

# 目录

<b>An Introduction to TOEFL Reading.....</b>	<b>2</b>
<b>Attempts at Determining Earth's Age.....</b>	<b>4</b>
<b>Water Supply in Venice.....</b>	<b>11</b>
<b>The Early History of Motion Pictures.....</b>	<b>19</b>
<b>The Origins of Writing.....</b>	<b>27</b>
<b>Soil Fertilization.....</b>	<b>34</b>
<b>The Collapse of the Maya.....</b>	<b>42</b>
<b>Urban Development in the United States in the 19th Century.....</b>	<b>50</b>
<b>The Climate of Japan.....</b>	<b>58</b>
<b>Economic Decline in Europe during the 14th Century.....</b>	<b>66</b>
<b>Early Theories of Continental Drift.....</b>	<b>73</b>
<b>Bioluminescence in Marine Creatures.....</b>	<b>81</b>
<b>Bird Colonies.....</b>	<b>88</b>
<b>Artisans in Sixteenth-Century Europe.....</b>	<b>96</b>
<b>Disease and History.....</b>	<b>105</b>
<b>Earth's Atmosphere.....</b>	<b>114</b>
<b>The Role of Diapause.....</b>	<b>123</b>
<b>Birdsong.....</b>	<b>131</b>
<b>Greek Sacred Groves and Parks.....</b>	<b>140</b>
<b>The Chaco Phenomenon.....</b>	<b>148</b>
<b>Dinosaurs and Parental Care.....</b>	<b>157</b>
<b>The Plow and the Horse in Medieval Europe.....</b>	<b>165</b>
<b>Egypt Circa 3100 B.C.....</b>	<b>174</b>
<b>Surface Fluids on Venus and Earth.....</b>	<b>183</b>
<b>Population Growth in Nineteenth-Century Europe.....</b>	<b>192</b>
<b>Costs of Quitting a Job.....</b>	<b>201</b>
<b>Stone Tools and Pottery Fragments.....</b>	<b>210</b>
<b>The Role of the Ocean in Controlling Climate.....</b>	<b>218</b>
<b>Animal Behavior.....</b>	<b>226</b>
<b>Grain in Colonial North America.....</b>	<b>234</b>
<b>Sea Turtle Hatchling Strategies for Navigation.....</b>	<b>242</b>

# An Introduction to TOEFL Reading

## The Description of TOEFL IBT Reading Section

Approximately 700 words	3–4 passages 12–14 questions per passage	60 –80 minutes

## Reading Passages

The TOEFL IBT Reading section includes 3 to 4 reading passages. There are 12 to 14 questions per passage. You have from 60 to 80 minutes to answer all questions in the section. The reading passages are approximately 700 words long, but the passages used may vary somewhat in length. Some passages may be slightly longer than 700 words, and some may be slightly shorter.

The reading passages are excerpts from college-level textbooks that would be used in introductions to a discipline or topic. The excerpts are changed as little as possible because the goal of the TOEFL iBT is to assess how well students can read the kind of writing that is used in an academic environment.

The passages will cover a variety of different subjects. **Don't worry if you are unfamiliar with the topic of a passage.** All the information needed to answer the questions will be in the passage.

## Academic Reading Skills

The Reading section measures your ability to understand university-level academic texts and passages. In many academic settings around the world, students are expected to read and understand information from textbooks and other academic materials written in English. The following are **three purposes for academic reading**:

### Reading to find information

- effectively scanning text for key facts and important information
- increasing reading fluency and rate

### Basic comprehension

- understanding the general topic or main idea, major points, important facts and details, vocabulary in context, and pronoun references
- making inferences about what is implied in a passage

**Reading to learn**

- recognizing the organization and purpose of a passage
- understanding relationships between ideas
- organizing information into a category chart or a summary in order to recall major points and important details
- inferring how ideas throughout the passage connect

**TOEFL iBT Reading Questions**

TOEFL iBT Reading questions cover Basic Information skills, Inferencing skills and Reading to Learn skills. There are 10 question types. The following chart summarizes the categories and types of TOEFL iBT Reading questions.

**TOEFL Reading Question Types:****Basic Information and Inferencing questions (11 to 13 questions per set)**

1. Factual Information questions (3 to 6 questions per set)
2. Negative Factual Information questions (0 to 2 questions per set)
3. Inference questions (0 to 2 questions per set)
4. Rhetorical Purpose questions (0 to 2 questions per set)
5. Vocabulary questions (3 to 5 questions per set)
6. Reference questions (0 to 2 questions per set)
7. Sentence Simplification questions (0 to 1 question per set)
8. Insert Text questions (0 to 1 question per set)

**Reading to Learn questions (1 per set)**

9. Prose Summary
10. Fill in a Table

## **Attempts at Determining Earth's Age**

Since the dawn of civilization, people have been curious about the age of Earth. In addition, we have not been satisfied in being able to state merely the relative geologic age of a rock or fossil. Human curiosity demands that we know actual age in years.

Geologists working during the nineteenth century understood rock bodies, they would have to concentrate on natural processes that continue at a constant rate and that also leave some sort of tangible record in the rocks. Evolution is one such process, and geologist Charles Lyell (1797-1875) recognized this. By comparing the amount of evolution exhibited by marine mollusks then, Lyell estimated that 80 million years had elapsed since the beginning of the Tertiary Period. He came astonishingly close to the mark, since it was actually about 65 million years. However, for older sequence of evolutionary development, estimates based on parts in the fossil record. Rates of evolution for many orders of plants and animals were not well understood.

In another attempt, geologists reasoned that if rates of deposition could be determined for sedimentary rocks, they might be able to estimate the time required for deposition of a given thickness of strata, or rock layers. Similar reasoning suggested that one could estimate total elapsed geologic time by dividing the average thickness of sediment transported annually to the oceans into the total thickness of sedimentary rock that had ever been deposited in the past. Unfortunately, such estimates did not adequately account for past difference in rates of sedimentation or losses to the total section of strata during episodes of erosion. Also, some very ancient sediments were no longer recognizable, having been converted to igneous and metamorphic rocks in the course of mountain building. Estimates of Earth's total age based on sedimentation rates ranged from as little as million to over a billion year.

Yet another scheme for approximating Earth's age had been proposed in 1715 by Sir Edmund Halley (1656-1742), whose name we associate with the famous comet. Halley surmised that the ocean formed soon after the origin of the planet and therefore would be only slightly younger than the age of the solid Earth. He reasoned that the original ocean was not salty and that subsequently salt derived from the weathering of rocks was brought to the sea by streams. Thus, if one knew the total amount of salt dissolved in the ocean

and the amount added each year, it might be possible to calculate the ocean's age in 1899, Irish geologist John Joly (1857-1933) attempted the calculation. From information provide by gauges placed at the mouths of streams. Joly was able to estimate the annual increment of salt to the oceans. Then, knowing the salinity of ocean water and the approximate volume of water, he calculated the amount of salt already held in solution in the oceans. An estimate of the age of the ocean was obtained by dividing the total salt in the ocean by the rate of salt added each year. Beginning with essentially non-saline oceans, it would have taken about 90 million years of the oceans to reach their present salinity, according to Joly. The figure, however, was off the currently accepted mark of 4.54 billion by a factor of 50, largely because there was no way to account accurately by recycled salt and salt incorporated into clay mineral deposited on the sea floors. Even though in error, Joly's calculations clearly supported those geologists who insisted on an age for Earth far in excess of a few million years. The belief in Earth's immense antiquity was also supported by Darwin, Huxley, and other evolutionary biologists, who saw the need for time in the hundreds of millions of years to accomplish the organic evolution apparent in the fossil record.

## **Paragraph 2**

Geologists working during the nineteenth century understood rock bodies, they would have to concentrate on natural processes that continue at a constant rate and that also leave some sort of **tangible** record in the rocks. Evolution is one such process, and geologist Charles Lyell (1797-1875) recognized this. BY comparing the amount of evolution exhibited by marine mollusks then, Lyell estimated that 80 million years had elapsed since the beginning of the Tertiary Period. He came astonishingly close to the mark, since it was actually about 65 million years. However, for older **sequence** of evolutionary development, estimates based on parts in the fossil record. Rates of evolution for many orders of plants and animals were not well understood.

1. The word "**tangible**" in the passage is closest in meaning to
  - A. physical
  - B. related
  - C. significant

- D. helpful
2. It can be inferred from paragraph 2 that Charles Lyell based his study of the marine mollusk fossils on which of the following assumptions?
- A. The Tertiary Period was separated into division of time that were equal in length.
  - B. Mollusks lived under rocks in the sea during the Tertiary period.
  - C. Evolution of mollusks proceeded at a uniform rate over time
  - D. Mollusks have evolved less rapidly with the passing of time
3. The word “**sequence**” in the passage is closest in meaning to
- A. observations
  - B. senses
  - C. series
  - D. categories
4. According to paragraph 2, Lyell’s strategy for estimation geologic dates was not very accurate for periods before the Tertiary Period partly because
- A. Marine mollusks did not evolve until the Tertiary Period
  - B. fossil records of the very distant past are incomplete
  - C. there was not much agreement about how to identify or categorize earlier eras
  - D. the duration of previous geologic periods was difficult to determine

### **Paragraph 3**

In **another attempt**, geologists reasoned that if rates of deposition could be determined for sedimentary rocks, they might be able to estimate the time required for deposition of a given thickness of strata, or rock layers. Similar reasoning suggested that one could estimate total elapsed geologic time by dividing the average thickness of sediment transported annually to the oceans into the total thickness of sedimentary rock that had ever been deposited in the past. Unfortunately, such estimates did not adequately account for past difference in rates of sedimentation or losses to the total section of strata during episodes of erosion. Also, some very ancient sediments were no longer recognizable, having been **converted** to igneous and metamorphic rocks in the course of mountain building. Estimates of Earth’s total age based on sedimentation rates ranged from as little as million to over a billion year.

5. The phrase “**another attempt**” in the passage refers to
- A. trying to understand the fossil record
  - B. trying to determine the evolutionary rate of marine mollusks
  - C. trying to understand natural processes
  - D. trying to determine Earth’s actual age
6. The word “**converted**” in the passage is closest in meaning to
- A. added
  - B. changed
  - C. restored
  - D. reduced
7. According to paragraph 3, all of the following were problems with the calculation of Earth’s age using the study of sedimentary rocks EXCEPT
- A. the inconsistency of sedimentation rates over time
  - B. the effect of geologic process on sedimentary rock
  - C. the expansion of some sedimentary rocks due to Earth’s internal heat
  - D. the loss of an unknown number of sedimentary layers due to erosion

#### **Paragraph 4**

Yet another scheme for **approximating** Earth’s age had been proposed in 1715 by Sir Edmund Halley (1656-1742), whose name we associate with the famous comet. Halley surmised that the ocean formed soon after the origin of the planet and therefore would be only slightly younger than the age of the solid Earth. He reasoned that the original ocean was not salty and that **subsequently** salt derived from the weathering of rocks was brought to the sea by streams. Thus, if one knew the total amount of salt dissolved in the ocean and the amount added each year, it might be possible to calculate the ocean’s age. In 1899, Irish geologist John Joly (1857-1933) attempted the calculation. From information provided by gauges placed at the mouths of streams, Joly was able to estimate the annual increment of salt to the oceans. Then, knowing the salinity of ocean water and the approximate volume of water, he calculated the amount of salt already held in solution in the oceans. An estimate of the age of the ocean was obtained by dividing the total salt in the ocean by the rate of salt added each year. Beginning with essentially non-saline oceans, it would have taken about 90 million years for the oceans to

reach their present salinity, according to Joly. The figure, however, was off the currently accepted mark of 4.54 billion by a factor of 50, largely because there was no way to account accurately by recycled salt and salt incorporated into clay mineral deposited on the sea floors. Even though in error, Joly's calculations clearly supported those geologists who insisted on an age for Earth far in excess of a few million years. The belief in Earth's immense antiquity was also supported by **Darwin, Huxley, and other evolutionary biologists**, who saw the need for time in the hundreds of millions of years to accomplish the organic evolution apparent in the fossil record.

8. The word “**approximating**” in the passage is closest in meaning to
- A. thinking about
  - B. researching
  - C. estimating
  - D. demonstrating
9. The word “**subsequently**” in the passage is closest in meaning to
- A. later
  - B. furthermore
  - C. evidently
  - D. accidentally
10. According to paragraph 4, John Joly's calculations were founded on all the following EXCEPT
- A. knowing how salty the ocean water is
  - B. estimating how much salt enters the ocean each year
  - C. accounting for the amount of salt that is recycled
  - D. figuring the volume of water contained in the ocean
11. According to paragraph 4, in which of the following ways could Joly's estimate of Earth's age be considered significant?
- A. It proved that Halley's idea about the age of the ocean was fairly accurate.
  - B. It indicated that Earth was much older than some scientists had claimed.
  - C. It was favored by the majority of scientists at the end of the nineteenth century
  - D. It was the basis for much modern research into the salinity of the ocean
12. The author mentions **“Darwin, Huxley, and other evolutionary**



**biologists”** in order to

- A. Provide evidence that Joly’s calculations inspired scientists working on other lines of scientific inquiry
- B. Support the claim that all of the leading scientists of the time believed that Earth was just over 90 million years old
- C. Argue that Joly’s calculations would have been more exact if he had collaborated with experts in other fields
- D. Provide examples of scientists who believed the age of Earth to be greater than just a few million on year, like Joly, in order to account for their findings

## **Paragraph 2**

Geologists working during the nineteenth century understood rock bodies, they would have to concentrate on natural processes that continue at a constant rate and that also leave some sort of tangible record in the rocks. Evolution is one such process, and geologist Charles Lyell (1797-1875) recognized this. ■By comparing the amount of evolution exhibited by marine mollusks then, Lyell estimated that 80 million years had elapsed since the beginning of the Tertiary Period. He came astonishingly close to the mark, since it was actually about 65 million years. ■However, for older sequence of evolutionary development, estimates based on parts in the fossil record. ■Rates of evolution for many orders of plants and animals were not well understood. ■

13. Look at the four squares [■] that indicate where the following sentence could be added to the passage.

**More fundamentally, Lyell’s evolutionary approach is intrinsically limited because Earth existed long before life and evolution began.**

Where would the sentence best fit?

14. **Directions:** An introductory sentence for a brief summary of the passage is provided below. Complete the summary by selecting the THREE answer choices that express the most important ideas in the passage. Some sentences do not belong in the summary because they express ideas that are not

presented in the passage or are minor ideas in the passage. **This question is worth 2 points.**

**Since the dawn of civilization, people have been curious about Earth's age**

**Answer choices**

- A. It was not until the nineteenth century that attempts were made to determine the relative geologic age of rocks and fossils.
- B. Charles Lyell made a good estimate of the Tertiary Period from the fossil record, but his method could not be extended to earlier geological periods.
- C. Attempts were made to calculate Earth's age from the thickness of surviving sedimentary rock and from the current level of the oceans' salinity.
- D. In the nineteenth century, scientists made a number of important, but unsuccessful, attempts to calculate Earth's age from the record of various natural processes.
- E. Darwin and Huxley supported the accuracy of John Joly's Calculation of Earth's age because it agree with their view of how long evolution had been in progress.
- F. Earth's true age, 4.54 billion years, was determined by combining data from the geological and fossil records.

## **Water Supply in Venice**

The city of Venice, built on saltwater marshes and crisscrossed by canals, experienced problems with its water supply for most of its history. One fifteenth-century French traveler noted that “in a city” in which the inhabitants are in water up to their mouths, they often go thirsty “How was the community to solve this important problem?

Water drawn from the lagoon (the large, shallow body of water between Venice and the Mediterranean Sea) and the canals within the city served many domestic uses such as washing and cooking inventories of even the most modest households list large numbers of buckets, which were emptied and rinsed, the ones used to carry the brackish (somewhat salty) canal water were kept separate from those intended for fresh water. Still, even serving such needs would have been impossible if the canals of Venice had been extremely polluted. The government was obliged to impose controls, and in the early fourteenth century, the Great Council prohibited the washing of all cloth and dyed woolens in the canals, adding that water used for dyeing could not be flushed into the canals. Henceforth dirty water of that sort was to go into the lagoon. Thanks to resistance on the part of the dyers, infractions were many, the law did not reflect common practice. A century later, however, most of the dye works that used blood or indigo (a dark blue dye) had shifted to the periphery of the city, as had all activities “that let off bad odors or smells.”, such as butchering. Blood, carcasses, and spoiled meat were to go into the lagoon. The canals of Venice began to be protected in the name of nascent ecological awareness.

Much more stringent measures were necessary to guarantee a supply of drinking water, however. In the early centuries of settlement in the lagoon basin, the populations depended on wells on the nearby coastal region. By the ninth century, however, with the increase in population density, cisterns became necessary. Basically, the cisterns were large, covered pits dug into the ground and lined with clay to hold water. The cisterns were located in the city, but unlike the wells, the cisterns were not supplied with water from the lagoon, they collected rainwater instead. Cisterns became widespread in the growing city.

Over a period of several hundred years, Venice developed an elaborate

system of cisterns and some of the gutters or pipes that carried rainwater to the cisterns and that, for a single cistern, might extend over an area of several streets. Wealthy households had their own cisterns. In less affluent areas of the city, cisterns were often owned and maintained by neighborhood groups. In crowded parts of the city where landlords offered small houses for rent, one or two cisterns were provided for each street. A network of public cisterns paralleled these private and semiprivate arrangements. Every public square in the city had a cistern to serve the poorest Venetians.

In the thirteenth century, a decision was made to create 50 additional cisterns, primarily in the recently urbanized area at the edge of the city. At the same time, a campaign was launched to repair the existing cisterns. Expansion of the cistern system stopped during much of the fourteenth century as Venice, like other cities in Europe, suffered from bubonic plague. In the fifteenth century, however, a new program of cistern construction and repair was undertaken.

In spite of the expansion of the cistern system, Venice continued to have problems with its water supply, especially during dry periods. Flotillas of boats had to be dispatched to the mouths of nearby rivers—first to the Bottenigo, then to the Brenta—to fetch fresh water. The fresh water was then sold by the bucket or poured into the cisterns. The public authorities made efforts to take bolder action to ensure the supply of fresh water from this parallel source and a number of projects were suggested during the fourteenth and fifteenth centuries to channel river water and even to construct an aqueduct. However, the high cost of such initiatives precluded their execution.

### Paragraph 1

The city of Venice, built on saltwater marshes and crisscrossed by canals, experienced problems with its water supply for most of its history. One fifteenth-century French traveler noted that **“in a city” in which the inhabitants are in water up to their mouths, they often go thirsty** “How was the community to solve this important problem?

1. Why does the author include the quotation **“in a city” in which the inhabitants are in water up to their mouths, they often go thirsty**?

A. To indicate that the French traveled to Venice frequently in the fifteenth

century.

- B. To illustrate the opinion of other Europeans about the water situation in Venice
- C. To suggest that the water supply problem of Venice continued well beyond the fifteenth century.
- D. To emphasize how serious the water problem was in Venice.

## Paragraph 2

Water drawn from the lagoon (the large, shallow body of water between Venice and the Mediterranean Sea) and the canals within the city served many domestic uses such as washing and cooking inventories of even the most modest households list large numbers of buckets, which were emptied and rinsed, the ones used to carry the brackish (somewhat salty) canal water were kept separate from those intended for fresh water. Still, even serving such needs would have been impossible if the canals of Venice had been extremely polluted. The government was **obliged** to impose controls, and in the early fourteenth century, the Great Council prohibited the washing of all cloth and dyed woollens in the canals, adding that water used for dyeing could not be flushed into the canals. **Henceforth**, dirty water of that sort was to go into the lagoon. Thanks to resistance on the part of the dyers, infractions were many, the law did not reflect common practice. A century later, however, most of the dye works that used blood or indigo(a dark blue dye) had shifted to the periphery of the city, as had all activities “that let off bad odors or smells.”, such as butchering. Blood, carcasses, and spoiled meat were to go into the lagoon. The canals of Venice began to be protected in the name of nascent ecological awareness.

2. The word “**Henceforth**” in the passage is closest in meaning to

- A. Instead of this
- B. In addition
- C. From this time on
- D. In effect

3. The word “**obliged**” in the passage is closest in meaning to

- A. forced
- B. allowed

- C. expected
  - D. Persuaded
4. According to paragraph 2, why did the government place restrictions on dyers?
- A. To protect the city's drinking water
  - B. To prevent the lagoon from being polluted
  - C. To keep canal water clean
  - D. To discourage the use of blood and indigo for dyeing cloth
5. According to paragraph 2, how did dyers respond to the controls imposed by the government?
- A. They switched from using dyes that let off bad odors or smells to new dyes that smelled much better
  - B. They resisted initially but eventually moved most of the dyeing operations outside the city center
  - C. They argued that the government did not consider common practice before imposing the controls
  - D. They started washing cloth and woolens dyed with blood and indigo in the lagoon

### **Paragraph 3**

Much more stringent measures were necessary to guarantee a supply of drinking water, however. In the early centuries of settlement in the lagoon basin, the populations depended on wells on the nearby coastal region. By the ninth century, however, with the increase in population density, cisterns became necessary. Basically, the cisterns were large, covered pits dug into the ground and lined with clay to hold water. The cisterns were located in the city, but unlike the wells, the cisterns were not supplied with water from the lagoon, they collected rainwater instead. Cisterns became widespread in the growing city.

6. It can be inferred from paragraph 3 that wells on the nearby coastal region
- A. were smaller in size than the cisterns located in the city
  - B. served as a water source for the growing number of cisterns in the city
  - C. increased in number as the population density increased

D. Provided enough water for only a relatively small number of people

#### **Paragraph 4**

Over a period of several hundred years, Venice developed an elaborate system of cisterns and gome-the gutters or pipes that carried rainwater to the cisterns and that, for a single cistern, might extend over an area of several streets. Wealthy households had their own cisterns. In less affluent areas of the city, cisterns were often owned and maintained by neighborhood groups. In crowded parts of the city where landlords offered small house for rent, one or two cisterns were provided for each street. A network of public cisterns paralleled these private and semiprivate arrangements. Every public square in the city had a cistern to serve the poorest venetians.

7. According to paragraph 4, all of the following were true of Venice's system of cisterns and gome EXCEPT

- A. It was developed over several centuries
- B. It collected rainwater
- C. It was maintained with fees paid by the public
- D. It reflected the social and economic diversity of the city of Venice

#### **Paragraph 5**

In the thirteenth century, a decision was made to create 50 additional cisterns, primarily in the recently urbanized area at the edge of the city. At the same time, a campaign was **launched** to repair the existing cisterns. Expansion of the cistern system stopped during much of the fourteenth century as Venice, like other cities in Europe, suffered from bubonic plague. In the fifteenth century, however, a new program of cistern construction and repair was undertaken.

8. The word "**launched**" in the passage is closest in meaning to

- A. paid for
- B. started
- C. proposed
- D. agreed on

9. According to paragraph 5, all of the following had an effect on cisterns in Venice from the thirteenth to the fifteenth century EXCEPT

- A. the construction of cisterns in other cities in Europe
- B. the establishment of programs to construct and repair cisterns
- C. the outbreak of bubonic plague
- D. the urbanization of an area at the edge of the city

### Paragraph 6

In spite of the expansion of the cistern system, Venice continued to have problems with its water supply, especially during dry periods. Flotillas of boats had to be dispatched to the mouths of nearby rivers—first to the Bottenigo, then to the Brenta—to fetch fresh water. The fresh water was then sold by the bucket or poured into the cisterns. The public authorities made efforts to take bolder action to **ensure** the supply of fresh water from **this parallel source** and a number of projects were suggested during the fourteenth and fifteenth centuries to channel river water and even to construct an aqueduct. However, the high cost of such initiatives precluded their execution.

10. The phrase “**this parallel source**” refers to

- A. flotillas of boat
- B. nearby rivers
- C. the cisterns
- D. an aqueduct

11. The word “**ensure**” in the passage is closest in meaning to

- A. improve
- B. increase
- C. control
- D. Guarantee

12. According to paragraph 6, how did public authorities respond to problems with the water supply during dry periods?

- A. They sent boats to fetch fresh water from nearby rivers
- B. They channeled river water into the cisterns
- C. They constructed an aqueduct
- D. They sold water from the cisterns in buckets to the public



#### Paragraph 4

Over a period of several hundred years, Venice developed an elaborate system of cisterns and gome-the gutters or pipes that carried rainwater to the cisterns and that, for a single cistern, might extend over an area of several streets. ■Wealthy households had their own cisterns. ■In less affluent areas of the city, cisterns were often owned and maintained by neighborhood groups. ■In crowded parts of the city where landlords offered small house for rent, one or two cisterns were provided for each street. ■A network of public cisterns paralleled these private and semiprivate arrangements. Every public square in the city had a cistern to serve the poorest venetians.

13. Look at the four squares [■] that indicate where the following sentence could be added to the passage.

**The complexity of the cistern system was social as well as physical.**

Where would the sentence best fit?

14. **Directions:** An introductory sentence for a brief summary of the passage is provided below. Complete the summary by selected THREE answer choices that express the most important ideas in the passage. Some sentences do not belong in the summary express ideas that are not presented in the passage or are minor ideas in the passage. **This question is worth 2 points.**

**The city of Venice experienced problems with its water supply for most of its history.**

#### Answer Choices

- A. The water from the lagoon between Venice and the Mediterranean Sean could not be used for drinking because it was extremely polluted.
- B. From the ninth to the fifteenth century, Venice developed a system to collected and store rainwater in cisterns for use by the population
- C. Wealthy households were able to build their own cisterns, but everyone else had to use public cisterns located in the city's many squares.
- D. By the early fourteenth century, the water in Venice's canals was becoming too polluted for household use prompting the city council to prohibit the use of the canals by dyers and butchers.
- E. By the fifteenth century, cisterns supplied by rainwater proved to be inadequate

quate, but the cost of the projects proposed for a permanent solution was too high for the projects to be undertaken.

- F. The expansion and repair of the cistern system was interrupted for much of the fourteenth century because of the bubonic plague, a situation that worsened the water supply problem.

## **The Early History of Motion Pictures**

Motion pictures and television are possible because of two quirks of the human perceptual system: the phi phenomenon and persistence of vision. The phi phenomenon refers to what happens when a person sees one light source go out while another one close to the original is illuminated. To our eyes, it looks like the light moves from one place to another. In persistence of vision, our eyes continue to see an image for a split second after the image has disappeared from view. First observed by the ancient Greeks, persistence of vision became more widely known in 1824 when Peter Roget (who also developed the thesaurus) demonstrated that humans begin to retain an image of an object for about one-tenth of a second after the object is taken from view. Following Roget's pronouncement, a host of toys that depended on this principle sprang up in Europe. Bearing fanciful names (the Thaumatrope, the Praxinoscope), these devices made a series of hand-drawn pictures appear to move.

Before long, several people realized that a series of still photographs on celluloid film could be used instead of hand drawing. In 1878 a colorful Englishman later turned American, Edward Muybridge, attempted to settle a \$25,000 bet over whether the four feet of a galloping horse ever simultaneously left the ground. He arranged a series of 24 cameras alongside a racetrack to photograph a galloping horse. Rapidly viewing the series of pictures produced an effect much like that of a motion picture. Muybridge's technique not only settled the bet (the feet did leave the ground simultaneously at certain instances) but also photography. Instead of 24 cameras taking one picture in rapid order, it was Thomas Edison and his assistant, William Dickson, who finally developed what might have been the first practical motion-picture camera and viewing device. Edison was apparently trying to provide a visual counterpart to his recently invented phonograph. When his early efforts did not work out, he turned the project over to his assistant. Using flexible film, Dickson solved the vexing problem of how to move the film rapidly through the camera by perforating its edge with tiny holes and pulling it along by means of sprockets, projections on a wheel that fit into the holes of the film. In 1889 Dickson had perfected a machine called the Kinetoscope and even starred in a brief film demonstrating how it

worked.

These early efforts in the Edison lab were not directed at projecting movies to large crowds. Still influenced by the success of his phonograph, Edison thought a similar device could make a money by showing brief films to one person at a time for a penny a look. Edison built a special studio to produce films for his new invention, and by 1894, Kinetoscope parlors were spring up in major cities. The long-range commercial potential of his invention was lost on Edison. He reasoned that the real money would be made by selling his peep-show machine. If a large number of people were shown the film at the same time, fewer machines would be needed. Developments in Europe proved Edison wrong as inventors there devised large-screen projection devices. Faced with competition, Edison perfected the Vitascope and unveiled it in New York City in 1896.

Early monies were simple snippets of action—acrobats tumbling, horse running, jugglers juggling, and so on. Eventually, the novelty wore off and films became less of an attraction. Public interest was soon rekindled when early filmmakers discovered that movies could be used to tell story. In France, Alice Guy-Blachè produced *The Cabbage Fairy*, a one-minute film about a fairy who produces children in a Cabbage patch, and exhibited it at the Paris International Exhibition in 1896. Guy-Blachè went on to found her own studio in America. Better known is the work of a fellow French filmmaker and magician, Georges Méliès. In 1902 Méliès produced a science-fiction film that was the great-great-grandfather of *Star Wars* and *Star Trek*; it was called *A Trip to the Moon*.

### **Paragraph1**

Motion pictures and television are possible because of two quirks of the human perceptual system: the phi phenomenon and persistence of vision. The phi phenomenon refers to what happens when a person sees one light sources go out while another one close to the original is illuminated. To our eyes, it looks like the light moves from one place to another. In persistence of vision, our eyes continue to see an image for a spit second after the image has disappeared from view. First observed by the ancient Greeks, persistence of vision became more widely known in 1824 when Peter Roget(who also

developed the thesaurus) demonstrated that human begins retain an image of an object for about one-tenth of a second after the object is taken from view. Following Roget's **pronouncement**, a host of toys that depended on this principle sprang up in Europe. Bearing fanciful manes (the Thaumatrope, the Praxinoscope), these devices made a series of hand-drawn pictures appear to move.

1. According to paragraph 1, what is the phi phenomenon?
  - A. The appearance of movement that occurs when one light is turned off while another lights up nearby
  - B. The tendency to see two lights placed close together as coming from a single light source
  - C. The fact that the human eye sees a light source for a split second after it has disappeared
  - D. The impression that there are several light sources when there is actually only one
2. According to paragraph 1, which of the following statements does NOT correctly describe persistence of vision?
  - A. It was originally noticed by the ancient Greeks
  - B. It refers to an image of an object seen by the human eye for one-tenth of a second after the object has disappeared
  - C. It is a scientific principle that was already widely accepted before Peter Roget demonstrated its validity
  - D. It provided the basis for a number of European toys, including the Thaumatrope and the Praxinoscope
3. The word "**pronouncement**" in the passage is closest in meaning to
  - A. statement
  - B. advice
  - C. theory
  - D. Experiment

## **Paragraph 2**

Before long, several people realized that a series of still photographs on celluloid film could be used instead of hand drawing. In 1878 a colorful Englishman later turned American. Edward Muybridge, attempted to settle a

\$25,000 bet over whether **the four feet of a galloping horse ever simultaneously left the ground**. He arranged a series of 24 cameras alongside a racetrack to photograph a galloping horse. Rapidly viewing the series of pictures produced an effect much like that of a motion picture. Muybridge's technique not only settled the bet (the feet did leave the ground simultaneously at certain instances) but also photography. Instead of 24 cameras taking one picture in rapid order, it was Thomas Edison and his assistant, William Dickson, who finally developed what might have been the first practical motion-picture camera and viewing device. Edison was apparently trying to provide a visual **counterpart** to his recently invented phonograph. When his early efforts did not work out, he turned the project over to his assistant. Using **flexible** film, Dickson solved the vexing problem of how to move the film rapidly through the camera by perforating its edge with tiny holes and pulling it along by means of sprockets, projections on a wheel that fit into the holes of the film. In 1889 Dickson had perfected a machine called the Kinetoscope and even starred in a brief film demonstrating how it worked.

4. In paragraph 2, why does the author mention the bet that Edward Muybridge tried to settle about whether “**the four feet of a galloping horse ever simultaneously left the ground**”?

- A. To introduce and explain a fundamental principle of motion-picture photography
- B. To demonstrate that still photographs produced a visual effect that surpassed that of hand-drawn pictures
- C. To emphasize that photographers had to be willing to take risks in order to portray their subjects
- D. To suggest the difficulty of trying to capture animal movement in motion-picture photography

5. The word “**counterpart**” in the passage is closest in meaning to

- A. addition
- B. invention
- C. component
- D. equivalent

6. The word “**flexible**” in the passage is closest in meaning to

A. connected

B. smooth

C. bendable

D. Delicate

7. According to paragraph 2, how did Muybridge contribute to the development of motion-picture technology?

A. He invented the first motion-picture camera.

B. He demonstrated the technique of taking a series of photographs and viewing them in rapid succession

C. He asked Edison and Dickson to create a motion-picture camera that was both practical and economical

D. He combined hand drawings and still photographs to create movie-like effects

8. Paragraph 2 suggests that Thomas Edison's early efforts to develop a motion-picture camera failed because he could not figure out how to

A. display the camera's pictures to an audience

B. move the film quickly through the camera

C. line the edge of the film with holes that were small enough

D. prevent the film from tearing

### **Paragraph 3**

These early efforts in the Edison lab were not directed at projecting movies to large crowds. Still influenced by the success of his phonograph, Edison thought a similar device could make a money by showing brief films to one person at a time for a penny a look. Edison built a special studio to produce films for his new invention, and by 1894, Kinetoscope parlors were spring up in major cities. The long-range commercial potential of his invention was lost on Edison. He reasoned that the real money would be made by selling his peep-show machine. If a large number of people were shown the film at the same time, fewer machines would be needed. Developments in Europe proved Edison wrong as inventors there devised large-screen projection devices. Faced with competition, Edison perfected the Vitascope and unveiled it in New York City in 1896.

9. According to paragraph 3, what were Kinetoscope parlors?

- A. Places where people could pay a penny to view a short film by looking into a machine
  - B. Places where people could gather in crowds to watch short films projected onto large screens
  - C. Special studios where Edison produced films that would be shown by his newly invented machine
  - D. Places where Edison sold his phonographs, peep-show machines, and other popular inventions
10. Which of the following can be inferred from paragraph 3 about the scope?
- A. It was widely used in Europe before being adopted in the United States
  - B. It never made as much money as the equivalent European projection device
  - C. It was a larger version of the original Kinetoscope
  - D. It was designed to show motion pictures to large groups of people

#### **Paragraph 4**

Early monies were simple snippets of action—acrobats tumbling, horse running, jugglers juggling, and so on. Eventually, the novelty wore off and films became less of an attraction. Public interest was soon **rekindled** when early filmmakers discovered that movies could be used to tell story. In France, Alice Guy-Blachè produced *The Cabbage Fairy*, a one-minute film about a fairy who produces children in a Cabbage patch, and exhibited it at the Paris International Exhibition in 1896. Guy-Blachè went on to found her own studio in America. Better known is the work of a fellow French filmmaker and magician, Georges Méliès. In 1902 Méliès produced a science-fiction film that was the great-great-grandfather of *Star Wars* and *Star Trek*; it was called *A Trip to the Moon*.

11. The word “**rekindled**” in the passage is closest in meaning to
- A. reported
  - B. renewed
  - C. reinforced
  - D. Rewarded
12. In paragraph 4, the author describes the film *The Cabbage Fairy* in order to



- A. argue for the importance of continuous action to keep audiences interested
- B. suggest that early films were more popular than live performances were
- C. provide an example of one of the first films to tell a story
- D. emphasize how relatively short most early movies were

#### **Paragraph 4**

Early movies were simple snippets of action—acrobats tumbling, horse running, jugglers juggling, and so on. Eventually, the novelty wore off and films became less of an attraction. Public interest was soon rekindled when early filmmakers discovered that movies could be used to tell story. ■ In France, Alice Guy-Blaché produced *The Cabbage Fairy*, a one-minute film about a fairy who produces children in a Cabbage patch, and exhibited it at the Paris International Exhibition in 1896. ■ Guy-Blaché went on to found her own studio in America. ■ Better known is the work of a fellow French filmmaker and magician, Georges Méliès. ■ In 1902 Méliès produced a science-fiction film that was the great-great-grandfather of *Star Wars* and *Star Trek*; it was called *A Trip to the Moon*.

13. Look at the four squares [■] that indicate where the following sentence could be added to the passage.

**Although she directed hundreds of short films and produced hundreds more over the course of her career, she has largely been forgotten.**

Where would the sentence best fit?

**14. Directions:** An introductory sentence for a brief summary of the passage is provided below. Complete the summary by selected THREE answer choices that express the most important ideas in the passage. Some sentences do not belong in the summary because they express ideas that are not presented in the passage or are minor ideas in the passage. This question is worth 2 points.  
**The phi phenomenon and persistence of vision are two characteristics of the human perceptual system that make motion pictures and television possible.**

#### **Answer Choices**

- A. When the persistence of vision became widely known, it inspired the

development of toys that made hand-drawn pictures appear to move

- B. The invention of the motion-picture camera led to the discovery that a horse's feet do not leave the ground while the horse is galloping.
- C. The primary competitors in early motion-picture technology were Edison's Kinetoscope and the European-designed and manufactured large-screen projection devices
- D. The motion-picture camera develop from the experiments in sequential photography that were originally done by Edward Muybridge
- E. Later developments in film included a focus on large-screens projection rather than individual viewing machines and narrative films rather than simple action sequences.
- F. French filmmakers Alice Guy-Blachè and Georges started the first two major movie studios in America and in France, respectively.

## **The Origins of Writing**

It was in Egypt and Mesopotamia (modern-day Iraq) that civilization arose, and it is there that we find the earliest examples of that key feature of civilization, writing. These examples, in the form of inscribed clay tablets that date to shortly before 3000 B.C.E, have been discovered among the archaeological remains of the Sumerians, a gifted people settled in southern Mesopotamia.

The Egyptians were not far behind in developing writing, but we cannot follow the history of their writing in detail because they used a perishable writing material. In ancient times the banks of the Nile were lined with papyrus plants, and from the papyrus reeds the Egyptians made a form of paper, it was excellent in quality but, like any paper, fragile. Mesopotamia's rivers boasted no such useful reeds, but its land did provide good clay, and as a consequence the clay tablet became the standard material. Though clumsy and bulky it has a virtue dear to archaeologists, it is durable. Fire, for example, which is death to papyrus paper or other writing materials such as leather and wood, simply bakes it hard, thereby making it even more durable. So when a conqueror set a Mesopotamian palace ablaze, he helped ensure the survival of any clay tablets in it. Clay, moreover, is cheap, and forming it into tablets is easy, factors that helped the clay tablet become the preferred writing material not only throughout Mesopotamia but far outside it as well, in Syria, Asia Minor, Persia, and even for a while in Crete and Greece. Excavators have unearthed clay tablets in all these lands. In the Near East they remained in use for more than two and a half millennia, and in certain areas they lasted down to the beginning of the common era until finally yielding, one and for all, to more convenient alternatives.

The Sumerians perfected a style of writing suited to clay. This script consists of simple shapes, basically just wedge shapes and lines that could easily be incised in soft clay with a reed or wooden stylus; scholars have dubbed it cuneiform from the wedge-shaped marks (*cunei* in Latin) that are its hallmark. Although the ingredients are merely wedges and lines, there are hundreds of combinations of these basic forms that stand for different sounds words. Learning these complex signs required long training and much practice, inevitably was largely limited to a small professional class, the scribes.

The Akkadians conquered the Sumerians around the middle of the third millennium B.C.E, and they took over the various cuneiform signs used for writing Sumerian and gave them sound and word values that fit their own language. The Babylonians and Assyrians did the same, and so did peoples in

Syria and Asia Minor. The literature of the Sumerians was treasured throughout the Near East, and long after Sumerian ceased to be spoken, the Babylonians and Assyrians and others kept it alive as a literary language, the way Europeans kept Latin alive after the fall of Rome. For the scribes of these non-Sumerian languages, training was doubly demanding since they had to know the values of the various cuneiform signs for Sumerian as well as for their own language.

The contents of the earliest clay tablets are simple notations of numbers of commodities--animals, jars, baskets, etc. Writing, it would appear, started as a primitive form of bookkeeping. Its use soon widened to document the multitudinous things and acts that are involved in daily life, from simple inventories of commodities to complicated governmental rules and regulations.

Archaeologists frequently find clay tablets in batches. The batches, some of which contain thousands of tablets, consist for the most part of documents of the types just mentioned: bills, deliveries, receipts, inventories, loans, marriage contracts, divorce settlements, court judgments, and so on. These records of factual matters were kept in storage to be available for reference—they were in effect, files, or to use the term preferred by specialists in the ancient Near East, archives. Now and then these files include pieces of writing that are of a distinctly different order, writings that do not merely record some matter of fact but involve creative intellectual activity. They range from simple textbook material to literature—and they make an appearance very early, even from the third millennium B.C.E

### **Paragraph 1**

It was in Egypt and Mesopotamia (modern-day Iraq) that civilization arose, and it is there that we find the earliest examples of that **key** feature of civilization, writing. These examples, in the form of inscribed clay tablets that date to shortly before 3000 B.C.E, have been discovered among the archaeological remains of the Sumerians, a gifted people settled in southern Mesopotamia.

1. The word “**key**” in the passage is closest in meaning to
  - A. frequent
  - B. essential
  - C. original
  - D. familiar

## Paragraph 2

The Egyptians were not far behind in developing writing, but we cannot follow the history of their writing in detail because they used a perishable writing material. In ancient times the banks of the Nile were lined with papyrus plants, and from the papyrus reeds the Egyptians made a form of paper, it was excellent in quality but, like any paper, fragile. Mesopotamia's rivers boasted no such useful reeds, but its land did provide good clay, and as a consequence the clay tablet became the standard material. Though clumsy and bulky it has a **virtue** dear to archaeologists, it is durable. Fire, for example, which is death to papyrus paper or other writing materials such as leather and wood, simply bakes it hard, thereby making it even more durable. So when a conqueror set a Mesopotamian palace ablaze, he helped ensure the survival of any clay tablets in it. Clay, moreover, is cheap, and forming it into tablets is easy, factors that helped the clay tablet become the preferred writing material not only throughout Mesopotamia but far outside it as well, in Syria, Asia Minor, Persia, and even for a while in Crete and Greece. Excavators have unearthed clay tablets in all these lands. In the Near East they remained in use for more than two and a half millennia, and in certain areas they lasted down to the beginning of the common era until finally yielding, one and for all, to more convenient alternatives.

2. The word "**virtue**" in the passage is closest in meaning to
  - A. price
  - B. design
  - C. desirable quality
  - D. physical characteristic
3. Which of the sentences below best expresses the essential information in the highlighted sentence in the passage? Incorrect choices change the meaning in important ways or leave out essential information.
  - A. In part because of its low cost and ease of use, clay became the preferred writing material throughout Mesopotamia and well beyond it.
  - B. Clay was cheap throughout Mesopotamia, so clay tablets from Mesopotamia became the preferred writing material as far as the Mediterranean.
  - C. For a while, the clay tablets were the preferred writing material in Crete and Greece.
  - D. Moreover, because clay was used as the writing material of choice in Mesopotamia, Syria, Asia Minor, Persia, and the Mediterranean, it was cheap and popular.

4. What can be inferred from paragraph 2 about clay as a writing material?
  - A. It had to be baked before it could be written on.
  - B. Its good points outweighed its bad points.
  - C. Its durability was its most important feature for its users.
  - D. It was not available in Egypt.
5. In paragraph 2, why does the author discuss the Egyptian use of papyrus as a writing material?
  - A. To describe the superiority of papyrus over leather and wood as a writing material
  - B. To explain why writing in Egypt did not develop as quickly as it did Mesopotamia
  - C. To explain why archaeologists' knowledge of the early history of writing relies mainly on Sumerian cuneiform
  - D. To explain why the Sumerians preferred clay tablets for writing over papyrus

### **Paragraph 3**

The Sumerians perfected a style of writing suited to clay. This script consists of simple shapes, basically just wedge shapes and lines that could easily be incised in soft clay with a reed or wooden stylus; scholars have dubbed it cuneiform from the wedge-shaped marks (cunei in Latin) that are its hallmark. Although the ingredients are merely wedges and lines, there are hundreds of combinations of these basic forms that stand for different sounds words. Learning these complex signs required long training and much practice, inevitably was largely limited to a small professional class, the scribes.

6. According to paragraph 3, all of the following are true of cuneiform writing EXCEPT
  - A. It was composed of very simple shapes.
  - B. It was perfected by the ancient Sumerians.
  - C. It influenced the choice of material on which it was written.
  - D. It was understood by very few Sumerians.

### **Paragraph 4**

The Akkadians conquered the Sumerians around the middle of the third millennium B.C.E, and they took over the various cuneiform signs used for writing Sumerian and gave them sound and word values that fit their own language. The Babylonians and Assyrians did the same, and so did peoples in Syria and Asia Minor. The literature of the Sumerians was treasured

throughout the Near East, and long after Sumerian ceased to be spoken, the Babylonians and Assyrians and others kept it alive as a literary language, the way Europeans kept Latin alive after the fall of Rome. For the scribes of these non-Sumerian languages, training was doubly demanding since they had to know the values of the various cuneiform signs for Sumerian as well as for their own language.

