

Multiple Choice

Identify the letter of the choice that best completes the statement or answers the question.

- ___ 1. Which of the following statements is *not* correct?
- Plants and other producers get their energy directly from the sun.
 - Animals get their energy from the sun indirectly.
 - Rare bacteria that live deep in the ocean get their energy from hydrogen sulfide in hot water.
 - Consumers get their energy directly from the sun.
- ___ 2. Which kind of organism obtains energy only from producers?
- decomposers
 - herbivores
 - omnivores
 - All of the above
- ___ 3. Which of the following does *not* contain carbon from the bodies of plants and animals that died millions of years ago?
- coal
 - oil
 - natural gas
 - phosphate salts
- ___ 4. Which gas makes up 78 percent of our atmosphere but can be used by plants only when transformed by bacteria first?
- nitrogen
 - oxygen
 - hydrogen
 - carbon dioxide
- ___ 5. Which of the following plants is likely to be a pioneer species?
- lichen
 - grass
 - shrub
 - oak tree
- ___ 6. What kind of natural disaster helps some forest communities by allowing some trees to release their seeds, by clearing away deadwood, and by encouraging new growth?
- fire
 - flood
 - windstorm
 - drought
- ___ 7. Where would an ecologist be least likely to go to study primary succession?
- a new island formed by a volcanic eruption
 - a gravel-filled valley that had been covered by a glacier until recently
 - a locked, abandoned asphalt parking lot in New York City
 - the Amazon Rain Forest
- ___ 8. Which statement describes how humans are affecting the balance of carbon in the atmosphere?
- Fewer agricultural crops are planted, reducing the amount of carbon dioxide released into the atmosphere.
 - Burning fossil fuels in great quantities has increased the amount of carbon dioxide in the atmosphere.
 - Overgrazing of grasslands has reduced the amount of carbon dioxide in the atmosphere.
 - Severe drought in large areas of the world has decreased the amount of carbon dioxide that is released into the atmosphere.
- ___ 9. Which of the following are photosynthetic organisms?
- fungal decomposers
 - deeply buried soil bacteria
 - freshwater algae
 - intestinal bacteria
- ___ 10. Consumers are organisms that
- eat only other animal species.
 - get solar or other energy indirectly.

- c. are also known as self-feeders.
 - d. occupy an ecosystem's lowest energy level.
- ___ 11. The energy consumed by organisms
- a. can be stored in fat and sugar molecules.
 - b. remains constant at all trophic levels.
 - c. undergoes magnification in food chains.
 - d. is not partially lost during digestion.
- ___ 12. Plants play a crucial role in the carbon cycle because they
- a. do not release carbon dioxide during cellular respiration.
 - b. allow carbon to enter an ecosystem through photosynthesis.
 - c. have special bacteria that live in their root systems.
 - d. are chemically converted into fossil fuels when burned.
- ___ 13. The bacteria that live within the roots of a soybean plant are a critical part of the nitrogen cycle because they
- a. provide the plant with sugars needed for growth.
 - b. transform nitrates into nitrogen gas for release.
 - c. change atmospheric nitrogen into a usable form.
 - d. release nitrogen by decomposing dead plant parts.
- ___ 14. Succession is possible because
- a. climates change over time.
 - b. it is a rapid and chaotic process that is very difficult to control.
 - c. existing plants reproduce quickly.
 - d. new species make the environment less suitable for previous ones.
- ___ 15. Which of the following is an example of secondary succession?
- a. breaking down of bare rock by fungi and mosses
 - b. pioneer plants begin to grow after glacial melting
 - c. growth of plants after a forest is destroyed by fire
 - d. appearance of weeds in cracks in a concrete surface
- ___ 16. Which of the following is responsible for making nitrogen in the atmosphere usable by living organisms?
- a. absorption of nitrogen into water systems
 - b. conversion of nitrogen into carbohydrates by photosynthesis
 - c. nitrogen-fixing bacteria
 - d. decomposing bacteria
- ___ 17. Which item is a carbon sink and *not* part of the carbon cycle?
- a. carbon in the atmosphere in the form of carbon dioxide
 - b. consumers breaking down carbohydrates into carbon dioxide during respiration
 - c. carbon found within limestone rocks
 - d. carbon dioxide being converted into carbohydrates during photosynthesis
- ___ 18. What type of vegetation would you expect to find on an abandoned farm that has remained undisturbed for 150 years?
- a. short grasses
 - b. shrubs
 - c. young pine trees
 - d. tall, mature oak trees
- ___ 19. Which of the following is one of the largest carbon reservoirs on Earth?
- a. limestone
 - b. fossil fuels
 - c. Amazon rain forest
 - d. Atlantic Ocean
- ___ 20. Thick fur on deer is *not* an example of coevolution. Why?
- a. because thick fur is an adaptation
 - b. because deer with thick fur live longer
 - c. because thick fur evolved in response to a cold climate, not in response to other organisms
 - d. because in the lowlands, where the climate was sunny and warm, deer that did not have

thick fur became separated from other deer that did have thick fur

- ___ 21. An example of a population is
- a. all trees in a forest.
 - b. all maple trees in a forest.
 - c. all plants in a forest.
 - d. all animals in a forest.
- ___ 22. The density of a population is
- a. the number of individuals born every year.
 - b. the proportion of males and females.
 - c. the number of individuals living in cities.
 - d. the number of individuals per unit area.
- ___ 23. Each of the following is an example of a parasite *except*
- a. a roundworm in a human's intestine.
 - b. a cow in a pasture.
 - c. a tick on a cat.
 - d. mistletoe on a tree.
- ___ 24. In which of the following relationships is neither species harmed?
- a. predation
 - b. competition
 - c. parasitism
 - d. commensalism
- ___ 25. Which of the following populations has a random dispersion?
- a. flock of flamingoes
 - b. pine trees in a pine forest
 - c. herd of bison
 - d. solitary snakes in a desert
- ___ 26. Which of the following would most likely cause a large number of density-independent deaths in a population?
- a. winter storms
 - b. disease-carrying insects
 - c. predators
 - d. limited resources
- ___ 27. Which of the following organisms has the highest reproductive potential?
- a. dogs
 - b. elephants
 - c. bacteria
 - d. humans
- ___ 28. A species of plant has exponential growth after it is introduced into an area where it has never lived. Which statement best describes exponential growth?
- a. Each individual plant grows much larger than usual.
 - b. The population immediately decreases.
 - c. Within a few years the population increases dramatically.
 - d. The species' reproductive potential declines.
- ___ 29. The relationship between acacia trees and the ants that live on them is an example of
- a. commensalism.
 - b. mutualism.
 - c. parasitism.
 - d. predation.
- ___ 30. A female dog's niche includes all of the following *except*
- a. fleas that infest the dog.
 - b. the number of puppies the dog has.
 - c. how the dog protects its owners.
 - d. the neighbor's enclosed yard.
- ___ 31. Which of the following has the greatest effect on reproductive potential?
- a. producing more offspring at a time
 - b. reproducing more often
 - c. having a longer life span
 - d. reproducing earlier in life
- ___ 32. A true statement about parasitism is that parasites
- a. may cause their hosts to become more vulnerable to predators.
 - b. do not live on or in their hosts' bodies.
 - c. are always animals and never plants.
 - d. immediately kill their hosts.
- ___ 33. Which of the following is *not* an example of exponential growth?
- a. rabbit populations after being introduced to Australia
 - b. reindeer of the Pribilof Islands after eating most of the lichens

