is condensation, the conversion of a vapor into a liquid. During condensation, the molecules of a gas come in contact with drops of liquid and are absorbed by them. The condensation point of a substance is the same as the boiling point. Examples of condensation are the steam that forms on your glasses when you enter a heated room from the cold outdoors, or the moisture that forms on the outside of an iced drink. Dew, fog, clouds, and rain are examples in nature of condensation that takes place when warm air is cooled. Any gas can be converted to a liquid if it is cooled sufficiently. Many industrial processes require the liquefication of air and other gases.

When the rate of evaporation is exactly equal to the rate of condensation, a state of equilibrium exists. An example of this occurs when liquid is in a closed container. Some of the molecules of the liquid evaporate and disperse into the air inside the container. At the same time, other air molecules inside the container collide with the surface of the liquid and condense at the same speed, and the amount of liquid and amount of vapor in the container remain constant.

CHAPTER 7
ANSWER KEY

Identifying Evidence

1. A plastic raincoat prevents the rain from penetrating, but a wool coat does not. Plastic is impermeable to water, and wool is not.
2. If a bottle of perfume is left open in a closed room, the smell will eventually spread all over the room. The molecules of a gas spread, or diffuse, to fill the entire area.
3. The earth is round. A person traveling directly east from the equator will eventually return to the starting place.
4. A bell rung in a vacuum makes no sound. Sound is only produced when there are molecules to transmit it.
5. Life as we know it cannot exist on Venus. There is no oxygen or water on Venus.
6. Morphine is addictive. Hospital patients who are given morphine as a pain reliever sometimes develop a physical dependence on the drug.
7. Death often occurs when drugs and alcohol are used together. Certain combinations of alcohol and drugs can be fatal.
8. Glass is fragile, or breakable. A glass bottle dropped on a hard surface is likely to break.

Drawing Conclusions from Evidence

1. b
2. a
3. b
4. b
5. a
6. a
7. a

Evaluating Evidence

1. c, d
2. c
3. a
4. a, b, d
5. a, c
6. a, b, c

Identifying Deductive and Inductive Reasoning*

1. I
2. I
3. I
4. D
5. D
6. I
7. D
8. D

Using Reasoning

There is no attempt here to teach formal logic. The object of the exercise is only to increase awareness of false reasoning.

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* Conclusions from inductive reasoning may or may not be true.

1. False deduction because first premise is false. All birds do not fly. (All birds have feathers.)
2. False inductive reasoning. Although the characteristics coexist in Einstein, there is no evidence of their relationship.
3. Even if all metals were solid (no true, mercury is a liquid metal), it does not follow that all solids are metal.
4. Conclusion does not follow from the premise. Premise does not specify that animals are classified according to t he way they walk.
5. False inductive reasoning. Example is not representative or typical.
6. The first premise is not all inclusive. That is, it does not say that all elements are either gases or liquids.
7. False inductive reasoning. Example is not typical or representative.
8. First premise is false. Being a genius and working hard are not mutually exclusive.
9. Conclusion does not follow from premise. The lack of proof that it is harmful is not evidence that it is safe.
10. Even if all animals have tails, it does not follow that everything that has a tail is an animal.

Vocabulary Building

excites - stimulates
portions - doses
tired - fatigued
awake - alert
harmful - detrimental
excitability - irritability
endurance - tolerance
not enough - insufficient
persuade - convince

Suffixes

1. connection
2. conduction
3. radiation
4. insulation
5. acceleration
6. gravitation
7. lubrication
8. calculation
9. elimination
10. attraction
11. absorption
12. correlation
13. exertion
14. speculation
15. extension
16. demonstration
17. formulation

1. connector
2. radiator
3. insulator
4. resistor
5. accelerator
6. demonstrator
7. correlator
8. speculator
9. lubricator
10. calculator

Vocabulary in Context (reading skills)

1. b
2. a
3. a
4. a
5. a
6. a
7. a
8. b
9. b
10. b
11. b
12. a
13. b
14. a
15. a
16. b
17. a
18. b
19. b

