Reviewing Vocabulary

Complete the paragraph by writing the correct term on the appropriate line. Use these choices:

- archaeabacteria
- fossils
- protocells
- biogenesis
- plate tectonics
- spontaneous generation

From ancient times until recently, it was believed that living organisms could arise from nonliving materials. This belief is referred to as (1) __________________________. According to the three-century-old writings of Jean Van Helmont, if a dirty shirt and grains of wheat are placed in a container and left for 21 days, mice will form from the fermenting wheat. With the invention of the microscope and careful experimentation, it has been reasonably proven that life arises only from life. This idea is referred to as (2) __________________________. The oldest organisms of which scientists have any record are approximately 3.4 billion years old. (3) __________________________ provide evidence of such organisms. The question of how the first unicellular organisms were produced from inorganic materials is a problem scientists are still studying. One possible answer is that conditions on the ancient Earth led to the formation of organized structures that carried out some life activities. These structures, called (4) __________________________, were capable of growth and division. After much time, they evolved into heterotrophic prokaryotes. Over more time, organisms evolved that could synthesize food from inorganic raw materials. These organisms were probably similar to today’s prokaryotes that survive in harsh conditions without oxygen. These organisms are known as (5) __________________________.

The geological activity of Earth has influenced the development of organisms. For example, at the beginning of the Mesozoic Era, the modern continents were merged into one large landmass. The landmass broke into individual continents that moved apart. The theory that explains how the continents moved is called (6) __________________________. As the continents moved apart, descendants of organisms living on the continents may have experienced different climates because of the new locations of the continents.
Understanding Main Ideas (Part A)

In the space at the left, write the letter of the word or phrase that best completes the statement or answers the question.

1. A clear fish imprint in a rock indicates that the rock is probably
   a. volcanic.      b. sedimentary.    c. metamorphic.    d. igneous.

2. Which fact is the basis for using the fossil record as evidence for the order of evolution?
   a. In undisturbed layers of rock strata, the older fossils are found in the deeper layers.
   b. There are fossils of all life forms to be found in rock layers.
   c. All fossils were formed at the same time.
   d. Fossils have been shown to provide a complete record of human evolution.

3. A theory concerning the origin of life states that Earth’s ancient atmosphere contained
   a. water vapor, carbon dioxide, and nitrogen.
   b. water vapor, oxygen, and hydrogen.
   c. methane, ammonia, and oxygen.
   d. methane, carbon dioxide, and oxygen.

4. Which group of organisms is believed to have been the earliest to evolve?
   a. land plants       b. cyanobacteria    c. aquatic dinosaurs    d. mammals

5. According to one theory, the first prokaryotes probably obtained their food
   a. through the synthesis of organic molecules from inorganic molecules.
   b. through a combination of photosynthesis and aerobic respiration.
   c. by eating carbohydrates formed by autotrophs.
   d. by consuming organic molecules available in their environment.

6. Entire organisms, with even their most delicate parts intact, have been found preserved in
   a. igneous rock formations and ice.
   b. mineral deposits and metamorphic rock.
   c. amber and ice.
   d. amber and mineral deposits.

7. While looking for fossils on an eroded hillside, you discover fossil coral and fish in
   one layer. In a layer just above, you find the fossil imprint of a fern frond and some
   fossil moss. Assuming the rock has not been disturbed, which of the following is the
   most probable conclusion?
   a. The area had been a sea until recent times.
   b. A forest had once grown there but had become submerged by water.
   c. A sea had been replaced by land in ancient times.
   d. A saltwater sea had changed to a freshwater lake in ancient times.
Understanding Main Ideas (Part B)

In the space at the left, write the letter of the word or phrase that best completes the statement or answers the question.

1. Which event contributed most directly to the evolution of aerobic organisms?
   a. an increase in the concentration of methane in the ancient atmosphere
   b. a decrease in the sun’s light intensity
   c. the presence of organisms able to carry on photosynthesis
   d. an increase in the number of organisms carrying on fermentation

2. Urey and Miller subjected water, ammonia, methane, and hydrogen to heating and cooling cycles and jolts of electricity in an attempt to
   a. determine how the dinosaurs became extinct.
   b. find out whether the conditions of ancient Earth could have formed complex organic compounds.
   c. determine the age of microfossils.
   d. find out how ozone forms in the atmosphere.

Answer the following questions.