- c. a bank account that earns interest
 - d. mold appearing on bread overnight
- ___ 34. The carrying capacity of an environment for a particular species at a particular time is determined by the
- a. number of individuals in the species.
 - b. distribution of the population.
 - c. reproductive potential of the species.
 - d. supply of the most limited resources.
- ___ 35. Which of the following statements explains why the growth of orchids on the high branches of tropical trees is an example of commensalism?
- a. The orchids draw nourishment from the trees.
 - b. The trees are neither benefited nor harmed.
 - c. The orchids keep parasites away.
 - d. The trees receive nutrients from the orchids.
- ___ 36. Which of the following statements is *not* correct?
- a. Mutualism is a type of symbiosis.
 - b. Yucca moths and yucca plants have a symbiotic relationship.
 - c. Symbiosis is a relationship in which two organisms live apart.
 - d. Coyotes and foxes are competitors because they feed on the same kinds of animals.
- ___ 37. Which of the following is one of the main properties used to describe a population?
- a. number of individuals
 - b. color of individuals
 - c. number of species
 - d. kind of adaptations
- ___ 38. Which of the following statements is correct?
- a. An organism's niche is only the part of its habitat that it eats.
 - b. An organism's habitat is a location.
 - c. Habitat and niche are the same thing.
 - d. An organism's niche is outside its habitat.
- ___ 39. Competition for food *cannot* occur
- a. between two populations.
 - b. among members of the same population.
 - c. among populations whose niches overlap.
 - d. between animals from two different ecosystems.
- ___ 40. Which of the following reproductive situations will limit a population's biotic potential?
- a. the minimum number of offspring each pair can produce
 - b. the maximum number of offspring each individual can produce
 - c. the number of interactions each individual has
 - d. the size of offspring each individual can produce
- ___ 41. The difference between a predator and a parasite is that a predator
- a. usually kills and eats its prey.
 - b. benefits from another organism.
 - c. lives in or on a host.
 - d. harms another organism.
- ___ 42. Which factor contributed most to the exponential growth of the human population?
- a. more food, better hygiene
 - b. higher birth rates
 - c. higher fertility rates
 - d. increased immigration
- ___ 43. A population pyramid is created by
- a. studying a group of people and noting when each member dies.
 - b. graphing the distribution of ages in a population at a specific time.
 - c. calculating the number of children a woman gives birth to in her lifetime.
 - d. estimating the demand for services within a community.
- ___ 44. Educating women worldwide has lowered birthrates partly because
- a. educated women need to bear many children to ensure that some will survive.
 - b. educated women may learn family-planning techniques.
 - c. educated women contribute less to their family income.

- d. All of the above
- ___ 45. Human population growth was most rapid during which period of human history?
- a. Ice Ages
 - b. Stone Ages
 - c. Bronze and Iron Ages
 - d. Modern Age
- ___ 46. Because birth rates have begun to fall, Earth's population will
- a. soon stabilize at the level it is today—about 6 billion.
 - b. begin to decrease until it reaches 5 billion.
 - c. increase for a short time and then decrease to current levels.
 - d. stabilize somewhere around 9 billion by 2050.
- ___ 47. Growth rates for different parts of the world vary depending on the level of development of the region. Which region is experiencing the biggest increase in population?
- a. Europe
 - b. North America
 - c. Asia
 - d. Australia
- ___ 48. Which of the following makes it difficult to reduce population growth?
- a. High literacy rates result in women wanting to have more children.
 - b. Population sizes will not decline until some people start having to do without food and other necessities of life.
 - c. Many people live in cities, where large families are an advantage.
 - d. Many people have low literacy and limited access to healthcare.
- ___ 49. Which of the following is *not* a strategy that could slow population growth?
- a. public advertising
 - b. economic incentives
 - c. legal punishments
 - d. limiting education for women
- ___ 50. An increase in waterborne diseases could possibly be alleviated by
- a. adequate sewage treatment facilities for growing populations.
 - b. very rapid growth of large cities.
 - c. sufficient fuelwood.
 - d. Both (a) and (b)
- ___ 51. Between 1880 and 1930 human population doubled due to
- a. the Industrial revolution.
 - b. a combination of high birth rates and low death rates.
 - c. improvements in societal infrastructure and services.
 - d. All of the above
- ___ 52. Countries that have entered the third stage of demographic transition are most probably characterized by
- a. weak or developing economies.
 - b. death rates that far exceed birth rates.
 - c. social conditions that favor smaller families.
 - d. populations with a high proportion of young people.
- ___ 53. Which of the following is a reason that wood is considered a limited resource in many developing countries?
- a. Wood is used in place of money to buy food.
 - b. Fuelwood allows people to purify their water by boiling it.
 - c. Excess wood is used to construct shantytowns.
 - d. People cut down trees faster than they can grow.
- ___ 54. During Stage 2 of a population's demographic transition, the death rate
- a. increases.
 - b. decreases.
 - c. remains the same.
 - d. is zero.
- ___ 55. Countries with high growth rates usually have an age structure that has
- a. an even distribution over all ages.
 - b. more older people than young people.
 - c. more younger people than older people.

- d. more middle-aged people than younger people.
- ___ 56. Which of the following diseases is often spread through unsafe public water sources?
a. dysentery
b. influenza
c. chicken pox
d. AIDS
- ___ 57. Scientists predict population sizes by using
a. survivorship, migration, life expectancy, and replacement structure.
b. age structure, fertility rate, and migration.
c. replacement rate, fertility rate, age rates, and survivorship.
d. age structure, survivorship, fertility rate, and migration.
- ___ 58. Which of the following would *not* cause population to decrease in a region?
a. increased immigration
b. increased emigration
c. decreased fertility rates
d. decreased survivorship
- ___ 59. Which of the following is *not* described by the model of demographic transition?
a. life expectancy
b. education of women
c. immigration
d. industrialization
- ___ 60. Less-developed countries suffer more from rapid population growth because they are less likely to have the _____ to support the population.
a. fertility rates
b. cultural values
c. infrastructure
d. family-planning methods
- ___ 61. Populations are growing more rapidly in
a. Italy.
b. Canada.
c. Japan.
d. Peru.
- ___ 62. World population growth will eventually stop when
a. the population reaches 9 billion.
b. most countries have replacement-level fertility rates.
c. most countries have higher death rates.
d. the worldwide infant mortality rate increases.
- ___ 63. An endangered species is
a. a species in danger of extinction.
b. a species growing on public land.
c. an organism brought to a place where it has not lived before.
d. a species that has disappeared entirely.
- ___ 64. How many species are estimated to be living on Earth?
a. between 10,000 and 100,000
b. between 500,000 and 1 million
c. between 1 and 2 million
d. between 10 and 50 million
- ___ 65. Which of the following would be *most* effective in slowing the loss of biodiversity?
a. freezing fertilized eggs of endangered animals in case the species become extinct in the wild
b. setting aside small plots of land in a variety of ecosystems, such as forests, grasslands, and marshes
c. creating large parks/preserves in biodiversity hotspots
d. requiring every country to maintain a seed bank
- ___ 66. In what part of the world are the greatest number of extinctions occurring?
a. in tropical rain forests
b. in deserts
c. in the Arctic
d. in Europe and the United States
- ___ 67. The International Union for Conservation of Nature and Natural Resources (IUCN)
a. is known for trying to save endangered species through dramatic, attention-grabbing protests.
b. is an organization of multinational corporations united to fight conservation efforts.

- c. is a collaboration of about 200 governmental agencies and 700 private conservation groups from around the world.
 - d. was disbanded after the Earth Summit of 1992.
- ___ 68. Which of the following statements about the California condor is correct?
- a. The California condor has made a dramatic comeback and has been removed from the endangered species list.
 - b. The California condor is the subject of a captive-breeding program.
 - c. Several hundred breeding pairs of California condors have been released into the wild.
 - d. All of the above
- ___ 69. The United States laws that protect endangered species
- a. are considered to be the strongest in the world.
 - b. are much weaker than the legal protections in most other countries.
 - c. are rarely enforced.
 - d. apply to only 10 species of animals and about 20 species of plants.
- ___ 70. According to biologists, what percentage of species have become or are expected to become extinct between 1900 and 2100?
- a. 1 percent
 - b. 10 percent
 - c. 25 percent
 - d. 60 percent
- ___ 71. Reintroducing the gray wolf in certain areas of the northwestern United States
- a. is beneficial for all of those working in that area.
 - b. creates a mutualist interaction between wolves and elks.
 - c. is in accordance with the U.S. Endangered Species Act of 1973.
 - d. discourages hunters from hunting other animals.
- ___ 72. Which of the following would *not* be illegal under the Endangered Species Act?
- a. capturing a wild animal listed as a threatened species for exhibition in a zoo, provided the animal is well cared for
 - b. digging up an endangered plant in a public park and selling it
 - c. destroying the habitat of an endangered plant during the building of a federal highway
 - d. having a permit to capture and conduct research with endangered species
- ___ 73. Earth's various organisms appear to be
- a. mostly small vertebrates.
 - b. largely known to scientists.
 - c. concentrated in certain biomes.
 - d. evolving at an unprecedented rate.
- ___ 74. The current rate of species extinction is
- a. slower than at any other time in this century.
 - b. attributable to the actions of humans.
 - c. the result of natural environmental processes.
 - d. of little consequence to Earth's long-term survival.
- ___ 75. The fact that organisms are adapted to survive in particular environments helps to explain why
- a. captive-breeding programs are often ineffective.
 - b. non-native plant species never flourish in new areas.
 - c. habitat destruction accounts for most extinctions.
 - d. compromise is impossible on environmental issues.
- ___ 76. The type of hunting that threatens species survival the most is
- a. sanctioned by industrialized nations.
 - b. legal hunting done by sports enthusiasts.
 - c. ignored by global conservation groups.
 - d. especially a problem in less developed nations.
- ___ 77. The level of biodiversity that involves a variety of habits and communities is
- a. ecosystem diversity.
 - c. population diversity.