Skimming

1. a
2. cocaine, amphetamines, narcotics, marijuana, barbiturates

Understanding the Reading

1. F
2. F
3. F
4. F
5. T
6. F
7. F
8. T
9. F
10. T
11. F
12. T

Vocabulary in Context (listening skills)

1. a
2. b
3. b
4. b
5. b
6. b
7. b
8. b
9. b
10. a

Understanding the Lecture

1. F
2. F
3. T
4. T
5. T
6. T
7. F
8. F
9. F
10. T
11. F
12. T

LECTURE:

The Physiological Effects of Alcohol

So far, in this chapter, we have discussed the harmful effects of smoking and drugs. Alcohol is another substance that affects our minds and our bodies.

Until recent years, little was known about the effects of alcohol. Recent research has shown that some people are more likely to become addicted than others, but it is not known why. Effects depend on how much is consumed and over what period of time. Either five ounces of wine, twelve ounces of beer, or one and one-half ounces of 80 proof spirits will put two-thirds of an ounce of pure alcohol into the bloodstream. Once an ounce of alcohol is absorbed into the bloodstream, it takes about an hour for the body to burn it. Drinking coffee or taking a shower does not speed up the process.

It is an interesting and potentially dangerous fact that small amounts of alcohol can make some people feel good while larger amounts make them feel depressed. This observation has been supported by evidence. Alcohol taken in small quantities can bring pleasurable feelings and give some people a boost in confidence and social poise. The danger lies in the fact that many people think that if a little is good, a lot will be even better. The truth is that studies have shown that small doses of alcohol pump up the heart rate while high doses can depress or slow down the heart rate and lead to addiction. Although small quantities may not be harmful, alcohol taken in large quantities causes serious changes in the body's chemistry, affecting nearly every part of the body.

Alcohol has a marked effect of the nervous system. In moderate quantities, it may be beneficial in relieving tension. At the same time, judgment and coordination are impaired, shown by the fact that alcohol is a factor in more than half of all fatal automobile accidents in North America. Alcohol impairs the ability of the nerve cells to transmit messages. There is evidence of this in the unclear speech, blurred vision, and temporary loss of memory of intoxicated people.

Chronic alcoholism affects the muscles in the body. Research shows that the muscles of heavy users are inflamed and show sings of degeneration, and the hearth is sometimes enlarged leading to death.

Alcohol affects sexuality and reproduction. Although moderate amounts can increase sexual desire, alcohol usually decreases the ability to perform. Chronic alcoholism can impair sperm production and lead to sterility. This is partly caused by the destruction of the male sex hormone, testosterone, in the liver.

Chronic alcoholism has a detrimental effect on the liver. Heavy drinking causes fat to accumulate in the liver. Passage of blood becomes impaired, the capacity of the liver to process food decreases, and the general health of the individual deteriorates.

One of the worst effects of alcohol is on the brain. Heavy drinking can lead to confusion and even unconsciousness. Pregnant women are advised not to drink at all, especially in the early months, because of the harm it can cause the unborn baby. Alcohol affects each person differently, and every user should be aware of its potential effects. Any short term benefits may be outweighed by long term negative effects.

CHAPTER 8
ANSWER KEY

Imperative Verbs

1. Make
2. Tie
3. Insert
4. Move
5. Place
6. Check

Arranging Items Chronologically

1. 3, 1, 4, 2
2. 5, 3, 1,4, 2
3. 1, 4, 3, 2
4. 1, 3, 4, 2
5. 3, 2, 1
6. 4, 2, 1, 3

Using Imperative Verbs (Answers will vary)

1. Obtain a battery, some insulated wire, a nail, and some paper clips.
2. Connect one end of the wire to a battery node.
3. Coil the wire around a nail.
4. Connect the other end of the wire to the other battery node.
5. Use the nail to pick up paper clips.

(Explanation: Electric currents produce magnetic fields. If you disconnect the nail from the battery, it will no longer be magnetized.)

