
Biology

Florida Biology Benchmark Review and Practice



HOUGHTON MIFFLIN HARCOURT

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Florida Biology Standards Review

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Introduction

These practice activities are correlated to the Florida Next Generation Sunshine State Standards for Life Science and designed to prepare your students to take the FCAT.

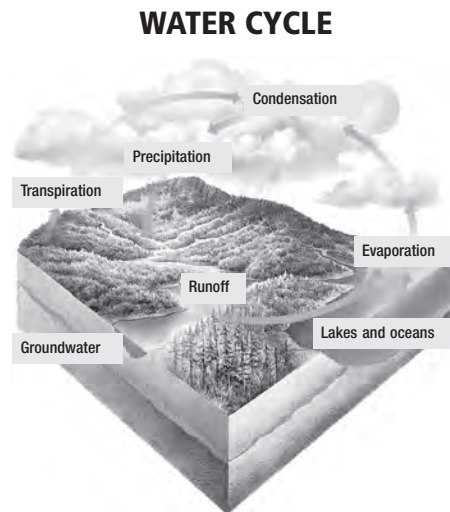
In terms of content, the questions reflect the types of science content reflected in the curriculum. In terms of style, the practice tests reflect the type of wording likely to be encountered on the actual FCAT science test.

SC.912.E.7.1**Biology**

Analyze the movement of matter and energy through the different biogeochemical cycles, including water and carbon.

STANDARD REVIEW**The Water Cycle**

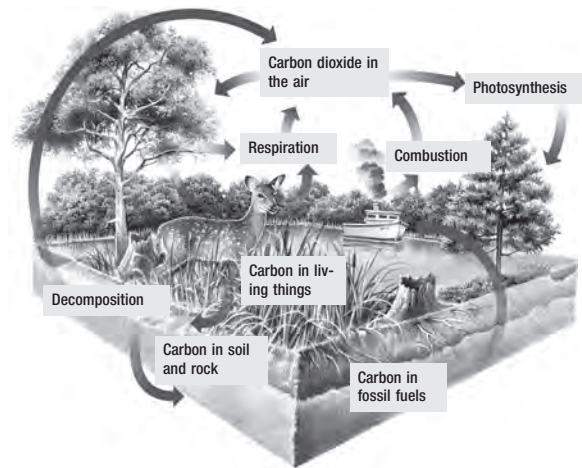
The movement of water between the oceans, atmosphere, land, and living things is known as the *water cycle*. During *evaporation*, the Sun's heat causes water to change from liquid to vapor. In the process of *condensation*, the water vapor cools and returns to a liquid state. The water that falls from the atmosphere to the land and oceans is *precipitation*. Some of the precipitation that falls on land flows into streams, rivers, and lakes and is called *runoff*. Some precipitation seeps into the ground and is stored in spaces between or within rocks. This water, known as *groundwater*, will slowly flow back into the soil, streams, rivers, and oceans.

**The Carbon Cycle**

Carbon is an essential substance in the fuels used for life processes. Carbon moves through the environment in a process called the *carbon cycle*. Part of the carbon cycle is a short-term cycle. In this short-term cycle, plants convert carbon dioxide from the atmosphere into sugars and starches. Plants use these substances for energy, releasing carbon dioxide into the air. Other organisms eat the plants to get the carbon. Like plants, the organisms break down sugars for energy, releasing some of the carbon back into the air. The decay of dead organisms and wastes also releases carbon into the air.

SC.912.E.7.1**Biology**

Part of the carbon cycle is a long-term cycle in which carbon moves through the Earth system over a very long period. Carbon is stored in the geosphere in buried plant or animal remains. Fossil fuels, which contain carbon, formed from plant and animal remains that were buried millions of years ago. Carbon is also stored in a type of rock called a *carbonate*. Carbonate forms from shells and bones of once-living organisms.

CARBON CYCLE

SC.912.E.7.1

Biology

STANDARD PRACTICE

- 1** By what process do clouds form in the atmosphere?
 - A. condensation
 - B. decomposition
 - C. precipitation
 - D. respiration

- 2** Which of the following statements about groundwater is true?
 - F. It is salty like ocean water.
 - G. It never reenters the water cycle.
 - H. It stays underground for a few days.
 - I. It is stored in underground caverns or porous rock.

- 3** By what process is the carbon in fossil fuels released into the atmosphere?
 - A. combustion
 - B. decomposition
 - C. erosion
 - D. respiration

- 4** Which of the following sources of carbon takes the **shortest** time to form?
 - F. coal
 - G. limestone
 - H. natural gas
 - I. plant remains

SC.912.L.14.1**Biology**

Describe the scientific theory of cells (cell theory) and relate the history of its discovery to the process of science.

SC.912.N.3.1

STANDARD REVIEW

When the English scientist Robert Hooke used a crude microscope to observe a thin slice of cork in 1665, he saw “a lot of little boxes.” The boxes reminded him of the small rooms in which monks lived, so he called them cells. Hooke later observed cells in the stems and roots of plants. Ten years later, the Dutch scientist Anton van Leeuwenhoek used a microscope to view water from a pond, and he discovered many living creatures. He named them “animalcules,” or tiny animals. Today we know that they were not animals but single-celled organisms.

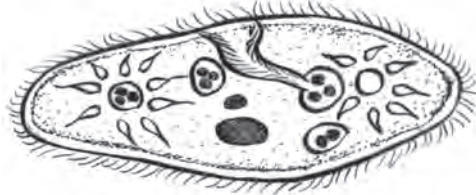
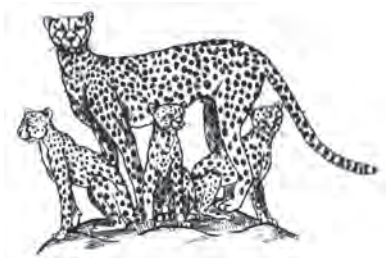
It took scientists more than 150 years to fully appreciate the discoveries of Hooke and Leeuwenhoek. In 1838, the German botanist Mattias Schleiden concluded that cells make up not only the stems and roots but every part of a plant. A year later, the German zoologist Theodor Schwann claimed that animals are also made of cells. In 1858, Rudolph Virchow, a German physician, determined that cells come only from other cells.

The observations of Schleiden, Schwann, and Virchow form the cell theory, which has three parts:

1. All living things are made of one or more cells.
2. Cells are the basic units of structure and function in organisms.
3. All cells arise from existing cells.

SC.912.L.14.1**Biology****STANDARD PRACTICE**

- 1** The combined observations of Mattias Schleiden, Theodor Schwann, and Rudolph Virchow resulted in the formation of the cell theory. Which of the following is part of the cell theory?
- A. All cells contain the same organelles.
 - B. All cells arise from carbon molecules.
 - C. All living things are made of one or more cells.
 - D. Cells are complex units of structure and function in organisms.
- 2** According to the cell theory, cells are the basic units of structure and function in organisms. Which scientist observed plant cells and gave them the name “cells”?
- F. Hooke
 - G. Leeuwenhoek
 - H. Schleiden
 - I. Schwann
- 3** A cheetah, like those shown below at left, and a paramecium, like the one shown below at right, are both living things.



According to the cell theory, what can you conclude about these two very different organisms?

- A. They are made of many cells.
- B. They are made of one or more cells.
- C. They come from the same kind of cell.
- D. They come from noncellular structures.

SC.912.L.14.1

Biology

- 4** In science, a theory is an explanation for some phenomenon that is based on observation, experimentation, and reasoning. One important theory in biology is the cell theory. What kinds of observations led to the development of the cell theory?
- F. testing of first vaccines
 - G. discoveries of fossil bacteria
 - H. isolations of DNA and RNA
 - I. microscopic views of plants and animals

SC.912.L.14.2**Biology**

Relate structure to function for the components of plant and animal cells. Explain the role of cell membranes as a highly selective barrier (passive and active transport).

STANDARD REVIEW

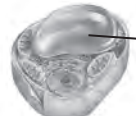
Cells share common structural features, including an outer boundary called the cell membrane. The cell membrane encloses the cell and separates the cell interior, called the cytoplasm, from its surroundings. The cell membrane also regulates what enters and leaves a cell—including gases, nutrients, and wastes.

Movement across the cell membrane that does not require energy from the cell is called passive transport. One kind of passive transport, diffusion, is the movement of a substance from an area of high concentration to an area of lower concentration caused by the random motion of particles of the substance. The diffusion of water through a selectively permeable membrane is called osmosis. In facilitated diffusion, a carrier protein transports a substance across the cell membrane down the concentration gradient of the substance.

Active transport is the movement of a substance against the concentration gradient of the substance. Active transport requires cells to use energy. In animal cells, the sodium-potassium pump uses energy supplied by ATP to transport sodium ions out of the cell and potassium ions into the cell. During endocytosis, substances are moved into a cell by a vesicle that pinches off from the cell membrane. During exocytosis, substances inside a vesicle are released from a cell as the vesicle fuses with the cell membrane.

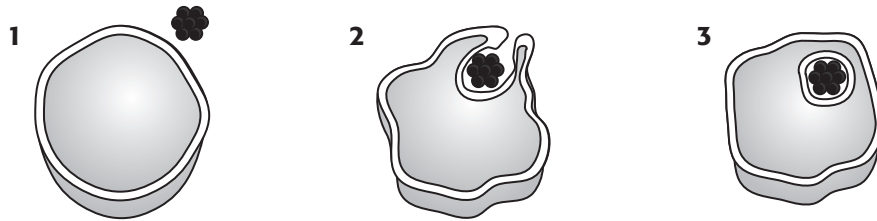
Within the cytoplasm are many structures, often suspended in a system of microscopic fibers called the cytoskeleton. The cytoplasm includes organelles that carry out various life processes. Organelles are structures that perform specific functions within the cell. Different types of cells have different organelles. The table below summarizes the functions of different organelles.

Table 1 Organelles and Their Functions

 Nucleus the organelle that contains the cell's DNA and is the control center of the cell	 Chloroplast the organelle that uses the energy of sunlight to make food
 Ribosome the organelle in which amino acids are hooked together to make proteins	 Golgi complex the organelle that processes and transports proteins and other materials out of cell
 Endoplasmic reticulum the organelle that makes lipids, breaks down drugs and other substances, and packages proteins for Golgi complex	 Large central vacuole the organelle that stores water and other materials
 Mitochondrion the organelle that breaks down food molecules to make ATP	 Lysosome the organelle that digests food particles, wastes, cell parts, and foreign invaders

SC.912.L.14.2**Biology****STANDARD PRACTICE**

- 1** The diffusion of water through a selectively permeable membrane is called osmosis. Which description represents the effects of osmosis on a plant cell when the concentration of sugar particles is greater inside the cell than outside?
- A. Water diffuses into the cell, and the cell swells.
 - B. Water diffuses out of the cell, and the cell shrinks.
 - C. Water moves into and out of the cell at equal rates, and cell size remains the same.
 - D. Water is blocked from moving into or out of the cell, and cell size remains the same.
- 2** The illustration below shows a cell and a large particle. Many substances, such as proteins and polysaccharides, are too large to be transported into a cell by carrier proteins. In a process called endocytosis, the large particle is brought into the cell.



Which of the following statements correctly summarizes this process?

- F. Waste materials can enter the cell by the same process.
- G. The particle passes directly through a protein doorway in the cell membrane.
- H. The particle passes directly through the phospholipids that make up the cell membrane.
- I. The cell membrane surrounds the particle and forms a vesicle that is brought into the cell.

SC.912.L.14.2**Biology**

- 3** Cells can have two kinds of endoplasmic reticulum (ER): smooth ER, which has no ribosomes, and rough ER, which has ribosomes embedded in its membrane. What would happen if the rough endoplasmic reticulum in the cell of an organism lost all of its ribosomes?
- A. ATP production in the cell would stop.
 - B. Protein production in the organism would stop.
 - C. Storage of proteins within the cell would increase.
 - D. Proteins would no longer be exported from the cell.
- 4** An oxygen molecule comes into contact with the outside of a cell's lipid bilayer. What process would allow the molecule to move into the cell?
- F. osmosis
 - G. active transport
 - H. simple diffusion
 - I. facilitated diffusion

SC.912.L.14.3**Biology**

Compare and contrast the general structures of plant and animal cells. Compare and contrast the general structures of prokaryotic and eukaryotic cells.

STANDARD REVIEW

The smallest and simplest cells are prokaryotes, which are bacteria. A prokaryote is a single-celled organism that lacks a nucleus and other internal compartments. Prokaryotic cells depend on a strong cell wall to give the cell shape. A prokaryotic cell wall is made of strands of polysaccharides connected by short chains of amino acids. Some prokaryotic cell walls are surrounded by a structure called a capsule, which is also composed of polysaccharides. The capsule enables prokaryotes to cling to almost anything, including teeth, skin, and food. Many prokaryotes have flagella, which are long, threadlike structures that protrude from the cell's surface and enable movement.

The first cells with internal compartments were primitive eukaryotic cells, which evolved about 2.5 billion years ago. A eukaryote, such as a plant or an animal, is an organism whose cells have a nucleus. The nucleus is an internal compartment that houses the cell's DNA. Other internal compartments, or organelles, enable eukaryotic cells to function in ways different from prokaryotes. An organelle is a structure that carries out specific activities in the cell.

Many organelles—such as the endoplasmic reticulum, vesicles, Golgi apparatus, lysosomes, and mitochondria—are found in both animal cells and plant cells. However, plant cells have three additional structures that are not found in animal cells:

- The cell wall—composed of proteins and carbohydrates, including the polysaccharide cellulose—surrounds the cell membrane of plant cells.
- Chloroplasts are organelles that use light energy to make carbohydrates from carbon dioxide and water.
- The central vacuole is a large membrane-bound space that stores water and may contain many substances, including ions, nutrients, and wastes; when full, it makes the cell rigid.

Many single-celled eukaryotes use flagella for movement. Short hairlike structures called cilia protrude from the surface of other eukaryotic cells. Flagella or cilia propel some cells through their environment. In other cells, cilia and flagella move substances across the cell's surface.

SC.912.L.14.3**Biology****STANDARD PRACTICE**

- 1 Plants play an important role in the carbon cycle by producing carbohydrates. Which of the following organelles enables plants to make carbohydrates from carbon dioxide and water?
- A. cell wall
 - B. central vacuole
 - C. chloroplast
 - D. nucleus
- 2 The digestive system breaks down materials into substances the body can use. What structure inside the cell is most similar to the digestive system in humans?
- F. cytoplasm
 - G. lysosome
 - H. nucleolus
 - I. ribosome
- 3 The diagram below shows a cell.

STRUCTURE OF A CELL

What type of organism might contain this type of cell?

- A. algae
- B. animal
- C. bacterium
- D. plant

SC.912.L.14.3

Biology

- 4 Cells may have different shapes and different amounts of organelles, depending on their function. Which features do plant cells have that animal cells lack?
- F. chloroplast, ribosome, and cell wall
 - G. Golgi apparatus, cytoskeleton, and vesicle
 - H. cell wall, chloroplast, and central vacuole
 - I. central vacuole, chloroplast, and smooth ER

SC.912.L.14.4**Biology**

Compare and contrast structure and function of various types of microscopes.

STANDARD REVIEW

Different types of microscopes have different qualities and uses. Light microscopes that use two lenses are called compound light microscopes. In a typical compound light microscope, a light bulb in the base shines light up through the specimen, which is mounted on a glass slide. Both lenses magnify the image. Thus, a microscope with a $40\times$ lens and a $10\times$ lens produces a total magnification of $400\times$. The most powerful compound light microscopes have a total magnification of up to $2,000\times$, which is sufficient for viewing objects as small as $0.5\text{ }\mu\text{m}$ in diameter.

Electron beams have a much shorter wavelength than that of visible light, so electron microscopes are much more powerful than light microscopes. Electron microscopes can magnify an image up to $200,000\times$, and they can be used to study very small structures inside cells or on cell surfaces. In electron microscopes, both the electron beam and the specimen must be placed in a vacuum chamber so that the electrons in the beam will not bounce off gas molecules in the air. Because living cells cannot survive in a vacuum, they cannot be viewed using electron microscopes. Also, electron microscope images are always in black and white unless scientists have added artificial colors to make certain structures more visible.

Two kinds of electron microscopes are transmission electron microscopes and scanning electron microscopes. In a transmission electron microscope, the electron beam is directed at a very thin slice of a specimen stained with metal ions. A transmission electron micrograph (TEM) can reveal a cell's internal structure in fine detail. In a scanning electron microscope, the electron beam is focused on a specimen coated with a very thin layer of metal. A scanning electron micrograph (SEM) shows three-dimensional images of cell surfaces.

The scanning tunneling microscope uses a needle-like probe to measure differences in voltage caused by electrons that leak, or tunnel, from the surface of the object being viewed. A computer tracks the movement of the probe across the object, enabling objects as small as individual atoms to be viewed. The computer generates a three-dimensional image of the specimen's surface. The scanning tunneling microscope can be used to study living organisms.

SC.912.L.14.4

Biology

STANDARD PRACTICE

- 1 Which of the following instruments produces highly magnified images of a cell's internal structure but cannot be used to examine living cells?
 - A. hand lens
 - B. light microscope
 - C. scanning electron microscope
 - D. transmission electron microscope

- 2 How does a microscope help scientists observe objects?
 - F. It measures objects.
 - G. It magnifies images.
 - H. It performs calculations.
 - I. It stains transparent objects.

- 3 A scientist examines a sample of tissue using the instrument shown below.



What kind of instrument is she using?

- A. hand lens
- B. light microscope
- C. scanning electron microscope
- D. transmission electron microscope

SC.912.L.14.4

Biology

- 4 Why might a scientist use colored dyes when viewing items under a compound light microscope?
- F. to make them more visible
 - G. to make them more attractive
 - H. to make them appear more realistic
 - I. to make them appear more three-dimensional
- 5 Which of the following items is best observed under a compound light microscope?
- A. an atom
 - B. a colony of ants
 - C. a single-celled organism
 - D. an underground fungal system
- 6 The Dutch scientist Anton van Leeuwenhoek used a microscope that made objects appear 300 times as large as they were. If a cell appeared to be 6 mm long under the microscope, how long was the cell in real life?
- F. 0.02 mm
 - G. 0.05 mm
 - H. 0.20 mm
 - I. 0.50 mm

SC.912.L.14.6**Biology**

Explain the significance of genetic factors, environmental factors, and pathogenic agents to health from the perspectives of both individual and public health.

HE.912.C.1.3

STANDARD REVIEW

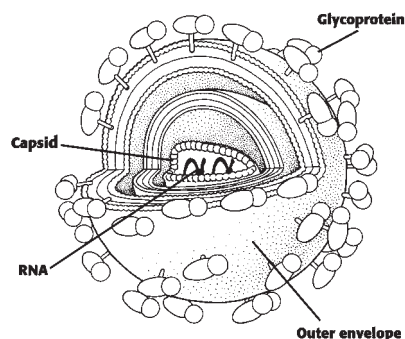
In general, you can get infectious diseases in any of five different ways: through person-to-person contact, air, food, water, and animal bites. They are caused by pathogens, which are disease-causing agents. Pathogens can be bacteria, viruses, fungi, or protists. Diseases transferred from person to person are considered contagious, or communicable. For example, when a person sneezes, droplets of saliva and mucus carrying pathogens are expelled from the mouth and nose. If another person breathes these droplets, the pathogens can infect that person.

Some diseases are not infectious. They are instead caused by environmental factors, such as poisons or a lack of a certain type of nutrient in the diet. Some are caused when a person's genetic material is damaged or copied incorrectly, resulting in genes that produce faulty proteins. Changes in genetic material are called mutations. Mutations can occur randomly. Or, they can be caused by exposure to environmental factors, such as radiation or chemicals.

When a mutation occurs in the genetic material of an egg or sperm, it can be passed from parent to offspring. Harmful effects produced by inherited mutations are called genetic disorders. Some genetic disorders include sickle cell anemia, cystic fibrosis, hemophilia, and Huntington's disease.

SC.912.L.14.6**Biology****STANDARD PRACTICE**

- 1 In the 1800s, many people living in cities in the United States died of infectious diseases such as cholera, which is caused by a bacterium that pollutes water. Cholera is no longer a major problem in the United States. What is the **most likely** reason for the elimination of cholera as a major disease?
- A. Advances in medicine have led to cures for cholera.
 - B. People have learned the importance of washing their hands.
 - C. Sewage treatment plants have eliminated such pathogens from drinking water.
 - D. Regulations have prevented factories from dumping pollution into lakes and rivers.
- 2 Throughout history, amoebic dysentery has resulted in the deaths of many soldiers. Deaths from this illness have often exceeded the number of deaths from wounds. What likely led to the high rate of infection by the amoeba that causes this disease?
- F. lack of available vaccines
 - G. lack of doctors to treat the sick soldiers
 - H. lack of vitamins and minerals in the diet
 - I. unclean food and water on the battlefield
- 3 The diagram below shows an HIV particle.



What is the function of the glycoproteins on the outside of the virus?

- A. to carry genetic material
- B. to propel the virus forward
- C. to help the virus invade cells
- D. to protect the HIV particle from antibodies

SC.912.L.14.6

Biology

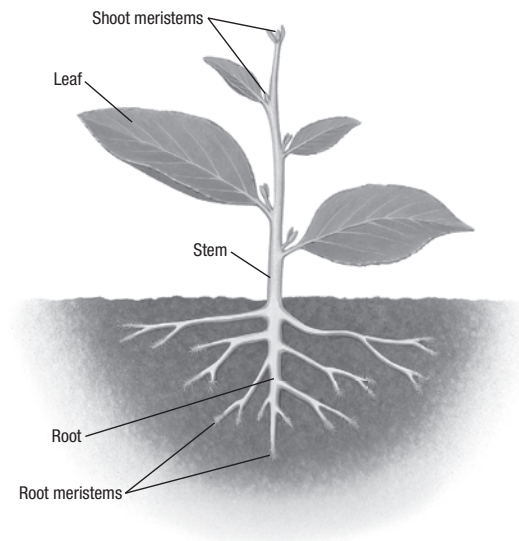
- 4 Diseases can be caused by many different types of organisms, including protozoa. Which of the following diseases is caused by a protozoan?
- F. anthrax
 - G. influenza (flu)
 - H. malaria
 - I. tuberculosis
- 5 Although many types of bacteria are helpful and do not cause disease, nearly half of all human diseases are bacterial. Better sanitation and the use of antibiotics over the last century have affected death rates from bacterial infections in which way?
- A. death rates have increased
 - B. death rates have decreased
 - C. death rates have remained the same
 - D. death rates have increased and then decreased

SC.912.L.14.7**Biology**

Relate the structure of each of the major plant organs and tissues to physiological processes.

STANDARD REVIEW

Nearly all plants have a body that consists of a vertical shaft from which specialized structures branch, as shown below. The part of a plant's body that grows mostly upward is called the shoot. In most plants, the part of the body that grows downward is called the root. Zones of actively dividing plant cells, called meristems, produce plant growth. The vertical body form results as new cells are made at the tips of the plant body.



Specialized cells that transport water and other materials within a plant are found in vascular tissues. Relatively soft-walled cells transport organic nutrients in a kind of tissue called phloem. Hard-walled cells transport water and mineral nutrients in a kind of tissue called xylem, which also helps support the plant body.

A watertight covering called the cuticle, which reduces water loss, is a waxy layer that covers the nonwoody aboveground parts of most plants. The cuticle does not let oxygen or carbon dioxide pass through it. Pores called stomata (singular, stoma) permit plants to exchange oxygen and carbon dioxide. A pair of specialized cells called guard cells border each stoma, as seen below. Stomata open and close as the guard cells change shape.



SC.912.L.14.7**Biology**

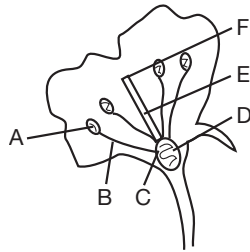
Some plants reproduce through seeds. A seed is a structure that contains the embryo of a plant. An embryo is an early stage in the development of plants and animals. Most plants living today are seed plants—vascular plants that produce seeds. Some, such as pine trees, are gymnosperms, seed plants whose seeds do not develop within a sealed container (a fruit). Most seed plants are flowering plants, or angiosperms. Angiosperms produce seeds that develop enclosed within a specialized structure called a fruit.

SC.912.L.14.7**Biology****STANDARD PRACTICE**

1 The stomata on a saguaro cactus must open to let in carbon dioxide from the atmosphere. When each stoma opens, however, water can escape from the plant. How does the saguaro minimize the loss of water when stomata open?

- A. Guard cells open and close the stomata rapidly during the day to let as little water as possible escape.
- B. Guard cells open the stomata only at night, when the air temperature is cooler and the humidity somewhat higher.
- C. Guard cells always keep the stomata open slightly, so that carbon dioxide can flow in but very little water can flow out.
- D. The saguaro has fewer stomata than any other plant, an adaptation that prevents water loss through transpiration.

2 The diagram below shows a flower.

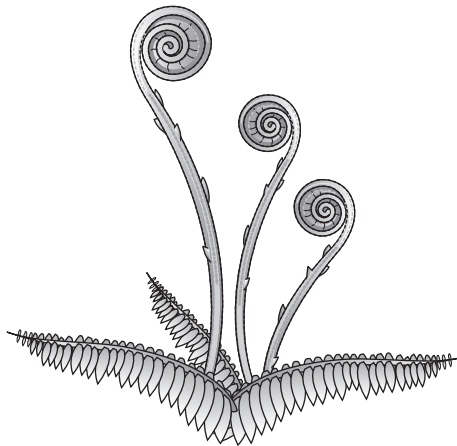


Which parts of the flower are male reproductive structures?

- F. parts A and B
- G. parts C and D
- H. parts E and F
- I. parts D, E, and F

SC.912.L.14.7**Biology**

- 3 A unique characteristic of the banyan tree is that roots grow down from its branches into the ground. The tree can appear to have several trunks. What advantage does this root characteristic give the banyan tree over other trees?
- A. The roots provide shelter for ground-dwelling animals, which carry nutrients to the tree.
 - B. The banyan can grow near the equator, because aboveground roots are more protected from the sun.
 - C. The banyan can only grow in humid climates, because aboveground roots are more likely to dry out and die during droughts.
 - D. The banyan can grow in areas prone to hurricanes and typhoons, because the roots make the tree more stable in high winds.
- 4 The drawing below shows fiddleheads from a fern.



A fiddlehead develops into what plant part?

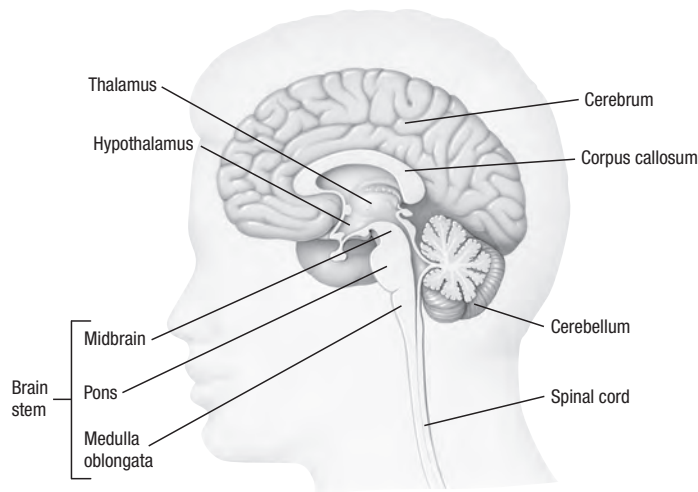
- F. stem
- G. seed
- H. flower
- I. leaf or frond

SC.912.L.14.26**Biology**

Identify the major parts of the brain on diagrams or models.

STANDARD REVIEW

The brain, shown in the diagram below, is the body's main processing center. It consists of three major parts—the cerebrum, the cerebellum, and the brain stem.



The cerebrum is the largest part of the brain. The capacity for learning, memory, perception, and intellectual function resides in the cerebrum. The cerebrum has a folded outer layer with many bumps and grooves. A long, deep groove down the center divides the cerebrum into right and left halves, or hemispheres. The cerebral hemispheres communicate through a connecting band of axons called the corpus callosum. Most sensory and motor processing occurs in the cerebral cortex, the folded thin outer layer of the cerebrum.

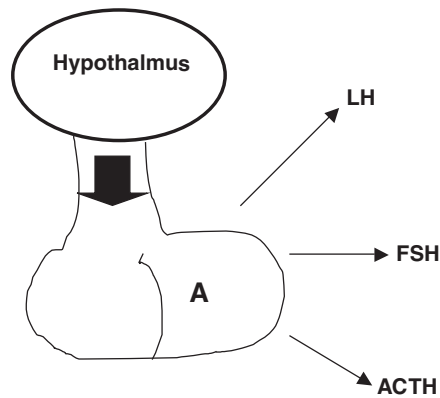
The cerebellum regulates balance, posture, and movement. The cerebellum smooths and coordinates ongoing movements, such as walking, by timing the contraction of skeletal muscles. The cerebellum integrates and responds to information about body position from the cerebrum and the spinal cord to control balance and posture.

The brain stem is a collection of structures leading down to the spinal cord and connecting the cerebral hemispheres with the cerebellum. The lower brain stem consists of the midbrain, the pons, and the medulla oblongata. These structures relay information throughout the central nervous system and play an important role in homeostasis by regulating vital functions, such as heart rate, breathing rate, body temperature, and sleep.

The upper brain stem contains important relay centers that direct information to and from different parts of the brain. The thalamus is a critical site for sensory processing. Sensory information from all parts of the body converges on the thalamus, which relays the information to appropriate areas of the cerebral cortex. The hypothalamus, along with the medulla oblongata, helps regulate many vital homeostatic functions, such as breathing and heart rate. The hypothalamus is responsible for feelings of hunger and thirst. It also regulates many functions of the endocrine system by controlling the secretion of many hormones.

SC.912.L.14.26**Biology****STANDARD PRACTICE**

- 1** Which part of the brain plays a major role in homeostasis by regulating such processes as heart rate and breathing through the autonomic nervous system?
- A. brainstemw
 - B. cerebrum
 - C. hypothalamus
 - D. thalamus
- 2** The diagram shows that the hypothalamus stimulates a gland to release hormones.

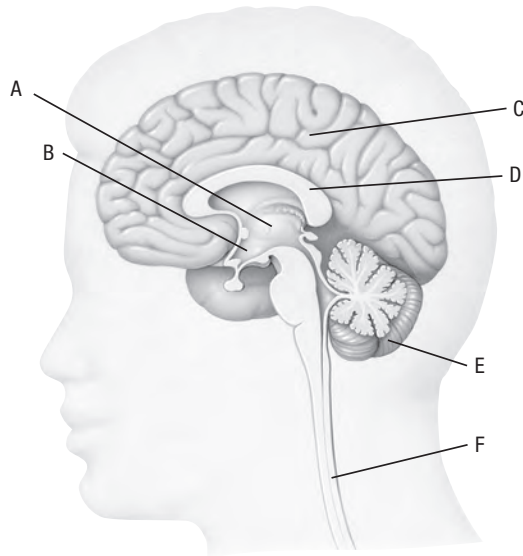


Which endocrine gland does the area marked A refer to?

- F. testis
- G. ovary
- H. adrenal gland
- I. anterior lobe of the pituitary

SC.912.L.14.26**Biology**

- 3** The diagram below shows parts of the central nervous system.



What is the function of part *E*?

- A. learning and memorization
- B. coordinating movement, balance, and posture
- C. regulating functions of the endocrine system
- D. allowing communication between both sides of the brain

- 4** Which structure connects the cerebral hemispheres with the cerebellum?

- F. brain stem
- G. corpus callosum
- H. sensory receptor
- I. spinal cord

SC.912.L.14.36**Biology**

Describe the factors affecting blood flow through the cardiovascular system.

STANDARD REVIEW

The human cardiovascular system is made up of blood vessels, blood, and the heart, which together function to transport materials, remove wastes, and distribute heat. Blood vessels allow for the movement of blood to all cells in the body. The pumping action of the heart, however, is needed to provide enough pressure to move blood throughout the body. The heart is made up mostly of cardiac muscle tissue, which contracts to pump blood.

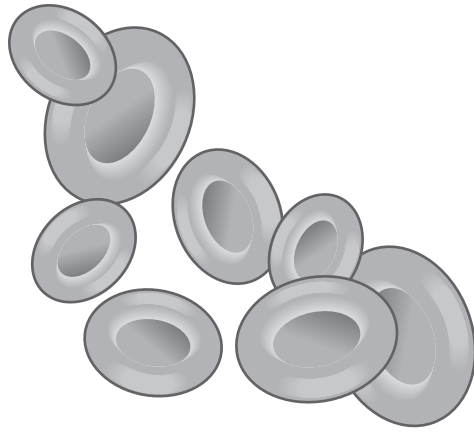
The human heart has two separate circulatory loops. The right side of the heart is responsible for driving the pulmonary circulation loop, which pumps oxygen-poor blood through the pulmonary arteries to the lungs. Gas exchange—the release of carbon dioxide and pick up of oxygen—occurs in the lungs. The oxygenated blood is then returned to the left side of the heart through pulmonary veins.

The left side of the heart is responsible for driving the systemic circulation loop, which pumps oxygen-rich blood through a network of arteries to the tissues of the body. Oxygen-poor blood is then returned to the right side of the heart through the veins.

As blood flows through the blood vessels of the body, it provides cells with nutrients and oxygen and carries away wastes and carbon dioxide. Blood consists of plasma (water, metabolites, wastes, salts, and proteins), red blood cells, white blood cells, and platelets. Red blood cells carry oxygen. White blood cells fight infection and disease. Platelets help clot the blood and stop bleeding in a wound.

SC.912.L.14.36**Biology****STANDARD PRACTICE**

- 1** A red blood cell has a flattened disc shape, as illustrated below.