- _____ 89. How can zoos, botanic gardens, and wildlife parks help save species?
- by preserving threatened species from destruction.
 - by collecting species from remote wilderness areas.
 - by participating in captive breeding programs.
 - Both (a) and (c)
- _____ 90. Reduction in the sea otter population affected the Pacific coast ecosystem by
- decreasing the biodiversity of the ecosystem.
 - reducing the size of the sea urchin population.
 - promoting the increased growth of the nearby kelp beds.
 - increasing the biodiversity of the ecosystem.

Completion

Complete each sentence or statement.

91. A process in which energy from the sun is used to make sugar molecules is called _____.
92. In deep-ocean ecosystems, the _____ that escapes from the cracks in the ocean floor is used by bacteria to make their own food.
93. Nitrogen-fixing bacteria live within the nodules on the roots of plants called _____.
94. Some natural disasters, such as _____, help some forest communities by allowing some trees to release their seeds, by clearing away deadwood, and by encouraging new growth.
95. On new islands formed by volcanic activity, you will most likely find _____ succession.
96. The first organisms to colonize any newly available area are known as _____.
97. During primary succession, _____ often begin the process by breaking down the rocks into soil.
98. When energy is passed from one trophic level to the next, only about _____ of the energy is passed to the next level.
99. In the deep-ocean ecosystem, _____ would occupy the bottom trophic level of an energy pyramid.
100. Excessive use of _____ on lawns and gardens can affect the nitrogen and phosphorus cycles in nearby lakes and streams.
101. During succession, a final and stable community is referred to as a(n) _____.
102. Succession that occurs on abandoned farmland is called _____ succession.
103. A gradual process of change and replacement of the types of species in a community is called _____ succession.
104. Organisms called _____ can transform unusable nitrogen in the atmosphere into chemical compounds containing nitrogen that can be used by other organisms.
105. A common type of succession that occurs on a surface where an ecosystem has previously existed is known as _____.
106. A lion is an example of a group of consumers called _____.
107. Bacteria and fungi are examples of a group of consumers called _____.

108. The energy transfer in a(n) _____ is more complex than energy transfer in a food chain, because the interaction between many organisms is considered.
109. The ultimate source of energy for all organisms except those living deep in the ocean near a thermal vent is the _____.
110. In the carbon cycle, the source of carbon for producers is the _____.
111. Underground carbon sources composed of plants and animals that died millions of years ago are known as _____.
112. The burning of _____ over many years has resulted in an increase in the amount of carbon dioxide in the atmosphere.
113. A population's _____ is usually described as even, clumped, or random.
114. A robin that does not affect the tree in which it nests is an example of _____.
115. If two species use the same food source at different times, they are _____ competitors.
116. Unlike a predator in relation to its prey, a parasite does not usually _____ its host.
117. The average age at which members of a species reproduce is that species' _____.
118. The maximum number of offspring that each member of a population can produce is the population's _____.
119. The three main properties used to describe a population are _____, _____, and _____.
120. The _____ of an ecosystem for a particular species is the maximum population that the ecosystem can support indefinitely.
121. The amount of food available for wolves in an area determines the ecosystem's carrying capacity for wolves and is a(n) _____ resource for wolves.
122. Members of a species compete indirectly for resources by competing for a(n) _____ and for social dominance.
123. A population's _____ is the number of its members per unit area or per volume.
124. Deaths that are caused by a disease spreading through a population are _____ dependent.
125. A species' _____ includes that species' physical home, the environmental factors necessary for that species' survival, and all its interactions with other organisms.
126. Niche _____ is when each species uses less of the niche than it is capable of using, in order to reduce competition for resources with other species.
127. The type of interaction between cats and mice is _____.
128. A liver fluke is a(n) _____ that harms its host as it obtains food.
129. A(n) _____ usually only weakens its host, while a(n) _____ usually kills its prey.
130. A relationship in which two organisms live in close association, such as mutualism and commensalism, is called _____.
131. If a pair of mice finds a place to live with plenty of food and no predators, the population of mice will probably undergo _____ growth.

132. Over a long period of time, two species can develop adaptations that increase the benefit of their relationship in the process of _____.
133. A population has a(n) _____ growth rate when the death rate is higher than the birth rate.
134. The _____ is the average number of children each parent must have in order to replace themselves in the population.
135. During the _____ stage of demographic transition, the birth rate drops and the size of the population begins to decrease.
136. The _____ and _____ revolutions brought about changes that caused exponential growth of the world human population.
137. A shortage of _____ can decrease the food supply available to a growing population.
138. The study of human population patterns is called _____.
139. The United Nations has designated _____ countries to be given priority for foreign aid.
140. One way to stabilize the world population is to reduce _____ by improving women's status and educational opportunities.
141. Most demographers predict a(n) _____ population growth rate and a world population of _____ in 2050.
142. A(n) _____ helps demographers predict which age groups will experience the most growth.
143. Type I and Type III survivorship curves indicate populations that are growing _____.
144. An adequate supply of fuelwood helps to prevent disease by allowing water to be boiled to _____ it.
145. The theory of demographic transition is based on the idea that industrial development causes _____ and _____ progress that affects population growth rates.
146. Local water supplies may be contaminated when they are also used for _____ disposal.
147. Population on the continent of _____ is expected to shrink by the year 2050.
148. Some less-developed countries have tried to move forward in demographic transition by directly reducing _____ with advertising and economic incentives.
149. The world population will stop growing when fertility rates decline to _____.
150. During the last 200 years, the human population has undergone _____ growth.
151. The percentage of members of a group that are likely to survive to any given age is called _____.
152. Wealthy, developed countries such as Japan and Germany are in the fourth, or _____, stage of demographic transition, when the population size begins to decline.
153. The illegal hunting and slaughter of African elephants for their ivory tusks is also known as _____.
154. A(n) _____ is any species that is essential to the health of an ecosystem.
155. A recreational experience among life forms and ecosystems is called _____.

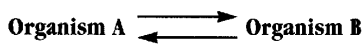
156. Any species with a declining population that could become endangered is a(n) _____.
157. A(n) _____ is any species likely to become extinct if it is not protected.
158. The death of many species in a relatively short time is known as _____.
159. A(n) _____ is an organism that is not native to a particular region.
160. A(n) _____ is an organism that is critical to an ecosystem's functioning.
161. The kind of diversity represented by all the different genes found in a population is called _____.
162. The sources of many antibiotics are in chemicals produced by _____.
163. A crop produced by combining genetic materials is called _____.
164. Fire ants in the southeastern United States are an example of a(n) _____.
165. The passenger pigeon is an example of a bird that was once abundant in the United States but is now _____.
166. The Florida panther is a(n) _____ as a result of habitat destruction.
167. Honeycreepers found in the Hawaiian Islands are an example of a(n) _____.
168. The Amazon rain forest is an example of a habitat with a high species variability known as a(n) _____.
169. The application of biological sciences to create products such as drugs from plants or other organisms is known as _____.
170. A(n) _____ program is being used to help increase the population of California condors.

Short Answer

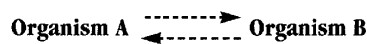
171. All living things must be able to make proteins, and protein molecules always contain nitrogen. Explain how the nitrogen used for making proteins in a lion's body traveled from the atmosphere to the lion. How will it be returned to the atmosphere after the lion dies?
172. Use your knowledge of energy flow within ecosystems to offer a simple explanation for the following statement: "All flesh is grass."
173. The phosphorus, carbon, and nitrogen cycles are termed biogeochemical cycles—*bio* meaning "living"; *geo* for the earth (soil); and *chemical* referring to matter changing form. Explain why this term is appropriate.
174. Describe one way in which consumers depend on producers.
175. Explain why an energy pyramid is used to represent the amount of energy at each trophic level.
176. Explain how carbon is cycled from the atmosphere through producers and consumers, and back into the atmosphere.
177. Briefly explain how fossil fuels are formed and where they are located.
178. A local lake is experiencing algal bloom and many of the fish are dying. Explain why this may be occurring.