3. Explain the role of plate tectonics in the theory of continental drift.

4. Explain the relationship between early photosynthetic autotrophs and the eventual rise of aerobic life forms.
Reviewing Vocabulary

Write the word or phrase that best completes the statement. Use these choices:

- adaptive radiation
- vestigial structure
- punctuated equilibrium
- mimicry
- natural selection
- gene pool
- polyploid
- stabilizing selection
- camouflage
- genetic drift
- artificial selection
- allelic frequency

1. ___________________________ is a technique in which the breeder selects particular traits.
2. A structural adaptation enabling an organism to blend in with its environment is ___________________________.
3. Another structural adaptation called ___________________________ protects an organism by copying the appearance of another species.
4. The total number of genes present in a population is the ___________________________.
5. The ___________________________ is the percentage of a particular allele in a population.
6. The alteration of allelic frequencies by chance events is known as ___________________________.
7. ___________________________ is the type of selection that favors average individuals in a population.
8. Any species with a multiple set of chromosomes is known as a(n) ___________________________.
9. ___________________________ is a mechanism for change in a population in which organisms with favorable variations live, reproduce, and pass on their favorable traits.
10. The concept that speciation occurs relatively quickly with long periods of stability in between is known as ___________________________.
11. Any structure that no longer serves its original function in a living organism but may have been used in an ancestor is known as a(n) ___________________________.
12. The evolution of an ancestral species into an array of species that occupy different niches is called ___________________________. 
Understanding Main Ideas (Part A)

In the space at the left, write the letter of the word or phrase that best completes the statement.

1. Natural selection can best be defined as the
   a. survival of the biggest and strongest organisms in a population.
   b. elimination of the smallest organisms by the biggest organisms.
   c. survival and reproduction of the organisms that occupy the largest area.
   d. survival and reproduction of the organisms that are genetically best adapted to the environment.

2. Structures that have a similar embryological origin and structure but are adapted for different purposes, such as a bat wing and a human arm, are called
   a. embryological structures.
   b. analogous structures.
   c. homologous structures.
   d. homozygous structures.

3. Mutations such as polyploidy and crossing over provide the genetic basis for
   a. evolution.
   b. spontaneous generation.
   c. biogenesis.
   d. sexual reproduction.

4. Within a decade of the introduction of a new insecticide, nearly all of the descendants of the target pests were immune to the usual-sized dose. The most likely explanation for this immunity to the insecticide is that
   a. eating the insecticide caused the bugs to become resistant to it.
   b. eating the insecticide caused the bugs to become less resistant to it.
   c. it destroyed organisms that cause disease in the insects, thus allowing them to live longer.
   d. it selected random mutations that were present in the insect population and that provided immunity to the insecticide.

5. The flying squirrel of North America very closely resembles the flying phalanger of Australia. They are similar in size, have long, bushy tails, and skin folds that allow them to glide through the air. The squirrel is a placental mammal, while the phalanger is a marsupial. These close resemblances, even though genetically and geographically separated by great distances, can best be explained by
   a. convergent evolution.
   b. divergent evolution.
   c. spontaneous generation.
   d. vestigial structures.

6. Hawaiian honeycreepers are a group of birds with similar body shape and size. However, they vary greatly in color and beak shape. Each species occupies its own niche and is adapted to the foods available in its niche. The evolution from a common ancestor to a variety of species is an example of
   a. divergent evolution.
   b. cross-pollination.
   c. vegetative propagation.
   d. convergent evolution.
Understanding Main Ideas (Part B)

In the space at the left, write the letter of the word or phrase that best completes the statement or answers the question.

1. Which of the following is not a factor that causes changes in the frequency of homozygous and heterozygous individuals in a population?
   a. mutations  
   b. migration  
   c. random mating  
   d. genetic drift

2. When checking shell color for a species of snail found only in a remote area seldom visited by humans, scientists discovered the distribution of individuals that is shown in the graph. Based on the information shown in the graph, the snail population is undergoing
   a. stabilizing selection.  
   b. disruptive selection.  
   c. artificial selection.  
   d. directional selection.