7. According to paragraph 4, how did the Akkadians use the Sumerian language?
- A. They used Sumerian for speaking but used their own national language for writing.
  - B. They used the complex cuneiform signs developed by the Babylonians and Assyrians rather than the Sumerian signs.
  - C. They developed their own cuneiform shapes on clay tablets to replace those used by the Sumerians.
  - D. They assigned new sound and word values to the signs of Sumerian cuneiform.
8. Paragraph 4 answer all the following questions about Sumerians writing in the period after the Sumerians were conquered EXCEPT
- A. Did Sumerians literature continue to be read?
  - B. Did Sumerians continue to be spoken?
  - C. Did scribes compose new texts in Sumerians?
  - D. Did Sumerians have the same fate as Latin had after the fall of Rome?

### **Paragraph 5**

The contents of the earliest clay tablets are simple notations of numbers of commodities--animals, jars, baskets, etc. Writing, it would appear, started as a primitive form of bookkeeping. Its use soon widened to **document** the multitudinous things and acts that are involved in daily life, from simple inventories of commodities to complicated governmental rules and regulations.

9. The word “**document**” in the passage is closest in meaning to
- A. include
  - B. influence
  - C. organize
  - D. record
10. According to paragraph 5, writing was first used for
- A. simple bookkeeping
  - B. description of daily events

- C. counting the contents of clay tablets
- D. government reports

### Paragraph 6

Archaeologists frequently find clay tablets in batches. The batches, some of which contain thousands of tablets, consist for the most part of documents of the types just mentioned: bills, deliveries, receipts, inventories, loans, marriage contracts, divorce settlements, court judgments, and so on. These records of factual matters were kept in storage to be available for reference—they were in effect, files, or to use the term preferred by specialists in the ancient Near East, archives. **Now and then** these files include pieces of writing that are of a distinctly different order, writings that do not merely record some matter of fact but involve creative intellectual activity. They range from simple textbook material to literature-and they make an appearance very early, even from the third millennium B.C.E

- 11. The phrase “**Now and then**” in the passage is closest in meaning to
  - A. always
  - B. occasionally
  - C. sooner or later
  - D. first and last
- 12. According to paragraph 6, large batches of clay writing tablets were stored because the tablets
  - A. were being produced quickly and in large quantities
  - B. did not serve any practical purpose for most Mesopotamians
  - C. contained information that needed to be available for future reference
  - D. could not be used again once they had been written on

### Paragraph 4

The Akkadians conquered the Sumerians around the middle of the third millennium B.C.E, and they took over the various cuneiform signs used for writing Sumerian and gave them sound and word values that fit their own language. ■The Babylonians and Assyrians did the same, and so did peoples in Syria and Asia Minor. ■The literature of the Sumerians was treasured throughout the Near East, and long after Sumerian ceased to be spoken, the Babylonians and Assyrians and others kept it alive as a literary language, the way Europeans kept Latin alive after the fall of Rome. ■For the scribes of these non-Sumerian languages, training was doubly demanding since they had to know the values of the various cuneiform signs for Sumerian as well as for



their own language. ■

13. Look at the four squares [■] that indicate where the following sentence could be added to the passage.

**However, the Sumerian language did not entirely disappear.**

Where would the sentence best fit?

14. **Directions:** An introductory sentence for a brief summary of the passage is provided below. Complete the summary by selecting the THREE answer choices that express the most important ideas in the passage. Some sentences do not belong in the summary because they express ideas that are not presented in the passage or are minor ideas in the passage. This question is worth 2 points.

**The earliest example of writing has been found in Mesopotamia and date to shortly before 3000 B.C.E**

#### **Answer Choices**

- A. Writing was developed first by the Sumerians using wedge-shaped marks (cuneiform) on clay tablets and then by the Egyptians using papyrus paper.
- B. Scribes using cuneiform in Assyria, Babylon, Syria and Asia Minor had to learn all the language that used the cuneiform script.
- C. Batches of clay tablets, sometimes with as many as a thousand tablets each, are often found by archaeologists.
- D. Writing was invented in the same areas in which civilization began by the ancient civilizations of Mesopotamia, Asia Minor and the Mediterranean.
- E. The development of cuneiform is known because it was written on a long-lasting and because it was long and widely used throughout the ancient Near East
- F. Cuneiform tablets generally dealt with business and factual matters, but other topics, including literature, were also recorded and valued

## **Soil Fertilization**

Fertilizers partially restore plant nutrients lost by erosion, crop harvesting and leaching. Farmers can use either organic fertilizer from plant and animal materials or commercial inorganic fertilizer produced from various minerals. Three basic types of organic fertilizer are animal manure, green manure, and compost. Animal manure includes the waste matter of cattle, horses, poultry, and other farm animals. It improves soil structure, adds organic, nitrogen, and stimulates beneficial soil bacteria and fungi.

Despite its effectiveness, the use of animal manure in the United States has decreased. There are three reasons for this: the replacement of most mixed animal-raising and crop-farming operations with separate operations for growing crops and raising animals; the high costs of transporting animal manure from feedlots near urban areas to distant rural crop-growing areas; and the replacement of horses and other draft animal that added manure to the soil with tractors and other motorized farm machinery.

Green manure is fresh or growing green vegetation plowed into the soil to increase the organic matter and humus (degraded organic matter) available to the next crop. Compost is a sweet smelling, dark-brown, humuslike material that is rich in organic matter and soil nutrients. It is produced when microorganisms in soil (mostly fungi and aerobic bacteria) break down organic matter such as leaves, food wasters, paper, and wood in the presence of oxygen. Compost is a rich natural fertilizer and soil conditioner that aerates soil, improves its ability to retain water and nutrients, helps prevent erosion, and prevents nutrients from being wasted by being dumped in landfills. Compost is produced by piling up alternating layers of nitrogen-rich wastes (such as grass clippings, weeds, animal manure, and vegetable kitchen scraps), carbon-rich plant wastes (dead leaves, hay, straw, sawdust), and topsoil. Compost provides a home for microorganisms that help decompose plant and manure layers and reduces the amount of plant wastes taken to landfills and incinerators.

Another form of organic fertilizer is the spores of mushrooms, puffballs, and truffles. Rapidly growing and spreading mycorrhizae fungi in the spores attach to plant roots and help them take in moisture and nutrients from the soil. Unlike typical fertilizers that must be applied every few weeks, one application of mushroom fungi lasts all year and costs just pennies per plant. The fungi also produce a bigger root system, which makes plants more disease resistant.

Corn, tobacco, and cotton can deplete the topsoil of nutrients, especially nitrogen, if planted on the same land several years in a row. One way to reduce such losses is crop rotation. Farmers plant areas or strips with nutrient-depleting crops one year. In the next year they plant the same areas with legumes, whose root nodules and nitrogen to the soil. In addition to helping restore soil nutrients, this method reduces erosion by keeping the soil covered with vegetation and helps reduce crop losses to insects by presenting them with a changing target.

Today, many farmers rely on commercial inorganic fertilizers containing nitrogen (as ammonium ions, nitrate ions, or urea), phosphorus (as phosphate ions), and potassium (as potassium ions). Inorganic commercial fertilizers are easily transported, stored, and applied. Worldwide, their use increased about tenfold between 1950 and 1989 but declined by 12% between 1990 and 1999. Today, the additional food they help produce feeds one of every three people in the world; without them, world food output would drop an estimated 40%.

Commercial inorganic fertilizers have some disadvantages, however. These include (1) not adding humus to the soil. (2) reducing the soil's content of organic matter and thus its ability to hold water (unless animal manure and green manure are also added to the soil), (3) lowering the oxygen content of soil and keeping fertilizer from being taken up as efficiently, (4) typically supplying only two or three of the twenty or so nutrients needed by plants, and (5) releasing nitrous oxide, a greenhouse gas that can enhance global warming. The widespread use of commercial inorganic fertilizers, especially on sloped land near streams and lakes, also causes water pollution as nitrate and phosphate fertilizer nutrients are washed into nearby bodies of water. The resulting plant nutrient enrichment causes algae blooms that use up oxygen dissolved in the water, thereby killing fish.

### Paragraph1

Fertilizers partially restore plant nutrients lost by erosion, crop harvesting and leaching. Farmers can use either organic fertilizer from plant and animal materials or commercial inorganic fertilizer produced from various minerals. Three basic types of organic fertilizer are animal manure, green manure, and compost. Animal manure includes the waste matter of cattle, horses, poultry, and other farm animals. It improves soil structure, adds organic, nitrogen, and stimulates **beneficial** soil bacteria and fungi.

1. The word “**beneficial**” in the passage is closest in meaning to  
A. necessary

- B. helpful
- C. several
- D. hidden

### **Paragraph 2**

Despite its effectiveness, the use of animal manure in the United States has decreased. There are three reasons for this: the replacement of most mixed animal-raising and crop-farming operations with separate operations for growing crops and raising animals; the high costs of transporting animal manure from feedlots near urban areas to distant rural crop-growing areas; and the replacement of horses and other draft animal that added manure to the soil with tractors and other motorized farm machinery.

2. According to paragraph 2, all of the following contributed to the decrease in the use of animal manure in the United States EXCEPT
- A. changes in crop-farming and animal-raising operations
  - B. high transportation costs
  - C. the movement of large numbers of feedlots to distant rural areas
  - D. the introduction of motorized farm machinery

### **Paragraph 3**

Green manure is fresh or growing green vegetation plowed into the soil to increase the organic matter and humus (degraded organic matter) available to the next crop. Compost is a sweet smelling, dark-brown, humuslike material that is rich in organic matter and soil nutrients. It is produced when microorganisms in soil (mostly fungi and aerobic bacteria) break down organic matter such as leaves, food wasters, paper, and wood in the presence of oxygen. Compost is a rich natural fertilizer and soil conditioner that aerates soil, improves its ability to retain water and nutrients, helps prevent erosion, and prevents nutrients from being wasted by being dumped in landfills. Compost is produced by pilling up alternating layers of nitrogen-rich wastes (such as grass clippings, weeds, animal manure, and vegetable kitchen scraps), carbon-rich plant wastes (dead leaves, hay, straw, sawdust), and topsoil. Compost provides a home for microorganisms that help decompose plant and manure layers and reduces the amount of plant wastes taken to landfills and incinerators.

3. According to paragraph 3, what is one advantage of using compost in raising crops?
- A. It makes the soil easier to plow in preparation for planting

- B. Water and nutrients stay in the soil and enable plant growth
  - C. The damage to soil from microorganisms is reduced
  - D. Excess oxygen is removed from the soil
4. According to paragraph 3, one important physical effect of compost is that it
- A. adds an oxygen-rich layer to the layers rich in nitrogen and carbon
  - B. decreases the quality of plant material that needs to be discarded
  - C. helps keep the same amount of moisture in each layer of soil
  - D. reduces the amount of fungi and aerobic bacteria in the pile

#### **Paragraph 4**

Another form of organic fertilizer is the spores of mushrooms, puffballs, and truffles. Rapidly growing and spreading mycorrhizae fungi in the spores attach to plant roots and help them take in moisture and nutrients from the soil. Unlike typical fertilizers that must be applied every few weeks, one application of mushroom fungi lasts all year and costs just pennies per plant. The fungi also produce a bigger root system, which makes plants more disease resistant.

5. According to paragraph 4, each of the following is an advantage of using mushroom spores as fertilizer EXCEPT
- A. The cost of using mushroom spores is relatively low.
  - B. A single application of mushroom is enough for a whole year
  - C. Mushroom fungi are nutrients that plants can take in easily
  - D. Mushroom fungi help protect plants from disease

#### **Paragraph 5**

Corn, tobacco, and cotton can deplete the topsoil of nutrients, especially nitrogen, if planted on the same land several years in a row. One way to reduce such losses is crop rotation. Farmers plant areas or strips with nutrient-depleting crops one year. In the next year they plant the same areas with legumes, whose root nodules and nitrogen to the soil. In addition to helping restore soil nutrients, this method reduces erosion by keeping the soil covered with vegetation and helps reduce crop losses to insects by presenting them with a changing **target**.

6. What is the “**target**” referred to in the passage?
- A. Crops losses that are caused by insects
  - B. The crop being grown at any given time
  - C. The areas that are planted with legumes

- D. The various insects that cause crop losses
- 7. According to paragraph 5, one of the main reasons for using legumes in crop rotation is that legumes
  - A. have no serious insect pests
  - B. cover the soil more completely than any other crop does
  - C. build up the nitrogen content of the soil
  - D. are very easy to plant strips

### Paragraph 6

Today, many farmers **rely** on commercial inorganic fertilizers containing nitrogen (as ammonium ions, nitrate ions, or urea), phosphorus (as phosphate ions), and potassium (as potassium ions). Inorganic commercial fertilizers are easily transported, stored, and applied. Worldwide, their use increased about tenfold between 1950 and 1989 but declined by 12% between 1990 and 1999. Today, the additional food they help produce feeds one of every three people in the world; without them, world food output would drop an estimated 40%.

### Paragraph 7

Commercial inorganic fertilizers have some disadvantages, however. These include (1) not adding humus to the soil. (2) reducing the soil's content of organic matter and thus its ability to hold water (unless animal manure and green manure are also added to the soil), (3) lowering the oxygen content of soil and keeping fertilizer from being taken up as efficiently, (4) typically supplying only two or three of the twenty or so nutrients needed by plants, and (5) releasing nitrous oxide, a greenhouse gas that can enhance global warming. The widespread use of commercial inorganic fertilizers, especially on sloped land near streams and lakes, also causes water pollution as nitrate and phosphate fertilizer nutrients are washed into nearby bodies of water. The resulting plant nutrient enrichment causes algae blooms that use up oxygen dissolved in the water, thereby killing fish.

- 8. The word "**rely**" in the passage is closest in meaning to
  - A. Save
  - B. Depend
  - C. Pile
  - D. Waste money
- 9. According to paragraph 6, what is true about the quantities of commercial inorganic fertilizers used globally?

- A. They are likely to drop by about 40% in the next ten years.
- B. They have increased at a steady rate since 1950.
- C. They increased during in the 1990s, but at a slower rate than over the previous 40 years.
- D. They dropped during in the 1990s after having risen sharply over the previous 40 years.

### Paragraph 7

Commercial inorganic fertilizers have some disadvantages, however. These include (1) not adding humus to the soil. (2) reducing the soil's content of organic matter and thus its ability to hold water (unless animal manure and green manure are also added to the soil), (3) lowering the oxygen content of soil and keeping fertilizer from being taken up as efficiently, (4) typically supplying only two or three of the **twenty or so** nutrients needed by plants, and (5) releasing nitrous oxide, a greenhouse gas that can enhance global warming. **The widespread use of commercial inorganic fertilizers, especially on sloped land near streams and lakes, also causes water pollution as nitrate and phosphate fertilizer nutrients are washed into nearby bodies of water.** The resulting plant nutrient enrichment causes algae blooms that use up oxygen dissolved in the water, thereby killing fish.

10. How is paragraph 7 related to paragraph 6?

- A. Paragraph 7 presents the drawbacks of practice that paragraph 6 presents as an advantage.
- B. Paragraph 7 argues that the viewpoint presented in paragraph 6 is based on several factual errors.
- C. Paragraph 7 provides supporting evidence for some of the claims made in paragraph 6.
- D. Paragraph 7 contrasts recently developed practices with the more traditional established ones discussed in Paragraph 6.

11. The phrase "**twenty or so**" in the passage is closest in meaning to

- A. not quite twenty
- B. roughly twenty
- C. no more than twenty
- D. a total of twenty

12. Which of the sentences below best expresses the essential information in the highlighted sentence in the passage? Incorrect choices change the meaning in important ways or leave out essential information.

- A. The main cause of water pollution is the wide spread use of commercial

inorganic fertilizers on sloped land near streams and lakes

- B. In addition, the widespread use of commercial inorganic fertilizers causes Water Pollution when nitrates and phosphates are washed into streams and lakes
- C. Also, the widespread commercial production of inorganic fertilizer has caused water pollution in bodies of water such as streams and lakes
- D. The most commonly used commercial inorganic fertilizer are nitrate and phosphate fertilizers, which cause water pollution if they enter streams and lakes

### Paragraph 1

Fertilizers partially restore plant nutrients lost by erosion, crop harvesting and leaching. ■Farmers can use either organic fertilizer from plant and animal materials or commercial inorganic fertilizer produced from various minerals. ■Three basic types of organic fertilizer are animal manure, green manure, and compost. ■Animal manure includes the waste matter of cattle, horses, poultry, and other farm animals. ■It improves soil structure, adds organic, nitrogen, and stimulates beneficial soil bacteria and fungi.

13. Look at the four squares [■] that indicate where the following sentence could be added to the passage.

**Thus, they help keep farmland productive over the long term.**

Where would the sentence best fit?

14. **Directions:** An introductory sentence for a brief summary of the passage is provided below. Complete the summary by selecting the THREE answer choices that express the most important ideas in the passage. Some sentences do not belong in the summary because they express ideas that are not presented in the passage or are minor ideas in the passage. This question is worth 2 points.

**Both organic and inorganic fertilizers are used to keep croplands productive.**

### Answer choices

- A. Animal manures are effective organic fertilizers, but their use in the United States has decreased because of changes in modern farming.
- B. Many economically important crops, including corn, tobacco, and cotton, can only be grown in the same fields year after year if large amount of inorganic fertilizers are added to the soil



- C. Since 1950, farmers worldwide have begun to replace organic fertilizers with inorganic commercial ones, because the latter helps soil to retain oxygen
- D. Compost, a humuslike material that is rich in organic material, is often used together with green manure, since the combination of the two helps to prevent soil erosion
- E. Green manures, compost, mushroom spores, and crop rotation, if used correctly, all have positive impacts on growing conditions for crops that go beyond simply providing nutrients
- F. Commercial inorganic fertilizers play a key role in feeding the world's population but they can also cause serious environmental damage

## **The Collapse of the Maya**

The Mayan society of Central America (2000 B.C-A.D 1500), like other ancient states, was characterized by populations unprecedented both in their size and density. It was not just the number of people that lived in the Mayan city-states but also the relatively small area into which they were concentrated. To support such populations, societies developed various intensive agricultural including large-scale irrigation and hill-slope (the cutting of horizontal ridges into hillsides so they can be farmed). These were designed both to increase yields from a given area and to increase the absolute amount of land under cultivation. These strategies were in essence very successful: they made it possible to feed larger populations than ever before and supported the growth of cities. But they also placed considerable strains on the environment and rendered it increasingly fragile and vulnerable to unexpected climatic events, and even to short-term fluctuations. Thus, the argument is that because of their size and ever more intensive agriculture, the Mayan and other ancient state societies were fundamentally unsustainable.

Claims about environment degradation and disaster have figured prominently in discussion of the collapse of the Mayan city-states of the Central American lowlands. When two explorers came upon the Mayan cities in the 1830s, they were struck by the sight of tall pyramids and elaborately carved stones among luxuriant forest growth. Here was the archetypal picture of a great lost civilization: abandoned cities submerged in vegetation. Theories of catastrophic collapse or apocalyptic overthrow came naturally to mind to explain these dramatic scenes.

Recent studies of the Mayan collapse (beginning around A.D 900) have emphasized the gradual and progressive nature of the process, beginning in the earliest in the South and advancing northward. It was not a single, sudden event, as had once been thought. Warfare and social unrest are thought to have played a part, but these may well have arisen through pressure from other causes. The Mayan cities had, after all, flourished for over 500 years and had frequently been at war with each other.

But what about the possibility of food shortages? These could have come about through either natural or humanly induced changes in the environment. Increasingly fierce competition between Mayan cities led to an upsurge of monument construction during the eighth and ninth centuries A.D, which would have placed added strain on agricultural production and expansion. Interstate rivalry may hence have pushed the Maya toward overexploitation of their fragile ecosystem. Deforestation and soil erosion might ultimately have

destroyed the capacity of the land to support the high population levels of the Mayan cities, leading to famine, social unrest, and the collapse of the major Mayan centers.

Yet it may be incorrect to lay the blame entirely on human action. Several of the lowland cities, such as Tikal, appear to have depended heavily on the cultivation of raised fields set in the marshy depressions known as bajos, which today flood intermittently in the rainy season but may originally have been permanent lakes. The raise-field system of intensive cultivation (created by digging surrounding canals and using the soil removed to elevate the fields for planting) allows year-round food production through the constant supply of soil nutrients that erode into the drainage ditches dug around the raised fields, nutrients that are then collected and replaced. Stable water levels were essential to this subsistence system, but evidence from Lake Chichancanab in Yucatan shows that between A.D 800 and A.D 1000 this region suffered its driest period of climate in several thousand years. We may expect that as a result water level fell, and the raised fields in many areas became unusable. But the human response must be viewed through the lens of the social, political, and cultural circumstances. These exerted a powerful mediating effect on the way the Maya endeavored to cope with their difficulties. Had population levels been lower, the impact of the drought may not have been catastrophic, as it was, the Maya were already reaching the limits of the available subsistence capacity, and Mayan elites had espoused certain social and political agendas (including expensive warfare and competition with each other). It was against this specific background that a period of drought led quickly to crisis and collapse.

### **Paragraph 1**

The Mayan society of Central America (2000 B.C-A.D 1500), like other ancient states, was characterized by populations unprecedented both in their size and density. It was not just the number of people that lived in the Mayan city-states but also the relatively small area into which they were concentrated. To support such populations, societies developed various intensive agricultural including large-scale irrigation and hill-slope (the cutting of horizontal ridges into hillsides so they can be farmed). These were designed both to increase yields from a given area and to increase the absolute amount of land under cultivation. These strategies were in essence very successful: they made it possible to feed larger populations than ever before and supported the growth of cities. But they also placed considerable strains on the

environment and rendered it increasingly fragile and vulnerable to unexpected climatic events, and even to short-term fluctuations. Thus, the argument is that because of their size and ever more intensive agriculture, the Mayan and other ancient state societies were fundamentally unsustainable.

1. According to paragraph 1, ancient societies increased their agricultural output by
  - A. increasing the percentage of the population that worked as farmers
  - B. creating large irrigation systems
  - C. being highly selective of the fields they would farm
  - D. moving more people into the city to free up farmland
2. Which of the following can be inferred from paragraph 1 about the intensive agricultural methods of the Maya?
  - A. They helped the Maya overcome short-term fluctuations in the climate.
  - B. They could not supply all of the food required for the growth of Mayan cities.
  - C. They strained the environment more than the Maya's previous farming techniques did.
  - D. They were invented by the Maya to help them grow new kinds of crops.

## **Paragraph 2**

Claims about environment degradation and disaster have figured prominently in discussion of the collapse of the Mayan city-states of the Central American lowlands. When two explorers came upon the Mayan cities in the 1830s, they were struck by the sight of tall pyramids and **elaborately** carved stones among luxuriant forest growth. Here was the archetypal picture of a great lost civilization: **abandoned** cities submerged in vegetation. Theories of catastrophic collapse or apocalyptic overthrow came naturally to mind to explain these dramatic scenes.

3. The word "**elaborately**" in the passage is closest in meaning to
  - A. with great detail
  - B. artistically
  - C. mysteriously
  - D. gently hand-made
4. The word "**abandoned**" in the passage is closest in meaning to
  - A. carefully hidden
  - B. destroyed
  - C. enormous
  - D. no longer occupied

5. In paragraph 2, the author implies which of the following about the collapse of the Mayan city-states?
- A. The fact that vegetation had grown over the ruins of Mayan buildings indicates that environmental degradation did not contribute to the Mayan collapse.
  - B. Early explorers supposed that there was a catastrophic collapse of the Mayan city states largely because this view fit their preconceived ideas about lost civilizations.
  - C. The condition of the tall pyramids and carved stones discovered by early explorers proves that Mayan city-states were violently overthrown.
  - D. The Mayan cities were abandoned because they became submerged in vegetation

### Paragraph 3

Recent studies of the Mayan collapse (beginning around A.D 900) have emphasized the gradual and progressive nature of the process, beginning in the earliest in the South and advancing northward. It was not a single, sudden event, as had once been thought. Warfare and social unrest are thought to have played a part, but these may well have arisen through pressure from other causes. The Mayan cities had, after all, **flourished for over 500 years and had frequently been at war with each other.**

6. Why does the author include the information that Mayan cities had “flourished for over 500 years and had frequently been at war with each other”?
- A. To identify a possible reason for the eventual collapse of Mayan society
  - B. To make the point that war and social unrest alone do not account for the Mayan collapse
  - C. To explain why recent studies argue that human actions were responsible for the Mayan collapse
  - D. To provide evidence that frequent wars weakened Mayan society only very gradually
7. According to paragraph 3, recent studies claim which of the following about the Mayan collapse?
- A. It was caused primarily by frequent wars between rival city-states.
  - B. It was caused by a single sudden event.
  - C. It was preceded by social unrest in northern city-states.
  - D. It began in southern city-states and spread to others.

#### Paragraph 4

But what about the possibility of food shortage? These could have come about through either natural or humanly induced changes in the environment. Increasingly fierce competition between Mayan cities led to an upsurge of monument construction during the eighth and ninth centuries A.D, which would have placed added strain on agricultural production and expansion. Interstate rivalry may hence have pushed the Maya toward overexploitation of their fragile ecosystem. Deforestation and soil erosion might ultimately have destroyed the capacity of the land to support the high population levels of the Mayan cities, leading to famine, social unrest, and the collapse of the major Mayan centers.

8. All of the following are mentioned in paragraph 4 as possible direct or indirect caused of food shortages EXCEPT
- A. increased monument construction
  - B. rivalries between states
  - C. deforestation and erosion
  - D. introduction of new crops

#### Paragraph 5

Yet it may be incorrect to lay the blame **entirely** on human action. Several of the lowland cities, such as Tikal, appear to have depended heavily on the cultivation of raised fields set in the marshy depressions known as bajos, which today flood **intermittently** in the rainy season but may originally have been permanent lakes. The raise-field system of intensive cultivation (created by digging surrounding canals and using the soil removed to elevate the fields for planting) allows year-round food production through the constant supply of soil nutrients that erode into the drainage ditches dug around the raised fields, nutrients that are then collected and replaced. Stable water levels were essential to this subsistence system, but evidence from Lake Chichancanab in Yucatan shows that between A.D 800 and A.D 1000 this region suffered its driest period of climate in several thousand years. We may expect that as a result water level fell, and the raised fields in many areas became unusable. But the human response must be viewed through the lens of the social, political, and cultural circumstances. These exerted a powerful mediating effect on the way the Maya endeavored to cope with their difficulties. Had population levels been lower, the impact of the drought may not have been catastrophic, as it was, the Maya were already reaching the limits of the available subsistence capacity, and Mayan elites had espoused

certain social and political agendas (including expensive warfare and competition with each other).It was against this specific background that a period of drought led quickly to crisis and collapse.

9. The word “**entirely**” in the passage is closet in meaning to
- A. generally
  - B. clearly
  - C. completely
  - D. specifically
10. The word “**intermittently**” in the passage is closet in meaning to
- A. constantly
  - B. periodically
  - C. usually
  - D. especially
11. According to paragraph 5, why did the raised fields in many areas become unusable?
- A. The marshy depressions around the fields flooded in the rainy season
  - B. Intensive cultivation of the fields drained the soil of nutrients.
  - C. The area where the fields were located experienced a drop in water levels.
  - D. Unstable design caused the failure of the drainage ditches.
12. According to paragraph 5, all of the following made it more difficult for the Maya to cope with effects of the drought EXCEPT
- A. failure to properly cultivate the fields
  - B. high population levels
  - C. competition between Mayan groups
  - D. warfare

### **Paragraph 5**

Yet it may be incorrect to lay the blame entirely on human action. ■Several of the lowland cities, such as Tikal, appear to have depended heavily on the cultivation of raised fields set in the marshy depressions known as bajos, which today flood intermittently in the rainy season but may originally have been permanent lakes. ■The raise-field system of intensive cultivation (created by digging surrounding canals and using the soil removed to elevate the fields for planting) allows year-round food production through the constant supply of soil nutrients that erode into the drainage ditches dug around the raised fields, nutrients that are then collected and replaced. ■Stable water levels were essential to this subsistence system, but evidence from Lake Chichancanab in Yucatan shows that between A.D 800 and A.D

1000 this region suffered its driest period of climate in several thousand years.

■ We may expect that as a result water level fell, and the raised fields in many areas became unusable. But the human response must be viewed through the lens of the social, political, and cultural circumstances. These exerted a powerful mediating effect on the way the Maya endeavored to cope with their difficulties. Had population levels been lower, the impact of the drought may not have been catastrophic, as it was, the Maya were already reaching the limits of the available subsistence capacity, and Mayan elites had espoused certain social and political agendas (including expensive warfare and competition with each other). It was against this specific background that a period of drought led quickly to crisis and collapse.

13. Look at the four squares [■] that indicate where the following sentence could be added to the passage.

**Nature apparently also contributed to the food shortages.**

Where would the sentence best fit?

14. **Directions:** An introductory sentence for a brief summary of the passage is provided below. Complete the summary by selecting the THREE answer choices that express the most important ideas in the passage. Some sentences do not belong in the summary because they express ideas that are not presented in the passage or are minor ideas in the passage. This question is worth 2 points.

**Since the discovery of the Mayan ruins in the 1830s, researchers have tried to explain the collapse of Mayan civilization.**

#### **Answer choices**

- A. The Mayan attempt to develop intensive agricultural methods to support large populations in relatively small areas probably was unsuccessful and could have caused the Mayan collapse.
- B. The discovery of intact pyramids submerged in vegetation among the Mayan ruins led researchers to believe that Mayan cities were simply overgrown rather than catastrophically destroyed.
- C. Warfare and rivalry between Mayan states may have caused food shortages that contributed to the eventual collapse of Mayan civilization.
- D. Early theories that the Mayan collapse was a sudden, catastrophic event were followed by views that treated the collapse as a gradual process.
- E. The continuing warfare and social unrest that started in the North and spread to the South provided researchers with evidence that the Mayan



collapse took hundreds of years to occur.

- F. Drought between A. D. 800 and A. D. 1000 likely caused the Mayan system of intensive irrigated agriculture to fall, which could have brought about a rapid collapse of the Mayan states.

## **Urban Development in the United States in the 19th Century**

In discussing the growth of cities in the United States in the nineteenth century, one cannot really use the term “urban planning,” as it suggests modern concerns for spatial and service organization which, in most instances, did not exist before the planning revolution called the City Beautiful Movement that began in the 1890s. While there certainly were urban areas that were “planned” in the comprehensive contemporary sense of the word before that date, most notably Washington, D.C., these were the exception. Most “planning” in the nineteenth century was limited to areas much smaller than a city and was closely associated with developers trying to make a profit from a piece of land. Even when these small-scale plans were well designed, the developers made only those improvements that were absolutely necessary to attract the wealthy segment of the market. Indeed, it was the absence of true urban planning that allowed other factors to play such an important role in shaping the nineteenth century American city.

Three forces particularly affected the configuration of urban and suburban areas in the nineteenth century: economics, transportation technology, and demographics. Added to these was the characteristic American preference both for independent living, usually associated with having an individual, free-standing home for one’s family, and for rural living. Economics affected urbanization in two ways. First, economic considerations influenced location decisions for business and industry, which often preempted choice sites. Second, industrial growth generated higher incomes for large segments of the population, which in turn provided more money for larger homes and commuter transportation. Related to economics (since costs to individuals always played a role) were improvements in transportation, from the first horse-drawn buses of the 1820s to electrified street railways at the end of the century. Each transport innovation extended the distance that a person could reasonably travel as a commuter or shopper, while constant system improvements and increased ridership lessened costs.

Demographic patterns also affected urbanization in two ways: first, urban populations grew steadily throughout the century due to immigration from rural areas, principally by those seeking factory work, and emigration from abroad. Therefore cities expanded as new housing had to be provided. Secondly, at the same time that new residents were surging into cities, many urbanites, particularly those of the middle classes, began to leave. While a preference for rural living explained part of this exodus, it was also due to the

perception that various urban problems were becoming worse.

Many nineteenth-century urban problems were those that continue to plague cities today—crime, pollution, noise—but others were the direct result of lack of planning and regulation, such as threat of fire, poor sanitation, and shoddy building construction. Fire was a significant problem in urban areas of North America from the time of the first European settlement. Construction with combustible materials coupled with close placement of buildings and the use of open flames in heating, cooking, and lighting meant that the potential for raging fires was ever present. Lack of sanitation, and the ensuing public health problems it created, was a more constant, if less dramatic, urban issue. It was not until the 1860s that any serious, concerted effort was made to develop proper systems for water delivery and sewage removal. In spite of remarkable strides made in the 1870s and 1880s by the newly established profession of sanitary engineering, the common nineteenth-century pattern of individual unprofessionally planned and installed cesspools (underground tanks for holding household sewage) continued. This led to water contamination and the spread of disease by rodents and insects.

Problems of the fire and poor sanitation were inextricably linked with the last major urban problem of the nineteenth century—lack of coordination in the physical expansion of cities and their infrastructure systems (systems for providing services such as water, gas, electricity, and sewage). Typically, development was both unplanned and unrestricted, with landowners making all choices of lot size, services, and street arrangement based only on their individual needs in the marketplace. Distortions of streets and abrupt changes in the distance of houses from the street in urban areas, which so clearly delineate where one development ended and another began, were just the most obvious problems that this lack of coordination created.

### **Paragraph 1**

In discussing the growth of cities in the United States in the nineteenth century, one cannot really use the term “urban planning,” as it suggests modern concerns for spatial and service organization which, in most instances, did not exist before the planning revolution called the City Beautiful Movement that began in the 1890s. While there certainly were urban areas that were “planned” in the comprehensive contemporary sense of the word before that date, most notably Washington, D.C. , these were the exception. Most “planning” in the nineteenth century was limited to areas much smaller than a city and was closely associated with developers trying to make a profit

from a piece of land. Even when these small-scale plans were well designed, the developers made only those improvements that were absolutely necessary to attract the wealthy segment of the market. Indeed, it was the absence of true urban planning that allowed other factors to play such an important role in shaping the nineteenth century American city.

1. Which of the sentences below best expresses the essential information in the highlighted sentence in the passage? Incorrect choices change the meaning in important ways or leave out essential information
  - A. Understanding the growth of cities in nineteenth-century America requires recognizing how the City Beautiful Movement of the 1890s changed “urban planning.”
  - B. For the most part, there was no “urban planning”, as that term is understood today, before the beginning of the City Beautiful Movement in the 1890s.
  - C. Concerns for spatial and service organization had little impact on the growth of cities before the 1890s when the City Beautiful Movement began.
  - D. The growth of cities in nineteenth-century America resulted in the creation of the City Beautiful Movement in the 1890s and the rise of the term “urban planning.”
2. According to paragraph 1, Washington. D.C. was
  - A. a typical nineteenth-century American city
  - B. a city that was planned in separate sections by land developers
  - C. the very first city in America to be described as “planned”
  - D. one of the few cases of true urban planning in America before the 1890s
3. Select the TWO answer choices that, according to paragraph 1, best describe most urban plans in the nineteenth century. To receive credit, you must select TWO answers.
  - A. They were created to profit land developers.
  - B. They typically affected only part of a city rather than the whole city.
  - C. Their success sometimes directly led to other necessary improvements in cities.
  - D. They were carefully reviewed by city governments.

## **Paragraph 2**

Three forces particularly affected the configuration of urban and suburban areas in the nineteenth century: economics, transportation technology, and demographics. Added to these was the characteristic American preference both for independent living, usually associated with having an individual,

free-standing home for one's family, and for rural living. Economics affected urbanization in two ways. First, economic considerations influenced location decisions for business and industry, which often preempted choice sites. Second, industrial growth generated higher incomes for large segments of the population, which in turn provided more money for larger homes and commuter transportation. Related to economics (since costs to individuals always played a role) were improvements in transportation, from the first horse-drawn buses of the 1820s to electrified street railways at the end of the century. Each transport innovation extended the distance that a person could reasonably travel as a commuter or shopper, while constant system improvements and increased ridership lessened costs.

4. In paragraph 2, the author mentions the characteristic American preference both for independent living and for rural living to
- A. identify one of the factors that affected the configuration of urban and suburban areas in America in the nineteenth century
  - B. explain which of the three forces mentioned ---economics, transportation technology, and demographics---was the most important in shaping American cities and suburbs.
  - C. explain how decisions were made in American nineteenth-century cities and suburbs about locations for businesses and factories.
  - D. provide evidence showing that industrial growth was able to generate higher incomes for much of the population in nineteenth-century cities and suburbs in America.

### Paragraph 3

Demographic patterns also affected urbanization in two ways: first, urban populations grew **steadily** throughout the century due to immigration from rural areas, principally by those seeking factory work, and emigration from abroad. Therefore cities expanded as new housing had to be provided. Secondly, at the same time that new residents were surging into cities, many urbanites, particularly those of the middle classes, began to leave. While a preference for rural living explained part of this exodus, it was also due to the perception that various urban problems were becoming worse.

5. The word "**steadily**" in the passage is closest in meaning to
- A. significantly
  - B. rapidly
  - C. continuously
  - D. unevenly

## **Paragraph 2**

Three forces particularly affected the configuration of urban and suburban areas in the nineteenth century: economics, transportation technology, and demographics. Added to these was the characteristic American preference both for independent living, usually associated with having an individual, free-standing home for one's family, and for rural living. Economics affected urbanization in two ways. First, economic considerations influenced location decisions for business and industry, which often preempted choice sites. Second, industrial growth generated higher incomes for large segments of the population, which in turn provided more money for larger homes and commuter transportation. Related to economics (since costs to individuals always played a role) were improvements in transportation, from the first horse-drawn buses of the 1820s to electrified street railways at the end of the century. Each transport innovation extended the distance that a person could reasonably travel as a commuter or shopper, while constant system improvements and increased ridership lessened costs.

6. According to paragraph 2, what is one reason that transportation costs in American cities decreased during the nineteenth century?
- A. The number of people using transportation increased.
  - B. The cost of energy such as electricity decreased.
  - C. Commuters and shoppers began living closer to their destinations.
  - D. Transportation suppliers had to compete for riders.

## **Paragraph 3**

Demographic patterns also affected urbanization in two ways: first, urban populations grew steadily throughout the century due to immigration from rural areas, principally by those seeking factory work, and emigration from abroad. Therefore cities expanded as new housing had to be provided. Secondly, at the same time that new residents were surging into cities, many urbanites, particularly those of the middle classes, began to leave. While a preference for rural living explained part of this exodus, it was also due to the perception that various urban problems were becoming worse.

7. Which of the following can be inferred from paragraph 3 about changes in the demographics of cities during the nineteenth century?
- A. The reason most people left the city was to take jobs in the country.
  - B. The middle class population increased.
  - C. The population became more ethnically diverse.
  - D. The working class population tended to live in the oldest housing.

#### Paragraph 4

Many nineteenth-century urban problems were those that continue to **plague** cities today—crime, pollution, noise—but others were the direct result of lack of planning and regulation, such as threat of fire, poor sanitation, and shoddy building construction. Fire was a significant problem in urban areas of North America from the time of the first European settlement. Construction with combustible materials coupled with close placement of buildings and the use of open flames in heating, cooking, and lighting meant that the potential for raging fires was ever present. Lack of sanitation, and the ensuing public health problems it created, was a more constant, if less dramatic, urban issue it was not until the 1860s that any serious, concerted effort was made to develop proper systems for water delivery and sewage removal. In spite of remarkable strides made in the 1870s and 1880s by the newly established profession of sanitary engineering, the common nineteenth-century pattern of individual unprofessionally planned and installed cesspools (underground tanks for holding household sewage) continued. This led to water contamination and the spread of disease by rodents and insects.

8. The word “**plague**” in the passage is closest in meaning to
- A. be discussed in
  - B. be found in
  - C. isolate
  - D. cause trouble for
9. According to paragraph 4, each of the following contributed to the threat of fire in nineteenth-century American cities EXCEPT
- A. the distance from one building to the next
  - B. the types of water-delivery systems used
  - C. the methods used for heating and cooking
  - D. the kinds of materials used in constructing buildings
10. According to paragraph 4, lack of adequate systems for removing sewage led to
- A. the appearance of new types of rodents and insects
  - B. the development of new, more effective cesspools
  - C. disruptions of water-delivery systems
  - D. contamination of water supplies

#### Paragraph 5

Problems of the fire and poor sanitation were inextricably linked with the last major urban problem of the nineteenth century—lack of coordination in the physical expansion of cities and their infrastructure systems (systems for providing services such as water, gas, electricity, and sewage). Typically,

development was both unplanned and unrestricted, with landowners making all choices of lot size, services, and street arrangement based only on their individual needs in the marketplace. Distortions of streets and **abrupt** changes in the distance of houses from the street in urban areas, which so clearly delineate where one development ended and another began, were just the most obvious problems that this lack of coordination created.

11. The word “**abrupt**” in the passage is closest in meaning to
- A. noticeable
  - B. random
  - C. variable
  - D. sudden
12. According to paragraph 5, one of the major consequences of the lack of restrictions and comprehensive urban planning was that
- A. infrastructure systems were coordinated by local groups rather than by city governments
  - B. cities became smaller over time because people began leaving
  - C. landowners developed urban lots however they wished
  - D. some housing developments that were begun were never completed

## **Paragraph 2**

Three forces particularly affected the configuration of urban and suburban areas in the nineteenth century: economics, transportation technology, and demographics. Added to these was the characteristic American preference both for independent living, usually associated with having an individual, free-standing home for one’s family, and for rural living. ■Economics affected urbanization in two ways. First, economic considerations influenced location decisions for business and industry, which often preempted choice sites. ■Second, industrial growth generated higher incomes for large segments of the population, which in turn provided more money for larger homes and commuter transportation. ■Related to economics (since costs to individuals always played a role) were improvements in transportation, from the first horse-drawn buses of the 1820s to electrified street railways at the end of the century. ■Each transport innovation extended the distance that a person could reasonably travel as a commuter or shopper, while constant system improvements and increased ridership lessened costs.

13. Look at the four squares [■] that indicates where the following sentence could be added to the passage.



**As a result, many locations that would have been ideal for housing ---or for urban parks or other public spaces--- were unavailable for such use.**

Where would the sentence best fit?

14. **Directions:** An introductory sentence for a brief summary of the passage is provided below. Complete the summary by selecting the THREE answer choices that express the most important ideas in the passage. Some answer choices do not belong in the summary because they express ideas that are not presented in the passage or are minor ideas in the passage. This question is worth 2 points.

**In general, the growth of American cities in the nineteenth century was not guided by comprehensive urban planning**

**Answer choices**

- A. By the end of the nineteenth century, the City Beautiful Movement had influenced the design of most large cities in the United States
- B. Improved transportation and higher incomes enabled large segments of the population to move farther away from the places they worked and shopped.
- C. There was little concern about the threat to public health posed by the widespread use of cesspools until sanitary engineering became established in the 1860s.
- D. During the nineteenth century, the need of local business and industries were ignored in urban planning.
- E. Industrial growth attracted many immigrants—from rural areas and abroad—into American cities in search of factory work and thus led to more urban housing.
- F. Unplanned and unregulated development combined with inadequate water and sewage systems created public health problems and put cities at serious risk from fires.

## **The Climate of Japan**

At the most general level, two major climatic forces determine Japan's weather. Prevailing westerly winds move across Eurasia, sweep over the Japanese islands, and continue eastward across the Pacific Ocean. In addition, great cyclonic airflows (masses of rapidly circulating air) that arise over the western equatorial Pacific move in a wheel-like fashion northeastward across Japan and nearby regions. During winter months heavy masses of cold air from Siberia dominate the weather around Japan. Persistent cold winds skim across the Sea of Japan from the northwest, picking up moisture that they deposit as several feet of snow on the western side of the mountain ranges on Honshu Island. As the cold air drops its moisture, it flows over high ridges and down eastern slopes to bring cold, relatively dry weather to valleys and coastal plains and cities.

In spring the Siberian air mass warms and loses density, enabling atmosphere currents over the Pacific to steer warmer air into northeast Asia. This warm, moisture-laden air covers most of southern Japan during June and July. The resulting late spring rains then give way to a drier summer that is sufficiently hot and muggy, despite the island chain's northerly latitude, to allow widespread rice cultivation.

Summer heat is followed by the highly unpredictable autumn rains that accompany the violent tropical windstorm known as typhoons. These cyclonic storms originate over the western Pacific and travel in great clockwise arcs, initially heading west toward the Philippines and southern China, curving northward later in the season. Cold weather drives these storms eastward across Japan through early autumn revitalizing Siberian air mass and ushering in a new annual weather cycle.

This yearly cycle has played a key role in shaping Japanese civilization. It has assured the islands ample precipitation, ranging irregularly from more than 200 centimeters annually in parts of the southwest to about 100 in the northeast and averaging 180 for the country as a whole. The moisture enables the islands to support uncommonly lush forest cover, but the combination of precipitous slopes and heavy rainfall also gives the islands one of the world's highest rates of natural erosion, intensified by both human activity and the natural shocks of earthquakes and volcanism. These factors have given Japan its wealth of sedimentary basins, but they have also made mountainsides extremely susceptible to erosion and landslides and hence generally unsuitable for agricultural manipulation.