179. A student noticed that lichens were growing on the surface of a rocky cliff. Describe how lichens contribute to primary succession.
180. Describe an energy pyramid that could be present in a small garden.
181. Describe how DDT moves through an aquatic food chain. Explain how this almost resulted in the extinction of the bald eagle.
182. Only about 10 percent of the energy is passed from one trophic level to the next. Explain where the other 90 percent of the available energy goes.
183. Some states are allowing grass carp, a fish that is a native of China and the Soviet Union, to be used to clean lakes that have overabundant vegetation. Grass carp can eat large quantities of vegetation. Many of these grass carp are sterile and unable to reproduce. This limits the population of offspring and provides some control over the amount of vegetation that is removed from an ecosystem. Other fish that are being used are able to reproduce and are showing up in rivers and tributaries where they haven't been intentionally introduced. What effect could an uncontrolled grass carp population have on the energy pyramids of a lake environment?
184. In the 1930s, a large section of the Plains States in the U.S. became known as the Dust Bowl because of the dust blizzards created by erosion of exposed topsoil. During this time, land was overcultivated and poorly managed. Poor land management and severe drought resulted in dust blizzards and crop failures. Many farmers had to abandon their farms to search for other occupations. What type of succession would you expect to find in the abandoned farmlands? Explain your answer.
185. Your grandparents, who love to garden, are thinking about buying a house in the country. Next weekend, they are going to look at two houses. One has a large garden that hasn't been cultivated since the owners moved back to the city three years ago. The other is part of a small farm that was abandoned 25 years ago. Use what you know about succession to make a list of some of the likely advantages of each place.

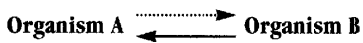
—— = Positive effect
 - - - - = Negative effect
 = No effect



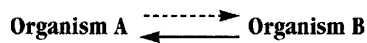
a. _____



b. _____



c. _____



d. _____

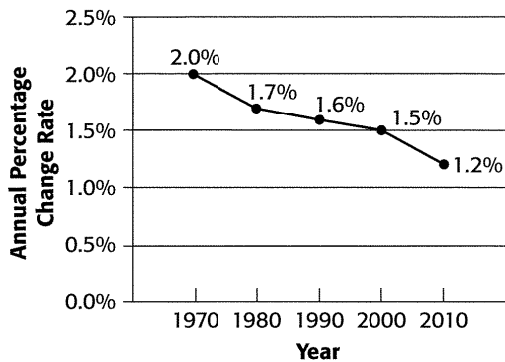
or

186. The diagrams above show four different types of interactions between species. An arrow pointing from one organism to another means that the first organism has an effect on the second organism. Label each diagram with the correct type of interaction.

187. The cholla and organ-pipe are flowering cacti that depend on bats for pollination. The bats pollinate the cacti as they eat the nectar in cacti's flowers and spread seeds when they eat the cactus fruit. Studies of the cacti show that they are not producing as much fruit as they could. It was also noted that bats living near these cacti had been driven from their cave homes by local villagers. What is the relationship between the bats and the cacti? How did the reduction in the number of bats affect the cacti?
188. Termites live almost exclusively on wood but cannot actually digest it themselves. Instead, they must depend on certain protozoa (single-celled organisms) that live in their gut to break down the wood into nutrients their body can use. In return, the termites provide an appropriate environment to sustain the protozoa. What is the relationship between the termites and the protozoa? How is this relationship similar to the one between humans and intestinal bacteria?
189. If a population of rabbits experiences exponential growth, what might happen to the population of coyote in the area. Explain your reasoning.
190. Predict what might happen to the population of rabbits and coyote if the rabbits exceed the carrying capacity of the environment. Explain your reasoning.
191. Choose any two species with a close relationship that might have coevolved adaptations and describe how the adaptations benefit both species.
192. Construct a table that compares and contrasts a parasite and a predator.
193. Explain how two species can compete for the same resource even if they never come into contact with each other.
194. Choose two populations and compare them in terms of size, density, and dispersion.
195. List three reproductive behaviors of individual members of a species that affect the reproductive potential of a species. Which one of the three behaviors has the greatest effect on reproductive potential?
196. What are three density-dependent causes of death in a population? What are two density-independent causes of death?
197. Choose an organism and give examples of parts of its niche. What is the difference between its niche and its habitat?
198. Give two examples of species that have the same habitat as hawks but different niches.
199. Aphids obtain the nutrients they need by sucking on the juices of host plants. This will later weaken the plants. What type of relationship do aphids and their host plants have? Explain your answer.
200. What is the mathematical statement that describes a population that is growing?
201. What are the advantages of slower population growth?
202. Explain why most of the increase in world population is occurring in the developing countries.
203. Projections about stabilization of the human population focus on a gradual decline in global birth rates. What factors might cause a more abrupt halt in population growth?

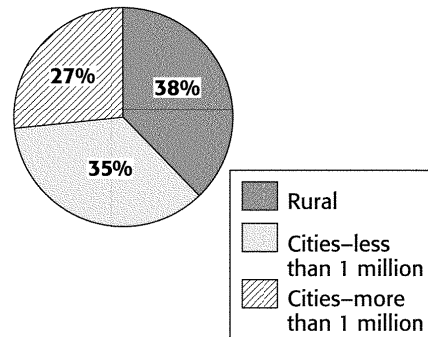
Graph A

**World Population Change Rate:
Actual and Projected**

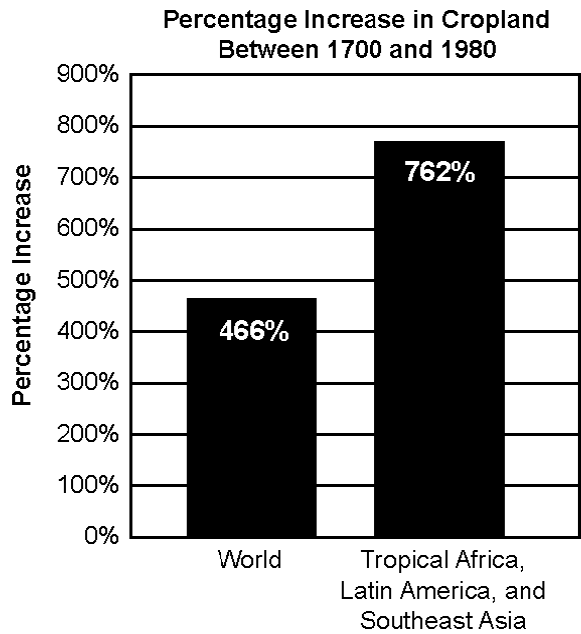


Graph B

**Projected Distribution of World
Population in 2020**



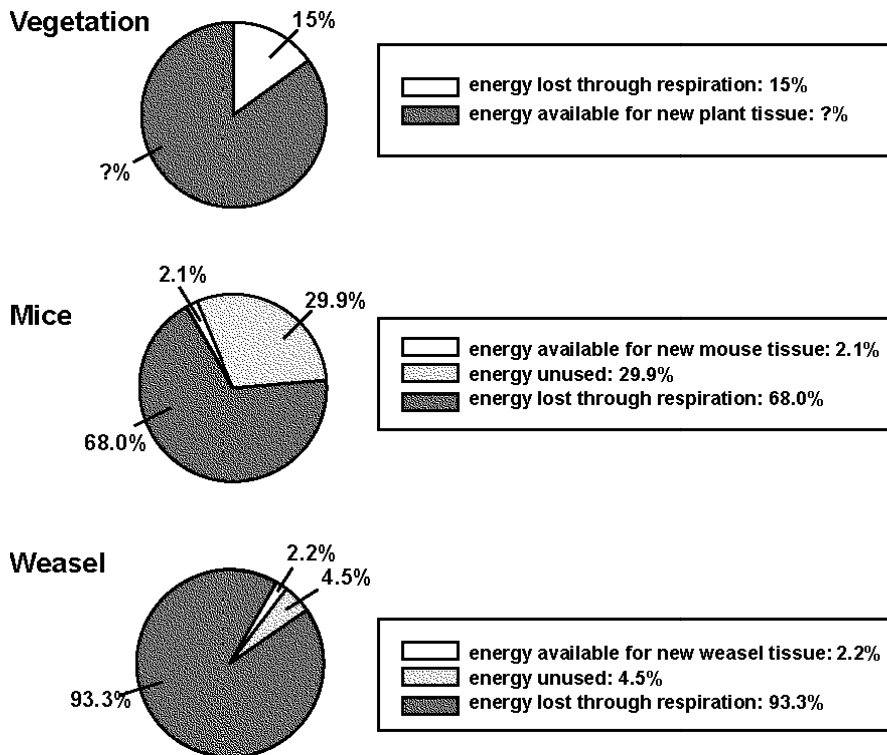
204. Using information in the chapter plus the data in Graph A above, describe two trends—one in the rate of growth in world population, the other in total world population.
205. The world population in the year 2020 is projected to be approximately 8 billion. According to Graph B above, approximately how many of these people will live in cities?
206. According to the theory of demographic transition, why do birth rates fall during the third stage?
207. Explain why the human population of Earth is still growing rapidly even though birth rates have begun to fall slightly.
208. How might an improvement in a country's educational opportunities lead to a decrease in its birth rate?
209. Why do contagious diseases spread more readily in denser populations?
210. In a preindustrial region, such as sub-Saharan Africa, what changes might cause the population to begin undergoing demographic transition?
211. What are some ways to increase life expectancy?
212. What kinds of information could a population pyramid provide to a community for future planning?
213. What factors change to cause a population explosion during the second stage of demographic transition?
214. Why are biologists uncertain about how many species are living on Earth today?
215. What are the two main benefits of protecting entire ecosystems rather than individual species of plants or animals?
216. Explain how exotic species threaten ecosystems.
217. Some conservationists feared that a complete ban on ivory sales would cause an increase in the poaching of elephants. However, poaching decreased after the ban. Why do you think that the complete ban was more effective than limiting ivory sales?
218. Does it make a difference if a biological preserve is 10 hectares or 100 hectares? Explain your answer.
219. On the graph below, what is similar about the three areas represented by the bar on the right?