3. The theory of continental drift hypothesizes that Africa and South America slowly drifted apart after once being a single landmass. The monkeys on the two continents, although very similar, show numerous genetic differences. Which factor is probably the most important in maintaining these differences?
   a. comparative anatomy  
   b. comparative embryology  
   c. geographic isolation  
   d. fossil records

4. Which combination of characteristics in a population would provide the greatest potential for evolutionary change?
   a. small population, few mutations  
   b. small population, many mutations  
   c. large population, few mutations  
   d. large population, many mutations

5. Upon close examination of the skeleton of an adult python, a pelvic girdle and leg bones can be observed. These features are an example of
   a. artificial selection.  
   b. homologous structures.  
   c. vestigial structures.  
   d. comparative embryology.

6. Mutations occur because of
   a. the introduction of new variations from elsewhere.  
   b. the introduction of new variations through mistakes in DNA replication.  
   c. the chance survival and reproduction of new variations.  
   d. change in allele or genotype frequencies.
Thinking Critically

Read the information that follows and then answer the questions.

A study of the squirrel population in a large northern city revealed that many of the squirrels inhabited large park areas that were also populated by numerous squirrel predators. The graph at the right reflects the data collected in regard to color and number of squirrels.

1. Explain why the light- and dark-colored squirrels might be selected for and the medium-colored squirrels selected against.

2. Explain how this type of disruptive selection can lead to the separation of this population into two distinct species.
Applying Scientific Methods

A biologist studying a variety of fly in the rain forest noticed that the types of foods the fly preferred were located either high in the trees or in the foliage on the ground. There didn’t seem to be any of the preferred foods anywhere in between. An experiment was designed that would select for a genetically determined behavior known as geotaxis. If a fly shows positive geotaxis, it flies downward. If the fly shows negative geotaxis, it flies upward.

1. In terms of evolution and natural selection, why would the researcher suspect that the flies being studied would show geotaxis?

To conduct the experiment, the flies being studied were marked and placed in a maze (illustrated below). Each fly was placed in the “start” chamber. To exit from this area, the fly had to make a decision about which of the three exits to enter. One exit faced upward, indicating negative geotaxis, and another exit aimed downward, indicating positive geotaxis. A third exit permitted the fly to remain on middle ground. Each fly was placed in the maze 15 times and its choice of direction recorded. Some flies consistently went upward and entered the food vial at the end of the exit tube. Others consistently went downward and entered the food vial at the lower end. Some flies chose the upward and downward exits equal numbers of times; others went for the middle exit.

2. If the selection of direction is a genetic trait, what should happen when flies consistently selecting the upward exit are mated, those selecting the downward exit are mated, and the “no preference” and middle choice flies discarded?
Applying Scientific Methods  

3. What type of selection pressure is operating in this experiment? Explain your answer.

________________________________________________________________________

________________________________________________________________________

________________________________________________________________________

4. Describe what would be happening to the frequency of the allele for negative geotaxis in the above experiment.

________________________________________________________________________

________________________________________________________________________

5. What might be acting in the flies’ environment to select for flies that do not exhibit a distinct preference for flying upward at every trial or downward at every trial?

________________________________________________________________________

________________________________________________________________________

________________________________________________________________________

6. What might eventually happen if in the wild the flies developed into two populations, with one showing positive geotaxis and the other showing negative geotaxis?

________________________________________________________________________

________________________________________________________________________

________________________________________________________________________
Learning Vocabulary

Complete the paragraphs by writing the correct term on the appropriate line. Use these choices:

- haplorhines
- bipedal
- australopithecines
- Neandertals
- primates
- hominids
- prehensile tail
- opposable thumb
- Cro-Magnon

A distinctive characteristic of humans is (1) __________________________ locomotion, the ability to walk on two legs in an upright position. Another characteristic that humans share with most (2) __________________________ is the ability to touch the thumb to the forefinger. Called the (3) __________________________, it permits objects to be tightly grasped.

Anthropologists are also concerned with the origin of humans. Primates are classified in two groups, the strepsirrhines and the (4) __________________________. The strepsirrhines are small-bodied and include the lemurs and pottos. The other group can be divided into Old World monkeys, New World monkeys, and hominoids. Hominoids include the humanlike, bipedal primates such as the apes, chimpanzees, and gorillas. New World monkeys are entirely arboreal. Their success in the tree tops can be partially attributed to their (5) __________________________, which functions almost like an extra hand, enabling them to tightly grasp branches.