What advantage does the shape of a red blood cell provide?

- A. decreases its surface area-to-volume ratio in order to limit cell growth
 - B. increases its surface area-to-volume ratio so it can take in nutrients efficiently
 - C. increases its surface area-to-volume ratio so that the cell can grow much larger
 - D. decreases its surface area-to-volume ratio so more cells can fit in a blood vessel
- 2** Some disorders result in a drastic drop-off in the number of platelets in the blood. What effect would a low “platelet count” have on the body?
- F. A person with this disorder would become anemic.
 - G. The risk of bleeding from a wound would increase.
 - H. The body would not be able to fight off infectious diseases.
 - I. The risk of stroke or heart attack would increase due to blood clots.
- 3** An investigation traces the concentration of oxygen gas contained in blood as the blood passes through the circulatory system. Which choice below begins with the area of the circulatory system where blood has the highest oxygen level and ends where blood contains the lowest oxygen level?
- A. capillaries, veins, right ventricle, lungs, left ventricle
 - B. lungs, left ventricle, capillaries, veins, right ventricle
 - C. right ventricle, lungs, left ventricle, capillaries, veins
 - D. veins, right ventricle, lungs, left ventricle, capillaries

SC.912.L.14.36**Biology**

- 4** Heart rate, or the rate at which the muscles in the heart contract, is controlled by the sinoatrial node, a group of cells in the cardiac muscle of the right atrium. Heart rate decreases when you are asleep and increases when you are awake. Some people require an artificial pacemaker to regulate their heart rate if it is too slow. Which hypothesis explains how the body might be affected by a dangerously slow heart rate?
- F. The body might have trouble falling asleep or feeling rested after a full night of sleep.
 - G. Cells in the body might not receive enough oxygen, which could cause the person to faint.
 - H. The adrenal gland might not produce enough hormones to prepare the body for a quick reaction.
 - I. Breathing might become shallow, which could cause the person to retain too much carbon dioxide.
- 5** A lack of which component(s) might cause concern about blood-clotting ability in someone about to undergo surgery?
- A. platelets
 - B. red blood cells
 - C. white blood cells
 - D. red and white blood cells

SC.912.L.14.52**Biology**

Explain the basic functions of the human immune system, including specific and nonspecific immune response, vaccines, and antibiotics.

HE.912.C.1.8

STANDARD REVIEW

The immune system consists of cells and tissues found throughout the body. The body uses both nonspecific and specific defense mechanisms to detect and destroy pathogens, thereby preventing or reducing the severity of infection.

The body's surface defenses are nonspecific, meaning they do not target specific pathogens. Your skin is the first of your immune system's nonspecific defenses against pathogens. Skin acts as a nearly impenetrable barrier to invading pathogens, keeping them outside the body. Oil and sweat make the skin's surface acidic, inhibiting the growth of many pathogens. Sweat also contains the enzyme lysozyme, which digests bacterial cell walls. Mucous membranes are layers of epithelial tissue that produce a sticky, viscous fluid called mucus that serves as a barrier to pathogens and produces chemical defenses.

When pathogens break through your body's first line of defense, four important nonspecific defenses take action:

- Body temperature increases and slows the growth of bacteria.
- An inflammatory response causes local blood vessels to dilate, increasing blood flow to the infection site.
- Blood flow brings white blood cells that can attack and kill pathogens.
- Blood flow also brings special proteins that kill or inhibit pathogens.

Pathogens that have survived the first and second lines of nonspecific defenses still face a third line of specific defenses—the immune response. The immune response consists of an army of individual cells that rush throughout the body to combat specific invading pathogens. Four main kinds of white blood cells participate in the immune response: macrophages, cytotoxic T cells, B cells, and helper T cells. Each kind of cell has a different function. Macrophages consume pathogens and infected cells. Cytotoxic T cells attack and kill infected cells. B cells label invaders for later destruction by macrophages. Helper T cells activate both cytotoxic T cells and B cells. Macrophages can attack any pathogen. B cells and T cells, however, respond only to pathogens for which they have a genetically programmed match. These four kinds of white blood cells interact to remove pathogens from the body.

SC.912.L.14.52**Biology****STANDARD PRACTICE**

- 1** The hypothesis that germs cause disease is called germ theory. Before the 1880s, many scientists believed in the idea of spontaneous generation—the sudden appearance of living organisms from nonliving matter. Today germ theory is accepted as one of the great discoveries of medicine. Which of the following is a way in which germ theory has had an impact on modern health care?
- A. the development of safer anesthetics
 - B. the development of genetic medicine
 - C. the development of vaccines against childhood diseases
 - D. the rise in public awareness about the causes of heart disease
- 2** The human immune system can produce a specific response or a nonspecific response to infection. Which of the following is a specific immune response of the human immune system?
- F. fever
 - G. inflammation
 - H. antigen display
 - I. interferon release
- 3** When a pathogen infects a host cell, the body produces specialized white blood cells that detect and destroy the specific pathogen. Pathogens have unique proteins on their surfaces called antigens. The specificity of the immune system is due to the antigen receptors on immune cells. These antigen receptors bind to antigens that match their shape exactly. Helper T cells are regulatory white blood cells with specific antigen receptors on their surfaces. Activated helper T cells do not directly attack infected body cells or pathogens. Instead, they grow and divide, producing more helper T cells with identical receptors on their surfaces. The helper T cells activate the destruction of the infected cells and the removal of extracellular pathogens from the body. How does the presence of more helper T cells affect the immune response to a specific pathogen?
- A. the more helper T cells, the more antibodies are produced
 - B. the more helper T cells, the less the body is able to react to a specific pathogen
 - C. the more helper T cells that are activated, the more robust the immune response
 - D. the more helper T cells, the more infected body cells will be attacked and destroyed

SC.912.L.14.52**Biology**

- 4 Louis Pasteur, a French microbiologist, developed a vaccine against rabies. In 1885, he tested it on a young man infected with the microbe that causes rabies. Medical researchers searching for a vaccine against the virus that causes AIDS say that a vaccine against this disease faces years of testing. Why can't doctors try out untested vaccines on people today as Pasteur did in the 1880s?
- F. Drug companies delay releasing vaccines because they need to maximize profits.
 - G. There is much more unnecessary government red tape today than there was in the 1880s.
 - H. Vaccines developed today are not as effective as those that were developed in the 1800s.
 - I. Ethical issues and laws prevent doctors from giving people vaccines that may contain unknown hazards.
- 5 In the immune system's specific response, white blood cells can target specific types of disease-causing microbes. How do white blood cells recognize invading microbes?
- A. Receptor proteins on their surfaces bind to specific antigens.
 - B. Helper T cells release antibodies that bind with the antigens.
 - C. Natural killer cells puncture and destroy the infected body cells.
 - D. Plasma cells bind to the viral antigens and mark them for destruction.
- 6 Two types of white blood cells are macrophages and natural killer cells. How are the roles of a macrophage and a natural killer cell different?
- F. Macrophages target specific cells, while natural killer cells kill all pathogens.
 - G. Macrophages ingest pathogens and dead cells, while natural killer cells only target cancer cells.
 - H. Macrophages attack lymph cells, and natural killer cells clean up debris from dead cells.
 - I. Macrophages ingest and kill pathogens, while natural killer cells puncture the cell membranes of infected cells.

SC.912.L.15.1**Biology**

Explain how the scientific theory of evolution is supported by the fossil record, comparative anatomy, comparative embryology, biogeography, molecular biology, and observed evolutionary change.

SC.912.N.1.6

STANDARD REVIEW

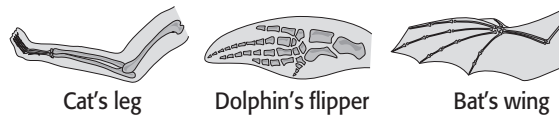
In 1859, the English naturalist Charles Darwin published convincing evidence that species evolve, and he proposed a reasonable mechanism explaining how evolution occurs. Darwin proposed that individuals that have physical or behavioral traits that better suit their environment are more likely to survive and will reproduce more successfully than those that do not have such traits. Darwin called this differential rate of reproduction natural selection. In time, the number of individuals that carry favorable characteristics that are also inherited will increase in a population. And thus the nature of the population will change—a process called evolution.

Darwin further suggested that organisms differ from place to place because their habitats present different challenges to, and opportunities for, survival and reproduction. Each species has evolved and has accumulated adaptations in response to its particular environment. An adaptation is an inherited trait that has become common in a population because the trait provides a selective advantage.

Scientists have found many different kinds of evidence that supports the theory of evolution. Fossils offer the most direct evidence that evolution takes place. Evidence of orderly change can be seen when fossils are arranged according to their age. The anatomy and development of living things also shows evidence of evolution. For example, the similarities of structures in different vertebrates provide evidence that all vertebrates share a common ancestor. Biological molecules also show evolutionary relationships. Differences in amino acid sequences and DNA sequences are greater between species that are more distantly related than between species that are more closely related.

SC.912.L.15.1**Biology****STANDARD PRACTICE**

- 1** When Darwin first proposed his theory of evolution by natural selection, the field of genetics did not yet exist. In what way does genetic science now contribute to the study of evolution?
- A. Scientists can create organisms that were extinct using DNA from fossils and better understand how they evolved.
 - B. Scientists can use genetic engineering to carry out the process of evolution over just months instead of millions of years.
 - C. Scientists can compare the DNA from fossils in rock to determine evolutionary relationships among extinct species.
 - D. Scientists can determine evolutionary relationships among living species by comparing amino acid sequences coded for by DNA.
- 2** Scientists look at evidence to determine possible evolutionary relationships and mechanisms. Which of the following provides strong evidence for evolution?
- F. the fossil record
 - G. forensic biology
 - H. phylogenetic trees
 - I. works of philosophy
- 3** The pictures below show similarities among the forelimbs of three mammals.



These similarities provide evidence for which of the following hypotheses?

- A. Legs and wings may have evolved from flippers.
- B. All mammals have evolved from an ancestor that was a bat.
- C. A cat's leg, a dolphin's flipper, and a bat's wing have identical functions.
- D. Cats, dolphins, and bats may have had the same ancestor millions of years ago.

SC.912.L.15.1**Biology**

- 4** How does drug resistance develop in bacteria?
- F. Unsanitary conditions allow all kinds of bacteria to breed, including those that are antibiotic resistant.
 - G. In the bloodstream, different species of bacteria exchange genes and become resistant to antibiotics.
 - H. Mutations in some bacterial genes make the bacteria stronger and better able to defeat the body's immune system.
 - I. In the presence of an antibiotic, bacteria with genes that make them resistant survive and eventually take over the population.
- 5** Biologists look at how organisms are related and when they first appeared on Earth. Which of the following is true about the organisms that live on Earth today?
- A. All organisms that have ever lived on Earth can still be found alive today.
 - B. Some of the organisms alive today have been around for 4.6 billion years.
 - C. The organisms alive today are the same as the ones that are found in fossils.
 - D. The organisms alive today evolved from organisms that previously lived on Earth.

SC.912.L.15.4**Biology**

Describe how and why organisms are hierarchically classified and based on evolutionary relationships.

LA.910.4.2.2

STANDARD REVIEW

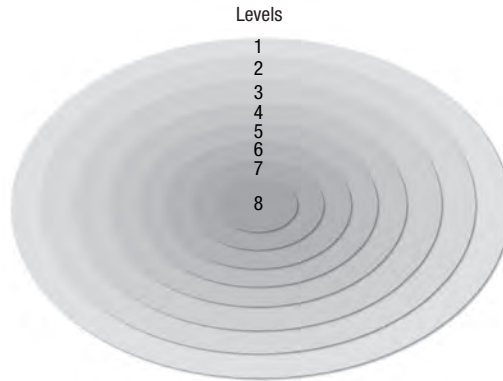
Modern classification of living things is based on a system developed by the Swedish biologist Carl Linnaeus. It is organized into a ranked system of groups that increase in inclusiveness. Similar genera are grouped into a family. Similar families are combined into an order. Orders with common properties are united in a class. Classes with similar characteristics are assigned to a phylum. Similar phyla are collected into a kingdom. Similar kingdoms are grouped into domains. All living things are grouped into one of three domains. Two domains, Archaea and Bacteria, are each composed of a single kingdom of prokaryotes. The third domain, Eukarya, contains all four kingdoms of eukaryotes.

Linnaeus's classification system was based on his observation that organisms have different degrees of similarity. For instance, a tiger resembles a gorilla more closely than either resembles a fish. According to Darwin's views, organisms that are more similar to one another than they are to other organisms have descended from a more recent common ancestor. Therefore, classification based on similarities should reflect an organism's phylogeny, that is, its evolutionary history. Inferring evolutionary connections from similarities, however, can be misleading. Not all features—or characters—are inherited from a common ancestor. Consider the wings of a bird and the wings of an insect. Both enable flight, but the structures of the two kinds of wings differ.

Most biologists today analyze evolutionary relationships using cladistics. Cladistics is a method of analysis that reconstructs phylogenies by inferring relationships based on shared characters. Cladistics can be used to hypothesize the sequence in which different groups of organisms evolved. To do this, cladistics focuses on the nature of the characters in different groups of organisms.

SC.912.L.15.4**Biology****STANDARD PRACTICE**

- 1** In the Linnaean system of classification, organisms are grouped in successive levels of hierarchy based on similarities in their form and structure. The diagram below models the eight basic levels of the modern Linnaean system.



Which level of the Linnaean system does level 8 represent in the figure?

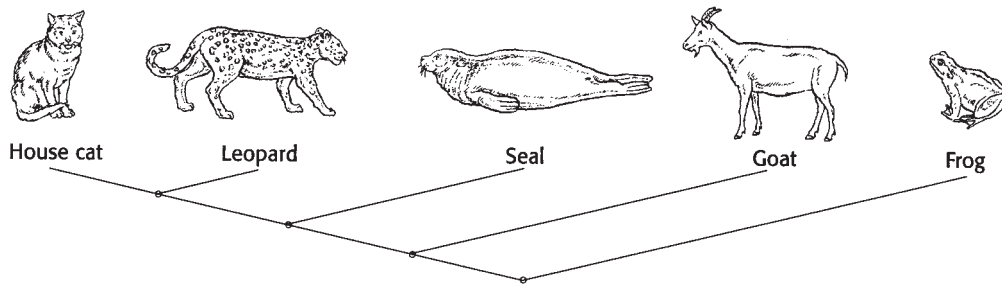
- A. class
 - B. domain
 - C. family
 - D. species
- 2** Which series represents the correct order of levels of classification, from broadest to narrowest?
- F. domain, kingdom, phylum, order, class, family, genus, species
 - G. domain, kingdom, phylum, class, order, family, genus, species
 - H. kingdom, phylum, domain, order, class, family, genus, species
 - I. species, genus, family, class, order, phylum, kingdom, domain

SC.912.L.15.4

Biology

- 3 The diagram below shows the evolutionary relationships among five animals.

ANIMAL CLADOGRAM

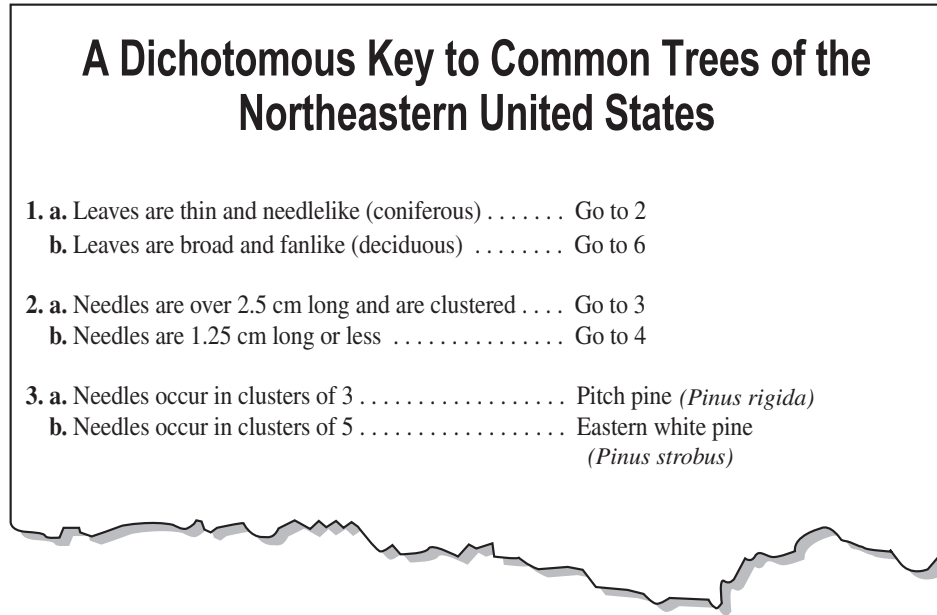


What major characteristic is the same for all five animals?

- A. All are carnivores.
- B. All have backbones.
- C. All spend their entire lives on land.
- D. All maintain a constant body temperature.

SC.912.L.15.4**Biology**

- 4 Below is part of a field guide that several students have been using to identify trees in a local park.



The students notice that one plant has thin 1.2-cm needles that occur in clusters.

Which of the following inferences can be made?

- F. The plant is deciduous.
- G. The plant is a *Pinus rigida*.
- H. The plant is an Eastern white pine.
- I. The plant cannot be identified from the information provided.

SC.912.L.15.5**Biology**

Explain the reasons for changes in how organisms are classified.

STANDARD REVIEW

More than 2,000 years ago, the Greek philosopher and naturalist Aristotle grouped plants and animals according to their structural similarities. Later Greeks and Romans grouped plants and animals into basic categories such as oaks, dogs, and horses. Eventually each unit of classification came to be called a *genus* (plural, *genera*), the Latin word for “group.” Starting in the Middle Ages, genera were named in Latin. The science of naming and classifying organisms is called taxonomy.

Until the mid-1700s, biologists named a particular type of organism by adding descriptive phrases to the name of the genus. These phrases sometimes consisted of 12 or more Latin words. They were called polynomials (from *poly*, meaning “many,” and *nomen*, meaning “name”). For example, the European honeybee once had a 12-part scientific name: *Apis pubescens, thorace subgriseo, abdomine fusco, pedibus posticis glabris, untrunque margine ciliatus*. As you can see, the polynomial could become very large and awkward. Polynomials were often changed by biologists, so organisms were rarely known to everyone by the same name.

A simpler system for naming organisms was developed by the Swedish biologist Carl Linnaeus. Linnaeus used a two-word Latin name for each species. Linnaeus’s two-word system for naming organisms is called binomial nomenclature (from *bi*, meaning “two”). His two-part name for the European honeybee was *Apis mellifera*, the genus name followed by a single descriptive word. This unique two-part name for a species is now referred to as its *scientific name*.

Linnaeus worked out a broad system of classification for plants and animals in which an organism’s form and structure are the basis for arranging specimens in a collection. The genera and species that he described were later organized into a ranked system of groups that increase in inclusiveness. The different groups into which organisms are classified have expanded since Linnaeus’s time and now consist of eight levels: domain, kingdom, phylum, class, order, family, genus, and species.

SC.912.L.15.5**Biology****STANDARD PRACTICE**

- 1** Biologists used to name an organism by adding descriptive phrases to the name of the genus. Why did Linnaeus develop a scientific name for a species composed of two Latin words?
- A. to help identify species and prevent Latin from becoming a dead language
 - B. to help scientists keep knowledge about species within the scientific community
 - C. to prevent confusion by preventing other, competing systems of classification from developing
 - D. to provide a consistent naming system that would allow scientists all over the world to easily identify an individual species
- 2** Linnaeus's system was based on his judgment of the importance of various similarities among living things. Scientists have traditionally used similarities in appearance and structure to group organisms. However, this approach has proven problematic. What is one way that this approach could be problematic?
- F. Some groups look different but turn out not to be related.
 - G. Some groups look similar but turn out to be closely related.
 - H. There is always a clear pattern between appearance and relatedness.
 - I. There is no consistent relationship between structures and relatedness.
- 3** Protists are classified using a different system than that used for most other types of organisms. How does the system used to classify protists differ from other classification systems?
- A. Unlike other systems, the system used to classify protists has not changed significantly in decades.
 - B. Because protists are similar to each other, the classification of protists is much simpler than other classifications.
 - C. Because protists share characteristics with members of other kingdoms, molecular sequencing is critical to classifying protists.
 - D. Because there are few fossils of protists, the classification of protists is based on shared characteristics of only living species.

SC.912.L.15.5

Biology

- 4 The ancient Greeks grouped plants and animals according to their structural similarities. What are modern classification systems based on?
- F. solely on structural characteristics of organisms
 - G. on similar behaviors as well as similar characteristics
 - H. solely on evolutionary relationships between organisms
 - I. on evolutionary relationships as well as similar characteristics
- 5 In addition to the six kingdoms that all organisms are divided into, many scientists also recognize three domains. These domains are divided by five characteristics: cell type, the presence of cell walls, body type, nutrition, and genetics. What is the main division of the way nutrition is gathered?
- A. prokaryotic versus eukaryotic
 - B. unicellular versus multicellular
 - C. extremophiles versus methanogens
 - D. autotrophs versus heterotrophs

SC.912.L.15.6**Biology**

Discuss distinguishing characteristics of the domains and kingdoms of living organisms.

STANDARD REVIEW

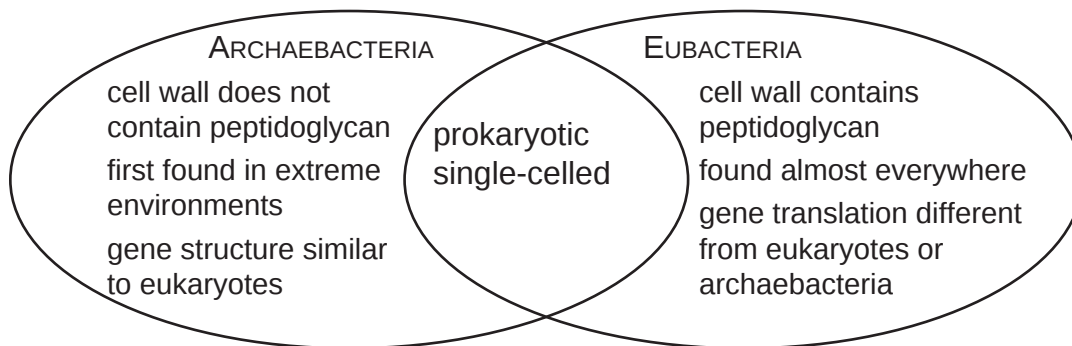
For many decades, scientists recognized two basic forms of life, prokaryotes and eukaryotes. Then, scientists showed that the group of prokaryotes that make up the kingdom Archaeobacteria are more closely related to eukaryotes than they are to the other kingdom of prokaryotes, Eubacteria. Thus, now living things are classified into three domains.

The domain thought to be the oldest is Bacteria, which is composed of the organisms in the kingdom Eubacteria. Archaea is the second prokaryotic domain and is also composed of a single kingdom, Archaeobacteria. A third domain, Eukarya, contains all four of the eukaryotic kingdoms: Animalia (animals), Fungi (fungi), Plantae (plants), and Protista (protists). The table below summarizes the major characteristics of the organisms in the six kingdoms and three domains.

Domain and Kingdom Characteristics						
Domain	Kingdom	Characteristics				
		Cell type	Cell structure	Body type	Nutrition	Example
Bacteria	Eubacteria	Prokaryotic	Cell wall, peptidoglycan	Unicellular	Autotrophic and heterotrophic	Enterobacteria Spirochetes
Archaea	Archaeobacteria	Prokaryotic	Cell wall, no peptidoglycan	Unicellular	Autotrophic and heterotrophic	Methanogens
Eukarya	Protista	Eukaryotic	Mixed	Unicellular and multicellular	Autotrophic and heterotrophic	Amoebas Euglenas Kelps
Eukarya	Fungi	Eukaryotic	Cell wall, chitin	Unicellular and multicellular	Heterotrophic	Yeasts Mushrooms
Eukarya	Plantae	Eukaryotic	Cell wall, cellulose	Multicellular	Autotrophic	Ferns Pine trees
Eukarya	Animalia	Eukaryotic	No cell wall	Multicellular	Heterotrophic	Birds Earthworms

SC.912.L.15.6**Biology****STANDARD PRACTICE**

- 1** Scientists find a new organism that is composed of many cells, gets its nutrition from decaying organisms, and has cell walls. To what kingdom would the new organism belong?
- A. Animalia B. Eubacteria
C. Fungi D. Protista
- 2** Which of the following properties could be used to distinguish between an organism in the domain Bacteria and one in the domain Eukarya?
- F. contains membrane-bound organelles
G. uses energy to carry out multiple functions
H. uses simple mechanical motion to move around
I. is composed of organic chemicals such as amino acids
- 3** The Venn diagram below compares the two kingdoms Archaeobacteria and Eubacteria.



Which of the following scientific explanations supports the division of archaea, or archaeobacteria, and bacteria into two different domains?

- A. Archaea cause disease, but bacteria do not.
B. Bacteria have a nucleus, but archaea do not.
C. Archaea are single-celled, but bacteria often have more than one cell.
D. Archaea and bacteria exhibit differences in cell walls, cell membranes, and gene structure.

SC.912.L.15.6

Biology

- 4 Some people confuse slime molds with fungi that are also called molds. What would be a reason that taxonomists chose to classify slime molds as protists rather than fungi?
- F. Slime molds are able to reproduce using spores.
 - G. Slime molds live in cool, moist places in a forest.
 - H. Slime molds are able to decompose small bits of rotting matter.
 - I. Slime molds are able to move during certain phases of their life.

SC.912.L.15.8**Biology**

Describe the scientific explanations of the origin of life on Earth.

SC.912.N.1.3

STANDARD REVIEW

Scientists who study the origins of life think that the path to the development of living things began when molecules of nonliving matter reacted chemically during the first billion years of Earth's history. These chemical reactions produced many different simple, organic molecules. Energized by the sun and volcanic heat, these simple, organic molecules formed more-complex molecules that eventually became the building blocks of the first cells.

In the 1920s, the Russian scientist A. I. Oparin and the British scientist J.B.S. Haldane both suggested that the early Earth's oceans contained large amounts of organic molecules. This hypothesis became known as the primordial soup model. Earth's vast oceans were thought to be filled with many different organic molecules. Oparin and Haldane hypothesized that these molecules formed spontaneously in chemical reactions activated by energy from solar radiation, volcanic eruptions, and lightning.

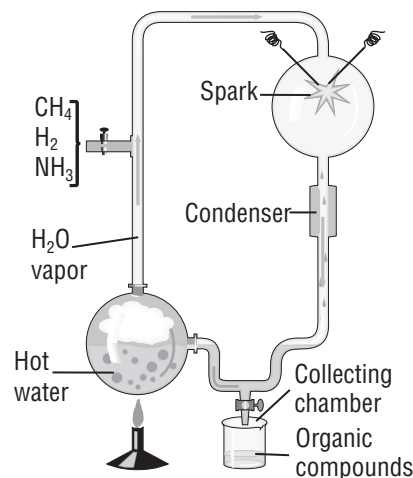
In 1953, the primordial soup model was tested by Stanley Miller and Harold Urey. Miller placed the gases that he and Urey proposed had existed on early Earth into a device made up of glass tubes and vessels. To simulate lightning, he provided electrical sparks. After a few days, Miller found a complex collection of organic molecules, including some of life's basic building blocks: amino acids, fatty acids, and other hydrocarbons. These results support the hypothesis that some basic chemicals of life could have formed spontaneously under conditions like those in the experiment.

Scientists have reevaluated the Miller-Urey experiment in light of the fact that we now know that four billion years ago, Earth did not have a protective layer of ozone gas, O₃. Without ozone, ultraviolet radiation would have destroyed any ammonia and methane present in the atmosphere.

In 1986, the geophysicist Louis Lerman suggested that the key processes that formed the chemicals needed for life took place within bubbles beneath the ocean's surface. In this bubble model, he proposed that ammonia, methane, and other gases resulting from the numerous eruptions of undersea volcanoes were trapped in underwater bubbles. Inside the bubbles, these gases might have been protected from damaging ultraviolet radiation and could have undergone chemical reactions. Eventually, the bubbles rose to the surface and burst, releasing simple organic molecules into the air. In the air, the simple organic molecules were exposed to ultraviolet radiation and lightning, which provided energy for further reactions. The more-complex organic molecules that formed fell into the ocean with rain, starting another cycle.

SC.912.L.15.8**Biology****STANDARD PRACTICE**

- 1** Two models of the origin of life on Earth are the primordial soup model and the bubble model. What do these two models of how life began on Earth have in common?
- A. Both explain how UV radiation produces ammonia and methane.
 - B. Both involve only chemical reactions that take place within the ocean.
 - C. Both include chemical reactions that take place when there is lightning.
 - D. Both involve only chemical reactions that take place within the atmosphere.
- 2** American scientists Stanley Miller and Harold Urey used an apparatus similar to the one in the diagram below to simulate how life could have formed on Earth. The apparatus contained hydrogen gas, water vapor, ammonia, and methane. These gases were subjected to a spark, to simulate lightning.



They found that organic molecules could form from the inorganic gases. Their theory of how life began, however, did not hold up under further testing. What crucial fact did they not have when they conducted their experiment?

- F. There was no lightning in Earth's early atmosphere.
- G. Ammonia and methane were not in the early atmosphere.
- H. The chemicals used in the experiment were contaminated.
- I. Organic molecules already existed before the atmosphere formed.

SC.912.L.15.8**Biology**

- 3** The Miller-Urey experiment showed that, under certain conditions, organic compounds could form from inorganic molecules. What is one consequence of this experiment?
- A. Scientists think that life could not have developed through natural chemical and physical processes.
 - B. The experiment proved that methane and ammonia will always give rise to organic molecules in any circumstance.
 - C. Scientists think it is possible that organic compounds formed from the inorganic compounds present on Earth billions of years ago.
 - D. The experiment used the exact inorganic compounds present on Earth billions of years ago and left little doubt about the mechanism of early life.
- 4** The bubble model states that the key processes that formed the chemicals needed for life took place within bubbles beneath the ocean's surface. What important role did bubbles play according to the bubble model?
- F. They provided protection from damaging ultraviolet radiation.
 - G. They allowed the reactions to take place in the presence of oxygen.
 - H. They kept the chemical products from ever entering Earth's atmosphere.
 - I. They gave the activation energy needed for spontaneous chemical reactions.

SC.912.L.15.10**Biology**

Identify basic trends in hominid evolution from early ancestors six million years ago to modern humans, including brain size, jaw size, language, and manufacture of tools.

STANDARD REVIEW

A primate is a member of the mammalian order Primates. Hominids are primates that walk upright on two legs. Hominids are members of the group that led to the evolution of humans. According to the fossil record, hominids first appeared on Earth about 5 million to 7 million years ago. The early hominids best represented by fossil finds belong to the group known as australopithecines. Australopithecines belong to the genus *Australopithecus*. Their brains were generally as large as those of modern chimpanzees. They were much smaller, however, than the brains of modern humans.

Our genus, *Homo*, is composed of at least three species. The first members of the genus *Homo* appeared on Earth more than 2 million years ago. In the early 1960s, stone tools were discovered near hominid bones. Because of its association with tools, this hominid was named *Homo habilis*. The Latin word *homo* means “man,” and the Latin word *habilis* means “handy.” Fossils indicated that *Homo habilis* lived in Africa for about 500,000 years and then became extinct.

The species that replaced *Homo habilis* is called *Homo erectus*. *Homo erectus* was larger than *Homo habilis* and also had a large brain. This species evolved in Africa and migrated into Asia and Europe. *Homo erectus* survived for more than 1 million years. The species disappeared about 200,000 years ago, as early modern humans emerged. Most scientists think that *Homo erectus* was the direct ancestor of our species, *Homo sapiens*.

Of the three modern humans, *Homo sapiens* is the only surviving species of the genus *Homo*. The name *Homo sapiens* is from the Latin *homo*, meaning “man,” and *sapiens*, meaning “wise.” Early *Homo sapiens* left behind many fossils and artifacts, including the first known paintings.

SC.912.L.15.10**Biology****STANDARD PRACTICE**

- 1** Which species name meaning “handyman” was given to a set of hominid fossils found near stone tools?
- A. *Homo erectus*
 - B. *Homo habilis*
 - C. *Homo neanderthalensis*
 - D. *Homo sapiens*
- 2** How do hominids differ from other primates?
- F. They are bipedal.
 - G. They have long arms.
 - H. They have grasping hands.
 - I. They have binocular vision.
- 3** The following table classifies three different organisms.

CLASSIFICATION OF THREE DIFFERENT ORGANISMS

Organism	Class	A	Family	Genus
Bacterium	Scotobacteria	Spirochaetales	Spirochaetaceae	<i>Cristispira</i>
Box elder	Dicotyledones	Sapindales	Aceraceae	<i>Acer</i>
Human	Mammalia	Primates	Hominidae	B

Which level of classification is represented by the box labeled A?