220. How can the increased use of tropical rain forests for cattle grazing and farming affect the environment? Where is the greatest number of species extinctions taking place?
221. Explain the difference between an endangered species and a threatened species.
222. Briefly explain three ways to save individual species.
223. Is it possible to predict the effect(s) of eliminating a species from an ecosystem? Explain your answer.
224. How can introducing sustainable land-use practices in biodiversity hotspots help preserve ecosystems?
225. List and describe the three levels of biodiversity that are observed in nature and studied worldwide.
226. Do you think the Endangered Species Act has been effective in preventing extinctions? Explain.

Problem

fig.(a)



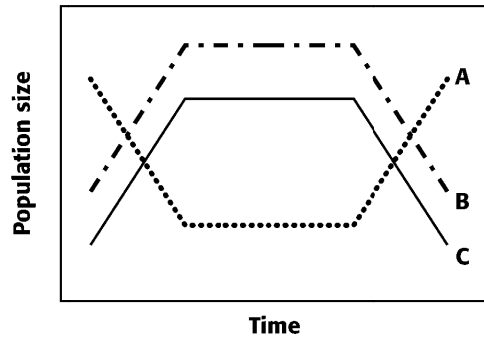
227. Determine the percentage of energy available for new plant tissue in the farm-field ecosystem represented by the pie graphs in fig.(a).
228. Compare the energy losses due to respiration for the three organisms in the pie graphs in fig.(a).
229. In fig.(a), the mice eat only 1.6 percent of the available plant material. Other consumers may eat only a portion of the remaining vegetation. What eventually happens to the energy stored in the plant material that is not eaten?
230. Zebra mussels were accidentally imported to the Great Lakes from Europe in the 1980s. (They were stowaways on cargo ships.) These small mollusks have no natural enemies in the United States. Zebra mussels multiply quickly and attach themselves permanently to anything—fish, boats, rocks, pipes, buoys, or other zebra mussels! Huge water intake pipes for cities have been clogged, channel markers sunk, and marine engines damaged by the mussels. How could zebra mussels be eliminated from the Great Lakes?
231. Viruses are the cause of many infectious diseases, such as common colds, flu, and chickenpox. Viruses can be passed from one person to another in many different ways. Under what conditions do you think viral diseases will spread most rapidly between humans? What can be done to slow the spread of these viruses?
232. Country “A” (population = 100 million) has an average age of 15, and the average number of children per woman is 2.1. Country “B” (population = 100 million) has an average age of 30, and the average number of children per woman is 2.4. Which country will have the larger population growth? Explain your reasoning.
233. On January 1, 2000, a country has 200 million people and an annual population growth rate of 8 percent. Over time, the growth rate falls, averaging 6 percent over the next 10 years. How large is the country’s population on January 1, 2010? Show your work, and round your answer to the nearest million people.

234. Currently, the world population is approximately six billion people. About 20 percent of the world's current population lives in China. If China experiences a 5 percent *decline* in population in each of the next five years, and if the rest of the world experiences a 2 percent *growth* in population in each of the next five years, at the end of the five-year period, what percentage of the world's population will live in China? (You may round your answer to the nearest percent.)
- Hint: First calculate the actual numeric figures of the current population of China (20 percent of 6 billion) and also the current population of the rest of the world (80 percent of 6 billion). Then apply the rates of decline to "China's population figure" and the rate of growth to "the rest of the world's population figure" before calculating your final answer.
235. The California Floristic Province is home to 3,488 native plant species. Of these species, 2,124 are endemic and 565 are either threatened or in danger of extinction. How many of these endangered or threatened species would you estimate are also endemic species?
236. It is estimated that 1.8 percent of tropical forest habitat is lost per year. If this habitat loss results in an average of .5 percent of species lost each year, how many species would be lost in 10 years' time? Assume a low estimate of only five million species on Earth. How long would it be before one million species would be lost (if current rates of extinction continued)?
237. Coral reefs are estimated to generate upwards of \$375 billion as a result of tourist revenue and coastal protection, and as sources of food and new chemical products. Currently, sixty percent of reefs are threatened by human activities. If a third of these threatened ecosystems were seriously damaged, how much would this loss be worth?

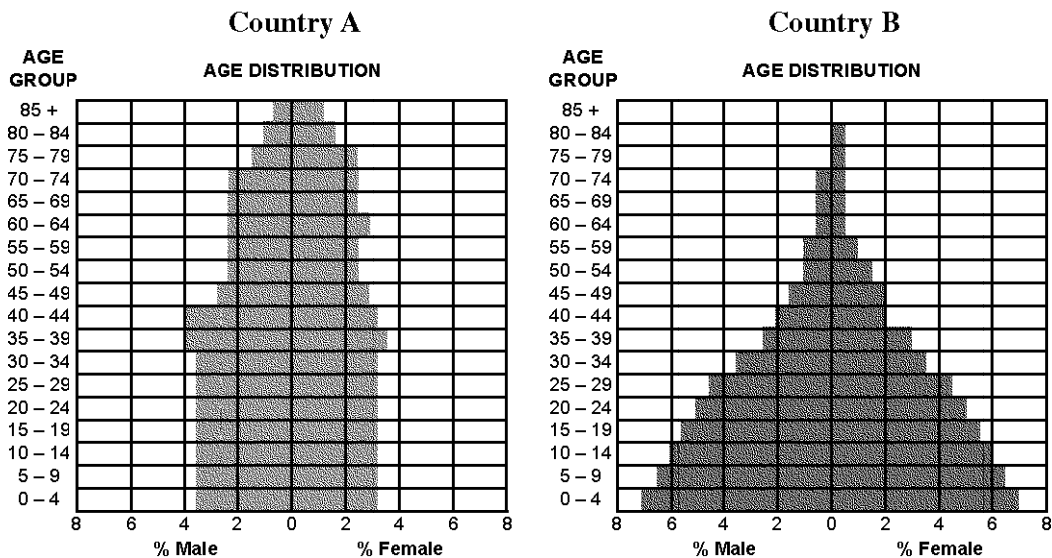
Essay

238. Draw a food web that shows the following relationships. (You may draw pictures or just write the names.) In a mountain meadow, grasshoppers and aphids eat the flowers and grasses. Ladybugs eat the aphids, and blue jays eat the grasshoppers and ladybugs. Blue jays also eat grass seeds and pine nuts and even an occasional small frog from the pond. The frogs ate algae in the pond when they were tadpoles, but now they catch grasshoppers and other insects. The field mice eat grass seeds and pine nuts. Rabbits eat young grass shoots, and the deer graze on small green willow twigs. Owls and hawks eat the frogs, mice, and rabbits, and once in a while a cougar visits the meadow and preys on a fawn or sick deer. Use arrows to show who eats what. Then answer the following question: Do you think there would be more rabbits or owls living in this area? Explain your answer.
239. Succession from bare rock to mature plant community on an island in northern Lake Superior included the following stages: exposed rock, lichens and mosses, small herbs and shrubs, black spruce, and white spruce?
- Was the succession primary or secondary? Explain.
 - What is the most likely explanation for the exposed rock?
 - Identify the pioneer organisms.
 - How are lichens able to live on bare rock?
 - Small herbs and shrubs require soil to support their roots. How was this soil formed?
 - Why did the taller white spruce trees flourish and eventually replace the black spruce?
 - The white spruce are a part of which community?
240. Imagine that one species no longer exists, or becomes extinct, immediately after the extinction of another species. Which relationship did the two species more likely have, competition or commensalism? Explain your reasoning.