Modern humans and humanlike fossils are classified as (6) __________________________. Based on fossil evidence and biochemical evidence, it is believed that apes and humans began to evolve about 30 million years ago, developing along different paths but arising from the same common ancestor. In 1924, Raymond Dart discovered a skull with both apelike and human characteristics. The skull derived from the first of several African primates, now collectively referred to as (7) __________________________, which show both humanlike and apelike qualities. Homo sapiens may have first appeared between 100 000 and 500 000 years ago. The first of the species to have communicated through spoken language appeared around 100 000 years ago. They have been named (8) __________________________. About 35 000 years ago, these disappeared from the fossil record as a group called (9) __________________________ evolved.
Understanding Main Ideas (Part A)

In the space at the left, write the letter of the word or phrase that best completes the statement or answers the question.

1. Which is the oldest hominid species to be unearthed?
   a. *Homo habilis*  
   b. *Homo erectus*  
   c. *Australopithecus afarensis*  
   d. *Australopithecus africanus*

2. The skeleton of the hominid nicknamed “Lucy” gave anthropologists evidence that
   a. cavemen coexisted with dinosaurs.  
   b. Neandertals coexisted with *Homo habilis*.  
   c. upright walking evolved after large brains.  
   d. upright walking evolved before large brains.

3. Most early hominid fossils have been found in
   a. Egypt.  
   b. France.  
   c. Africa.  

4. The earliest primate identifiable from the fossil record is
   a. *Purgatorius*.  
   b. *Australopithecus*.  
   c. *Neandertalus*.  
   d. *Afarensis*.

5. The first hominids to make and use simple stone tools were
   a. *Homo sapiens*.  
   b. *Homo habilis*.  
   c. *Australopithecus afarensis*.  
   d. *Australopithecus africanus*.

6. As primates evolved, they developed
   a. a good sense of smell and large lower vertebrae.  
   b. good vision and large teeth.  
   c. stereoscopic vision and rotating shoulder joints.  
   d. large teeth and a well-developed collar bone.

7. The hominid that had the most advanced tool-making abilities and spoken language was
   a. Cro-Magnon.  
   b. Neandertal.  
   c. *Purgatorius*.  
   d. *Homo habilis*.

8. Based on the fossil record, it has been determined the earliest primates probably lived in the
   a. grasslands.  
   b. mountains.  
   c. forests.  
   d. deserts.

9. Primates evolved approximately
   a. 200,000 years ago.  
   b. 2 million years ago.  
   c. 8 million years ago.  
   d. 66 million years ago.

10. The anthropologists who discovered the skull of *Homo habilis* were
    a. the Leakeys.  
    b. the Darts.  
    c. the Johansons.  
    d. the Priestleys.
Understanding Main Ideas (Part B)

In the space at the left, write the letter of the word or phrase that best completes the statement or answers the question.

1. Which factor may have played a large role in human evolution?
   a. a geologic event that released much radiation into the environment, which in time resulted in an increased mutation rate
   b. climatic changes that caused existing primates to search for new food sources
   c. flooding due to melting glaciers causing primates to seek refuge in the trees
   d. massive grassland fires that caused existing primates to flee to the mountains

2. Evidence that *Homo erectus* was more intelligent than its predecessors would include
   a. a small cranial capacity as indicated by their skeletal remains.
   b. involved messages they wrote on cave walls.
   c. signs of agriculture and tilled fields.
   d. tools, such as hand axes, that have been found near their fire pits.

3. Some primate skeletons were located in a cave in association with these things: a variety of tools, the charred bones of some animals they had cooked and eaten, and numerous paintings on the walls. Carbon-14 dating techniques determined that the bones and other artifacts were about 35,000 years old. The skeletal remains probably belonged to
   a. *A. afarensis*.
   b. *Homo habilis*.
   c. Cro-Magnons.
   d. *Homo erectus*.

4. The jaw from the skull of the genus *Homo* and one from the genus *Australopithecus* are different in that the jaw from the genus *Homo* would
   a. be much heavier with large teeth and well-defined canines.
   b. be smaller with smaller teeth and not so much definition of tooth type.
   c. be larger with a multitude of small teeth with well-defined canines.
   d. be smaller with larger teeth that were all about the same.

5. The nucleotide sequence of human and chimpanzee genes differs by about only 1.6%. This fact, along with the fossil record, reveals that
   a. humans descended from chimpanzees.
   b. chimpanzees descended from humans.
   c. humans and chimpanzees evolved from a common ancestor.
   d. convergent evolution has resulted in chimpanzees and humans becoming more alike.