The island chain's mountainous backbone and great length from north to

south produce climatic diversity that has contributed to regional differences. Generally sunny winters along the Pacific seaboard have made habitation there relatively pleasant. Along the Sea of Japan, on the other hand, cold, snowy winters have discouraged settlement. Furthermore, although annual precipitation is high in that region, much of it comes as snow and rushes to the sea as spring runoff, leaving little moisture for farming.

Summer weather patterns in northern Honshu, and especially along the Sea of Japan, have also discouraged agriculture. The area is subject to the *yamase* effect, when cool air from the north sometimes lowers temperatures sharply and damages farm production. The impact of this effect has been especially great on rice cultivation because, if it is to grow well, the rice grown in Japan requires a mean summer temperature of 20°centigrade or higher. A drop of 2°–3° can lead to a 30–50 percent drop in rice yield, and the *yamase* effect is capable of exceeding that level. This *yamase* effect does not, however, extend very far south, where most precipitation comes in the form of rain and the bulk of it in spring, summer, and fall, when most useful for cultivation. Even the autumn typhoons, which deposit most of their moisture along the southern seaboard, are beneficial because they promote the start of the winter crops that for centuries have been grown in southern Japan.

In short, for the past two millennia, the climate in general and patterns of precipitation in particular have encouraged the Japanese to cluster their settlements along the southern coast, most densely along the sheltered Inland Sea, moving into the northeast. There the limits that topography imposed on production have been tightened by climate, with the result that agricultural output has been more modest and less reliable, making the risk of crop failure and hardship commensurately greater.

### **Paragraph 1**

At the most general level, two major climatic forces determine Japan's weather. Prevailing westerly winds move across Eurasia, sweep over the Japanese islands, and continue eastward across the Pacific Ocean. In addition, great cyclonic airflows (masses of rapidly circulating air) that arise over the western equatorial Pacific move in a wheel-like fashion northeastward across Japan and nearby regions. During winter months heavy masses of cold air from Siberia dominate the weather around Japan. Persistent cold winds skim across the Sea of Japan from the northwest, picking up moisture that they deposit as several feet of snow on the western side of the mountain ranges on Honshu Island. As the cold air drops its moisture, it flows over high ridges and

down eastern slopes to bring cold, relatively dry weather to valleys and coastal plains and cities.

1. According to paragraph 1, all of the following are true of the cold air from Siberia EXCEPT
  - A. It gathers moisture as it moves across the sea of Japan
  - B. It is responsible for the snow that falls on the western side of Honshu island
  - C. It is warmed by the cyclonic airflow from the south that mix-with it.
  - D. It is responsible for the cold, dry weather of the eastern valleys and coastal plains and cities

### Paragraph 2

In spring the Siberian air mass warms and loses density, **enabling** atmosphere currents over the Pacific to steer warmer air into northeast Asia. This warm, moisture-laden air covers most of southern Japan during June and July. The resulting late spring rains then give way to a drier summer that is sufficiently hot and muggy, **despite the island chain's northerly latitude**, to allow widespread rice cultivation.

2. The word “**enabling**” in the passage is closest in meaning to
  - A. preparing
  - B. requiring
  - C. allowing
  - D. distributing
3. Why does the author include the phrase “**despite the island chain's northerly latitude**” in the paragraph?
  - A. To indicate that one would not expect such hot, muggy weather at Japan's latitude
  - B. To compare Japan's climate to the climate of more northerly latitudes
  - C. To give a reason for the hot,muggy weather experienced in Japan during the summer
  - D. To explain why Japan's climate is only suitable for rice cultivation

### Paragraph 3

Summer heat is followed by the highly unpredictable autumn rains that accompany the violent tropical windstorm known as typhoons. These cyclonic storms originate over the western Pacific and travel in great clockwise arcs, initially heading west toward the Philippines and southern China, curving northward later in the season. Cold weather drives these storms eastward

across Japan through early autumn revitalizing Siberian air mass and ushering in a new annual weather cycle.

4. According to paragraph 3, all of the following are true of autumn storms EXCEPT
- A. They involve rain combined with tropical windstorms
  - B. Cyclonic storms have a predictable pattern of travel
  - C. Their movement creates a weather cycle that repeats itself
  - D. They begin as northern Siberian air masses with consistent rains following the summer heat

#### **Paragraph 4**

This yearly cycle has played a key role in shaping Japanese civilization. It has assured the islands ample precipitation, ranging irregularly from more than 200 centimeters annually in parts of the southwest to about 100 in the northeast and averaging 180 for the country as a whole. The moisture enables the islands to support uncommonly lush forest cover, but the combination of precipitous slopes and heavy rainfall also gives the islands one of the world's highest rates of natural erosion, intensified by both human activity and the natural shocks of earthquakes and volcanism. These factors have given Japan its wealth of sedimentary basins, but they have also made mountainsides extremely **susceptible to** erosion and landslides and hence generally unsuitable for agricultural manipulation.

5. All of the following are mentioned in paragraph 4 as contribute in paragraph 4 as contribute to the high rate of erosion in the Japanese EXCEPT
- A. very steep slopes and heavy rainfall
  - B. intense agricultural manipulation
  - C. earthquakes and volcanic activities
  - D. human activity
6. The phrase "**susceptible to**" is closest in meaning to
- A. slow to replace losses from
  - B. likely to be affected by
  - C. unable to benefit from
  - D. well-known for

#### **Paragraph 5**

The island chain's mountainous backbone and great length from north to south produce climatic diversity that has contributed to regional differences.

Generally sunny winters along the Pacific seaboard have made habitation there relatively pleasant. Along the Sea of Japan, on the other hand, cold, snowy winters have discouraged settlement. Furthermore, although annual precipitation is high in that region, much of it comes as snow and rushes to the sea as spring runoff, leaving little moisture for farming.

7. According to paragraph 5, which of the following is a major factor in the limited habitation in the area along the Sea of Japan?
- A. It has too many mountains
  - B. It is vulnerable to floods during spring runoff
  - C. Its climate is highly irregular and unpredictable
  - D. It is cold and snowy during winter

### Paragraph 6

Summer weather patterns in northern Honshu, and especially along the Sea of Japan, have also discouraged agriculture. The area is subject to the *yamase* effect, when cool air from the north sometimes lowers temperatures sharply and damages farm production. The impact of this effect has been especially great on rice cultivation because, if it is to grow well, the rice grown in Japan requires a mean summer temperature of 20°centigrade or higher. A drop of 2°–3° can lead to a 30–50 percent drop in rice yield, and the *yamase* effect is capable of **exceeding** that level. This *yamase* effect does not, however, extend very far south, where most precipitation comes in the form of rain and the bulk of it in spring, summer, and fall, when most useful for cultivation. Even the autumn typhoons, which deposit most of their moisture along the southern seaboard, are beneficial because they promote the start of the winter crops that for centuries have been grown in southern Japan.

8. According to paragraph 6, how can the *yamase* effect lead lower rice production in northern Honshu?
- A. It can cause temperatures to drop below the level required for rice to grow well
  - B. It can limit the amount of summer rainfall, resulting in less water for cultivation
  - C. It can damage a large portion of the land on which rice is grown
  - D. It can prevent rice cultivation during seasons other than summer
9. Which of the following can be inferred from paragraph 6 about farming in southern Japan?
- A. Farming is limited to rice cultivation
  - B. Farming is difficult because of the *Yamase* effect

- C. Farming takes place throughout the year
- D. Farming suffers from the effects of autumn typhoons
- 10. The word “**exceeding**” is closest in meaning to
  - A. almost reaching
  - B. going beyond
  - C. maintaining
  - D. reducing

### Paragraph 7

In short, for the past two millennia, the climate in general and patterns of precipitation in particular have encouraged the Japanese to **cluster** their settlements along the southern coast, most densely along the sheltered Inland Sea, moving into the northeast. There the limits that topography imposed on production have been tightened by climate, with the result that agricultural output has been more modest and less reliable, making the risk of crop failure and hardship commensurately greater.

- 11. The word “**cluster**” in the passage is closest in meaning to
  - A. build
  - B. group
  - C. move
  - D. expand
- 12. Which of the sentences below best expresses the essential information in the highlighted sentence in the passage? Incorrect choices change the meaning in important ways or leave out essential information
  - A. Agricultural production has been more successful in northeastern Japan than along the island Sea, where topography and climate make life difficult for people
  - B. Topography and climate have combined to limit agricultural production in northeastern Japan, resulting in an increased risk of crop failure and hardship
  - C. Along the inland Sea, where topography makes the climate more severe decreased agriculture output has resulted from crop failure and hardship.
  - D. The risk of crop failure in northeastern Japan has caused greater hardship than have climate and topography

### Paragraph 4

This yearly cycle has played a key role in shaping Japanese civilization.■  
It has assured the islands ample precipitation, ranging irregularly from more

than 200 centimeters annually in parts of the southwest to about 100 in the northeast and averaging 180 for the country as a whole.■The moisture enables the islands to support uncommonly lush forest cover, but the combination of precipitous slopes and heavy rainfall also gives the islands one of the world's highest rates of natural erosion, intensified by both human activity and the natural shocks of earthquakes and volcanism.■These factors have given Japan its wealth of sedimentary basins, but they have also made mountainsides extremely susceptible to erosion and landslides and hence generally unsuitable for agricultural manipulation.■

13. Look at the four squares [■] that indicates where the following sentence could be added to the passage.

**Such a large amount of rainfall has both positive and negative effects on the environment of Japanese islands.**

Where would the sentence best fit?

14. **Directions:** An introductory sentence for a brief summary of the passage is provided below. Complete the summary by selecting the THREE answer choices that express the most important ideas in the passage. Some answer choices do not belong in the summary because they express ideas that are not presented in the passage or are minor ideas in the passage. This question is worth 2 points.

**Japan's yearly weather cycle influences settlement patterns and agriculture across the islands.**

**Answer choices**

- A. The weather effects has a great impact on rice growth in northern Japan but does not affect cultivation in southern Japan, where precipitation comes in the forms of rain rather than
- B. Agriculture practices that stabilize sediments have reduced erosion and landscape allowed the growth of lush forests in Japan
- C. Climate changes during the last two millennia have caused the Japanese to move their settlements towards the northeast, where the climate is more favorable to agriculture
- D. Japan's yearly weather cycle makes farming possible only in the summer, as the effects of the Siberia air mass result in winters that are too cold and snowy for agriculture.
- E. Cold westerly winds from Siberia and cyclonic airflows from the Pacific Ocean provide ample rainfall for farming but contribute to high rates of erosion



- F. Settlements are most concentrated along the Pacific seaboard to the south where climate and topography are more suitable for crop cultivation than along the Sea of Japan.

## **Economic Decline in Europe during the 14th Century**

After three hundred years of impressive gains in wealth and population, Europe's economy began to slow around 1300. Several factors accounted for the decline. One of the most important, though perhaps the least dramatic to relate, was a shift in climate. The remarkably fair weather of the twelfth and thirteenth centuries took a decided turn for the worse in the fourteenth. Chronicler's comments, tree-ring examination, and pollen analysis all indicate that over the course of the fourteenth century Europe's average annual temperature declined approximately two degrees Celsius— which may sound like very little at first, but if one considers current projections about the possible effects of global warming, in which the average annual temperature shift is only one degree Celsius, a rather different impression emerges. As the temperature dropped, shortening the summer growing season and affecting the resilience of certain vegetable species, the wind and rain increased. This meant that crop yields declined precipitously and the agricultural economy began to contract. As food supplies dwindled, costs rose accordingly and cut into the amount of capital that people had available for other purchases or investments. This in turn added to the gradual constriction of the commercial economy.

Just as significant were changes in the geopolitics of the Mediterranean world. The decline of the Byzantine Empire, which had dominated the eastern Mediterranean, meant the interruption of trade routes to central and eastern Asia. The rise of new political powers signaled a new era in Mediterranean connections, one in which religious loyalty and ethnic fidelity mattered more than commercial ties. Consequently the movement of goods and services between east and west began to slow. European interest in circumnavigating Africa and exploring westward into the Atlantic Ocean, in fact, originated in the desire into the trade with eastern Asia that had long sustained Europe's economic growth.

A more immediate cause of the sputtering economy was an observable absence; since the eleventh century there had been few significant changes in the technology of agriculture. Developments like the wheeled plow, the rotation of crops, and the use of natural fertilizer that had made possible the agricultural revolution of the past two hundred years had had no follow-up. Farming was still conducted in 1300 roughly the same way it had been done in 1100, but with a considerably larger population to feed, there was little surplus left to generate fresh capital. As a consequence, food production fell perilously close to subsistence level. Although the failure of agriculture to keep up with

the growing population did not become a crisis until the fourteenth century, clear signs of the problem had already emerged by the middle of the thirteenth century, when occasionally low yields due to bad weather or social disruption revealed how perilous the balance between Europe's population and its food supply had become. Apart from territories beset by war, the tentativeness of the food supply became evident first on the farmlands most recently brought under cultivation during the economic depression of the twelfth century. The less established farmers of these lands frequently did not have the means to survive successive poor harvests. Tenant farmers unable to pay their rents thus began to slip into debt, and landlords who depended on rents for their income began to rely increasingly on urban financiers for credit.

Even whole governments became entangled in the credit crisis, England being the most notable example. The cycle of indebtedness was hardly inevitable, but the string of bank failures and commercial collapses in the first half of the fourteenth century was striking. The famed Bardi and Peruzzi banks of Florence (the two largest financial houses of Europe) collapsed spectacularly in the 1340's. They were soon followed by the Riccardi bank of Lucca, whose massive loans had kept the English government afloat for years. Many more houses collapsed in turn.

An important demographic trend resulted from and contributed to the economic malaise: large-scale migration of rural populations into the cities. Europe's overall population growth from 1050 to 1300 had been primarily due to an increase in the number of rural folk. But as economic forces made agrarian life more perilous around 1300, hard-pressed farmers and their families began to migrate to the cities in large number in search of work. Many cities doubled in size, and some even tripled, over the course of just one or two generations. Few were capable of absorbing such large numbers of people.

### **Paragraph1**

After three hundred years of impressive gains in wealth and population, Europe's economy began to slow around 1300. Several factors **accounted for** the decline. One of the most important, though perhaps the least dramatic to relate, was a shift in climate. The remarkably fair weather of the twelfth and thirteenth centuries took a decided turn for the worse in the fourteenth. Chronicler's comments, tree-ring examination, and pollen analysis all indicate that over the course of the fourteenth century Europe's average annual temperature declined approximately two degrees Celsius— which may sound

like very little at first, but if one considers **current projections about the possible effects of global warming**, in which the average annual temperature shift is only one degree Celsius, a rather different impression emerges. As the temperature dropped, shortening the summer growing season and affecting the resilience of certain vegetable species, the wind and rain increased. This meant that crop yields declined precipitously and the agricultural economy began to contract. As food supplies dwindled, costs rose accordingly and cut into the amount of capital that people had available for other purchases or investments. This in turn added to the gradual constriction of the commercial economy.

1. The phrase “**accounted for**” in the passage is closest in meaning to
  - A. predicted
  - B. explained
  - C. typified
  - D. worsened
2. Why does the author mention “**current projection about the possible effects of global warming**” in the passage?
  - A. To argue that global warming was a faction in the climate shift of the fourteenth century in Europe
  - B. To suggest that the current climate change is greater than the climate change in the fourteenth century in Europe
  - C. To show the direct connection between temperature changes in the fourteenth century and changes that are currently occurring in Europe
  - D. To emphasize the impact of the temperature changes that occurred during the fourteenth century in Europe.
3. In paragraph 1, all of the following are mentioned as factors that contributed to the decline of the agricultural economy in the fourteenth century EXCEPT
  - A. an increase in rain and wind
  - B. a shortened growing season
  - C. the investment of capital in areas other than agriculture
  - D. a significant drop in temperature

## **Paragraph 2**

Just as significant were changes in the geopolitics of the Mediterranean world. The decline of the Byzantine Empire, which had dominated the eastern Mediterranean, meant the interruption of trade routes to central and eastern Asia. The rise of new political powers signaled a new era in Mediterranean

connections, one in which religious loyalty and ethnic fidelity mattered more than commercial ties. Consequently the movement of goods and services between east and west began to slow. European interest in circumnavigating Africa and exploring westward into the Atlantic Ocean, in fact, originated in the desire into the trade with eastern Asia that had long sustained Europe's economic growth.

4. In paragraph 2, the author implies that Byzantine Empire
  - A. allowed international trade from which Europe benefited
  - B. became a dominated force during the fourteenth century
  - C. centered its rule on religion and ethnic ties
  - D. interrupted trade routes to Asia that had already been established
5. According to paragraph 2, European interest in exploring the coast of Africa and the Atlantic Ocean grew out of a wish to
  - A. build a roadblock against Asian powers
  - B. restore valuable trade with eastern Asia
  - C. create faster trade routes to eastern Asia
  - D. connect trade between the eastern Mediterranean and the Atlantic Ocean

### Paragraph 3

A more immediate cause of the sputtering economy was an observable absence; since the eleventh century there had been few significant changes in the technology of agriculture. Developments like the wheeled plow, the rotation of crops, and the use of natural fertilizer that had made possible the agricultural revolution of the past two hundred years had had no follow-up. Farming was still conducted in 1300 roughly the same way it had been done in 1100, but with a **considerably** larger population to feed, there was little surplus left to generate fresh capital. As a consequence, food production fell perilously close to subsistence level. **Although the failure of agriculture to keep up with the growing population did not become a crisis until the fourteenth century, clear signs of the problem had already emerged by the middle of the thirteenth century, when occasionally low yields due to bad weather or social disruption revealed how perilous the balance between Europe's population and its food supply had become.** Apart from territories beset by war, the tentativeness of the food supply became evident first on the farmlands most recently brought under cultivation during the economic depression of the twelfth century. The less established farmers of these lands frequently did not have the means to survive successive poor harvests. Tenant farmers unable to pay their rents thus began to slip into debt, and landlords who depended on

rents for their income began to rely increasingly on urban financiers for credit.

6. According to paragraph 3, what was one cause of the economic problems in Europe of the fourteenth century?

- A. Farming techniques produced insufficient amounts of food
- B. Terntones that farmers had begun to use for agriculture for the first time were disrupted by war
- C. The technological improvements in farming made in earlier centuries were abandoned after 1300
- D. Farming techniques used capital that was needed for investment in the development of technology

7. Which of the sentences below best expresses the essential information in the highlighted sentence in the passage? Incorrect choices change the meaning in important ways or leave out essential information

- A. Maintaining the population of Europe with existing food supplies continued to be a problem after the middle of the thirteenth century
- B. The delicate balance between population and food supply in Europe was apparent in years of poor harvest half a century before it became a crisis in the fourteenth century
- C. Clear signs of the emerging crisis in Europe appeared in the thirteenth century in the form of bad weather, social unrest, and insufficient food
- D. In the thirteenth century, a problem emerged in Europe when the food sufficient to feed the population only

8. The word “**considerably**” in the passage is closest in meaning to

- A. significantly
- B. increasingly
- C. constantly
- D. naturally

9. It can be inferred from paragraph 3 that people who farmed on land recently brought under cultivation were at a bigger disadvantage than well-established farmers in fourteenth-century Europe because

- A. they land was located in areas that were engaged in war
- B. they relied on urban financiers for credit
- C. they had no surplus on which to live or money to pay their rent
- D. they did not use wheeled plows, rotate their crops, or use natural fertilizer

#### **Paragraph 4**

Even whole governments became entangled in the credit crisis, England being the most notable example. The cycle of indebtedness was hardly

inevitable, but the string of bank failures and commercial collapses in the first half of the fourteenth century was **striking**. The famed Bardi and Peruzzi banks of Florence (**the two largest financial houses of Europe**) collapsed spectacularly in the 1340's. They were soon followed by the Riccardi bank of Lucca, whose massive loans had kept the English government afloat for years. Many more houses collapsed in turn.

10. The word "**striking**" in the passage is closest in meaning to
- A. understandable
  - B. necessary
  - C. limiting
  - D. noteworthy
11. Why does the author mention in the passage that the Bardi and Peruzzi banks were "**the two largest financial houses of Europe**"?
- A. To indicate the connection between Florence banks and the English government
  - B. To emphasize the great impact that these bank failures had on the economy
  - C. To compare the Bardi and Peruzzi banks with the Richard bank
  - D. To indicate the success that these banks had previously achieved

#### **Paragraph 4**

An important demographic trend resulted from and contributed to the economic malaise: large-scale migration of rural populations into the cities. Europe's overall population growth from 1050 to 1300 had been primarily due to an increase in the number of rural folk. But as economic forces made agrarian life more perilous around 1300, hard-pressed farmers and their families began to migrate to the cities in large number in search of work. Farms, villages, and entire regions were abandoned. Many cities doubled in size, and some even tripled, over the course of just one or two generations. Few were capable of absorbing such large numbers of people.

12. Paragraph 5 suggests that the large-scale migration to cities resulted in which of the following?
- A. After two generations in the cities, migrants returned to agricultural life
  - B. The overall population in Europe declined
  - C. Farmers worked in cities, and their families worked the land
  - D. Cities contained large numbers of people who were unemployed

### Paragraph 5

An important demographic trend resulted from and contributed to the economic malaise: large-scale migration of rural populations into the cities. Europe's overall population growth from 1050 to 1300 had been primarily due to an increase in the number of rural folk. ■ But as economic forces made agrarian life more perilous around 1300, hard-pressed farmers and their families began to migrate to the cities in large number in search of work. ■ Many cities doubled in size, and some even tripled, over the course of just one or two generations. ■ Few were capable of absorbing such large numbers of people. ■

13. Look at the four squares [■] that indicates where the following sentence could be added to the passage.

**Farms, villages, and entire regions were abandoned.**

Where would the sentence best fit?

14. **Directions:** An introductory sentence for a brief summary of the passage is provided below. Complete the summary by selecting the THREE answer choices that express the most important ideas in the passage. Some sentences do not belong in the summary because they express ideas that are not presented in the passage or are minor ideas in the passage. **This question is worth 2 points.**

**The economic decline in Europe during the fourteenth century resulted from several factors.**

#### Answer choices

- A. Climate changes affected agriculture production, which led to food shortages.
- B. The loss of trade with central and East Asia negatively impacted economic growth.
- C. England was among the nations that suffered a credit crisis.
- D. The performance of the commercial economy could not keep pace with the agricultural economy.
- E. The lack of innovation in agricultural technology affected food production
- F. Migrations from city to rural areas led to an increase in the number of rural folk.



## Early Theories of Continental Drift

**Paleozoic** 545 to 245 million years ago

Carboniferous 360 to 286 million years ago

Pennsylvanian 320 to 286 million years ago

Permian 286 to 245 million years ago

**Mesozoic** 245 to 66 million years ago

Jurassic 205 to 144 million years ago

The idea that the past geography of Earth was different from today is not new. The earliest maps showing the east coast of South America and the west coast of Africa probably provided people with the first evidence that continents may have once been joined together, then broken apart and moved to their present positions.

During the late nineteenth century, Austrian geologist Eduard Suess noted the similarities between the Late Paleozoic plant fossils of India, Australia, South Africa, and South America. The plant fossils comprise a unique group of plants that occurs in coal layers just above the glacial deposits on these southern continents. In this book *The Face of the Earth* (1885), he proposed the name “Gondwanaland” (called Gondwana here) for a supercontinent composed of the aforementioned southern landmasses. Suess thought these southern continents were connected by land bridges over which plants and animals migrated. Thus, in his view, the similarities of fossils on these continents were due to the appearance and disappearance of the connecting land bridges.

The American geologist Frank Taylor published a pamphlet in 1910 presenting his own theory of continental drift. He explained the formation of mountain ranges as a result of the lateral movements of continents. He also envisioned the present-day continents as parts of larger polar continents that eventually broke apart and migrated toward equator after Earth’s rotation was supposedly slowed by gigantic tidal forces. According to Taylor, these tidal forces were generated when Earth’s gravity captured the Moon about 100

million years ago. Although we know that Taylor's explanation of continental drift is incorrect, one of his most significant contributions was his suggestion that the Mid-Atlantic Ridge—an underwater mountain chain discovered by the 1872-1876 British *HMS Challenger* expeditions—might mark the site at which an ancient continent broke apart, forming the present –day Atlantic Ocean.

However, it is Alfred Wegener, a German meteorologist, who is generally credited with developing the hypothesis of continental drift. In his monumental book, *The Origin of Continents and Oceans* (1915), Wegener proposed that all landmasses were originally united into a single supercontinent that he named "Pangaea." Wegener portrayed his grand concept of continental movement in a series of maps showing the breakup of Pangaea and the movement of various continents to their present-day locations. What evidence did Wegener use to support his hypothesis of continental drift? First, Wegener noted that the shorelines of continents fit together, forming a large supercontinent and that marine, nonmarine, and glacial rock sequences of Pennsylvanian to Jurassic ages are almost identical for all Gondwana continents, strongly indicating that they were joined together at one time. Furthermore, mountain ranges and glacial deposits seem to match up in such a way that suggests continents could have once been a single landmass. And last, many of the same extinct plant and animal groups are found today on widely separated continents, indicating that the continents must have been in proximity at one time. Wegener argued that this vast amount of evidence from a variety of sources surely indicated the continents must have been close together at one time in the past.

Alexander Du Toit, a South African geologist was one of Wegener's ardent supporters. He noted that fossils of the Permian freshwater reptile "Mesosaurus" occur in rocks of the same age in both Brazil and South Africa. Because the physiology of freshwater and marine animals is completely different, it is hard to imagine how a freshwater reptile could have swum across the Atlantic Ocean and then found a freshwater environment nearly identical to its former habitat. Furthermore, if Mesosaurus could have swum across the ocean, its fossil remains should occur in other localities besides Brazil and South Africa. It is more logical to assume that Mesosaurus lived in lakes in what are now adjacent areas of South America and Africa but were

then united in a single continent.

Despite what seemed to be overwhelming evidence presented Wegener and later Du Toit and others, most geologists at the time refused to entertain the idea that the continents might have moved in the past

### **Paragraph 2**

During the late nineteenth century, Austrian geologist Eduard Suess noted the similarities between the Late Paleozoic plant fossils of India, Australia, South Africa, and South America. The plant fossils comprise a unique group of plants that occurs in coal layers just above the glacial deposits on these southern continents. In this book *The Face of the Earth* (1885), he proposed the name “Gondwanaland” (called Gondwana here) for a supercontinent composed of the aforementioned southern landmasses. Suess thought these southern continents were connected by land bridges over which plants and animals migrated. Thus, in his view, the similarities of fossils on these continents were due to the appearance and disappearance of the connecting land bridges.

1. According to paragraph 2, Eduard Suess believed that similarities of plant and animal fossils on the southern continents were due to
  - A. living in the southern climate
  - B. crossing the land bridges
  - C. fossilization in the coal layers
  - D. movements of the supercontinent

### **Paragraph 3**

The American geologist Frank Taylor published a pamphlet in 1910 presenting his own theory of continental drift. He explained the formation of mountain ranges as a result of the lateral movements of continents. He also envisioned the present-day continents as parts of larger polar continents that eventually broke apart and migrated toward equator after Earth’s rotation was supposedly slowed by gigantic tidal forces. According to Taylor, these tidal forces were **generated** when Earth’s gravity captured the Moon about 100 million years ago. Although we know that Taylor’s explanation of continental drift is incorrect, one of his most significant contributions was his suggestion

that the Mid-Atlantic Ridge—an underwater mountain chain discovered by the 1872-1876 British *HMS Challenger* expeditions—might mark the site at which an ancient continent broke apart, forming the present –day Atlantic Ocean.

2. According to paragraph 3, Frank Taylor believed that
  - A. present-day continents broke off from larger continents and drifted toward the poles due to tidal forces
  - B. the lateral shifting of continents caused the formation of mountain ranges
  - C. polar continents began to join together when Earth’s gravity captured the Moon 100 million years ago
  - D. Earth’s gravity and speed of rotation created large polar continents
3. Which of the following can be inferred from paragraph 3 about the Mid-Atlantic Ridge?
  - A. It was once above sea level.
  - B. It formed at the same time that Earth’s gravity captured the Moon.
  - C. It was much more extensive when it was first formed than it is today.
  - D. It was unknown before the *HMS Challenger* voyages.
4. The word “**generated**” in the passage is closest in meaning to
  - A. strengthened
  - B. released
  - C. produced
  - D. present

#### Paragraph 4

However, it is Alfred Wegener, a German meteorologist, who is generally credited with developing the hypothesis of continental drift. In his **monumental** book, *The Origin of Continents and Oceans* (1915), Wegener proposed that all landmasses were originally united into a single supercontinent that he named “Pangaea.” Wegner **portrayed** his grand concept of continental movement in a series of maps showing the breakup of Pangaea and the movement of various continents to their present-day locations. What evidence did Wegener use to support his hypothesis of continental drift? First, Wegener noted that the shorelines of continents fit together, forming a large supercontinent and that marine, nonmarine, and glacial rock sequences of Pennsylvanian to Jurassic ages are almost identical

for all Gondwana continents, strongly indicating that they were joined together at one time. Furthermore, mountain ranges and glacial deposits seem to match up in such a way that suggests continents could have once been a single landmass. And last, many of the same extinct plant and animal groups are found today on widely separated continents, indicating that the continents must have been in proximity at one time. Wegener argued that this **vast** amount of evidence from a variety of sources surely indicated the continents must have been close together at one time in the past.

5. The word “**monumental**” in the passage is closest in meaning to
  - A. final
  - B. persuasive
  - C. well-known
  - D. great and significant
6. The word “**portrayed**” in the passage is closest in meaning to
  - A. proved
  - B. formed
  - C. depicted
  - D. defended
7. The word “**vast**” in the passage is closest in meaning to
  - A. enormous
  - B. significant
  - C. convincing
  - D. additional
8. According to paragraph 4, Wegener felt confident that his theory are correct in part because
  - A. contemporary scientists were unable to successfully challenge his evidence
  - B. many different types of evidence seemed to support his theory
  - C. his theory accounted for phenomena that earlier theories could not explain
  - D. he had used the most advanced techniques available to gather his evidence
9. According to paragraph 4, Wegener pointed to all of the following in support of his theory of continental drift EXCEPT:
  - A. Plants and animals now living on some continents appear to be descended from plants and animals that originated on other continents.
  - B. Rock sequences associated with the continents are extremely similar.

- C. The coastlines of some continents seem to fit together.
- D. Mountains on some continents would be adjacent to mountains on other continents if these continents were joined.

### Paragraph 5

Alexander Du Toit, a South African geologist was one of Wegener's ardent supporters. He noted that fossils of the Permian freshwater reptile "Mesosaurus" occur in rocks of the same age in both Brazil and South Africa. Because **the physiology of freshwater and marine animals is completely different**, it is hard to imagine how a freshwater reptile could have swum across the Atlantic Ocean and then found a freshwater environment nearly identical to its former habitat. Furthermore, if Mesosaurus could have swum across the ocean, its fossil remains should occur in other localities besides Brazil and South Africa. It is more **logical** to assume that Mesosaurus lived in lakes in what are now adjacent areas of South America and Africa but were then united in a single continent.

10. Why does the author mention the fact that "**the physiology of freshwater and marine animals is completely different**"?
- A. To explain why Du Toit was able to determine that Mesosaurus was a freshwater reptile
  - B. To explain why Du Toit concluded that certain fossils in rocks in Brazil and South Africa were those of the same animal
  - C. To cast doubt on the idea that Mesosaurus could have swum from one landmass to another
  - D. To show Du Toit determined which landmass Mesosaurus originated on
11. The word "**logical**" in the passage is closest in meaning to
- A. satisfactory
  - B. modern
  - C. reasonable
  - D. popular
12. Which of the following can be inferred from paragraph 5 about the Permian Mesosaurus of Brazil and South Africa?
- A. It was the dominant animal in the habitats in which it lived
  - B. It lived in similar environments in both places.

- C. It was a weak swimmer compared with other freshwater reptiles.
- D. Its physiology differed from that of modern freshwater reptiles.

### Paragraph 5

Alexander Du Toit, a South African geologist was one of Wegener's ardent supporters. ■He noted that fossils of the Permian freshwater reptile "Mesosaurus" occur in rocks of the same age in both Brazil and South Africa. ■Because the physiology of freshwater and marine animals is completely different, it is hard to imagine how a freshwater reptile could have swum across the Atlantic Ocean and then found a freshwater environment nearly identical to its former habitat. ■Furthermore, if Mesosaurus could have swum across the ocean, its fossil remains should occur in other localities besides Brazil and South Africa. ■It is more logical to assume that Mesosaurus lived in lakes in what are now adjacent areas of South America and Africa but were then united in a single continent.

13. Look at the four squares [■] that indicates where the following sentence could be added to the passage.

**In addition to supplying new geological evidence for continental drift, he crafted convincing arguments based on ancient life forms.**

Where would the sentence best fit?

14. Directions: An introductory sentence for a brief summary of the passage is provides below. Complete the summary by selecting the THREE answer choices that express the most important ideas in the passage. Some sentences do not belong in the summary because they express ideas that are not presented in the passage or are minor ideas in the passage. **This question is worth 2 points.**

**Several theories involving the movement of continents were proposed in the nineteenth and early twentieth centuries**

### Answer Choices

- A. Early maps showing the coastlines of South America and Africa inspired Eduard Suess to search for fossil evidence that today's southern continents had once been joined in a single landmass.

- B. To Eduard Suess, continental drift accounted for the presence of the same types of fossils on different continents that had at times been connected by land bridges.
- C. Du Toit's study of the freshwater reptile Mesosaurus added to the already considerable body of evidence that Alfred Wegener had gathered in support of the idea of continental drift.
- D. Frank Taylor expanded on Eduard Suess's theory of continental drift by arguing that tidal forces 100 million years ago had broken continents apart and caused the rise of the Mid-Atlantic Ridge.
- E. Alfred Wegener, who first developed the theory of continental drift argued that all landmasses were originally part of a supercontinent that broke up into separate continents.
- F. Early theories of continental drift were not widely accepted at the time because they failed to explain why continents moved.



## **Bioluminescence in Marine Creatures**

At night along the sea's edge, the ocean sometimes seems to glow, as if lit from within. This glow is the result of bioluminescence, a phenomenon exhibited by many of the sea's zooplankton. Bioluminescence is the production of cold light through internal biological processes, as opposed to phosphorescence or fluorescence, both of which are re-emitted light that was initially absorbed from an external source.

Many of the sea's creatures, including squid, dinoflagellates, bacteria, worms, crustaceans, and fish, are known to produce light. The process that marine creatures use to create light is like that of the common firefly and similar to that which creates the luminous green color seen in plastic glow sticks, often used as children's toys or for illumination during nighttime events. When a glow stick is bent, two chemicals mix, react, and create a third substance that gives off light. Bioluminescent organisms do essentially the same thing; they have a substance, called luciferin, that reacts with oxygen in the presence of enzyme, luciferase. When the reaction is complete, a new molecule is formed that gives off light—glowing blue—green in the underwater world. This biologically driven chemical reaction occurs within the organism's special light-producing cells, called photocytes, or light-producing organs, called photophores. Probably one of the most complex light-producing systems is that of the squid. Some squid have both photophores and chromatophores (organs for changing color) with their skin, thus enabling them to control both the color and intensity of the light produced. Recent research has also revealed that in some squid and fish, bioluminescent light may be produced by bacteria that live in a mutually beneficial partnership inside the animal's light organs.

How and why bioluminescence occurs is not fully understood; however, in the undersea realm, it appears to be used in a variety of interesting and ingenious ways. The most commonly observed form of bioluminescence in the sea is the pinpoint sparking of light at night that can create cometlike trails behind moving objects. Almost always, this is the result of dinoflagellates reacting to water motion. The relatively short, momentary displays of light may have evolved to startle, distract, or frighten would-be predators. Collection nets brought up from the sea's depths at night frequently glow

green at great distance. Slowly fading green blobs or pulses of light can be seen coming from the organisms within, often from gelatinous creatures. This type of light display may be used to stun disorient, or lure prey. Like a wide-eyed deer caught on a road and dazed by headlights, undersea creatures living within the ocean's darkness may be momentarily disoriented by short flashes of bioluminescent light. Another of the sea's light-producing organisms is a small copepod (a type of crustacean) named *Sapphirina iris*. In the water, *Sapphirina* creates short flashes of a remarkably rich, azure blue light. But its appearance under a microscope is even more spectacular, the living copepod appears as if constructed of delicately handcrafted, multicolored pieces of stained glass. Within the deep sea, some fish also have a dangling bioluminescent lure or a patch of luminescent skin near the mouth, which may be used to entice unsuspecting prey.

Other sea creatures have both light-sensing and light-producing organs. These creatures are thought to use bioluminescence as a form of communication or as a means of identifying an appropriate mate. In the lantern fish, the pattern of photophores distinguishes one species from another. In other fish, bioluminescence may help to differentiate males from females. The squid uses light as a means of camouflage. By producing light from the photophores on its underside, the squid can match light from above and become nearly invisible to predators looking up from below. Squid, as well as some of the gelatinous zooplankton, have also been known to release luminescent clouds or strands of organic material, possibly as a decoy to facilitate escape. And finally, because what they eat is often bioluminescent, many of the transparent deep-sea creatures have red or black stomachs to hide the potentially flashing contents of ingested bioluminescent creatures. Without such a blacked-out stomach, their digestive organs would flash like a neon sign that says, "Eat me, eat me!"

## **Paragraph 2**

Many of the sea's creatures, including squid, dinoflagellates, bacteria, worms, crustaceans, and fish, are known to produce light. The process that marine creatures use to create light is like that of **the common firefly** and similar to that which creates the luminous green color seen in plastic glow

sticks, often used as children's toys or for illumination during nighttime events. When a glow stick is bent, two chemicals mix, react, and create a third substance that gives off light. Bioluminescent organisms do essentially the same thing; they have a substance, called luciferin, that reacts with oxygen in the presence of enzyme, luciferase. When the reaction is complete, a new molecule is formed that gives off light—glowing blue—green in the underwater world. This biologically driven chemical reaction occurs within the organism's special light-producing cells, called photocytes, or light-producing organs, called photophores. Probably one of the most complex light-producing systems is that of the squid. Some squid have both photophores and chromatophores (organs for changing color) with their skin, thus enabling them to control both the color and intensity of the light produced. Recent research has also revealed that in some squid and fish, bioluminescent light may be produced by bacteria that live in a **mutually beneficial** partnership inside the animal's light organs.

1. Why does the author mention **the common firefly** in the passage?
  - A. To relate the light production of marine creature to that of a familiar light-producing species
  - B. To compare the light production of an insect with the more complex light production of marine creatures
  - C. To provide an example of a species that does not use a chemical reaction to produce light
  - D. To support the point that bioluminescence usually occurs at night
2. Which of the following statements about the chemical reaction that produces bioluminescence is NOT true, according to paragraph 2?
  - A. It occurs when luciferin reacts with oxygen.
  - B. It produces a glowing blue-green light.
  - C. It is much like the process by which children's toys are illuminated.
  - D. It requires organs called chromatophores.
3. Paragraph 2 demonstrates the complexity of certain squid by stating that
  - A. the squid employs its bioluminescent light to prevent bacteria from entering its organs
  - B. the squid controls both the color and intensity of the light it produces
  - C. the squid's light has greater intensity than that of fish

- D. the squid produces the enzyme luciferase when it produces light
4. The phrase “**mutually beneficial**” in the passage is closest in meaning to
- A. helpful to one another
  - B. generally practical
  - C. efficiently balanced
  - D. temporary by design
5. Which of the following statements about bioluminescent creatures is implied by paragraph 2?
- A. Bioluminescent creatures cannot produce light if bacteria enter their light organs.
  - B. Not all bioluminescent creatures have both photophores and chromatophores.
  - C. Most bioluminescent organisms do not need the enzyme luciferase in order to produce light.
  - D. Creatures with light-producing organs are much more common than those that have only light producing cells.

### Paragraph 3

How and why bioluminescence occurs is not fully understood; however, in the undersea realm, it appears to be used in a variety of interesting and **ingenious** ways. The most commonly observed form of bioluminescence in the sea is the pinpoint sparking of light at night that can create cometlike trails behind moving objects. Almost always, this is the result of dinoflagellates reacting to water motion. The relatively short, momentary displays of light may have evolved to startle, distract, or frighten would-be predators. Collection nets brought up from the sea’s depths at night frequently glow green at great distance. Slowly fading green blobs or pulses of light can be seen coming from the organisms within, often from gelatinous creatures. This type of light display may be used to stun, disorient, or lure prey. Like a wide-eyed deer caught on a road and dazed by headlights, undersea creatures living within the ocean’s darkness may be momentarily disoriented by short flashes of bioluminescent light. Another of the sea’s light-producing organisms is a small copepod (a type of crustacean) named *Sapphirina iris*. In

the water, *Sapphirina* creates short flashes of a remarkably rich, azure blue light. But its appearance under a microscope is even more spectacular, the living copepod appears as if constructed of **delicately** handcrafted, multicolored pieces of stained glass. Within the deep sea, some fish also have a dangling bioluminescent lure or a patch of luminescent skin near the mouth, which may be used to entice unsuspecting prey.

6. The word “**ingenious**” in the passage is closet in meaning to
- A. inventive
  - B. important
  - C. unusual
  - D. specialized
7. According to paragraph 3, when do dinoflagellates produce pinpoint sparkling displays of light?
- A. When they are caught in collection nets
  - B. When they are hunting food
  - C. When there is a sudden movement of the water around them
  - D. When they are stunned or disoriented
8. According to paragraph 3, what is notable when looking at *Sapphirina iris* under a microscope?
- A. It produces brief flashes of light.
  - B. Its body is a rich azure blue color.
  - C. It has luminescent skin on its mouth.
  - D. It looks as if it is made of glass of many colors.
9. Which of the following is NOT mentioned in paragraph 3 as a possible reason for the use of bioluminescence ?
- A. To provide a means of lighting the dark marine waters
  - B. To momentarily disorient other creatures
  - C. To frighten away potential predators
  - D. To attract prey
10. The word “**delicately**” in the passage is closet in meaning to
- A. individually
  - B. brilliantly
  - C. unusually
  - D. finely

#### Paragraph 4

Other sea creatures have both light-sensing and light-producing organs. These creatures are thought to use bioluminescence as a form of communication or as a means of identifying an appropriate mate. In the lantern fish, the pattern of photophores distinguishes one species from another. In other fish, bioluminescence may help to differentiate males from females. The squid uses light as a means of camouflage. By producing light from the photophores on its underside, the squid can match light from above and become nearly invisible to predators looking up from below. Squid, as well as some of the gelatinous zooplankton, have also been known to release luminescent clouds or strands of organic material, possibly as a decoy to facilitate escape. And finally, because what they eat is often bioluminescent, many of the transparent deep-sea creatures have red or black stomachs to hide the potentially flashing contents of **ingested** bioluminescent creatures. Without such a blacked-out stomach, their digestive organs would flash like a neon sign that says, “Eat me, eat me!”

11. According to paragraph 4, squid use bioluminescence to
  - A. communicate with other squid
  - B. locate mates
  - C. tell males and females apart
  - D. hide from predators
12. The word “**ingested**” in the passage is closest in meaning to
  - A. remaining
  - B. eaten
  - C. living
  - D. nutritious

#### Paragraph 4

Other sea creatures have both light-sensing and light-producing organs. These creatures are thought to use bioluminescence as a form of communication or as a means of identifying an appropriate mate. ■In the lantern fish, the pattern of photophores distinguishes one species from another. ■In other fish, bioluminescence may help to differentiate males from females. ■The squid uses light as a means of camouflage. ■By producing light from the photophores on its underside, the squid can match light from above

and become nearly invisible to predators looking up from below. Squid, as well as some of the gelatinous zooplankton, have also been known to release luminescent clouds or strands of organic material, possibly as a decoy to facilitate escape. And finally, because what they eat is often bioluminescent, many of the transparent deep-sea creatures have red or black stomachs to hide the potentially flashing contents of ingested bioluminescent creatures. Without such a blacked-out stomach, their digestive organs would flash like a neon sign that says, “Eat me, eat me!”

13. Look at the four squares [■] that indicate where the following sentence could be added to the passage

**Yet, certain species use bioluminescence for exactly the opposite purpose—to blend in with surroundings and become less identifiable.**

Where would the sentence best fit?

14. Directions: An introductory sentence for a brief summary of the passage is provided below. Complete the summary by selecting the THREE answer choices that express the most important ideas in the passage. Some sentences do not belong in the summary because they express ideas that are not presented in the passage or are minor ideas in the passage. This question is worth 2 points.