Choosing Verb Forms

1. a
2. b
3. b
4. a
5. a
6. a
7. a
8. a
9. b
10. a

Word Roots

1. e
2. h
3. c
4. i
5. b
6. j
7. f
8. d
9. g

Vocabulary in Context (reading skills)

1. b
2. b
3. a
4. a
5. a
6. a
7. a
8. a
9. b

Understanding the Reading

1. T
2. F
3. T
4. T
5. F
6. T
7. F
8. F
9. T
10. F
11. T
12. F

Vocabulary in Context (listening skills)

1. a
2. a
3. a
4. b
5. a
6. a
7. a

Understanding the Lecture

1. E
2. G
3. E
4. E
5. SN
6. E
7. G
8. WN
9. G
10. SN and WN
11. G
12. E
13. E

LECTURE:

The Four Forces of Nature

Isaac Newton identified gravity as one of the basic forces of nature. Since then, other forces have been discovered. Physicists believe there are four forces in nature: a gravitational force, an electromagnetic force, a strong nuclear force, and a weak nuclear force.

Gravitation is the force by which all bodies are attracted to each other. It keeps planets in their orbits and makes apples fall from trees. It is actually the weakest of the four forces, but its effects are strongly felt because celestial bodies are so massive.

The electromagnetic force is considered by many scientists to be the most important of all. The electromagnetic force is the powerful attraction of unlike electrical charges and repulsion of like charges. The nucleus of an atom has a positive electric charge and electrons orbiting the nucleus have a negative charge. Since opposite charges attract, these electric forces cause the nucleus and the electrons to be attracted to each other. This is the underlying force of chemistry because it is responsible for binding the particles of an atom together, holding atoms together to form molecules, and keeping molecules together to

form liquids and solids. In normal life, we are not aware of the electrical force because when positive and negative charges are equal, they cancel each other out and no force is felt at all.

The electromagnetic force causes friction. For example, as you walk, the atoms and molecules on the floor and on your feet are pressed out of shape and the electric force of one acts on the other. All contact forces are basically electrical. For example, when you push or pull an object with your hand, the electrical force acts to move the object, and provides the resistance to prevent your hand from going through the object!

The electrical force is even in action when you put a band-aid on your finger. The sticky side of the band-aid has a chemical that loosens the electrons so they jump over to your finger. Your finger becomes negatively charged and the band-aid becomes positively charged so the attraction of opposites holds them together.

The electrical force is similar to the gravitational force, acting across empty space, or rather an electromagnetic field. However, gravitation only attracts. Electrically charged substances either attract or repel. Finally, the electrical force is at work in all the processes of the body.

The remaining two forces are the nuclear forces that act only within the atom. Scientists divide them into two categories, the strong nuclear force and the weak nuclear force. The strong force is the one that acts on the nucleus of the atom to hold together the protons. Since the protons are positively charged, they repel each other and a very strong force is needed to hold them together. The weak force is the one responsible for certain types of radioactivity.

For a long time, it was thought that all events in nature could be explained by these four forces. Recently, however, scientists have discovered problems with this theory. For one thing, the gravitational pull deep in an Australian mine was found to be stronger than gravity on the surface of the earth. Also, some experiments have revealed differences in the rate certain objects fall toward the earth. To explain these differences, physicists have proposed that there may be a fifth force operating in the universe. This force, called **hypercharge**, is thought to be weaker than gravity and counteracts the force of gravity at short distances. So far, more experimentation is necessary before the hypothesis of a fifth force becomes accepted theory.