Population Size of A, B, and C Over Time



241. Examine the graph above. Each line represents a different species. What type of interaction could be occurring between species A and B? Between B and C? Explain the reasoning behind each of your answers.
242. Some people argue that there is no need to take measures to slow the growth of the human population on Earth. Other people argue that population growth must be slowed and stabilized within the next century. Write two paragraphs—one for each position—explaining why a person would hold each view.



243. What are the growth patterns shown in the above population pyramids for countries “A” and “B”?
244. Which stages of the demographic transition do these countries represent?
245. What problems are typically associated with the growth pattern seen in country “B”?
246. If the birth rate in country “A” declines from its current level, how might the population change over time?
247. How is population growth contributing to environmental degradation?
248. What are some social problems caused by rapid population growth?
249. A large percentage of media coverage of environmental issues focuses on pollution’s harm to Earth and human health. Write an editorial for your school newspaper or school video network that gives your opinion as to whether the extinction of species is as critical an environmental problem as pollution. Include your vision of the future of Earth if the problems are not addressed.

250. Write an essay that explains whether or not people should be concerned about the loss of biodiversity. Give examples of how biodiversity benefits both humans and the biosphere.

1

Answer Section

MULTIPLE CHOICE

1. ANS: D
2. ANS: B
3. ANS: D
4. ANS: A
5. ANS: C
6. ANS: A
7. ANS: D
8. ANS: B
9. ANS: C
10. ANS: B
11. ANS: A
12. ANS: B
13. ANS: C
14. ANS: D
15. ANS: C
16. ANS: C
17. ANS: C
18. ANS: D
19. ANS: A
20. ANS: C
21. ANS: B
22. ANS: D
23. ANS: B
24. ANS: D
25. ANS: D
26. ANS: A
27. ANS: C
28. ANS: C
29. ANS: B
30. ANS: D
31. ANS: D
32. ANS: A
33. ANS: B
34. ANS: D
35. ANS: B
36. ANS: C
37. ANS: A
38. ANS: B
39. ANS: D
40. ANS: B
41. ANS: A

42. ANS: A
43. ANS: B
44. ANS: B
45. ANS: D
46. ANS: D
47. ANS: C
48. ANS: D
49. ANS: D
50. ANS: A
51. ANS: D
52. ANS: C
53. ANS: D
54. ANS: B
55. ANS: C
56. ANS: A
57. ANS: D
58. ANS: A
59. ANS: C
60. ANS: C
61. ANS: D
62. ANS: B
63. ANS: A
64. ANS: D
65. ANS: C
66. ANS: A
67. ANS: C
68. ANS: B
69. ANS: A
70. ANS: C
71. ANS: C
72. ANS: D
73. ANS: C
74. ANS: B
75. ANS: C
76. ANS: D
77. ANS: A
78. ANS: A
79. ANS: B
80. ANS: D
81. ANS: D
82. ANS: B
83. ANS: D
84. ANS: C
85. ANS: C
86. ANS: B
87. ANS: D

- 88. ANS: B
- 89. ANS: D
- 90. ANS: A

COMPLETION

- 91. ANS: photosynthesis
- 92. ANS: hydrogen sulfide
- 93. ANS: legumes
- 94. ANS: fire
- 95. ANS: primary
- 96. ANS: pioneer species
- 97. ANS: lichens
- 98. ANS: 10 percent
- 99. ANS: bacteria
- 100. ANS: fertilizers
- 101. ANS: climax community
- 102. ANS: old-field
- 103. ANS: ecological
- 104. ANS: nitrogen-fixing bacteria
- 105. ANS: secondary succession
- 106. ANS: carnivores
- 107. ANS: decomposers
- 108. ANS: food web
- 109. ANS: sun
- 110. ANS: atmosphere
- 111. ANS: fossil fuels
- 112. ANS: fossil fuels
- 113. ANS: dispersion
- 114. ANS: commensalism
- 115. ANS: indirect
- 116. ANS: kill and eat
- 117. ANS: generation time
- 118. ANS: reproductive potential
- 119. ANS: size, density, dispersion
- 120. ANS: carrying capacity
- 121. ANS: limiting
- 122. ANS: territory
- 123. ANS: density
- 124. ANS: density
- 125. ANS: niche
- 126. ANS: restriction
- 127. ANS:
 - predation
 - predator-prey
- 128. ANS: parasite

- 129. ANS: parasite, predator
- 130. ANS: symbiosis
- 131. ANS: exponential
- 132. ANS: coevolution
- 133. ANS: negative
- 134. ANS: replacement level
- 135. ANS: fourth
- 136. ANS: industrial, scientific
- 137. ANS: arable land
- 138. ANS: demography
- 139. ANS: least-developed
- 140. ANS: fertility rates
- 141. ANS: medium, 9 billion
- 142. ANS: population pyramid
- 143. ANS:
slowly
not at all
- 144. ANS: sterilize
- 145. ANS: economic, social
- 146. ANS: sewage
- 147. ANS: Europe
- 148. ANS: birth rates
- 149. ANS: replacement level
- 150. ANS: exponential
- 151. ANS: survivorship
- 152. ANS: post-industrial
- 153. ANS: poaching
- 154. ANS: keystone species
- 155. ANS: ecotourism
- 156. ANS: threatened species
- 157. ANS: endangered species
- 158. ANS: mass extinction
- 159. ANS: exotic species
- 160. ANS: keystone species
- 161. ANS: genetic diversity
- 162. ANS: fungi
- 163. ANS: a hybrid variety
- 164. ANS: exotic species
- 165. ANS: extinct
- 166. ANS: endangered species
- 167. ANS: endemic species
- 168. ANS: biodiversity hotspot
- 169. ANS: biotechnology
- 170. ANS: captive-breeding

SHORT ANSWER

171. ANS:
Nitrogen-fixing bacteria capture nitrogen from the air and convert it to a form that can be used by plants. Herbivores acquire nitrogen by eating the plants, and the lion acquires nitrogen by eating the herbivores. After the lion dies, decomposers break down the lion's carcass and convert the nitrogen in it to ammonia. Other bacteria will convert the ammonia to nitrogen gas and release it into the atmosphere.
172. ANS:
All animals are dependent on the organic compounds synthesized by producers.
173. ANS:
These life-sustaining materials are continuously recycled through the air, water, soil, plants, and animals, changing form in the process. These chemical compounds may be a part of an organism at one point (organic carbon molecules) and part of its nonliving environment at another (atmospheric carbon dioxide).
174. ANS:
Accept any reasonable answer. Sample answer: Owls eat mice and mice eat grain. Both owls and mice depend upon the plants that produce grain for their energy source. Grain is the producer in this scenario.
175. ANS:
A pyramid is the perfect shape to represent energy levels. Because the base is the largest part of the pyramid, it is used to show where the most energy is located. As you go up the energy pyramid it gradually narrows, showing that trophic energy is lost at each succeeding trophic level.
176. ANS:
Carbon is in the atmosphere in the form of carbon dioxide. Plants remove the carbon dioxide from the air and convert it into carbohydrates through photosynthesis. Consumers eat plants or other organisms that eat plants and use the carbon in their bodies as their energy source. Organisms release carbon dioxide back into the atmosphere during cellular respiration and the process begins again.
177. ANS:
The bodies of carbon-containing organisms are converted into fats, oils, and other molecules that store energy. Over time these fats are converted into coal, oil, and natural gas underground.
178. ANS:
Excess fertilizer washes away and collects in lakes and streams. The nitrogen and phosphorus stimulate algal growth. The resulting algal bloom in the lakes and streams ties up the oxygen that would otherwise be used by aquatic organisms, suffocating them.
179. ANS:
Lichens are producers that are composed of two different species, a fungus and an alga. The alga photosynthesizes, while the fungus absorbs nutrients from rocks and holds water. The lichen slowly breaks down the rock into soil. Over time, the dead lichen adds organic material to the newly created soil, thus enabling other plants to grow.
180. ANS:
Accept all reasonable answers. Sample answer: Leaf lettuce gets its energy from the sun through photosynthesis. The lettuce would be on the bottom level of the pyramid as the producer. The primary consumer that could be on the next level of the energy pyramid is a leaf-eating caterpillar. A meadowlark could be the secondary consumer and occupy the next level of the energy pyramid. An owl could eat the meadowlark and occupy the top level of the energy pyramid as the tertiary consumer.
181. ANS:
Fish ate the algae and bacteria that contained the DDT. The fat in the tissues of the fish absorbed the DDT. Birds ate these contaminated fish, gradually accumulating increasing amounts of DDT in their bodies. The levels of DDT in the bodies of these birds began to affect the quality of their eggs. Many of these eggs didn't hatch, resulting in fewer birds. The bald eagle was one of the species of birds that was affected by DDT contamination.
182. ANS:

Ninety percent of the energy is lost through heat, cellular respiration, carrying out the functions of living such as producing new cells, maintaining body temperature, and movement.