- A. division
- B. kingdom
- C. order
- D. phylum

SC.912.L.15.10

Biology

- 4 What advantage did the development of bipedalism **most likely** confer to early hominids?
- F. It allowed them to see with binocular vision.
 - G. It allowed them to evolve an opposable thumb.
 - H. It allowed them to evolve a complex social structure.
 - I. It allowed them to move and hold objects at the same time.
- 5 A primate is a member of the mammalian order Primates, which have grasping hands and feet and forward orientation of the eyes. Which of the following is **not** a primate?
- A. hominid
 - B. monkey
 - C. shrew
 - D. tarsier

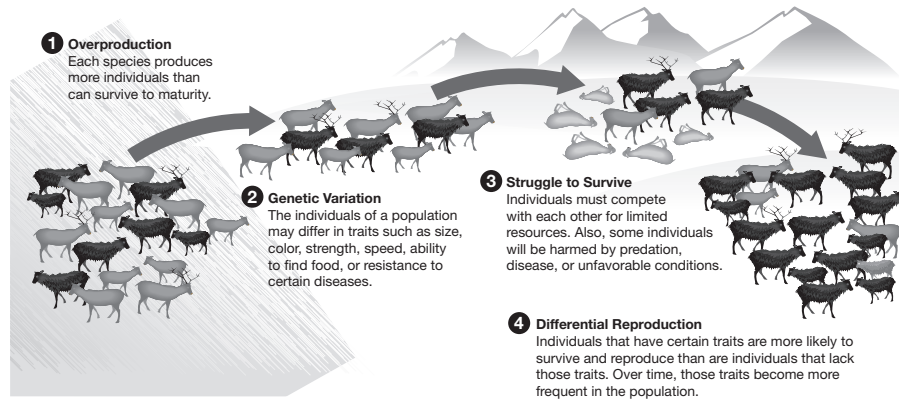
SC.912.L.15.13**Biology**

Describe the conditions required for natural selection, including: overproduction of offspring, inherited variation, and the struggle to survive, which result in differential reproductive success.

SC.912.N.1.4

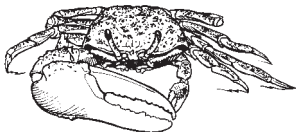
STANDARD REVIEW

Evolution is a change in the characteristics of a population from one generation to the next. Darwin proposed that evolution happened due to natural selection. Natural selection is the process by which individuals that have favorable variations and are better adapted to their environment survive and reproduce more successfully than less well adapted individuals do. Over many generations, natural selection can result in the evolution of new species, which is called speciation. The diagram below shows how natural selection changes populations.



SC.912.L.15.13**Biology****STANDARD PRACTICE**

- 1** Darwin developed his idea of evolution by natural selection based in part on observations he made in the Galápagos Islands. Which of the following ideas influenced Darwin's development of evolutionary theory?
- A. the discovery that genes are made of a biochemical called DNA
 - B. the idea formulated by ancient Greek philosophers that all substances are made of atoms
 - C. the development of the cell theory based on ideas from Mattias Schleiden, Theodor Schwann, and Rudolph Virchow
 - D. the observation by British economist Thomas Malthus that the human population could not continue growing faster than the food supply
- 2** Evolution is a change in the characteristics of a population from one generation to the next. Which of the following is the correct order for the steps of evolution by natural selection?
- F. overproduction—selection—adaptation—variation
 - G. overproduction—selection—adaptation—evolution
 - H. overproduction—variation—selection—adaptation
 - I. selection—variation—adaptation—overproduction
- 3** A population of crabs living on a sandy beach exhibits three colors: dark brown, light brown, and speckled, as shown below. The genotypes for these colors are *BB* for dark brown, *bb* for light brown, and *Bb* for speckled. The speckled color blends in extremely well with the color of the sand on the beach. The pattern appears to provide the speckled crabs with some protection from predatory birds.

PHENOTYPES AND GENOTYPES OF CRABSSpeckled (*Bb*)Dark Brown (*BB*)Light Brown (*bb*)

SC.912.L.15.13**Biology**

Which of the following conclusions can be drawn from the information above?

- A. Only the speckled crabs will survive, and all of their offspring will be speckled.
- B. The allele for light brown color will be lost because of predatory birds eating light brown crabs.
- C. The allele for dark brown color will be lost because of predatory birds eating dark brown crabs.
- D. Both the light brown and dark brown alleles will continue to be passed on in the crab population.

- 4 Speciation is the formation of new species as a result of evolution by natural selection. What effect could separation of populations have on speciation?
- F. One half of the species will go extinct if the population is separated.
 - G. The separated populations will always evolve into at least two different species.
 - H. If the environments differ enough, the separated populations may evolve differently.
 - I. By separating, the populations will no longer be able to interbreed and will die off.

- 5 The diagram below shows a sampling of Galápagos finches.



The evolution of beak sizes in Galápagos finches is a response to which of the following?

- A. the color of their beaks
- B. the types of seeds available
- C. whether the populations interbreed
- D. the nutritional content of the seeds they eat

SC.912.L.15.13

Biology

- 6** Which of the following mutations would be **most likely** to improve the chances that an organism would survive and reproduce?
- F. a stronger scent that makes an animal easier to find
 - G. a weaker scent that makes a flower less attractive to bees
 - H. weaker eyesight that makes an animal less likely to find prey
 - I. stronger leg muscles that allow an animal to jump away from danger

SC.912.L.15.14**Biology**

Discuss mechanisms of evolutionary change other than natural selection such as genetic drift and gene flow.

STANDARD REVIEW

The Hardy-Weinberg principle states that the frequencies of alleles in a population do not change unless evolutionary forces act on the population. However, genetic changes in a population can be caused by mutation and natural selection. Three other forces that cause evolutionary change are gene flow, nonrandom mating, and genetic drift.

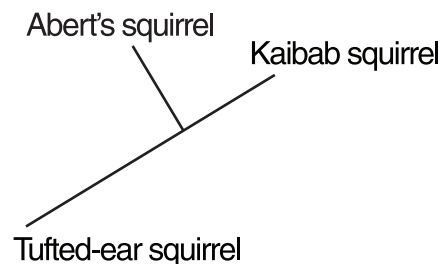
The movement of individuals from one population to another can cause genetic change. The movement of individuals to or from a population, called migration, creates gene flow, the movement of alleles into or out of a population. Gene flow occurs because new individuals (immigrants) add alleles to the population and departing individuals (emigrants) take alleles away.

Sometimes individuals prefer to mate with others that live nearby or are of their own phenotype, a situation called nonrandom mating. Mating with relatives (inbreeding) is a type of nonrandom mating that causes a lower frequency of heterozygotes than would be predicted by the Hardy-Weinberg principle. Inbreeding does not change the frequencies of alleles, but it does increase the proportion of homozygotes in a population. For example, populations of self-fertilizing plants consist mostly of homozygous individuals. Nonrandom mating also results when organisms choose their mates based on certain traits. In animals, females often select males based on their size, color, ability to gather food, or other characteristics.

In small populations, the frequency of an allele can be greatly changed by a chance event. For example, a fire or landslide can reduce a large population to a few survivors. When an allele is found in only a few individuals, the loss of even one individual from the population can have major effects on the allele's frequency. Because this sort of change in allele frequency appears to occur randomly, as if the frequency was drifting, it is called genetic drift. Small populations that are isolated from one another can differ greatly as a result of genetic drift. The cheetah, for example, is a species whose evolution has been seriously affected by genetic drift, and each cheetah is almost genetically uniform with other members of the population.

SC.912.L.15.14**Biology****STANDARD PRACTICE**

- 1** Gene flow is one force that can cause evolutionary change. Which example **best** illustrates gene flow?
- A. A flock of migrating geese enters into the territory of another flock and begins interbreeding.
 - B. A flock of geese becomes isolated on an island, and over time, the population begins to exhibit new characteristics.
 - C. Some individuals in a flock of geese have genes that are more advantageous, and over time, the numbers of these geese increase.
 - D. A flock of migrating geese loses its way to its wintering grounds, leaving other geese without competition for resources and enabling those geese to produce more offspring.
- 2** Evidence exists that during the millions of years in which the Grand Canyon formed, the canyon divided a single population of tufted-eared squirrels into two populations. One of these squirrel populations, the Kaibab squirrel, now lives in isolation from the other tufted-eared squirrels on the North Rim of the canyon. The other population, the Abert's squirrel, lives on the South Rim. Some biologists think that the two populations of squirrels have evolved into two separate species. Other biologists think that the Kaibab squirrel is a subspecies of the Abert's squirrel.



Feature	Abert's squirrel	Kaibab squirrel
Range	western United States; Mexico	North Rim; Kaibab Plateau
Habitat	ponderosa pine forest	ponderosa pine forest
Belly	white	black
Tail	white	white
Ears	tufted	tufted
Predators	hawks; human hunters	hawks

SC.912.L.15.14**Biology**

The cladogram above shows the evolution of the original tufted-ear squirrel population into two separate species. Which of the following factors would make the evolution of the squirrel population into separate species less likely?

- F. Different predators live on the North and South Rims of the canyon.
- G. A few of the squirrels manage to cross the canyon and breed with squirrels on the other side.
- H. Different trees grow on the North and South Rims of the canyon because of changes in the water table.
- I. A disease attacks one population of squirrels and kills most of them. The squirrels on the other side of the canyon are not affected.

3 Charles Darwin published his theory of evolution in 1859. In what way does modern evolutionary theory differ from the theory as proposed by Darwin?

- A. Darwin inferred that individuals can evolve, but modern genetic science has shown that this is not true.
- B. Darwin inferred that individuals do not evolve, but modern genetic science has shown that this is not true.
- C. Modern science has disproved most of Darwin's original theory of evolution, because Darwin knew nothing about genes and their role in heredity.
- D. Genetic studies have shown that gene expression and other factors operate along with natural selection, but most of Darwin's theory has been supported by modern science.

4 Genetic drift states that the random effects of everyday life can cause differences in the survival and reproduction of individuals. What is one effect of genetic drift on evolution?

- F. It produces only the traits in a population that are best adapted to the environment.
- G. It can cause an unusual amount of genetic variation within a single population of a species.
- H. It can cause a population's allele frequencies to become those predicted by the Hardy-Weinberg principle.
- I. It can cause certain traits in a population to increase even if those traits are not the ones that are best adapted to the environment.

SC.912.L.15.15**Biology**

Describe how mutation and genetic recombination increase genetic variation.

HE.912.C.1.4

STANDARD REVIEW

Scientists now know that genes are responsible for inherited traits. Therefore, certain forms of a trait become more common in a population because more individuals in the population carry the alleles for those forms. In other words, natural selection causes the frequency of certain alleles in a population to increase or decrease over time. Mutations and the recombination of alleles that occurs during sexual reproduction provide endless sources of new variations for natural selection to act upon.

Although mutation from one allele to another can eventually change allele frequencies, mutation rates in nature are very slow. Most genes mutate only about 1 to 10 times per 100,000 cell divisions, so mutation does not significantly change allele frequencies, except over very long periods of time. Furthermore, not all mutations result in phenotypic changes. Recall that more than one codon—3-base DNA coding sequence—can code for the same amino acid. Therefore, some mutations may result in no change in the amino acid coded for in a protein, and other changes in an amino acid that do occur may not affect how the protein works. Mutation is, however, an important source of variation and thus makes evolution possible.

Meiosis and the joining of gametes—processes that recombine alleles—are essential to evolution. No genetic process generates variation more quickly. In many cases, the pace of evolution appears to increase as the level of genetic variation increases. For example, when domesticated animals such as cattle and sheep are bred for large size, many large animals are produced at first. But as the existing genetic combinations become used up, the ability to obtain larger and larger animals slows down. Further progress must then wait for the formation of new gene combinations.

The pace of evolution is sped up by genetic recombination. The combination of genes from two organisms results in a third type, not identical to either parent. But bear in mind that natural selection does not always favor genetic change. Indeed, many modern organisms are little changed from their ancestors of the distant past. Natural selection may favor existing combinations of genes, slowing the pace of evolution.

SC.912.L.15.15**Biology****STANDARD PRACTICE**

- 1** One way that populations can change is when new alleles appear. What is the major source of new alleles in natural populations?
- A. mutations in sex cells
 - B. mutations in somatic cells
 - C. trait selection by natural selection
 - D. adaptations in individual organisms
- 2** At first, a mutation may make no difference to an individual. Even if the mutation results in a nonfunctional protein, the body's cell may have a functional copy of the gene as its second allele. However, this new nonfunctioning version could be passed on as a recessive allele. This kind of mutation is the probable origin of many recessive disorders. Only characteristics that are expressed can be targets of natural selection. Therefore, natural selection cannot operate against recessive alleles, even if they are unfavorable. What does this explain?
- F. why recessive alleles are never expressed
 - G. why genetic disorders can persist in a population
 - H. why advantageous offspring are more likely to survive and reproduce
 - I. why natural selection can act only against heterozygous carriers of a recessive disorder
- 3** Imagine that a mouse has white fur because of a mutation in its DNA. Which of the following conclusions can be drawn?
- A. The white mouse increases the diversity of the species.
 - B. The white mouse decreases the diversity of the species.
 - C. The internal organs of the white mouse must not function as well as those of other mice.
 - D. The white mouse is more likely to survive than other mice because it is more visible to predators.

SC.912.L.15.15

Biology

- 4 During meiosis, homologous chromosomes line up next to each other. In some cases, one arm of a chromatid crosses over the arm of another chromatid. What is the result of this process?
- F. the creation of an additional sex cell
 - G. continuity in the offspring cell's DNA
 - H. the independent assortment of genetic material
 - I. additional variation in the DNA of each sex cell formed

SC.912.L.16.1**Biology**

Use Mendel's laws of segregation and independent assortment to analyze patterns of inheritance.

SC.912.N.3.4

STANDARD REVIEW

Before the experiments of Gregor Johann Mendel in the mid-1800s, many people thought offspring were a blend of the traits of their parents. For example, if a tall plant were crossed with a short plant, the offspring would be medium in height. Mendel's results did not support the blending hypothesis. Instead, he developed these four hypotheses based directly on the results of his experiments:

1. *For each inherited character, an individual has two copies of the gene—one from each parent.*
2. *There are alternative versions of genes.* For example, the gene for flower color in peas can exist in a “purple” version or a “white” version. An individual receives one version, or allele, from each parent. Each allele can be passed on when the individual reproduces.
3. *When two different alleles occur together, one of them may be completely expressed, while the other may have no observable effect on the organism's appearance.* Mendel described the expressed form of the character as dominant. The trait that was not expressed when the dominant form was present was described as recessive. For example, if a plant has both purple and white alleles for flower color but blooms purple flowers, then purple is the dominant form; white is the recessive form.
4. *When gametes are formed, the alleles for each gene in an individual separate independently of one another. Thus, gametes carry only one allele for each inherited character. When gametes unite during fertilization, each gamete contributes one allele.* Each parent can contribute only one of the alleles because of the way gametes are produced during the process of meiosis.

Mendel's hypotheses brilliantly predicted the results of his crosses. Similar patterns of heredity have since been observed in countless other organisms. Because of their importance, Mendel's ideas are often referred to as the laws of heredity:

The Law of Segregation: The two alleles for a single gene segregate (separate) when gametes are formed.

The Law of Independent Assortment: The alleles of different genes separate independently of one another during gamete formation.

SC.912.L.16.1**Biology****STANDARD PRACTICE**

- 1** What evidence in pea plant crosses supported Mendel's law of independent assortment?
- A. When crossing true-breeding pea plants, all of the offspring exhibit traits that are exhibited in the parents.
 - B. When crossing hybrid pea plants, some of the offspring exhibit traits that are not exhibited in the parents.
 - C. When crossing pea plants that differ in two characteristics, traits produced by dominant factors always appear together.
 - D. When crossing pea plants that differ in two characteristics, traits produced by dominant factors do not necessarily appear together.
- 2** For a certain plant, purple flowers (allele: *P*) are dominant, and white flowers (allele: *p*) are recessive. A purple plant carrying both types of alleles is crossed with a true-breeding white plant. What are the possible genotypes (allele pairs) of the offspring?
- F. *pp* only
 - G. *Pp* only
 - H. *Pp* and *pp* only
 - I. *PP*, *pp*, and *Pp*
- 3** Rasheed crossed plants that were hybrid—have two different alleles—for the traits of flower color, seed color, and seed shape as part of an investigation designed to verify the results of Gregor Mendel's experiments. The table below displays the results.

RASHEED'S RESULTS

Characteristic	Offspring phenotypes		Ratio
flower color	705 purple	224 white	3:1
seed color	6,002 yellow	2,001 green	3:1
seed shape	5,474 round	1,850 wrinkled	3:1

Based on the information in the table above, which of the following is a valid conclusion?

- A. White flowers are dominant.
- B. Yellow seeds are a recessive trait.
- C. Wrinkled seeds are a recessive trait.
- D. Flower color is the result of environmental conditions.

SC.912.L.16.1

Biology

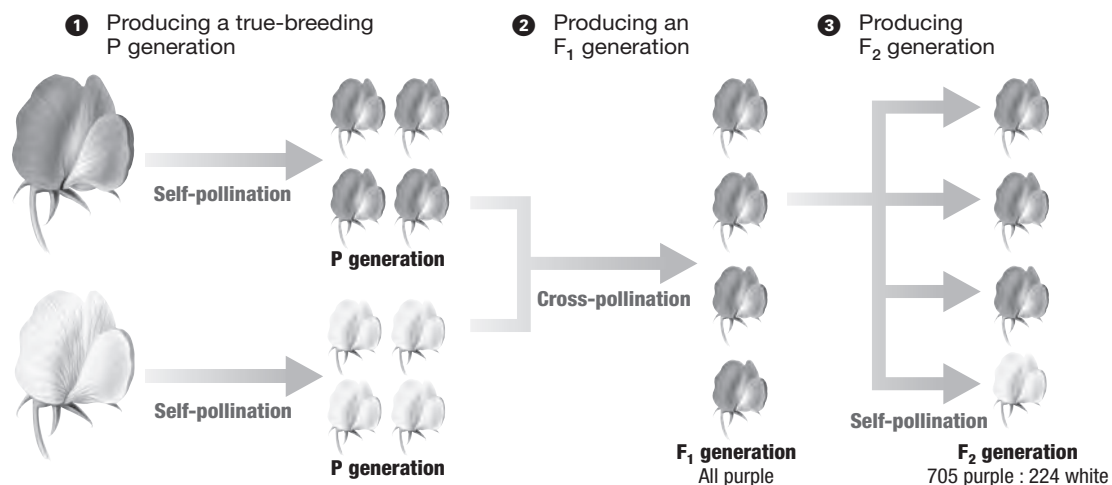
- 4 A lily has one allele for spotted pink petals and one allele for solid pink petals. The resulting flower has spotted pink petals. What must be true?
- F. The allele for solid pink petals is recessive.
 - G. The allele for spotted pink petals is dominant.
 - H. The alleles for spotted and solid pink petals are both recessive.
 - I. The alleles for spotted and solid pink petals are both dominant.

SC.912.L.16.2**Biology**

Discuss observed inheritance patterns caused by various modes of inheritance, including dominant, recessive, codominant, sex-linked, polygenic, and multiple alleles.

STANDARD REVIEW

Modern genetics is based on Gregor Johann Mendel's explanations for the patterns of heredity that he studied in garden pea plants. Mendel's first experiments used monohybrid crosses and were carried out in three steps, which are shown below.

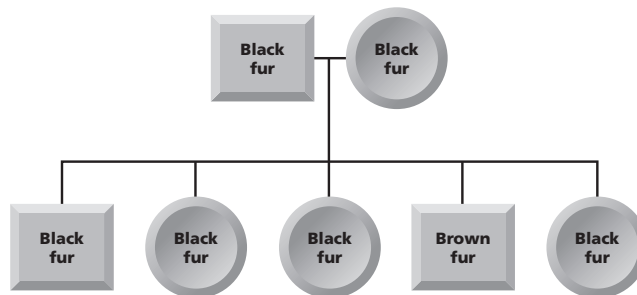


For each of the seven characteristics that Mendel studied in this experiment, he found a similar 3-to-1 ratio of contrasting traits in the F₂ generation. Mendel's experiments showed that offspring do not show a trait for every allele they receive. Instead, combinations of alleles determine traits. The set of alleles that an individual has for a characteristic is called the genotype. The trait that results from a set of alleles is the phenotype. In other words, genotype determines phenotype. Phenotype can also be affected by conditions in the environment, such as nutrients and temperature. If an individual has two of the same alleles of a certain gene, the individual is homozygous for the related character. On the other hand, if an individual has two different alleles of a certain gene, the individual is heterozygous for the related character. In the heterozygous case, the dominant allele is expressed.

Although Mendel was correct about the inheritance of the traits he studied, most patterns of inheritance are more complex than those that Mendel identified. First, not all genes have only two alleles. There can be multiple alleles. Second, not all characteristics are controlled by one gene. Other patterns of inheritance include sex-linked genes (when alleles are located only on the X or Y chromosome), polygenic inheritance (when several genes affect one characteristic), incomplete dominance (when an offspring has a phenotype between that of its parents), and codominance (when both alleles of a gene are fully expressed).

SC.912.L.16.2**Biology****STANDARD PRACTICE**

- 1 A gardener crossed a plant with red flowers with a plant that had white flowers. The offspring plants had pink flowers. What is the **most likely** genetic reason for these differences in color?
- A. codominance
B. recessive pink genes
C. polygenic inheritance
D. incomplete dominance
- 2 Gregor Mendel crossed a true-breeding tall plant (TT) with a true-breeding short plant (tt). What are the possible phenotypes for the offspring?
- F. all tall
G. all short
H. ratio of 1 tall : 1 short
I. ratio of 2 tall : 1 short
- 3 For a certain animal, black fur color is dominant over brown fur color. The pedigree below shows a cross between two individuals that have black fur.

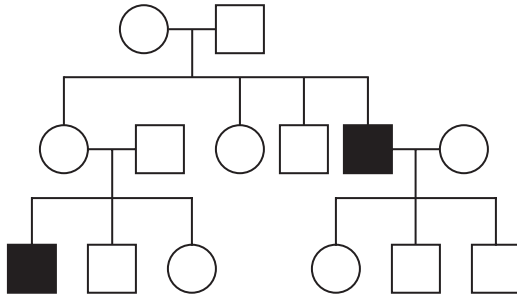


Which of the following must be true?

- A. Both parents are homozygous for the black-fur trait.
B. Both parents are heterozygous for the black-fur trait.
C. The offspring with brown fur has a mutant gene for fur color.
D. One parent is heterozygous and one is homozygous for fur color.

SC.912.L.16.2**Biology**

- 4 The diagram below shows a pedigree.



What can you conclude about the trait shown in this pedigree?

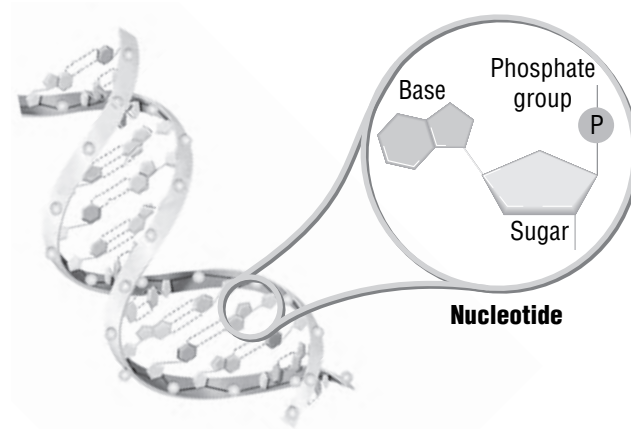
- F. The trait is autosomal and dominant.
 - G. The trait is Y-linked and dominant.
 - H. The trait is X-linked and dominant.
 - I. The trait is X-linked and recessive.
- 5 A population of crabs living on a sandy beach exhibits three colors: dark brown, light brown, and speckled. The genotypes for these colors are BB for dark brown, bb for light brown, and Bb for speckled. If a dark brown crab were crossed with a light brown crab, what would be the probable phenotypic ratio of their offspring?
- A. all speckled
 - B. all dark brown
 - C. 3 dark brown : 1 light brown
 - D. 1 dark brown : 2 speckled : 1 light brown
- 6 In snap peas, yellow flowers (Y) are dominant to white flowers (y). In the cross $YY \times Yy$, what would be the genotypic ratio of the F_1 generation?
- F. 1:1
 - G. 1:2
 - H. 1:3
 - I. 3:1

SC.912.L.16.3**Biology**

Describe the basic process of DNA replication and how it relates to the transmission and conservation of the genetic information.

STANDARD REVIEW

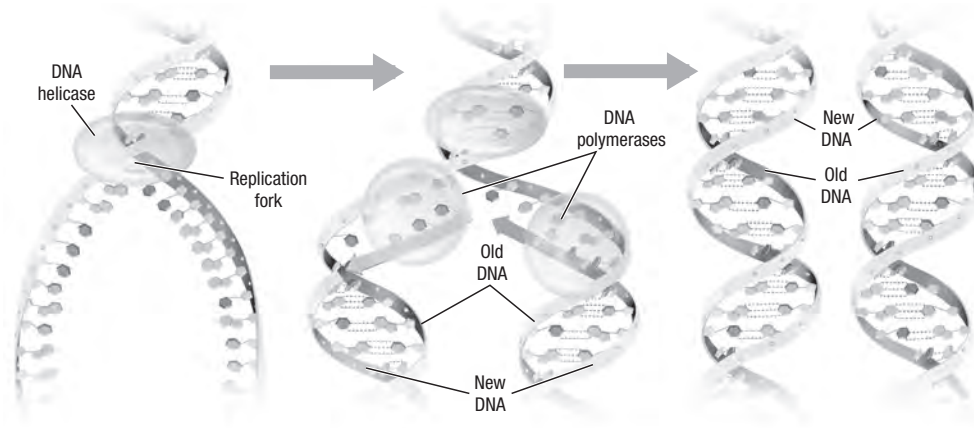
James Watson and Francis Crick were the first to piece together a model of the structure of DNA. The discovery of DNA's structure was important because it clarified how DNA could serve as genetic material. Watson and Crick determined that a DNA molecule is a double helix—two strands twisted around each other, like a winding staircase. As shown below, each strand is made of linked nucleotides. Nucleotides are the subunits that make up DNA. Each nucleotide is made of three parts: a phosphate group, a five-carbon sugar molecule, and a nitrogen-containing base. The five-carbon sugar in DNA nucleotides is called deoxyribose, from which DNA gets its full name, deoxyribonucleic acid.



While the sugar molecule and the phosphate group are the same for each nucleotide in a molecule of DNA, the nitrogen base may be any one of four different kinds: adenine (A), guanine (G), thymine (T), and cytosine (C). An adenine on one strand always pairs with a thymine on the opposite strand, and a guanine on one strand always pairs with a cytosine on the opposite strand.

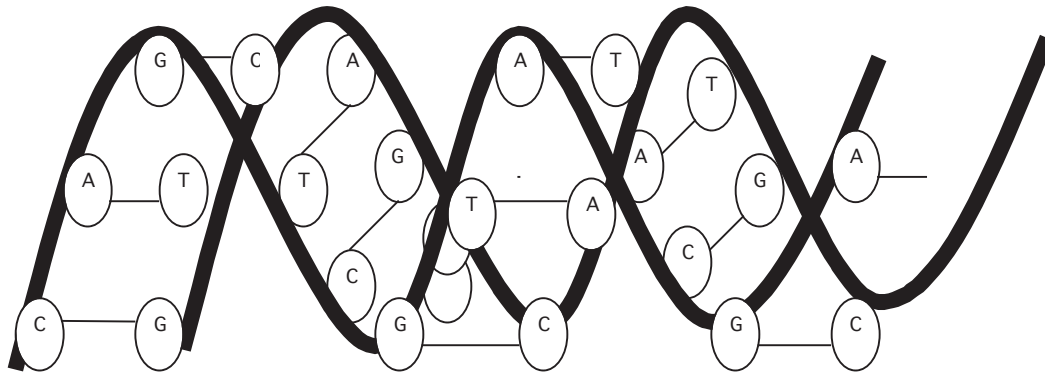
SC.912.L.16.3**Biology**

The process of making a copy of DNA is called DNA replication. DNA replication is summarized in the figure below. First, the two original strands separate. Then, DNA polymerases add complementary nucleotides to each strand. Because of the strictness of base-pairing rules, the result is always the formation of two DNA molecules that are identical to the original DNA molecule.



SC.912.L.16.3**Biology****STANDARD PRACTICE**

- 1** The diagram below represents an incomplete model of the DNA molecule.

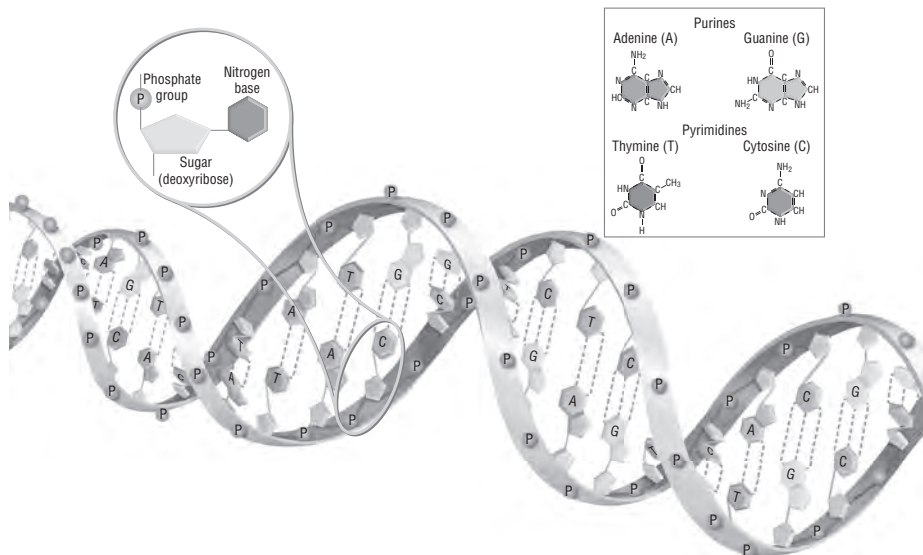


Even though the model is not complete, what pattern is evident in this representation of the DNA molecule?

- A. Every third base pair has a mutation.
 - B. Guanine is always paired with cytosine.
 - C. The model has a repeating base sequence.
 - D. There are two sugars between each phosphate.
- 2** James Watson and Francis Crick built a model showing that the structure of DNA is like a twisted ladder called a double helix. What purpose does the double helix structure serve?
- F. The double helix shows that one strand of the DNA ladder is inherited from each parent.
 - G. The sugars and phosphates that make up the sides of the DNA ladder twist and curve to conserve space in the cell.
 - H. The double helix structure of DNA is a random occurrence, and DNA could just as easily be a straight, single-strand molecule.
 - I. The pattern of complimentary bases on each side of the DNA ladder ensures that exact copies of the DNA are made during replication.

SC.912.L.16.3**Biology**

- 3** DNA is composed of strands of nucleotides that pair in regular patterns and are held together by the forces shown in the diagram below.



What forces, represented by dotted lines, hold together the two strands of DNA shown in the diagram above?

- A. ionic bonds
 - B. covalent bonds
 - C. hydrogen bonds
 - D. carbon-carbon bonds
- 4** The sequence of bases on one strand of a DNA molecule is AGCCTAG. After replication of the strand of DNA, what is the sequence of nitrogen bases on the complementary strand?
- F. AGCCTAG
 - G. CTAGGCA
 - H. GATCCGA
 - I. TCGGATC

SC.912.L.16.4**Biology**

Explain how mutations in the DNA sequence may or may not result in phenotypic change.
Explain how mutations in gametes may result in phenotypic changes in offspring.

STANDARD REVIEW

Although changes in an organism's hereditary information are relatively rare, they can occur. A change in the DNA of a gene is called a mutation. Mutations in gametes can be passed on to offspring of the affected individual, but mutations in body cells affect only the individual in which they occur.

Mutations that move an entire gene to a new location are called gene rearrangements. Changes in a gene's position often disrupt the gene's function because the gene is exposed to new regulatory controls in its new location.

Mutations that change a gene are called gene alterations. Gene alterations usually result in the placement of the wrong amino acid during protein assembly. This error will usually disrupt a protein's function. In a point mutation, a single nucleotide changes. In an insertion mutation, a sizable length of DNA is inserted into a gene. In a deletion mutation, segments of a gene are lost, often during meiosis. In a duplication mutation, a chromosome fragment attaches to its homologous chromosome, which will then carry two copies of a certain set of genes. Another type of mutation is an inversion mutation, in which the chromosome piece reattaches to the original chromosome but in a reverse orientation. If the piece reattaches to a nonhomologous chromosome, a translocation mutation results.

Because the genetic message is read as a series of triplet nucleotides, insertions and deletions of one or two nucleotides can upset the triplet groupings. Imagine deleting the letter C from the sentence "THE CAT ATE." Keeping the triplet groupings, the message would read "THE ATA TE," which is meaningless. A mutation that causes a gene to be read in the wrong three-nucleotide sequence is called a frameshift mutation.

SC.912.L.16.4**Biology****STANDARD PRACTICE**

- 1** Errors sometimes happen during DNA replication. If a DNA nucleotide that contains guanine is accidentally substituted for a DNA nucleotide that contains thymine, which of the following will always happen because of the error in DNA replication?
- A. The cell will die when it divides.
 - B. The cell will become a rapidly dividing cancer cell.
 - C. The cell will produce mRNA with a mutated nucleotide sequence.
 - D. The cell will have a better chance of surviving under different conditions.
- 2** Mutations can occur during mitosis, which produces body cells, and meiosis, which produces gametes. Which of the following statements about mutations is true?
- F. Mutations in the DNA of body cells cannot affect the individual in which they happen.
 - G. A mutation in the DNA of a body cell can cause the cell to produce a protein that does not function.
 - H. A mutation in the DNA of a gamete affects the body cells of the individual that produced the gamete.
 - I. Mutations in the DNA of body cells can cause the offspring to produce a protein that does not function.
- 3** Inheriting two copies of a recessive allele causes an individual to die before reaching sexual maturity. How is it that this recessive allele can be passed on from one generation to the next?
- A. Two homozygous dominant parents will not give the recessive allele to their offspring, so all will reach sexual maturity.
 - B. Homozygous dominant individuals usually live past sexual maturity to pass on the dominant allele to their offspring.
 - C. Heterozygous individuals can pass on the recessive allele because they do not die from having only one copy of the allele.
 - D. Two heterozygous parents who have reached sexual maturity will not give the recessive allele to their offspring, so all will reach sexual maturity.

SC.912.L.16.4**Biology**

- 4 A mutation in the DNA that produced the strand of messenger RNA shown in the chart below produced a new strand of mutant messenger RNA.