CHAPTER 9
ANSWER KEY

Understanding Mathematical Terms

1. $w = f \cdot d$
2. $v = \frac{d}{t}$
3. $v = l \cdot w \cdot h$
4. $p = \frac{w}{t}$
5. $k = \frac{1}{2}(m \cdot v)^2$
6. $c = \pi \cdot d$
7. $°C = \frac{5}{9}(°F - 32)$

Indefinite Articles

1. penicillin, a drug, diseases
2. a quasar, a galaxy
3. zinc, a moderately active metal
4. heat, energy
5. light, an extra fluorescent light
6. iron, glasses, glass
7. alpha rays, beta rays, gamma rays
8. a colorless, odorless, and tasteless gas

Definite Articles

1. A biochemistry professor, an experiment, guinea pigs, The experiment, the professor, the animals
2. The Humber Bridge, the longest suspension bridge, the world
3. a comet, the comet
4. Eckert, Mauchly, the first all electronic computer
5. The effect, living things, the amount, the rate

Number Prefixes

1. d
2. g
3. a
4. c
5. c
6. k
7. j
8. f
9. h
10. i

Vocabulary in Context (reading skills)

1. a
2. a
3. a
4. a
5. a
6. b
7. a
8. b
9. a
10. b
11. a

Drawing Conclusions

1. b
2. a
3. b
4. b
5. b
6. b
7. a
8. b
9. a
10. a

Vocabulary in Context (listening skills)

1. a
2. b
3. a
4. a
5. a
6. a
7. a
8 b
9. a
10. b
11. b
12. b

Understanding the Lecture

1. T
2. T
3. F
4. T
5. F
6. T
7. F
8. T
9. T
10. F
11. T
12. F
13. F

LECTURE:

The Remarkable Behavior of Gases

One of the reasons scientists study gases is that the behavior of gases can be understood in quantitative terms. The behavior of gases is subject to three related factors: temperature, pressure, and volume. A change in one of these factoirs - such as a drop in temperature - can bring about a change in the other factors. Moreover, the behavior of any one gas is the same for all gases or mixtures of gases. Therefore, basic rules or scientific laws have been established to help predict the effects of environmental changes on temperature, pressure, and volume. The first of these laws was discovered by the British

scientist Robert Boyle in 1662. Boyle found that if he squeezed a rubber ball, the volume of air inside it decreased. The more he squeezed, the less the volume of the confined air. In fact, if he doubled the pressure, the volume decreased to precisely half of what it was. If he quadrupled the pressure, the volume decreased to one quarter of what it was! Accordingly, he established that the volume of a gas is inversely proportional to the pressure applied to it, provided the temperature remains constant.

Boyle had demonstrated that pressure and volume are inversely related. However, temperature also affects the volume of a gas. In the late 1700s, in France, Jacques Charles noted that as a gas gets cooler, its volume contracts. In fact, with each degree it gets cooler its volume gets smaller so that if you cooled it to -273° Celsius, it would shrink to nothing and disappear! Lucky Jacques Charles did not have to worry about proving his hypothesis because no one could get temperatures down that low!

The similar behavior of gases led the Italian chemist Amadeo Avogadro to the discovery of another amazing fact. In the year 1811, Avogadro figured out that equal volumes of all gases at the same temperature and pressure contain the same number of particles. He assumed the particles were atoms but later they were determined to be groups of atoms, or molecules. Avogadro's "molecular hypotheses," as it is known today, is one of the most important principles of chemistry, and its implications played a role in the development of the atomic theory.

With the development of this hypothesis, the volume of a gas was understood to be relater to the movement of the molecules. That is, the volume of a gas increases because at higher temperatures molecules move faster, requiring more space to move around. Conversely, at lower temperatures, molecules slow down, requiring less space, and gases contract. In the 1860s, British physicist Lord Kelvin suggested that if a gas were reduced to -273° Celsius, it would not shrink and disappear, as Jacques Charles had suggested. Instead, the energy of the molecules would be reduced to zero. This temperature (-273.16 °Celsius to be precise) is considered the lowest possible temperature, that is, the complete absence of heat. It is known today as absolute zero or zero Kelvin. Even your mittens and ear muffs wouldn't help in this kind of temperature. To give you an idea of how cold it is, on the Kelvin scale, 150° is colder than the natural temperature at any spot on earth.