**Many of the sea’s creatures produce light through bioluminescence.**

#### **Answer Choices**

- A. Bioluminescent creature use a substance called luciferin and an enzyme to produce light in a biologically driven chemical reaction.
- B. Bioluminescence can be used to achieve various and sometimes seemingly opposite goals such as frightening away predators or luring prey.
- C. Bioluminescence can be used by some sea creatures as a form of communication or as a means of identifying an appropriate mate.
- D. The majority of bioluminescent creatures are gelatinous in nature, allowing them to produce light.
- E. The same bioluminescent creature cannot have both light-sensing and light-producing organs.
- F. Sea creatures that eat bioluminescent material possess special chemicals that keep their stomach contents from flashing.

## **Bird Colonies**

About 13 percent of bird species, including most seabirds, nest in colonies. Colonial nesting evolves in response to a combination of two environmental conditions: (1) a shortage of nesting sites that are safe from predators and (2) abundant or unpredictable food that is distant from safe nest sites. Colonial nesting has both advantages and disadvantages. First and foremost, individual birds are safer in colonies that are inaccessible to predators, as on small rocky islands. In addition, colonial birds detect predators more quickly than do small groups or pairs and can drive the predators from the vicinity of the nesting area. Because nests at the edges of breeding colonies are more vulnerable to predators than those in the centers, the preference for advantageous central sites promotes dense centralized packing of nests.

The yellow-rumped cacique, which nests in colonies in Amazonian Peru, demonstrates how colonial birds prevent predation. These tropical blackbirds defend their closed, pouchlike nests against predators in three ways. First, by nesting on islands and near wasp nests, caciques are safe from arboreal mammals such as primates. Second, caciques mob predators (work together as a group to attack predators). The effectiveness of mobbing as increases with group size, which increases with colony size. Third, caciques hide their nests from predators by mixing active nests with abandoned nests. Overall, nests in clusters on islands and near wasp nests suffer the least predation.

Coordinated social interactions tend to be weak when a colony is first forming, but true colonies provide extra benefits. Synchronized nesting, for example, produces abundance of eggs and chicks that exceeds the daily needs of local predators. Additionally, colonial neighbors can improve their foraging by watching others. This behavior is especially valuable when the offsite food supplies are restricted or variable in location, as are swarms of aerial insects harvested by swallows. The colonies American cliff swallows, for example, serve as information centers from which unsuccessful individual birds follow successful neighbors to good feeding sites. Cliff swallows that are unable to find food return to their colony, locate a neighbor that has been successful, and then follow that neighbor to its food source. All birds in the colony are equally likely to follow or to be followed and thus contribute to the sharing of information that helps to ensure their reproductive success. As a result of their



enhanced foraging efficiency, parent swallows in large colonies return with food for their nestlings more often and bring more food each trip than do parents in small colonies.

To support large congregations of birds, suitable colony sites must be near rich, clumped food supplies. Colonies of pinyon jays and red crossbills settle near seed-rich conifer forests, and wattled starlings nest in large colonies near locust outbreaks. The huge colonies of guanay cormorants and other seabirds that nest on the coast of Peru depend on the productive cold waters of the Humboldt Current. The combination of abundant food in the Humboldt Current and the vastness of oceanic habitat can support enormous populations of seabirds, which concentrate at the few available nesting locations. The populations crash when their food supplies decline during **El Niño** years.

Among the costs, colonial nesting leads to increased competition for nest sites and mates, the stealing of nest materials, and increased physical interference among other effects. In spite of food abundance, large colonies sometimes exhaust their local food supplies and abandon their nests. Large groups also attract predators, especially raptors, and facilitate the spread of parasites and diseases. The globular mud nests in large colonies of the American cliff swallow, for example, are more likely to be infested by fleas or other bloodsucking parasites than are nests in small colonies. Experiments in which some burrows were fumigated to kill the parasites showed that these parasites lowered survivorship by as much as 50 percent in large colonies but not significantly in small ones. The swallows inspect and then select parasite-free nests. In large colonies, they tend to build new nests rather than use old, infested ones. On balance, the advantages of colonial nesting clearly outweigh the disadvantages, given the many times at which colonial nesting has evolved independently among different groups of birds. Still lacking, however, is a general framework for testing different hypotheses for the evolution of coloniality

### **Paragraph 1**

About 13 percent of bird species, including most seabirds, nest in colonies. Colonial nesting evolves in response to a combination of two environmental

conditions: (1) a shortage of nesting sites that are safe from predators and (2) abundant or unpredictable food that is distant from safe nest sites. Colonial nesting has both advantages and disadvantages. First and foremost, individual birds are safer in colonies that are inaccessible to predators, as on small rocky islands. In addition, colonial birds detect predators more quickly than do small groups or pairs and can drive the predators from the **vicinity** of the nesting area. Because nests at the edges of breeding colonies are more vulnerable to predators than those in the centers, the preference for advantageous central sites promotes dense centralized packing of nests.

1. The word “**vicinity**” in the passage is closest in meaning to
  - A. protection
  - B. region
  - C. population
  - D. resources
2. Which of the sentences below best expresses the essential information in the highlighted sentence in the passage? Incorrect choices change the meaning in important ways or leave out essential information.
  - A. It is more advantageous for birds to choose central locations for their colonies rather than locations near the edges of their territory.
  - B. Compared to nests at the edges of colonies, centrally located nests are preferred for their safety from predators and therefore are more densely packed together.
  - C. Predators generally prefer the densely packed, central portion of nesting colonies, which can make this part of the colony more vulnerable to predators.
  - D. Birds nesting in colonies that are vulnerable to predators tend to prefer more densely packed nests to those less densely.

## **Paragraph 2**

The yellow-rumped cacique, which nests in colonies in Amazonian Peru, demonstrates how colonial birds prevent predation. These tropical blackbirds defend their closed, pouchlike nests against predators in three ways. First, by nesting on islands and near wasp nests, caciques are safe from arboreal mammals such as primates. Second, caciques mob predators (work together

as a group to attack predators). The effectiveness of mobbing as increases with group size, which increases with colony size. Third, caciques hide their nests from predators by mixing active nests with abandoned nests. Overall, nests in clusters on islands and near wasp nests suffer the least predation.

3. Paragraph 2 implies which of the following about yellow-rumped caciques?
- A. They are comparatively unlikely to be harmed by the wasps that attack their predators.
  - B. They are able to protect their nests without using colonies.
  - C. Mixing active nests with abandoned nests is the least useful way of defending their nests.
  - D. Most of their predators are members of other bird species.
4. Paragraph 2 claims that yellow-rumped cacique colonies defend themselves from predators in all of the following ways EXCEPT:
- A. They establish colonies in hard-to-reach places.
  - B. They physically attack invading predators.
  - C. They hide active nests among previously used ones.
  - D. They limit the size of their colonies so they are hard to find.

### **Paragraph 3**

Coordinated social interactions tend to be weak when a colony is first forming, but true colonies provide extra benefits. Synchronized nesting, for example, produces abundance of eggs and chicks that exceeds the daily needs of local predators. Additionally, colonial neighbors can improve their foraging by watching others. This behavior is especially valuable when the offsite food supplies are restricted or variable in location, as are swarms of aerial insects harvested by swallows. The colonies of American cliff swallows, for example, serve as information centers from which unsuccessful individual birds follow successful neighbors to good feeding sites. Cliff swallows that are unable to find food return to their colony, locate a neighbor that has been successful, and then follow that neighbor to its food source. All birds in the colony are equally likely to follow or to be followed and thus **contribute to** the sharing of information that helps to ensure their reproductive success. As a result of their enhanced foraging efficiency, parent swallows in large colonies return with food for their nestlings more often and bring more food each trip than do

parents in small colonies.

5. The phrase “**contribute to**” in the passage is closest in meaning to
- A. learn from
  - B. depend upon
  - C. take advantage of
  - D. add to
6. According to paragraph 3, what advantage do birds gain by hatching all the colony’s eggs at the same time?
- A. They are able to time the hatching of their chicks for when predators are not likely to be around.
  - B. Chicks hatch when food is abundant, which is generally only a few times a year.
  - C. Even if predators eliminate some of the newly hatched birds, many others will survive.
  - D. Weaker birds gain protection for their young by synchronizing their nesting behavior with that of the more dominant birds of the colony.
7. According to paragraph 3, cliff swallows closely observe other members of their colony in order to
- A. follow successful birds to safe nesting sites
  - B. learn the location of local predators
  - C. place their eggs near other birds in the colony
  - D. find good source of food

#### **Paragraph 4**

To support large congregations of birds, suitable colony sites must be near rich, clumped food supplies. Colonies of pinyon jays and red crossbills settle near seed-rich conifer forests, and wattled starlings nest in large colonies near locust outbreaks. The huge colonies of guanay cormorants and other seabirds that nest on the coast of Peru depend on the productive cold waters of the Humboldt Current. The combination of abundant food in the Humboldt Current and the vastness of oceanic habitat can support enormous populations of seabirds, which concentrate at the few available nesting locations. The populations crash when their food supplies decline during [El Niño](#) years.

8. Which of the following is a probable effect of the fact mentioned in paragraph 4 that there are few available nesting locations near the Humboldt Current?
- A. Seabirds compete with each other for a limited supply of food.
  - B. The number of seabirds at any one site is extremely large.
  - C. Some seabirds nest in conifer forests near locust outbreaks.
  - D. Colonies near the Humboldt Current small numbers of seabirds.

### Paragraph 5

Among the costs, colonial nesting leads to increased competition for nest sites and mates, the stealing of nest materials, and increased physical interference among other effects. In spite of food abundance, large colonies sometimes **exhaust** their local food supplies and abandon their nests. Large groups also attract predators, especially raptors, and facilitate the spread of parasites and diseases. The globular mud nests in large colonies of the American cliff swallow, for example, are more likely to be infested by fleas or other bloodsucking parasites than are nests in small colonies. Experiments in which some burrows were fumigated to kill the parasites showed that these parasites lowered survivorship by as much as 50 percent in large colonies but not significantly in small ones. The swallows inspect and then select parasite-free nests. In large colonies, they tend to build new nests rather than use old, infested ones. **On balance**, the advantages of colonial nesting clearly outweigh the disadvantages, given the many times at which colonial nesting has evolved independently among different groups of birds. Still lacking, however, is a general framework for testing different hypotheses for the evolution of coloniality

9. The word “**exhaust**” in the passage is closest in meaning to
- A. use up
  - B. leave
  - C. avoid
  - D. hide
10. The phrase “**On balance**” in the passage is closest in meaning to
- A. Nevertheless
  - B. Overall

- C. Therefore
  - D. Periodically
11. In paragraph 5, why does the author discuss experiments in which some burrows were fumigated?
- A. To demonstrate that parasites have a very negative effect on large colonies
  - B. To show that attacks by predators are a worse problem than the spread of parasites
  - C. To explain how swallows inspect nests for parasites
  - D. To prove that the benefits of colonial nesting outweigh the disadvantages
12. Which of the following questions is answered by paragraph 5?
- A. What causes colonies to have problems with their food supplies?
  - B. What are the disadvantages of colonial nesting?
  - C. What percentage of cliff swallow nests are infected by parasites?
  - D. How can one test the different hypotheses explaining the evolution of bird colonies?

### **Paragraph 3**

Coordinated social interactions tend to be weak when a colony is first forming, but true colonies provide extra benefits. ■ Synchronized nesting, for example, produces abundance of eggs and chicks that exceeds the daily needs of local predators. ■ Additionally, colonial neighbors can improve their foraging by watching others. ■ This behavior is especially valuable when the offsite food supplies are restricted or variable in location, as are swarms of aerial insects harvested by swallows. ■ The colonies of American cliff swallows, for example, serve as information centers from which unsuccessful individual birds follow successful neighbors to good feeding sites. Cliff swallows that are unable to find food return to their colony, locate a neighbor that has been successful, and then follow that neighbor to its food source. All birds in the colony are equally likely to follow or to be followed and thus contribute to the sharing of information that helps to ensure their reproductive success. As a result of their enhanced foraging efficiency, parent swallows in large colonies return with food for their nestlings more often and bring more food each trip than do parents in small colonies.

13. Look at the four squares [■] that indicates where the following sentence could be added to the passage.

**The overall survival of the nest generation is thus enhanced.**

Where would the sentence best fit?

14. Directions: An introductory sentence for a brief summary of the passage is provides below. Complete the summary by selecting the THREE answer choices that express the most important ideas in the passage. Some sentences do not belong in the summary because they express ideas that are not presented in the passage or are minor ideas in the passage. This question is worth 2 points.

**In response to environment pressure, many species of birds have developed the practice of nesting in colonies**

#### **Answer Choices**

- A. The abundance of food on rocky islands makes them an attractive environment for bird species that nest in colonies, including the yellow-rumped cacique.
- B. Because they are not able to physically defend themselves from predators, yellow-rumped caciques rely on hiding their active nests among empty nests to confuse predators.
- C. The challenge of protecting nests and newborn chicks from predators is a major contributor to the evolution of large colonies.
- D. Colonial life provides birds with benefits besides protection from predators including help with finding food.
- E. There are some disadvantages associated with life in large colonies like the increased rate of infestation by parasites.
- F. The concentration of bird colonies along coasts makes their inhabitants especially vulnerable to food shortages and weather-related destruction.

## **Artisans in Sixteenth-Century Europe**

For centuries European artisans had operated in small, autonomous handicraft businesses, but by the sixteenth century an evolving economic system—moving toward modern capitalism, with its free-market pricing, new organization of production, investments, and so on—had started to erode their stable and relatively prosperous position. What forces contributed to the decline of the artisan?

In a few industries there appeared technological innovations that cost more to install and operate than artisans—even associations of artisans—could afford. For example, in iron production, such specialized equipment as blast furnaces, tilt hammers, wire-drawing machines, and stamping, rolling, and slitting mills became more familiar components of the industry. Thus the need for fixed capital (equipment and buildings used in production) soared. Besides these items, expensive in their own right, facilities for water, storage, and deliveries were needed. In addition, pig (raw) iron turned out by blast furnaces could not be forged until refined further in a new intermediate stage. In late sixteenth-century Antwerp, where a skilled worker earned 125 to 250 guilders a year, a large blast furnace alone cost 3,000 guilders, and other industrial equipment was equally or more expensive.

Raw materials, not equipment, constituted artisans' major expense in most trades, however. Whereas in 1583 an Antwerp silk weaver paid 12 guilders for a loom( and made small payments over many years to pay off the debt for purchasing the loom), every six weeks he or she had to lay out 24 guilders for the 2 pounds of raw silk required to make a piece of cloth. Thus access to cheap and plentiful primary materials was a constant preoccupation for independent producers. Using local materials might allow even the poorest among them to avoid reliance on merchant suppliers. The loss of nearby sources could therefore be devastating. As silk cultivation waned around the Spanish cities of Cordoba and Toledo, weavers in these cities were forced to become employees of merchants who put out raw silk from Valencia and



Murcia provinces. In the Dutch Republic, merchants who imported unprocessed salt from France, Portugal, and Spain gained control of the salt-refining industry once exploitation of local salt marshes was halted for fear that dikes (which held back the sea from the low-lying Dutch land) would be undermined.

Credit was necessary for production but created additional vulnerabilities for artisans. Prices for industrial products lagged behind those of raw materials and foodstuffs, and this, coupled with rising taxes, made it difficult for many producers to repay their creditors. Periodic downturns, when food prices shot up and demand for manufactures fell off, drove them further into debt or even into bankruptcy, from which they might emerge only by agreeing to sell their products exclusively to merchants or fellow artisans who extended them loans. Frequent enough during periods of growth, such credit crises became deeper and lasted longer after about 1570, as did war-related disruptions of raw-material supplies and markets.

Artisans' autonomy was imperiled, too, by restrictions on their access to markets. During the sixteenth century, a situation like this often resulted from the concentration of export trade in a few great storage and distribution centers. The disappearance of regional markets where weavers in Flanders (what is now northern Belgium) had previously bought flax and sold linen left them at the mercy of big-city middlemen, who quickly turned them into domestic workers. In a similar fashion, formerly independent producers in southern Wiltshire in England, who had bought yarn from spinners or local brokers and sold their cloth to merchants in nearby Salisbury, became subject to London merchants who monopolized both wool supplies and woollens exports.

With good reason, finally, urban artisans feared the growth of industries in the countryside. For one thing, they worried that the spread of village crafts would reduce their supply of raw materials, driving up prices. City producers also knew that rural locations enjoyed lower living costs, wages, and taxes,

and often employed fewer or simplified processes. These advantages became a major preoccupation as competition intensified in the 1570s and 1580s.

### Paragraph 1

For centuries European artisans had operated in small, autonomous handicraft businesses, but by the sixteenth century an evolving economic system—moving toward modern capitalism, with its free-market pricing, new organization of production, investments, and so on—had started to erode their stable and relatively prosperous position. What forces contributed to the decline of the artisan?

1. Which of the sentences below best expresses the essential information in the highlighted sentence in the passage? Incorrect choices change the meaning in important ways or leave out essential information.
  - A. In the sixteenth century, the European economy moved toward a system of free-market pricing, new ways of production, and investments.
  - B. Before the sixteenth century, European makers of handicrafts enjoyed stability, autonomy, and relative prosperity.
  - C. By the sixteenth century, the rise of capitalism began to weaken the autonomy and relative prosperity of European artisans.
  - D. European artisans operated small, autonomous businesses before modern capitalism emerged in the sixteenth century.

### Paragraph 2

In a few industries there appeared technological innovations that cost more to install and operate than artisans—even associations of artisans—could afford. For example, in iron production, such specialized equipment as blast furnaces, tilt hammers, wire-drawing machines, and stamping, rolling, and slitting mills became more familiar components of the industry. Thus the need for fixed capital (equipment and buildings used in production) soared. **Besides** these items, expensive in their own right, facilities for water, storage,

and deliveries were needed. In addition, pig (raw) iron turned out by blast furnaces could not be forged until refined further in a new intermediate stage. In late sixteenth-century Antwerp, where a skilled worker earned 125 to 250 guilders a year, a large blast furnace alone cost 3,000 guilders, and other industrial equipment was equally or more expensive.

2. The word “ **Besides** ” in the passage is closest in meaning to
- A. In addition to
  - B. More important than
  - C. Different from
  - D. Together with
3. According to paragraph 2, how did technological advance contribute to the economic decline of artisans?
- A. Artisans had no place to store or use the new machines.
  - B. Goods produced by the new technology were cheaper than those produced by artisans.
  - C. The fixed costs of remaining in business became very high.
  - D. Artisans did not know how to use the new machines.

### **Paragraph 3**

Raw materials, not equipment, constituted artisans’ major expense in most trades, however. Whereas in 1583 an Antwerp silk weaver paid 12 guilders for a loom ( and made small payments over many years to pay off the debt for purchasing the loom), every six weeks he or she had to lay out 24 guilders for the 2 pounds of raw silk required to make a piece of cloth. Thus access to cheap and plentiful primary materials was a constant **preoccupation** for independent producers. Using local materials might allow even the poorest among them to avoid reliance on merchant suppliers. The loss of nearby sources could therefore be devastating. As silk cultivation waned around the Spanish cities of Cordoba and Toledo, weavers in these cities were forced to become employees of merchants who put out raw silk from Valencia and

Murcia provinces. In the Dutch Republic, merchants who imported unprocessed salt from France, Portugal, and Spain gained control of the salt-refining industry once exploitation of local salt marshes was halted for fear that dikes (which held back the sea from the low-lying Dutch land) would be undermined.

4. The word “**preoccupation**” in the passage is closest in meaning to
- A. necessity
  - B. concern
  - C. struggle
  - D. uncertainty
5. In paragraph 3, why does the author provide the information about an Antwerp silk weaver’s costs in 1583?
- A. To describe some typical costs in the silk-weaving industry
  - B. To support the statement that artisans’ main expense was materials, not equipment
  - C. To argue against the view that artisans did not have to borrow money to buy equipment
  - D. To show that materials were cheap and plentiful for most artisans
6. What can be inferred from paragraph 3 about local materials?
- A. They were of higher quality than imported materials.
  - B. They were usually more plentiful than imported materials.
  - C. They remained available even after merchants began to control the industries.
  - D. They tended to be more affordable than materials supplied by merchants.
7. According to paragraph 3, which of the following was sometimes an effect on artisans of the loss of local sources of their primary materials?
- A. They had to sell their products to merchants.
  - B. They needed to take loans in order to buy the materials from merchants.
  - C. They could no longer afford to be independent producers.
  - D. They imported the materials from distant sources.

#### Paragraph 4

Credit was necessary for production but created additional vulnerabilities for artisans. Prices for industrial products lagged behind those of raw materials and foodstuffs, and this, **coupled with** rising taxes, made it difficult for many producers to repay their creditors. Periodic downturns, when food prices shot up and demand for manufactures fell off, drove them further into debt or even into bankruptcy, from which they might emerge only by agreeing to sell their products exclusively to merchants or fellow artisans who extended them loans. Frequent enough during periods of growth, such credit crises became deeper and lasted longer after about 1570, as did war-related disruptions of raw-material supplies and markets.

8. The phrase “**coupled with**” in the passage is closest in meaning to
- A. caused by
  - B. compared with
  - C. affected by
  - D. combined with
9. According to paragraph 4, all of the following caused economic difficulties for artisans EXCEPT
- A. decreasing availability of credit
  - B. decreased demand for manufactured goods
  - C. increased taxes
  - D. problems caused by wars

#### Paragraph 5

Artisans’ **autonomy** was imperiled, too, by restrictions on their access to markets. During the sixteenth century, a situation like this often resulted from the concentration of export trade in a few great storage and distribution centers. The disappearance of regional markets where weavers in Flanders (what is now northern Belgium) had previously bought flax and sold linen left them at the mercy of big-city middlemen, who quickly turned them into

domestic workers. In a similar fashion, formerly independent producers in southern Wiltshire in England, who had bought yarn from spinners or local brokers and sold their cloth to merchants in nearby Salisbury, because subject to London merchants who monopolized both wool supplies and woolens exports.

10. The word “ **autonomy** ” in the passage is closest in meaning to
- A. independence
  - B. influence
  - C. ability to make a living
  - D. ability to adapt
11. Paragraph 5 supports which of the following statements about artisans during the sixteenth century?
- A. They had difficulty transporting their goods to the best markets.
  - B. They were at a disadvantage because the concentration of supplies and export was in the hands of big-city merchants.
  - C. They received higher wages as employees of big-city merchants.
  - D. They were able to obtain raw materials from local merchants.

### **Paragraph 6**

With good reason, finally, urban artisans feared the growth of industries in the countryside. For one thing, they worried that the spread of village crafts would reduce their supply of raw materials, driving up prices. City producers also knew that rural locations enjoyed lower living costs, wages, and taxes, and often employed fewer or simplified processes. These advantages became a major preoccupation as competition intensified in the 1570s and 1580s.

12. All of the following are identified in paragraph 6 as concerns that urban artisans had about the growth of industry in the countryside EXCEPT
- A. a decrease in the supply of raw materials
  - B. a cheaper cost of living in the countryside
  - C. a more manageable level of competition

D. less complex production processes in the countryside

Raw materials, not equipment, constituted artisans' major expense in most trades, however. ■ Whereas in 1583 an Antwerp silk weaver paid 12 guilders for a loom( and made small payments over many years to pay off the debt for purchasing the loom), every six weeks he or she had to lay out 24 guilders for the 2 pounds of raw silk required to make a piece of cloth. ■ Thus access to cheap and plentiful primary materials was a constant preoccupation for independent producers. ■ Using local materials might allow even the poorest among them to avoid reliance on merchant suppliers. ■ The loss of nearby sources could therefore be devastating. As silk cultivation waned around the Spanish cities of Cordoba and Toledo, weavers in these cities were forced to become employees of merchants who put out raw silk from Valencia and Murcia provinces. In the Dutch Republic, merchants who imported unprocessed salt from France, Portugal, and Spain gained control of the salt-refining industry once exploitation of local salt marshes was halted for fear that dikes (which held back the sea from the low-lying Dutch land) would be undermined.

13. Look at the four squares [■ ] that indicate where the following sentence could be added to the passage.

**This was possible because when transportation costs were low, the price of raw materials was generally also low.**

Where would the sentence best fit?

- 14.Directions:** An introductory sentence for a brief summary of the passage is provided below. Complete the summary by selecting the THREE answer choices that express the most important ideas in the passage. Some sentences do not belong in the summary because they express ideas that are not presented in the passage or are minor ideas in the passage. **This question is worth 2 points.**

**European artisans experienced a decline during the sixteenth century as result of a number of developments.**

**Answer choices**

- A.** Advances in technology in some industries increased the cost of the equipment, buildings, and facilities that artisans needed for producing and selling their goods.
- B.** Artisans' ability to earn profits was restricted by their dependence on creditors, to whom they were forced to sell their goods, and by competition from rural areas.
- C.** As industries came under the control of merchants, artisans lost access to cheap raw materials, and they had to borrow money to buy the materials they needed from merchant suppliers.
- D.** Iron production in the sixteenth century depended on new inventions such as blast furnaces, tilt hammers, wire-drawing machines, and stamping, rolling, and slitting mills.
- E.** The rising prices of food and other necessities often left artisans without enough money to pay their taxes and other business expenses.
- F.** In the new industrial system from which skilled artisans were progressively excluded, the quality of manufactured items gradually declined.



## **Disease and History**

### ***What is the relationship between disease and the evolution of human societies?***

Epidemiology is the study of the causes, distribution, and control of diseases in populations. Throughout history, there have been general trends in the relationship between diseases and the human species. Anthropologist George Armelagos has outlined these trends and refers to them as three “epidemiological transitions”.

For most of our species’ history, we lived in small, widely dispersed, nomadic groups. Our ancestors certainly experienced diseases of various sorts and would have come into contact with new diseases as they migrated to new environments. But infectious disease may not have had serious effects on large numbers of people or many different populations, since diseases would have had little chance of being passed on to many other humans.

When some people began to settle down and produce their food through farming and animal domestication – starting about 10,000 years ago – the *first epidemiological transition* occurred. Infectious diseases increased in impact, as larger and denser concentrations of people provided greater opportunity for disease to be passed from host to host. Animal domestication may have brought people into contact with new diseases previously limited to other species. Working the soil would have exposed farmers to insects and other pathogens. Irrigation in some areas provided breeding places for mosquitoes, increasing the incidence of malaria and other mosquito-borne diseases. Sanitation problems caused by larger, more sedentary populations would have helped transmit diseases in human waste, as would the use of animal dung for fertilizer. In addition, agriculture also led to a narrowing of food sources, as compared to the varied diets of hunters and gatherers. This could have resulted in nutritional deficiencies, moreover, the storage of food surpluses attracted new disease carriers such as insects and rats. Trade between settled communities helped spread diseases over large geographic

areas, as in the case of the Black Death in Europe. Epidemics, in the sense of diseases that affect a large number of populations at the same time, were essentially nonexistent until the development of agricultural economies.

Beginning in the last years of the nineteenth century and continuing into the twentieth, we experienced the *second epidemiological transition*. With modern medical science providing immunizations and antibiotics and with better public health measures and improved nutrition, many infectious diseases were brought under control, or even eliminated. In terms of what ailed and killed us, there was a shift to chronic diseases such as heart and lung diseases. The increase in many of these came not only from the fact that fewer people were dying from infectious disease and were living longer but also from the results of modern lifestyles in developed countries and among the upper classes of developing countries – a more sedentary life leading to less physical activity, more stress; environmental pollution, and high-fat diets. But at least, we thought, many of these problems were things we could potentially control; all those infectious epidemics were of the past.

But on the heels of the second transition had come the *third epidemiological transition*, and we are in it now. New diseases are emerging, and old ones are returning. Both of these phenomena can be understood in terms of evolutionary theory.

The return of old diseases is the result of the fact that microorganisms are evolving species themselves. For example, new and serious antibiotic-resistant strains of tuberculosis have recently appeared. This evolution may have been encouraged by what some authorities consider our overuse of antibiotics, giving microorganisms a greater chance to evolve resistance by exposing them to a constant barrage of selective challenges. Some bacteria reproduce *hourly*, and so the processes of genetic mutation and natural selection are speeded up in these species.

Emerging diseases are also the result of human activity in the modern world, which brings more people into contact with more diseases, some of

which were unheard of even a few decades ago. As people and their products become more mobile, and as our populations spread into previously little-inhabited areas, cutting down forests and otherwise altering ecological conditions, we contact other species that may carry diseases to which they are immune but that prove deadly to us.

### **Paragraph 2**

For most of our species' history, we lived in small, widely **dispersed**, nomadic groups. Our ancestors certainly experienced diseases of various sorts and would have come into contact with new diseases as they migrated to new environments. But infectious disease may not have had serious effects on large numbers of people or many different populations, since diseases would have had little chance of being passed on to many other humans.

1. The word “ **dispersed** ” in the passage is closest in meaning to
  - A. active
  - B. scattered
  - C. varied
  - D. linked
2. According to paragraph 2, why were infectious diseases not a serious problem for most of human history?
  - A. There were very few infectious diseases early in human history.
  - B. Population groups did not move around enough to be exposed to new diseases.
  - C. Many disease-causing organisms had features that made them difficult to pass on to other humans.
  - D. Population groups did not have enough contact with each other to spread diseases widely.

### **Paragraph 3**

When some people began to settle down and produce their food through

farming and animal domestication – starting about 10,000 years ago – the *first epidemiological transition* occurred. Infectious diseases increased in impact, as larger and denser concentrations of people provided greater opportunity for disease to be passed from host to host. Animal domestication may have brought people into contact with new diseases previously limited to other species. Working the soil would have exposed farmers to insects and other pathogens. Irrigation in some areas provided breeding places for mosquitoes, increasing the incidence of malaria and other mosquito-borne diseases. Sanitation problems caused by larger, more sedentary populations would have helped transmit diseases in human waste, as would the use of animal dung for fertilizer. In addition, agriculture also led to a narrowing of food sources, as compared to the varied diets of hunters and gatherers. This could have resulted in nutritional **deficiencies**, moreover, the storage of food surpluses attracted new disease carriers such as insects and rats. Trade between settled communities helped spread diseases over large geographic areas, as in the case of the Black Death in Europe. Epidemics, in the sense of diseases that affect a large number of populations at the same time, were essentially nonexistent until the development of agricultural economies.

3. The word “**deficiencies**” in the passage is closest in meaning to
- A. complications
  - B. illnesses
  - C. shortages
  - D. irregularities
4. According to paragraph 3, which of the following contributed to the rise of epidemics?
- A. The development of more deadly forms of human disease
  - B. The spread of ineffective treatments for infectious disease
  - C. The spread of mosquito-borne diseases to other disease carriers
  - D. The practice of exchanging goods between settled areas
5. Which of the following is NOT mentioned in paragraph 3 as a reason that

agriculture led to greater exposure to disease?

- A. Irrigation created areas where disease-carrying mosquitoes could reproduce.
  - B. People increasingly came into contact with disease-carrying animals attracted to food storage areas.
  - C. Agricultural products spoiled more readily, leading to more frequent episodes of disease.
  - D. Farming exposed humans to disease-carrying insects in the soil.
6. According to paragraph 3, how did sanitation problems in early farming societies lead to the spread of infectious diseases?
- A. Water used for irrigating crops was not always clean.
  - B. Larger populations were increasingly exposed to human and animal waste.
  - C. Farm products that spoiled in fields attracted insects and animals with diseases.
  - D. Lack of varied food sources occasionally forced communities to eat food that carried diseases.

#### **Paragraph 4**

Beginning in the last years of the nineteenth century and continuing into the twentieth, we experienced the *second epidemiological transition*. With modern medical science providing immunizations and antibiotics and with better public health measures and improved nutrition, many infectious diseases were brought under control, or even eliminated. In terms of what ailed and killed us, there was a shift to chronic diseases such as heart and lung diseases. The increase in many of these came not only from the fact that fewer people were dying from infectious disease and were living longer but also from the results of modern lifestyles in developed countries and among the upper classes of developing countries – a more sedentary life leading to less physical activity, more stress; environmental pollution, and high-fat diets. But at least,

we thought, many of these problems were things we could potentially control; all those infectious epidemics were of the past.

7. According to paragraph 4, what is true about chronic diseases during second epidemiological transition?
  - A. They were common among people with high living standards.
  - B. They could be controlled with antibiotics.
  - C. They affected more people than infectious diseases did.
  - D. They led people to seek healthier lifestyles.
8. According to paragraph 4, which of the following best describes the second epidemiological transition?
  - A. Modern medicine made it possible for people to live longer even if they had an infectious disease.
  - B. Infectious diseases were harder to cure due to factors like stress and pollution.
  - C. New infectious diseases appeared as quickly as modern medical science was able to control old ones.
  - D. Chronic diseases replaced infectious diseases as the major cause of human sickness and death.
9. According to paragraph 4, all of the following likely contributed to chronic disease EXCEPT
  - A. longer life expectancies
  - B. decreased physical activity
  - C. higher rates of poverty
  - D. changes in diet

### Paragraph 5

But on the heels of the second transition had come the *third epidemiological transition*, and we are in it now. New diseases are **emerging**, and old ones are returning. Both of these phenomena can be understood in terms of evolutionary theory.

10. The word “**emerging**” in the passage is closest in meaning to

- A. appearing
- B. spreading
- C. becoming more serious
- D. replacing others

### **Paragraph 6**

The return of old diseases is the result of the fact that microorganisms are evolving species themselves. For example, new and serious antibiotic-resistant strains of tuberculosis have recently appeared. This evolution may have been encouraged by what some authorities consider our overuse of antibiotics, giving microorganisms a greater chance to evolve resistance by exposing them to a constant barrage of selective challenges. Some bacteria reproduce *hourly*, and so the processes of genetic mutation and natural selection are speeded up in these species.

11. What can be inferred from the discussion of antibiotic-resistant strains of bacteria in paragraph 6?

- A. Most microorganisms cannot survive multiple exposures to antibiotics.
- B. Tuberculosis strains are much more likely to be antibiotic-resistant than are other microorganisms.
- C. Bacteria that reproduce quickly are more likely to become resistant to antibiotics.
- D. Exposing microorganisms to a constant barrage of antibiotics prevents them from evolving resistance.

### **Paragraph 7**

Emerging diseases are also the result of human activity in the modern world, which brings more people into contact with more diseases, some of which were unheard of even a few decades ago. As people and their products become more mobile, and as our populations spread into previously

little-inhabited areas, cutting down forests and otherwise altering ecological conditions, we contact other species that may carry diseases to which they are immune but that prove deadly to us.

12. Which of the sentences below best expresses the essential information in the highlighted sentence in the passage? Incorrect choices change the meaning in important ways or leave out essential information.
- A. Humans contact other species during population growth into previously little-inhabited areas.
  - B. Species that carry diseases deadly to humans live in areas with small, mobile populations.
  - C. Increased mobility and population expansion into new areas exposes humans to new, deadly diseases carried by other species.
  - D. Some species that humans contact in little-inhabited areas are immune to diseases that are deadly to humans.

When some people began to settle down and produce their food through farming and animal domestication – starting about 10,000 years ago – the *first epidemiological transition* occurred. ■ Infectious diseases increased in impact, as larger and denser concentrations of people provided greater opportunity for disease to be passed from host to host. ■ Animal domestication may have brought people into contact with new diseases previously limited to other species. ■ Working the soil would have exposed farmers to insects and other pathogens. ■ Irrigation in some areas provided breeding places for mosquitoes, increasing the incidence of malaria and other mosquito-borne diseases.

13. Look at the four squares [■] that indicate where the following sentence could be added to the passage. Where would the sentence best fit?

**But the denser populations of agricultural communities were only one of many factors contributing to the increased risk of disease.**



**14.Directions:** An introductory sentence for a brief summary of the passage is provided below. Complete the summary by selecting the THREE answer choices that express the most important ideas in the passage. Some sentences do not belong in the summary because they express ideas that are not presented in the passage or are minor ideas in the passage. **This question is worth 2 points.**

**Throughout history, the impact of diseases on humans has changed as human societies have developed.**

**Answer choices**

- A.** In early human history, nomadic groups started encountering diseases when they moved to new environments.
- B.** The transition to farming meant that humans had both more contact with one another and with other species that carried diseases, leading to disease epidemics.
- C.** Once advances in medical science resulted in better control or elimination of many infectious diseases, diseases resulting from the modern lifestyle became a major problem.
- D.** Infectious diseases have increased steadily in impact and severity from the agricultural revolution through today as a result of contact between human societies.
- E.** During the second epidemiological transition, better public health measures and improved nutrition helped control chronic diseases.
- F.** Humans today are at risk for contracting both new diseases and old diseases that have reemerged and, in some cases, have become resistant to antibiotics.

## **Earth's Atmosphere**

Earth's atmosphere has changed through time. Compared to the Sun, whose composition is representative of the raw materials from which Earth and other planets in our solar system formed, Earth contains less of some volatile elements, such as nitrogen, argon, hydrogen, and helium. These elements were lost when the envelope of gases, or primary atmosphere, that surrounded early Earth was stripped away by the solar wind or by meteorite impacts, or both. Little by little, the planet generated a new, secondary atmosphere by volcanic outgassing of volatile materials from its interior.

Volcanic outgassing continues to be the main process by which volatile materials are released from Earth – although it is now going on at a much slower rate. The main chemical constituent of volcanic gases (as much as 97 percent of volume) is water vapor, with varying amounts of nitrogen, carbon dioxide, and other gases. In fact, the total volume of volcanic gases released over the past 4 billion years or so is believed to account for the present composition of the atmosphere with one important exception: oxygen. Earth had virtually no oxygen in its atmosphere more than 4 billion years ago, but the atmosphere is now approximately 21 percent oxygen.

Traces of oxygen were probably generated in the early atmosphere by the breakdown of water molecules into oxygen and hydrogen by ultraviolet light (a process called photodissociation). Although this is an important process, it cannot begin to account for the present high levels of oxygen in the atmosphere. Almost all of the free oxygen now in the atmosphere originated through photosynthesis, the process whereby plants use light energy to induce carbon dioxide to react with water, producing carbohydrates and oxygen.

Oxygen is a very reactive chemical, so at first most of the free oxygen produced by photosynthesis was combined with iron in ocean water to form iron oxide-bearing minerals. The evidence of the gradual transition from oxygen-poor to oxygen-rich water is preserved in seafloor sediments. The minerals in seafloor sedimentary rocks that are more than about 2.5 billion

years old contain reduced (oxygen-poor) iron compounds. In rocks that are less than 1.8 billion years old, oxidized (oxygen-rich) compounds predominate. The sediments that were precipitated during the transition contain alternating bands of red (oxidized iron) and black (reduced iron) minerals. These rocks are called banded-iron formations. Because ocean water is in constant contact with the atmosphere, and the two systems function together in a state of dynamic equilibrium, the transition from an oxygen-poor to an oxygen-rich atmosphere also must have occurred during this period.

Along with the buildup of molecular oxygen ( $O_2$ ) came an eventual increase in ozone ( $O_3$ ) levels in the atmosphere. Because ozone filters out harmful ultraviolet radiation, this made it possible for life to flourish in shallow water and finally on land. This critical state in the evolution of the atmosphere was reached between 1100 and 542 million years ago. Interestingly, the fossil record shows an explosion of life forms 542 million years ago.

Oxygen has continued to play a key role in the evolution and form of life. Over the last 200 million years, the concentration of oxygen has risen from 10 percent to as much as 25 percent of the atmosphere, before settling (probably not permanently) at its current value of 21 percent. This increase has benefited mammals, which are voracious oxygen consumers. Not only do we require oxygen to fuel our high-energy, warm-blooded metabolism, our unique reproductive system demands even more. An expectant mother's used (venous) blood must still have enough oxygen in it to diffuse through the placenta into her unborn child's bloodstream. It would be very difficult for any mammal species to survive in an atmosphere of only 10 percent oxygen.

Geologists cannot yet be certain why the atmospheric oxygen levels increased, but they have a hypothesis. First photosynthesis is only one part of the oxygen cycle. The cycle is completed by decomposition, in which organic carbon combines with oxygen and forms carbon dioxide. But if organic matter is buried as sediment before it fully decomposes, its carbon is no longer

available to react with the free oxygen. Thus there will be a net accumulation of carbon in sediments and of oxygen in the atmosphere.

### **Paragraph 1**

Earth's atmosphere has changed through time. Compared to the Sun, whose composition is representative of the raw materials from which Earth and other planets in our solar system formed, Earth contains less of some volatile elements, such as nitrogen, argon, hydrogen, and helium. These elements were lost when the envelope of gases, or primary atmosphere, that surrounded early Earth was stripped away by the solar wind or by meteorite impacts, or both. Little by little, the planet generated a new, secondary atmosphere by volcanic outgassing of volatile materials from its interior.

1. In paragraph 1, why does the author state that Earth has less nitrogen, argon, hydrogen, and helium than the Sun?
  - A. To argue that these elements were once part of an early atmosphere, which disappeared
  - B. To suggest that these elements were drawn into the Sun's atmosphere
  - C. To provide evidence that Earth's original atmosphere came primarily from meteorites
  - D. To support the claim that Earth's atmosphere would have changed even more if it had contained more volatile elements

### **Paragraph 2**

Volcanic outgassing continues to be the main process by which volatile materials are released from Earth – although it is now going on at a much slower rate. The main chemical **constituent** of volcanic gases (as much as 97 percent of volume) is water vapor, with varying amounts of nitrogen, carbon dioxide, and other gases. In fact, the total volume of volcanic gases released over the past 4 billion years or so is believed to account for the present composition of the atmosphere with one important exception: oxygen. Earth

had virtually no oxygen in its atmosphere more than 4 billion years ago, but the atmosphere is now approximately 21 percent oxygen.

2. The word “**constituent**” in the passage is closest in meaning to
- A. source
  - B. equivalent
  - C. component
  - D. product
3. According to paragraph 2, the history of volcanic outgassing cannot explain which of the following?
- A. The lack of oxygen in the atmosphere 4 billion years ago
  - B. The amount of water vapor in the atmosphere today
  - C. The proportions of nitrogen and carbon dioxide in the atmosphere today
  - D. The present abundance of oxygen in the atmosphere

### **Paragraph 3**

Traces of oxygen were probably generated in the early atmosphere by the breakdown of water molecules into oxygen and hydrogen by ultraviolet light (a process called photodissociation). Although this is an important process, it cannot begin to account for the present high levels of oxygen in the atmosphere. Almost all of the free oxygen now in the atmosphere originated through photosynthesis, the process whereby plants use light energy to induce carbon dioxide to react with water, producing carbohydrates and oxygen.

4. Paragraph 3 suggests which of the following about the process of photodissociation?
- A. It is more common today than it was in the early history of the atmosphere.
  - B. It is responsible for only a small amount of the oxygen in the atmosphere today.
  - C. It removes trace amounts of oxygen from the atmosphere.
  - D. It produces more free oxygen than photosynthesis does.

#### Paragraph 4

Oxygen is a very reactive chemical, so at first most of the free oxygen produced by photosynthesis was combined with iron in ocean water to form iron oxide-bearing minerals. The evidence of the **gradual** transition from oxygen-poor to oxygen-rich water is preserved in seafloor sediments. The minerals in seafloor sedimentary rocks that are more than about 2.5 billion years old contain reduced (oxygen-poor) iron compounds. In rocks that are less than 1.8 billion years old, oxidized (oxygen-rich) compounds **predominate**. The sediments that were precipitated during the transition contain alternating bands of red (oxidized iron) and black (reduced iron) minerals. These rocks are called banded-iron formations. Because ocean water is in constant contact with the atmosphere, and the two systems function together in a state of dynamic equilibrium, the transition from an oxygen-poor to an oxygen-rich atmosphere also must have occurred during this period.

5. The word “**gradual**” in the passage is closest in meaning to
- A. crucial
  - B. original
  - C. beneficial
  - D. slow
6. The word “**predominate**” in the passage is closest in meaning to
- A. are in the majority
  - B. are present
  - C. are increasing
  - D. first appear
7. Which of the sentences below best expresses the essential information in the highlighted sentence in the passage? Incorrect choices change the meaning in important ways or leave out essential information.
- A. Since the oceans and the atmosphere function together, the atmosphere must have become oxygen rich during this period.
  - B. Because ocean water is in constant contact with the atmosphere, the two

systems maintain a dynamic equilibrium.

- C. The transition to an oxygen-rich atmosphere could not have happened without constant contact with the oceans.
  - D. Much of the oxygen in the oceans must have been pulled out of the atmosphere during this period.
8. According to paragraph 4, what can be learned from the type of iron compounds in seafloor rocks?
- A. How the process of photosynthesis has changed over time
  - B. The level of oxygen in the water at a certain time in history
  - C. How levels of iron in ocean water decreased over time
  - D. The overall mineral content of the ocean water
9. According to paragraph 4, banded-iron formations are found in what kind of rocks?
- A. Those that are more than 2.5 billion years old
  - B. Those that do not contain oxidized compounds
  - C. Those that are from a transitional period in terms of oxygen richness
  - D. Those that are less than 1.8 billion years old

### **Paragraph 5**

Along with the buildup of molecular oxygen (O<sub>2</sub>) came an eventual increase in ozone (O<sub>3</sub>) levels in the atmosphere. Because ozone filters out harmful ultraviolet radiation, this made it possible for life to flourish in shallow water and finally on land. This critical state in the evolution of the atmosphere was reached between 1100 and 542 million years ago. Interestingly, the fossil record shows an explosion of life forms 542 million years ago.