CODON AND ANTICODON PAIRING				
Transfer RNA	UGA	CUG	CAG	CUU
Messenger RNA	ACU	GAC	GUC	GAA

If the mutation was a deletion, which strand of the following sequences would **best** represent the resulting mutant messenger RNA?

- F. ACGGACGUCGAA
 - G. ACUACGUCGAA
 - H. ACUGACGUCCAA
 - I. ACUGCACGUCGAA
- 5 Most mutations involve a misplacement of a nucleotide on a DNA segment. Which of the following is **not** a possible result of a mutation?
- A. The mutation will be passed on to the next generation.
 - B. The mutation will cause immediate death of the individual.
 - C. The gene that contains the mutation will be expressed in a new way.
 - D. The gene that contains the mutation will be expressed in the same way as before the mutation.

SC.912.L.16.5**Biology**

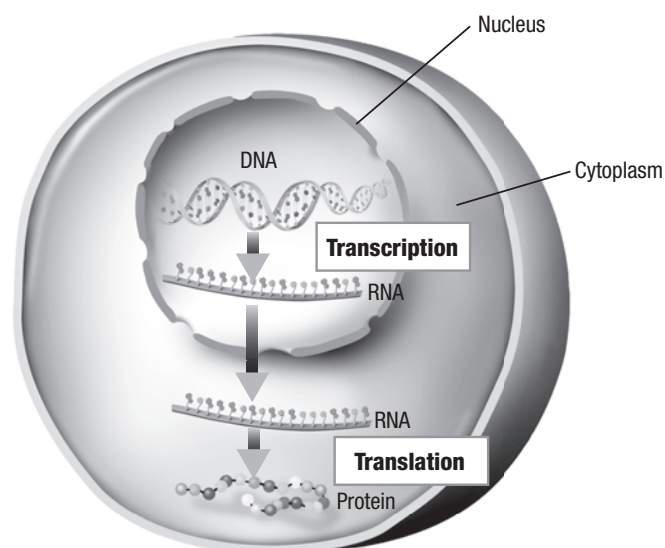
Explain the basic processes of transcription and translation, and how they result in the expression of genes.

STANDARD REVIEW

Traits, such as eye color, are determined by proteins that are built according to instructions coded in DNA. Recall that proteins have many functions, including acting as enzymes and cell membrane channels. Proteins, however, are not built directly from DNA. Ribonucleic acid is also involved.

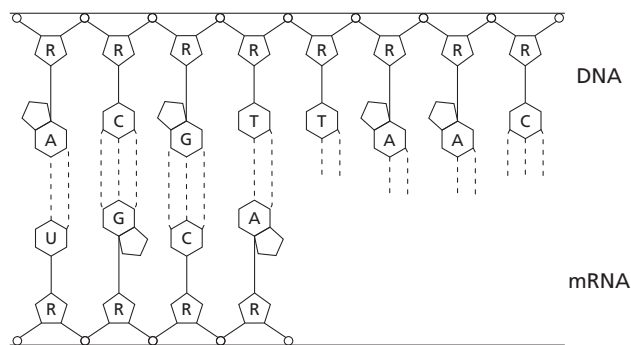
Like DNA, ribonucleic acid is a nucleic acid—a molecule made of nucleotides linked together. RNA differs from DNA in three ways. First, RNA consists of a single strand of nucleotides instead of the two strands found in DNA. Second, RNA nucleotides contain the five-carbon sugar ribose rather than the sugar deoxyribose, which is found in DNA nucleotides. Ribose contains one more oxygen atom than deoxyribose contains. And third, in addition to the A, G, and C nitrogen bases found in DNA, RNA nucleotides can have a nitrogen base called uracil—abbreviated as U. No thymine (T) bases are found in RNA. Like thymine, uracil is complementary to adenine whenever RNA base-pairs with another nucleic acid.

A gene's instructions for making a protein are coded in the sequence of nucleotides in the gene. The instructions for making a protein are transferred from a gene to an RNA molecule (called messenger RNA) in a process called transcription. Cells then use two different types of RNA (transfer RNA and ribosomal RNA) to read the instructions on the messenger RNA molecule and put together the amino acids that make up the protein in a process called translation. The entire process by which proteins are made based on the information encoded in DNA is called gene expression, or protein synthesis. This process is summarized in the figure below.



SC.912.L.16.5**Biology****STANDARD PRACTICE**

- 1 Which of the following identifies the process of forming a nucleic acid by using another molecule as a template and identifies its most common form?
- A. translation—the synthesis of RNA using one strand of DNA
 - B. transcription—the synthesis of RNA using one strand of DNA
 - C. replication—the synthesis of proteins using one strand of RNA
 - D. protein synthesis—the synthesis of proteins using one strand of DNA
- 2 What would **most likely** happen if tRNA malfunctioned during the assembly of a protein molecule?
- F. Amino acids would no longer be transported into the cell.
 - G. Mutations would happen in the segment of mRNA as it formed.
 - H. The wrong amino acids would be added to the new protein molecule.
 - I. Bonds between the amino acids would no longer form inside the ribosome.
- 3 The diagram below shows one process that occurs during gene expression.



What process does the diagram represent?

- A. DNA replication
- B. RNA replication
- C. transcription
- D. translation

SC.912.L.16.5**Biology**

- 4 Which of the following statements **best** describes the process of gene expression?
- F. Messenger, transfer, and ribosomal RNA transcribe information onto a cell's DNA.
 - G. The information in DNA is transcribed to RNA and then transcribed to amino acids.
 - H. The information in DNA is transcribed to RNA and then translated to make specific proteins.
 - I. The information in DNA is translated by messenger RNA and then translated to make ribosomal RNA.
- 5 What DNA sequence complements the messenger RNA sequence ACUGACGUCGAA?
- A. ACTGACGTCGAA
 - B. ACUGACGUCGAA
 - C. TGACTGCAGCTT
 - D. UGACUGCAGCUU
- 6 Which of the following statements **best** describes the relationship between genes and their outcomes?
- F. Every gene influences a single trait.
 - G. Similar genes produce the same outcome in every individual.
 - H. Every gene can be linked to one specific, predictable outcome.
 - I. The outcome of a gene is affected by the environment of the cells and the timing of gene expression.

SC.912.L.16.8**Biology**

Explain the relationship between mutation, cell cycle, and uncontrolled cell growth potentially resulting in cancer.

STANDARD REVIEW

Just as traffic lights control the flow of traffic, cells have a system that controls the phases of the cell cycle. Cells have a set of “red light–green light” switches that are regulated by feedback information from the cell. The cell cycle has key checkpoints (inspection points) at which feedback signals from the cell can trigger the next phase of the cell cycle (green light). Other feedback signals can delay the next phase to allow for completion of the current phase (yellow or red light). The cell cycle in eukaryotes is controlled by many proteins.

Certain genes contain the information necessary to make the proteins that regulate cell growth and division. If one of these genes is mutated, the protein may not function, and regulation of cell growth and division can be disrupted. Cancer, the uncontrolled growth of cells, may result. Cancer is essentially a disorder of cell division. Cancer cells do not respond normally to the body’s control mechanisms.

Some mutations cause cancer by overproducing growth-promoting molecules, thus speeding up the cell cycle. Others cause cancer by inactivating the control proteins that normally act to slow or stop the cell cycle.

SC.912.L.16.8**Biology****STANDARD PRACTICE**

- 1** Some genes code for the proteins that regulate cell growth and division. Which of the following are caused by uncontrolled, abnormal cell division?
- A. cancers
 - B. mutagens
 - C. oncogenes
 - D. transposons
- 2** Cancer is often characterized by tumors. Which would **most likely** trigger the formation of a tumor?
- F. a parasite that both lived and reproduced within the human body
 - G. a mutation in a gene that codes for a protein regulating cell division
 - H. a change in the DNA sequence of a gene that codes for skin coloration
 - I. a bacterial infection that caused inflammation and swelling in body tissues
- 3** Some cancers are caused by mutations that stop certain proteins from working. The inactivation of what kind of protein could lead to cancer?
- A. one that sped up the cell cycle
 - B. one that slowed down the cell cycle
 - C. one that acted as a growth-promoting molecule
 - D. one that responded to growth-promoting molecules
- 4** Cancer cells are body cells that do not function properly, leading to abnormal growth. Which process does not function normally in cancer cells?
- F. osmosis
 - G. cell cycle
 - H. photosynthesis
 - I. cellular respiration

SC.912.L.16.9**Biology**

Explain how and why the genetic code is universal and is common to almost all organisms.

SC.912.N.1.1

STANDARD REVIEW

Messenger RNA (mRNA) is the form of RNA that carries the instructions for making a protein from a gene and delivers it to the site of translation. The information is translated from the language of RNA—nucleotides—to the language of proteins—amino acids. The RNA instructions are written as a series of three-nucleotide sequences on the mRNA called codons. Each codon along the mRNA strand corresponds to an amino acid or signifies a start or stop signal for translation.

The chart below shows the genetic code—the amino acids and “start” and “stop” signals that are coded for by each of the possible 64 mRNA codons.

With few exceptions, the genetic code is the same in all organisms. For example, the codon GUC codes for the amino acid valine in bacteria, in eagles, in plants, and in your own cells. For this reason, the genetic code is often described as being nearly universal. It appears that all life-forms have a common evolutionary ancestor with a single genetic code. Some exceptions include the ways cell organelles that contain DNA (such as mitochondria and chloroplasts) and a few microscopic protists read “stop” codons.

1 Find the first base of the mRNA codon in this column of the table.

2 Follow that row to the column that matches the second base of the codon.

3 Move up or down in that box until you match the third base of the codon with this column of the chart.

First base	U	C	A	G	Third base
U	UUU] Phenylalanine UUC] UUA] Leucine UUG]	UCU] UCC] Serine UCA] UCG]	UAU] Tyrosine UAC] UAA] Stop UAG]	UGU] Cysteine UGC] UGA—Stop UGG—Tryptophan	U C A G
C	CUU] CUC] Leucine CUA] CUG]	CCU] CCC] Proline CCA] CCG]	CAU] Histidine CAC] CAA] Glutamine CAG]	CGU] CGC] Arginine CGA] CGG]	U C A G
A	AUU] AUC] Isoleucine AUA] AUG—Start	ACU] ACC] Threonine ACA] ACG]	AAU] Asparagine AAC] AAA] Lysine AAG]	AGU] Serine AGC] AGA] Arginine AGG]	U C A G
G	GUU] GUC] Valine GUA] GUG]	GCU] GCC] Alanine GCA] GCG]	GAU] Aspartic acid GAC] GAA] Glutamic acid GAG]	GGU] GGC] Glycine GGA] GGG]	U C A G

SC.912.L.16.9**Biology****STANDARD PRACTICE**

- 1** There are 64 possible mRNA codons that make up the genetic code. Which of the following is true of the genetic code?
- A. Codons can be only three amino acids long.
 - B. Codons can be one, two, or three bases long.
 - C. Each codon is linked to only one amino acid.
 - D. Each amino acid is linked to only one codon.
- 2** A strand of messenger RNA is attached to a ribosome and is directing protein synthesis. The next exposed codon of this messenger RNA has the code GAA. It is most likely to bond with a transfer RNA that has which amino acid?
- F. arginine
 - G. aspartic acid
 - H. glutamic acid
 - I. glutamine
- 3** Mutations have various effects on the amino acid sequence that determines protein structure and function. A silent mutation has no effect on the protein's function. Which mutation would result in a silent mutation?
- A. UAA to CAA
 - B. CCA to CCG
 - C. AUA to AUG
 - D. GCU to GGU
- 4** The genetic code is nearly universally. That is, with few exceptions, the same codons code for the same amino acids in all organisms. What does the near universality of the genetic code suggest?
- F. All life-forms can reproduce with one another.
 - G. All life-forms have the same number of genes.
 - H. All life-forms have a common evolutionary ancestor.
 - I. All life-forms arose about the same time in Earth's history.

SC.912.L.16.10**Biology**

Evaluate the impact of biotechnology on the individual, society and the environment, including medical and ethical issues.

SC.912.N.2.2

STANDARD REVIEW

Biotechnology has both positive and negative effects on individuals, society, and the environment. One topic of current debate is controversy over the risks and benefits of genetically modified crops. Today, genetic engineers can add favorable characteristics to a plant by manipulating the plant's genes. Genetic engineers can change plants in many ways, including making crop plants more tolerant to drought conditions and creating plants that can adapt to different soils, climates, and environmental stresses.

Many people, including influential scientists, have expressed concern that genetically modified crops (GM crops) might turn out to be dangerous. Scientists, the public, and regulatory agencies must work together to evaluate the risks and benefits of GM products.

What kind of unforeseen negative effects might “improved” GM crops have? Some food crops, such as corn and soybeans, have been genetically rendered resistant to glyphosate, a weed killer that is harmless to humans. Glyphosate, when used on a food crop, will kill the weeds but will not harm the GM crop, thus increasing food crop yields. Some scientists are concerned that the use of GM crops and the subsequent use of glyphosate will eventually lead to glyphosate-resistant weeds. This will leave farmers with few weed-control alternatives.

Some GM crops have genes added to improve nutritional character, as was done in rice. It is important to check that consumers are not allergic to the product of the introduced gene. For this reason, screening of GM crops for causes of allergy problems is now routine.

Are GM crops harmful to the environment? Will introduced genes pass from GM crops to their wild or weedy relatives? This sort of gene flow happens naturally all the time, so this concern is legitimate. For most crops, no closely related wild plant is around to receive the gene. The GM gene cannot pass to a nonrelative, because crop plants cannot successfully reproduce with unrelated species, any more than a cat can breed with a giraffe. There are wild relatives of corn in Mexico and Guatemala, which frequently exchange genes with corn crops. Scientists are divided about whether it makes any difference if one of the genes is a GM gene.

Might pests become resistant to GM toxins? Pests are becoming resistant to GM toxins just as they have become resistant to the chemical pesticides that are sprayed on crops. Some argue that because GM crops might select and promote the competition and survival of pests that are resistant to toxins can mean that GM crops do more harm than good.

SC.912.L.16.10**Biology****STANDARD PRACTICE**

- 1** Some bacteria—sometimes called “super bugs”—have developed a resistance to certain antibiotics. How does drug resistance develop in bacteria?
- A. Unsanitary conditions allow all kinds of bacteria to breed, including those that are antibiotic resistant.
 - B. In the bloodstream, different species of bacteria exchange genes and become resistant to antibiotics.
 - C. Mutations in some bacterial genes make the bacteria stronger and better able to defeat the body’s immune system.
 - D. In the presence of an antibiotic, bacteria with genes that make them resistant survive and eventually take over the population.
- 2** Every human begins as a single, fertilized egg. After about five days, a hollow ball has formed that contains about 30 specialized cells called stem cells. Embryonic stem cells can divide endlessly and give rise to every type of tissue in the body. Scientists hope that someday stem cells will make it possible to repair or replace damaged tissues. Embryonic stem cells used in research come from eggs that were fertilized in the laboratory and donated for research. Adult stem cells used in research are found in adult tissues. The use of embryonic stem cells is controversial because a human embryo is destroyed to obtain these cells. However, currently adult stem cells cannot be grown in the lab, and they occur in limited numbers in the body. Currently, large numbers of stem cells are needed for stem cell therapy. How does this fact affect the debate about the two sources of stem cells?
- F. Embryonic stem cells are readily available but are not thought to be useful for stem cell therapy.
 - G. Adult stem cells are rare, and research needs to be done in order to find techniques to harvest more adult stem cells.
 - H. Embryonic stem cells are rare, and research needs to be done in order to find techniques to harvest more adult stem cells.
 - I. Somatic cells are destroyed during the collection of adult stem cells and there would be too much damage to justify the harvesting of these cells.

SC.912.L.16.10**Biology**

- 3** Malaria is a tropical disease characterized by severe chills, headache, and fever. Malaria is caused by protists in the genus *Plasmodium*. The disease is spread from human to human when mosquitoes bite an infected person and transfer *Plasmodium* sporozoites to another person. Hoping to develop a product that prevents malarial infection, a scientist researches chemicals that kill different types of organisms. How might the scientist use a chemical to prevent the transmission of malaria from person to person?
- A. The scientist might develop a chemical that kills either the mosquito that transfers the protist or the protist itself.
 - B. The scientist might develop a chemical that kills all *Plasmodium* sporozoites found in water and food sources.
 - C. The scientist might develop a chemical that kills the protist after it has been transmitted from one person to another.
 - D. The scientist might develop a chemical that treats the more severe symptoms of malaria, such as chills, headache, and fever.
- 4** Microbiology is the study of microorganisms. How does studying the life cycle of microorganisms relate to modern medicine?
- F. The life cycle of microorganisms can provide important evidence of environmental degradation.
 - G. The life cycle of microorganisms can provide clues to how cells in the human body regulate themselves.
 - H. Scientists study the life cycle of microorganisms in order to find a way to treat cancer and other chronic illnesses.
 - I. Scientists study the life cycle of pathogens in order to find a way to interrupt the course of disease and the spread of infection.

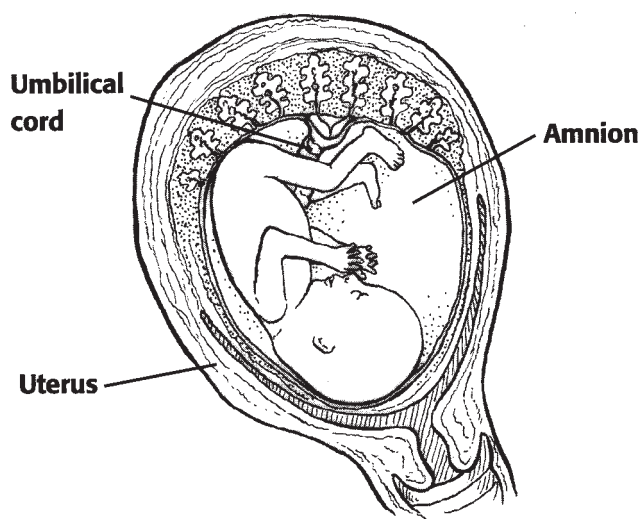
SC.912.L.16.13**Biology**

Describe the basic anatomy and physiology of the human reproductive system. Describe the process of human development from fertilization to birth and major changes that occur in each trimester of pregnancy.

STANDARD REVIEW

During fertilization, an egg and sperm unite within the mother's reproductive system. Development begins upon fertilization, with a single diploid cell from which billions of other cells arise. The uterus provides protection and nourishment during development. Human development takes about 9 months—a period known as gestation, or pregnancy. The 9 months of pregnancy are often divided into three trimesters, or 3-month periods. For the first 8 weeks of pregnancy, the developing human is called an embryo. From the eighth week of pregnancy until childbirth, the developing human is called a fetus.

The most crucial events of development occur very early in the first trimester. In the second week after fertilization—shortly after implantation—the embryo grows rapidly. Membranes that will protect and nourish it also develop. One of these membranes, the amnion, encloses and protects the embryo. Another membrane, the chorion, interacts with the uterus to form the placenta.



The placenta is the structure through which the mother nourishes the embryo. The mother's blood normally never mixes with the blood of the embryo. Instead, nutrients in the mother's blood diffuse through the placenta and are carried to the embryo through blood vessels in the umbilical cord. The waste products of the embryo also pass through the placenta into the mother's blood.

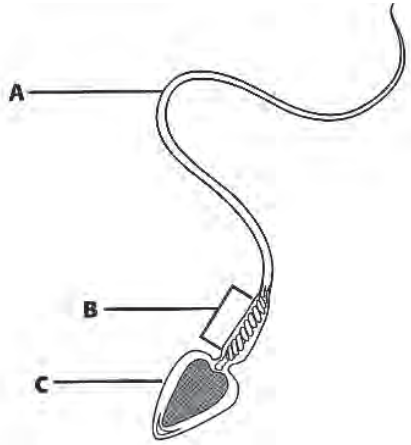
During the second and third trimesters, the fetus grows rapidly as its organs become functional. By the end of the third trimester, the fetus is able to exist outside the mother's body. After about 9 months of development, the fetus leaves the mother's body in a process called labor, which usually lasts several hours. During labor, the walls of the uterus contract, expelling the fetus from the uterus and through the vagina. The placenta and the umbilical cord are expelled after the baby is born.

SC.912.L.16.13**Biology****STANDARD PRACTICE**

- 1** The human mother's body nourishes the growing embryo during pregnancy. Which structure nourishes the embryo and removes wastes through a network of blood vessels?
- A. ovary
 - B. placenta
 - C. uterus
 - D. zygote
- 2** The point at which the umbilical cord attaches to the fetus becomes the belly button after birth. What is the function of the umbilical cord for mother and fetus during fetal development?
- F. Liquids consumed by the mother flow through the umbilical cord and into the stomach of the fetus.
 - G. Waste products produced by the fetus travel through the umbilical cord and out through the mother's kidneys.
 - H. Part of any food consumed by the mother passes from the mother's stomach, through the umbilical cord, and into the stomach of the fetus.
 - I. Nutrients from foods digested by the mother pass from her blood to the fetus through blood vessels in the umbilical cord.

SC.912.L.16.13**Biology**

- 3** The diagram shows a sperm cell.



Which part(s) secrete(s) enzymes that break down the outer layers of the ovum, allowing the sperm to enter?

- A. part A
 - B. part B
 - C. part C
 - D. parts A and C
- 4** A mature egg is called an ovum and is 75,000 times larger than a sperm cell. What can you infer from this comparison?
- F. The ovum contains more cytoplasm than the sperm.
 - G. The condition of the ovum is a better predictor of fetal health.
 - H. The sperm is more likely to reach the ovum due to its small size.
 - I. The ovum donates more genetic information to the zygote than the sperm.

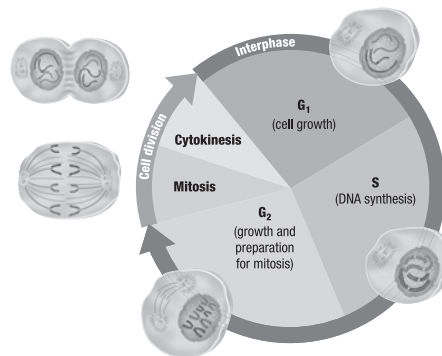
SC.912.L.16.14**Biology**

Describe the cell cycle, including the process of mitosis. Explain the role of mitosis in the formation of new cells and its importance in maintaining chromosome number during asexual reproduction.

STANDARD REVIEW

The life of a eukaryotic cell is traditionally shown as a cycle, as illustrated in the figure below. The cell cycle is a repeating sequence of cellular growth and division during the life of an organism. A cell spends 90 percent of its time in the first three phases of the cycle, which are collectively called interphase. A cell will enter the last two phases of the cell cycle only if it is about to divide. The five phases of the cell cycle are summarized below:

1. **First growth (G_1) phase:** During the G_1 phase, a cell grows rapidly and carries out its routine functions. For most organisms, this phase occupies the major portion of the cell's life. Cells that are not dividing remain in the G_1 phase.
2. **Synthesis (S) phase:** A cell's DNA is copied during this phase. At the end of this phase, each chromosome consists of two chromatids attached at the centromere.
3. **Second growth (G_2) phase:** In the G_2 phase, preparations are made for the nucleus to divide. Hollow protein fibers called microtubules are rearranged during G_2 in preparation for mitosis.
4. **Mitosis:** The process during cell division in which the nucleus of a cell is divided into two nuclei is called mitosis. Each nucleus ends up with the same number and kinds of chromosomes as the original cell.
5. **Cytokinesis:** The process during cell division in which the cytoplasm divides is called cytokinesis.

**Steps of Mitosis**

Step 1: Prophase Chromosomes coil up and become visible during prophase. The nuclear envelope dissolves and a spindle forms.

Step 2: Metaphase During metaphase the chromosomes move to the center of the cell and line up along the equator. Spindle fibers link the chromatids of each chromosome to opposite poles.

SC.912.L.16.14

Biology

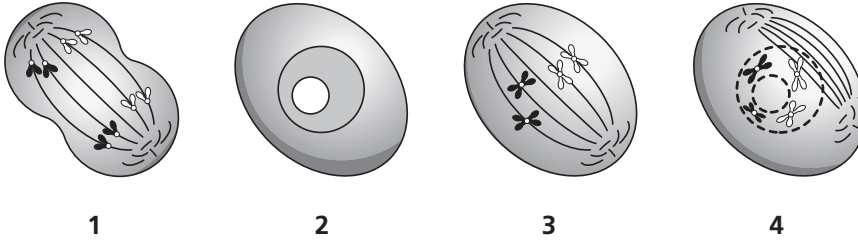
Step 3: Anaphase Centromeres divide during anaphase. The two chromatids (now called chromosomes) move toward opposite poles as the spindle fibers attached to them shorten.

Step 4: Telophase A nuclear envelope forms around the chromosomes at each pole. Chromosomes, now at opposite poles, uncoil and the spindle dissolves. The spindle fibers break down and disappear. Mitosis is complete.

Mitosis and cytokinesis produce new cells that are identical to the original cells and allow organisms to grow, replace damaged tissues, and, in some organisms, reproduce asexually.

SC.912.L.16.14**Biology****STANDARD PRACTICE**

- 1** The following diagrams show four stages of a cell dividing by mitosis.

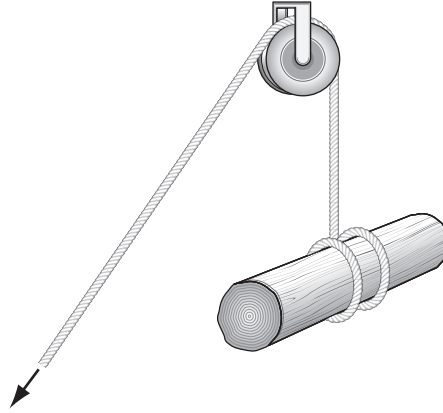


Which list of numbers names the diagrams in the correct sequence as they occur in the cell cycle?

- A. 1, 3, 4, 2 B. 2, 1, 3, 4
C. 2, 4, 3, 1 D. 4, 3, 2, 1
- 2** The cell cycle is a repeating sequence of cellular growth and division during the life of an organism. Which of the following is **not** a true statement concerning cell division of body cells?
- F. Cells divide in a process called meiosis.
G. Cells divide in order to maintain homeostasis.
H. Cells divide when the parent cell gets too big.
I. Cells divide in order to repair themselves when damaged.

SC.912.L.16.14**Biology**

- 3 Construction workers attach ropes and pulleys to wooden timbers on an old bridge. They use the rope and pulley system like the one in the diagram below to move the timbers away from each other, in order to dismantle the bridge.



Which stage of mitosis is similar to this way of dismantling a bridge?

- A. anaphase
 - B. metaphase
 - C. prophase
 - D. telophase
- 4 As part of the cell cycle, a cell produces new daughter cells that are identical to the original cell. During which phase are the two daughter cells physically separated?
- F. cytokinesis
 - G. synthesis phase
 - H. first growth phase
 - I. second growth phase

SC.912.L.16.16**Biology**

Describe the process of meiosis, including independent assortment and crossing over.
Explain how reduction division results in the formation of haploid gametes or spores.

STANDARD REVIEW

Some organisms reproduce by joining gametes to form the first cell of a new individual. The gametes are haploid—they contain one set of chromosomes. Meiosis is a form of cell division that halves the number of chromosomes when forming specialized reproductive cells, such as gametes or spores. Meiosis involves two divisions of the nucleus—meiosis I and meiosis II.

Steps of Meiosis

Before meiosis begins, the DNA in the original cell is replicated. Thus, meiosis starts with homologous chromosomes. Recall that homologous chromosomes are similar in size, shape, and genetic content. The stages of meiosis are summarized below:

Step 1: Prophase I The chromosomes condense, and the nuclear envelope breaks down. Homologous chromosomes pair along their length. Crossing-over occurs when portions of a chromatid on one homologous chromosome are broken and exchanged with the corresponding chromatid portions of the other homologous chromosome.

Step 2: Metaphase I The pairs of homologous chromosomes are moved by the spindle to the equator of the cell. The homologous chromosomes remain together.

Step 3: Anaphase I The homologous chromosomes separate. As in mitosis, the chromosomes of each pair are pulled to opposite poles of the cell by the spindle fibers. But the chromatids do not separate at their centromeres—each chromosome is still composed of two chromatids. The genetic material, however, has recombined.

Step 4: Telophase I Individual chromosomes gather at each of the poles. In most organisms, the cytoplasm divides (cytokinesis), forming two new cells. Both cells or poles contain one chromosome from each pair of homologous chromosomes. Chromosomes do not replicate between meiosis I and meiosis II.

Step 5: Prophase II A new spindle forms around the chromosomes.

Step 6: Metaphase II The chromosomes line up along the equator and are attached at their centromeres to spindle fibers.

Step 7: Anaphase II The centromeres divide, and the chromatids (now called chromosomes) move to opposite poles of the cell.

Step 8: Telophase II A nuclear envelope forms around each set of chromosomes. The spindle breaks down, and the cell undergoes cytokinesis. The result of meiosis is four haploid cells.

In humans, each gamete receives one chromosome from each of 23 pairs of homologous chromosomes. But, which of the two chromosomes that an offspring receives from each of the 23 pairs is a matter of chance. This random distribution of homologous chromosomes during meiosis is called independent assortment. Each of the 23 pairs of chromosomes segregates (separates) independently. Thus, 2^{23} (about 8 million) gametes with different gene combinations can be produced from one original cell by this mechanism. Crossing-over adds even more recombination.

SC.912.L.16.16**Biology****STANDARD PRACTICE**

- 1** Agricultural scientists develop a way to insert a third chromosome into the diploid body cells of a watermelon plant to create a seedless fruit. How could this extra chromosome affect watermelon offspring?
- A. All gametes produced would have twice the number of chromosomes, so offspring would be tetraploid.
 - B. Because the chromosome was inserted into a diploid body cell, it would not be passed to offspring through meiosis.
 - C. The extra chromosome would be passed to offspring through meiosis, so each generation would produce seedless fruit.
 - D. With three chromosomes, the watermelon would produce three times as many offspring as a normal watermelon plant.
- 2** During meiosis, homologous chromosomes line up next to each other. If one arm of a chromatid crosses over the arm of another chromatid, what results?
- F. the creation of an additional sex cell
 - G. the independent assortment of genetic material
 - H. a possible change in the offspring cell's functionality
 - I. additional variation in the DNA combination of each sex cell formed
- 3** Which statement explains why approximately half of an individual's DNA sequence comes from each parent?
- A. A cell from one parent undergoes meiosis, producing offspring cells that have both parents' DNA.
 - B. A cell from one parent undergoes mitotic cell division, producing offspring cells that have only half of that parent's DNA.
 - C. Cells in the parents undergo meiosis, producing haploid gametes that meet up during fertilization to produce a diploid individual.
 - D. Cells in the parents undergo mitosis, producing offspring cells that meet up during fertilization to produce an individual with half of each parent's DNA.

SC.912.L.16.16

Biology

- 4 Crossing-over contributes to the recombination of genetic material in offspring. When does crossing-over happen during meiosis?
- F. when the DNA of the diploid cell is copied
 - G. when homologous chromosomes move to opposite ends of the dividing cell
 - H. when spindle fibers move the chromosomes toward the midline of the dividing cell
 - I. when homologous chromosomes pair and portions of chromatids break off and are exchanged

SC.912.L.16.17**Biology**

Compare and contrast mitosis and meiosis and relate to the processes of sexual and asexual reproduction and their consequences for genetic variation.

STANDARD REVIEW

Some organisms look exactly like their parents and siblings. Others share traits with family members but are not identical to them. Some organisms have two parents, while others have one. The type of reproduction that produces an organism determines how similar the organism is to its parents and siblings. Reproduction, the process of producing offspring, can be asexual or sexual.

In asexual reproduction a single parent passes copies of all of its genes to each of its offspring; there is no fusion of haploid cells such as gametes. Asexual reproduction involves only mitosis, not meiosis. An individual produced by asexual reproduction is a clone, an organism that is genetically identical to its parent. Prokaryotes reproduce by a type of asexual reproduction called binary fission. Many eukaryotes, such as hydra, also reproduce asexually through a process called budding, in which new individuals split off from existing ones. Some multicellular eukaryotes undergo fragmentation, a type of reproduction in which the body breaks into several pieces. Some or all of these fragments later develop into complete adults when missing parts are regrown. Vegetative propagation is a similar reproductive method that farmers use to grow new crops.

In contrast, in sexual reproduction two parents each form reproductive cells through meiosis that have one-half the number of chromosomes. A diploid mother and father would give rise to haploid gametes, which join to form diploid offspring. Because both parents contribute genetic material, the offspring have traits of both parents but are not exactly like either parent. Sexual reproduction, with the formation of haploid cells, occurs in eukaryotic organisms, including humans.

Asexual reproduction is the simplest and most primitive method of reproduction. In a stable environment, asexual reproduction allows organisms to produce many offspring in a short period of time, without using energy to produce gametes or to find a mate. However, the DNA of these organisms varies little between individuals. This may be a disadvantage in a changing environment because a population of organisms may not be able to adapt to a new environment.

Sexual reproduction, on the other hand, provides a powerful means of quickly making different combinations of genes among individuals. Such genetic diversity is the raw material for evolution.