183. ANS:

Accept any reasonable answer. Sample answer: Grass carp could deplete the vegetation in an aquatic environment. This would remove a large portion if not all of the producers from the aquatic environment. Death through starvation would occur all the way up the energy pyramid.

184. ANS:

Secondary succession would quickly cover the abandoned farmland with grasses and weeds. Old-field succession would begin on the abandoned farmland.

185. ANS:

Answers may vary but should reflect the student's understanding of the process of succession. Answers might include the following points: Advantages at the recently vacated home—mostly small, weedy plants would have grown in the garden, which would be relatively easy to dig up or till; there would not have been time for large trees, which would be difficult to remove, to grow in the garden area. Advantage to the older site—fewer weeds and weed seeds to eliminate, and if trees in the garden area are cut down, they could be used as firewood.

186. ANS:

- a. mutualism
- b. competition
- c. commensalism
- d. predation, parasitism

187. ANS:

The relationship between the bats and cacti is mutualism; the bats eat the nectar in cacti's flowers and spread pollen and seeds. With a decreased bat population, flowers will go unpollinated and fruit will go uneaten, reducing the number of opportunities for the cactus plants to reproduce.

188. ANS:

The relationship between the termites and protozoa is mutualism—the termites receive nutrients in a usable form and the protozoa gain a hospitable environment. This relationship is similar to the one between humans and intestinal bacteria. Like the protozoa, the bacteria in human intestines break down some types of food that humans would otherwise be unable to digest. In return, humans provide a suitable environment for the bacteria, as do the termites for the protozoa.

189. ANS:

Answers may vary. Sample answer: The population of coyote might also experience exponential growth. The coyote are predators of rabbits and would have an abundant source of food as the rabbit population grows at an increasingly faster rate. With plenty of food available, more coyotes would survive to reproduce.

190. ANS:

Answers may vary. Sample answer: As the rabbits exceed the carrying capacity, they will run out of resources. Starvation and possibly diseases will severely reduce the population of the rabbits. The coyote will have less food available and their population will decline unless they find another food source.

191. ANS:

Answers may vary. Sample answer: A species of plant with red, tubular flowers and a species of hummingbird with long beaks may have coevolved. The hummingbird benefits by being attracted to the flowers where it finds an exclusive source of food. The plant benefits when the hummingbird pollinates the flowers it visits.

192. ANS:

Tables may vary, but should contain the idea that a parasite and predator are similar in that they benefit by obtaining resources while another species is harmed. They differ in that a parasite has a host that it lives in or on. Parasites may weaken their host but usually do not kill it to get the resource they need. Predators kill their prey to get food.

193. ANS:

Species can compete over time or space without meeting by utilizing the same resource at different times, such as one species of insect feeding on a plant during the day and another species of insect feeding on the same plant at night. Or, two species of plants that flower at the same time may be in competition for pollinators.

194. ANS:

Answers may vary. Sample answer: A population of Canada geese is often made up of a large number of individuals (size) in a small area such as a lake (density), while a population of redheaded woodpeckers is made up of a few individuals in each of several forested areas. The geese have a clumped dispersion and the woodpeckers have an even dispersion based on territories.

195. ANS:

producing more offspring at a time, reproducing more often, reproducing earlier in life. Reproducing earlier in life has the greatest effect.

196. ANS:

limited resources, predation, and disease; severe weather, natural disasters

197. ANS:

Answers may vary. Sample answer: A niche includes a species' physical home, environmental factors for its survival, and its interaction with other organisms. A habitat describes the location where it lives. Parts of a pet dog's niche include its food and water, where it sleeps, other animals it chases, and its role as a family pet. The dog's habitat may be a residential neighborhood, as opposed to a forest.

198. ANS:

Answers may vary. Sample answer: rabbits, snakes

199. ANS:

Parasitism; the aphids feed on the juices without immediately killing the plant.

200. ANS:

number of births + number of immigrants > number of deaths + number of emigrants

201. ANS:

When population growth is slow, there is a better chance that the carrying capacity of the land will not be exceeded and that environmental degradation can be avoided. In contrast, when a population is growing very quickly, it is difficult for governments to provide services such as a clean water supply, adequate sewage disposal, health care, and education for its citizens.

202. ANS:

Unlike the developed countries, birth rates remain elevated in developing countries. In those developing nations that have lower fertility rates, the number of women entering childbearing age is still rising. Thus, developing nations account for most of the increase in world population.

203. ANS:

Factors that would produce a sharp increase in global death rates could lead to a much lower population size. Such factors could include inadequate food supplies, disease, or warfare.

204. ANS:

Graph A shows that the percentage growth rate has been slowing since 1970. This trend is expected to continue into the 21st century. Even though the percentage rate of change is decreasing, total world population continues to grow rapidly.

205. ANS:

Approximately 5 billion (0.62×8 billion = 4.96 billion) will live in cities.

206. ANS:

Answers may vary. Sample answer: People choose to limit the size of their family because they feel more confident that their children will survive to adulthood, because they have greater access to family planning, and because they usually marry and have children at a later age.

207. ANS:

In many countries, most of the population is young and of childbearing age. Even if these people choose to have only one or two children, there are so many young adults that the population will continue to increase throughout their reproductive years.

208. ANS:

Educated women find that they have alternative opportunities and can contribute to their family's economic prosperity by holding a job and by having fewer children; men and women discover that they need not have a large number of children to ensure that a few survive, and they learn about methods of family planning.

209. ANS:

If the disease is contagious, it is more likely that others will be nearby and become infected; this causes diseases to spread more quickly. Also, denser populations often have poor water quality.

210. ANS:

Answers may vary. Sample answer: In preindustrial regions, both the birth and death rates are relatively high, so the population remains stable at low numbers. Improvements in food availability, hygiene, and education would reduce the death rate, allowing the population to grow.

211. ANS:

Life expectancy is most affected by infant mortality. Infant health can be improved by providing educational opportunities for parents, an adequate food supply, fuel for warmth and cooking, and a clean water supply.

212. ANS:

Answers may vary. Sample answer: A population pyramid will show a community what age groups make up the largest percentage of the population. The future needs of that population group can be anticipated, and future growth can be predicted.

213. ANS:

Death rates begin to decline as hygiene, nutrition, and education improve. However, birth rates remain high, so the population grows very fast.

214. ANS:

Many species have not been named, or even studied. Many are found in environments that are difficult to get to, such as deep caves, the bottom of the oceans, or tropical forests. It also takes a long time to locate, collect, study, and classify new species because biodiversity is great and more scientific effort is needed to complete the task.

215. ANS:

Ecosystems may contain species that haven't been identified yet or that haven't been studied enough to determine whether or not they are endangered. By preserving an ecosystem, we preserve all the species in it. In addition, healthy ecosystems are important for the health of the entire planet.

216. ANS:

Native species in ecosystems have not evolved ways to compete with or defend themselves against exotic species. Exotic species may quickly use up available resources or wipe out other species by predation.

217. ANS:

As long as some ivory was allowed to be sold, it was possible to forge documents and pass off illegal ivory as legal. Now, only people willing to break the law buy or sell ivory, and if caught, they cannot argue that they thought the ivory was legal.

218. ANS:

An effective preserve is large enough to maintain the species diversity of the ecosystems it contains. Also, some individual species require a large range to meet their basic needs, such as obtaining adequate food, finding suitable mates, and rearing their young. A 100 hectare preserve is more likely to contain and support a diverse assortment of species than is a 10 hectare preserve.

219. ANS:

These areas contain tropical rain forest ecosystems that hold the majority of the world's biological diversity. Conservationists designate many biodiversity hotspots within these areas.

220. ANS:

From 1700 to 1980, the tropical rain forests of the world showed a great increase in land area converted to cropland. This has a serious effect on biodiversity, and it damages the ecological balance of these very fragile environments. Most extinctions are occurring in tropical rain forests because farming and cattle grazing require big, open areas free of tropical vegetation.

221. ANS:

An endangered species is a species whose numbers have fallen so low that it is likely to become extinct in the near future if it is not protected soon. A threatened species is a species that is likely to become endangered if it is not protected soon. Unlike an endangered species, a threatened species' population has not yet to become so low that the species faces extinction.

222. ANS:

One method for saving species is through captive-breeding programs, in which animals are bred and their populations managed in zoos and animal parks. A second way to save species is botanical gardens, which preserve live plant and insect species. A third method of saving individual species is through germ-plasm banks, where the reproductive (germ) cells of species are stored for the future. Here, plants may be stored as seeds, and animals may be stored as frozen sperm and eggs.