Physicists today continue to study the remarkable behavior of gases, particularly at low temperatures. With the use of modern techniques they have been able to attain temperatures as low as one millionth of a degree above absolute zero (0.000001°K)! Absolute zero, however, remains unattainable.

CHAPTER 10
ANSWER KEY

Identifying Tenses

1. 4	a. simple past	b. active
2. 8	a. present perfect	b. active
3. 5	a. past perfect	b. passive

Using the Simple Past Tense

1. wrote
2. were found
3. appeared
4. lived
5. was formed
6. reproduced
7. were discovered
8. rotated

Using the Present Perfect Tense

1. has become
2. have been made
3. have been discovered
4. has still not been found
5. has recently been discovered
6. has just gone
7. have known
8. has been seen
9. have destroyed

Choosing the Correct Past Tense

believed	was covered
generated	decayed
was held	were attracted
performed	laid
placed	were found
was left	demonstrated
was covered	have performed

Forming Sentences That Report (Answer will vary)

1. The first test-tube baby was born in England in 1978.
2. The principles of geometry were developed by Euclid in Alexandria, Egypt in 300 B.C.
3. The plants and animals were classified by the Swedish Carolus Linnaeus in 1735.
4. In 1911, Marie Curie of France received the Nobel Prize for the discovery of plutonium and radium.
5. Pi-sheng of China invented printing with movable type in the 11th century.
6. In 1942, the Italian Enrico Fermi accomplished the controlled nuclear fission of uranium.

7. The first landing on the moon was made by the American Project Apollo in 1969.
8. William Harvey discovered the circulation of the blood in England in 1628.
9. In 1961, Juri Gagarin of the Soviet Union made the first space flight.
10. The American Jonas Salk developed a polio vaccine in 1954.
11. The incandescent lamp was invented by Thomas Edison in America in 1879.

Word Roots

1. c
2. e
3. b
4. f
5. a
6. d
7. g
8. h

Vocabulary in Context (reading skills)

1. a
2. a
3. b
4. a
5. a
6. a
7. a
8. a
9. b
10. b
11. b
12. b
13. a

Skimming

1. a
2. c

Distinguishing Fact from Opinion

1. F
2. F
3. O
4. O
5. F
6. O
7. F
8. F
9. F
10. F
11. O
12. F
13. O
14. O
15. O

Vocabulary in Context (listening skills)

1. a
2. b
3. a
4. a
5. a
6. b
7. b
8. a
9. a

Understanding the Lecture

1. F
2. F
3. F
4. T
5. F
6. T
7. T
8. T
9. F
10. T
11. F
12. T

LECTURE:

The Science of Genetics

Most of us take it for granted that we have inherited certain characteristics. We might be tall like our father, musical like our mother, brown-eyed like our grandmother. But why is it we inherit some traits and not others? You might think you are very different from your brother or sister, yet other people notice a family resemblance. How can we explain the differences - and the similarities? And how can a dog give birth to a litter of puppies that are all different?

Genetics is the branch of science that seeks to determine the answers to these questions, and to discover how plants and animals have developed over the past two billion years. The field of genetics began with the discoveries of a nineteenth century Austrian monk named Gregor Mendel, who was an amateur botanist. His unique contribution was that he studied one characteristic at a time to see how it was passed from one generation to another. He performed experiments with red and white flowered garden peas and obtained some interested results.

Mendel took the male cells (pollen grains) from a red flower and placed them on the female cells (pistils) of a white flower (a process called cross-pollination). When the flower produced seeds, he planted the seeds. Then, when the flowers began to bloom, Mendel observed that instead of the pink flowers or mixture of red and white flowers he expected, all the first generation flowers were red.

Next Mendel took the male cells and placed them on the female cells of these same red flowers (a process called self-pollination). Again the flowers produced seeds, and again Mendel planted them. This second generation produced some red and some white flowers. The interesting part of this was that the ratio of red flowers to white was precisely three to one! Also, there were no pink flowers. Thus Mendel showed that a mixture of characteristics did not blend into something that was in between the two. Rather, the characteristics remained distinct in the next generation.