SC.912.L.16.17**Biology****STANDARD PRACTICE**

- 1** Konesha's eyes are brown, just like her mother's eyes. Konesha has long fingers like her father, but her mother's fingers are much shorter. What is the **most likely** reason why Konesha's appearance is similar to and different from that of her parents?
- A. All of her traits depended upon pure chance.
 - B. Her eye color is an inherited trait, but finger length is a trait that evolved in Konesha.
 - C. She inherited some traits, such as eye color, from her mother and others, such as finger length, from her father.
 - D. She inherited her eye color from her mother but grew longer fingers because she had better nutrition as an infant.
- 2** Imagine that sex cells divided by mitosis instead of meiosis. What would then be the result of fertilization of an ovum by a sperm cell?
- F. Fertilization would result in the formation of two identical cells.
 - G. The new individual would be identical to only one of the parents.
 - H. Fertilization would cause crossing-over and recombination of genes.
 - I. Cells of the new individual would have double the necessary number of chromosomes.
- 3** Variation within organisms within a species increases the chance that a species will survive changing conditions. What kind of reproduction produces the most variation within a species?
- A. budding
 - B. parthenogenesis
 - C. sexual reproduction
 - D. asexual reproduction
- 4** Some 2,500 varieties of apples are grown in the United States, mainly by vegetative propagation. Which of the following are methods of producing apples in this way?
- F. grafting or budding
 - G. planting bulbs or corms
 - H. hand pollination or bee pollination
 - I. growing plants from seeds that germinate indoors

SC.912.L.16.17

Biology

- 5** A cheetah is a multicellular organism. A paramecium is a unicellular organism. How do these two organisms differ in terms of how they produce offspring?
- A. The cheetah uses sexual reproduction, while the paramecium uses meiosis.
 - B. The cheetah uses binary fission, while the paramecium uses sexual reproduction.
 - C. The cheetah uses asexual reproduction, while the paramecium uses binary fission.
 - D. The cheetah uses sexual reproduction, while the paramecium uses asexual reproduction.

SC.912.L.17.2**Biology**

Explain the general distribution of life in aquatic systems as a function of chemistry, geography, light, depth, salinity, and temperature.

MA.912.S.1.2

STANDARD REVIEW

Aquatic systems include freshwater and saltwater communities. Each differs in chemistry, geography, light, depth, salinity, and temperature and thus the kinds of life it supports.

Freshwater Communities Ponds and lakes have three zones in which organisms live. The littoral zone is a shallow zone near the shore. Here, aquatic plants live along with various predatory insects, amphibians, and small fish. The limnetic zone refers to the area that is farther away from the shore but close to the surface. It is inhabited by floating algae, zooplankton, and fish. The profundal zone is a deep-water zone that is below the limits of effective light penetration. Numerous bacteria and wormlike organisms eat debris on the lake's bottom, releasing large amounts of nutrients.

Wetland Communities Swamps, marshes, bogs, and other communities that are covered with a layer of water are called wetlands. Wetlands typically are covered with a variety of water-tolerant plants, called hydrophytes ("water plants"). Marsh grasses and cattails are hydrophytes. Wetlands are dynamic communities that support a diverse array of invertebrates, birds, and other animals. Wetlands are among the most productive ecosystems on Earth.

Shallow Ocean Water Communities The zone of shallow water is small in area, but compared with other parts of the ocean, it is inhabited by large numbers of species. The seashore between high and low tide, called the intertidal zone, is home to many species of marine invertebrates. Coral reef communities, the world's most diverse, occur in shallow tropical waters. The world's great fisheries are located in the coastal zones of cooler waters, where nutrients washed out from land support huge numbers of fishes.

Communities at the Surface of the Open Sea Drifting freely in the upper waters of the ocean is a diverse community of plankton, composed of bacteria, algae, fish larvae, and many small invertebrate animals. Fishes, whales, and invertebrates such as jellyfishes feed on plankton. And larger fishes and birds, in turn, feed on some of these animals. Photosynthetic plankton (algae such as diatoms and some bacteria) that form the base of this food chain account for about 40 percent of all the photosynthesis that takes place on Earth. Because light penetrates water only to the depth of about 100 m (328 ft), this rich community is confined to the ocean's surface.

Communities at the Ocean Depths In the deepest waters of the sea, the marine community lives in total darkness, in deep cold, and under great pressure. Despite what seem like hostile conditions, the deep ocean supports a diverse community of invertebrates and fishes. This includes great squids and angler fishes that attract prey with projections from their head that emit light. On the ocean floor, at an average depth of more than 3 km (1.9 mi), researchers have also found an abundance of species.

SC.912.L.17.2**Biology****STANDARD PRACTICE**

- 1** Zebra mussels are tiny clam-like organisms that strain plankton out of lake water. They attach to piers, boat hulls, pipes, and any other available surface. They prefer attaching to surfaces in water that is 2 to 7 feet deep but have been found at depths of 180 feet in water temperatures ranging from 7°C to 32°C. They live mainly in freshwater with salinities (salt concentrations) of 0.21 to 1.47 parts per thousand (ppt), but they can live in estuaries with salinities up to 13.40 ppt. Given what is known about the diet of zebra mussels, which variables influence their fundamental niche?
- A. nearby boats, fish larvae, water salinity, availability of plankton
 - B. water depth, water clarity, availability of plankton, water temperature, water salinity
 - C. water clarity, availability of native mussel species, water temperature, water salinity
 - D. availability of surfaces for attachment, water depth, water salinity, availability of plankton
- 2** Acid rains form when air pollution combines with moisture in the atmosphere and falls to Earth as precipitation that has a low pH. Which of the following effects **cannot** be attributed to acid rain?
- F. an increase in CO₂ in Earth's atmosphere
 - G. damage to historic buildings and monuments
 - H. death of aquatic organisms in lakes and streams
 - I. damage to trees and a decline of forest communities

SC.912.L.17.2**Biology**

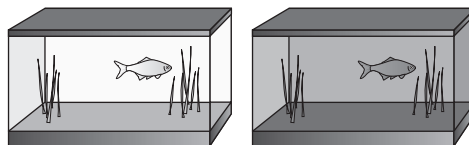
- 3 Constance made the table below during a field investigation on ocean life.

Characteristics of Several Ocean Zones	
Zones	Description
Intertidal	Air, sun, and water exposure; crashing waves
Neritic	Water depth less than 200 m; lots of sunlight; relatively warm water
Benthic	Very deep water; no light; cold except near thermal vents that emit heat and chemicals

Based on Constance's table, which of the following is a valid conclusion?

- A. Organisms in the intertidal zone must be able to withstand very cold water.
- B. There are no producers in the benthic zone that rely on photosynthesis.
- C. Organisms in the benthic zone must be able to tolerate occasional air exposure.
- D. The warm water and abundant sunlight in the neritic zone limits the plankton population.

- 4 A scientist set up two glass fish tanks. She put 5 L of water, a small fish, and several plants in each tank. She then sealed the tops of both tanks so that no air could leave or enter. Tank A was placed in a bright room. Tank B was placed in a dark room. After 45 hours, the fish in the tank that was kept in darkness died. The fish in the brightly lit tank remained healthy for more than 96 hours.



Based on the results of the experiment described above, what conclusion can you draw about the relationship between the aquarium conditions and the organisms that live within the aquarium?

- F. Fish cannot survive in an overcrowded aquarium.
- G. Fish cannot survive in an aquarium that does not contain plants.
- H. Fish cannot survive in a plant-filled aquarium kept in darkness for 45 hours.
- I. Fish cannot survive in a plant-filled aquarium that has been sealed so that no air can leave or enter.

SC.912.L.17.4**Biology**

Describe changes in ecosystems resulting from seasonal variations, climate change and succession.

STANDARD REVIEW

An ecosystem, or ecological system, consists of a community and all the physical aspects of its habitat, such as the soil, water, and weather. Earth's ecosystems may seem stable, but they are not static. They change seasonally, they can change suddenly, and they can even change over time. Climate change is one way that ecosystems can change. They can also change through a regular, progressive process called succession.

When a volcano forms a new island, a glacier recedes and exposes bare rock, or a fire burns all of the vegetation in an area, a new habitat is created. This change sets off a process of colonization and ecosystem development. The first organisms to live in a new habitat where soil is present tend to be small, fast-growing plants, called pioneer species. They may make the ground more hospitable for other species. Later waves of plant immigrants may then outcompete and replace the pioneer species.

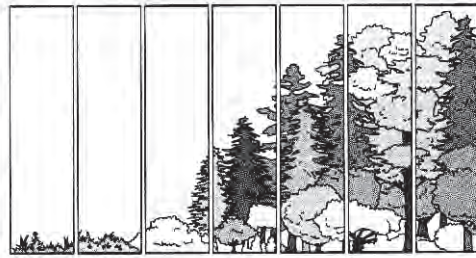
Succession is the somewhat regular progression of species replacement. Succession that occurs where life has not existed before is called primary succession. Succession that occurs in areas where there has been previous growth, such as in abandoned fields or forest clearings, is called secondary succession. It was once thought that the stages of succession were predictable and that succession always led to the same final community of organisms within any particular ecosystem. Ecologists now recognize that initial conditions and chance play roles in the process of succession. For example, if two species are in competition, a sudden change in the climate may favor the success of one species over the other. For this reason, no two successions are alike.

SC.912.L.17.4**Biology****STANDARD PRACTICE**

- 1** After fires destroyed 793,000 acres of aspen and pine forest in Yellowstone National Park in the unusually dry summer of 1988, biologists were able to study the long-term effects of fire on an ecosystem. The biologists found that the soil after the fire was more fertile and soon gave rise to small plants and new pine trees. What ecological process were the biologists observing?
- A. biodiversity
 - B. equilibrium
 - C. food web energy flow
 - D. succession
- 2** Forest fires can burn down all of the trees and plants living in an area. However, new growth can spring from the decaying organic matter left behind. What is the gradual, sequential regrowth of a community of species after a forest fire?
- F. adaptation
 - G. pioneer succession
 - H. primary succession
 - I. secondary succession
- 3** The tropical rain forests have been called the lungs of the planet. They take huge quantities of carbon dioxide from the atmosphere during photosynthesis and give off large quantities of oxygen. Vast tracts of tropical rain forests are being cleared for farms by people cutting down and burning the trees. Which of the following is the **best** hypothesis about the effect that rain forest destruction may have on atmospheric carbon dioxide levels?
- A. Rain forest destruction will not influence overall carbon dioxide levels, because it will affect only areas around the equator.
 - B. Any carbon dioxide added to the atmosphere because of rain forest destruction will fall into the oceans and be used in building coral reefs.
 - C. Cutting down rain forest trees will decrease atmospheric carbon dioxide levels, because plants give off carbon dioxide as a result of cellular respiration.
 - D. Cutting down trees, which take carbon dioxide from the atmosphere, and burning the trees, which adds carbon dioxide to the atmosphere, will increase atmospheric carbon dioxide levels.

SC.912.L.17.4**Biology**

- 4 The panels in the diagram below show how an area progresses over time.



What process is illustrated by the diagram?

- F. pioneer speciation G. primary succession
H. secondary succession I. ecosystem boundaries
- 5 A biologist compares how different ecosystems undergo succession. She divides the series of events that happen during primary succession and secondary succession into three different stages. Which feature might be used to distinguish secondary succession from primary succession?
- A. the lack of pioneer species in the second stage
B. the presence of pioneer species in the final stage
C. the presence of trees and large plants in the final stage
D. the presence of soil and organic matter in the first stage
- 6 A nursery owner wants Easter lilies to bloom in the spring and poinsettias to bloom during the December holidays. Which plant response would the owner manipulate to make sure each plant bloomed for the appropriate season?
- F. photoperiodism, a response to the length of days and nights
G. heliotropism, a response to the position of the Sun in the sky
H. phototropism, a response to the direction from which light is coming
I. dormancy, in which a seed remains inactive until conditions are suitable for growth

SC.912.L.17.5**Biology**

Analyze how population size is determined by births, deaths, immigration, emigration, and limiting factors (biotic and abiotic) that determine carrying capacity.

MA.912.S.3.2

STANDARD REVIEW

A population consists of all the individuals of a species that live together in one place at one time. Every population tends to grow because individuals tend to have multiple offspring over their lifetime. A population grows when more individuals are born than die in a given period. But eventually, limited resources in an environment limit the growth of a population.

When population size is plotted against time on a graph, the population growth curve resembles a *J*-shaped curve and is called an exponential growth curve. An exponential growth curve is a curve in which the rate of population growth stays the same, and as a result, the population size increases steadily.

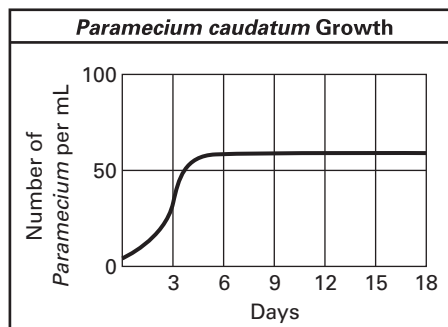
However, populations do not usually grow unchecked. Their growth is limited by predators, disease, and the availability of resources. Eventually, growth slows, and the population may stabilize. The population size that an environment can sustain is called the carrying capacity.

As a population grows, limited resources (that is, resources in short supply) eventually become depleted. When this happens, the growth of the population slows. The population model can be adjusted to account for the effect of limited resources, such as food and water. These resources are called density-dependent factors because the rate at which they become depleted depends upon the population density of the population that uses them.

The population model that takes into account the declining resources available to populations is called the logistic model of population growth, after the mathematical form of the equation. The logistic model is a population model in which exponential growth is limited by a density-dependent factor. Unlike the simple model, the logistic model assumes that birth and death rates vary with population size. When a population is below carrying capacity, the growth rate is rapid. However, as the population approaches the carrying capacity, death rates begin to rise and birthrates begin to decline. Competition for food, shelter, mates, and limited resources tends to increase as a population approaches its carrying capacity. The accumulation of wastes also increases. As a result, the rate of growth slows. The population eventually stops growing when the death rate equals the birthrate.

SC.912.L.17.5**Biology****STANDARD PRACTICE**

- 1 Researchers have found that a local squirrel population fluctuates from year to year, increasing one year and decreasing the next. Which of the following factors would cause the squirrel population to grow?
- A. the birth rate is equal to the death rate
 - B. emigration is greater than immigration
 - C. the death rate is higher than the birth rate
 - D. the birth rate is greater than the death rate
- 2 Your class has been observing the population growth of a species of *Paramecium*, a single-celled organism, for 18 days. Your data are shown in the graph below. Food was occasionally added to the test tube in which the paramecia were grown.



Look at the graph above. What is the carrying capacity of the test-tube environment as long as food is added?

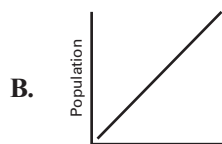
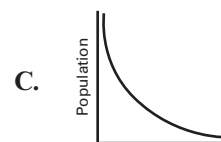
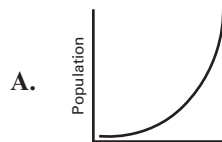
- F. about 10 paramecia
- G. about 50 paramecia
- H. about 65 paramecia
- I. about 100 paramecia

SC.912.L.17.5**Biology**

- 3** Examine the table below.

Year	Human Population Growth (billions)
1804	1
1927	2
1960	3
1975	4
1987	5
1999	6

Which graph **most closely** represents human population growth based on the data provided above?



- 4** All populations fluctuate in size. Which of the following is a nonenvironmental factor that might cause a population to be reduced in size?
- F. decreased predation
 - G. increased competition
 - H. emergence of disease resistance
 - I. increased availability of a food source
- 5** Which is a way in which the Central Arizona Project, which diverts water from the Colorado River, could have contributed to population growth in southern Arizona?
- A. It provided water for neighborhood lawns.
 - B. It enabled better flood control during rains in the desert.
 - C. It provided an opportunity for recreational fishing and swimming.
 - D. It provided a reliable supply of water for drinking and agricultural irrigation.

SC.912.L.17.5

Biology

- 6** The population size that an environment can sustain is called the carrying capacity. Which of the following factors would **not** decrease the carrying capacity of a pond environment?
- F. drought
 - G. flooding
 - H. food shortages
 - I. unusually low temperatures

SC.912.L.17.8**Biology**

Recognize the consequences of the losses of biodiversity due to catastrophic events, climate changes, human activity, and the introduction of invasive, non-native species.

STANDARD REVIEW

The variety of organisms, their genetic differences, and the communities and ecosystems in which they occur is termed biodiversity. Biodiversity is a measure of both the number of different species in a community (species richness) and the relative numbers of each of the species (species diversity). Some of the most diverse communities are those living in tropical rainforests.

Over the last 50 years, about half of the world's tropical rainforests have been burned to make pasture and farmland or have been cut for timber. Many thousands of square miles more will be destroyed this year. The people responsible, often poor farmers, view the forest lands as a resource to be developed, much as Americans viewed North American forests a century ago.

The problem is that as the rainforests disappear, so do their inhabitants. No one knows how many species are being lost. To find out, scientists carefully catalogue all of the residents of one small segment of forest and then extrapolate their data. That is, scientists use what they know to predict what they don't know. The resulting estimates vary widely, but it is clear Earth is losing many species. Some 10 percent of well-known species teeter on the brink of extinction. Worst-case estimates are that we will lose up to one-fifth of the world's species of plants and animals—about 1 million species— during the next 50 years. An extinction of this size has not occurred in at least 65 million years, since the end of the age of dinosaurs.

The tragedy of extinction is that as species disappear, so do our chances to learn about them and their possible benefits. This situation is comparable to burning a library before reading the books—we lose forever the knowledge we might have gained. Also, experiments have clearly demonstrated that an ecosystem's biodiversity and productivity are related. That is, increased species richness leads to greater productivity.

SC.912.L.17.8**Biology****STANDARD PRACTICE**

- 1** Imagine that a city located in a desert environment has grown significantly over the last few decades. Which statement **best describes** how the growth of the metropolitan city would impact the desert environment in the area?
- A. Biodiversity would decrease in the area but increase in the desert beyond the city.
 - B. By destroying habitat to build homes and highways, the growth of the city would decrease the biodiversity in the desert.
 - C. The growth of the city would have little impact on the environment, because few animals likely lived there before growth happened.
 - D. By bringing in water, the growth of the city would improve the entire desert environment and increase the biodiversity.
- 2** As an increasing amount of carbon dioxide is sent into the atmosphere by burning fossil fuels, the oceans absorb more and more of the excess carbon. Some of the carbon reacts chemically in seawater to form an acid. The more carbon the ocean takes in, the more acidic the water becomes. If the water becomes too acidic, tiny organisms that make up plankton may not be able to make protective shells. One of the areas that would be greatly affected is the Antarctic. What effect, if any, might this harm to plankton have on an Antarctic marine food web?
- F. It would have no effect, because the organisms in plankton include algae, which do not have shells.
 - G. It would be beneficial, because consumers in the third trophic level could more easily eat zooplankton that do not have protective shells.
 - H. Damage to the Antarctic ecosystem would be extensive but could be repaired as new plankton drifts south to replace the plankton that died off.
 - I. The dying off of these tiny organisms would be disastrous, because zooplankton is a major source of food for small and large marine organisms.

SC.912.L.17.8**Biology**

- 3** Biologists speculate that in the mid-1980s, a cargo ship from Eastern Europe dumped ballast water containing a tiny clam-like organism called the zebra mussel into the Great Lakes. The zebra mussel is native to waters in Eastern Europe but had never lived in North America. The zebra mussels began to attach to piers, boat hulls, pipes, and any other available surface. Conditions in the Great Lakes were ideal for these filter feeders, which strain plankton out of lake water. Plankton is a food resource for other small aquatic animals and fish larvae. Zebra mussels can strain food from about one liter of water per day. These invaders thrived and spread throughout the Great Lakes. They now threaten other North American waterways. The presence of large quantities of plankton decreases water clarity. Since zebra mussels were introduced, the clarity of Lake Erie's water has increased 600%. What does this **most likely** indicate about zebra mussels?
- A. In clear water, it is easy to catch zebra mussels.
 - B. Zebra mussels could be used to solve water pollution problems.
 - C. There is not enough data given to infer a link between zebra mussels and water clarity.
 - D. Zebra mussels are such efficient feeders that they have greatly reduced the amount of plankton in Lake Erie.
- 4** Imagine that a nonnative bird species appears in an ecosystem. Which of the following will **not** be a likely change in the ecosystem?
- F. Native bird species will immediately migrate to another area.
 - G. Bird predator species will temporarily have more available prey.
 - H. Each food chain in the ecosystem will adjust over time to include the new species of bird.
 - I. Birds that share the same niche of the new species will have more competition for food resources.

SC.912.L.17.9**Biology**

Use a food web to identify and distinguish producers, consumers, and decomposers. Explain the pathway of energy transfer through trophic levels and the reduction of available energy at successive trophic levels.

LA.910.2.2.3

STANDARD REVIEW

Everything that organisms do in ecosystems—running, breathing, burrowing, growing—requires energy. The flow of energy is the most important factor that controls what kinds of organisms live in an ecosystem and how many organisms the ecosystem can support.

Most life on Earth depends on photosynthetic organisms, which capture some of the Sun's light energy and store it as chemical energy in organic molecules. These organic compounds are what we call food. The rate at which organic material is produced by photosynthetic organisms in an ecosystem is called primary productivity. Primary productivity determines the amount of energy available in an ecosystem. Most organisms in an ecosystem can be thought of as chemical machines driven by the energy captured in photosynthesis. Organisms that first capture energy, the producers, include plants, some kinds of bacteria, and algae. Producers make energy-storing molecules. All other organisms in an ecosystem are consumers. Consumers are those organisms that consume plants or other organisms to obtain the energy necessary to build their molecules.

Ecologists study how energy moves through an ecosystem by assigning organisms in that ecosystem to a specific level, called a trophic level, in a graphic organizer based on the organism's source of energy. Energy moves from one trophic level to another. The path of energy through the trophic levels of an ecosystem is called a food chain. However, in most ecosystems, energy does not follow simple straight paths because individual animals often feed at several trophic levels. This creates a complicated, interconnected group of food chains called a food web.

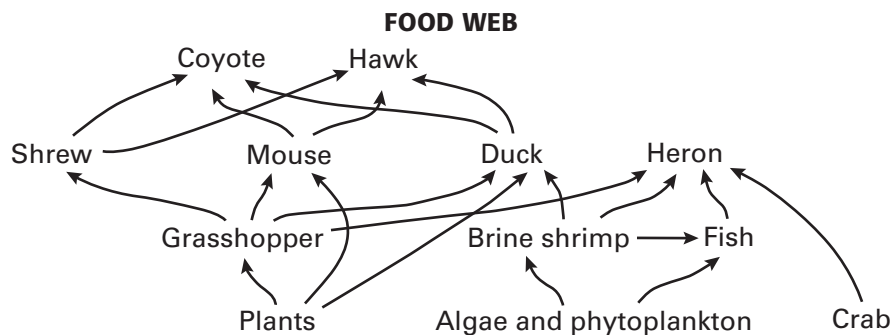
The lowest trophic level of any ecosystem is occupied by the producers, such as plants, algae, and bacteria. Producers use the energy of the Sun to build energy-rich carbohydrates. Many producers also absorb nitrogen gas and other key substances from the environment and incorporate them into their biological molecules.

At the second trophic level are herbivores, animals that eat plants or other primary producers. They are the primary consumers. Cows and horses are herbivores, as are caterpillars and some ducks. At the third trophic level are secondary consumers, animals that eat other animals. These animals are called carnivores. Tigers, wolves, and snakes are carnivores. Some animals, such as bears, are both herbivores and carnivores; they are called omnivores. Many ecosystems contain a fourth trophic level composed of those carnivores that consume other carnivores. They are called tertiary consumers, or top carnivores.

In every ecosystem there is a special class of consumers called detritivores, which include worms and fungal and bacterial decomposers. Detritivores are organisms that obtain their energy from the organic wastes and dead bodies that are produced at all trophic levels.

SC.912.L.17.9**Biology****STANDARD PRACTICE**

- 1 The Yellowstone area contains organisms representing all trophic levels, including plants, algae, moss, fungi, blue jays, fish, and grizzly bears. Which sequence **best represents** the transfer of energy through Yellowstone trophic levels?
- A. fungi to moss to algae to fish
- B. blue jay to moss to fungi to plant
- C. algae to fish to grizzly bear to fungi
- D. plant to blue jay to algae to grizzly bear
- 2 The food web below represents the interactions between organisms in a salt marsh ecosystem and organisms in an old field ecosystem.



Which of the following is the correct flow of energy?

- F. The crab gets energy from eating plants.
- G. The heron gets energy from eating plants.
- H. The crab gets energy from eating the heron.
- I. The heron gets energy from eating the crab.
- 3 Kerry drew the following food chain in her science notebook.
- plants → grasshoppers → rats → owls
- How would the grasshoppers be classified in this food chain?
- A. producer
- B. primary consumer
- C. tertiary consumer
- D. secondary consumer

SC.912.L.17.9

Biology

- 4** Very rarely do ecosystems contain more than four trophic levels, because there is not enough energy to support more. In which trophic level is there the **least** energy available?
- F. producer
 - G. primary consumer
 - H. tertiary consumer
 - I. secondary consumer

SC.912.L.17.11**Biology**

Evaluate the costs and benefits of renewable and nonrenewable resources, such as water, energy, fossil fuels, wildlife, and forests.

STANDARD REVIEW

A natural resource is any natural material that is used by humans. Examples of natural resources are water, petroleum, minerals, forests, and animals. Most resources are changed and made into products that make people's lives more comfortable and convenient. The energy we get from resources, such as gasoline and wind, ultimately comes from the Sun's energy.

Some natural resources can be renewed. A renewable resource is a natural resource that can be replaced at the same rate at which the resource is used. Although many resources are renewable, they still can be used up before they can be renewed. Trees, for example, are renewable. However, some forests are being cut down faster than new forests can grow to replace them.

Not all of Earth's natural resources are renewable. A nonrenewable resource is a resource that forms at a rate that is much slower than the rate at which it is consumed. When these resources become scarce, humans will have to find other resources to replace them. Most of the energy we use comes from a group of natural resources called fossil fuels. A fossil fuel is a nonrenewable energy resource formed from the remains of plants and animals that lived long ago. Examples of fossil fuels include petroleum, coal, and natural gas. Once fossil fuels are used up, new supplies won't be available for thousands or even millions of years. Second, obtaining and using fossil fuels has environmental consequences, such as acid rain and global warming. To continue to have access to energy and to overcome pollution, we must find alternative sources of energy.

SC.912.L.17.11**Biology****STANDARD PRACTICE**

- 1** When the supplies of a product decrease, the price of the product tends to increase. How might continuing increases in the price of fossil fuels affect research on the development of renewable resources, such as wind power and solar energy?
- A. Research on the development of renewable resources would likely decline.
 - B. Research on the development of renewable resources would likely increase.
 - C. There would be less research on alternative energies and more on fossil fuels.
 - D. Increased fossil fuel prices would have little effect on research and development.
- 2** Public officials in Florida had to decide whether to build a new coal-fired electric power plant or invest in developing more solar energy. Which of the following sums up the arguments likely made by those who favored coal and those who favored solar energy?
- F. pro coal: coal mines need more business; pro solar: Florida is an ideal state for solar energy because of its abundant sunshine
 - G. pro coal: invest in this relatively cheap and reliable energy source; pro solar: invest in solar energy because coal supplies are running out faster than oil supplies
 - H. pro coal: coal is a relatively cheap and abundant energy source; pro solar: Florida is ideal for solar energy, which produces no pollutants, because of its abundant sunshine
 - I. pro coal: a coal-fired power plant gives off less pollution than any other type of power plant; pro solar: investments in solar energy will help develop technologies for safer nuclear power plants

SC.912.L.17.11**Biology**

- 3** The picture below shows windmills on a wind farm.



Which of the following is a positive effect of using windmills instead of fossil fuels to obtain energy?

- A. reduction in CO₂ emissions
 - B. decrease in overall electrical use
 - C. use of more habitat for wind farms
 - D. increase in the use of metal resources
- 4** Conservation is the wise use of natural resources. One way to practice conservation is the three Rs—reduce, reuse, and recycle. When people practice conservation in these ways, how do they affect the environment?
- F. They do not affect the environment.
 - G. They protect the environment by using fewer natural resources.
 - H. They decrease the amount of natural resources in the environment.
 - I. They cause an increase in the amount of pollution in the environment.

SC.912.L.17.13**Biology**

Discuss the need for adequate monitoring of environmental parameters when making policy decisions.

SC.912.N.2.1

STANDARD REVIEW

It is easy to get discouraged when considering the world's many serious environmental problems. But do not lose track of the conclusion that emerges from our examination of these environmental problems—each of the world's many problems is solvable. If one looks at how environmental problems have been overcome, a clear pattern emerges.

Five Steps to Success

Viewed simply, there are five components to successfully solving any environmental problem.

1. **Assessment.** The first stage is scientific analysis of the problem, the gathering of information about what is happening. To construct a scientific model of an ecosystem, data must be collected and analyzed. A model makes it possible to describe the current state of the ecosystem. A model would also allow scientists to make predictions about the future of the ecosystem.
2. **Risk analysis.** Using the information obtained by scientific analysis, scientists predict the consequences of different types of environmental intervention. It is also essential to evaluate any negative effects associated with a plan of action.
3. **Public education.** When it is possible to describe alternative courses of action, the public must be informed. This involves explaining the problem in understandable terms, such as at a public meeting, presenting the alternative actions available, and explaining the probable costs and results of the different choices.
4. **Political action.** The public, through its elected officials, selects and implements a course of action. Individuals can be influential at this stage by exercising their right to vote and by contacting their elected officials.
5. **Follow-through.** The results of any action should be carefully monitored to see if the environmental problem is being solved.

SC.912.L.17.13**Biology****STANDARD PRACTICE**

- 1** Imagine that a community plans to build a shopping mall. Which statement describes how the local government should consider the effects of development on wildlife in the area?
- A. Local governments do not have to consider the impacts of development on endangered species at all.
 - B. Local governments always need to consider the needs of the developer first and the needs of wildlife second.
 - C. Local governments need to consider if a species is endangered and at risk of extinction due to habitat destruction.
 - D. Local governments do not face pressure from environmentalists or developers when making decisions regarding wildlife.
- 2** When developing environmental policies, elected officials and environmental activists often consult scientists to assess problems and verify the results of solutions. Which actions are part of environmental science as well as environmental activism?
- F. taking a side and persuading others to act
 - G. making assumptions and drawing conclusions
 - H. observing, collecting data, and controlling variables
 - I. making educated guesses and implementing good ideas
- 3** Members of an environmental protection group have noticed that fish populations have decreased in a local wetland area. They think that pollution in runoff from nearby farms is to blame. What is the first step they should take to solve the problem and restore the wetland fish populations?
- A. Enact laws that prohibit farming near wetland areas and near creeks that drain into them.
 - B. Educate other communities whose wetlands are at risk of the dangers of having farms nearby.
 - C. Collect and analyze data to assess which factors are causing the fish populations to decrease.
 - D. Bring in fish from other wetlands to restore the original fish population size of the local wetland area.

SC.912.L.17.13**Biology**

- 4 After implementing a solution to an environmental problem, environmental workers often continue to collect and analyze data associated with the problem area. Why is it important for public officials to follow through and check the results of implemented solutions to environmental problems?
- F. Once data is collected in an area, public officials will always have to monitor that area.
 - G. The act of collecting data ensures that the problem will never come back again in that area.
 - H. Public officials always monitor the environment whether or not there has been an environmental problem.
 - I. Collected data can show public officials whether the solution is actually working or whether it needs to be modified.

SC.912.L.17.20**Biology**

Predict the impact of individuals on environmental systems and examine how human life-styles affect sustainability.

STANDARD REVIEW

The global rate of population growth has been declining. The United Nations projects that the world's population will stabilize at 9.7 billion by the year 2050. However, population growth rates are uneven across Earth. Population growth tends to be the highest in countries that can least afford it. Already limited resources are strained further, and natural resources—ground water, land for farming, forests—are ever more quickly depleted or polluted.

No one knows whether the Earth can support six billion people indefinitely, much less the far larger population that lies in our future. Building a sustainable world is the most important task facing humanity's future. The quality of life available to your children in the new century will depend to a large extent on our success.

One industry where sustainable practices can help support human activity without depleting natural resources is agriculture. Sustainable agriculture refers to farming that remains productive and profitable through practices that help replenish the soil's nutrients, reduce erosion, and control weeds and insect pests.

In an ecosystem, decomposers return mineral nutrients to the soil. However, when the plants are harvested and shipped away, there is a net loss of nutrients from the soil where the plants were growing. The amount of organic matter in the soil also decreases, making the soil less able to hold water and more likely to erode.

One way to protect soil is through the planting of cover crops. After harvest, farmers can plant cover crops, such as rye, clover, or vetch, instead of letting the ground lie bare. Cover crops keep the soil from compacting and washing away, and they help the soil absorb water. They also provide a habitat for beneficial insects, slow the growth of weeds, and keep the ground from overheating. When cover crops are plowed under, they return nutrients to the soil.

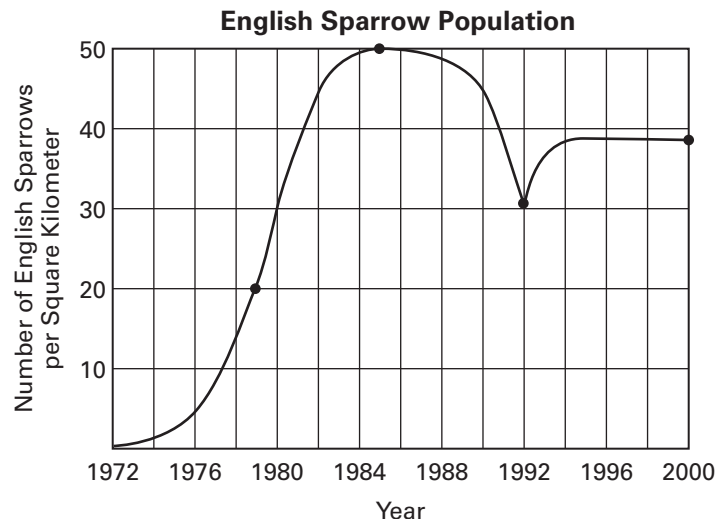
Rotational grazing can also protect land resources. Farmers who raise cattle and sheep can divide their pastures into several grazing areas. By rotating their livestock from one area to another, they can prevent the animals from overgrazing the pasture. This allows the plants on which the animals feed to live longer and be more productive. Water quality improves as the pasture vegetation becomes denser. Animals distribute manure more evenly with rotational grazing than they do in feed lots or unmanaged pastures.