6. Evidence for the determination of bipedal locomotion in an animal could be found by an examination of the
   a. skull.
   b. upper arm (humerous).
   c. finger (carpal).
   d. jaw.
Thinking Critically

Answer the following questions.

1. Early primates spent most, if not all of their time in trees. How did their successful adaptations there eventually lead to important hominid adaptations?

2. Why is bipedal locomotion an important hominid trait?

3. You are on an expedition searching for early hominid fossils. You unearth a jaw bone. What traits would indicate to you that you have discovered an ape jaw and not a hominid jaw?

4. Why is it that we are still piecing together a picture of how human evolution occurred and how is it possible that our understanding of it might be flawed?
Applying Scientific Methods

It is speculated that environmental changes in the African habitat from warm, moist forest to cool, dry grassland exerted selection pressures on all native species, including prehumans. Of all the theories attempting to explain hominid evolution, the one presently receiving much attention links the emergence of humankind to wide-scale climatic change. Two such major events in human evolution occurred, the first 2.8 million years ago and the second, 1 million years ago.

Ocean-bottom core samples taken from the west coast of Africa, the Arabian Sea, and the Gulf of Aden off the east coast of Africa lend credibility to this theory. A thick layer of dust and silicate particles has been found in the cores at levels determined to have been deposited 2.8 million and 1 million years before the present. Scientists attribute the deposits to the fact that grasses draw large quantities of silicates from the soil and concentrate them in their tissues for structural use. In a grassland environment, as grasses live, die, and decompose over many years, quantities of silicates accumulate in the surface soil.

Deposits of dust and silicates also coincide with ice sheet formation and the onset of two ice ages in the Northern Hemisphere. Computer models show that the cooling and ice sheet formation influenced weather in both hemispheres. The models illustrate how cool, dry winds would have been diverted toward Africa as the ice sheets grew.

Another important piece of information has been obtained from the Gulf of Aden core. It contains volcanic ash, along with dust and silicates blown by monsoon winds from the Rift Valley. This type of ash is also found in association with some hominid fossils discovered in the Rift Valley.

1. What does the above information tell us about the African environment that existed approximately 2.8 million and 1 million years ago? Explain.

2. Describe what the African environment might have been like 2 million years ago.
Applying Scientific Methods  

3. In what way does the presence of volcanic ash in the Gulf of Aden cores and in the Rift Valley help in tracing human evolution?

When African forests declined and were replaced with vast areas of grassland, competition for food among animal species intensified. In an attempt to survive, hominids radiated outward from small forested areas. A vegetarian group, the australopithecines, emerged a few thousand years after the cooling period 2.8 million years ago. These hominids had to rely on seeds and tubers during the harsher seasons and on dense vegetation along river banks during the remainder of the year. Exploiting a variety of habitats at about the same time as the australopithecines was the first representative of the genus Homo. Members of this group consumed many kinds of food, including meat.

4. How would a diet of meat improve the chances of this group's survival, compared to australopithecines?

5. How would a diet of meat select for a different jaw and tooth structure than is seen in earlier primates?
Role of Isolation in Speciation

Use with Chapter 15, Section 15.2

Creation of a Kipuka—an isolated area

Inversions in gene sequences

Species 1

| a | b | c | d | e | f | g | h | i | j |

Species 2

| a | b | g | f | e | d | c | h | i | j |

Species 3

| a | b | g | f | e | i | h | c | d | j |

Picture-winged Drosophila

Size: Similar to common housefly

Source: Volcano Watching, Hawaii Natural History Dept. & US Dept. of Interior.
Ken Kaneshiro hypothesizes that the rapid increase in genetic variation in picture-wing *Drosophila* in kipukas on Hawaii may result from greater acceptance of changes in the steps in courtship. One of the steps is shown here.

1. Define *speciation* and discuss how it is at work in the kipukas.

2. Define *geographic isolation* and discuss how it is at work in the kipukas.

3. Define *reproductive isolation* and discuss how it is at work in the kipukas.

4. On the transparency, you can see a series of genes for three species of organisms. Explain what has happened to the genes. How could this change lead to a separate species?

5. Kaneshiro studies *Drosophila*, which have very short life cycles. Birds also live within the kipukas. Form a hypotheses to explain why Kaneshiro would decide not to study birds.