10. According to paragraph 5, which of the following happened sometime between 1100 and 542 million years ago?
- A. A sudden explosion of life forms on land occurred together with a sharp decline of life in the water.

- B. Ultraviolet radiation became more harmful to living organism.
- C. Molecular oxygen levels in the atmosphere stabilized, and ozone levels began to rise.
- D. Ozone reduced ultraviolet radiation to a level acceptable for life on land.

### Paragraph 6

Oxygen has continued to play a key role in the evolution and form of life. Over the last 200 million years, the concentration of oxygen has risen from 10 percent to as much as 25 percent of the atmosphere, before setting (probably not permanently) at its current value of 21 percent. This increase has benefited mammals, which are voracious oxygen consumers. Not only do we require oxygen to fuel our high-energy, warm-blooded metabolism, our unique reproductive system demands even more. An expectant mother's used (venous) blood must still have enough oxygen in it to **diffuse** through the placenta into her unborn child's bloodstream. It would be very difficult for any mammal species to survive in an atmosphere of only 10 percent oxygen.

11. The word “ **diffuse** ” in the passage is closest in meaning to
- A. spread
  - B. break
  - C. squeeze
  - D. speed
12. According to paragraph 6, which of the following is NOT true of the connection between mammals and oxygen?
- A. Mammals are able to survive only because oxygen levels are relatively high.
  - B. Mammals first emerged when atmospheric oxygen levels reached 10 percent.
  - C. A mammal's unborn child receives oxygen through the mother's placenta.
  - D. Mammals use a lot of oxygen partly because they are warm-blooded.



Along with the buildup of molecular oxygen (O<sub>2</sub>) came an eventual increase in ozone (O<sub>3</sub>) levels in the atmosphere. ■ Because ozone filters out harmful ultraviolet radiation, this made it possible for life to flourish in shallow water and finally on land. ■ This critical state in the evolution of the atmosphere was reached between 1100 and 542 million years ago. ■ Interestingly, the fossil record shows an explosion of life forms 542 million years ago. ■

13. Look at the four squares [■] that indicate where the following sentence could be added to the passage.

**The timing strongly suggests that atmospheric changes were responsible for this sudden increase in new life.**

Where would the sentence best fit?

- 14.Directions:** An introductory sentence for a brief summary of the passage is provided below. Complete the summary by selecting the THREE answer choices that express the most important ideas in the passage. Some sentences do not belong in the summary because they express ideas that are not presented in the passage or are minor ideas in the passage. **This question is worth 2 points.**

**Internal and external forces on Earth's atmosphere have changed its chemical composition over time.**

**Answer choices**

- A. Over the last 4 billion years, outgassing destroyed Earth's primary atmosphere of volatile elements and replaced it with nonvolatile materials including carbon dioxide.
- B. Mammals could not have survived without an oxygen-rich atmosphere, and land-based life would not be possible without the ozone layer to filter solar radiation.
- C. Although they are currently at about 21 percent, oxygen levels will probably not always remain this high.

- D. The small amount of oxygen in Earth's early atmosphere was due to photodissociation and, later, photosynthesis created free oxygen.
- E. When oxygen levels in the ocean water reach a critical level about 542 million years ago, life emerged in the oceans, as shown by sedimentary rocks.
- F. The breakdown of organic matter removes free oxygen, but if this process is interrupted, extra oxygen may accumulate in the atmosphere.

## **The Role of Diapause**

If conditions within an organism's environment occasionally or regularly become harsh, it may be advantageous for an organism to have a resistant stage built into the life cycle. In such a life history strategy, the organism suspends any growth, reproduction, or other activities for a period of time so that they may occur at a later, more hospitable time. This genetically determined resting stage, characterized by the cessation of development and protein synthesis and suppression of the metabolic rate, is called *diapause*. Many other kinds of resting stages, with different levels of suppression of physiological activities, are known. Some of these resistant stages can be extremely long-lived. In one case, seeds of the arctic lupine, a member of the pea family recovered from ancient lemming burrows in the Arctic, germinated in three days even though they were carbon-dated at more than 10,000 years old!

Unfavorable conditions that are relatively predictable probably pose a simpler problem for organisms than do unpredictable conditions. Adaptations to the regular change of seasons in the temperate and polar regions may be relatively simple. For example, many seeds require a period of *stratification*, exposure to low temperatures for some minimum period, before they will germinate. This is a simple adaptation to ensure that germination occurs following the winter conditions rather than immediately prior to their onset. In contrast, unfavorable conditions that occur unpredictably pose considerable problems for organisms. In fact, unpredictability is probably a greater problem than is the severity of the unfavorable period. How can organisms cope with the unpredictable onset of good or poor conditions?

Many adaptations to this general problem are based on a resting stage that awaits favorable conditions. We will consider two examples from the vertebrates. The first is the red kangaroo. This marsupial inhabits the deserts of central Australia where the onset of rains and the resulting sudden growth of vegetation are extremely unpredictable. Obviously, it is advantageous for a

kangaroo female to produce young at a time when plant productivity is sufficient to support her offspring. For such a relatively large mammal, however, gestation (the period of development during pregnancy) is so long that if a female waited to mate and carry the young until after the rains came, the favorable period might be past. The kangaroo's life history adaptation to this problem involves the use of embryonic diapause during gestation (development in the uterus).

After a 31-day gestation period, the female gives birth to a tiny helpless young typical of marsupials. The newborn crawls into the mother's pouch and attaches to a teat where it continues to grow and develop. After 235 days it leaves the pouch but remains with the mother and obtains milk from her. Two days after giving birth, the female mates again. The fertilized egg enters a 204-day period of diapause during which it remains in the uterus but does not attach. It then implants, and 31 days later, birth of the second young occurs. Note that the first young leaves the pouch at just this time. Again, the female mates, fertilization occurs, and another diapause follows. The eventual result is that at any one time, the female has three young at various stages of development one in diapause, one in the pouch, and one outside the pouch. Among other benefits, this allows her to freeze the development of an embryo during times of drought and food shortage until the offspring in the pouch is able to leave.

A similar strategy – accelerated development combined with a resting stage – has also allowed amphibians to inhabit deserts. The spadefoot toads, such as Couch's spadefoot toad, inhabit some of the most severe deserts in North America. Adults of this species burrow deeply into the substrate where it is cooler and perhaps more moist. Here they enter into a resting state in which they are covered with a protective layer of dead skin. When it rains, the adults emerge and congregate to mate at temporary ponds. Development is greatly accelerated: the eggs hatch within 48 hours, and the tadpoles change into toads at 16- 18 days. Consequently, they can complete the life cycle during

the brief window of favorable conditions, then return to the resistant resting stage to await the next rainfall. Resting stages thus comprise a series of adaptations that allow the species to avoid the most difficult conditions for life.

### **Paragraph 1**

If conditions within an organism's environment occasionally or regularly become harsh, it may be advantageous for an organism to have a resistant stage built into the life cycle. In such a life history strategy, the organism suspends any growth, reproduction, or other activities for a period of time so that they may occur at a later, more hospitable time. This genetically determined resting stage, characterized by the cessation of development and protein synthesis and suppression of the metabolic rate, is called *diapause*. Many other kinds of resting stages, with different levels of suppression of physiological activities, are known. Some of these resistant stages can be extremely long-lived. In one case, seeds of the arctic lupine, a member of the pea family recovered from ancient lemming burrows in the Arctic, germinated in three days even though they were carbon-dated at more than 10,000 years old!

1. According to paragraph 1, why do some organisms have a resting stage during their life cycle?
  - A. To recover from injuries suffered during harsh conditions
  - B. To devote all of their energy to a period of growth and reproduction
  - C. To wait for local conditions to become favorable for important life events
  - D. To prepare to move to a different environment if conditions become harsh
2. Why does the author mention "seeds of the arctic lupine"?
  - A. To argue that members of the pea family are extremely resistant to cold temperatures
  - B. To provide information about what ancient lemmings ate during their long resting periods

- C. To provide an example of an organism with a resting stage that has many different levels of suppression of physiological activities.
- D. To support the claim that some resting stages last an extremely long time

### Paragraph 2

Unfavorable conditions that are relatively predictable probably pose a simpler problem for organisms than do unpredictable conditions. Adaptations to the regular change of seasons in the temperate and polar regions may be relatively simple. For example, many seeds require a period of *stratification*, exposure to low temperatures for some minimum period, before they will germinate. This is a simple adaptation to ensure that germination occurs following the winter conditions rather than immediately prior to their onset. In contrast, unfavorable conditions that occur unpredictably pose considerable problems for organisms. In fact, unpredictability is probably a greater problem than is the **severity** of the unfavorable period. How can organisms cope with the unpredictable onset of good or poor conditions?

- 3. According to paragraph 2, why do many seeds require a period of stratification?
  - A. To slowly build up a tolerance for lower and lower temperatures
  - B. To guarantee that the seeds grow after and not before
  - C. To make sure that the seeds can deal with unpredictable conditions
  - D. To give the seeds enough time to germinate before winter begins
- 4. The word “ **severity** ” in the passage is closest in meaning to
  - A. length
  - B. harshness
  - C. unexpectedness
  - D. completeness

### Paragraph 4

After a 31-day gestation period, the female gives birth to a tiny helpless

young typical of marsupials. The newborn crawls into the mother's pouch and attaches to a teat where it continues to grow and develop. After 235 days it leaves the pouch but remains with the mother and obtains milk from her. Two days after giving birth, the female mates again. The fertilized egg enters a 204-day period of diapause during which it remains in the uterus but does not attach. It then implants, and 31 days later, birth of the second young occurs. Note that the first young leaves the pouch at just this time. Again, the female mates, fertilization occurs, and another diapause follows. The eventual result is that at any one time, the female has three young at various stages of development one in diapause, one in the pouch, and one outside the pouch. Among other benefits, this allows her to freeze the development of an embryo during times of drought and food shortage until the offspring in the pouch is able to leave.

5. According to paragraph 4, all of the following statements are true about the young offspring of the red kangaroo EXCEPT:

- A. After birth, a newborn crawls into the mother's pouch where it grows and develops.
- B. After a young kangaroo leaves its mother's pouch, it still needs its mother's milk.
- C. A mother usually gives birth to three baby kangaroos at the same time.
- D. A baby kangaroo spends 235 days in the mother's pouch after its birth.

6. Paragraph 4 supports all of the following statements about the red kangaroo of central Australia EXCEPT:

- A. A female kangaroo mates again shortly after her newborn enters her pouch.
- B. During diapause, a young kangaroo stays in the female's pouch and growth of a second fertilized egg inside the uterus is delayed.
- C. A female kangaroo can freeze the development of her young at each stage of their development.
- D. The adaptation of diapause enables female kangaroos to ensure the

survival of their young during periods of environmental stress.

7. What is the main purpose of paragraph 4 in the passage?
- A. To give the details of an adaptation mentioned in paragraph 3
  - B. To describe an adaptation different from the one explained in paragraph 3
  - C. To introduce an adaptation that is described in detail in paragraph 5
  - D. To discuss an adaptation that is not as successful as the one discussed in paragraph 5

### **Paragraph 5**

A similar strategy – accelerated development combined with a resting stage – has also allowed amphibians to inhabit deserts. The spadefoot toads, such as Couch’s spadefoot toad, inhabit some of the most severe deserts in North America. Adults of this species burrow deeply into the substrate where it is cooler and perhaps more moist. Here they enter into a resting state in which they are covered with a protective layer of dead skin. When it rains, the adults emerge and **congregate** to mate at temporary ponds. Development is greatly accelerated: the eggs hatch within 48 hours, and the tadpoles change into toads at 16- 18 days. **Consequently**, they can complete the life cycle during the brief window of favorable conditions, then return to the resistant resting stage to await the next rainfall. Resting stages thus **comprise** a series of adaptations that allow the species to avoid the most difficult conditions for life.

8. The word “**congregate**” in the passage is closest in meaning to
- A. begin
  - B. gather
  - C. hurry
  - D. expect
9. The word “**Consequently**” in the passage is closest in meaning to
- A. Eventually
  - B. In addition



- C. As a result
  - D. However
10. The word “ **comprise** ” in the passage is closest in meaning to
- A. consist of
  - B. bring about
  - C. are similar to
  - D. take the place of
11. According to paragraph 5, how do amphibians such as spadefoot toad survive the severe heat conditions in the North American deserts?
- A. They dig down into the ground and go into a resistant resting state.
  - B. They remain in the ponds that develop after it has rained.
  - C. They lose their outer layer of skin.
  - D. Their eggs lie dormant until the desert air becomes cooler and more moist.
12. According to paragraph 5, which of the following occurs during the life cycle of the spadefoot toad?
- A. The female’s’ eggs hatch under the surface of the desert.
  - B. The adults mate during the dry period.
  - C. The newborn grows into an adult before unfavorable conditions.
  - D. The newborn enters a resting stage before it becomes an adult.

Unfavorable conditions that are relatively predictable probably pose a simpler problem for organisms than do unpredictable conditions. Adaptations to the regular change of seasons in the temperate and polar regions may be relatively simple. For example, many seeds require a period of *stratification*, exposure to low temperatures for some minimum period, before they will germinate. ■ This is a simple adaptation to ensure that germination occurs following the winter conditions rather than immediately prior to their onset. ■ In contrast, unfavorable conditions that occur unpredictably pose considerable problems for organisms. ■ In fact, unpredictability is probably a greater problem than is the severity of

the unfavorable period. ■ How can organisms cope with the unpredictable onset of good or poor conditions?

13. Look at the four squares [■ ] that indicate where the following sentence could be added to the passage. Where would the sentence best fit?

**Such adaptations to predictable conditions can also be made by animals, such as by hibernating during the coldest months.**

- 14.Directions:** An introductory sentence for a brief summary of the passage is provided below. Complete the summary by selecting the THREE answer choices that express the most important ideas in the passage. Some sentences do not belong in the summary because they express ideas that are not presented in the passage or are minor ideas in the passage. **This question is worth 2 points.**

**Some organisms adapt to periodic harsh conditions by building a resistant stage, or diapause, into their life cycle.**

**Answer choices**

- A. The diapause stage evolved very early and is most common in species that first appeared more than 10,000 years ago.
- B. Unpredictable conditions are more problematic for organisms than are fairly predictable changes such as the seasons.
- C. The female red kangaroo adapts to unfavorable conditions by delaying the development of her fertilized egg until an embryo would be able to move into the pouch.
- D. Some seeds may germinate in three days even if they have been exposed to very low temperatures for a long time.
- E. Some marsupials can care for three newborns in their pouch at the same time, allowing the young to leave the pouch only when conditions are favorable for their growth.
- F. Some amphibians adapt to desert life by combining accelerated development with resting stages deep underground.

## **Birdsong**

Birdsong is the classic example of how genes (hereditary information) and environment both have a crucial role to play in the behavioral development of animals. Since the pioneering work of W. H. Thorpe on chaffinches (a common European bird), many species have been studied, and it has become clear both that learning plays an important role for all species and also that there are constraints on what they are able to learn.

Thorpe was able to show that learning from others was involved in chaffinch birds through a series of experiments on hand-reared chicks (young birds). As in most other species, only the males sing. Thorpe found that, if he raised young males in total isolation from all others, the song they produced was quite different from that of a normal adult. It was about the right length and in the correct frequency range, it was also split up into a series of notes as it should be. But these notes lacked the detailed structure found in wild birds, nor was the song split up into distinct phrases as it usually is. This suggested that song development requires some social influence. Later experiments in which researchers played recordings of songs to young birds showed just how precise this influence was, many of them would learn the exact pattern of the recording they had heard. A remarkable feature here was in the first few weeks of life, yet they did not sing themselves until about eight months old. They are thus able to store a memory of the sound within their brain and then match their own output to their collection of it when they mature.

Young chaffinches normally learn only chaffinch song, though Thorpe found they could be trained to sing the song of a tree pipit (another type of bird), which is very similar to that of their own species. In general, however, the constraints on learning which birds have ensure that they only learn songs appropriate to the species to which they themselves belong. These constraints may be in their brain's circuitry, the young bird hatching with a rough idea of the sounds that it should copy. The crude song of a bird reared in isolation gives some clues as to what this rough idea may be the length, the frequency

range and the breaking up into notes are all aspects of chaffinch song shared between normal birds and those reared in isolation. In other cases the constraints are more social, young birds only being prepared to learn from individuals with whom they have social interactions. Thus, in a number of species, it has been found that they will not copy from recordings, but will do so from a live tutor. In some cases this may occur when they are young birds, but in others the main learning period is when they set up their territories and interact with neighbors for the first time, enabling them to match their neighbor's songs and so countersing with them. Whatever the nature of the learning rules in a particular species, there is no doubt that they are effective, it is very unusual to hear a wild bird singing a song which is not typical of its own species despite the many different songs which often occur in a small patch of woodland.

However, not all birds show the same learning pattern as do chaffinches. There are some species which produce normal sounds even if deaf, so that they cannot hear their own efforts, much less copy those of others. The cooing of doves and the crowing of cocks are examples here. In other cases, such as parrots and hill mynahs, birds can be trained to copy a huge variety of sounds, though those they learn in the wild are usually more restricted. The amazing capability of mynahs has apparently arisen simply because birds in an area learn a small number of their calls from each other, males from males and females from females, and these calls are highly varied in structure. The ability to master them has led the birds, incidentally, to be capable of saying "hello" and mimicking a wide variety of other sounds.

### **Paragraph 1**

Birdsong is the classic example of how genes (hereditary information) and environment both have a crucial role to play in the behavioral development of animals. Since the **pioneering** work of W. H. Thorpe on chaffinches (a common European bird), many species have been studied, and

it has become clear both that learning plays an important role for all species and also that there are constraints on what they are able to learn.

1. The word “ **pioneering** ” in the passage is closest in meaning to
  - A. recent
  - B. famous
  - C. original
  - D. controversial

## **Paragraph 2**

Thorpe was able to show that learning from others was involved in chaffinch birds through a series of experiments on hand-reared chicks (young birds). As in most other species, only the males sing. Thorpe found that, if he raised young males in total isolation from all others, the song they produced was quite different from that of a normal adult. It was about the right length and in the correct frequency range, it was also split up into a series of notes as it should be. But these notes lacked the detailed structure found in wild birds, nor was the song split up into **distinct** phrases as it usually is. This suggested that song development requires some social influence. Later experiments in which researchers played recordings of songs to young birds showed just how precise this influence was, many of them would learn the exact pattern of the recording they had heard. A remarkable feature here was in the first few weeks of life, yet they did not sing themselves until about eight months old. They are thus able to store a memory of the sound within their brain and then match their own output to their collection of it when they mature.

2. The word “ **distinct** ” in the passage is closest in meaning to
  - A. short
  - B. simple
  - C. separate
  - D. similar
3. According to paragraph 2, all of the following are characteristics of the

songs of the young chaffinches in Thorpe's experiment EXCEPT:

- A. They were not identical to the songs of normal adult chaffinches.
  - B. They lacked the complex form of the songs of wild chaffinches.
  - C. They were as long as the songs of normal adult chaffinches.
  - D. They were clearly different from each other.
4. According to paragraph 2, researchers discovered which of the following by playing recordings of songs to chaffinches?
- A. Chaffinches could no longer be taught to reproduce sounds after the first few weeks of life.
  - B. Chaffinches could not reproduce songs with exactly the same patterns of recorded songs.
  - C. Chaffinches at the age of eight months could recall and reproduce a song that they heard in the first few weeks of life.
  - D. Chaffinches that learned a song from recordings in the first few weeks of life were later unable to copy the sounds of mature chaffinches.
5. All of the following are mentioned in paragraph 2 as characteristic of wild chaffinches EXCEPT:
- A. They are able to copy songs very precisely.
  - B. Their song development requires interaction with other chaffinches.
  - C. Their songs are not as well-structured as the songs of other birds.
  - D. It is the males of the species that do the singing.

### **Paragraph 3**

Young chaffinches normally learn only chaffinch song, though Thorpe found they could be trained to sing the song of a tree pipit (another type of bird), which is very similar to that of their own species. In general, however, the constraints on learning which birds have ensure that they only learn songs appropriate to the species to which they themselves belong. These constraints may be in their brain's circuitry, the young bird hatching with a rough idea of the sounds that it should copy. The crude song of a bird reared in isolation

gives some clues as to what this rough idea may be the length, the frequency range and the breaking up into notes are all aspects of chaffinch song shared between normal birds and those reared in isolation. In other cases the constraints are more social, young birds only being prepared to learn from individuals with whom they have social interactions. Thus, in a number of species, it has been found that they will not copy from recordings, but will do so from a live tutor. In some cases this may occur when they are young birds, but in others the main learning period is when they set up their territories and interact with neighbors for the first time, **enabling** them to match their neighbor's songs and so countersing with them. Whatever the nature of the learning rules in a particular species, there is no doubt that they are effective, it is very unusual to hear a wild bird singing a song which is not typical of its own species despite the many different songs which often occur in a small patch of woodland.

6. The word “**enabling**” in the passage is closest in meaning to
- A. allowing
  - B. challenging
  - C. forcing
  - D. preparing
7. It can be inferred from paragraph 3 that one of the functions of songs in birds is to
- A. bring together birds living in groups with birds living in isolation
  - B. help young birds distinguish other young birds from adults
  - C. make possible interactions between birds of different species
  - D. help birds to establish territories
8. Which of the sentences below best expresses the essential information in the highlighted sentence in the passage? Incorrect choices change the meaning in important ways or leave out essential information.
- A. Songs produced by chaffinches reared in isolation are cruder than the songs of wild birds.

- B. The song of a bird reared in isolation suggests which aspects of chaffinch song may be inborn.
  - C. Comparing the crude songs of chaffinches reared in isolation to the songs of wild chaffinches suggests differences as well as similarities.
  - D. By studying the song aspects of chaffinches reared in isolation, researchers have gained a better understanding of the songs produced by wild birds.
9. According to paragraph 3, in some species, young birds do not copy songs from recordings because
- A. they learn to sing only by live interactions with other birds
  - B. their ability to learn from recordings occurs later in life
  - C. they can only learn songs from the birds living in their area of woodland
  - D. they can only learn songs from other birds of their own species
10. Why does the author mention that it is very unusual to hear a wild bird singing a song which is not typical of its own species?
- A. To explain why a variety of different bird songs are often heard in a relatively small area
  - B. To argue that social constraints have a greater impact upon learning than do genetic constraints
  - C. To provide an example of how the process of learning rules varies from one species to another
  - D. To illustrate how effective the different constraints upon learning are in young birds

#### **Paragraph 4**

However, not all birds show the same learning pattern as do chaffinches. There are some species which produce normal sounds even if deaf, so that they cannot hear their own efforts, much less copy those of others. The cooing of doves and the crowing of cocks are examples here. In other cases, such as parrots and hill mynahs, birds can be trained to copy a huge variety of sounds,



though those they learn in the wild are usually more **restricted**. The amazing capability of mynahs has apparently arisen simply because birds in an area learn a small number of their calls from each other, males from males and females from females, and these calls are highly varied in structure. The ability to master them has led the birds, incidentally, to be capable of saying “hello” and mimicking a wide variety of other sounds.

11. The word “**restricted**” in the passage is closest in meaning to
- A. important
  - B. popular
  - C. limited
  - D. accurate
12. According to paragraph 4, why are mynahs able to learn to make a wide variety of sounds?
- A. They have the ability to imitate any sound that they are exposed to
  - B. The frequency with which mynahs travel from one small area to another exposes them to a wide variety of sounds.
  - C. They are exposed in the wild to calls that are very different from each other.
  - D. An acute sense of hearing allows them to listen to and copy many different sounds.

Young chaffinches normally learn only chaffinch song, though Thorpe found they could be trained to sing the song of a tree pipit (another type of bird), which is very similar to that of their own species. ■ In general, however, the constraints on learning which birds have ensure that they only learn songs appropriate to the species to which they themselves belong. ■ These constraints may be in their brain’s circuitry, the young bird hatching with a rough idea of the sounds that it should copy. ■ The crude song of a bird reared in isolation gives some clues as to what this rough idea may be the length, the frequency range and the breaking up

into notes are all aspects of chaffinch song shared between normal birds and those reared in isolation. ■ In other cases the constraints are more social, young birds only being prepared to learn from individuals with whom they have social interactions.

13. Look at the four squares [■] that indicate where the following sentence could be added to the passage.

**Are these constraints genetic, environmental, or both?**

Where would the sentence best fit?

- 14.Directions:** An introductory sentence for a brief summary of the passage is provided below. Complete the summary by selecting the THREE answer choices that express the most important ideas in the passage. Some sentences do not belong in the summary because they express ideas that are not presented in the passage or are minor ideas in the passage. **This question is worth 2 points.**

**A combination of hereditary and environmental factors is believed to determine the sounds that birds are able to produce.**

**Answer choices**

- A. Although only male chaffinches are able to sing in the wild, Thorpe found that he could teach hand-reared females to copy songs from recordings and live tutors.
- B. Chaffinches reared in isolation produce songs that differ significantly from those of normal birds, suggesting that some social influence is important for learning a song precisely.
- C. Birds vary a great deal with respect to both the variety of sounds they are able to learn and the conditions that must be present for them to be able to learn their species' song.
- D. Chaffinches that are exposed only to other bird species for the first few weeks of their life are likely to learn the songs of those species instead of the chaffinch song.

- E. Researchers believe that both the circuitry of a bird's brain and its interactions with other birds of the same species may prevent birds from learning the songs of other species.
- F. The ability of deaf birds to produce their normal species' song suggests that genes play a much greater role than environment in determining the behavior of most bird species.

## **Greek Sacred Groves and Parks**

In Greek and Roman civilization, parks were associated with spirituality, public recreation, and city living. Greek philosophers pondered the meaning of nature and its innermost workings, the relationships between animals and humankind, and how matter related to spirit. The philosophy of Aristotle (384–332 B.C.) advanced the fundamental notion of nature as the embodiment of everything outside culture, an essence opposed to art and artificiality. This sense of nature and culture as distinct opposites continues to govern ideas about the environment and society today. Meanwhile, the suggestion of a state of nature, wholesome and pure, defined in opposition to civilized life, found acceptance in Aristotle's time through the concept of the Golden Age –a legendary ideal that had significance for landscape planning and artistic experiment. Described by Greek poets and playwrights, the Golden Age of perpetual spring depicted an era before the adoption of agriculture, when humans embraced nature's wonder and communicated with spirits in sacred woods. In *The Odyssey* (800 B.C.), Homer, the great Greek writer, described a garden that was a place of constant productivity, where "fruit never fails nor runs short, winter and summer alike."

Greek interest in spirituality and nature manifested itself in the tradition of the sacred grove. Usually comprised of a few trees, a spring, or a mountain crag, sacred groves became intensely mystical places by their associations with gods, spirits, or celebrated folk heroes. Twisted trees, sections of old-growth forest, and rocks or caves typically surrounded the naturalistic shrines and altars. As the Roman official and writer Pliny the Elder (A.D. 23–79) put it, "Trees were the first temples of the gods, and even now simple country people dedicate a tree of exceptional height to a god with the ritual of olden times, and we... worship forests and the very silences they contain."

The Greeks were not alone in their spiritual veneration of nature. Examples of pantheism –the belief that God and the universe or nature are the same – and the worship of trees permeated many cultures. The nations of northern Europe utilized trees as places of worship. In Scandinavian mythology, the tree called Yggdrasil held up the world, its branches forming the heavens and its roots stretching into the underworld. A spring of knowledge bubbled at its base, and an eagle perched amid its sturdy branches. The Maori people of New

Zealand celebrated a tree that separated the sky from the earth. For many ancient civilizations, trees signified life, permanence, and wisdom.

In some spiritual traditions, landscapes such as gardens or deserts were treated as abstract emblems of spiritual states such as innocence or despair. Rather than symbolic landscapes, as in the Judeo-Christian tradition, Greek sacred groves operated as literal homes of the gods. Instead of being confined to prehistory or celestial space, spiritual parkscapes were present within the existing cultural terrain. One could not visit a symbol of peace and serenity, but one could experience these qualities in a sacred grove.

The spiritual significance of the sacred grove mandated specific preservationist measures. Civil restrictions and environmental codes of practice governed the use of such spaces. Enclosing walls prevented sheep from desecrating sacred sites, while patrolling priests issued spiritual guidance along with fines for vandalism. Laws forbade hunting, fishing, or the cutting of trees. Those not dissuaded by monetary penalties were threatened with the anger of the resident gods.

Such environmental care suggested to historian J. Donald Hughes that sacred groves represented “classical national parks.” By helping to insulate sacred groves from pressures of deforestation, erosion, and urbanization, Greek codes protected ecosystems from destruction. Sacred groves nonetheless represented imperfect parkscapes. Some encompassed relatively small areas such as a section of a hillside or a series of caves. Meanwhile, the fundamental purpose of the grove –the visitation of resident gods –sometimes promoted activities not entirely conducive to modern concepts of conservation. Animals were routinely captured to serve as sacrifices to the gods. Many groves witnessed horticultural and architectural improvements. Flowers were planted, trails cut, and statues, fountains, and caves installed for the benefit of visitors. The grove served as a recreational center for Greek society, a realm of ritual, performance, feasting, and even chariot racing.

### **Paragraph 1**

In Greek and Roman civilization, parks were associated with spirituality, public recreation, and city living. Greek philosophers **pondered** the meaning of nature and its innermost workings, the relationships between animals and

humankind, and how matter related to spirit. The philosophy of Aristotle (384–332 B.C.) advanced the **fundamental** notion of nature as the embodiment of everything outside culture, an essence opposed to art and artificiality. This sense of nature and culture as distinct opposites continues to govern ideas about the environment and society today. Meanwhile, the suggestion of a state of nature, wholesome and pure, defined in opposition to civilized life, found acceptance in Aristotle’s time through the concept of the Golden Age –a legendary ideal that had significance for landscape planning and artistic experiment. Described by Greek poets and playwrights, the Golden Age of perpetual spring depicted an era before the adoption of agriculture, when humans embraced nature’s wonder and communicated with spirits in sacred woods. In *The Odyssey* (800 B.C.), Homer, the great Greek writer, described a garden that was a place of constant productivity, where “fruit never fails nor runs short, winter and summer alike.”

1. The word “**pondered**” in the passage is the closest in meaning to
  - A. explained
  - B. argued over
  - C. thought about
  - D. understood
2. The word “**fundamental**” in the passage is the closest in meaning to
  - A. famous
  - B. basic
  - C. revolutionary
  - D. original
3. Which of the sentences below best expresses the essential information in the highlighted sentence in the passage? Incorrect choices change the meaning in important ways or leave out essential information.
  - A. Aristotle used the concept of the Golden Age to explain how the pure beauty of nature could be recreated in a new, carefully planned state.
  - B. During the Golden Age of Aristotle’s time, human activities such as landscape planning and art reached the height of creativity.
  - C. In ancient Greek thought, both art and nature were characterized by purity and wholesomeness within a Golden Age.

- D. During Aristotle's time, the idea that nature is pure and distinct from civilization was expressed in the idea of the perfect Golden Age, which influenced both art and landscape design.
4. In paragraph 1, why does the author include the quotation from *The Odyssey*?
- A. To support the idea that modern ideas about nature have not changed much since the ancient Greeks
  - B. To contrast Homer's ideas about nature with those of Aristotle
  - C. To argue that the adoption of agriculture advanced Greek culture
  - D.** To give an example of an ancient **Greek description** of the Greek description of the Golden Age

## **Paragraph 2**

Greek interest in spirituality and nature manifested itself in the tradition of the sacred grove. Usually comprised of a few trees, a spring, or a mountain crag, sacred groves became intensely mystical places by their associations with gods, spirits, or celebrated folk heroes. Twisted trees, sections of old-growth forest, and rocks or caves typically surrounded the naturalistic shrines and altars. As the Roman official and writer Pliny the Elder (A.D. 23–79) put it, “Trees were the first temples of the gods, and even now simple country people dedicate a tree of exceptional height to a god with the ritual of olden times, and we... worship forests and the very silences they contain.”

5. In paragraph 2, the author quotes Pliny the Elder in order to support the claim that
- A. only simply country people believed in gods who lived in forests
  - B. Greek beliefs about forests differed from Roman beliefs about forests
  - C.** sacred groves had mystical meanings because of their association with gods
  - D. Greeks were more interested in nature than in spirituality

### **Paragraph 3**

The Greeks were not alone in their spiritual veneration of nature. Examples of pantheism –the belief that God and the universe or nature are the same – and the worship of trees permeated many cultures. The nations of northern Europe utilized trees as places of worship. In Scandinavian mythology, the tree called Yggdrasil held up the world, its branches forming the heavens and its roots stretching into the underworld. A spring of knowledge bubbled at its base, and an eagle perched amid its sturdy branches. The Maori people of New Zealand celebrated a tree that separated the sky from the earth. For many ancient civilizations, trees signified life, permanence, and wisdom.

6. What is the purpose of paragraph 3 in the larger discussion of ancient Greek beliefs?
- A. To connect the Greek view of nature to the associations between nature and religion that exist in many different cultures in the world
  - B. To contrast the history and development of Greek religion to the development of other religions of the time
  - C. To demonstrate the influences of Greek beliefs on other religions
  - D. To argue that ancient religions eventually rejected the spirituality of trees

### **Paragraph 4**

In some spiritual traditions, landscapes such as gardens or deserts were treated as abstract emblems of spiritual states such as innocence or despair. Rather than symbolic landscapes, as in the Judeo-Christian tradition, Greek sacred groves operated as literal homes of the gods. Instead of being confined to prehistory or celestial space, spiritual parksapes were present within the existing cultural terrain. One could not visit a symbol of peace and serenity, but one could experience these qualities in a sacred grove.

7. It can be inferred from paragraph 4 that the ancient Greeks believed that their gods
- A. resided only in celestial space
  - B. actually lived on Earth
  - C. did not exist in prehistoric times



D. were only representations of ideas

### Paragraph 5

The spiritual significance of the sacred grove **mandated** specific preservationist measures. Civil restrictions and environmental codes of practice governed the use of such spaces. Enclosing walls prevented sheep from desecrating sacred sites, while patrolling priests issued spiritual guidance along with fines for vandalism. Laws forbade hunting, fishing, or the cutting of trees. Those not dissuaded by monetary penalties were threatened with the anger of the resident gods.

8. The word “**mandated**” in the passage is closest in meaning to
- A. contributed to
  - B. produced
  - C. limited
  - D. required
9. All of the following are mentioned in paragraph 5 as ways the Greeks protected their sacred groves EXCEPT
- A. by building protective walls around the groves
  - B. by allowing only priests in sacred groves
  - C. by punishing those who cut trees, hunted or fished in the groves
  - D. by telling people that the gods could punish vandals of the groves

### Paragraph 6

Such environmental care suggested to historian J. Donald Hughes that sacred groves represented “classical national parks.” By helping to insulate sacred groves from pressures of deforestation, erosion, and urbanization, Greek codes protected ecosystems from destruction. Sacred groves nonetheless represented imperfect parkscapes. Some encompassed relatively small areas such as a section of a hillside or a series of caves. Meanwhile, the fundamental purpose of the grove –the visitation of resident gods –sometimes **promoted** activities not entirely conducive to modern concepts of conservation. Animals were routinely captured to serve as sacrifices to the

gods. Many groves witnessed horticultural and architectural improvements. Flowers were planted, trails cut, and statues, fountains, and caves installed for the benefit of visitors. The grove served as a recreational center for Greek society, a realm of ritual, performance, feasting, and even chariot racing.

10. The word “**promoted**” in the passage is closest in meaning to
- A. repeated
  - B. altered
  - C. encouraged
  - D. performed
11. Why are the sacred groves of the ancient Greeks referred to as “**imperfect parkscapes**” in the passage?
- A. The Greeks protected their sacred groves from deforestation and erosion but allowed people to build houses on the grounds.
  - B. The ancient Greeks often changed the environment of the groves by adding plants, building shrines, and capturing animals for sacrifice.
  - C. The Greeks allowed only religious ceremonies in the groves.
  - D. The ancient Greeks had strict size limits on how big a sacred area could be.
12. Which of the following is NOT mentioned in paragraph 6 as a change made to the landscapes of sacred groves?
- A. The introduction of new animals to the area
  - B. The construction of statues and fountains
  - C. The planting of flowers
  - D. The creation of trails

In some spiritual traditions, landscapes such as gardens or deserts were treated as abstract emblems of spiritual states such as innocence or despair. ■ Rather than symbolic landscapes, as in the Judeo-Christian tradition, Greek sacred groves operated as literal homes of the gods. ■ Instead of being confined to prehistory or celestial space, spiritual

parkscapes were present within the existing cultural terrain. ■ One could not visit a symbol of peace and serenity, but one could experience these qualities in a sacred grove. ■

13. Look at the four squares [■] that indicate where the following sentence could be added to the passage.

**This, however, was not the Greek attitude.**

Where would the sentence best fit?

14. **Directions:** An introductory sentence for a brief summary of the passage is provided below. Complete the summary by selecting the THREE answer choices that express the most important ideas in the passage. Some sentences do not belong in the summary because they express ideas that are not presented in the passage or are minor ideas in the passage. **This question is worth 2 points.**

**Ancient Greeks and Romans thought of parks and natural spaces as spiritual and recreational sites.**

**Answer Choices**

- A. Sacred groves consisting of trees, springs, or mountains were organized as shrines to Greek gods.
- B. The belief in a divine presence in all natural things originated with the ancient Greeks and spread to other cultures around the world.
- C. In cultures where the climate made cultivation of sacred groves impossible, trees retained only a symbolic value in mythical stories.
- D. Because of their association with ancient Greek gods, spirits and heroes, there are still many sections of forest in modern Greece.
- E. Trees have played significant roles in the religious practices and beliefs of Greeks and numerous other cultures.
- F. Because groves were spiritually important to ancient Greeks, they were often protected from damage and were the sites of various communal activities.

## **The Chaco Phenomenon**

A truly remarkable transformation in settlement patterns occurred in the San Juan basin in northwestern New Mexico in the late tenth and early eleventh centuries, with small household farmsteads giving way to aggregated communities centered on communal masonry buildings that are now called “great houses.” These structures are found throughout the basin but are concentrated in Chaco Canyon, where several examples contained hundreds of rooms and reached four stories in height. The largest great house is Pueblo Bonito, with over 600 rooms covering two acres. The entire episode of great house construction in Chaco, the Bonito phase (A.D. 900-1140), was obviously a time of immense cooperative effort. At least 200,000 wooden beams averaging 5 meters long and 20 centimeters in diameter were brought to the canyon from distances between 40 and 100 kilometers away to build a dozen great houses, signifying a huge labor investment and a complex production process. The bulk of construction took place in the eleventh century, but by A.D. 1140 it had ceased abruptly, after which there was a rapid decline in use of the great houses and apparent abandonment of the canyon in the thirteenth century.

For more than a century archaeologists have struggled to understand the circumstances surrounding the rise and collapse of Chacoan society –dubbed the Chaco Phenomenon. In particular, research has focused on determining why such an apparently inhospitable place as Chaco, which today is extremely arid and has very short growing seasons, should have favored the concentration of labor that must have been required for such massive construction projects over brief periods of time. Until the 1970s, it was widely assumed that Chaco had been a forested oasis that attracted farmers who initially flourished but eventually fell victim to their own success and exuberance, as they denuded the canyon of trees and vegetation to build large great houses. In the 1980s this reconstruction was largely dismissed in response to evidence that there had never been a forest in Chaco, and that canyon soils had poor agricultural potential. As scientific interpretations about Chaco changed, the focus of explanatory models changed from the attractiveness of the canyon for farmers to the position of the canyon within a regional network of dispersed agricultural communities.

The adoption of a regional perspective in explaining the Chaco Phenomenon was based in part on the discovery of formal trails connecting many of the great houses in Chaco, as well as linking the canyon to smaller great house located throughout the San Juan basin, the latter are referred to as Chaco “outliers.” These trails are densest around the concentration of great houses in the center, and the canyon itself is roughly at the center of the basin. Consequently, the canyon occupies the geographical and social center of the network formed by the connecting trails. The current consensus view is that religion provides the fundamental explanation for this centrifugal pattern.

Archaeologists now describe Chaco during the Bonito phase as a location of high devotional expression and the pilgrimage center of a sacred landscape. These descriptions emphasize aspects of the archaeological record presumed to be associated with ritual activity, including caches of turquoise beads and pendants, unusual ceramic vessels and wooden objects, several rooms with multiple human burials, and especially the large number of kivas (multipurpose rooms used for religious, political, and social functions) found in great houses. Most of these indicators occur only at Pueblo bonito, but archaeologists generally assume that all the great houses had a similar ritual function. In fact, some scholars have suggested that the great houses were temples rather than residences.

However, new geological field studies in Chaco have produced results that may require a significant reassessment of the assumption that the canyon was not a favorable agricultural setting. It appears that during the first half of the eleventh century, during the extraordinary boom in construction, a large volume of water and suspended sediment flowed into the canyon. A large natural lake may have existed at the western end of Chaco, near the biggest concentration of great houses. The presence of large quantities of water and, equally important, a source of sediment that replenished agricultural fields, presumably made the canyon an extremely attractive place for newly arriving people from the northern San Juan River basin.

### **Paragraph 1**

A truly remarkable transformation in settlement patterns occurred in the San Juan basin in northwestern New Mexico in the late tenth and early

eleventh centuries, with small household farmsteads giving way to aggregated communities centered on communal masonry buildings that are now called “great houses.” These structures are found throughout the basin but are concentrated in Chaco Canyon, where several examples contained hundreds of rooms and reached four stories in height. The largest great house is Pueblo Bonito, with over 600 rooms covering two acres. The entire episode of great house construction in Chaco, the Bonito phase (A.D. 900-1140), was obviously a time of immense cooperative effort. At least 200,000 wooden beams averaging 5 meters long and 20 centimeters in diameter were brought to the canyon from distances between 40 and 100 kilometers away to build a dozen great houses, **signifying** a huge labor investment and a complex production process. The bulk of construction took place in the eleventh century, but by A.D. 1140 it had **ceased** abruptly, after which there was a rapid decline in use of the great houses and apparent abandonment of the canyon in the thirteenth century.

The word “**signifying**” in the passage is closest in meaning to

- A. creating
- B. indicating
- C. initiating
- D. requiring

1. The word “**ceased**” in the passage is closest in meaning to

- A. slowed down
- B. accelerated
- C. stopped
- D. changed in style

2. According to paragraph 1, all of the following provide evidence that the Bonito phase was a time of immense cooperative effort EXCEPT

- A. the large amounts of material needed
- B. the size of the Pueblo Bonito complex
- C. the unusual materials used in construction
- D. the distance the materials needed to be transported

## Paragraph 2

For more than a century archaeologists have struggled to understand the

circumstances surrounding the rise and collapse of Chacoan society –dubbed the Chaco Phenomenon. In particular, research has focused on determining why such an apparently inhospitable place as Chaco, which today is extremely arid and has very short growing seasons, should have favored the concentration of labor that must have been required for such massive construction projects over brief periods of time. Until the 1970s, it was widely assumed that Chaco had been a forested oasis that attracted farmers who initially flourished but eventually fell victim to their own success and exuberance, as they denuded the canyon of trees and vegetation to build large great houses. In the 1980s this reconstruction was largely dismissed in response to evidence that there had never been a forest in Chaco, and that canyon soils had poor agricultural potential. As scientific interpretations about Chaco changed, the focus of explanatory models changed from the attractiveness of the canyon for farmers to the position of the canyon within a regional network of dispersed agricultural communities.

3. Which of the sentences below best expresses the essential information in the highlighted sentence in the passage? Incorrect choices change the meaning in important ways or leave out essential information.
- A. Researchers have tried to establish why an area as dry as Chaco was the site of such large construction efforts.
  - B. Researchers have tried to establish whether the concentration of massive construction projects in a brief period of time made Chaco the dry area that it is today.
  - C. Researchers have established that Chaco's brief growing season required a concentration of labor to produce large quantities of food in a short period of time.
  - D. Researchers have established that the hot, dry climate of Chaco forced workers to complete construction on large buildings in short periods of time.
4. According to paragraph 2, before 1970, scholars believed that Chacoan society collapsed because
- A. Chaco never had the forests that were needed for the development of a

- stable agricultural economy
- B. farmers used up the natural resources in Chaco that had originally allowed the society to succeed
  - C. Chaco suffered a long-term drought that prevented farmers from growing enough food
  - D. laborers left Chaco to find other work after they finished building the great houses there
5. It can be inferred from paragraph 2 that the pre-1970s theory about the Chaco Phenomenon
- A. was based on the widespread farm and tool remains found by archaeologists on the site
  - B. was largely reinforced by findings in the 1980s
  - C. was not supported by substantial evidence
  - D. was so strong that it went unchallenged for many decades
6. The word “dispersed” in the passage is closest in meaning to
- A. connected
  - B. scattered
  - C. stable
  - D. developed
7. According to paragraph 2, why did scientists change their view about the cause of the collapse of Chacoan society?
- A. They found evidence that Chaco had always lacked trees and good soil.
  - B. They discovered that Chaco Canyon was much drier than they had previously believed.
  - C. They learned that the population was not large enough to supply the laborers needed to build the great houses.
  - D. They found evidence that the farming economy was excessively concentrated in the central canyon.