SC.912.L.17.20**Biology****STANDARD PRACTICE**

- 1** Sustainable agriculture is farming that remains productive and profitable while still conserving natural resources. Which of the following is an example of a sustainable agriculture practice?

- A. preventing cattle from ever grazing on pastures
- B. removing all manure from pastures where cattle graze
- C. allowing cattle to graze over an entire pasture year round
- D. rotating parts of a pasture on which cattle get to graze throughout the year

- 2** The graph below shows the English sparrow population in an area over several years.

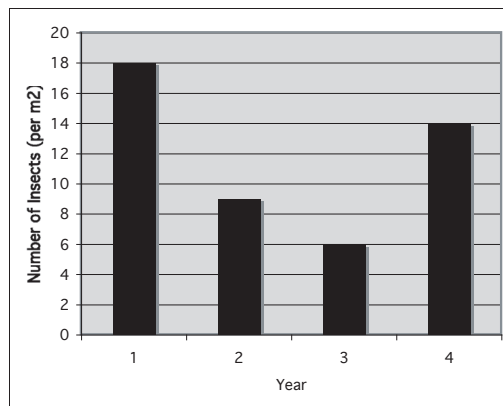


In 1988, a large shopping mall was built in the area where the sparrows lived. According to the information in the graph, how did this affect the sparrow population over a period of time?

- F. The population increased because humans fed the sparrows.
- G. The sparrow population was unaffected by the shopping mall.
- H. The population increased because predators were taken away.
- I. The sparrow population decreased because of habitat destruction.

SC.912.L.17.20**Biology**

- 3 The world's population exceeded 6 billion in October 1999, and the annual increase is now about 94 million people. About 260,000 people are added to the world population each day, or about 180 every minute. Which of the following is **not** a result of the increasing human population?
- A. fewer old-growth forests
 - B. more stress on natural resources such as water
 - C. increased carrying capacity of many ecosystems
 - D. less undeveloped land available for animal habitats
- 4 The following graph shows the number of insects present on a field after it has been sprayed with the same insecticide once a year over four years.



What is the **most reasonable** hypothesis for the increase in insects seen in year four?

- F. The insecticide used in year four was stronger than it was in previous years.
- G. The insects in the field in year four were the same species as in previous years.
- H. The population of insects resistant to the insecticide had increased over the four years.
- I. Insects from a neighboring field had moved into the area before the insecticide was applied in year four.

SC.912.L.18.1**Biology**

Describe the basic molecular structures and primary functions of the four major categories of biological macromolecules.

STANDARD REVIEW

Four principal classes of organic compounds are found in living things: carbohydrates, lipids, proteins, and nucleic acids.

Carbohydrates are organic compounds made of carbon, hydrogen, and oxygen atoms in the proportion of 1:2:1. Carbohydrates are a key source of energy, and they are found in most foods. The building blocks of carbohydrates are single sugars, called monosaccharides, such as glucose, $C_6H_{12}O_6$, and fructose. Disaccharides are double sugars formed when two monosaccharides are joined. For example, sucrose, or common table sugar, consists of both glucose and fructose. Polysaccharides such as starch are chains of three or more monosaccharides. Starch and cellulose, which are found in plants, and glycogen, which is made by animals, are examples of polysaccharides.

Lipids are nonpolar molecules that are not soluble or mostly insoluble in water. They include fats, phospholipids, steroids, and waxes. Phospholipids make up the lipid bilayer of cell membranes. Steroids include cholesterol, which is found in animal cell membranes. Other lipids include some light-absorbing compounds, such as the plant pigment chlorophyll. Fats are lipids that store energy.

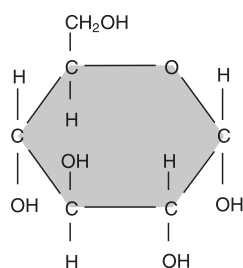
Proteins are usually large molecules formed by linked smaller molecules called amino acids. Amino acids are the building blocks of proteins. Twenty different amino acids are found in proteins. Some amino acids are polar, and others are nonpolar. Some amino acids are electrically charged, and others are not charged. Proteins fold into compact shapes, determined in part by how the protein's amino acids interact with water and one another.

Some proteins are enzymes and promote chemical reactions. Other proteins have important structural functions. Other proteins called antibodies help your body defend against infection. Specialized proteins in muscles enable your muscles to contract. In your blood, a protein called hemoglobin carries oxygen from your lungs to body tissues.

Nucleic acids are long chains of smaller molecules called nucleotides. A nucleotide has three parts: a sugar, a base, and a phosphate group, which contains phosphorus and oxygen atoms. There are two types of nucleic acids—DNA and RNA—and each type contains four kinds of nucleotides. DNA, or deoxyribonucleic acid, consists of two strands of nucleotides that spiral around each other. Chromosomes contain long strands of DNA, which stores hereditary information. RNA, or ribonucleic acid, may consist of a single strand of nucleotides or of base-paired nucleotides. RNA plays many key roles in the manufacture of proteins.

SC.912.L.18.1**Biology****STANDARD PRACTICE**

- 1** Two of the four principle classes of organic compounds are proteins and nucleic acids. What is the relationship between proteins and nucleic acids?
- A. Nucleic acids use proteins for energy.
 - B. Nucleic acids are a subset of proteins.
 - C. Proteins are long polymers of nucleic acids.
 - D. Nucleic acids contain the information to make proteins.
- 2** Proteins are used to enable movement, provide structure and support, and carry out important chemical reactions inside the body. What is needed in order for the human body to synthesize proteins?
- F. a diet rich in amino acids
 - G. sufficient sunlight and water
 - H. 1,200 calories of nutrients per day
 - I. minerals and fats in sufficient amounts
- 3** The diagram below illustrates the structure of glucose.



Which of the following describes how the body uses molecules like the one illustrated above?

- A. Sugars form carbohydrates, which are linked together to form fats that store energy.
- B. Carbohydrates are broken down into glucose, which is stored inside the body's cells.
- C. Sugars are broken down into proteins that become the building blocks of the body's tissues.
- D. Carbohydrates, such as glucose, are broken down to release chemical energy that is used by the body's cells.

SC.912.L.18.1

Biology

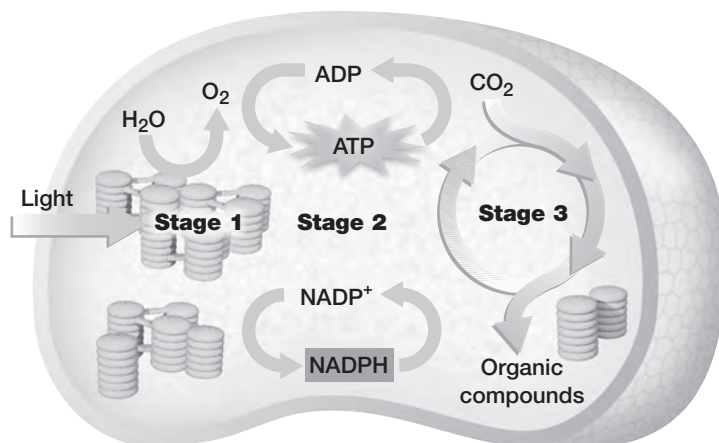
- 4** Phospholipids are linear molecules with one polar end and one nonpolar end. How does this structure relate to their function in cell membranes?
- F. The polar tails of phospholipids form the outside of the cell membrane.
 - G. The nonpolar heads of phospholipids form the outside of the cell membrane.
 - H. The polar heads of phospholipids combine to form the middle of the cell membrane, with the tails on the outside.
 - I. The nonpolar tails of phospholipids combine to form the middle of the cell membrane, with the heads on the outside.

SC.912.L.18.7**Biology**

Identify the reactants, products, and basic functions of photosynthesis.

STANDARD REVIEW

Photosynthesis is the process that provides energy for almost all life. As the figure below shows, photosynthesis has three stages:

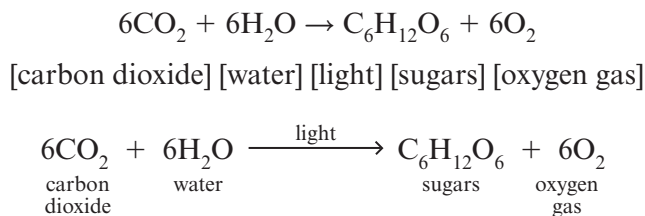


Stage 1: Energy is captured from sunlight. Pigments such as chlorophyll absorb light energy, which excites electrons.

Stage 2: Light energy is converted to chemical energy, which is temporarily stored in ATP and the energy carrier molecule NADPH. This stage occurs when the excited electrons are passed through a series of molecules—called an electron transport chain—along a thylakoid membrane.

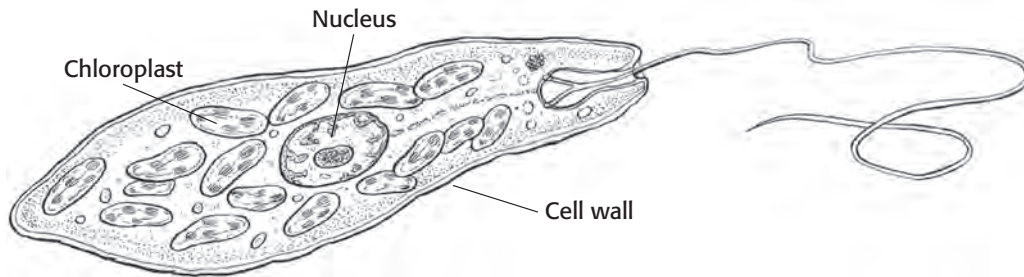
Stage 3: The chemical energy stored in ATP and NADPH powers the formation of organic compounds, using carbon dioxide, CO₂. The most common way that this happens is called the Calvin cycle.

Photosynthesis occurs in the chloroplasts of plant cells and algae and in the cell membrane of certain prokaryotes. Photosynthesis can be summarized by the following equation:



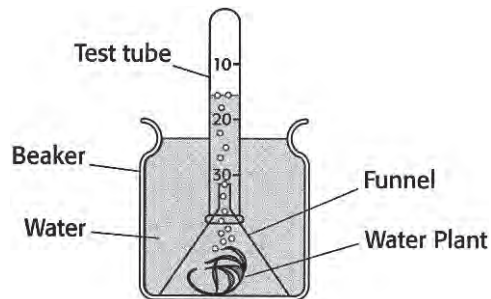
SC.912.L.18.7**Biology****STANDARD PRACTICE**

- 1** The illustration below shows a single-cell organism.



What is the role of the chloroplasts in this organism?

- A. to store energy
 - B. to absorb water
 - C. to aid in asexual reproduction
 - D. to make food through the process of photosynthesis
- 2** Latecia conducted an experimental investigation of the gas production of a water plant. She placed a beaker upside down over a water plant submerged in water and collected the gas that the water plant produced when kept in sunlight. After several days, a large bubble of gas collected in the upside-down beaker.

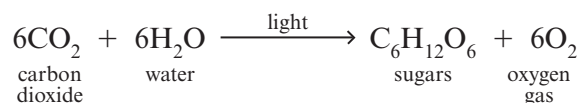
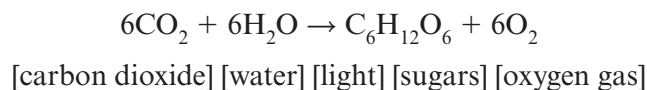


Given that the gas came from the water plant, what are the contents of the bubble of gas collected in the test tube?

- F. The gas contains one of the products of respiration, oxygen.
- G. The gas contains one of the products of photosynthesis, oxygen.
- H. The gas contains one of the products of respiration, carbon dioxide.
- I. The gas contains one of the products of photosynthesis, carbon dioxide.

SC.912.L.18.7**Biology**

- 3 Daniel found the equation below in a textbook about cells.



What process is described by this equation?

- A. cellular respiration
 - B. fermentation
 - C. glycolysis
 - D. photosynthesis
- 4 Autotrophs, such as plants, use light to make their own food. What happens to the light absorbed by a plant during photosynthesis?
- F. It is converted to kinetic energy.
 - G. It is converted to chemical energy, which the plant stores.
 - H. It powers a reaction that produces carbon dioxide and water.
 - I. It powers a reaction that produces oxygen and carbon dioxide.

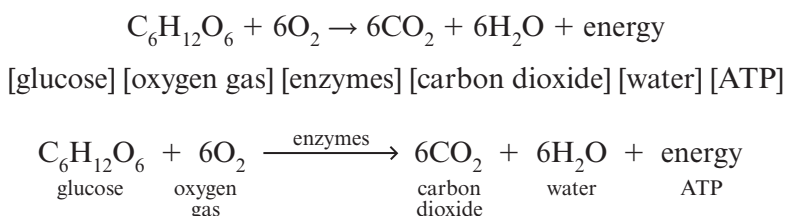
SC.912.L.18.8**Biology**

Identify the reactants, products, and basic functions of aerobic and anaerobic cellular respiration.

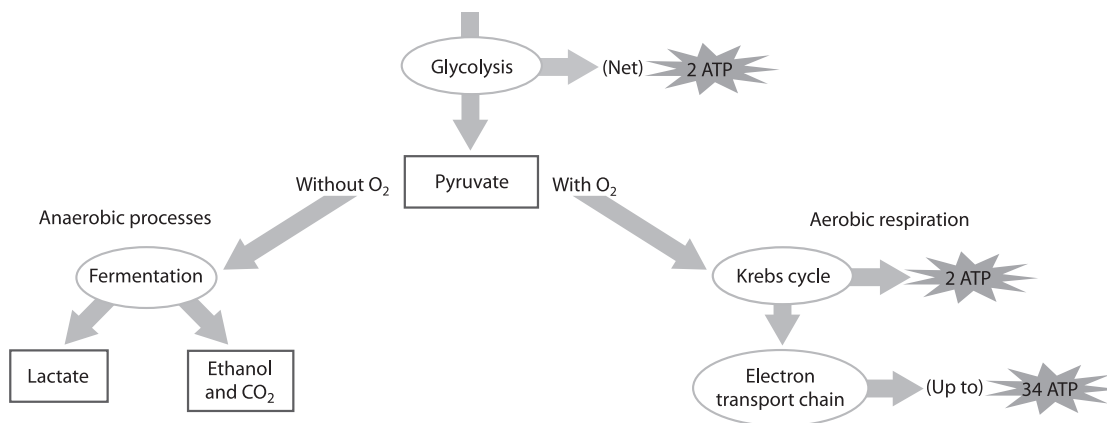
STANDARD REVIEW

Most of the foods we eat contain usable energy. Much of the energy in a banana, for example, is stored in proteins, carbohydrates, and fats. But before you can use that energy, it is transferred to ATP. Like in most organisms, your cells transfer the energy in organic compounds, especially glucose, to ATP through a process called cellular respiration. Oxygen in the air you breathe makes the production of ATP more efficient, although some ATP is made without oxygen. Metabolic processes that require oxygen are called aerobic. Metabolic processes that do not require oxygen are called anaerobic, meaning “without air.”

Cellular respiration is the process cells use to harvest the energy in organic compounds, particularly glucose. The breakdown of glucose during cellular respiration can be summarized by the following equation:



As the figure below shows, cellular respiration occurs in two stages.



Stage 1: Glucose is converted to pyruvate, producing a small amount of ATP and NADH.

Stage 2: When oxygen is present, pyruvate and NADH are used to make a large amount of ATP. This process is called aerobic respiration. Aerobic respiration occurs in the mitochondria of eukaryotic cells and in the cell membrane of prokaryotic cells. When oxygen is not present, pyruvate is converted to either lactate or ethanol and carbon dioxide.

SC.912.L.18.8**Biology****STANDARD PRACTICE**

- 1 The flow chart below shows a process that generates ATP.



Where does this process take place within a cell?

- A. chloroplast
 - B. mitochondria
 - C. nucleus
 - D. ribosome
- 2 Cells use sugars to produce energy through several different processes. Which process would provide the **most** energy for cell functions?
- F. glycolysis
 - G. aerobic respiration
 - H. aerobic fermentation
 - I. anaerobic fermentation
- 3 The Krebs cycle, fermentation, electron transport, and the breakdown of starch are processes of respiration. Which process could take place within an airtight bottle that contained no oxygen?
- A. Krebs cycle
 - B. fermentation
 - C. electron transport
 - D. breakdown of starch
- 4 Running for a long period of time, such as during a marathon, can result in muscle fatigue. Which process is important to a runner at the end of a marathon?
- F. the electron transport chain to produce ATP
 - G. the Krebs cycle to produce NADH and FADH₂
 - H. alcoholic fermentation to release carbon dioxide
 - I. lactic acid fermentation to produce ATP without oxygen

SC.912.L.18.8

Biology

- 5 There are two kinds of fermentation. What results from alcoholic fermentation?
- A. the production of lactate
 - B. the production of oxygen
 - C. the production of ethanol
 - D. the production of pyruvate
- 6 Humans and other heterotrophs get their energy from eating food. What process in human body cells transfers the energy stored in a grilled cheese sandwich to ATP?
- F. electrolysis
 - G. Calvin cycle
 - H. photosynthesis
 - I. cellular respiration

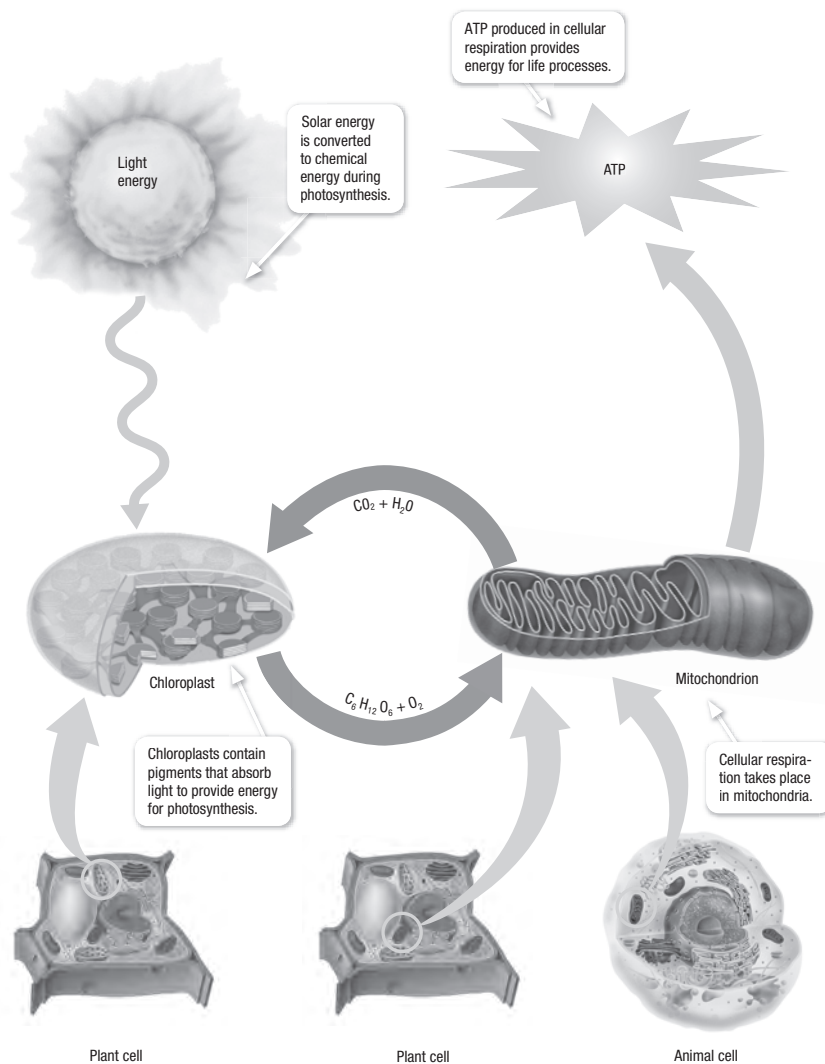
SC.912.L.18.9**Biology**

Explain the interrelated nature of photosynthesis and cellular respiration.

SC.912.E.7.1

STANDARD REVIEW

Photosynthesis and cellular respiration are related processes. The diagram below shows how the substances produced by photosynthesis are used during cellular respiration and vice versa.



SC.912.L.18.9**Biology****STANDARD PRACTICE**

- 1** Plant cells have mitochondria, which use glucose to produce ATP. Where does the glucose originate?
- A. photosynthesis, which occurs in chloroplasts
 - B. fermentation, which occurs in the absence of oxygen
 - C. exocytosis, which transports the glucose into the cells
 - D. diffusion, which transports the glucose from the digestive tract
- 2** Photosynthesis and cellular respiration are interrelated processes. During which biogeochemical cycle do the biological processes of photosynthesis and cellular respiration play key roles?
- F. carbon cycle
 - G. nitrogen cycle
 - H. hydrogen cycle
 - I. phosphorus cycle
- 3** A carbon sink is a part of the Earth's ecosystem that stores carbon in one form or another for hundreds, thousands, and even millions of years. Forests and oceans are known to be carbon sinks. Which of the following marine organisms play a major role in making the ocean a carbon sink?
- A. marine mammals, because they are high up on the food chain
 - B. whales, because they are large and can take up large amounts of carbon dioxide
 - C. seaweeds and phytoplankton, because they use carbon dioxide during photosynthesis
 - D. zooplankton, because they make shells and skeletons from calcium carbonate dissolved in seawater
- 4** The general equations for photosynthesis and cellular respiration show how the two processes are interconnected in natural cycles. Which substance is a product of cellular respiration and a reactant in photosynthesis?
- F. ATP
 - G. glucose
 - H. oxygen
 - I. water

SC.912.L.18.10**Biology**

Connect the role of adenosine triphosphate (ATP) to energy transfers within a cell.

STANDARD REVIEW

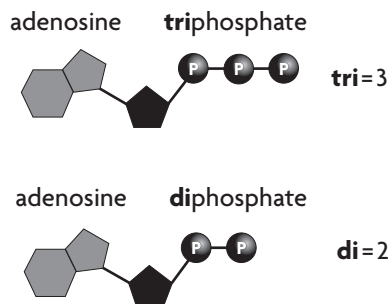
ATP, or adenosine triphosphate, is an important biological molecule. ATP is composed of a single nucleotide with two extra energy-storing phosphate groups. When food molecules are broken down inside cells, some of the energy in the molecules is stored temporarily in ATP. Cells need a steady supply of ATP to function.

When a log burns, the energy stored in wood is released quickly as heat and light. But in cells, chemical energy stored in food molecules is released gradually in a series of enzyme-assisted chemical reactions. The product of one chemical reaction becomes a reactant in the next reaction. In the breakdown of starch, for example, each reaction releases energy.

When cells break down food molecules, some of the energy in the molecules is released as heat. Much of the remaining energy is stored temporarily in molecules of ATP. Like money, ATP is a portable form of energy “currency” inside cells. ATP delivers energy wherever energy is needed in a cell. The energy released from ATP can be used to power other chemical reactions, such as those that build molecules. In cells, most chemical reactions require less energy than is released from ATP. Therefore, enough energy is released from ATP to drive most of a cell’s activities.

The three phosphate groups in ATP form a chain that branches from a five-carbon sugar called ribose. This phosphate “tail” is unstable because the phosphate groups are negatively charged and therefore repel each other. The phosphate groups store energy like a compressed spring does. This energy is released when the bonds that hold the phosphate groups together are broken.

Breaking the outer phosphate bond requires an input of energy. Much more energy is released, however, than is consumed by the reaction. As shown in the figure below, the removal of a phosphate group from ATP produces adenosine diphosphate, or ADP. This reaction releases energy in a way that enables cells to use the energy. Cells use the energy to power metabolism. The following equation summarizes the reaction:



SC.912.L.18.10**Biology****STANDARD PRACTICE**

- 1** ATP is a cell's main form of energy "currency." Which of the following comprises an ATP molecule?
- A. adenine, the sugar ribose, and three phosphate groups
 - B. adenine, the sugar deoxyribose, and two phosphate groups
 - C. a nitrogenous base, a phosphate group, and the sugar ribose
 - D. a complex molecule of amino acids surrounding Z
- 2** ATP and ADP both play a role in cellular reactions involving energy. How are these two molecules related?
- F. Adding a phosphate group to ATP produces ADP and releases energy.
 - G. Adding a phosphate group to ADP produces ATP and releases energy.
 - H. ADP breaks down to produce ATP and a phosphate group, releasing energy.
 - I. ATP breaks down to produce ADP and a phosphate group, releasing energy.
- 3** *Daphnia* is a small water invertebrate that is almost transparent. Like all animals, *Daphnia* require chemical energy to live. It uses structures called gills to extract oxygen from the water to help it obtain chemical energy. Which statement below describes how they obtain chemical energy?
- A. *Daphnia* absorb glucose from algae and then use fermentation to release chemical energy in the form of ATP.
 - B. *Daphnia* absorb pyruvate from algae and then use gluconeogenesis to release chemical energy in the form of ADP.
 - C. *Daphnia* absorb glucose from algae and then use cellular respiration to release chemical energy in the form of ATP.
 - D. *Daphnia* absorb glucose from algae and then use cellular respiration to release chemical energy in the form of NADP.

SC.912.L.18.10

Biology

- 4 ATP provides the energy needed to carry out many cell functions. Which of the following processes does **not** require ATP?
- F. making more ATP
 - G. muscle contraction
 - H. active transport of protein across a membrane
 - I. passive transport of oxygen across a cell membrane

SC.912.L.18.11**Biology**

Explain the role of enzymes as catalysts that lower the activation energy of biochemical reactions. Identify factors, such as pH and temperature, and their effect on enzyme activity.

STANDARD REVIEW

The chemical reactions in cells occur quickly and at relatively low temperatures because of the action of many enzymes. Enzymes are substances that increase the speed of chemical reactions. Most enzymes are proteins. Enzymes are catalysts, which are substances that reduce the activation energy of a chemical reaction. An enzyme increases the speed of a chemical reaction by reducing the activation energy of the reaction. Enzymes help organisms maintain homeostasis. Without enzymes, chemical reactions would not occur quickly enough to sustain life.

Enzymes assist biochemical reactions by bringing key molecules together. A substance on which an enzyme acts during a chemical reaction is called a substrate. Enzymes act only on specific substrates. An enzyme's shape determines its activity. Typically, an enzyme is a large protein with one or more deep folds on its surface. These folds form pockets called active sites. As shown in the figure below, an enzyme's substrate fits into the active site. An enzyme acts only on a specific substrate because only that substrate fits into its active site. Your body's cells contain many different enzymes, and each enzyme catalyzes a different chemical reaction.



Any factor that changes the shape of an enzyme can affect the enzyme's activity. For example, enzymes operate most efficiently within a certain range of temperatures. Temperatures outside this range can either break or strengthen some of the enzyme's bonds, changing its shape. Moreover, each enzyme operates best within a certain range of pH values. A pH value outside this range can cause bonds in an enzyme to break, reducing the enzyme's effectiveness.

SC.912.L.18.11**Biology****STANDARD PRACTICE**

- 1** Most enzymes operate most efficiently within a certain range of temperatures. Enzymes in your body probably work best at what temperature?
- A. 25°C
 - B. 30°C
 - C. 37°C
 - D. 98°C
- 2** Enzymes are protein catalysts. What is the role of a catalyst?
- F. provides extra energy for a reaction
 - G. lowers the activation energy of a reaction
 - H. allows only irreversible reactions to happen
 - I. eliminates the activation energy of a reaction
- 3** Living things use enzymes in the chemical reactions of metabolism. When food is digested, it is metabolized to release energy. Which statement **best describes** the role of an enzyme in this process?
- A. Because enzymes are proteins, they only react with other protein molecules, resulting in the production of glucose.
 - B. The active site of the enzyme attached to the substrate of a food molecule produces carbon molecules, the building blocks of cells.
 - C. The active site of an enzyme attached to a substrate prevents the chemical reactions involved in metabolism from happening too quickly.
 - D. The active site of the enzyme binds to a substrate on a food molecule and the enzyme changes shape slightly, causing a chemical reaction to happen.

SC.912.L.18.11**Biology**

- 4** The table below lists some digestive enzymes found in the human small intestine.

Digestive Enzymes in the Small Intestine		
Enzyme	Substrate	Digested product
Amylase (pancreas)	starch	disaccharides
Trypsin (pancreas)	proteins	peptides
Lipase (pancreas)	fat	fatty acid and glycerol
Maltase, sucrase, lactase	disaccharides	monosaccharides
Peptidase	peptides	amino acids

Based on the information in the table, what would be one effect of an injured pancreas?

- F. The blood levels of monosaccharides would increase.
 - G. The absorption of amino acids would be more efficient.
 - H. The body would be unable to process starches, proteins, and fats.
 - I. The levels of the enzymes amylase, trypsin, and lipase would increase.
- 5** Many of the proteins in the human body are enzymes that catalyze chemical reactions. What is the relationship between enzymes and activation energy?
- A. When an enzyme catalyzes a reaction, it increases the activation energy of the reaction.
 - B. When an enzyme catalyzes a reaction, it increases the activation energy of the product.
 - C. When an enzyme catalyzes a reaction, it decreases the activation energy of the reaction.
 - D. When an enzyme catalyzes a reaction, it does not affect the activation energy of the reaction.

SC.912.L.18.12**Biology**

Discuss the special properties of water that contribute to Earth's suitability as an environment for life: cohesive behavior, ability to moderate temperature, expansion upon freezing, and versatility as a solvent.

STANDARD REVIEW

Water has many unique properties that make it an important substance for life. One such property is its ability to store heat energy. Water absorbs heat more slowly and retains this energy longer than many other substances do. Many organisms release excess heat through water evaporation. For example, humans cool themselves by sweating. The water vapor lost through the evaporation of sweat carries heat away from the body.

Two other important properties of water are cohesion and adhesion. Cohesion is an attraction between substances of the same kind. The hydrogen bonds between water molecules cause the cohesion of liquid water. Because of cohesion, water and other liquids form thin films and drops. Adhesion is an attraction between different substances. Water molecules are attracted to many other similarly polar substances. Adhesion powers a process, called capillary action, in which water molecules move upward through a narrow tube, such as the stem of a plant.

Another important property of water is its ability to dissolve many substances. A solution is a mixture in which one or more substances are evenly distributed in another substance. The polarity of water enables many substances to dissolve in water. Ionic compounds and polar molecules dissolve best in water. Nonpolar molecules, however, do not dissolve well in water.

SC.912.L.18.12**Biology****STANDARD PRACTICE**

- 1** A florist places a bouquet of white carnations in water containing blue dye. After a time, the flowers turn blue. What process helped the carnations to change color?
- A. water's ability to form crystals
 - B. ability of H_2O to dissolve NaCl
 - C. cohesion and adhesion of water molecules
 - D. formation of covalent bonds between hydrogen and oxygen molecules
- 2** Which of these statements correctly explains why water is a good solvent for many ionic compounds?
- F. Water is a polar compound.
 - G. Water is an ionic compound.
 - H. Water molecules are nonpolar.
 - I. Water molecules completely separate into ions in solution.
- 3** What is the attractive force between two of the same kind of particle?
- A. adhesion
 - B. capillary action
 - C. cohesion
 - D. polarity
- 4** Which of the following is not a unique property of water?
- F. Water molecules stick together by cohesion.
 - G. Frozen water is less dense than liquid water.
 - H. Water molecules stick to other polar substances.
 - I. Hydrogen bonds allow water to heat and cool very quickly.

SC.912.L.18.12**Biology**

- 5** Water has the ability to store heat longer than other substances. What benefit does this property of water provide to organisms?
- A. It provides the ability to dissolve nonpolar compounds.
 - B. It provides the appropriate catalyst for chemical reactions.
 - C. It enables organisms to function with a higher cellular pH.
 - D. It allows organisms to maintain a stable internal temperature.
- 6** Many fish and aquatic plants can survive a cold winter because the layer of ice that forms at the top of a lake insulates the water below and prevents the lake from freezing solid. What unique property of water contributes to this effect?
- F. Water absorbs heat when it evaporates and forms a gas.
 - G. Water expands and becomes less dense when it freezes.
 - H. Water molecules completely separate into ions in solution.
 - I. Water forms hydrogen bonds with ions and other polar substances.

PRACTICE TEST 1

- 1** A scientist notices that a local population of frogs has started to develop deformities. He designs an experiment to identify the source of the deformities, using unhatched frog eggs and a variety of environmental stimuli. Which of the following would be the dependent variable in this experiment?
- A. the introduction of pesticides to the frog eggs
 - B. the number of frog eggs used in the study's sample
 - C. the development of deformities in the hatched frogs
 - D. the size of the aquariums in which the frog eggs were kept
- 2** A scientist wants to draw conclusions about all mammals based on the results of a study in which she compares the anatomies of house cats, leopards, seals, goats, and frogs. Her peers suggest that data from other studies might better support her conclusions. Why might this experiment be a poor choice for finding data that support her conclusions?
- F. The study does not include mammals, so she cannot use the data to draw conclusions about mammals.
 - G. The study includes only mammals, so she cannot use the data to make conclusions about invertebrates.
 - H. The study includes only vertebrates, so she cannot use the data to draw conclusions about invertebrate mammals.
 - I. The study includes only a few mammals, so she cannot use the data to safely draw conclusions about all mammals.
- 3** Most scientists have biases, but they try to prevent bias from influencing their work. What is bias?
- A. having a point of view that is objective
 - B. having a point of view that is impartial
 - C. having a point of view that lacks prejudice
 - D. having a point of view that can influence an experiment

- 4 Water movement into and out of cells is of prime importance to all living things. A single-celled organism has star-shaped organelles called contractile vacuoles to move water from inside to outside the cell. The data presented in the table below were obtained in an experiment in which the organism was placed in water with different salt concentrations.