Mendel concluded that there are certain factors (later called genes) that determine the color of the plants. He also established that the red factor was stronger or dominant, and the white factor was weaker, or recessive. But the recessive factor did not disappear; it only became hidden and sometimes emerged in a later generation (witness: the red flowers produced white flowers). This explains why, for example, two dark-haired parents sometimes give birth to a blond child. Both parents may be carrying recessive genes for blond hair.

Gregor Mendel made genetics into a science. He was able to predict exactly the number and type of plants his experiments would produce. Unhappily for him, Mendel's work was not recognized in the scientific world until 16 years after his death. Since then, experiments have been performed with numerous traits of plants and animals which have demonstrated the universal applicability of Mendel's findings. The principles of heredity that Mendel established were significant in substantiating Darwin's theory of evolution.

CHAPTER 11
ANSWER KEY

Using Precise Descriptions

1. Too vague. Specifying when life began would make it more scientific.
2. Does not indicate if 5,500 feet is the width, depth, or length.
3. Does not indicate item of comparison. Cooler than what? another star? inner layers?
4. Again, does not indicate item of comparison. Less corrosive than what?
5. Does not specify unit of measurement. Degrees Celsius? Degrees Fahrenheit?
6. Does not indicate point of reference. Away from what?
7. Does not indicate basis for comparison. Highest in the Himalayas? in Asia? in the world?
8. Does not specify a.m. or p.m. Does not indicate date.

Describing with Adjectives (Answers will vary)

1. salt, sugar
2. wood, paper
3. fruits, vegetables, grains
4. carbon monoxide, arsenic
5. lemon, grapefruit
6. gold, silver
7. wood, metal
8. tile, marble
9. sand, tree bark
10. glass, flower
11. glass, water
12. steel, diamond, marble
13. rubber, sponge, muscle
14. tree sap, lava
15. rubber, plant gum
16. air, water
17. alcohol, perfume
18. fog, jungle
19. the earth, a rainbow
20. gasoline, petroleum
21. acids (sulfuric acid)

Using Adjectives with -ed and -ing

1. a
2. a
3. b
4. b
5. a
6. a
7. a
8. a
9. a
10. b

Forming Compound Nouns

1. chemical reaction
2. water displacement
3. air compression
4. fuel pump
5. gas density
6. food preservation
7. bird migration
8. word processor
9. acid rain
10. drug addict

1. large oil container
2. excessive air pollution

3. high blood pressure
4. serious birth defect
5. powerful radiation detection device

Writing Smooth Sentences (Answers will vary)

1. Uranus, the third largest planet, is orbited by many thin rings and at least 15 satellites.
2. Granite is a hard and shiny igneous rock that is made of several kinds of metals.
3. Calcium is a silvery metal that is found in limestone, marble, chalk, and marine animal shells.
4. The brontosaurus was a large, 30 ton plant-eating dinosaur that lived in shallow waters.
5. Quasars are star-like objects that emit more radiation than entire galaxies.
6. The cerebrum, the largest part of the brain, controls the senses and the muscles.
7. Hemophilia is an inherited disease in which the blood does not clot properly.
8. The greenhouse effect is the gradual warming of the earth by gases that are trapped in the atmosphere.

Word Roots

1. f
2. e
3. c
4. g
5. a
6. i
7. b
8. d
9. j

Vocabulary in Context (reading skills)

1. b
2. a
3. b
4. a
5. b
6. a
7. a
8. a
9. a
10. a
11. a
12. b

Skimming

1. b
2. c

Making Inferences

1. S
2. N
3. I
4. S
5. I
6. S
7. S
8. N
9. N
10. I
11. S
12. I

Vocabulary in Context (listening skills)

1. a
2. b
3. a
4. b
5. a
6. b
7. b
8. a
9. b

Understanding the Lecture

1. T
2. F
3. F
4. T
5. F
6. F
7. T
8. T
9. F
10. F
11. F
12. F
13. T

LECTURE:

Beyond Our Planet

One of the most fascinating topics in science is the study of what lies beyond our planet and whether there is any life out there as we know it. Our solar system consists of nine planets and their satellites, plus numerous asteroids, comets, and meteors. The planets travel in elliptical orbits around the sun, kept in place by the sun's gravitational force.