### **Paragraph 3**

The adoption of a regional perspective in explaining the Chaco Phenomenon was based in part on the discovery of formal trails connecting many of the great houses in Chaco, as well as linking the canyon to smaller great house located throughout the San Juan basin, the latter are referred to as Chaco



“outliers.” These trails are densest around the concentration of great houses in the center, and the canyon itself is roughly at the center of the basin. Consequently, the canyon occupies the geographical and social center of the network formed by the connecting trails. The current consensus view is that religion provides the fundamental explanation for this centrifugal pattern.

#### **Paragraph 4**

Archaeologists now describe Chaco during the Bonito phase as a location of high devotional expression and the pilgrimage center of a sacred landscape. These descriptions emphasize aspects of the archaeological record presumed to be associated with ritual activity, including caches of turquoise beads and pendants, unusual ceramic vessels and wooden objects, several rooms with multiple human burials, and especially the large number of kivas (multipurpose rooms used for religious, political, and social functions) found in great houses. Most of these indicators occur only at Pueblo bonito, but archaeologists generally assume that all the great houses had a similar ritual **function**. In fact, some scholars have suggested that the great houses were temples rather than residences.

8. According to paragraph 3 and 4, which of the following best describes how archaeologists arrived at their current view of the nature of Chaco during the Bonito phase?
- A. They discovered a large number of kivas, which probably served as temporary houses for pilgrims on their way to the main temple.
  - B. They found a series of paths leading to the outlines, which seem to have been centers of trade for makers of jewelry and other products.
  - C. They found turquoise beads and pendants and other valuable objects, leading to the theory that the great houses were wealthy residences.
  - D. They discovered many objects and rooms associated with ritual activity, leading to the theory that Chaco was a religious center.
9. The word “ **function** ” in the passage is closest in meaning to
- A. center
  - B. practice
  - C. design
  - D. purpose

### Paragraph 5

However, new geological field studies in Chaco have produced results that may require a significant reassessment of the assumption that the canyon was not a favorable agricultural setting. It appears that during the first half of the eleventh century, during the extraordinary boom in construction, a large volume of water and suspended sediment flowed into the canyon. A large natural lake may have existed at the western end of Chaco, near the biggest concentration of great houses. The presence of large quantities of water and, equally important, a source of sediment that replenished agricultural fields, presumably made the canyon an extremely attractive place for newly arriving people from the northern San Juan River basin.

10. According to paragraph 5, what is the possible significance of new geological field studies in Chaco?
- A. They indicate that during the construction boom the Chaco area probably did have enough water and sediment to attract farmers to that area.
  - B. They could undermine the theory of Chaco as a religious center.
  - C. They show the presence of excessive amounts of water, which may have led to the departure of most of the people living there during the Bonito phase.
  - D. They suggest that the kind of sediment present in Chaco in the eleventh century was not favorable for agriculture.
11. Why does the author state that “A large natural lake may have existed at the western end of Chaco, near the biggest concentration of great houses.”
- A. To suggest that geological studies are better than archaeological studies in identifying the historical uses of land
  - B. To demonstrate that large construction projects require a large population of workers
  - C. To support the idea that Chaco may have been favorable to agriculture during the Bonito phase
  - D. To show that the Chacoan people preferred to build their homes near water

■ The adoption of a regional perspective in explaining the Chaco Phenomenon was based in part on the discovery of formal trails connecting many of the great houses in Chaco, as well as linking the canyon to smaller great house located throughout the San Juan basin, the latter are referred to as Chaco “outliers.” ■ These trails are densest around the concentration of great houses in the center, and the canyon itself is roughly at the center of the basin. ■ Consequently, the canyon occupies the geographical and social center of the network formed by the connecting trails. ■ The current consensus view is that religion provides the fundamental explanation for this centrifugal pattern.

12. Look at the four squares [■ ] that indicate where the following sentence could be added to the passage.

**Scholars have attempted to find a reason for this weblike arrangement of great houses around a central canyon.**

Where would the sentence best fit?

**13.Directions:** An introductory sentence for a brief summary of the passage is provided below. Complete the summary by selecting the THREE answer choices that express the most important ideas in the passage. Some sentences do not belong in the summary because they express ideas that are not presented in the passage or are minor ideas in the passage. **This question is worth 2 points.**

**The population of the Chaco Canyon in New Mexico changed significantly between the tenth and eleventh centuries, as evidenced by the remains of its great houses.**

**Answer Choices**

- A. Before the 1970s, scholars believed that the fall of Chacoan society was caused by farmers’ cutting down all the trees to build their great houses.
- B. After discovering trails connecting Chaco to surrounding communities, scholars came to believe that there were many forested oases to support those communities.

- C. Archaeological evidence has led current scholars to believe that Chaco was a religious center during the Bonito phase.
- D. Archaeological findings indicate that Chaco Canyon was completely abandoned by the end of the thirteenth century.
- E. Researchers' finding in the 1980s revealed that Chaco Canyon had been a fertile agricultural area that caused the population near the center of the canyon to increase steadily during the Bonito phase.
- F. Recent geological studies indicating the presence of water in Chaco Canyon in the eleventh century may alter scholars' belief that the area was not favorable for farming.

## Dinosaurs and Parental Care

From fossil evidence alone the question of whether or not dinosaurs cared for their young is very difficult to answer. Because behaviors are not preserved in the fossil record, we can only make inferences from indirect evidence. Parental care can be divided into two types of behavior, prehatching (building nests and incubating eggs—for example, sitting on top of them so as to warm the eggs and encourage hatching) and posthatching (feeding the young and guarding the nests). Most of our evidence comes from alleged dinosaur rookeries (places where nests are built). Several have been excavated in eastern Montana, where a large concentration of dinosaur nests was found at a place now called Egg Mountain. Most of these probably belonged to the hadrosaur *Maiasaura*. Preserved in these nests are the bones of baby dinosaurs. The finds at Egg Mountain and other sites around the world document that dinosaurs laid their eggs in nests.

The nests at Egg Mountain are reported to be equally spaced, separated by a space corresponding to the length of an adult *Maiasaura*. From this arrangement scientists have inferred that the nests were separated in this way to allow incubation in a tightly packed nesting colony. Although this interpretation is open to challenge, the discovery of *Oviraptor* adults on top of *Oviraptor* egg clutches (as determined by embryos in some eggs), is relatively powerful evidence that at least these dinosaurs incubated their nests.

Evidence for parental care following hatching is much more controversial. Behavioral speculation based on indirect fossil evidence is dangerous because the data is not always as unambiguous as might appear. At Egg Mountain, many nests contain baby dinosaur bones. Not all the dinosaurs in the nest are the same size. Many of the small bones found in the nests are associated with jaws and teeth, teeth that show signs of wear. It seems reasonable to assume that the wear was caused by the chewing of the coarse plants that were the hatchlings' diet. Because the young were still in the nest, this food may have been brought to the rookery by foraging adults. This line of reasoning suggests that these animals had an advanced system of parental care. A closer look at the evidence clouds this interpretation. Analysis of dinosaur embryos indicates that worn surfaces are present on the teeth of juveniles even before hatching. Just as a human baby moves inside the mother before birth,

modern-day archosaurs also grind their teeth before birth, wearing the surface in some spots. Thus, the fossil evidence for an advanced parental care system in extinct dinosaurs is suggestive but inconclusive, and it is hard even to imagine the sort of paleontologic discovery that could settle this debate for good.

The strongest evidence that extinct dinosaurs had some form of advanced parental care system is based on an understanding of the phylogenetic relationships among dinosaurs and their closest living relatives. Living dinosaurs (birds), even primitive ones such as ostriches and kiwis, exhibit parental care, so some form of parental care can be inferred to have existed in the last common ancestor of all birds. Although unappreciated, crocodiles are reptiles that are also caring parents. They build nests, guard the nests, and in some cases dig their young out of the nest when they hear the chirping young ones hatching. The young even communicate with each other while still in the egg by high-frequency squeaks (as birds do). Some evidence suggests that this squeaking is a cue for the synchronization of the hatching. Since birds and crocodiles share a common ancestor, the simplest explanation for the characteristics they share (such as nest building and some form of parental care) is that they evolved only once—that these attributes were present in their common ancestor and passed on to its descendants. Because extinct dinosaurs also descended from that ancestor, the simplest and most general theory is that extinct dinosaurs also shared these characteristics, even though they cannot be directly observed, and we cannot be sure how elaborate their parental care was.

### **Paragraph 1**

From fossil evidence alone the question of whether or not dinosaurs cared for their young is very difficult to answer. Because behaviors are not preserved in the fossil record, we can only make inferences from indirect evidence. Parental care can be divided into two types of behavior, prehatching (building nests and incubating eggs—for example, sitting on top of them so as to warm the eggs and encourage hatching) and posthatching (feeding the young and guarding the nests). Most of our evidence comes from **alleged** dinosaur rookeries (places where nests are built). Several have been excavated in

eastern Montana, where a large concentration of dinosaur nests was found at a place now called Egg Mountain. Most of these probably belonged to the hadrosaur *Maiasaura*. Preserved in these nests are the bones of baby dinosaurs. The finds at Egg Mountain and other sites around the world document that dinosaurs laid their eggs in nests.

1. The word “ **alleged** ” in the passage is closest in meaning to
  - A. scattered
  - B. supposed
  - C. isolated
  - D. exposed
2. Paragraph 1 answers which of the following questions about parental care in dinosaurs?
  - A. Which type of parental care was more important for the survival of dinosaur young, prehatching care or posthatching care?
  - B. Why were dinosaur remains in eastern Montana preserved rather than destroyed over time?
  - C. Did *Maiasaura* hadrosaurs provide types of parental care not provided by other dinosaurs?
  - D. What evidence supports the view that *Maiasaura* females laid their eggs in nests?

## Paragraph 2

The nests at Egg Mountain are reported to be equally spaced, separated by a space corresponding to the length of an adult *Maiasaura*. From this arrangement scientists have inferred that the nests were separated in this way to allow incubation in a tightly packed nesting colony. Although this interpretation is open to challenge, the discovery of *Oviraptor* adults on top of *Oviraptor* egg clutches (as determined by embryos in some eggs), is relatively powerful evidence that at least these dinosaurs incubated their nests.

3. According to paragraph 1 and 2, the fossil record most clearly shows that dinosaurs engaged in which of the following behaviors?
  - A. Laying eggs in nests
  - B. Hiding eggs
  - C. Feeding young

- D. Storing food
4. According to paragraph 2, which of the following supports of the theory that the *Maiasaura* incubated their eggs?
- A. The examination of embryos found in some eggs
  - B. The large concentration of nests in one location
  - C. The amount of space between nests
  - D. The discovery of adult *Maiasaura* bones on top of egg clutches

### Paragraph 3

Evidence for parental care following hatching is much more **controversial**. Behavioral speculation based on indirect fossil evidence is dangerous because the data is not always as unambiguous as might appear. At Egg Mountain, many nests contain baby dinosaur bones. Not all the dinosaurs in the nest are the same size. Many of the small bones found in the nests are associated with jaws and teeth, teeth that show signs of wear. It seems reasonable to assume that the wear was caused by the chewing of the coarse plants that were the hatchlings' diet. Because the young were still in the nest, this food may have been brought to the rookery by foraging adults. This line of reasoning suggests that these animals had an advanced system of parental care. A closer look at the evidence clouds this interpretation. Analysis of dinosaur embryos indicates that worn surfaces are present on the teeth of juveniles even before hatching. Just as a human baby moves inside the mother before birth, modern-day archosaurs also grind their teeth before birth, wearing the surface in some spots. Thus, the fossil evidence for an advanced parental care system in extinct dinosaurs is suggestive but **inconclusive**, and it is hard even to imagine the sort of paleontologic discovery that could settle this debate for good.

5. The word “**controversial**” in the passage is closest in meaning to
- A. limited
  - B. convincing
  - C. relevant
  - D. debatable
6. The word “**inconclusive**” in the passage is closest in meaning to
- A. not decisive



- B. insignificant
  - C. not valid
  - D. misleading
7. According to paragraph 3, the patterns of wear found on the teeth of young dinosaurs may indicate which of the following?
- A. Baby dinosaurs were eating food brought to them by their parents.
  - B. Early development of jaw and teeth varied according to a dinosaur's size.
  - C. Dinosaurs went foraging for food at an early age.
  - D. Baby dinosaurs did not begin to eat solid food until after they left the nest.
8. In paragraph 3, why does the author mention that baby archosaurs ground their teeth inside the egg?
- A. To support the claim that baby dinosaurs in the eggs shared certain behaviors with human babies before birth
  - B. To contrast the behavior of baby archosaurs with that of other types of dinosaurs.
  - C. To cast doubt on the claim that adult dinosaurs fed their hatchlings in the nest
  - D. To explain why the teeth of baby archosaurs were more worn than those of other juveniles

#### **Paragraph 4**

The strongest evidence that extinct dinosaurs had some form of advanced parental care system is based on an understanding of the phylogenetic relationships among dinosaurs and their closest living relatives. Living dinosaurs (birds), even primitive ones such as ostriches and kiwis, exhibit parental care, so some form of parental care can be inferred to have existed in the last common ancestor of all birds. Although unappreciated, crocodiles are reptiles that are also caring parents. They build nests, guard the nests, and in some cases dig their young out of the nest when they hear the chirping young ones hatching. The young even communicate with each other while still in the egg by high-frequency squeaks (as birds do). Some evidence suggests that this squeaking is a cue for the synchronization of the hatching. Since birds and crocodiles share a common ancestor, the simplest explanation for the characteristics they share (such as nest building and some form of parental

care) is that they evolved only once—that these attributes were present in their common ancestor and passed on to its descendants. Because extinct dinosaurs also descended from that ancestor, the simplest and most general theory is that extinct dinosaurs also shared these characteristics, even though they cannot be directly observed, and we cannot be sure how **elaborate** their parental care was.

9. Which of the sentences below best expresses the essential information in the highlighted sentence in the passage? Incorrect choices change the meaning in important ways or leave out essential information.

***Phylogenetic:*** *having to do with evolutionary development*

- A. The simplest explanation for the similarities between birds and crocodiles is that they evolved at the same time.
- B. A common ancestor is probably the source of the shared traits of crocodiles and birds.
- C. The originally similar traits of birds and crocodiles increased after evolving through a shared ancestor.
- D. Only one shared pattern of behavior –that of nest building –was present in the common ancestor of birds and crocodiles.

10. The word “**elaborate**” in the passage is closest in meaning to

- A. widespread
- B. reliable
- C. well developed
- D. long lasting

11. Paragraph 4 answers all of the following questions about crocodiles EXCEPT

- A. What is the evidence that crocodiles are caring parents?
- B. Why do crocodile parents communicate with the young inside their eggs?
- C. What is a possible reason for the high-frequency sounds that crocodiles make inside their eggs?
- D. How do crocodiles participate in the hatching process of their young?

12. In paragraph 4, the author discusses birds and crocodiles in order to

- A. contrast patterns of parenting behavior in both living and extinct animals

- B. provide evidence that sophisticated parental care behaviors evolved only relatively recently
- C. demonstrate that parental care behaviors have continued to evolve since the time of the dinosaurs
- D. support the theory that extinct dinosaurs probably inherited some kind of parental care system

From fossil evidence alone the question of whether or not dinosaurs cared for their young is very difficult to answer. Because behaviors are not preserved in the fossil record, we can only make inferences from indirect evidence. Parental care can be divided into two types of behavior, prehatching (building nests and incubating eggs—for example, sitting on top of them so as to warm the eggs and encourage hatching) and posthatching (feeding the young and guarding the nests). ■ Most of our evidence comes from alleged dinosaur rookeries (places where nests are built). ■ Several have been excavated in eastern Montana, where a large concentration of dinosaur nests was found at a place now called Egg Mountain. Most of these probably belonged to the hadrosaur *Maiasura*. Preserved in these nests are the bones of baby dinosaurs. The finds at Egg Mountain and other sites around the world document that dinosaurs laid their eggs in nests.

13. Look at the four squares [■ ] that indicate where the following sentence could be added to the passage

**Evidence of the former is easier to find than that of the latter.**

Where would the sentence best fit?

- 14.Directions:** An introductory sentence for a brief summary of the passage is provided below. Complete the summary by selecting the THREE answer choices that express the most important ideas in the passage. Some sentences do not belong in the summary because they express ideas that are not presented in the passage or are minor ideas in the passage. **This question is worth 2 points.**

**Scientists must use indirect evidence to determine whether extinct dinosaurs cared for their young.**

### **Answer choices**

- A. Because baby dinosaur bones and eggs were very delicate, there are relatively few preserved as fossils, so little is known about dinosaur young.
- B. Fossils from sites like Egg Mountain indicate that dinosaurs built nests, and perhaps that they incubated their eggs and fed their hatchlings.
- C. Fossil evidence such as the spacing of nests may indicate advanced parental care but can have different interpretations.
- D. Tightly packed Oviraptor rookeries indicate that dinosaurs may have tended to nest in large colonies in order to better protect both eggs and hatchlings.
- E. Discovery of hadrosaur bones of different sizes in the same nest may indicate that, in some species, older siblings took care of younger ones.
- F. The strongest evidence comes from extinct dinosaurs' nearest living relatives, birds and crocodiles, who do engage in many forms of parental care.

## **The Plow and the Horse in Medieval Europe**

One of the most important factors driving Europe's slow emergence from the economic stagnation of the Early Middle Ages (circa 500-1000 B.C.E.) was the improvement of agricultural technology. One innovation was a new plow, with a curved attachment (moldboard) to turn over wet, heavy soils, and a knife (or coulter) in front of the blade to allow a deeper and easier cut. This more complex plow replaced the simpler "scratch" plow that merely made a shallow, straight furrow in the ground. In the lands around the Mediterranean, with light rains and mild winters, this had been fine, but in the wetter terrain north and west of the Danube and the Alps, such a plow left much to be desired, and it is to be wondered if it was used at all. Cleared lands would more likely have been worked by hand tilling, with little direct help from animals, and the vast forests natural to Northern Europe remained either untouched, or perhaps cleared in small sections by fire, and the land probably used only so long as the ash-enriched soil yielded good crops and then abandoned for some other similarly cleared field. Such a pattern of agriculture and settlement was no basis for sustained cultural or economic life.

With the new heavy plow, however, fields could be cleared, sowed, and maintained with little more difficulty than in the long-settled lands of Southern Europe, while the richness of the new soils, the reliability of the rains, and the variety of crops now possible made for an extremely productive agriculture. The new tool, however, imposed new demands, technical, economic, and social. The heavy plow was a substantial piece of capital, unlike a simple hand hoe, and this had the same sorts of implications that capitalization always has—it favored the concentration of wealth and control. Moreover, making full use of it required more animal power, and this had a host of implications of its own. The full importance of this was even more apparent in the centuries after 1000, when oxen began to give way in certain parts of Western Europe to horses.

The powerful, rugged farm horse was itself a product of improvement during the Middle Ages, and it was part of complex set of technical changes and capabilities. The introduction of new forms of equipment for horses transformed this animal into the single most important assist to human labor and travel. Instead of the old harness used by the ancient Greeks and Romans, there appeared from Central Asia the rigid, padded horse collar. Now, when the horse pulled against a load, no longer did the load pull back against its neck and windpipe but rather rode on the sturdy shoulders. When this innovation was combined with the iron horseshoe, the greater speed and stamina of the horse displaced oxen wherever it could be afforded. The large importance of this lay not only in more efficient farmwork, but in swifter and surer transportation between town and countryside. The farmer with horses could move products to market more frequently and at greater distances than with only oxen, and the urban development that was to transform the European economic and social landscape after the eleventh century was propelled in large part by these new horse-centered transport capabilities.

Another indicator of how compelling and important was the new horse agriculture was its sheer cost. Unlike oxen and other cattle, horses cannot be supported exclusively on hay and pasturage, they require, particularly in northern climates where pasturing seasons are short, cropped food, such as oats and alfalfa. Unlike grass and hay, these are grown with much of the same effort and resources applied to human nourishment, and thus their acquisition represents a sacrifice, in a real sense, of human food. The importance of this in a world that usually lived at the margins of sufficient diet is hard to overstate. The increased resources that went into making the horse central to both the medieval economy and in a separate but related development, medieval warfare, are the surest signs of the great utility the animal now assumed.

### Paragraph 1

One of the most important factors driving Europe's slow emergence from the economic **stagnation** of the Early Middle Ages (circa 500-1000 B.C.E.) was the improvement of agricultural technology. One innovation was a new plow, with a curved attachment (moldboard) to turn over wet, heavy soils, and a knife (or coulter) in front of the blade to allow a deeper and easier cut. This more complex plow replaced the simpler "scratch" plow that merely made a shallow, straight furrow in the ground. In the lands around the Mediterranean, with light rains and mild winters, this had been fine, but in the wetter terrain north and west of the Danube and the Alps, such a plow left much to be desired, and it is to be wondered if it was used at all. Cleared lands would more likely have been worked by hand tilling, with little direct help from animals, and the vast forests natural to Northern Europe remained either untouched, or perhaps cleared in small sections by fire, and the land probably used only so long as the ash-enriched soil yielded good crops and then abandoned for some other similarly cleared field. Such a pattern of agriculture and settlement was no basis for **sustained** cultural or economic life.

1. The word "**stagnation**" in the passage is closest in meaning to
  - A. instability
  - B. lack of growth
  - C. dependence on others
  - D. decline
2. According to paragraph 1, what was the main advantage of the new plow over the scratch plow?
  - A. The new plow created straighter rows.
  - B. The new plow was easier for animals to pull.
  - C. The new plow could dig deeper into the soil.
  - D. The new plow was easier to make
3. The word "**sustained**" in the passage is closest in meaning to
  - A. continued

- B. established
  - C. ordinary
  - D. active
4. According to paragraph 1, the scratch plow was particularly unsuited to
- A. the lands around the Mediterranean
  - B. places where the soil was often dry
  - C. places where land was cleared and worked by hand
  - D. places where the soil was particularly wet and heavy
5. Paragraph 1 implies which of the following about agriculture before the introduction of the new plow?
- A. Limited rainfall had prevented large-scale agricultural development.
  - B. Most of Europe's developed agricultural communities were located in the south.
  - C. Several other important innovations immediately preceded the development of the new plow.
  - D. Much of Europe's forestland had been converted to agricultural use.
6. Which of the sentences below best expresses the essential information in the highlighted sentence in the passage? Incorrect choices change the meaning in important ways or leave out essential information.
- A. Tilling by hand was so difficult that cleared land in Northern Europe was often abandoned and allowed to return to its natural forested state.
  - B. Cleared land was probably tilled by hand, while the forests of Northern Europe were cleared only in small sections and used for short periods.
  - C. In the vast natural forests of Northern Europe, farmers had to work the land by hand, with little direct help from animals.
  - D. Fire enabled northern European farmers to enrich cleared land enough to cultivate their crops for short periods of time.



## Paragraph 2

With the new heavy plow, however, fields could be cleared, sowed, and maintained with little more difficulty than in the long-settled lands of Southern Europe, while the richness of the new soils, the reliability of the rains, and the variety of crops now possible made for an extremely productive agriculture. The new tool, however, imposed new demands, technical, economic, and social. The heavy plow was a substantial piece of capital, unlike a simple hand hoe, and this had the same sorts of **implications** that capitalization always has—it **avored the concentration of wealth and control**. Moreover, making full use of it required more animal power, and this had a host of **implications** of its own. The full importance of this was even more apparent in the centuries after 1000, when oxen began to give way in certain parts of Western Europe to horses.

7. The word “**implications**” in the passage is closest in meaning to
- A. requirements
  - B. inequalities
  - C. consequences
  - D. disadvantages
8. What can be inferred from the information that the new plow “**avored the concentration of wealth and control**”?
- A. Wealthy farmers in the south had a significant economic advantage over farmers in the north.
  - B. The production and sale of the new plow became an important source of capital.
  - C. The new plow was more popular in parts of Europe where oxen were used for farming than in parts where horses were used.
  - D. Greater economic equality existed in northern Europe before the introduction of the new plow.

### Paragraph 3

The powerful, rugged farm horse was itself a product of improvement during the Middle Ages, and it was part of complex set of technical changes and capabilities. The introduction of new forms of equipment for horses transformed this animal into the single most important assist to human labor and travel. Instead of the old harness used by the ancient Greeks and Romans, there appeared from Central Asia the rigid, padded horse collar. Now, when the horse pulled against a load, no longer did the load pull back against its neck and windpipe but rather rode on the sturdy shoulders. When this innovation was combined with the iron horseshoe, the greater speed and stamina of the horse displaced oxen wherever it could be afforded. The large importance of this lay not only in more efficient farmwork, but in swifter and surer transportation between town and countryside. The farmer with horses could move products to market more frequently and at greater distances than with only oxen, and the urban development that was to transform the European economic and social landscape after the eleventh century was propelled in large part by these new horse-centered transport capabilities.

9. According to paragraph 3, which of the following contributed to the dramatic rise in the agricultural use of horses in Europe?
- A. A powerful new breed of farm horse was brought to Europe from Central Asia.
  - B. Farmers began using rigid, padded collars that allowed horses to pull heavy loads more easily.
  - C. For the first time, horses became cheaper than oxen.
  - D. Farmers began studying the farming techniques used by the ancient Greeks and Romans.
10. According to paragraph 3, what role did horses play in the larger social changes of the eleventh century?
- A. The raising and selling of horses became important economic and cultural activities in Europe.

- B. Horses stimulated the growth of urban areas by providing quick, reliable transportation.
- C. Owners of successful horse-based farms became influential members of society.
- D. Horse transportation enabled Europeans to interact with other cultures like those of Central Asia.

#### **Paragraph 4**

Another indicator of how compelling and important was the new horse agriculture was its sheer cost. Unlike oxen and other cattle, horses cannot be supported **exclusively** on hay and pasturage, they require, particularly in northern climates where pasturing seasons are short, cropped food, such as oats and alfalfa. Unlike grass and hay, these are grown with much of the same effort and resources applied to human nourishment, and thus their acquisition represents a sacrifice, in a real sense, of human food. The importance of this in a world that usually lived at the margins of sufficient diet is hard to overstate. The increased resources that went into making the horse central to both the medieval economy and in a separate but related development, medieval warfare, are the surest signs of the great utility the animal now assumed.

11. The word “**exclusively**” in the passage is closest in meaning to
- A. cheaply
  - B. easily
  - C. reliably
  - D. solely
12. In paragraph 4, why does the author emphasize the amount of effort and resources needed to grow alfalfa and oats?
- A. To illustrate how valuable horses were by showing how much farmers were willing to sacrifice to keep them
  - B. To provide evidence that, in medieval Europe, both horses and humans

lived at the margins of a sufficient diet

- C. To argue that it made more sense to devote land to growing food for humans than to growing food for horses
- D. To explain why oxen and other cattle that ate grass and hay continued to be more common than horses

One innovation was a new plow, with a curved attachment (moldboard) to turn over wet, heavy soils, and a knife (or coulter) in front of the blade to allow a deeper and easier cut. ■ This more complex plow replaced the simpler “scratch” plow that merely made a shallow, straight furrow in the ground. ■ In the lands around the Mediterranean, with light rains and mild winters, this had been fine, but in the wetter terrain north and west of the Danube and the Alps, such a plow left much to be desired, and it is to be wondered if it was used at all. ■ Cleared lands would more likely have been worked by hand tilling, with little direct help from animals, and the vast forests natural to Northern Europe remained either untouched, or perhaps cleared in small sections by fire, and the land probably used only so long as the ash-enriched soil yielded good crops and then abandoned for some other similarly cleared field. ■ Such a pattern of agriculture and settlement was no basis for sustained cultural or economic life.

13. Look at the four squares [■] that indicate where the following sentence could be added to the passage.

**In fact, it sliced the ground so thoroughly that fields could be planted after only one plowing rather than the two needed before.**

Where would the sentence best fit?

14. **Directions:** An introductory sentence for a brief summary of the passage is provided below. Complete the summary by selecting the THREE answer choices that express the most important ideas in the passage. Some

sentences do not belong in the summary because they express ideas that are not presented in the passage or are minor ideas in the passage. **This question is worth 2 points.**

**Agricultural innovations with important social and economic consequences occurred in eleventh-century Europe**

**Answer choices**

- A. Light rains and unpredictable winters had made most of the soil in Europe unsuitable for enough agriculture to sustain economic development
- B. Farmers switched from oxen to horses to pull their plows because inexpensive pasturage for oxen decreased significantly in the centuries after 1000 B.C.E.
- C. The introduction of iron horseshoes enabled farmers to transport goods farther than they could with the more expensive oxen.
- D. Improvements in the design of plows opened up vast areas of land in Northern Europe that had previously been unusable for sustained agriculture.
- E. With help from a new kind of harness from Asia, horses were able to pull the new heavy plow and to transport goods to market more quickly and frequently.
- F. The horse came to be valued so greatly that farmers devoted some of their land to growing crops for their horses rather than using this land to grow food for their families.

## **Egypt Circa 3100 B.C.**

The city of Memphis, located on the Nile near the modern city of Cairo, was founded around 3100 B.C., as the first capital of a recently united Egypt. The choice of Memphis by Egypt's first kings reflects the site's strategic importance. First, and most obvious, the apex of the Nile River delta was a politically opportune location for the state's administrative center, standing between the united lands of Upper and Lower Egypt and offering ready access to both parts of the country. The older predynastic (pre- 3100 B.C.) centers of power. This and Hierakonpolis, were too remote from the vast expanse of the delta, which had been incorporated into the unified state. Only a city within easy reach of both the Nile valley to the south and the more spread out, difficult terrain to the north could provide the necessary political control that the rulers of early dynastic Egypt (roughly 3000-2600 B.C.) required.

The region of Memphis must have also served as an important node for transport and communications, even before the unification of Egypt. The region probably acted as a conduit for much, if not all, of the river-based trade between northern and southern Egypt. Moreover, commodities (such as wine, precious oils, and metals) imported from the Near East by the royal courts of predynastic Upper Egypt would have been channeled through the Memphis region on their way south. In short, therefore, the site Memphis offered the rulers of the Early Dynastic Period an ideal location for controlling internal trade within their realm, an essential requirement for a state-directed economy that depended on the movement of goods.

Equally important for the national administration was the ability to control communications within Egypt. The Nile provided the easiest and quickest artery of communication, and the national capital was, again, ideally located in this respect. Recent geological surveys of the Memphis region have revealed much about its topography in ancient times. It appears that the location of Memphis may have been even more advantageous for controlling trade, transport, and communications than was previously appreciated. Surveys and

drill cores have shown that the level of the Nile floodplain has steadily risen over the last five millennia. When the floodplain was much lower, as it would have been in predynastic and early dynastic times, the outwash fans (fan-shaped deposits of sediments) of various wadis (stream-beds or channels) that carry water only during rainy periods) would have been much more prominent features on the east bank. The fan associated with the Wadi Hof extended a significant way into the Nile floodplain, forming a constriction in the vicinity of Memphis. The valley may have narrowed at this point to a mere three kilometers, making it the ideal place for controlling river traffic.

Furthermore, the Memphis region seems to have been favorably located for the control not only of river-based trade but also of desert trade routes. The two outwash fans in the area gave access to the extensive wadi systems of the eastern desert. In predynastic times, the Wadi Digla may have served as a trade route between the Memphis region and the Near East, to judge from the unusual concentration of foreign artifacts found in the predynastic settlement of Maadi. Access to, and control of, trade routes between Egypt and the Near East seems to have been a preoccupation of Egypt's rulers during the period of state formation. The desire to monopolize foreign trade may have been one of the primary factors behind the political unification of Egypt. The foundation of the national capital at the junction of an important trade route with the Nile valley is not likely to have been accidental. Moreover, the Wadis Hof and Digla provided the Memphis region with accessible desert pasturage. As was the case with the cities of Hierakonpolis and Elkab, the combination within the same area of both desert pasturage and alluvial arable land (land suitable for growing crops) was a particularly attractive one for early settlement, this combination no doubt contributed to the prosperity of the Memphis region from early predynastic times.

### Paragraph 1

The city of Memphis, located on the Nile near the modern city of Cairo, was founded around 3100 B.C., as the first capital of a recently united Egypt. The choice of Memphis by Egypt's first kings reflects the site's strategic importance. First, and most obvious, the apex of the Nile River delta was a politically opportune location for the state's administrative center, standing between the united lands of Upper and Lower Egypt and offering ready access to both parts of the country. The older predynastic (pre- 3100 B.C.) centers of power, This and Hierakonpolis, were too remote from the **vast** expanse of the delta, which had been incorporated into the unified state. Only a city within easy reach of both the Nile valley to the south and the more spread out, difficult terrain to the north could provide the necessary political control that the rulers of early dynastic Egypt (roughly 3000-2600 B.C.) required.

1. The word "**vast**" in the passage is closest in meaning to
  - A. fertile
  - B. huge
  - C. unique
  - D. irregular
2. According to paragraph 1, why was Memphis a better choice for the capital of a united Egypt than either This or Hierakonpolis?
  - A. Memphis was in a better location for maintaining administrative control.
  - B. Memphis had long been a regional administrative center by the time Egypt was united.
  - C. This and Hierakonpolis had never actually been incorporated into the unified state.
  - D. Egyptian rulers had failed to keep political control over This and Hierakonpolis in predynastic times.
3. It can be inferred from paragraph 1 that one consequence of the unification of Egypt was
  - A. the reduction of the strategic importance of older centers of power



- B. the opportunity for the recently united Egypt to become economically self-sufficient
  - C. the increase in political tensions between the rulers of Upper and Lower Egypt
  - D. the reduction of Egypt's dependence upon the Nile for trade and communications
4. Which of the following best describes how paragraph 1 is organized?
- A. Two simultaneous developments are described, as well as the reasons why neither one would have occurred without the other.
  - B. A hypothesis is presented, and then points in favor of that hypothesis as well as points against it are discussed.
  - C. A major event is described, and then the most obvious effects of that event are presented.
  - D. A decision is described, and then one likely motivation for that decision is presented.

## **Paragraph 2**

The region of Memphis must have also served as an important node for transport and communications, even before the unification of Egypt. The region probably acted as a conduit for much, if not all, of the river-based trade between northern and southern Egypt. Moreover, commodities (such as wine, precious oils, and metals) imported from the Near East by the royal courts of predynastic Upper Egypt would have been channeled through the Memphis region on their way south. In short, therefore, the site Memphis offered the rulers of the Early Dynastic Period an ideal location for controlling internal trade within their realm, an essential requirement for a state-directed economy that depended on the movement of goods.

5. According to paragraph 2, when did Egypt import goods from the Near East?
- A. Once internal trade was fully controlled from Memphis

- B. Not until early dynastic Egypt established its state-directed economy
  - C. As early as predynastic times
  - D. Only when local supplies of those goods had been completely used up
6. Which of the sentences below best expresses the essential information in the highlighted sentence in the passage? Incorrect choices change the meaning in important ways or leave out essential information.
- A. Thus in Memphis, the rulers of the Early Dynastic Period were ideally placed to control internal trade, which they had to do in order to run their economy.
  - B. Therefore the rulers of the Early Dynastic Period thought Memphis was the ideal location for trade with nearby countries.
  - C. In short, a state-directed economy like that of the Early Dynastic Period requires choosing a single location to which goods can be moved-Memphis, in this case
  - D. In sum, then, a state-directed economy first developed during Egypt's Early Dynastic Period because Memphis was an ideal location for controlling trade.

### **Paragraph 3**

Equally important for the national administration was the ability to control communications within Egypt. The Nile provided the easiest and quickest artery of communication, and the national capital was, again, ideally located in this respect. Recent geological surveys of the Memphis region have revealed much about its topography in ancient times. It appears that the location of Memphis may have been even more advantageous for controlling trade, transport, and communications than was previously **appreciated**. Surveys and drill cores have shown that the level of the Nile floodplain has steadily risen over the last five millennia. When the floodplain was much lower, as it would have been in predynastic and early dynastic times, the outwash fans (fan-shaped deposits of sediments) of various wadis (stream-beds or channels)

that carry water only during rainy periods) would have been much more prominent features on the east bank. The fan associated with the Wadi Hof extended a significant way into the Nile floodplain, forming a constriction in the **vicinity** of Memphis. The valley may have narrowed at this point to a mere three kilometers, making it the ideal place for controlling river traffic.

7. The word “**appreciated**” in the passage is closest in meaning to
- A. proposed
  - B. understood
  - C. approved
  - D. expected
8. According to paragraph 3, recent research into the topography of the Memphis region in ancient times suggests which of the following?
- A. The level of the Nile floodplains was much higher in predynastic and dynastic times than in later times.
  - B. The sediment deposits of wadis were not as noticeable in predynastic and dynastic times than in later times.
  - C. The Nile valley at the point of Memphis was narrower in predynastic and dynastic times than it was in later times
  - D. Frequent rainy periods may have caused a significant reduction of trade traffic during the predynastic and dynastic times.
9. The word “**vicinity**” in the passage is closest in meaning to
- A. center
  - B. fields
  - C. city
  - D. surrounding area

#### **Paragraph 4**

Furthermore, the Memphis region seems to have been favorably located for the control not only of river-based trade but also of desert trade routes. The two outwash fans in the area gave access to the extensive wadi systems of the

eastern desert. In predynastic times, the Wadi Digla may have served as a trade route between the Memphis region and the Near East, to judge from the unusual concentration of foreign artifacts found in the predynastic settlement of Maadi. Access to, and control of , trade routes between Egypt and the Near East seems to have been a preoccupation of Egypt's rulers during the period of state formation. The desire to monopolize foreign trade may have been one of the primary factors behind the political unification of Egypt. The foundation of the national capital at the junction of an important trade route with the Nile valley is not likely **to have been accidental**. Moreover, the Wadis Hof and Digla provided the Memphis region with accessible desert pasturage. As was the case with the cities of Hierakonpolis and Elkab, the combination within the same area of both desert pasturage and alluvial arable land (land suitable for growing crops) was a particularly attractive one for early settlement, this combination no doubt contributed to the prosperity of the Memphis region from early predynastic times.

10. According to paragraph 4, which of the following is NOT a reason Memphis was chosen as the capital of a united Egypt?

- A. It was at the junction of a major trade route with the Nile valley.
- B. It was near land that could be used for animal grazing and for growing crops.
- C. The nearby outwash fans led into wadis that could be used as desert trade routes.
- D. Since foreign traders had settled in nearby Maadi, trade between the two cities could be established.

11. The phrase "**to have been accidental**" in the passage is closest in

- A. to have gone wrong
- B. to have been helpful
- C. to have occurred by chance
- D. to have made a difference

12. In paragraph 4, why does the author mention the cities of Hierakonpolis

and Elkab?

- A. To give an indication of the level of prosperity that Memphis is thought to have enjoyed from its earliest days
- B. To compare the Memphis region to them in terms of their similar combinations of characteristics providing advantages for early settlement
- C. To identify the models that the founders of Memphis followed in laying out the national capital
- D. To suggest that the combination of desert pasturage and alluvial arable land in the same area was very common

■ The region of Memphis must have also served as an important node for transport and communications, even before the unification of Egypt. ■ The region probably acted as a conduit for much, if not all, of the river-based trade between northern and southern Egypt. ■ Moreover, commodities (such as wine, precious oils, and metals) imported from the Near East by the royal courts of predynastic Upper Egypt would have been channeled through the Memphis region on their way south. ■ In short, therefore, the site Memphis offered the rulers of the Early Dynastic Period an ideal location for controlling internal trade within their realm, an essential requirement for a state-directed economy that depended on the movement of goods.

13. Look at the four squares [■] that indicate where the following sentence could be added to the passage.

**While considerations of political power and ease of administration were decisive in choosing the location of the new capital, the site clearly had other advantages.**

Where would the sentence best fit?

14. **Directions:** An introductory sentence for a brief summary of the passage is provided below. Complete the summary by selecting the THREE answer choices that express the most important ideas in the passage. Some

sentences do not belong in the summary because they express ideas that are not presented in the passage or are minor ideas in the passage. **This question is worth 2 points.**

**Around 3100 B.C. Memphis was chosen for its strategic importance to be the first capital of a recently united Egypt.**

**Answer Choices**

- A. River-based trade from northern Egypt and imported goods going south all passed through the Memphis region, making Memphis an ideal location for controlling trade.
- B. Recent geological surveys suggest that the topographical features of the Memphis region made it particularly well-suited for controlling communications and trade.
- C. The rulers of unified Egypt enjoyed a monopoly over foreign trade because all such trade was required to go through the Wadi Digla, to which the rulers controlled all access.
- D. After Memphis became the capital city, river-based trade along the Nile gained in importance, while land-based desert trade declined in importance.
- E. The Nile, despite a constriction of its valley near Memphis, was the most advantageous route for communication and travel once the floodplain had begun to rise.
- F. While the location of Memphis was agriculturally favorable, it was particularly attractive because it enabled Egypt's rulers to control trade moving through the desert from the Near East.

## **Surface Fluids on Venus and Earth**

A fluid is a substance, such as a liquid or gas, in which the component particles (usually molecules) can move past one another. Fluids flow easily and conform to the shape of their containers. The geologic processes related to the movement of fluids on a planet's surface can completely resurface a planet many times. These processes derive their energy from the Sun and the gravitational forces of the planet itself. As these fluids interact with surface materials, they move particles about or react chemically with them to modify or produce materials. On a solid planet with a hydrosphere and an atmosphere, only a tiny fraction of the planetary mass flows as surface fluids. Yet the movements of these fluids can drastically alter a planet. Consider Venus and Earth, both terrestrial planets with atmospheres.

Venus and earth are commonly regarded as twin planets but not identical twins. They are about the same size, are composed of roughly the same mix of materials, and may have been comparably endowed at their beginning with carbon dioxide and water. However, the twins evolved differently, largely because of differences in their distance from the Sun. With a significant amount of internal heat, Venus may continue to be geologically active with volcanoes, rifting, and folding. However, it lacks any sign of a hydrologic system (water circulation and distribution): there are no streams, lakes, oceans, or glaciers. Space probes suggest that Venus may have started with as much water as Earth, but it was unable to keep its water in liquid form. Because Venus receives more heat from the Sun, water released from the interior evaporated and rose to the upper atmosphere where the Sun's ultraviolet rays broke the molecules apart. Much of the freed hydrogen escaped into space, and Venus lost its water. Without water, Venus became less and less like Earth and kept an atmosphere filled with carbon dioxide. The carbon dioxide acts as a blanket, creating an intense greenhouse effect and driving surface temperatures high enough to melt lead and to prohibit the formation of carbonate minerals. Volcanoes continually vented more carbon

dioxide into the atmosphere. On Earth, liquid water removes carbon dioxide from the atmosphere and combines it with calcium, from rock weathering, to form carbonate sedimentary rocks. Without liquid water to remove carbon from the atmosphere, the level of carbon dioxide in the atmosphere of Venus remains high.

Like Venus, Earth is large enough to be geologically active and for its gravitational field to hold an atmosphere. Unlike Venus, it is just the right distance from the Sun so that temperature ranges allow water to exist as a liquid, a solid, and a gas. Water is thus extremely mobile and moves rapidly over the planet in a continuous hydrologic cycle. Heated by the Sun, the water moves in great cycles from the oceans to the atmosphere, over the landscape in river systems, and ultimately back to the oceans. As a result, Earth's surface has been continually changed and eroded into delicate systems of river valleys—a remarkable contrast to the surfaces of other planetary bodies where impact craters dominate. Few areas on Earth have been untouched by flowing water. As a result, river valleys are the dominant feature of its landscape. Similarly, wind action has scoured fine particles away from large areas, depositing them elsewhere as vast sand seas dominated by dunes or in sheets of loess. These fluid movements are caused by gravity flow systems energized by heat from the Sun. Other geologic changes occur when the gases in the atmosphere or water react with rocks at the surface to form new chemical compounds with different properties. An important example of this process was the removal of most of Earth's carbon dioxide from its atmosphere to form carbonate rocks. However, if earth were a little closer to the Sun, its oceans would evaporate, if it were farther from the Sun, the oceans would freeze solid. Because liquid water was present, self-replicating molecules of carbon, hydrogen, and oxygen developed life early in Earth's history and have radically modified its surface, blanketing huge parts of the continents with greenery. Life thrives on this planet, and it helped create the planet's oxygen- and nitrogen-rich atmosphere and moderate temperatures.



### **Paragraph 1**

A fluid is a substance, such as a liquid or gas, in which the component particles (usually molecules) can move past one another. Fluids flow easily and conform to the shape of their containers. The geologic processes related to the movement of fluids on a planet's surface can completely resurface a planet many times. These processes derive their energy from the Sun and the gravitational forces of the planet itself. As these fluids interact with surface materials, they move particles about or react chemically with them to **modify** or produce materials. On a solid planet with a hydrosphere and an atmosphere, only a tiny fraction of the planetary mass flows as surface fluids. Yet the movements of these fluids can **drastically** alter a planet. Consider Venus and Earth, both terrestrial planets with atmospheres.