Salt concentration	Rate of contractile vacuole contractions per minute
Very high	2
High	8
Medium	15
Low	22
Very low	30

The rate at which the contractile vacuole contracted to pump out excess water was recorded. How could you explain the observed relationship between the rate of contractile vacuole concentration and the salt concentration?

- F. When the salt concentration outside the cell is very high, diffusion causes water to move inside the cell, and the contractile vacuole has to contract more rapidly.
 - G. When the salt concentration outside the cell is very low, diffusion causes water to move outside the cell, and the contractile vacuole has to contract more rapidly.
 - H. When the salt concentration outside the cell is very high, diffusion causes water to move outside the cell, and the contractile vacuole does not need to contract as rapidly.
 - I. When the salt concentration outside the cell is very low, diffusion causes water to move outside the cell, and the contractile vacuole does not need to contract as rapidly.
- 5 The diagram below shows a newspaper headline.



What is this headline an example of?

- A. a fact
- B. a prediction
- C. a hypothesis
- D. an observation

- 6 The table below contains data that are part of a scientific investigation.

Age group in years	Average height in centimeters	
	Female	Male
At birth	50	51
2	87	88
4	103	104
6	117	118
8	128	128
10	139	139
12	152	149
14	160	162
16	163	172
18	163	174

Which of the following is **not** a testable hypothesis that this data could be used to support or disprove?

- F. Height is affected by childhood nutrition.
- G. All females are taller than males at age 12.
- H. Being taller is always better than being shorter.
- I. All men who are married are taller than their wives.

- 7 A scientific theory is not just good guesswork. There are several steps involved in developing a theory, and these steps could take many years before a hypothesis becomes accepted as a scientific theory.

Step 1
Question

Step 2
Form testable
hypothesis

Step 3
Hypothesis supported by experiment

Step 4
?

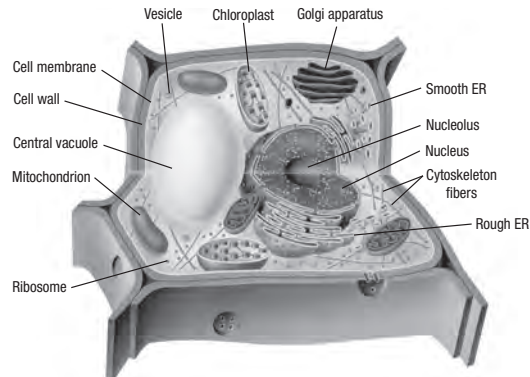
Theory

In the diagram, what process happens at Step 4?

- A. A team of scientists must form a committee to discuss the hypothesis.
- B. The results of the experiment must be published along with a ballot so that other scientists can vote on whether they support or reject the hypothesis.
- C. The scientist or team of scientists who formulated the hypothesis must do the supporting experiment over and over again to be sure they have it right.
- D. The results of the experiment must be published so that the experiment can be repeated by other scientists, along with additional experiments to prove or disprove the hypothesis.

- 8** The cumulative work of many scientists can often be summarized as theories or laws. How is a theory different from a law?
- F. A theory is a preliminary scientific explanation that can become a law only when it gains enough support and matches many observed phenomena.
 - G. A law is a preliminary scientific explanation that can become a theory only when it gains enough support and matches many observed phenomena.
 - H. A theory is a well-supported scientific explanation that makes useful predictions about phenomena, while a law is a well-supported description of observed phenomena.
 - I. A theory is an educated guess that can be tested through scientific observation and experimentation, while a law is a well-supported scientific explanation that makes useful predictions about phenomena.
- 9** The cell theory states that all cells arise from existing cells. Which scientist first determined this part of the cell theory?
- A. Hooke
 - B. Schleiden
 - C. Schwann
 - D. Virchow
- 10** Many organelles in a cell are bound by membranes. Which organelles consist of membranous tubes and sacs and serve as part of the cell's packaging and transport system?
- F. mitochondria and lysosomes
 - G. mitochondria and chloroplasts
 - H. ribosomes and endoplasmic reticulum
 - I. Golgi apparatus and endoplasmic reticulum

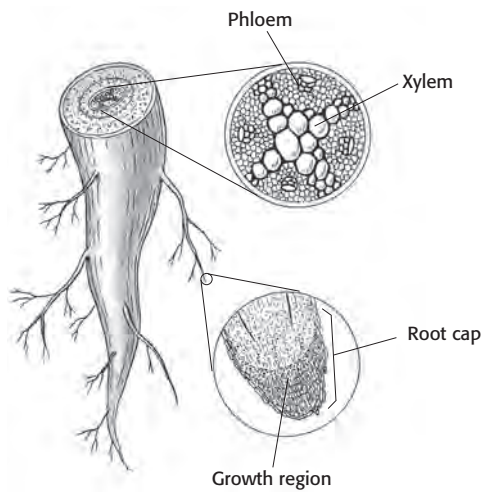
- 11** The diagram below shows a cell.



What type of organism might contain this type of cell?

- A. animal
 - B. bacterium
 - C. plant
 - D. prokaryote
- 12** Which of the following instruments is best used to create a three-dimensional image of a cell's organelle?
- F. a computer's digital camera
 - G. a compound light microscope
 - H. a scanning electron microscope
 - I. a transmission electron microscope
- 13** European sailors during the age of exploration in the 1500s and 1600s often spent long months at sea with little to eat other than hard biscuits and dried meat. They often developed a disease called scurvy, characterized by bleeding gums and loose teeth. What was the cause of this condition?
- A. dehydration
 - B. poor digestion
 - C. lack of protein in the diet
 - D. lack of vitamin C found in fruit

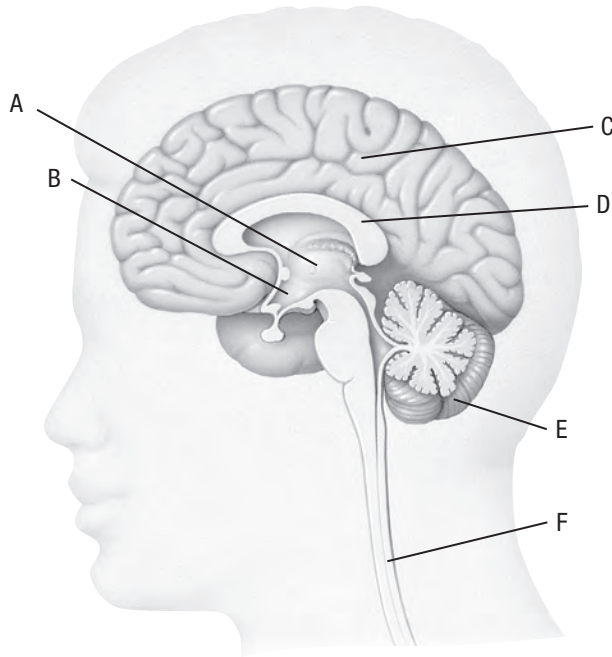
- 14 The illustration below shows a plant's root system.



Based on the illustration, which of the following statements is true?

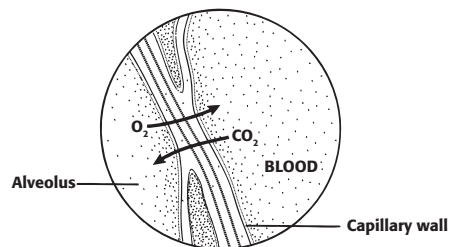
- F. Roots grow from their tips.
- G. Xylem forms a protective layer over the root cap.
- H. Roots contain xylem tissue but not phloem tissue.
- I. Most plants have only one growth region in their root system.

- 15** The diagram below shows the major parts of the human brain.



Which part of the brain receives sensory information from all parts of the body and relays the information to appropriate areas of the cerebral cortex?

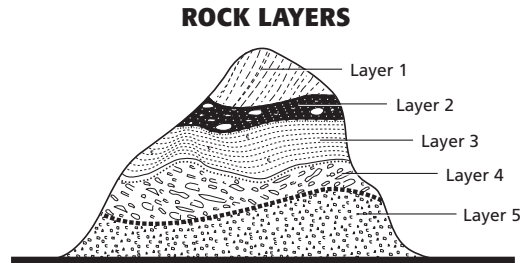
- A. part A
 - B. part B
 - C. part D
 - D. part E
- 16** The picture below shows the exchange of oxygen and carbon dioxide through a capillary wall.



This picture shows the exchange of gases between which two body systems?

- F. circulatory and digestive
- G. circulatory and respiratory
- H. endocrine and circulatory
- I. respiratory and endocrine

- 17** The inflammatory response is one of the immune system's nonspecific responses to infection. How does the inflammatory response act as a defense against infection?
- A. The high body temperature kills the disease-causing bacteria.
 - B. Oil and sweat on the surface of the skin inhibit bacterial growth.
 - C. Body heat destroys cellular proteins needed by the invaders to reproduce.
 - D. Release of histamine increases blood flow, which brings white blood cells.
- 18** While cutting through the side of a mountain to build a highway, workers expose several layers of rock, as shown in the figure below. Fossils of whale bones, shark teeth, and sand dollars are found in the rocks that form Layer 4. Fossils of rodents, toads, birds, and lizards are found in Layer 2.



The observations above support which of the following conclusions?

- F. When Layer 4 formed, the mountain was near a large lake.
- G. When Layer 4 formed, whales, sharks, and sand dollars lived in the mountains.
- H. When Layer 4 formed, an ocean covered the area where the fossils were found.
- I. When Layer 4 formed, whales, sharks, lizards, toads, and rodents were in the same food web.

- 19** In a classroom experiment, high school students conducted a survey to determine the similarities and differences among groups of invertebrates. They recorded their observations in Figure 1. They also made a chart of phyla in the animal kingdom showing evolutionary milestones (Figure 2). They wanted to know where each invertebrate specimen they examined would fit on a phylogenetic tree, with Chordata being the most evolved and Porifera being the least evolved.

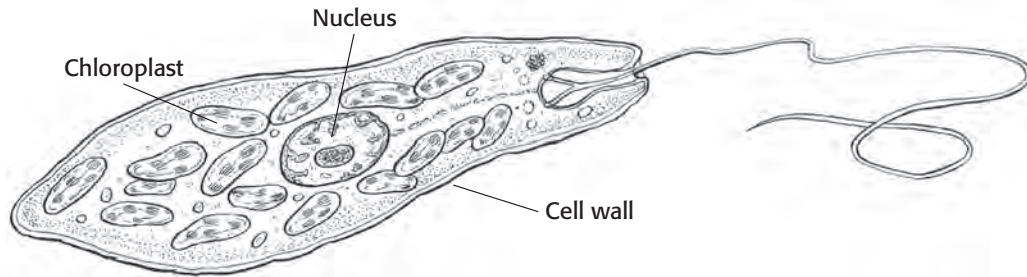
Animal	Phylum	Symmetry	Internal body plan	Other observations
Sponge	Porifera	Asymmetrical	Full of holes	
Hydra	Cnidaria	Radial	Tissues & Stinging cells	
Planarian	Platyhelminthes	Bilateral	Acoelomate	Gut has one opening
Roundworm	Nematoda	Bilateral	Pseudocoelomate	Threadlike
Earthworm	Annelida	Bilateral	Coelomate	Segmented
Snail	Mollusca	Bilateral	Coelomate	Muscular foot
Beetle	Arthropoda	Bilateral	Coelomate	Paired legs
Starfish	Echinodermata	Bilateral	Coelomate	Five arms with tube feet

Phylum	Evolutionary milestone
Chordata	Notocord
Echinodermata	Deuterostomes
Arthropoda	Jointed appendages
Annelida	Segmentation
Mollusca	Coelom
Nematoda	Pseudocoelom
Platyhelminthes	Bilateral symmetry
Cnidaria	Tissues
Porifera	Multicellularity

Examine the phyla in the chart of evolutionary milestones. Which two of the animals studied would be **most closely related**, according to the evolutionary hypothesis represented by a phylogenetic tree?

- A. the earthworm and the planarian
 - B. the earthworm and the beetle
 - C. the sponge and the snail
 - D. the starfish and the hydra
- 20** Early biologists thought that sponges were plants. What evidence supports this classification?
- F. Sponges have specialized cells.
 - G. Sponges prey on small animals.
 - H. Sponges carry out photosynthesis.
 - I. Sponges move very slowly if they move at all.

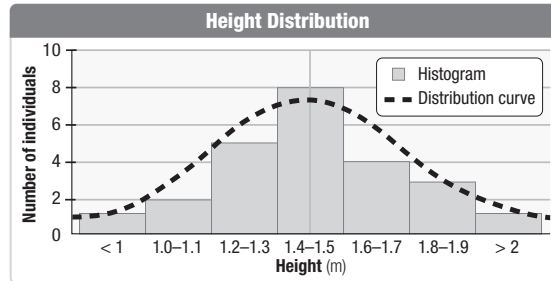
- 21** The single-celled organism shown below uses a whip-like flagellum to move. The organism has a nucleus and organelles surrounded by a membrane. The organism also has chloroplasts and a cell wall.



To which kingdom does the organism belong?

- A. Animalia B. Bacteria
C. Eubacteria D. Protista
- 22** Miller and Urey subjected hydrogen gas, water vapor, ammonia, and methane gases to sparks in a reacting chamber. What was produced, giving support to the primordial soup model of the origin of life?
- F. primitive plants G. organic compounds
H. single-celled organisms I. membrane-bound organelles
- 23** In what genus are humans classified?
- A. *sapiens* B. *Homo*
C. *Canis* D. *Animalia*
- 24** Banyan trees are found in places such as Florida, Hawaii, and India. The unique characteristic of this tree is that roots grow down from its branches into the ground. The tree can appear to have several trunks. What advantage does the banyan tree have over other trees?
- F. The roots make the tree more stable in high winds.
G. Above-ground roots are more protected from the Sun.
H. The roots provide shelter for ground-dwelling animals.
I. Above-ground roots may dry out and die during droughts.

- 25 A biology student measured the height of every student in her class and developed the histogram shown below. She then used a statistics software program to fit a curve through her data.



A group of exchange students visited the school for a semester. The average height of these students was 1.7 m. This changed the histogram of height in the class. What type of force on the class gene pool does this event represent?

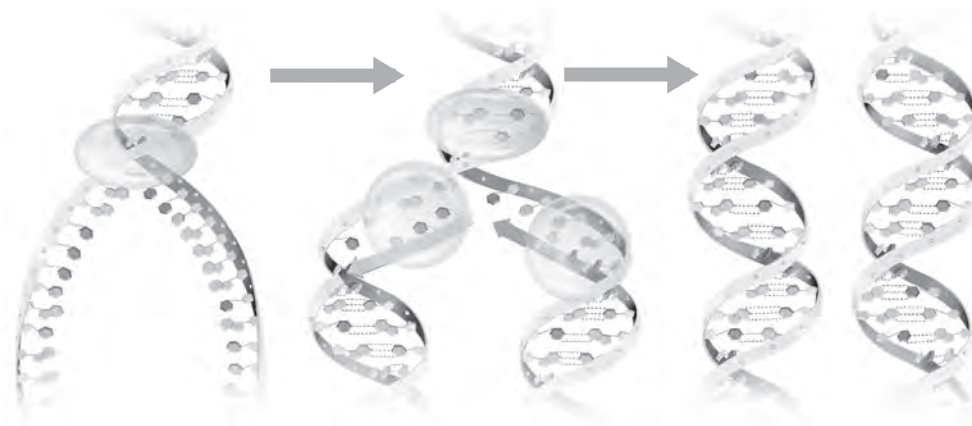
- A. genetic drift
 - B. immigration
 - C. mutation
 - D. natural selection
- 26 Genetic variation can increase the pace of evolution. Which would **most likely** increase genetic variation in a population?
- F. cloning
 - G. twinning
 - H. crossing-over
 - I. asexual reproduction
- 27 In humans, having freckles (F) is dominant to not having freckles (f). Having a cleft chin (C) is also dominant to not having a cleft chin (c). Which statement is true of the offspring of a cross between parents that are both heterozygous for both traits ($FfCc$)?
- A. Any offspring with freckles must also have a cleft chin.
 - B. Any offspring who does not have freckles must have a cleft chin.
 - C. All of the offspring will be heterozygous for both traits.
 - D. The offspring could exhibit both traits, neither trait, or only one of the traits.

- 28 The Punnett square below shows a cross between two rabbits. Black fur (B) is dominant to brown fur (b).

		B	b
$Bb \times Bb$	B	1	2
	b	3	4

If individuals from box 1 and box 4 were crossed, what would be the genotypes of the offspring?

- F. all Bb G. Bb and bb
H. BB and bb I. BB and Bb
- 29 The illustration below shows a cellular process.



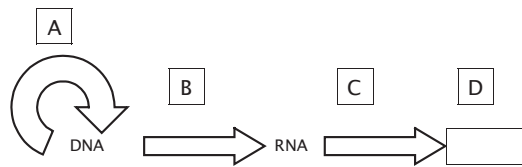
Which of the following is shown in this illustration?

- A. transcription
B. gene expression
C. DNA translation
D. DNA replication

- 30** The sequence of bases in a nucleotide of DNA makes up an organism's genetic code. How could a change in a sequence of DNA bases affect an organism?

F. DNA could change into RNA.
 G. The function of the resulting protein could change.
 H. The DNA nucleotide could form an ATP nucleotide.
 I. The gene could code for carbohydrates instead of proteins.

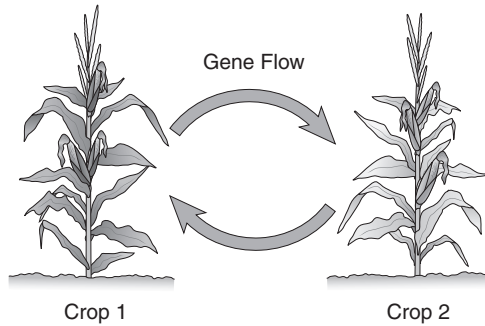
- 31** The diagram below shows the processes that occur during gene expression.



Which of the following is represented at letter B?

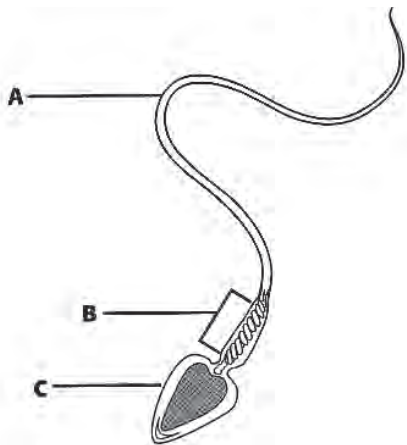
- A. translation
 B. replication
 C. transcription
 D. protein synthesis
- 32** Proteins control the cell cycle in healthy eukaryotes, causing cells to divide at a healthy rate. What disease is caused by uncontrolled, abnormal cell division?
- F. cancer
 G. heart disease
 H. leprosy
 I. tuberculosis
- 33** According to the genetic code, the mRNA codons UCU, UCC, UCA, and UCG all code for the amino acid serine. What does this fact tell you?
- A. The genetic code is the same for nearly all organisms.
 B. The genetic code does not dictate the amino acid sequence of proteins.
 C. A mutation in one base will always have a physical effect on the resulting protein.
 D. A mutation in one base could have absolutely no physical effect on the resulting protein.

- 34** The diagram below illustrates the concept of gene flow.



Which could be caused by gene flow from a crop plant engineered to be resistant to herbicides?

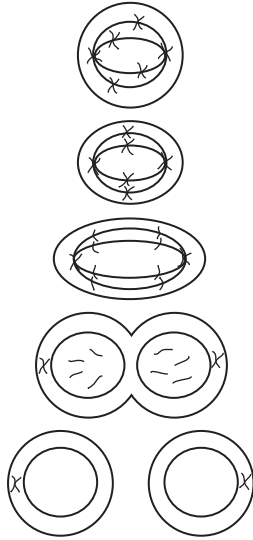
- F. Drug-resistant bacteria may evolve.
 - G. New species of poisonous insects may evolve.
 - H. The genetically engineered plants may eventually lose their herbicide resistance as it wears off.
 - I. Genetically engineered plants may cause the evolution of weeds that are immune to weed-killing chemicals.
- 35** The diagram shows a sperm cell.



Which statement is true?

- A. The sperm's nucleus is found in part A.
- B. The sperm's nucleus is found in part B.
- C. The sperm's nucleus is found in part C.
- D. A sperm cell has no nucleus.

- 36** Octavio drew the diagram below to illustrate a process in cells.



What process is shown?

- F. fertilization
 - G. meiosis
 - H. mitosis
 - I. osmosis
- 37** Meiosis is the form of cell division that produces gametes. Which of the following statements correctly describes gametes?
- A. In spermatogenesis, eight sperm cells are produced.
 - B. Eggs are diploid and, when fertilized, give rise to haploid cells.
 - C. In the formation of eggs, four identical haploid cells are produced.
 - D. In oogenesis, the cytoplasm divides unequally, producing an ovum and three smaller polar bodies.

- 38** In asexual reproduction, a single parent passes copies of all of its genes to each of its offspring. When is asexual reproduction in plants advantageous?

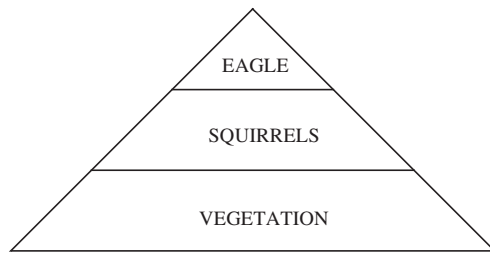
- F. when the environment is unstable
- G. when there is little competition for resources
- H. when plants are well adapted to the environment
- I. when there are multiple disease agents in the environment

- 39** The populations of fish and amphibians in a lake more than 100 miles downwind from a coal-fired power plant suddenly began to decline. Biologists sampled the water in the lake and found that it had a pH of 2.4. What conclusions could the biologists draw from their finding?

- A. Acid rain that had fallen on the lake had to have come from a pollution source close to the lake.
- B. Pollutants from the power plant could be making the lake water too alkaline to support life.
- C. The pH of the lake water was normal, so the decline in fish and amphibian populations had some other cause.
- D. The lake water had become very acidic, which could be linked to emissions from the distant power plant.

- 40** Even a tiny amount of moisture can support the life of mosses, which are nonvascular plants. Why are mosses good pioneer species?
- F. They grow very slowly.
 - G. They can survive in wet areas.
 - H. They can create a layer of soil on bare rock over time.
 - I. They can survive in areas that receive low levels of sunlight.
- 41** All populations fluctuate in size, influenced by abiotic and biotic factors. Which of the following is an abiotic factor that might reduce the size of a population?
- A. climate change
 - B. increased predation
 - C. emergence of a new disease
 - D. decreased availability of a food source
- 42** Two species of finches are in competition for the limited resources of an ecosystem. One species eats fruit and the second species eats seeds. If a third species of herbivore finches moves into the area, how will the ecosystem change?
- F. Resources will be more abundant.
 - G. Water will become more available.
 - H. The climate of the ecosystem will change.
 - I. Fruit and seed resources will become less abundant.

- 43** The diagram below is an energy pyramid.



Which of the following is the correct flow of energy?

- A. The eagle gets energy from eating plants.
 - B. The vegetation gets energy from the squirrels.
 - C. The squirrels get energy from eating the eagle.
 - D. The eagle gets energy from eating the squirrels.
- 44** A nonrenewable resource is a resource that forms at a rate that is much slower than the rate at which it is consumed. Which of the following resources is a nonrenewable resource?
- F. coal
 - G. trees
 - H. wildlife
 - I. fresh water
- 45** Before implementing any one solution to an environmental problem, scientists first analyze collected data to predict the consequences of the different possible solutions. Why is it important to perform such a risk analysis before taking action?
- A. It can prevent the environmental problem from ever occurring in any other unrelated area.
 - B. It can convince the public that there is no need to waste money on follow-up investigations.
 - C. It can help officials avoid or prepare for any negative effects associated with a plan of action.
 - D. It can solve the environmental problem without the need of public education or political action.

46 Carbon dioxide is released when people burn fuel. It is also used by plants during photosynthesis. Why is carbon dioxide then considered an air pollutant?

- F. Too much carbon dioxide can lead to illness in humans.
- G. Carbon dioxide can cause undesirable changes in climate.
- H. Carbon dioxide is responsible for changes in the ozone layer.
- I. Carbon dioxide can mix with other gases to cause air pollution.

47 Four categories of complex, highly organized molecular substances are needed for nearly all of the processes of organisms. Which of the following correctly identifies these four categories of complex, highly organized molecular substances?

- A. lipids, proteins, water, nucleic acids
- B. lipids, proteins, enzymes, nucleic acids
- C. carbohydrates, lipids, proteins, nucleic acids
- D. carbohydrates, enzymes, nucleotides, amino acids

48 One contribution to the buildup of greenhouse gases in the atmosphere is from humans' use of fossil fuels. Fossil fuels result from the gradual transformation of layers of organic matter in sediment into natural gas, coal, and petroleum. When fossil fuels are burned, they release a greenhouse gas that can be used by plants for photosynthesis. Thus, planting more trees can partly reduce the effect of burning fossil fuels. What greenhouse gas is released when fossil fuels are burned and also plays a major role in photosynthesis?

- F. carbon dioxide
- G. carbon monoxide
- H. methane
- I. oxygen

49 Hans Krebs, a German biochemist, was awarded a Nobel Prize in 1953 for the discovery of an important cycle. What does his cycle represent?

- A. the last stage of photosynthesis
- B. the first stage of aerobic respiration
- C. the process of carbon dioxide fixation
- D. the flow of hydrogen ions through the mitochondria

- 50** The chemical equations that sum up photosynthesis and cellular respiration have many of the same substances because these two processes are interrelated. Which two substances are the products of one of these processes and the reactants of the other process?
- F. oxygen and water
 - G. glucose and water
 - H. carbon dioxide and water
 - I. carbon dioxide and glucose
- 51** Living things get the energy they need from carbohydrates such as glucose. What is the relationship between carbohydrates and ATP?
- A. ATP is a type of carbohydrate.
 - B. ATP produces carbohydrates in the cell.
 - C. Cells use carbohydrates to produce ATP.
 - D. ATP and carbohydrates react to form proteins.
- 52** The diagram below shows how living things use enzymes in chemical reactions to release energy.



How do enzymes affect the reactions in which they take part?

- F. Most enzymes slow down chemical reactions.
- G. Enzymes are converted into products in the reaction.
- H. Enzymes increase the activation energy of the reaction.
- I. Enzymes decrease the activation energy of the reaction.

53 Water has both cohesive and adhesive forces that are relatively strong. That is, its molecules are strongly attracted to one another and to many other kinds of molecules. What kind of bond forms between two different water molecules?

- A. compound bond
- B. double bond
- C. hydrogen bond
- D. ionic bond

54 Javier notices that one of his house plants has drooping leaves. Which description explains what happens when he waters the plant?

- F. The sudden movement of water by osmosis into the plant cells causes the cells to swell and burst.
- G. The environment changes from hypotonic to hypertonic, the central vacuole swells, and the leaves stop drooping.
- H. The environment changes from isotonic to hypertonic, mitochondria in the plant cells take up the additional water, and the leaves stop drooping.
- I. The environment changes from isotonic to hypotonic, water moves into cells by osmosis, vesicles in the plant cells swell, and the leaves stop drooping.

55 There is a pair of identical twins in Tanisha's class. One of them was affected by a severe illness during his first few months of life. Although he survived, he is much shorter than his twin brother. How is this difference explained?

- A. The genetic code of any individual uniquely determines all polygenic traits.
- B. Height is a trait that can be influenced by both environmental and genetic factors.
- C. The disease caused a mutation in the smaller twin's DNA, resulting in a smaller phenotype.
- D. The twins' genotype is identical, so the smaller twin will have to end up the same size as his brother.

56 Which of the following would **most likely** remove carbon dioxide from the air?

- F. Burning logs.
- G. Planting trees.
- H. Killing weeds.
- I. Breeding livestock.

57 Male birds of paradise have extremely long, showy tail feathers. Which of the following statements **best** describes a selective advantage for having this trait?

- A. The bird is easier for predators to spot.
- B. The bird must eat more to produce extra-large feathers.
- C. The bird flies slowly because of drag created by the feathers.
- D. The bird attracts more females and therefore mates more frequently.

58 If a heterozygous individual (Aa) were crossed with another heterozygous individual (Aa), what is the chance that their offspring would have a heterozygous genotype?

- F. 0%
- G. 50%
- H. 75%
- I. 100%

59 The development of recombinant DNA technology was a major step forward in genetic science. Which of the following developments represents an advance in medicine that the application of genetic science allowed?

- A. development of genetic counseling as a career
- B. development of a method of DNA fingerprinting
- C. production of proteins, such as insulin, for use as drugs
- D. cloning of animals and engineering of agricultural crops

60 In 1998, forest fires swept through the forests of Yellowstone National Park. After the fires, biologists observed that new lodgepole pine seedlings began to sprout in the burned areas. The lodgepole pine cones are sealed with a resin that requires great heat to break open and release seeds. What testable hypothesis could you form from this observation?

- F. Lodgepole pine seeds sprout easily.
- G. Lodgepole pine is adapted to frequent forest fires.
- H. Lodgepole pine will grow where other plants cannot.
- I. Not all lodgepole pine seeds are contained in a cone.

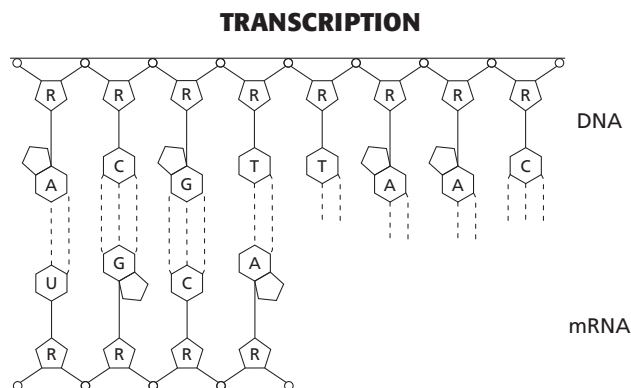
- 61 Grasses, hawks, mice, and snakes are all organisms that live in a prairie. In the prairie food chain, which is the correct arrangement according to energy flow?

A. hawk → snake → mouse → grass
B. grass → snake → mouse → hawk
C. grass → mouse → snake → hawk
D. hawk → mouse → snake → grass

- 62 Sustainable agriculture is farming that conserves natural resources and helps keep the farmed land productive indefinitely. This kind of agriculture minimizes the amount of energy, water, pesticides, and fertilizer needed to grow crops. Sustainable agriculture involves planting productive, pest-resistant crops that require fewer resources and less maintenance. How do the resources needed for sustainable agriculture compare with the resources needed for large-scale agriculture?

F. More resources are usually needed for the initial setup and planning of traditional large-scale agriculture techniques.
G. More resources are needed throughout the growing season for all crops grown with sustainable agriculture techniques.
H. Fewer resources are needed for the initial setup and planning of sustainable agriculture, and less water, energy, and other costs will be needed over time.
I. More resources may be needed for the initial setup and planning of sustainable agriculture, but less water, energy, and other costs will be needed over time.

- 63 The diagram below is a model of a cellular process called transcription.



What class of biological molecules is represented in the diagram above?

A. carbohydrates
B. nucleic acids
C. lipids
D. proteins

64 A sample of digestive juice was removed from the stomach of a pig. The juice was placed in a test tube, along with some grains of wheat. A second, identical test tube that contained an equal number of wheat grains was set up. However, pure water was used rather than digestive juice. The test tubes were kept at 40°C, which is about the temperature inside a pig's stomach. After eight hours, the grains of wheat in the digestive juice had broken apart into tiny particles. The grains of wheat in the water were wet but otherwise unchanged. Which of the following is a valid conclusion from this experiment?

- F. Water does not play a role in the digestion of food in pigs.
- G. Pigs can easily digest wheat but cannot digest other grains.
- H. High temperatures increase the process of digestion in pigs.
- I. Digestive juices help to break down food in a pig's stomach.

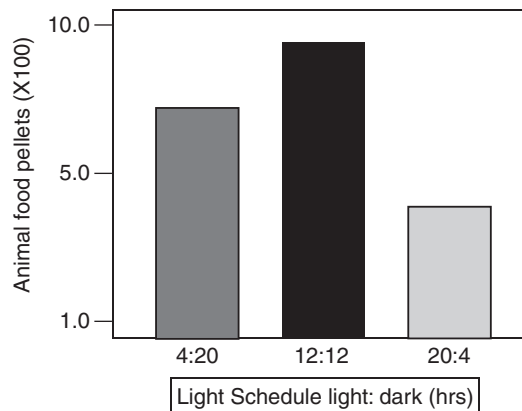
PRACTICE TEST 2

- 1** A scientist wants to investigate male-guppy behavior in the presence of female guppies. She puts two longtailed guppies in the same fish tank. The male guppies appear to be indifferent to each other's presence. However, when the scientist adds one female guppy to the tank, the male guppies become aggressive toward one another. Throughout the experiment, the scientist gives the fish enough food so that they do not need to compete for it. In the experiment, why does the scientist maintain the abundance of food before and during the presence of the female guppy?
- A. The scientist wants to see how the guppies react to various amounts of food.
 - B. The scientist wants to see if the female is more interested in food than the male guppies.
 - C. The scientist wants the guppies to have enough energy to display their natural behavior.
 - D. The scientist must ensure that the guppy's behavior is not affected by the need to compete for food.
- 2** It may seem obvious to people living in the modern world that disease is caused by germs or pathogens, but germ theory took centuries to be developed and accepted. Germ theory proposes that microorganisms are the cause of many diseases. This theory was highly controversial when it was first proposed, but it is now a cornerstone of modern medicine. Before germ theory, the view was that disease was spontaneously generated. This ancient view of the cause of disease was first published more than 2,000 years ago. Spontaneous generation was first questioned in 1546, when Girolamo Fracastoro proposed that diseases could be transferred from person to person through small things like seeds. Germ theory was also supported by the observations of Anton van Leeuwenhoek, who first examined pond water under a microscope and identified microorganisms. Other scientists, such as Louis Pasteur, added more evidence to the growing support for germ theory and led to innovations that changed human society, such as antibiotics. What is one reason why germ theory was controversial when it was first proposed?
- F. Most of the public had little experience with diseases.
 - G. The previous theory that disease was spontaneously generated had only recently been accepted.
 - H. The technology had not yet been developed to view microorganisms, many of which can cause disease.
 - I. The previous theory that disease was spontaneously generated had immediate and recognizable evidence.