The closest planet to the sun is Mercury which is only slightly larger than our moon. Mercury is very hot and has no atmosphere. Therefore, there is no possibility of life. Venus, the next planet, is almost the same size as the earth. Despite its proximity to the earth, its surface is so cloudy that scientists cannot see it. Venus is so hot and dry, there is little hope of finding any life on its surface either.

The third planet in order from the sun is the earth and the fourth planet is Mars. Mars has a rugged terrain with huge volcanoes and deep canyons. Like the earth, it has icy polar regions which change with the seasons. Accordingly, scientists and writers of science fiction have always been intrigued by its potential for sustaining life. However, recent explorations have not turned up any evidence of life.

Beyond Mars there are innumerable asteroids or minor planets that may be pieces of a planet that once exploded. After the asteroids comes Jupiter, the largest planet. Jupiter has 16 moons. Its mass is composed almost entirely of hydrogen, and it may in fact be a ball of gas with no surface at all. Some scientists believe the planet may be shrinking. Jupiter spins rapidly on its axis and moves slowly around the sun, giving it short days and long years. If there is life on Jupiter, it must be very different from life on earth. Firstly, the organisms would not breathe oxygen because Jupiter's atmosphere has none. Secondly, they would have to float on gas. Of course, Jupiter is so far from the sun that it is likely to be too cold

to support any life. But some scientists have suggested that a protective atmosphere may keep the planet warm. Or, Jupiter may have a different source of energy such as energy produced by the planet contracting.

Saturn, the beautiful planet with the rings, follows Jupiter. The rings are not solid; they are made up of separate particles which orbit Saturn. One of the most spectacular sights in the universe must be the view from Saturn of its magnificent rings with the sun shining on them to produce a rainbow of colors (a sight human beings will never see!). Saturn has over 20 satellites and is the second largest planet.

Uranus and Neptune are next in order. They are both large planets that are quite far from the sun and, accordingly, very cold. Uranus is orbited by thin rings and many moons. Pluto is a small, dark planet, the farthest from the sun. If you were on Pluton, the sun would look like a star.

Comets are also part of our solar system. A comet consists of a central mass of cosmic matter with a tail that streams away from the sun. Comets travel through our solar system sometimes sweeping once around our sun and vanishing into space. Halley's comet, named for Demon Halley who predicted its orbit, returns to the earth every 76 years.

Meteors are bits of cosmic matter that enter our atmosphere and burn up. They appear to us as falling stars. Meteorites are meteors that survive the atmosphere and land on earth.

In between these various celestial bodies, these is no atmosphere, no air, no water. Most of our universe is just empty space. As for life existing elsewhere, most scientists believe that "intelligent life" probably does not exist in our solar system, but it probably does exist out there beyond our solar system. We may never reach these other worlds, but they are almost certainly there.

CHAPTER 12
ANSWER KEY

Identifying Predictions

1. P
2. I
3. H
4. I
5. P
6. H
7. P
8. H

Formulating Hypothetical Predictions

1. If we studied, we would pass.
2. If a cure were found for leukemia, many lives would be saved.
3. If chlorine were inhaled in large doses, it would be fatal.
4. If mercury were heated to 357°C, it would boil.
5. If the fuel ignited, the engine would start.
6. If it were a clear night we would see the eclipse.
7. If the wires were insulated, they could be used to carry electric current.
8. If the air temperature dropped below 0°C, the rain would turn to snow.

Formulating Impossible Predictions

1. If we had studied, we would have passed.
2. If we had spoken the same language, we would have understood each other better.
3. If we had moved the clocks back one hour, we would have had an extra hour of daylight in the morning.
4. If the bridge had been properly designed, it would not have collapsed.
5. If the standards had been lower, more students would have passed.
6. If the satellite had not been interrupted, it would have continued in its orbit.
7. If the egg cell had been fertilized by sperm carrying an x chromosome, the baby would have been a girl.
8. If he had eaten a balanced diet, he would have been healthier.