1. The word "**modify**" in the passage is closest in meaning to
  - A. obtain
  - B. change
  - C. replace
  - D. absorb
  
2. The word "**drastically**" in the passage is closest in meaning to
  - A. gradually
  - B. permanently
  - C. extensively
  - D. possibly
  
3. Paragraph 1 supports all of the following statements about fluids EXCEPT
  - A. They can chemically react with particles on a planet's surface.
  - B. Most of their mass does not flow but remains in place.
  - C. Their movement can reshape the surface of certain kinds of planets.
  - D. Their movement is driven by the Sun and by gravity.

## Paragraph 2

Venus and earth are commonly regarded as twin planets but not identical twins. They are about the same size, are composed of roughly the same mix of materials, and may have been comparably endowed at their beginning with carbon dioxide and water. However, the twins evolved differently, largely because of differences in their distance from the Sun. With a significant amount of internal heat, Venus may continue to be geologically active with volcanoes, rifting, and folding. However, it lacks any sign of a hydrologic system (water circulation and distribution): there are no streams, lakes, oceans, or glaciers. Space probes suggest that Venus may have started with as much water as Earth, but it was unable to keep its water in liquid form. Because Venus receives more heat from the Sun, water released from the interior evaporated and rose to the upper atmosphere where the Sun's ultraviolet rays broke the molecules apart. Much of the freed hydrogen escaped into space, and Venus lost its water. Without water, Venus became less and less like Earth and kept an atmosphere filled with carbon dioxide. The carbon dioxide acts as a blanket, creating an intense greenhouse effect and driving surface temperatures high enough to melt lead and to **prohibit** the formation of carbonate minerals. Volcanoes continually vented more carbon dioxide into the atmosphere. On Earth, liquid water removes carbon dioxide from the atmosphere and combines it with calcium, from rock weathering, to form carbonate sedimentary rocks. Without liquid water to remove carbon from the atmosphere, the level of carbon dioxide in the atmosphere of Venus remains high.

4. The word "**prohibit**" in the passage is closest in meaning to
- A. prevent
  - B. speed up
  - C. affect
  - D. encourage

5. According to paragraph 2, what is one difference between Earth and Venus?
- A. Earth has less water in its atmosphere than Venus does.
  - B. Earth has a hydrologic system, but Venus does not.
  - C. Earth is less geologically active than Venus is.
  - D. Earth has more carbon dioxide than Venus does.
6. It can be inferred from paragraph 2 that Earth evolved differently than Venus did in part because
- A. there was more volcanic activity on early Venus than on early Earth
  - B. they received different amounts of solar energy
  - C. their interiors contained different amounts of heat
  - D. their early atmospheres contained different levels of oxygen and nitrogen
7. According to paragraph 2, all of the following played a role in keeping carbon dioxide levels high in the atmosphere of Venus EXCEPT
- A. the breaking apart of water molecules by ultraviolet rays
  - B. the evaporation of water released from the planet's interior
  - C. the escape of hydrogen into space
  - D. the release of molecules from melting metals such as lead

### **Paragraph 3**

Like Venus, Earth is large enough to be geologically active and for its gravitational field to hold an atmosphere. Unlike Venus, it is just the right distance from the Sun so that temperature ranges allow water to exist as a liquid, a solid, and a gas. Water is thus extremely mobile and moves rapidly over the planet in a continuous hydrologic cycle. Heated by the Sun, the water moves in great cycles from the oceans to the atmosphere, over the landscape in river systems, and **ultimately** back to the oceans. As a result, Earth's surface has been continually changed and eroded into delicate systems of river valleys—a remarkable contrast to the surfaces of other planetary bodies where impact craters dominate. Few areas on Earth have been untouched by flowing

water. As a result, river valleys are the dominant feature of its landscape. Similarly, wind action has scoured fine particles away from large areas, depositing them elsewhere as vast sand seas dominated by dunes or in sheets of loess (fine-grained soil deposits). These fluid movements are caused by gravity flow systems energized by heat from the Sun. Other geologic changes occur when the gases in the atmosphere or water react with rocks at the surface to form new chemical compounds with different properties. An important example of this process was the removal of most of Earth's carbon dioxide from its atmosphere to form carbonate rocks. However, if earth were a little closer to the Sun, its oceans would evaporate, if it were farther from the Sun, the oceans would freeze solid. Because liquid water was present, self-replicating molecules of carbon, hydrogen, and oxygen developed life early in Earth's history and have radically modified its surface, blanketing huge parts of the continents with greenery. Life thrives on this planet, and it helped create the planet's oxygen- and nitrogen-rich atmosphere and moderate temperatures.

8. The word "**ultimately**" in the passage is closest in meaning to
- A. finally
  - B. slowly
  - C. repeatedly
  - D. constantly
9. According to paragraph 3, Earth's surface is different from the surfaces of many other planetary bodies in which of the following ways?
- A. It is more strongly marked by river valleys and erosion.
  - B. It is more geologically active.
  - C. It is covered by impact craters.
  - D. It has an atmosphere.

10. According to paragraph 3, why is water able to move so freely on Earth?
- A. Earth's temperatures are such that water exists in solid, liquid, and gas forms.
  - B. Earth is large enough to be geologically active and for its gravitational field to hold an atmosphere.
  - C. Earth's surface allows river valleys to develop across the landscape.
  - D. Earth has active winds that blow across seas and oceans, causing fluid movements.
11. Why does the author point out that on Earth “gases in the atmosphere or water react with rocks at the surface to form new chemical compounds”?
- A. To explain why scientists believe that few areas on Earth have been untouched by flowing water
  - B. To identify one of several ways in which the movement of fluids can affect the surface of a planet
  - C. To provide evidence that fluid movements are caused by gravity
  - D. To identify an effect of wind scouring fine particles away from large areas
12. Which of the sentences below best expresses the essential information in the highlighted sentence in the passage? Incorrect choices change the meaning in important ways or leave out essential information.
- A. Life on Earth is responsible for many changes to the planet's surface, including blankets of greenery.
  - B. Self-replicating molecules of carbon, hydrogen, and oxygen led to the development of life early in Earth's history.
  - C. The presence of water made it possible for the life to develop early in Earth's history and to significantly change its surface.
  - D. Early in life's history on Earth, self-replicating molecules of carbon, hydrogen, and oxygen began blanketing the surface in greenery.

Venus and earth are commonly regarded as twin planets but not identical twins. They are about the same size, are composed of roughly the same mix of materials, and may have been comparably endowed at their beginning with carbon dioxide and water. However, the twins evolved differently, largely because of differences in their distance from the Sun. With a significant amount of internal heat, Venus may continue to be geologically active with volcanoes, rifting, and folding. ■ However, it lacks any sign of a hydrologic system (water circulation and distribution): there are no streams, lakes, oceans, or glaciers. ■ Space probes suggest that Venus may have started with as much water as Earth, but it was unable to keep its water in liquid form. ■ Because Venus receives more heat from the Sun, water released from the interior evaporated and rose to the upper atmosphere where the Sun's ultraviolet rays broke the molecules apart. ■ Much of the freed hydrogen escaped into space, and Venus lost its water. Without water, Venus became less and less like Earth and kept an atmosphere filled with carbon dioxide. The carbon dioxide acts as a blanket, creating an intense greenhouse effect and driving surface temperatures high enough to melt lead and to prohibit the formation of carbonate minerals. Volcanoes continually vented more carbon dioxide into the atmosphere. On Earth, liquid water removes carbon dioxide from the atmosphere and combines it with calcium, from rock weathering, to form carbonate sedimentary rocks. Without liquid water to remove carbon from the atmosphere, the level of carbon dioxide in the atmosphere of Venus remains high.

13. Look at the four squares [■] that indicate where the following sentence could be added to the passage.

**Venus may not have always been this way.**

Where would the sentence best fit?

14. **Directions:** An introductory sentence for a brief summary of the passage is provided below. Complete the summary by selecting the THREE answer choices that express the most important ideas in the passage. Some sentences do not belong in the summary because they express ideas that are not presented in the passage or are minor ideas in the passage. **This question is worth 2 points.**

**Over time, the movement of surface fluids has greatly changed Venus and Earth.**

**Answer Choices**

- A. Although Venus is about the same size as Earth, its greater volcanic activity has added considerably to carbon dioxide levels in its atmosphere.
- B. Like Venus, Earth has an atmosphere, but Earth's atmosphere has far more oxygen and nitrogen than does the atmosphere of Venus.
- C. On Earth, chemical reactions involving fluids remove carbon dioxide from the atmosphere by giving rise to carbonate rocks, and winds energized by gravity flow systems move fine particles from one place to another.
- D. Because Venus lost the water it originally had, most of its carbon dioxide remained in its atmosphere, causing the planet to become very warm.
- E. On Earth, the dominance of river valley landscapes and the existence of life are due to the planet's hydrologic cycle.
- F. The evaporation of liquid water from Earth's surface is largely limited by the life forms that have developed, particularly the vegetation.

## **Population Growth in Nineteenth-Century Europe**

Because of industrialization, but also because of a vast increase in agricultural output without which industrialization would have been impossible, Western Europeans by the latter half of the nineteenth century enjoyed higher standards of living and longer, healthier lives than most of the world's peoples. In Europe as a whole, the population rose from 188 million in 1800 to 400 million in 1900. By 1900, virtually every area of Europe had contributed to the tremendous surge of population, but each major region was at a different stage of demographic change.

Improvements in the food supply continued trends that had started in the late seventeenth century. New lands were put under cultivation, while the use of crops of American origin, particularly the potato, continued to expand. Setbacks did occur. Regional agricultural failures were the most common cause of economic recessions until 1850, and they could lead to localized famine as well. A major potato blight (disease) in 1846-1847 led to the deaths of at least one million persons in Ireland and the emigration of another million, and Ireland never recovered the population levels the potato had sustained to that point. Bad grain harvests at the same time led to increased hardship throughout much of Europe.

After 1850, however, the expansion of foods more regularly kept pace with population growth, though the poorer classes remained malnourished. Two developments were crucial. First, the application of science and new technology to agriculture increased. Led by German universities, increasing research was devoted to improving seeds, developing chemical fertilizers, and advancing livestock. After 1861, with the development of land-grant universities in the United States that had huge agricultural programs, American crop-production research added to this mix. Mechanization included the use of horse-drawn harvesters and seed drills, many developed initially in the United States. It also included mechanical cream separators and other food-processing devices that improved supply.



The second development involved industrially based transportation. With trains and steam shipping, it became possible to move foods to needy regions within Western Europe quickly. Famine (as opposed to malnutrition) became a thing of the past. Many Western European countries, headed by Britain, began also to import increasing amounts of food, not only from Eastern Europe, a traditional source, but also from the Americas, Australia, and New Zealand. Steam shipping, which improved speed and capacity, as well as new procedures for canning and refrigerating foods (particularly after 1870), was fundamental to these developments.

Europe's population growth included an additional innovation by the nineteenth century: it combined with rapid urbanization. More and more Western Europeans moved from countryside to city, and big cities grew most rapidly of all. By 1850, over half of all the people in England lived in cities, a first in human history. In one sense, this pattern seems inevitable. Growing numbers of people pressed available resources on the land, even when farmwork was combined with a bit of manufacturing, so people crowded into cities seeking work or other resources. Traditionally, however, death rates in cities surpassed those in the countryside by a large margin, cities had maintained population only through steady in-migration. Thus rapid urbanization should have reduced overall population growth, but by the middle of the nineteenth century this was no longer the case. Urban death rates remained high, particularly in the lower-class slums, but they began to decline rapidly.

The greater reliability of food supplies was a factor in the decline of urban death rates. Even more important were the gains in urban sanitation, as well as measures such as inspection of housing. Reformers, including enlightened doctors, began to study the causes of high death rates and to urge remediation. Even before the discovery of germs, beliefs that disease spread by "miasmas" (noxious forms of bad air) prompted attention to sewers and open garbage. Edwin Chadwick led an exemplary urban crusade for underground sewers in

England in the 1830s. Gradually, public health provisions began to cut into customary urban mortality rates. By 1900, in some parts of Western Europe life expectancy in the cities began to surpass that of the rural areas. Industrial societies had figured out ways to combine large and growing cities with population growth, a development that would soon spread to other parts of the world.

### **Paragraph 1**

Because of industrialization, but also because of a vast increase in agricultural output without which industrialization would have been impossible, Western Europeans by the latter half of the nineteenth century enjoyed higher standards of living and longer, healthier lives than most of the world's peoples. In Europe as a whole, the population rose from 188 million in 1800 to 400 million in 1900. By 1900, virtually every area of Europe had contributed to the tremendous surge of population, but each major region was at a different stage of demographic change.

1. According to paragraph 1, which of the following is true about Europe in the nineteenth century?
  - A. A large increase in food production led to industrialization.
  - B. Population changes occurred at the same pace in the major regions.
  - C. The standard of living rose to the level of that in most parts of the world.
  - D. The tremendous rise in population led to greater agricultural output in every region.

### **Paragraph 2**

Improvements in the food supply continued trends that had started in the late seventeenth century. New lands were put under cultivation, while the use of crops of American origin, particularly the potato, continued to expand. Setbacks did occur. Regional agricultural failures were the most common cause of economic recessions until 1850, and they could lead to localized

famine as well. A major potato blight (disease) in 1846-1847 led to the deaths of at least one million persons in Ireland and the emigration of another million, and Ireland never recovered the population levels the potato had sustained to that point. Bad grain harvests at the same time led to increased hardship throughout much of Europe.

2. According to paragraph 2, which of the following caused the food supply to increase in most of Western Europe during the nineteenth century?
  - A. Replacement of seventeenth-century farming techniques with more modern ones
  - B. Improved grain harvests in most European countries
  - C. Reduced demand for food as a result of a decreased population
  - D. Use of new land to grow crops
3. In paragraph 2, why does the author mention the potato blight that occurred in Ireland?
  - A. To identify a crop that was more successful in the United State than it was in Western Europe
  - B. To support a claim about regional agricultural failures
  - C. To give an example of a problematic trend that had started in the late seventeenth century
  - D. To provide evidence that many countries in Europe experienced a loss of population in the nineteenth century

### **Paragraph 3**

After 1850, however, the expansion of foods more regularly **kept pace with** population growth, though the poorer classes remained malnourished. Two developments were crucial. First, the application of science and new technology to agriculture increased. Led by German universities, increasing research was devoted to improving seeds, developing chemical fertilizers, and advancing livestock. After 1861, with the development of land-grant universities in the United States that had huge agricultural programs,

American crop-production research added to this mix. Mechanization included the use of horse-drawn harvesters and seed drills, many developed initially in the United States. It also included mechanical cream separators and other food-processing devices that improved supply.

4. The phrase “**kept pace with**” in the passage is closest in meaning to
- A. exceeded
  - B. matched the increase in
  - C. increased the rate of
  - D. caused
5. According to paragraph 3, all of the following factors helped the supply of food meet the needs of a growing population EXCEPT
- A. increased agricultural research in Germany
  - B. introduction of new crops
  - C. development of food-processing devices
  - D. agricultural programs in universities in the United States

#### **Paragraph 4**

The second development involved industrially based transportation. With trains and steam shipping, it became possible to move foods to needy regions within Western Europe quickly. Famine (as opposed to malnutrition) became a thing of the past. Many Western European countries, headed by Britain, began also to import increasing amounts of food, not only from Eastern Europe, a traditional source, but also from the Americas, Australia, and New Zealand. Steam shipping, which improved speed and **capacity**, as well as new procedures for canning and refrigerating foods (particularly after 1870), was fundamental to these developments.

6. The word “**capacity**” in the passage is closest in meaning to
- A. variety of goods
  - B. distance
  - C. reliability

- D. available storage space
7. According to paragraph 4, famine became less of a problem in Western Europe during the nineteenth century because of
- A. the decline of malnutrition
  - B. the construction of more food-storage facilities
  - C. faster means of transportation
  - D. improved agricultural methods in Eastern Europe

### Paragraph 5

Europe's population growth included an additional innovation by the nineteenth century: it combined with rapid urbanization. More and more Western Europeans moved from countryside to city, and big cities grew most rapidly of all. By 1850, over half of all the people in England lived in cities, a first in human history. In one sense, this pattern seems **inevitable** as growing numbers of people pressed available resources on the land, even when farmwork was combined with a bit of manufacturing, so people crowded into cities seeking work or other resources. Traditionally, however, death rates in cities surpassed those in the countryside by a large margin, cities had maintained population only through steady in-migration. Thus rapid urbanization should have reduced overall population growth, but by the middle of the nineteenth century this was no longer the case. Urban death rates remained high, particularly in the lower-class slums, but they began to decline rapidly.

8. The word "**inevitable**" in the passage is closest in meaning to
- A. unexplainable
  - B. undesirable
  - C. unavoidable
  - D. unpredictable
9. According to paragraph 5, which of the following factors led to rapid urbanization in the first half of the nineteenth century?

- A. The destruction of many farms due to bad harvests
- B. The reduction in the amount of good-quality farmland
- C. The rise in death rates in the countryside
- D. The lack of jobs in the countryside

### Paragraph 6

The greater reliability of food supplies was a factor in the decline of urban death rates. Even more important were the gains in urban sanitation, as well as measures such as inspection of housing. Reformers, including enlightened doctors, began to study the causes of high death rates and to urge remediation. Even before the discovery of germs, beliefs that disease spread by “miasmas” (noxious forms of bad air) prompted attention to sewers and open garbage. Edwin Chadwick led an exemplary urban crusade for underground sewers in England in the 1830s. Gradually, public health provisions began to cut into customary urban mortality rates. By 1900, in some parts of Western Europe life expectancy in the cities began to **surpass** that of the rural areas. Industrial societies had figured out ways to combine large and growing cities with population growth, a development that would soon spread to other parts of the world.

10. The word “**surpass**” in the passage is closest in meaning to
- A. exceed
  - B. influence
  - C. equal
  - D. differ from
11. Which of the following can be inferred from paragraph 6 about underground sewers?
- A. They became common in most of Western Europe in the 1830s.
  - B. They helped reduce deaths caused by disease in cities.
  - C. They led to the discovery that disease could be caused by germs.
  - D. They encouraged people to leave rural areas and move to the cities.

12. Paragraph 6 mentions all of the following as factors that contributed the rapid decline of urban death rates EXCEPT
- A. the greater reliability of food supplies
  - B. improvements in sanitation
  - C. advances in the treatment of disease
  - D. provisions for inspecting houses

The greater reliability of food supplies was a factor in the decline of urban death rates. ■ Even more important were the gains in urban sanitation, as well as measures such as inspection of housing. ■ Reformers, including enlightened doctors, began to study the causes of high death rates and to urge remediation. Even before the discovery of germs, beliefs that disease spread by “miasmas” (noxious forms of bad air) prompted attention to sewers and open garbage. Edwin Chadwick led an exemplary urban crusade for underground sewers in England in the 1830s. ■ Gradually, public health provisions began to cut into customary urban mortality rates. ■ By 1900, in some parts of Western Europe life expectancy in the cities began to surpass that of the rural areas. Industrial societies had figured out ways to combine large and growing cities with population growth, a development that would soon spread to other parts of the world.

13. Look at the four squares [■] that indicate where the following sentence could be added to the passage.

**Such individual efforts had substantial, concrete effects on society.**

Where would the sentence best fit?

14. **Directions:** An introductory sentence for a brief summary of the passage is provided below. Complete the summary by selecting the THREE answer choices that express the most important ideas in the passage. Some sentences do not belong in the summary because they express ideas that are

not presented in the passage or are minor ideas in the passage. **This question is worth 2 points.**

**Western Europe experienced a tremendous growth in population in the nineteenth century.**

**Answer Choices**

- A. Agricultural failures became less damaging after 1850 because of advances in science and technology as well as improvements in the transportation and preservation of foods.
- B. The development of better food-processing technologies allowed many Western European countries to grow their own food without having to import it from other countries.
- C. High death rates in the cities began to decline as food supplies became more reliable and as reformers prompted improvements in sanitation and housing.
- D. Although agricultural failures led to deaths and emigration, population levels were restored within a short time.
- E. As the population in the countryside began increasing faster than the supply of food and living space, people began moving to the cities in search of jobs and other resources.
- F. The improvements in crop-growing methods created new jobs on the farms, causing people from the overcrowded cities to move to the countryside to find those jobs.



## **Costs of Quitting a Job**

Economic theory predicts that when the costs of quitting one's job are relatively low, mobility is more likely. This observation underlines the analysis of the rise in quit rates during periods of prosperity, and the effects of mobility costs can be seen when looking at residential location and job turnover. Industries with high concentrations of employment in urban areas, where a worker's change of employer does not necessarily require investing in a change of residence, appear to have higher rates of job turnover than industries concentrated in nonmetropolitan areas do.

Beyond the costs that can be associated with such measurable characteristics as age and residential location are those that are psychic in nature. These latter costs, though unobservable to the researcher, are very likely to differ widely across individuals. Some people adapt more quickly to new surroundings than others do, for example. Recent studies have found considerable heterogeneity among workers in their propensity to change jobs, with one study reporting that almost half of all permanent separations that took place over a three-year period involved a small number (13 percent) of workers who had three or more separations during the period (in contrast, 31 percent of workers had no separations at all during the period).

It is also possible that the costs of job changing by employees vary internationally. Data suggest that workers in the United States may well be more likely to change employers than workers elsewhere may be. Indeed, data confirm that, on average, American workers have been with their current employers fewer years than workers in most other developed countries, particularly workers in Europe and Japan, have been with theirs. It is not known why Americans are more mobile than most others are, but one possibility relates to the lower levels of company training received by American workers. Another possibility, however, is that the costs of mobility are lower in the United States (despite the fact that Japan and Europe are more densely populated and hence more urban). What would create these lower costs?

One hypothesis that has received at least some investigation is that housing policies in Europe and Japan increase the costs of residential, and therefore job, mobility. Germany, the United Kingdom, and Japan, for

example, have controls on the rent increases that proprietors can charge to existing renters while tending to allow proprietors the freedom to negotiate any mutually agreeable rent on their initial lease with the renter. Thus, it is argued that renters who move typically face very large rent increases in these countries. Similarly, subsidized housing is much more common in these countries than in the United States, but since it is limited relative to the demand for it, those British, German, or Japanese workers fortunate enough to live in subsidized units are reluctant (it is argued) to give them up. The empirical evidence on the implications of housing policy for job mobility, however, is both limited and mixed.

It could also be hypothesized that the United States, Australia, and Canada, all of which exhibit shorter job tenures than do most European countries or Japan, are large, sparsely populated countries that historically have attracted people willing to emigrate from abroad or resettle internally over long distances. In a country of “movers,” moving may not be seen by either worker or employer as an unusual or especially traumatic event.

While questions remain about the causes of different job mobility rates across countries, the social desirability of job mobility can also be debated. On one hand, mobility can be seen as socially useful because it promotes both individual well-being and the quality of job matches. Moreover, the greater the number of workers and employers “in the market” at any given time, the more flexibility an economy has in making job matches that best adapt to a changing environment. Indeed, when focusing on this aspect of job mobility, economists have long worried whether economies have enough mobility. On the other hand, lower mobility costs (and therefore greater mobility) among workers may well serve to reduce the incentives of their employers to provide job training. Whether the presence of job changing costs is a social boon or bane, these costs and the mobility associated with them are factors with which all employers must contend.

### **Paragraph 1**

Economic theory predicts that when the costs of quitting one’s job are relatively low, mobility is more likely. This observation underlines the analysis of the rise in quit rates during periods of prosperity, and the effects of mobility

costs can be seen when looking at residential location and job turnover. Industries with high concentrations of employment in urban areas, where a worker's change of employer does not necessarily require investing in a change of residence, appear to have higher rates of job turnover than industries concentrated in nonmetropolitan areas do.

1. According to paragraph 1, people are more likely to quit their jobs in which **TWO** of the following situations? To receive credit, you must select **TWO** answers.
  - A. They are living in good economic times.
  - B. They are moving from urban areas to non-urban areas.
  - C. They are living in urban areas.
  - D. They do not like their employers.
2. Which of the sentences below best expresses the essential information in the highlighted sentence in the passage? Incorrect choices change the meaning in important ways or leave out essential information.
  - A. Workers in urban areas change jobs less frequently than do those in nonmetropolitan areas because the costs associated with a change of residence are higher in urban areas.
  - B. Industries located in urban areas experience higher rates of job turnover than do those in nonmetropolitan areas because workers can often change employers without having to change where they live.
  - C. Industries located in urban areas tend to have lower rates of job turnover than do those in nonmetropolitan areas because they are more likely to invest in residences for workers.
  - D. Workers in urban industries are likely to change jobs more frequently than are those in nonmetropolitan industries because it is less costly for workers to change residences in urban than in nonmetropolitan areas.

## Paragraph 2

Beyond the costs that can be associated with such measurable characteristics as age and residential location are those that are psychic in nature. These latter costs, though unobservable to the researcher, are very likely to differ widely across individuals. **Some people adapt more quickly to new surroundings than others do**, for example. Recent

studies have found considerable heterogeneity among workers in their propensity to change jobs, with one study reporting that almost half of all permanent separations that took place over a three-year period involved a small number (13 percent) of workers who had three or more separations during the period (in contrast, 31 percent of workers had no separations at all during the period).

3. Why does the author note that “**Some people adapt more quickly to new surroundings than others do**”?
- A. To argue that some people experience little psychic cost when they change jobs
  - B. To support the claim that the psychic cost of changing jobs is likely to differ widely between individuals
  - C. To illustrate why some psychic costs are unobservable to researchers
  - D. To argue that psychic costs alone cannot fully explain changes in mobility rates
4. According to paragraph 2, what do students reveal about the tendency for workers to change jobs?
- A. It relates more to economic costs than to psychic costs.
  - B. It decreases with age.
  - C. It vanes greatly.
  - D. It increases over time.

### **Paragraph 3**

It is also possible that the costs of job changing by employees vary internationally. Data suggest that workers in the United States may well be more likely to change employers than workers elsewhere may be. Indeed, data confirm that, on average, American workers have been with their current employers fewer years than workers in most other developed countries, particularly workers in Europe and Japan, have been with theirs. It is not known why Americans are more mobile than most others are, but one possibility relates to the lower levels of company training received by American workers. Another possibility, however, is that the costs of mobility are lower in the United States (despite the fact that Japan and Europe are more densely populated and hence more urban). What would create these

lower costs?

5. According to paragraph 3, what is one possible explanation for why American workers change jobs more frequently than workers elsewhere do?
  - A. The relatively small percentage of American workers who live in urban areas
  - B. The tendency of American employers to provide less training for workers
  - C. The recent decrease in mobility costs in the United States
  - D. The lower average population density in the United States

#### **Paragraph 4**

One hypothesis that has received at least some investigation is that housing policies in Europe and Japan increase the costs of residential, and therefore job, mobility. Germany, the United Kingdom, and Japan, for example, have controls on the rent increases that proprietors can charge to existing renters while tending to allow proprietors the freedom to negotiate any mutually agreeable rent on their initial lease with the renter. Thus, it is argued that renters who move typically face very large rent increases in these countries. Similarly, subsidized housing is much more common in these countries than in the United States, but since it is limited relative to the demand for it, those British, German, or Japanese workers fortunate enough to live in subsidized units are reluctant (**it is argued**) to give them up. The empirical evidence on the implications of housing policy for job mobility, however, is both limited and mixed.

6. According to paragraph 4, what may contribute to high mobility costs in Germany, the United Kingdom, and Japan?
  - A. Rent control does not apply to a renter's first lease on a property.
  - B. Governments have significantly reduced housing subsidies.
  - C. There is little control on the rent increases that can be charged after the initial agreement.
  - D. When a renter leaves a housing unit that has been subsidized, the unit will not be subsidized for the next renter.
7. What is the author's purpose in using the parenthetical phrases "**it is argued**"?

- A. To indicate that the view that workers are reluctant to leave subsidized housing is widely accepted
- B. To suggest that the view that workers are reluctant to leave subsidized housing has not been proved true
- C. To emphasize that the view that workers are reluctant to leave subsidized housing was based on careful reasoning
- D. To oppose the view that workers are reluctant to leave subsidized housing

### **Paragraph 5**

It could also be hypothesized that the United States, Australia, and Canada, all of which exhibit shorter job tenures than do most European countries or Japan, are large, **sparsely** populated countries that historically have attracted people willing to emigrate from abroad or resettle internally over long distances. In a country of “movers,” moving may not be seen by either worker or employer as an unusual or especially **traumatic** event.

- 8. By indicating that the United States , Australia, and Canada are “**sparsely**” populated, the author means that the population of these countries
  - A. is widely scattered
  - B. has increased rapidly
  - C. is very large
  - D. has remained stable over the years
- 9. Paragraph 5 supports which of the following ideas about mobility costs for American workers compared with mobility costs for workers in most European countries?
  - A. Mobility costs are higher for American workers because they have shorter job tenures.
  - B. American workers get more help from employers in covering the costs of moving to a new job.
  - C. The psychic costs of resulting internally to take a job are lower for American workers
  - D. The economic costs of emigrating to take a job are higher for American workers

10. The word “**traumatic**” in the passage is closest in meaning to
- A. Important
  - B. Unreasonable
  - C. Expensive
  - D. Upsetting

### Paragraph 6

While questions remain about the causes of different job mobility rates across countries, the social desirability of job mobility can also be debated. On one hand, mobility can be seen as socially useful because it promotes both individual well-being and the quality of job matches. Moreover, the greater the number of workers and employers “in the market” at any given time, the more flexibility an economy has in making job matches that best adapt to a changing environment. Indeed, when focusing on this aspect of job mobility, economists have long worried whether economies have enough mobility. On the other hand, lower mobility costs (and therefore greater mobility) among workers may well serve to reduce the **incentives** of their employers to provide job training. Whether the presence of job changing costs is a social boon or bane, these costs and the mobility associated with them are factors with which all employers must contend.

11. According to paragraph 6, high job mobility rates may benefit an economy by
- A. making it more likely that the economic environment will change significantly
  - B. encouraging employers to increase the sizes of their workforces
  - C. making it more likely that jobs will be filled by people who are suited to them
  - D. encouraging workers to improve their skills
12. The word “**incentives**” in the passage is closest in meaning to
- A. authority
  - B. obligation
  - C. ability
  - D. motivation

## Paragraph 6

While questions remain about the causes of different job mobility rates across countries, the social desirability of job mobility can also be debated. On one hand, mobility can be seen as socially useful because it promotes both individual well-being and the quality of job matches. ■ Moreover, the greater the number of workers and employers “in the market” at any given time, the more flexibility an economy has in making job matches that best adapt to a changing environment. ■ Indeed, when focusing on this aspect of job mobility, economists have long worried whether economies have enough mobility. ■ On the other hand, lower mobility costs (and therefore greater mobility) among workers may well serve to reduce the incentives of their employers to provide job training. ■ Whether the presence of job changing costs is a social boon or bane, these costs and the mobility associated with them are factors with which all employers must contend.

13. Look at the four squares [■] that indicate where the following sentence could be added to the passage

**According to this view, greater mobility could result in a less skilled workforce.**

Where would the sentence best fit?

14. Directions: An introductory sentence for a brief summary of the passage is provided below. Complete the summary by selected THREE answer choices that express the most important ideas in the passage. Some sentences do not belong in the summary because they express ideas that are not presented in the passage or are minor ideas in the passage. **This question is worth 2 points.**

**According to economic theory, workers are more likely to change jobs when the associated costs are low.**

## Answer Choices

- A. Since job changes by a minority of workers can radically alter overall job mobility rates, job mobility rates tell us little about the mobility costs facing the average worker



- B. Presidential location and individual psychic factors could account for some differences in job mobility among workers
- C. Economists argue strongly for job mobility despite the social and economic costs associated with it.
- D. Outside of the United States, subsidized housing and controls on rent increases explain why there is less job mobility in urban areas than in nonmetropolitan areas.
- E. Possibly due to housing and other differences, mobility costs may be lower in the United States than in most other developing nations which could help account for differences in job mobility.
- F. High job mobility arguably has both benefits, in terms of individual well-being and economic flexibility, and economic costs.

## **Stone Tools and Pottery Fragments**

Aside from ancient buildings, in sheer bulk the largest part of the archaeological record is made up of stone tools and pottery fragments (shards). Stone tools are the earliest known artifacts, having been first used more than two million years ago, and they have remained in use to the present day. When a chunk of fine-grain stone is struck with sufficient force at the proper angle with another rock or with a wood or bone baton, a shock wave will pass through the stone and detach a flake of the desired size and shape. In analyzing ancient stone tools, many archaeologists have mastered the skills needed to make stone tools themselves. Few things are sharper than a fragment struck from fine-grain flint or from obsidian (volcanic glass). Obsidian is so fine grained that flakes of it can have edges only about twenty molecules thick-hundreds of times thinner than steel tools.

Through experimentation, some archaeologists are able to produce copies of almost every stone tool type used in antiquity. A common research strategy is to make flint tools, use them to cut up meat, saw wood, clean hides, bore holes, etc, and then compare the resulting wear traces with the marks found on ancient artifacts. Sometimes electron-scanning microscopes are used to study minute variations in these use marks. Some rough correspondence can be found between the types of uses and the characteristics of wear marks, but there are many ambiguities.

Ethnographic data from people who still use these tools, like one study of how the IKung hunter-gatherers use different styles of stone spear points to identify their different social groupings, indicate that even crude-looking stone tools may reflect a great deal of the social and economic structure.

Ceramics were in use much later than the first stone tools (appearing in quantity in many places about 10,000 years ago), but they were used in such massive quantities in antiquity that, for many archaeologists, work life consists mainly of the slow sorting and analyzing of pottery fragments. Ceramic pots were first made by hand and dried in the sun or in low temperature kilns, a process that did not produce a very durable material. But in many areas of Africa, Asia and Europe high-temperature kilns produced pottery that is nearly a form of glass, and fragments of these pots survive even when the pottery is broken.

Ceramics form such a large part of archaeologists' lives because ceramics express so much about the people who made them. Pots are direct indicators of function in that they show how diets and economies changed over time. Archaeologists have documented how pottery in the American Southwest changed in prehistoric times as a diet developed that included boiled seeds of various native plants, and pottery was developed to withstand the heat and mechanical stresses of the boiling process.

Ceramics are almost always analyzed on the basis of their style. This idea of style is hard to define, but changing styles are the basis on which archaeologists date much of the archaeological record. But for many archaeologists, ceramic styles are more than just convenient devices of dating. For many archaeologists, stylistic decoration of artifacts is the primary means by which one can enter the cognitive world of the ancients. Societies throughout history have invested their objects with styles that have profound and complex meanings and effects. In the case of the Maya and every other early civilization, rulers used particular symbols and styles as mechanisms through which they portrayed, communicated, and implemented their power. In all societies, styles fix social meaning and are powerful ways in which social groups define and construct their culture. Styles of objects, language, and personal behavior identify people in terms of gender, age group, ethnic group, socioeconomic class, and in many other important ways. Some researchers, for example, have argued that a particular kind of pottery, called Ramey incised (which is incised with figures of eyes, fish, arrows, and abstract objects and was used by the people in the area of present-day Missouri and Illinois at about A.D. 900), was primarily used to distribute food but was also used to communicate the idea that the society's elite, for whom the pots were made, were mediators of cosmic forces.

### **Paragraph 1**

Aside from ancient buildings, in sheer bulk the largest part of the archaeological record is made up of stone tools and pottery fragments (shards). Stone tools are the earliest known artifacts, having been first used more than two million years ago, and they have remained in use to the present day. When a chunk of fine-grain stone is struck with sufficient force at the proper

angle with another rock or with a wood or bone baton, a shock wave will pass through the stone and **detach** a flake of the desired size and shape. In analyzing ancient stone tools, many archaeologists have mastered the skills needed to make stone tools themselves. Few things are sharper than a fragment struck from fine-grain flint or from obsidian (volcanic glass). Obsidian is so fine grained that flakes of it can have edges only about twenty molecules thick-hundreds of times thinner than steel tools.

1. The word “**detach**” in the passage is closest in meaning to
  - A. separate
  - B. sharpen
  - C. loosen
  - D. produce
2. According to paragraph 1, each of the following is true of stone tools EXCEPT
  - A. They were first produced more than two million years ago.
  - B. They are still being used today.
  - C. They are made of fine-grained stones such as flint or obsidian.
  - D. Their edges are never as thin or as sharp as those of steel tools.

## Paragraph 2

Through experimentation, some archaeologists are able to produce copies of almost every stone tool type used in antiquity. A common research strategy is to make flint tools, use them to cut up meat, saw wood, clean hides, bore holes, etc, and then compare the resulting wear traces with the marks found on ancient artifacts. Sometimes electron-scanning microscopes are used to study **minute** variations in these use marks. Some rough correspondence can be found between the types of uses and the characteristics of wear marks, but there are many **ambiguities**.

3. The word “**minute**” in the passage is closest in meaning to
  - A. unusual
  - B. important
  - C. hidden
  - D. tiny

4. The word “**ambiguities**” in the passage describes things that
- A. do not make any sense
  - B. are not well documented
  - C. can be interpreted in more than one way
  - D. do not fit with the available data
5. According to paragraph 2, archaeologists make and use their own stone tools in order to
- A. find out how strong different types of stone tools are
  - B. find out what kinds of tasks such tools were used for in ancient times
  - C. study the copies under electron microscopes and to avoid damaging the originals
  - D. show that ancient multipurpose tools were practical and easy to use

### **Paragraph 3**

Ethnographic data from people who still use these tools, like one study of how the IKung hunter-gatherers use different styles of stone spear points to identify their different social groupings, indicate that even crude-looking stone tools may reflect a great deal of the social and economic structure.

6. Which of the following questions about the IKung is answered in paragraph 3?
- A. Are the IKung rare among today’s hunter-gatherers in using stone tools?
  - B. Is the social structure of the IKung more complex than that of most hunter-gatherer societies?
  - C. Does the IKung’s use of several styles of stone tools have a social function?
  - D. Do the IKung use stone tools other than spear points?

### **Paragraph 4**

Ceramics were in use much later than the first stone tools (appearing in quantity in many places about 10,000 years ago), but they were used in such massive quantities in antiquity that, for many archaeologists, work life consists mainly of the slow sorting and analyzing of pottery fragments. Ceramic pots were first made by hand and dried in the sun or in low temperature kilns, a process that did not produce a very durable material. But in many areas of Africa, Asia and Europe high-temperature kilns produced

pottery that is nearly a form of glass, and fragments of these pots survive even when the pottery is broken.

7. According to paragraph 4, which of the following is true of the earliest ceramics?

- A. They were in use before the earliest stone tools.
- B. They were used in only a few places 10,000 years ago.
- C. They appeared in many places about 10,000 years ago.
- D. They were all baked in low-temperature kilns.

8. Paragraph 4 suggests sun-dried pots

- A. interest archaeologists less than stone tools because they are not as old.
- B. account for comparatively few of the pottery fragments that archaeologists study.
- C. are more common in Africa, Asia, or Europe than other parts of the world.
- D. are easier to sort and analyze than pottery made in high-temperature kilns.

### **Paragraph 5**

Ceramics form such a large part of archaeologists' lives because ceramics express so much about the people who made them. Pots are direct indicators of function in that they show how diets and economies changed over time. Archaeologists have documented how pottery in the American Southwest changed in prehistoric times as a diet developed that included boiled seeds of various native plants, and pottery was developed to withstand the heat and mechanical stresses of the boiling process.

9. In paragraph 5, the author discusses pottery in the American Southwest in order to

- A. emphasize that ceramics are usually the only means of reconstructing the diet and economic activity of prehistoric peoples.
- B. argue that changes in the style of pottery are usually a result of changes in food preparation.
- C. explain why certain types of prehistoric pottery have been able to survive better than others.
- D. support the claim that ceramics provide important dining and economical information about their users.

## Paragraph 6

Ceramics are almost always analyzed on the basis of their style. This idea of style is hard to define, but changing styles are the basis on which archaeologists date much of the archaeological record. But for many archaeologists, ceramic styles are more than just convenient devices of dating. For many archaeologists, stylistic decoration of artifacts is the primary means by which one can enter the cognitive world of the ancients. Societies throughout history have invested their objects with styles that have profound and complex meanings and effects. In the case of the Maya and every other early civilization, rulers used particular symbols and styles as mechanisms through which they **portrayed**, communicated, and implemented their power. In all societies, styles fix social meaning and are powerful ways in which social groups define and construct their culture. Styles of objects, language, and personal behavior identify people in terms of gender, age group, ethnic group, socioeconomic class, and in many other important ways. Some researchers, for example, have argued that a particular kind of pottery, called Ramey incised (which is incised with figures of eyes, fish, arrows, and abstract objects and was used by the people in the area of present-day Missouri and Illinois at about A.D 900), was primarily used to distribute food but was also used to communicate the idea that the society's elite, for whom the pots were made, were mediators of cosmic forces.

10. The word “**portrayed**”, in the passage is closest in meaning to
- A. claimed
  - B. represented
  - C. defended
  - D. established
11. According to paragraph 6, decorating artifacts in particular styles served each of the following functions in ancient societies EXCEPT
- A. to maintain the power of the societies' rulers
  - B. to mark socially relevant distinctions between groups
  - C. to establish the superiority of a society's artistic values
  - D. to define important aspects of the society's culture

12. Which of the sentences below best expresses the essential information in the highlighted sentence in the passage? Incorrect choices change the meaning in important ways or leave out essential information.
- A. Some researchers argue that pottery of the Ramey Incises style was used not only to distribute food but also to communicate that the society's elite were mediators of cosmic forces.
  - B. Some researchers argue that the figures of eyes, fish, arrows and abstract objects were incised on Ramey Incised pottery to communicate that those who provided the pots were members of the elite.
  - C. Some researchers argue that the primary function of Ramey Incised pottery was food distribution rather than a way of communicating the status of the society's elite.
  - D. Some researchers argue that, based on the kinds of symbols incised on pottery, that pottery was sometimes used to mediate cosmic forces.

### **Paragraph 6**

Ceramics are almost always analyzed on the basis of their style. This idea of style is hard to define, but changing styles are the basis on which archaeologists date much of the archaeological record. But for many archaeologists, ceramic styles are more than just convenient devices of dating. For many archaeologists, stylistic decoration of artifacts is the primary means by which one can enter the cognitive world of the ancients. Societies throughout history have invested their objects with styles that have profound and complex meanings and effects. ■ In the case of the Maya and every other early civilization, rulers used particular symbols and styles as mechanisms through which they portrayed, communicated, and implemented their power. ■ In all societies, styles fix social meaning and are powerful ways in which social groups define and construct their culture. ■ Styles of objects, language, and personal behavior identify people in terms of gender, age group, ethnic group, socioeconomic class, and in many other important ways. ■ Some researchers, for example, have argued that a particular kind of pottery, called Ramey incised (which is incised with figures of eyes, fish, arrows, and abstract objects and was used by the people in the area of present-day Missouri and Illinois at about A.D 900), was primarily used to distribute food but was also



used to communicate the idea that the society's elite, for whom the pots were made, were mediators of cosmic forces. Where would the sentence best fit?

13. Look at the four squares [■] that indicates where the following sentence could be added to the passage.

**Maya rulers, for example, used symbols on their war banners to communicate that they had great power because of the support of patron gods.**

14. Direction: An introductory sentence for a brief summary of the passage is provided below. Complete the summary by selecting the THREE answer choices that express the important ideas in the passage. Some sentences do not belong in the summary because they express ideas that are not presented in the passage or are minor ideas in the passage. **This question is worth 2 points.**

**Stone tools and pottery fragments are two of the most common kinds of archaeological finds.**

#### **Answer Choices**

- A. Stone tools are the oldest known artifacts, predating the development of ceramics by about two million years.
- B. The styles of stone tools produced by prehistoric peoples are more reliable indicators of their society's social and economic structure than the styles of their ceramics.
- C. Some researchers believe that the figures and symbols found on pottery may have multiple meanings, but this has not yet been fully established.
- D. Archaeologists know how stone tools were made and can produce copies themselves, but it is often difficult to determine how any particular ancient tool was used.
- E. The earliest evidence of ceramic production comes from Africa, Asia, and Europe, where the development of specialized technologies made pots nearly indestructible.
- F. Because pottery had both practical and symbolic uses, it can tell researchers a lot about the diet, economy, and social structure of ancient societies.

## **The Role of the Ocean in Controlling Climate**

To predict what the climate will be like in the future, scientists must rely on sophisticated computer models. These models use mathematical equations to represent physical processes and interactions in the atmosphere, ocean, and on land. A starting point is usually based on current measurements or estimates of past conditions. Then, using a spherical grid laid out over the entire globe, thousands of calculations are performed at grid intersections to represent and assess how conditions in the air, in the sea, and on land will change over time. Because of their complexity and size, supercomputers are used to run full-scale climate models. Much of the uncertainty in their outputs comes from the way that various aspects of the climate are represented by different models, and even more so, because there are aspects of climate that are not well understood—one of which is how the ocean impacts climate.