- 3** A botanist has recently developed an enzyme called NoGro. This enzyme acts as an herbicide by preventing cell growth in the leaves of a certain species of tree that is an invasive plant species in Florida. The botanist wants to test the effects of temperature on NoGro so that NoGro can be applied to the invasive tree under optimal conditions on Florida farms. After looking into the background of the study, you discover that the botanist performing this investigation is being paid by a company that will make a lot of money if NoGro proves to be useful at eradicating the invasive tree. How might this affect your view of the research in this experiment?

- A. You should not consider this an important experiment, because it was funded by industry and not a governmental agency.
- B. You should approach the results of the experiment with skepticism and review the experimental methods and results carefully.
- C. You should ignore the conflict of interest between the botanist and the company because all scientific endeavors are performed without bias.
- D. You should immediately dismiss the entire experiment because the results were definitely skewed to make NoGro look more effective than it actually is.

- 4** The graph below is from an experiment where total light exposure was adjusted for three groups of rats. Each group had 12 rats and each group was exposed to different amounts of light versus dark in a 24-hour period for three months. Food consumption was measured in each group following each 24-hour period. Food pellets are reported as means per group for three months. (Note: All rats used in the experiment were the same age and breed. All were fed the same kind of food pellets.)



What could you infer from the graph?

- F. Light schedules affect the appetites of rats.
- G. Rats eat more when they are exposed to more light.
- H. The appetites of rats are unrelated to light schedule.
- I. Rats eat more when they are exposed to higher temperatures.

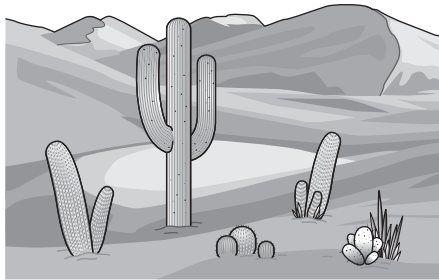
- 5** Darwin's theory of evolution was criticized fiercely during his time. Modern scientists now accept the theory while they still debate many of its details. Though a theory cannot be "proven," significant evidence can be used to support it. What kind of evidence has led biologists to accept modern evolutionary theory?
- A. comparing the sequence of DNA base pairs of different species
 - B. comparing different literary accounts of the origin of life on Earth
 - C. comparing the anatomies of purebred pets and other domesticated species
 - D. comparing Darwin's knowledge with that of modern evolutionary scientists
- 6** Every year, monarch butterflies travel thousands of miles from their summer homes in northern states and Canada to wintering spots in Mexico and southern California. In spring, they make the journey back again. However, the butterflies die before they reach their northern homes. New butterflies, hatched from eggs laid by migrating monarchs, complete the journey. A scientist wanted to know how the new butterflies found their way to their northern homes if they had never been there before. Which of the following is **not** a testable hypothesis about monarch migratory behavior?
- F. Monarchs can sense Earth's magnetic field.
 - G. Monarchs are prettier than other types of butterflies.
 - H. Monarchs follow routes that have many milkweed plants.
 - I. Monarchs can smell the remains of the last season's dead monarchs.
- 7** A theory is a set of related hypotheses that have been tested and confirmed many times by many scientists. Which of the following could cause a long-held theory to be challenged or even overturned by the scientific community?
- A. new evidence that better matches the new theory than previous evidence
 - B. a popular celebrity who disagrees with the ideas outlined in the old theory
 - C. a scientist who has strong beliefs that the old theory is wrong but little evidence
 - D. a group of scientists who believe that new theories are usually better than old theories

- 8** A newspaper headline says, “Detective Has Theory on How Computers Were Stolen from Warehouse.” Which of the following words **most accurately** reflects the use of the term *theory* in this newspaper headline?
- F. experiment G. fact
H. hypothesis I. law
- 9** The careful observations of many scientists have resulted in the development of the cell theory. Which of the following is **not** part of this theory?
- A. All cells contain a nucleus.
B. All cells come from existing cells.
C. The cell is the basic unit of all living things.
D. All organisms are made up of one or more cells.
- 10** Sodium-potassium pumps, endocytosis, and exocytosis all involve active transport. Which of the following is a characteristic of active transport?
- F. It involves facilitated diffusion.
G. It requires energy from the cell.
H. It relies on vesicles that often function as pumps.
I. It moves substances with a concentration gradient.
- 11** Which could be found in a prokaryote?
- A. endoplasmic reticulum
B. flagellum
C. mitochondrion
D. nucleus
- 12** Advancements in which of the following pieces of technology allowed scientists to make new discoveries about materials on an atomic level?
- F. telescope G. otoscope
H. light microscope I. electron microscope

- 13** AIDS is a fatal disease caused by HIV, a virus that attacks and destroys the human immune system. Which of the following activities is a risk factor for transmitting HIV?

- A. sharing needles
- B. shaking hands or kissing
- C. being bitten by mosquitoes and ticks
- D. coming in contact with infected toilet seats

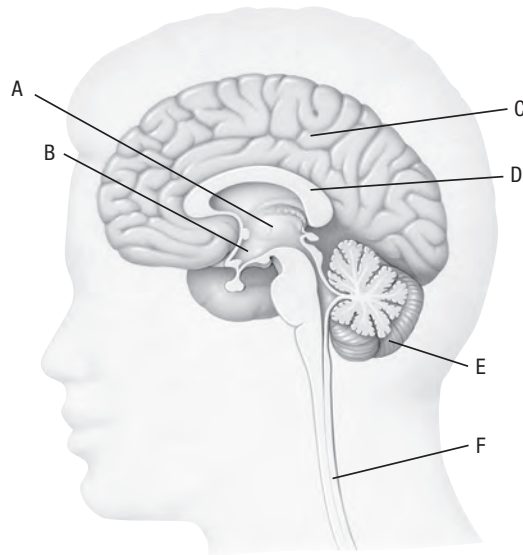
- 14** Various types of cactuses, such as those shown in the picture below, thrive in Arizona's deserts even though there is little annual rainfall there.



Which adaptation listed below allows all types of cactuses to survive long periods without rain?

- F. waxy cuticle on their surface
- G. deep roots that tap underground water
- H. cessation of photosynthesis in summer
- I. ability to take water from other desert plants

- 15 The diagram below shows the major parts of the human brain.

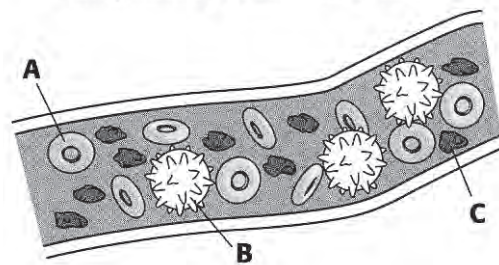


What is part *D*?

- | | |
|---------------|--------------------|
| A. cerebellum | B. corpus collasum |
| C. midbrain | D. pons |

- 16 The picture below models a blood vessel carrying different components of blood.

Components of Human Blood



If human blood did not contain component *C*, which function could you conclude the blood incapable of?

- F. clotting
- G. fighting disease
- H. carrying oxygen
- I. having red color

- 17 In the past, smallpox, which is caused by a virus, was a common and deadly disease. Now, people no longer get smallpox. Which method eradicated the smallpox virus?

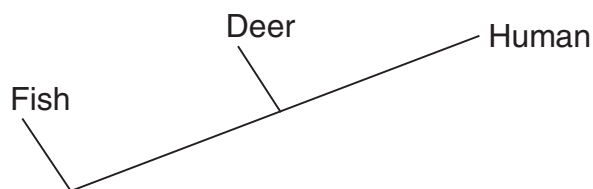
A. vaccination B. cooking food thoroughly
C. water purification programs D. more sanitary living conditions

- 18 A species of toad living in an area is similar in form to toad fossils found in very old rock. Which hypothesis does this observation support?

F. Toads living near the area have evolved slowly over time.
G. Toads evolved rapidly, because there are many variations in form.
H. This species of toad burrowed into the rock and became fossilized.
I. The toads living today migrated to the area from a different region.

- 19 A new animal was discovered in a remote area of Southeast Asia. The animal seemed to resemble a crocodile. Biologists have several ways that they can classify the mystery animal and determine its evolutionary history. One way involves identifying important characteristics of the animal and forming a hypothesis about the order in which it evolved from a common ancestor. The first step in this process is to analyze the characteristics in a data table.

ANIMAL	CHARACTERISTICS			
	Backbone	Lungs	Mammary glands	Bipedal
Fish	Yes	No	No	No
Deer	Yes	Yes	Yes	No
Human	Yes	Yes	Yes	Yes
Mystery animal	Yes	Yes	No	No



The cladogram above, based on the data in the table, could show the evolutionary relationships of these animals. Where would a biologist place the mystery animal on the cladogram?

A. before the fish B. between the fish and the deer
C. between the deer and the human D. after the human

- 20** Today, biologists classify sponges as animals rather than plants. What evidence supports today's classification?
- F. Sponges have asymmetry.
 - G. Sponges do not have a backbone.
 - H. Sponges cannot make their own food.
 - I. Sponges do not have tissues or organs.
- 21** Scientists used to group fungi with plants. Which of the following is a major factor that determines why fungi are not classified as part of the plant kingdom?
- A. Fungi do not have leaves.
 - B. Fungi grow close to the ground.
 - C. Fungi can reproduce either sexually or asexually.
 - D. Fungi are heterotrophs, but plants are autotrophs.
- 22** According to the primordial soup model, the first organic molecules could have formed from simpler inorganic substances in Earth's early oceans, but only if there were a source of energy to cause such chemical reactions to take place. Which are possible sources of energy that could have led to the production of these first precursors to life?
- F. lightning and cellular respiration
 - G. nuclear radiation and photosynthesis
 - H. photosynthesis and cellular respiration
 - I. solar radiation, volcanic eruptions, and lightning
- 23** Which species name meaning "wise man" describes hominid fossils associated with the first known paintings?
- A. *Homo erectus*
 - B. *Homo habilis*
 - C. *Homo neanderthalensis*
 - D. *Homo sapiens*

- 24** In a population of clover flowers, there are both white and purple varieties. The cows that graze the field where the clovers grow prefer the purple variety. Over time, the white clover flowers become much more numerous and the purple ones more scarce. This is an example of what process?
- F. evolution
 - G. reproduction
 - H. natural selection
 - I. genetic mutation
- 25** Immigration to the United States in the 1800s from Eastern Europe is an example of which type of force for genetic change?
- A. increased birth rate
 - B. genetic equilibrium
 - C. gene flow through interbreeding
 - D. increased chance of genetic mutation
- 26** Sexual reproduction increases genetic variation in a population. Which is a way that meiosis and fertilization lead to genetic variation?
- F. Alleles are recombined when gametes from different parents join together.
 - G. Mutations are usually repaired by cellular machinery before genes are expressed.
 - H. DNA is replicated when a fertilized egg becomes a growing embryo through mitosis.
 - I. Parents that are homozygous for the same trait will have offspring that are also homozygous for that trait.
- 27** A parent that is heterozygous for two different traits ($AaBb$) can pass any combination of two alleles (AB , Ab , aB , or ab) to its offspring. Which statement explains why this is possible?
- A. There are alternative versions of genes.
 - B. The two alleles for a single gene separate when gametes are formed.
 - C. For each inherited character, an individual has two copies of the gene.
 - D. The alleles of different genes separate independently of one another during gamete formation.

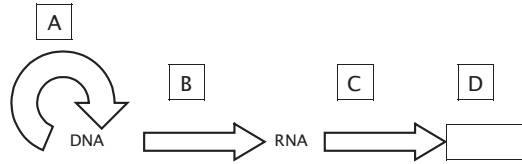
- 28 The Punnett square below shows a cross between two rabbits. Black fur (*B*) is dominant to brown fur (*b*).

		<i>B</i>	<i>b</i>
<i>Bb</i> × <i>Bb</i>	<i>B</i>	1	2
	<i>b</i>	3	4

What would be the phenotype of the offspring indicated by box 3?

- F. black
 - G. white
 - H. brown
 - I. a mixture of brown and black
- 29 During replication, a double-stranded DNA molecule opens up exposing the bases on each strand. Complementary bases line up with the bases on each of the exposed original strands, forming two new strands. The sequence of bases on one of the original strands is CGGTAGGG. What is the sequence of bases on its complementary strand of DNA?
- A. CGGTAGGG
 - B. CGGTUGGG
 - C. GCCATCCC
 - D. GCCAUCCC
- 30 The base sequences below show two different sequences of the same gene.
Wild Type: TTGACTCGGTATAC
Mutant: TTGACTCGTATAC
What type of mutation is illustrated?
- F. deletion
 - G. insertion
 - H. inversion
 - I. substitution

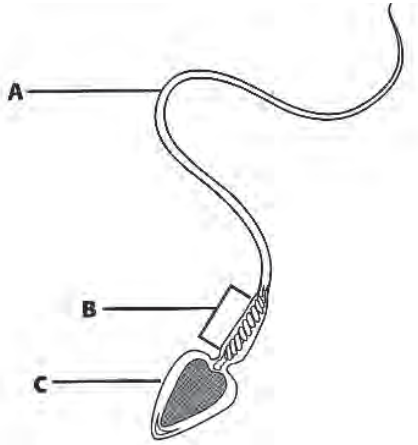
- 31 The diagram below shows the processes that occur during gene expression.



At which step would transfer RNA (tRNA) be necessary?

- A. step A B. step B
C. step C D. step D
- 32 Cancer is one of the leading causes of death in the United States. Which of the following **best** describes cancer?
- F. an infection of foreign bodies called tumors
G. an uncontrolled growth and division of cells
H. an infectious cellular disease that you inherit
I. an individual's immune system attacking itself
- 33 According to the genetic code, the mRNA codons UGU and UGC code for the amino acid cysteine, the mRNA codon UGA is a stop codon, and the mRNA codon UGG codes for the amino acid tryptophan. What would a mutation in the second base of the codon UGA likely mean for the resulting protein?
- A. The resulting protein would most likely be unaffected.
B. The resulting protein would most likely be unusually long.
C. The resulting protein would most likely be unusually short.
D. The resulting protein would most likely differ by one amino acid.
- 34 A consumer asked a genetic scientist whether genes from a genetically modified food plant could possibly cause harm by incorporating themselves into human DNA. What was the scientist's **most likely** response?
- F. No, because a person's genome comes only from the sex cells of parents.
G. No, because genetically modified DNA can never be passed to offspring.
H. Too little is known about genetic engineering to be able to answer that question.
I. No, because humans have always consumed plant and animal DNA with no ill effects.

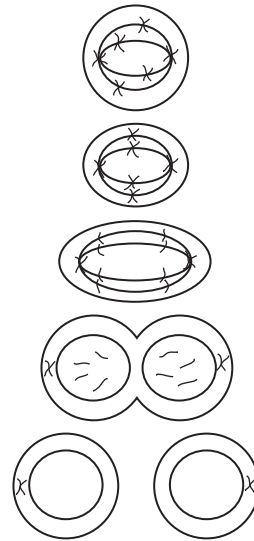
- 35** The diagram shows a sperm cell.



A sperm cell needs lots of ATP, which allows the tail to transport it into the female reproductive system. Which statement is true?

- A. The sperm's mitochondria are found in part A.
- B. The sperm's mitochondria are found in part B.
- C. The sperm's mitochondria are found in part C.
- D. Sperm do not contain mitochondria.

- 36** The diagram below shows the process of cell division.



Which of the following statements about the process is correct?

- F. Two cells are produced, each containing half of the DNA of the parent cell.
- G. Four cells are produced, each containing half of the DNA of the parent cell.
- H. Two cells are produced, each containing a complete set of the parent cell's DNA.
- I. Three cells are produced: one cell receives the entire DNA of the parent and the other two synthesize new DNA from spare nucleotides.

- 37** The following chart shows the number of $2n$ chromosomes in various organisms.

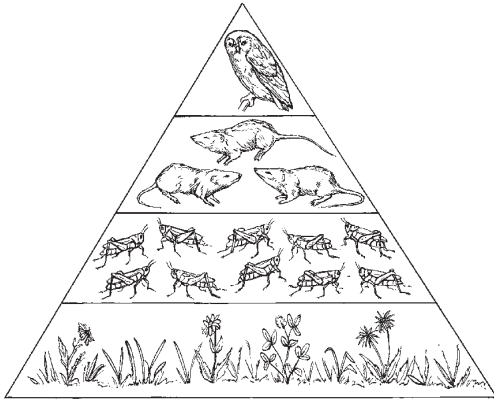
Organism	Number of $2n$ Chromosomes
Mosquito	6
Corn	20
Human	46
Dog	78

Which series lists the number of chromosomes in each gamete of a mosquito, corn, a human, and a dog?

- A. 3, 10, 23, 39
 - B. 3, 15, 22, 46
 - C. 6, 20, 23, 39
 - D. 6, 20, 46, 78
- 38** Cells and the organisms they make up reproduce through cell division. Some organisms reproduce through mitosis, while others reproduce through meiosis and fertilization. What advantage does meiosis give to organisms that reproduce sexually?
- F. Meiosis ensures that offspring inherit genes from their parents.
 - G. Meiosis ensures that offspring will not inherit any genetic disorders.
 - H. Meiosis ensures that offspring are genetically different from their parents.
 - I. Meiosis ensures that offspring will have identical phenotypes to their parents.
- 39** Rivers and the aquatic life that live within them can change over time due to human activity and natural forces. Which of these changes would likely have the greatest effect on a river system?
- A. A city being built near the mouth of the river.
 - B. A bridge that crosses the river high in the mountains.
 - C. A change in the salinity of the ocean into which it flows.
 - D. A dam on the river near where it flows from the mountains.

- 40** Tropical rain forests receive as much as 450 cm of rain per year. They are the richest biome in terms of number of species. Which statement **best explains** how destruction of tropical rain forests could affect the carbon cycle?
- F. Destroying rain forest trees would cause carbon dioxide levels in the atmosphere to drop dangerously low.
 - G. A loss of rain forest trees would have only a small effect on the carbon cycle, because they are green all year long.
 - H. Rain forest destruction would cause only a small increase in carbon dioxide levels if the roots were left to remove carbon dioxide from the air.
 - I. Cutting down rain forests could increase atmospheric carbon dioxide levels, because trees that could take up carbon dioxide would be removed.
- 41** The United States experienced a rapid growth of its population of in the early 1900s. Which of the following factors did **not** contribute to this rapid population growth?
- A. Immigration was greater than emigration.
 - B. The birth rate was higher than the death rate.
 - C. More people moved from farms to large cities.
 - D. Advances in technology led to cleaner food and water supplies.
- 42** Noxious weeds are weeds that invade ecosystems and grow very quickly and aggressively. In Colorado, more than 1 million acres are affected by noxious weeds. How do noxious weeds affect the biodiversity of an ecosystem?
- F. The biodiversity increases slightly because they represent another species in the area.
 - G. They increase the biodiversity because they increase the total energy of the producers.
 - H. The biodiversity usually decreases greatly as the noxious weeds outcompete the local plants.
 - I. The biodiversity is not affected at all since the noxious weeds simply replace the dominant plant in the ecosystem.

- 43 The diagram below is an energy pyramid.



In what level is there the **least energy** available?

- A. the level that contains rats
 - B. the level that contains grasses
 - C. the level that contains the owl
 - D. the level that contains grasshoppers
- 44 A renewable resource is a natural resource that can be replaced at the same rate at which the resource is used. Which of the following is true of renewable resources?
- F. They are less useful than nonrenewable resources.
 - G. Many of them can become scarce if used too quickly.
 - H. They must be converted into nonrenewable resources.
 - I. No matter how much we conserve, they will one day be gone.
- 45 There is a general pattern in how environmental workers and activists overcome environmental problems. Which lists five steps of solving an environmental problem in the order in which they happen?
- A. assessment, public education, political action, risk analysis, follow-through
 - B. assessment, risk analysis, public education, political action, follow-through
 - C. follow-through, assessment, public education, political action, risk analysis
 - D. public education, risk analysis, assessment, follow-through, political action

46 In 1985, a researcher in Antarctica noticed that ozone levels in the atmosphere seemed to be as much as 35 percent lower than the average values during the 1960s. Satellite images taken over the South Pole revealed that the ozone concentration was unexpectedly lower over Antarctica than elsewhere in the Earth's atmosphere. It was as if an "ozone eater" were causing a mysterious zone of below-normal concentration, an area that researchers called the ozone hole. Which human activities are thought to be responsible for creating this ozone hole in the upper atmosphere?

- F. increasing the human population and cutting down forests
- G. burning fossil fuels and the related increase in atmospheric CO₂
- H. burning sulfur-rich coal and increasing levels of greenhouse gases
- I. producing and releasing chemicals called chlorofluorocarbons (CFCs)

47 What are the subunits that make up complex carbohydrates?

- A. amino acids
- B. fatty acids
- C. monosaccharides
- D. nucleotides

48 Photosynthesis allows plants to produce most of the organic molecules they need. What is the primary source of energy for photosynthesis?

- F. ATP
- G. fermentation
- H. heat
- I. sunlight

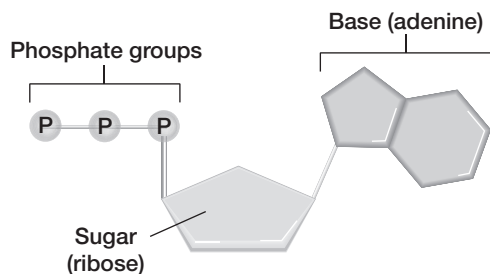
49 Which of the following pairings shows the substance released during cellular respiration and the cellular structure that is responsible for that process?

- A. O₂ and chloroplast
- B. ATP and chloroplast
- C. CO₂ and mitochondria
- D. glucose and mitochondria

50 In the carbon cycle, cellular respiration is the process responsible for the conversion of carbon-containing sugars into carbon dioxide gas, which can then become part of the atmosphere. What process can remove this gas from the atmosphere and return it to the biosphere?

- F. fermentation
- G. glycolysis
- H. photosynthesis
- I. transpiration

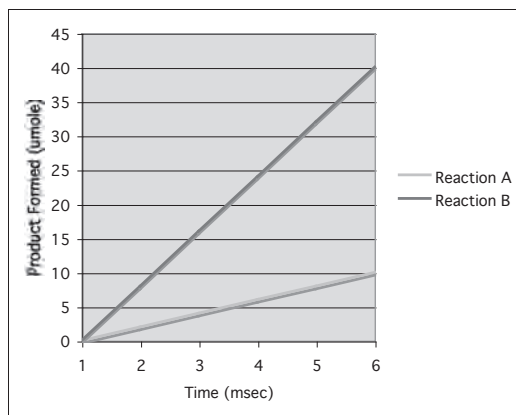
- 51 Frank made the drawing of ATP shown below.



How is this molecule **most often** involved with the production of energy in a cell?

- A. Energy is released when the third phosphate group breaks off.
- B. Energy is produced when a fourth phosphate group binds to the molecule.
- C. Energy is produced when the sugar ribose is metabolized in the Krebs cycle.
- D. Energy is released when the adenine base is used to form part of an RNA molecule.

- 52 The graph below shows the reaction rates of two different reactions.



Which of the following statements could explain the difference in the two reactions?

- F. Reaction A is catalyzed by an enzyme.
- G. Reaction B is catalyzed by an enzyme.
- H. Reaction A occurs at a faster rate than Reaction B.
- I. Reaction A and reaction B have the same reaction rate.

- 53** Water is often called the “universal solvent” because it can dissolve many different kinds of substances. What kinds of substances mix easily with water?

A. lipids, fats, and oils
B. ionic and polar substances
C. nonpolar covalent substances
D. polar and nonpolar substances

- 54** A student places a bunch of grapes in a bowl of plain water and a second bunch of grapes in a bowl of salt water. After an hour, the grapes in the plain water are swollen, whereas the grapes in the salt water are shriveled. What cellular process caused the grapes to shrivel?

F. active transport
G. diffusion
H. exocytosis
I. osmosis

- 55** Modern scientists have observed that genetic changes happen over time in all natural populations. Therefore, by comparing amino acid sequences, scientists can determine how similar one species is to another. The table below compares amino acids in a number of species.

Hemoglobin Comparison	
Animal with hemoglobin	Amino acids that differ from human hemoglobin
Gorilla	1
Rhesus monkey	8
Mouse	27
Chicken	45
Frog	67
Lamprey	125

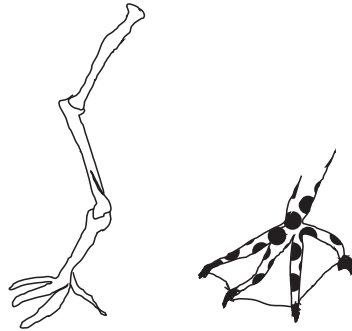
Based on the information in the table, which animal is **most closely** related to humans?

A. chicken
B. gorilla
C. lamprey
D. rhesus monkey

- 56** The Hardy-Weinberg principle states that the frequencies of alleles in a population do not change unless evolutionary forces act on the population. According to this principle, which of the following is **not** a factor in bringing about a change in the frequency of alleles and genotypes in a population?

F. gene flow G. genetic equilibrium
H. mutation I. natural selection

- 57** Examine the illustrations of the two bird feet shown below.



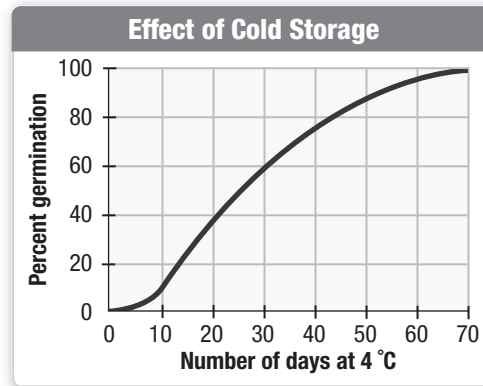
In what types of environments would such feet have a selective advantage?

- A. pine and fir forests B. water and wetlands
C. mountains and rocky cliffs D. deserts and deciduous forests
- 58** A trait for flower color shows incomplete dominance, where heterozygous individuals have pink flowers. If a homozygous individual were crossed with a heterozygous individual, what percentage of their offspring would exhibit pink flowers?
- F. 0% G. 50%
H. 75% I. 100%

- 59** Genetic engineering involves both ethical and scientific issues. Which of the following is **not** an ethical factor in pursuing genetic research?

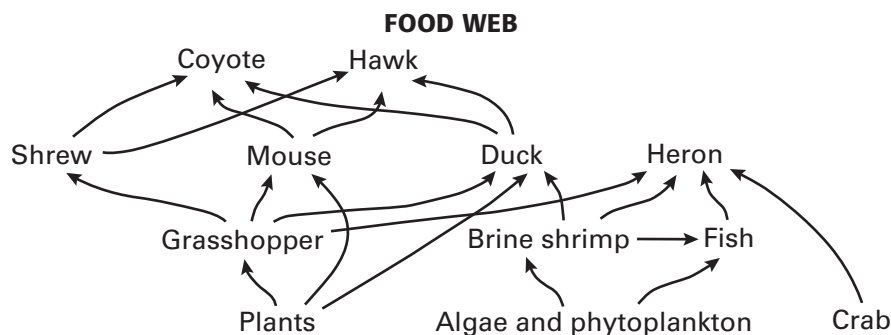
A. debate over the wisdom of allowing patents for specific genes or gene sequences
B. concern that a genetically modified organism could cause unforeseen environmental harm
C. debate over whether research on introns or research on transposons should receive the most funding
D. concern about who should be allowed to have information about the results of genetic tests on individuals

- 60 The graph below shows the percentage of seeds that germinate after being in cold storage for a varying number of days.



Some plants require a cold period to break seed dormancy. What would likely happen to seeds that usually experience a period of dormancy in cold weather if they are planted in a tropical climate?

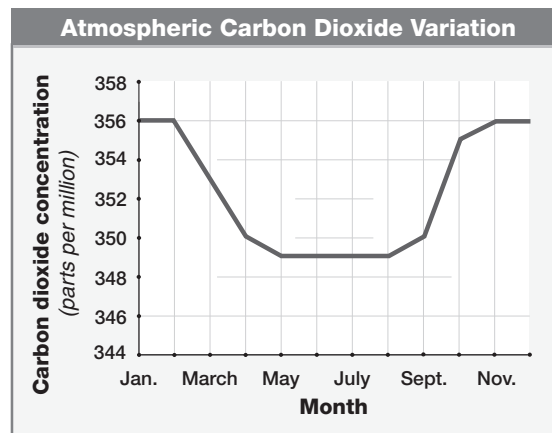
- F. The seeds would not germinate.
 - G. The seeds would germinate very quickly.
 - H. The plants that grew from the seeds would have larger flowers.
 - I. The flowers of the new plants would not produce any more seeds.
- 61 The food web below represents the interactions between organisms in a salt marsh ecosystem and organisms in an old field ecosystem.



Which group of organisms is missing from this diagram?

- A. Consumers are missing from this diagram.
- B. Producers are missing from this diagram.
- C. Decomposers are missing from this diagram.
- D. All the different types of organisms are included.

- 62** The International Panel on Climate Change is a group of scientists from many countries who study and monitor the temperature of Earth's atmosphere. The panel has concluded that Earth's climate is growing steadily warmer. The reason for this global warming, they contend, is an increase of carbon dioxide in the atmosphere, resulting from the burning of fossil fuels in power plants, factories, and automobile engines. Carbon dioxide is a greenhouse gas that causes heat to build up in the atmosphere. Although there are seasonal variations in the amount of atmospheric carbon dioxide, the panel reports that overall atmospheric levels have been steadily rising since the late 1700s, when the Industrial Revolution began. The graph below shows how atmospheric carbon dioxide concentration varies over a year.



How can the dip in carbon dioxide levels shown on the graph be related to the carbon cycle?

- F. Fewer trees are cut for firewood during warmer months.
- G. Erosion of farmland removes carbon dioxide from the air.
- H. More carbon dioxide is dissolved in lake and ocean waters during the warm summer months.
- I. Increased plant growth and photosynthesis during summer months remove more carbon dioxide from the atmosphere.

- 63** Which of the following statements is true?
- A. Water molecules gain energy during evaporation.
 - B. Water molecules lose energy during evaporation.
 - D. Water molecules lose energy during precipitation.
 - C. Water molecules gain energy during condensation.
- 64** Enzymes catalyze chemical reactions that keep cells alive. Imagine that a cell had no enzymes. How would having no enzymes affect the chemical reactions in the cell?
- F. They would happen too slowly to support cellular processes.
 - G. They would happen too rapidly to support cellular processes.
 - H. They would happen at the same rate as they do with enzymes.
 - I. They would happen normally, only they would use different reactants.

FCAT Practice Test 1

Answer Sheet for Practice Test 1

1 A B C D	14 F G H I	27 A B C D	40 F G H I	53 A B C D
2 F G H I	15 A B C D	28 F G H I	41 A B C D	54 F G H I
3 A B C D	16 F G H I	29 A B C D	42 F G H I	55 A B C D
4 F G H I	17 A B C D	30 F G H I	43 A B C D	56 F G H I
5 A B C D	18 F G H I	31 A B C D	44 F G H I	57 A B C D
6 F G H I	19 A B C D	32 F G H I	45 A B C D	58 F G H I
7 A B C D	20 F G H I	33 A B C D	46 F G H I	59 A B C D
8 F G H I	21 A B C D	34 F G H I	47 A B C D	60 F G H I
9 A B C D	22 F G H I	35 A B C D	48 F G H I	61 A B C D
10 F G H I	23 A B C D	36 F G H I	49 A B C D	62 F G H I
11 A B C D	24 F G H I	37 A B C D	50 F G H I	63 A B C D
12 F G H I	25 A B C D	38 F G H I	51 A B C D	64 F G H I
13 A B C D	26 F G H I	39 A B C D	52 F G H I	

FCAT Practice Test 2

Answer Sheet for Practice Test 2

1 A B C D	14 F G H I	27 A B C D	40 F G H I	53 A B C D
2 F G H I	15 A B C D	28 F G H I	41 A B C D	54 F G H I
3 A B C D	16 F G H I	29 A B C D	42 F G H I	55 A B C D
4 F G H I	17 A B C D	30 F G H I	43 A B C D	56 F G H I
5 A B C D	18 F G H I	31 A B C D	44 F G H I	57 A B C D
6 F G H I	19 A B C D	32 F G H I	45 A B C D	58 F G H I
7 A B C D	20 F G H I	33 A B C D	46 F G H I	59 A B C D
8 F G H I	21 A B C D	34 F G H I	47 A B C D	60 F G H I
9 A B C D	22 F G H I	35 A B C D	48 F G H I	61 A B C D
10 F G H I	23 A B C D	36 F G H I	49 A B C D	62 F G H I
11 A B C D	24 F G H I	37 A B C D	50 F G H I	63 A B C D
12 F G H I	25 A B C D	38 F G H I	51 A B C D	64 F G H I
13 A B C D	26 F G H I	39 A B C D	52 F G H I	