Completing Sentences

1. are
2. had predicted
3. reaches
4. heated
5. will hibernate
6. would rust
7. would have turned
8. would liquefy

Creating Predictions (Answers will vary)

1. people didn't drink and drive
2. they exercised more
3. we drove electric automobiles
4. there were no tests
5. there would be less traffic on the freeways

6. there would be many disputes about who controls it
7. English would be easier to learn
8. I could sleep later in the morning
9. I would go to ....

Word Roots

1. transmitted
2. aqueduct
3. psychosomatic
4. psychomotor
5. conductor
6. cardiac
7. submit
8. ductile
9. helio
10. cardiograph
11. geometry

Vocabulary in Context

1. a
2. b
3. b
4. b
5. a
6. a
7. a
8. a
9. a
10. a
11. a
12. a

Distinguishing Fact from Opinion

1. F
2. F
3. O
4. O
5. O
6. F
7. F
8. F
9. F
10. O
11. O
12. O

Vocabulary in Context (listening skulls)

1. a
2. a
3. a
4. b
5. b
6. b
7. a
8. a
9. a

Understanding the Lecture

1. F
2. F
3. F
4. T
5. T
6. T
7. F
8. F
9. F
10. F
11. T
12. T
13. F.

LECTURE:

The Wonder of Water

It is difficult to overestimate the importance of water in our lives. All living matter, including rocks, food, and minerals, contains water. There is water underground and in the atmosphere. Areas of the world that have an adequate supply of water provide for fertile lands that can support many people in contrast to arid desert areas where people cannot live.

Nearly three-fourths of the earth's surface is one big ocean in which the continents are the large islands. Most of the earth's life exists in the ocean, and the ocean contains enormous quantities of nearly every element, including uranium, magnesium, silver, and gold. Despite its importance, until recent years, as little was known about the ocean as about another planet. Today we know, for example, that the land surface of the ocean has extremely high mountains and deep valleys. The island of Hawaii is the top of a mountain that is 33,000 feet high - higher than any mountain in the Himalayas. And there are underwater canyons that are vastly larger than the Grand Canyon in the Uniter States.

Water is a colorless, odorless, tasteless liquid that is transparent. The green or blue color of the sea is found only in deep water. Any taste in the water is usually due to the presence of minerals dissolved in the water.

Water is the most versatile substance. It is frequently called the universal solvent because many substances dissolve in water: sugar, gases, salt, and many minerals. Scientists believe the salt in the ocean water comes from the erosion of rocks.

The climate on earth is unique among all the planets in our solar system in that it allows water to exist in all three states: solid, liquid, and gas. Water is one of the few materials which expands when it freezes. For example, if you freeze a closed bottle filled with water, the bottle will shatter. This expanding facility breaks stones and makes dirt out of rocks. Since ice takes up more space than water, it is less dense and floats on the tops of the oceans. If it did not, our oceans would be frozen solid.

Another unique characteristic of water is that it heats and cools more slowly than most other materials, especially other liquids. It takes more to boil water or melt ice than most substances require. These properties of water exert a powerful moderating effect on our climate. Water tends to moderate the temperature all year round. Areas near the ocean are generally warmer in winter and cooler in summer than inland areas.

Water is remarkable in another way. If we could follow a drop of water we might find that it travels around the world. As the sun warms the ocean, some of the water evaporates into the air. As the air rises to cooler parts of the atmosphere, it condenses and forms clouds. Some of the water falls as snow or rain on the mountains. In the spring, the snow melts and the water runs downhill through streams and rivers. Eventually most of the water returns to the ocean via the ground, waterfalls, streams, rivers. This perpetual circulation of water from the oceans to the air to the land and back to the oceans is called the water cycle.

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