The ocean's role in global warming stems principally from its huge capacity to absorb carbon dioxide and to store and transport heat. In the sea, photosynthesis by marine plants and algae, especially phytoplankton, removes great quantities of carbon dioxide from the atmosphere. Hence, the greater the growth (productivity) of phytoplankton in the sea, the greater the removal of carbon dioxide. But what controls the ocean's productivity? There are several limiting factors, but results from a recent experiment suggest that in areas of the ocean where other nutrients are plentiful, iron may be one of the most important and, until recently, unrecognized variables controlling phytoplankton production. Some have proposed a radical, highly controversial and uncertain means to counteract global warming—adding iron to the oceans to induce phytoplankton blooms. Perhaps increased phytoplankton growth would use up a significant amount of carbon dioxide in the atmosphere, but perhaps not, and there might well be side effects that could be detrimental to the ocean ecosystem.

Within the ocean, the production of limestone, in the form of calcium carbonate skeletons or shells, also reduces atmospheric carbon dioxide. However, when deposits of limestone become exposed and weathered on land or are recycled in the sea, carbon dioxide is released back into the atmosphere. What is not well understood is how much carbon dioxide resides in the sea and at what rate it is taken up and recycled. Relatively new research has also

discovered beneath the sea a new and potentially significant threat to skyrocketing Earth temperature: gas hydrates. Gas hydrates are a solid, crystalline form of water, like ice, except that they contain additional gas, typically methane, and are often found stored in ocean sediments. Increased ocean temperatures could cause gas hydrates to dissociate, releasing massive amounts of methane gas into the atmosphere and cause undersea landslides in the process. Consequently, hydrates may, if released, significantly increase global warming as well as create a geologic hazard to offshore drilling operations.

The ocean is also a great reservoir and transporter of heat. Heat from the ocean warms the atmosphere and fuels tropical storms. Heat is transported by currents from the equator to the poles. Ocean circulation is strongly controlled by wind and by the sea's balance of salt and heat. Scientists think that climate warming may slow down circulation, while cooling may speed it up, but these responses are not well understood. Evaporation from the ocean also supplies the precipitation that creates fields of snow and ice at high latitudes. Snow and ice coverage change the reflectivity Earth's surface and are an important influence on how much incoming radiation is either absorbed or reflected. Furthermore, clouds and water vapor in the atmosphere come mainly from the sea and strongly influence climate. Surprisingly, clouds are one of the least understood and most poorly modeled parts of the climate change equation. Most climate modeling grids fail to take into account common-sized cloud formations. Aerosols, tiny particles of soot, dust, and other materials, are thought to seed cloud formation scatter incoming radiation and promote cooling, but this effect, which would counteract warming, is also only superficially understood. Computer models of climate change must take into account all of the processes within the ocean, over land, and in the sky that potentially influence warming. No wonder there is such uncertainty.

### **Paragraph 1**

To predict what the climate will be like in the future, scientists must rely on sophisticated computer models. These models use mathematical equations to represent physical processes and interactions in the atmosphere, ocean, and on land. A starting point is usually based on current measurements or

estimates of past conditions. Then, using a spherical grid laid out over the entire globe, thousands of calculations are performed at grid intersections to represent and assess how conditions in the air, in the sea, and on land will change over time. Because of their complexity and size, supercomputers are used to run full-scale climate models. Much of the uncertainty in their outputs comes from the way that various aspects of the climate are represented by different models, and even more so, because there are aspects of climate that are not well understood—one of which is how the ocean impacts climate.

1. According to paragraph 1, the results of full-scale climate models are questionable in part because
  - A. the supercomputers used for such modeling are large and complex
  - B. thousands of calculations have to be performed to assess conditions
  - C. past conditions cannot always be estimated accurately
  - D. there are multiple ways to represent the same aspect of climate

## Paragraph 2

The ocean's role in global warming stems **principally** from its huge capacity to absorb carbon dioxide and to store and transport heat. In the sea, photosynthesis by marine plants and algae, especially phytoplankton, removes great quantities of carbon dioxide from the atmosphere. Hence, the greater the growth (productivity) of phytoplankton in the sea, the greater the removal of carbon dioxide. But what controls the ocean's productivity? There are several limiting factors, but results from a recent experiment suggest that in areas of the ocean where other nutrients are plentiful, iron may be one of the most important and, until recently, unrecognized variables controlling phytoplankton production. Some have proposed a radical, highly **controversial** and uncertain means to counteract global warming—adding iron to the oceans to **induce** phytoplankton blooms. Perhaps increased phytoplankton growth would use up a significant amount of carbon dioxide in the atmosphere, but perhaps not, and there might well be side effects that could be detrimental to the ocean ecosystem.

2. The word “**principally**” in the passage is closest in meaning to
  - A. obviously
  - B. apparently

- C. mainly
  - D. originally
3. Which of the sentences below best expresses the essential information in the highlighted sentence in the passage? Incorrect choices change the meaning in important ways or leave out essential information.
- A. Iron may be one of the most important factors in controlling phytoplankton production in ocean waters that are rich in other nutrients.
  - B. Results from a recent experiment suggest that several factors limiting phytoplankton production in ocean waters have gone unrecognized.
  - C. Although it was not recognized until recently, nutrients are plentiful in areas of the ocean where iron controls phytoplankton production.
  - D. Until recently, the importance of iron was not taken into account in experiments concerning phytoplankton production.
4. The word “**controversial**” in the passage is closest in meaning to
- A. experimental
  - B. fascinating
  - C. producing disagreement
  - D. demonstrating poor judgment
5. The word “**induce**” in the passage is closest in meaning to
- A. supply nutrients to
  - B. cause the formation of
  - C. expand
  - D. strengthen
6. According to paragraph 2, how might increasing phytoplankton growth help lower global temperatures?
- A. By cooling the oceans
  - B. By decreasing carbon dioxide levels in the ocean
  - C. By reducing the amount of carbon dioxide in the atmosphere
  - D. By transporting heat from the ocean’s surface to deeper levels

### **Paragraph 3**

Within the ocean, the production of limestone, in the form of calcium carbonate skeletons or shells, also reduces atmospheric carbon dioxide. However, when deposits of limestone become exposed and weathered on land

or are recycled in the sea, carbon dioxide is released back into the atmosphere. What is not well understood is how much carbon dioxide resides in the sea and at what rate it is taken up and recycled. Relatively new research has also discovered beneath the sea a new and potentially significant threat to skyrocketing Earth temperature: gas hydrates. Gas hydrates are a solid, crystalline form of water, like ice, except that they contain additional gas, typically methane, and are often found stored in ocean sediments. Increased ocean temperatures could cause gas hydrates to dissociate, releasing massive amounts of methane gas into the atmosphere and cause undersea landslides in the process. Consequently, hydrates may, if released, significantly increase global warming as well as create a geologic hazard to offshore drilling operations.

7. According to paragraph 3, which of the following reduces atmospheric carbon dioxide?
  - A. The weathering of limestone
  - B. The production of limestone
  - C. The recycling of carbon dioxide
  - D. The presence of methane in gas hydrates
8. According to paragraph 3, why are gas hydrates a possible threat to the global climate?
  - A. If disturbed by offshore drilling, they can destroy limestone deposits.
  - B. They can replace regular ice at certain locations.
  - C. If melted, they may release a lot of carbon dioxide into the atmosphere.
  - D. They contain a lot of methane, which may be released as the ocean warms

#### **Paragraph 4**

The ocean is also a great reservoir and transporter of heat. Heat from the ocean warms the atmosphere and **fuels** tropical storms. Heat is transported by currents from the equator to the poles. Ocean circulation is strongly controlled by wind and by the sea's balance of salt and heat. Scientists think that climate warming may slow down circulation, while cooling may speed it up, but these responses are not well understood. Evaporation from the ocean also supplies the precipitation that creates fields of snow and ice at high latitudes. Snow and ice coverage change the reflectivity Earth's surface and

are an important influence on how much incoming radiation is either absorbed or reflected. Furthermore, clouds and water vapor in the atmosphere come mainly from the sea and strongly influence climate. Surprisingly, clouds are one of the least understood and most poorly modeled parts of the climate change equation. **Most climate modeling grids fail to take into account common-sized cloud formations.** Aerosols, tiny particles of soot, dust, and other materials, are thought to seed cloud formation scatter incoming radiation and promote cooling, but this effect, which would counteract warming, is also only superficially understood. Computer models of climate change must take into account all of the processes within the ocean, over land, and in the sky that potentially influence warming. No wonder there is such uncertainty.

9. The word “**fuels**” in the passage is closest in meaning to
1. provides energy for
  2. determines the route of
  3. carries
  4. breaks up
10. Which of the following is NOT mentioned in paragraph 4 as a way in which the ocean affects the climate?
- A. It stores heat
  - B. It moves heat from the equator toward the poles.
  - C. It speeds up wind circulation.
  - D. It warms up the atmosphere.
11. Paragraph 4 suggests that a significant decrease in snow and ice fields at high latitudes would have what effect?
- A. More clouds and water vapor would be produced in the atmosphere.
  - B. More of the Sun’s radiation would be absorbed by Earth.
  - C. The oceans would cool more quickly.
  - D. More precipitation would occur at low latitudes.
12. Why does the author mention that “**Most climate modeling grids fail to take into account common-sized cloud formations**”?
- A. To suggest why the influence of clouds on climate change is still undetermined
  - B. To explain why research on climate change does not focus on clouds

- C. To help explain why it is unclear whether aerosols have the effect of counteracting warming
- D. To explain in part why scientists are uncertain how much incoming radiation is absorbed or reflected

### Paragraph 3

Within the ocean, the production of limestone, in the form of calcium carbonate skeletons or shells, also reduces atmospheric carbon dioxide. ■ However, when deposits of limestone become exposed and weathered on land or are recycled in the sea, carbon dioxide is released back into the atmosphere. ■ What is not well understood is how much carbon dioxide resides in the sea and at what rate it is taken up and recycled. ■ Relatively new research has also discovered beneath the sea a new and potentially significant threat to skyrocketing Earth temperature: gas hydrates. ■ Gas hydrates are a solid, crystalline form of water, like ice, except that they contain additional gas, typically methane, and are often found stored in ocean sediments. Increased ocean temperatures could cause gas hydrates to dissociate, releasing massive amounts of methane gas into the atmosphere and cause undersea landslides in the process. Consequently, hydrates may, if released, significantly increase global warming as well as create a geologic hazard to offshore drilling operations.

13. Look at the four squares [■] that indicate where the following sentence could be added to the passage

**Nor is carbon dioxide the only gaseous substance in the ocean that may affect climate.**

Where would the sentence best fit?

14. Directions: An introductory sentence for a brief summary of the passage is provided below. Complete the summary by selected THREE answer choices that express the most important ideas in the passage. Some sentences do not belong in the summary because they express ideas that are not presented in the passage or are minor ideas in the passage. This question is worth 2 points.



**The oceans affect the climate in numerous ways, some of which are poorly understood and therefore cannot be accurately modeled in computer climate programs.**

**Answer Choices**

- A. Estimates of future conditions are entered into supercomputers to calculate climate possibilities at various places on earth.
- B. Oceans absorb a great deal of carbon dioxide from the air through limestone production and photosynthesis or phytoplankton.
- C. Gases are stored in the sea in the form of shells and hydrates, but gases stored in these ways can be recycled to the atmosphere where they may cause warming.
- D. The ocean's capacity to absorb carbon dioxide remains great despite recent reduction of marine plant nutrients such as iron.
- E. Ocean circulation is strongly controlled by wind and by the sea's balance of salt and heat.
- F. The ocean holds and moves a great deal of heat, and as water evaporates, it produces clouds, snow, and ice, which all affect global temperatures.

## **Animal Behavior**

By the early 1900s the field of animal behavior had split into two major branches. One branch, ethology, developed primarily in Europe. To ethologists, what is striking about animal behaviors is that they are fixed and seemingly unchangeable? For example, kittens and puppies play in characteristic but different ways. Present a kitten with a ball of yarn and invariably it draws back its head and bats the yarn with claws extended. Kittens are generally silent as they play, and their tails twitch. Puppies, by contrast, are most likely to pounce flat-footed on a ball of yarn. They bit and bark and their tails wag. Ethologists came to believe that ultimately even the most complex animal behaviors could be broken down into a series of unchangeable stimulus/response reactions. They became convinced that the details of these patterns were as distinctive of a particular group of animals as were anatomical characteristics. For well over half a century, their search for and description of innate patterns of animal behavior continued.

Meanwhile, mainly in North America, the study of animal behavior took a different tack, developing into comparative behavior. Of interest to comparative behaviorists was where a particular came from, that is, its evolutionary history, how the nervous system controlled it, and the extent to which it could be modified. In 1894, C. Lloyd Morgan, an early comparative behaviorist, insisted that animal behavior be explained as simply as possible without reference to emotions or motivations since these could not be observed or measured. In Morgan's research, animals were put in simple situations, presented with an easily described stimulus, and their resultant behavior described.

The extension to animals of behaviorism—the idea that the study of behavior should be restricted to only those elements that can be directly observed—was an important development in comparative behavior. Studies of stimulus/response and the importance of simple rewards to enforce and modify animal behavior were stressed. Not surprisingly, comparative behaviorists worked most comfortably in the laboratory. Comparative behaviorists stressed the idea that animal behavior could be modified, while their ethologist colleagues thought it was innate and unchangeable. Inevitably, the two approaches led to major disagreements.

To early ethologists, the major driving force in behavior was instinct, behaviors that are inherited and unchangeable. Moths move towards light because they inherit the mechanism to so respond to light. Although dogs have more options available to them, they bark at strangers for much the same reasons. The comparative behaviorists disagreed: learning and rewards are more important factors than instinct in animal behavior. Geese are not born with the ability to retrieve lost eggs when they roll out the nest, they learn to do so. If their behavior seems sometimes silly to humans because it fails to take new conditions into account, that is because the animal's ability to learn is limited. There were too many examples of behaviors modified by experience for comparative behaviorists to put their faith in instincts.

The arguments came to a peak in the 1950s and became known as the nature or nurture controversy. Consider how differently an ethologist and a comparative behaviorist would interpret the begging behavior of a hatchling bird. The first time a hatchling bird is approached by its parent, it begs for food. All baby birds of a particular species beg in exactly the same way. Obviously, said the ethologists, they inherited the ability and the tendency to beg. Baby birds did not have to learn the behavior, they were born with it—a clear example of innate, unchanging behavior. Not so, countered the comparative behaviorists. Parent birds teach their young to beg by stuffing food in their open mouths. Later experiments showed that before hatching, birds make and respond to noises of their nest mates and adults. Is it not possible that young birds could learn to beg prenatally?

It was hard for ethologists to accept that innate behaviors could be modified by learning. It was equally difficult for comparative behaviorists to accept that genetic factors could dominate learning experiences. The controversy raged for over a decade. Eventually, however, the distinctions between the two fields narrowed. The current view is that both natural endowments and environmental factors work together to shape behavior.

### **Paragraph 1**

By the early 1900s the field of animal behavior had split into two major branches. One branch, ethology, developed primarily in Europe. To ethologists, what is striking about animal behaviors is that they are fixed and

seemingly unchangeable? For example, kittens and puppies play in characteristic but different ways. Present a kitten with a ball of yarn and invariably it draws back its head and bats the yarn with claws extended. Kittens are generally silent as they play, and their tails twitch. Puppies, by contrast, are most likely to pounce flat-footed on a ball of yarn. They bit and bark and their tails wag. Ethologists came to believe that **ultimately** even the most complex animal behaviors could be broken down into a series of unchangeable stimulus/response reactions. They became convinced that the details of these patterns were as distinctive of a particular group of animals as were anatomical characteristics. For well over half a century, their search for and description of innate patterns of animal behavior continued.

1. The word “**ultimately**” in the passage is closest in the meaning to
  - A. noticeably
  - B. importantly
  - C. some of the time
  - D. in the end
2. According to paragraph 1, what do ethologists think is the most notable characteristic of animal behavior?
  - A. Animal responses in most situations are predictable and do not vary
  - B. In similar situations, different animal species often behave in similar ways.
  - C. Even in ordinary situations, animal behavior can be unusually complex.
  - D. Animal behavior may sometimes include stimulus/response reactions.

## **Paragraph 2**

Meanwhile, mainly in North America, the study of animal behavior took a different tack, developing into comparative behavior. Of interest to comparative behaviorists was where a particular came from, that is, its evolutionary history, how the nervous system controlled it, and the extent to which it could be modified. In 1894, C. Lloyd Morgan, an early comparative behaviorist, insisted that animal behavior be explained as simply as possible without reference to emotions or motivations since these could not be observed or measured. In Morgan’s research, animals were put in simple situations, presented with an easily described stimulus, and their resultant behavior described.

3. According to paragraph 2, C. Lloyd Morgan agreed with which of the following statements about animal behavior?
  - A. Only those elements of animal behavior that could be observed and measured should be used to explain it.
  - B. Any study of animal behavior should include an explanation of emotions and motivations.
  - C. Emotions and motivations can be measured indirectly using simple experimental situations.
  - D. Experimental situations are less than ideal if researchers want to develop a comprehensive explanation of animal behavior.
4. According to paragraph 2, comparative behaviorists were interested in finding answers to all of the following questions EXCEPT
  - A. How has animal behavior changed over time?
  - B. How can emotions causing a specific behavior in one animal species help explain behavior in other animal species?
  - C. To what degree can animal behavior be changed?
  - D. How does the nervous system regulate animal behavior?

### **Paragraph 3**

The extension to animals of behaviorism—the idea that the study of behavior should be restricted to only those elements that can be directly observed—was an important development in comparative behavior. Studies of stimulus/response and the importance of simple rewards to enforce and modify animal behavior were stressed. Not surprisingly, comparative behaviorists worked most comfortably in the laboratory. Comparative behaviorists stressed the idea that animal behavior could be modified, while their ethologist colleagues thought it was innate and unchangeable. Inevitably, the two approaches led to major disagreements.

5. Paragraph 3 suggests that comparative behaviorists' conclusions concerning animal behavior were based
  - A. on the observation that rewards do not affect inherited animal behavior
  - B. on the application of stress to modify animal behavior
  - C. most often on the results of laboratory experiments
  - D. more on stimulus/response reactions than on simple rewards

#### Paragraph 4

To early ethologists, the major driving force in behavior was instinct, behaviors that are inherited and unchangeable. Moths move towards light because they inherit the mechanism to so respond to light. Although dogs have more options available to them, they bark at strangers for much the same reasons. The comparative behaviorists disagreed: learning and rewards are more important factors than instinct in animal behavior. Geese are not born with the ability to **retrieve** lost eggs when they roll out the nest, they learn to do so. If their behavior seems sometimes silly to humans because it fails to take new conditions into account, that is because the animal's ability to learn is limited. There were too many examples of behaviors modified by experience for comparative behaviorists to put their faith in instincts.

6. The word “**retrieve**” in the passage is closest in meaning to
- A. find
  - B. recover
  - C. remember
  - D. hatch
7. According to paragraph 4, why did comparative behaviorists believe that their view of instinct in animal behavior was correct?
- A. They had observed that animals can respond to the same stimulus in different ways.
  - B. They had demonstrated that animals could use learned behaviors in new conditions.
  - C. They had acquired sufficient evidence that instincts vary from one animal to another.
  - D. They had shown that the behavior of many different animals had been changed by learning.

#### Paragraph 5

The arguments came to a peak in the 1950s and became known as the nature or nurture controversy. Consider how differently an ethologist and a comparative behaviorist would interpret the begging behavior of a hatchling bird. The first time a hatchling bird is approached by its parent, it begs for food. All baby birds of a particular species beg in exactly the same way.

**Obviously**, said the ethologists, they inherited the ability and the tendency to beg. Baby birds did not have to learn the behavior, they were born with it—a clear example of innate, unchanging behavior. Not so, **countered** the comparative behaviorists. Parent birds teach their young to beg by stuffing food in their open mouths. Later experiments showed that before hatching, birds make and respond to noises of their nest mates and adults. Is it not possible that young birds could learn to beg prenatally?

8. The word “**Obviously**” in the passage is closest in meaning to
- A. Originally
  - B. Clearly
  - C. Similarly
  - D. Consequently
9. The word “**countered**” in the passage is closest in meaning to
- A. learned
  - B. argued back
  - C. assumed
  - D. predicted
10. In paragraph 5, why does the author discuss the begging behavior of a hatchling bird?
- A. To support the view that instinct explains animal behavior better than learning does
  - B. To demonstrate that ethologists are correct about the limited ability of animals to learn
  - C. To contrast an ethologist’s explanation of a particular animal behavior with that of a comparative behaviorist
  - D. To question whether the discussion about the roles of nature and nurture was a valid one

### **Paragraph 6**

It was hard for ethologists to accept that innate behaviors could be modified by learning. It was equally difficult for comparative behaviorists to accept that genetic factors could dominate learning experiences. The controversy raged for over a decade. Eventually, however, the distinctions between the two fields narrowed. The **current** view is that both natural

endowments and environmental factors work together to shape behavior.

11. The word “**current**” in the passage is closest in meaning to

- A. ideal
- B. basic
- C. alternative
- D. present

#### **Paragraph 4**

To early ethologists, the major driving force in behavior was instinct, behaviors that are inherited and unchangeable. ■ Moths move towards light because they inherit the mechanism to so respond to light. ■ Although dogs have more options available to them, they bark at strangers for much the same reasons. ■ The comparative behaviorists disagreed: learning and rewards are more important factors than instinct in animal behavior. ■ Geese are not born with the ability to retrieve lost eggs when they roll out the nest, they learn to do so. If their behavior seems sometimes silly to humans because it fails to take new conditions into account, that is because the animal’s ability to learn is limited. There were too many examples of behaviors modified by experience for comparative behaviorists to put their faith in instincts.

Look at the four squares [■] that indicate where the following sentence could be added to the passage. Where would the sentence best fit?

**This view is supported by the behavior of insects as well as animals.**

12. Directions: Select from the seven phrases below the phrases that correctly characterize ethologists and the phrases that correctly characterize comparative behaviorists. Drag each phrase you select into the phrases will NOT be used. This question is worth 3 points.

#### **Ethologists**

- 
- 

#### **Comparative Behaviorists**

- 
- 
-



### **Answer Choices**

- A. Worked primarily in North America
- B. Argued that animal behavior is passed on from one generation to another without change over time
- C. Maintained from the start that behaviors that are inherited could be influenced by learning
- D. Believed that stimulus-response reactions serve to distinguish one animal from another just as their physical features do
- E. Studied stimulus-response reactions and emphasized the importance of rewards for enforcing and changing behavior
- F. Conducted more experiments with birds than with any other species
- G. Studied primarily how physical characteristics often determine behavior.

## **Grain in Colonial North America**

Although the colonists of seventeenth- and early-eighteenth-century British North America consumed most of the grain produced in the colonial economy, few households were self-sufficient. Instead, they traded with their neighbors for what they did not produce themselves. In any given year, farmers who produced more grain than they needed would exchange their surpluses locally with other farmers who had different surpluses, with local laborers who supported themselves by selling their labor, or with the local storekeeper, who might also be the miller (trade person who ground grain into flour). Satisfying the domestic demand for breadstuff, then, depended on trade between neighbors. The colonists recorded these myriad transactions as credits and debts in their individual account books. Debts and credits could remain outstanding for years before being settled. Trading based on book credit gave more value to maintaining equilibrium between local supply and demand and to preserving a cooperative spirit among neighbors than to expanding production beyond the immediate needs of the locality.

Colonists also traded grain surpluses long-distance, responding to impersonal demand beyond the community. Some of the long-distance trade catered to regional and urban domestic demand. As the urban areas matured, they increasingly relied on producers in distant areas for grain and other agricultural supplies. In the early 1750s, the most densely populated towns of eastern and southern New England had begun importing substantial quantities of flour and rice from the middle and southern colonies to compensate for grain deficits that developed in their region. Other urban areas followed their example, though their greater proximity to grain regions enabled them to tap supplies closer to home. Assuming that in the early 1770s at least half of the demand for grain from farmers with surpluses was satisfied through long-distance channels, the proportion of grain produced for consumption beyond the local market probably accounted for about a quarter of total grain production consumed by humans.

The colonists organized the long-distance grain economy differently from their local economy. New mechanisms enabled the long-distance economy to respond sensitively to variations in demand, and these in turn gave it greater dynamism than the community-centered, local economy possessed. The

contrast between the local and long-distance grain trade is best illustrated by looking at the flour-milling industry.

Nearly every area of colonial settlement had a local gristmill to which farmers brought grain to be custom ground. The limited capital value of most custom mills, the need to process rye and corn as well as wheat, together with seasonal factors affecting the water supply, restricted the volume of wheat flour that could be produced. The production of flour for long-distance exchange and particularly for export usually took place in merchant mills that were larger, had more capital, and were increasingly specialized.

The difference between a merchant mill and a custom mill was one of degree as much as kind. Most merchant mills had started as custom mills, and the colonial and state governments often compelled merchant mills to set aside certain days for custom work. Mills that acquired the designation “merchant” did so because they catered to the demand of merchants in the principal ports. These merchants enabled certain millers to specialize in wheat flour by placing orders for large parcels of it and paying in cash. That in turn allowed the millers to offer cash to the primary producers and grain brokers who delivered wheat to their mills. Cash was the economic motivator of this export-oriented economy for the simple reason that farmers would prepare and haul their grain to landings and mills and even increase their wheat acreage to obtain this commodity.

Cash gave farmers choices they did not enjoy when they traded with neighbors alone. Beyond opening up access to a range of products that could not be produced locally, it freed them from the web of mutual indebtedness and allowed more choices in the selection of trading partners. In other words, the cash economy allowed producers to seek the best bargains in that wider, impersonal market of which the export of agricultural surpluses formed the principal part. Of course, few in this age would have welcomed total release from the support and obligations that local trade conferred.

### **Paragraph 1**

Although the colonists of seventeenth- and early-eighteenth-century British North America consumed most of the grain produced in the colonial economy, few households were self-sufficient. Instead, they traded with their

neighbors for what they did not produce themselves. In any given year, farmers who produced more grain than they needed would exchange their surpluses locally with other farmers who had different surpluses, with local laborers who supported themselves by selling their labor, or with the local storekeeper, who might also be the miller (trade person who ground grain into flour). Satisfying the domestic demand for breadstuff, then, depended on trade between neighbors. The colonists recorded these myriad transactions as credits and debts in their individual account books. Debts and credits could remain outstanding for years before being settled. Trading based on book credit gave more value to maintaining equilibrium between local supply and demand and to **preserving** a cooperative spirit among neighbors than to expanding production beyond the immediate needs of the locality.

1. According to paragraph 1, why did North American colonists trade with their neighbors?
  - A. They preferred not to accept cash for goods they had to trade.
  - B. They were not able to produce everything that they needed.
  - C. They had difficulty establishing book credit with the local storekeepers.
  - D. They wanted to balance the credits and debts in their account books.
2. The word “**preserving**” in the passage is closest in meaning to
  - A. limiting
  - B. revealing
  - C. maintaining
  - D. creating

## **Paragraph 2**

Colonists also traded grain surpluses long-distance, responding to impersonal demand beyond the community. Some of the long-distance trade catered to regional and urban domestic demand. As the urban areas matured, they increasingly relied on producers in distant areas for grain and other agricultural supplies. In the early 1750s, the most densely populated towns of eastern and southern New England had begun importing **substantial** quantities of flour and rice from the middle and southern colonies to compensate for grain deficits that developed in their region. Other urban areas followed their example, though their greater proximity to grain regions

enabled them to tap supplies closer to home. Assuming that in the early 1770s at least half of the demand for grain from farmers with surpluses was satisfied through long-distance channels, the proportion of grain produced for consumption beyond the local market probably accounted for about a quarter of total grain production consumed by humans.

3. According to paragraph 2, what happened as urban areas matured?
  - A. Urban areas became increasingly dependent on grain produced in distant areas.
  - B. Urban areas began to rely on their own stored surpluses of wheat flour.
  - C. Urban consumers were forced to reduce their consumption of grain by one fourth.
  - D. Urban areas relied more on rice and less on wheat.
4. The word “**substantial**” in the passage is closest in meaning to
  - A. modest
  - B. sufficient
  - C. necessary
  - D. large

### Paragraph 3

The colonists organized the long-distance grain economy differently from their local economy. New mechanisms enabled the long-distance economy to respond sensitively to variations in demand, and these in turn gave it greater dynamism than the community-centered, local economy possessed. The contrast between the local and long-distance grain trade is best illustrated by looking at the **flour-milling industry**.

5. What is the purpose of the discussion of the “**flour-milling industry**”?
  - A. To contrast the organization of the grain trade with the organization of the flour-milling industry.
  - B. To explain how the economic organization of the long-distance trade in grain differed from that of the local economy.
  - C. To illustrate how the local flour-milling industry differed from the long-distance flour-milling industry.
  - D. To argue that the flour-milling industry made the long-distance grain trade more dynamic than the local grain trade.

#### Paragraph 4

Nearly every area of colonial settlement had a local gristmill to which farmers brought grain to be custom ground. The limited capital value of most custom mills, the need to process rye and corn as well as wheat, together with seasonal factors affecting the water supply, restricted the volume of wheat flour that could be produced. The production of flour for long-distance exchange and particularly for export usually took place in merchant mills that were larger, had more capital, and were increasingly specialized.

6. According to paragraph 4, all of the following limited the milling capacity of local gristmills to produce wheat flour EXCEPT
- A. limitations on their capital value
  - B. seasonal shortages of water
  - C. the lack of trained mill workers
  - D. the need to process several types of grain

#### Paragraph 5

The difference between a merchant mill and a custom mill was one of degree as much as kind. Most merchant mills had started as custom mills, and the colonial and state governments often **compelled** merchant mills to set aside certain days for custom work. Mills that acquired the designation “merchant” did so because they catered to the demand of merchants in the principal ports. These merchants enabled certain millers to specialize in wheat flour by placing orders for large parcels of it and paying in cash. That in turn allowed the millers to offer cash to the primary producers and grain brokers who delivered wheat to their mills. Cash was the economic motivator of this export-oriented economy for the simple reason that farmers would prepare and haul their grain to landings and mills and even increase their wheat acreage to obtain this commodity.

7. The word “**compelled**” in the passage is closest in meaning to
- A. required
  - B. advised
  - C. selected
  - D. helped

8. According to paragraph 5, a custom mill became a merchant mill by
- A. agreeing to sell grain to the state government at a reduced price
  - B. providing goods to fulfill the demand of traders in the main port cities
  - C. limiting the amount of work a mill would do for individual farmers to only a few days a week
  - D. hiring specialized millers to produce each type of flour
9. According to paragraph 5, why could merchant mills specialize in producing wheat flour?
- A. Grain farmers would accept cash from merchant mills for wheat, but not for other grains.
  - B. Merchant mills were not required by colonial and state government to mill grains other than wheat.
  - C. Millers who specialized in producing wheat flour for merchants were paid in advance.
  - D. Merchants ordered large amounts of wheat flour from the mills they dealt with
10. Paragraph 5 implies which of the following about the export trade in grain?
- A. The growth of the export trade caused most custom mills to go out of business.
  - B. The export trade did not have a significant economic impact beyond the large port cities.
  - C. The export trade's use of cash for payments led farmers to produce surpluses for this market.
  - D. In the export trade, most of the profits were made by the primary products and grain brokers

### **Paragraph 6**

Cash gave farmers choices they did not enjoy when they traded with neighbors alone. Beyond opening up access to a range of products that could not be produced locally, it freed them from the web of mutual indebtedness and allowed more choices in the selection of trading partners. In other words, the cash economy allowed producers to seek the best bargains in that wider,

impersonal market of which the export of agricultural surpluses formed the principal part. Of course, few in this age would have welcomed total release from the support and **obligations** that local trade conferred.

11. The word “**obligations**” in the passage is closest in meaning to
- A. trust
  - B. safety
  - C. responsibilities
  - D. advantages
12. Which of the following can be inferred from paragraph 6 about the result of the expanding export economy?
- A. Some commercial relationships became less local and more impersonal.
  - B. Farmers had a greater choice in the variety of crops to grow.
  - C. The demand for agricultural surpluses was greater than the supply.
  - D. The prices of local products decreased.

### Paragraph 6

Cash gave farmers choices they did not enjoy when they traded with neighbors alone. ■Beyond opening up access to a range of products that could not be produced locally, it freed them from the web of mutual indebtedness and allowed more choices in the selection of trading partners. ■In other words, the cash economy allowed producers to seek the best bargains in that wider, impersonal market of which the export of agricultural surpluses formed the principal part. ■Of course, few in this age would have welcomed total release from the support and obligations that local trade conferred.■

13. Look at the four squares [■] that indicates where the following sentence could be added to the passage.

**Consequently, most farmers who participated in the long distance cash economy continued to deal with local merchants through the system of trade credit.**

Where would the sentence best fit?

14. Direction: An introductory sentence for a brief summary of the passage is provided below. Complete the summary by selecting the THREE answer choices that express the important ideas in the passage. Some sentences do



not belong in the summary because they express ideas that are not presented in the passage or are minor ideas in the passage. This question is worth 2 points.

**Grain played an important role in the economy of colonial North America.**

**Answer Choices**

- A. Trade between neighbors was necessary to satisfy the local demand for grain and other products.
- B. Large amounts of grain from the countryside were brought to cities and ports, both for the residents' use and for the export trade.
- C. Merchant mills required large economic investments that were not available locally.
- D. Long-distance trade eventually replaced the need for local trade.
- E. Wheat farmers were attracted to the export trade because it allowed them to find the best price and because the cash it provided could be used for goods not available locally.
- F. After some time, cash replaced the trade system and individual account books disappeared.

## **Sea Turtle Hatchling Strategies for Navigation**

Sea turtles' eggs are laid at night to minimize the likelihood of their discovery by predators, and the offspring, when ready to emerge from their eggshells and dig their way out of the sand, hatch at night for the same reason. Since the offspring are especially vulnerable immediately after hatching, it is vital for them to get to the sea as soon as possible. Turtle hatchlings use a number of cues to tell them where the sea is.

The most important cue seems to be light. The night sky is usually brightest over the sea. Cover a turtle hatchling's eyes, and it cannot find the sea even if there is other information available, such as a downward slope of the sand toward the water's edge. The hatchlings respond to light cues covering a vertical range of only about 30° above the horizon or, depending on the species, even less. Responding only to lights that are close to the horizon decreases the risk that hatchlings will become confused. They seem less attracted to yellow light than to other colors—loggerhead turtles show an aversion to yellow light—and this preference may keep them from becoming disoriented by the rising Sun.

It is usually safest to have more than one internal compass, and hatchlings seem to be guided by more than light alone. They steer away from sand dunes and vegetation. Possibly these objects merely block light behind them that might mislead turtle hatchlings about where the sea is, but it is also possible that turtles are sensitive to the shape of such objects and process these shapes as signals that the sea is located in some other direction. Such reinforcing cues, however, are not enough to guide hatchlings away from the artificial lights that now burn on many a beach environment. Artificial lighting is often strong enough to completely overcome the signals a hatchling sea turtle is programmed to recognize. Artificial light, if it is bright enough, becomes a stimulus so powerful that the hatchlings respond to nothing else, crawling toward it from hundreds of meters away.

If all goes well and the hatchlings scramble over the sand in the right direction, avoid their enemies, and reach the surf, a new set of orienting mechanisms takes over. As soon as they are afloat, the hatchlings begin to swim at something over 1.5 kilometers per hour. They dive into the path of the wave undertow, where the receding waters sweep them outward, away from

the beach. When they surface again, they head for open sea. This time, they are guided not by sight but apparently exclusively by the direction of the incoming waves. Experiments with loggerheads, greens, and leatherbacks have shown that hatchlings swim toward approaching waves; but if the sea is calm, they swim randomly or in circles. Under experimental conditions, hatchlings will swim into the waves even if doing so sends them back to the beach again.

The farther a hatchling gets from shore, the less reliable wave direction becomes as a pointer to the open sea. Researchers have shown that hatchling green sea turtles released from a hatchery in Borneo, East Malaysia, are able to navigate around small islands and keep swimming offshore, even when there are few waves to guide them. They may be relying on yet another internal compass this time oriented to Earth's magnetic field. Recent experiments suggest that leatherback and olive ridley hatchlings "switch on" their geomagnetic compass almost as soon as they are out of the nest. Though the hatchlings position themselves geomagnetically as soon as they leave the nest and appear to be able to use that position as a reference point, they will not follow it automatically if other cues, such as light and sound, are available. Hatchlings find their geomagnetic compass useful only after they have already been able to determine the direction they should swim. A simple directional compass—one that always sent the turtles westward, for instance—would be useless if the open sea lay in some other direction. Therefore, a magnetic compass does not so much tell a hatchling turtle which way to go as keep it on course once it has determined the direction it should swim from some other cue.

### **Paragraph 1**

Sea turtles' eggs are laid at night to minimize the likelihood of their discovery by predators, and the offspring, when ready to emerge from their eggshells and dig their way out of the sand, hatch at night for the same reason. Since the offspring are especially vulnerable immediately after hatching, it is vital for them to get to the sea as soon as possible. Turtle hatchlings use a number of cues to tell them where the sea is.

1. Which of the sentences below best express the essential information in the highlighted sentence in the passage? Incorrect choices change the

meaning in important ways or leave out essential information.

- A. Sea turtle eggs are laid at night and hatch at night for the same reason.
- B. To minimize the likelihood of their discovery by predators, sea turtle hatchlings dig their way out of the sand at night.
- C. To minimize the likelihood of discovery by predators, sea turtle eggs are laid and hatch at night.
- D. Eggs that laid at night and offspring that emerge from the eggs at night are less likely to be discovered by predators

## **Paragraph 2**

The most important cue seems to be light. The night sky is usually brightest over the sea. Cover a turtle hatchling's eyes, and it cannot find the sea even if there is other information available, such as a downward slope of the sand toward the water's edge. The hatchlings respond to light cues covering a vertical range of only about 30° above the horizon or, depending on the species, even less. Responding only to lights that are close to the horizon decreases the risk that hatchlings will become confused. They seem less attracted to yellow light than to other colors—loggerhead turtles show an aversion to yellow light—and this preference may keep them from becoming disoriented by the rising Sun.

- 2. In paragraph 2, why does the author provide the information that sea turtle hatchlings cannot find the sea when their eyes are covered?
  - A. To identify a major reason that such turtles might not reach the sea
  - B. To support the claim that light is an important directional cue for such turtles
  - C. To point out the effect of yellow light on the attempts of such turtles to reach the sea
  - D. To provide evidence showing that such turtles easily lose their sense of direction
- 3. According to paragraph 2, which of the following is true of turtle hatchlings that are trying to make their way to the sea?
  - A. They are unable to distinguish the light of the rising Sun from other types of light.
  - B. They require the presence of yellow light in order to reach the water's

edge.

- C. They have trouble crossing downward slopes near the water's edge.
- D. They respond to light only when it is close to the horizon.

### Paragraph 3

It is usually safest to have more than one internal compass, and hatchlings seem to be guided by more than light alone. They steer away from sand dunes and vegetation. Possibly these objects merely block light behind them that might mislead turtle hatchlings about where the sea is, but it is also possible that turtles are sensitive to the shape of such objects and process these shapes as signals that the sea is located in some other direction. Such **reinforcing** cues, however, are not enough to guide hatchlings away from the artificial lights that now burn on many a beach environment. Artificial lighting is often strong enough to completely overcome the signals a hatchling sea turtle is programmed to recognize. Artificial light, if it is bright enough, becomes a stimulus so powerful that the hatchlings respond to nothing else, crawling toward it from hundreds of meters away.

- 4. The word "**reinforcing**" in the passage is closest in meaning to
  - A. guiding
  - B. supporting
  - C. indirect
  - D. valuable
- 5. Which of the following is offered in paragraph 3 as a possible explanation for sea turtle hatchlings' behavior of avoiding sand dunes and vegetation?
  - A. Sand dunes and vegetation may provide hiding places for animals that attack hatchlings.
  - B. Sand dunes and vegetation may block the pathway between hatchlings and the water's edge.
  - C. The shapes of sand dunes and vegetation may indicate the wrong direction to travel in.
  - D. The shapes of sand dunes and vegetation may resemble the shapes of some hatchling predators
- 6. Paragraph 3 supports which of the following statements about the artificial lights now found on many beaches?

- A. The lights have sometimes helped sea turtle hatchlings find their way to the sea.
- B. The lights can be bright enough to affect sea turtle hatchlings within hundreds of meters of them.
- C. The lights are commonly turned off during periods when sea turtle offspring are hatching.
- D. The lights tend to affect the behavior of sea turtle hatchlings less than other programming signals do.

#### **Paragraph 4**

If all goes well and the hatchlings scramble over the sand in the right direction, avoid their enemies, and reach the surf, a new set of orienting mechanisms takes over. As soon as they are afloat, the hatchlings begin to swim at something over 1.5 kilometers per hour. They dive into the path of the wave undertow, where the receding waters sweep them outward, away from the beach. When they surface again, they head for open sea. This time, they are guided not by sight but apparently **exclusively** by the direction of the incoming waves. Experiments with loggerheads, greens, and leatherbacks have shown that hatchlings swim toward approaching waves; but if the sea is calm, they swim randomly or in circles. Under **experimental** conditions, hatchlings will swim into the waves even if doing so sends them back to the beach again.

- 7. The word “**exclusively**” in the passage is closest in meaning to
  - A. with great accuracy
  - B. strongly
  - C. in part
  - D. only
- 8. Based on paragraph 4, sea turtle hatchlings are most likely to lose their sense of where the open sea is located when they
  - A. swim in calm seas
  - B. face incoming waves
  - C. collide with other objects floating in the water
  - D. swim in fast-moving, outgoing waters
- 9. The word “**experimental**” in the passage is closest in meaning to

- A. favorable
- B. trial
- C. Certain
- D. difficult

### Paragraph 5

The farther a hatchling gets from shore, the less reliable wave direction becomes as a pointer to the open sea. Researchers have shown that hatchling green sea turtles released from a hatchery in Borneo, East Malaysia, are able to navigate around small islands and keep swimming offshore, even when there are few waves to guide them. They may be relying on yet another internal compass this time oriented to Earth's magnetic field. Recent experiments suggest that leatherback and olive ridley hatchlings "**switch on**" their geomagnetic compass almost as soon as they are out of the nest. Though the hatchlings position themselves geomagnetically as soon as they leave the nest and appear to be able to use that position as a reference point, they will not follow it automatically if other cues, such as light and sound, are available. Hatchlings find their geomagnetic compass useful only after they have already been able to determine the direction they should swim. A simple directional compass—one that always sent the turtles westward, for instance—would be useless if the open sea lay in some other direction. Therefore, a magnetic compass does not so much tell a hatchling turtle which way to go as keep it on course once it has determined the direction it should swim from some other cue.

10. In paragraph 5, why does the author provide the information that hatchling green sea turtles can navigate around small islands and keep swimming offshore even when few waves are present?
- A. To point out a benefit of the fact that hatchlings use their geomagnetic compasses almost as soon as they leave the nest
  - B. To provide evidence that green sea turtles use different navigational techniques than leatherbacks and olive ridley turtles do
  - C. To provide a reason for considering the possibility that sea turtles navigate by detecting Earth's magnetic field
  - D. To provide evidence showing that hatchling do not automatically follow

their geomagnetic compass if other cues are available

11. The word “**switch on**” in the passage is closest in meaning to
- A. follow
  - B. change
  - C. control
  - D. activate
12. According to paragraph 5, all the following claims about the geomagnetic compass of sea turtle hatchlings are true EXCEPT
- A. In some species it is switched on almost as soon as a turtle hatches.
  - B. It helps keep the hatchlings heading in a direction that it is initially determined by some cue such as light or sound.
  - C. Its direction is followed automatically to swim toward open water
  - D. It can be used to navigate around islands when the waves stop indicating the direction of the open sea.

### **Paragraph 5**

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13. Look at the four squares [■] that indicate where the following sentence could be added to the passage

**This preference for other cues points to the special role of the geomagnetic compass in hatchling navigation.**

Where would the sentence best fit?

14. Directions: An introductory sentence for a brief summary of the passage is provided below. Complete the summary by selecting the THREE answer choices that express the most important ideas in the passage. Some sentences do not belong in the summary because they express ideas that are not presented in the passage or are minor ideas in the passage. This question is worth 2 points.

**To minimize attacks from predators, turtle hatchlings must quickly find their way to the water's edge.**

#### **Answer Choices**

- A. When light cues are absent, hatchlings use other navigational strategies, such as following the downward slope of the beach to find the water's edge.
- B. If the incoming waves are too strong to allow hatchlings to reach the open sea, they are carried back to the beach where they wait for calmer waters
- C. Once hatchlings reach the open sea, they begin to use their geomagnetic compasses as simple directional compasses.
- D. Hatchlings use light and cues such as shapes to help them locate the sea, though strong artificial light on land may lead them in the wrong direction.
- E. After they reach the water, hatchlings rely on incoming waves to indicate the direction in which the open sea is located.
- F. Hatchlings' geomagnetic compasses can help keep hatchlings on course toward the open sea, once other cues have been used to get them headed in the right direction.