223. ANS:

Answers may vary. Sample answer: No; we do not fully understand what effects we are having on the environment when we eliminate a species from an ecosystem. However, we have seen many cases where the results have been negative. Such losses have been at least partly responsible for dramatic changes to ecosystems over the last several centuries.

224. ANS:

This strategy involves growing food and trade crops among native trees and plants. For example, coffee plants can be grown in the shade of tropical trees. As a result, the migratory routes of birds, which roost in those trees, can be preserved.

225. ANS:

The first level is ecosystem diversity, which refers to the variety of habitats, ecosystems, and ecological processes. The next level is species diversity, which refers to variability between populations of species and between different species. The third level is genetic diversity, which refers to the variability of genes within a population.

226. ANS:

Answers may vary. Sample answers: Yes; many of the actions of local and federal governments and private owners taken to protect species resulted from this Act. The banning of the pesticide DDT has helped the bald eagle and peregrine falcon populations recover, as well as many agreements with developers that set apart large areas of land for conservation. No; it has imposed severe controls on the use of private property that may threaten any endangered species and stopped multimillion dollar construction projects in their tracks to save an insignificant species of fish. Still, many listed species go extinct or remain listed as endangered. For instance, mammals and birds are at the top of the list of endangered species because the former require large areas for their habitat, and birds are at high risk when they migrate temporarily between habitats. By not compensating property owners for losses, the act provides little incentive for individuals to protect species from extinction

PROBLEM

227. ANS:

$100\% - 15\% = 85\%$ of available energy is used in plant production.

228. ANS:

The plants lose a small percentage of their intake energy to respiration (15 percent). Both consumers expend the majority of their assimilated energies in respiration, although a substantial difference exists between the respiratory loss of the mouse (68 percent) and that of the weasel (93.3 percent).

229. ANS:
The remaining vegetation is eventually decomposed, and a portion of its stored energy is returned to the ecosystem via the decomposing organisms (mainly bacteria and fungi).
230. ANS:
Answers may vary. Sample answer: The European practice of introducing the natural predators of zebra mussels into their habitat could be explored to see if it could be used effectively in the United States.
231. ANS:
Answers may vary. Sample answers: Viruses are density dependent and will spread most rapidly in crowded conditions. The spread of viruses could be slowed by having healthy people avoid crowded conditions and by having people with the viruses stay home.
232. ANS:
Country "A" would probably grow more. Even though the women in this population have fewer children, more females will reach childbearing age earlier. (The average age for each population indicates a larger number of young people in the first population.)
233. ANS:
The 8 percent growth rate does not figure in at all because it applied to an earlier period. The population averaged 6 percent for the decade in question. Therefore, the total percent growth is $(1.06)^{10} = 1.791$. (Explanation: Each year of 6 percent growth represents 106% of the previous year's population. Note that $106\% = 1.06$. Therefore, 1.06^{10} represents ten years of growth. Since $1.06^{10} = 1.791$, the increase over ten years amounts to a 79.1% increase.) $200 \text{ million} \times 1.791 = 358 \text{ million people}$.
234. ANS:
China's current population ($0.2 \times 6 \text{ billion}$) equals 1.2 billion people. The rest of the world ($0.8 \times 6 \text{ billion}$) equals 4.8 billion people. A 5 percent decline over the next five years = $(0.95)^5 = 0.7738$. A 2 percent growth over the next five years = $(1.02)^5 = 1.1041$. Therefore, five years from now, China's projected population would be $(0.7738) \times 1.2 \text{ billion} = 0.92856 \text{ billion people}$. The rest of the world in five years will have $(1.1041) \times 4.8 \text{ billion} = 5.29968 \text{ billion people}$. The total population five years from now will be 6.22824 billion ($0.92856 + 5.29968 = 6.22824$). China's percentage will be $(0.92856) \text{ divided by } (6.22824)$ which equals 0.149088, which equals 15 percent. Thus, in five years, China would have 15 percent of the world's population.
235. ANS:
 343 species ($2,124 \text{ endemic species} / 3,488 \text{ native species} = .609$ or 60.9% and $.609 \times 565 \text{ species} = 343.4$)
236. ANS:
Approximately 250,000 species in 10 years and 1 million species in 40 years would be extinct. ($5 \times 10^{-2} \times 5 \times 10^6 = 25 \times 10^4$ or $250,000 \times 4 = 1 \times 10^6$ or 1 million)
237. ANS:
about \$75 billion per year ($60\% \times .33 = 19.8\%$ or $.198 \times \$375 = 74.25$)

ESSAY

238. ANS:
Students' diagrams should be similar to the one shown on page 122 of the text. Students should use arrows to show that most of the organisms in this ecosystem eat more than one kind of food. There would be more rabbits than owls in this ecosystem because owls eat at a higher trophic level than rabbits. Only a fraction of the energy that the rabbits obtained from plants is available to the owls. Ecosystems generally support fewer carnivores than herbivores.
239. ANS:
- The succession was primary because no previous ecosystem existed. Soil had to be formed by natural processes.

- b. retreating glaciers
- c. lichens and mosses
- d. A lichen is composed of a fungus and an alga living together in a mutualistic relationship. The fungus dissolves and absorbs nutrients from the rock, while the alga produces food by photosynthesis.
- e. Lichens and later mosses, aided by weathering, acted to break down the rock. Soil was formed over many years by the accumulation of broken rock, dust particles, and decaying organisms (e.g., lichens, bacteria, and mosses).
- f. Shade and other conditions created by the black spruce allowed for the successful germination and growth of the more shade-tolerant white spruce. The taller white spruce created a canopy overhead that caused the shade-intolerant black spruce to be gradually eliminated (the latter could no longer reproduce).
- g. climax community

240. ANS:

Commensalism; if the organisms were competing for resources, then the extinction of one would make more resources available for the other; thus, the other should thrive. If species A derives benefit from species B and species B becomes extinct, then species A might also become extinct.

241. ANS:

The populations of species A and B fluctuate in an opposite (inverse) manner, suggesting competition in which one species monopolizes available resources. Alternatively, species A might prey on B (predation). Thus, as the number of predators (A) diminishes, the number of prey (B) would rise. Then as A increases consumption of B, the population size of A would increase and the size of B would diminish. The population sizes of B and C fluctuate together (in synchrony), which could indicate mutualism, or alternatively, a highly specialized type of parasitism or predation.

242. ANS:

Answers may vary. People who argue that population growth does not need to be slowed generally take the position that a growing population is always an economic asset to a society and that technology will solve any problems that arise from population growth. People who argue that population growth must be slowed generally argue that the carrying capacity of Earth for its human population is not unlimited and, as with any other population, environmental catastrophe, mass starvation, and suffering will follow if the carrying capacity of Earth is exceeded.

243. ANS:

In country "A", the relatively even distribution of persons in the lower half of the pyramid would suggest that its population is either growing very slowly or has stabilized. In contrast, country "B"'s pyramid shows that a large proportion of its population is concentrated in the younger age groups. Thus, the number of women of childbearing age will continue to increase each year, and country "B"'s population will continue to grow rapidly.

244. ANS:

Based on their respective population patterns, country "A" has completed the demographic transition, while country "B" remains in transition (stage two).

245. ANS:

Problems associated with a rapidly growing population may include a shortage of fuelwood, contaminated water supplies, lack of enough arable land, inadequate housing, suburban sprawl, overcrowded schools, inadequate health care, and a decline in the standard of living.

246. ANS:

If country "A"'s birth rate drops below its death rate, the population growth will begin to slow.

247. ANS:

Answers may vary. Sample answer: As the human population increases, wilderness is converted to farmland, water is diverted for irrigation or polluted by industries and natural areas are used by people who need food, fuel, or a place to live.

248. ANS:

Answers may vary. Sample answer: Densely populated areas have a higher incidence of crime and violence due to people competing for the same resources. Homelessness and unemployment are also prevalent in areas where more people live than can be supported economically.

249. ANS:

Answers may vary. Students may focus on the loss of benefits to humans, the disruption of ecosystems that threatens the health of the entire planet, or the sense of loss that follows the disappearance of a unique species.

250. ANS:

Answers may vary. Sample answer: The interdependence of the wide variety of life forms on Earth is critical to ensuring that the various nutrient and energy cycles of Earth remains in balance. This balance is responsible for the quality of our air, water, and soil. Microorganisms such as the bacteria that live on the roots of some plants, for example, are an integral part of the nitrogen cycle. The effect of removing keystone species such as the Pacific sea otter demonstrates the role of individual organisms in maintaining the stability of ecosystems. Moreover, undiscovered or poorly studied species are a potential source of new chemicals, industrial materials, medicines, and new genes for crop breeding or genetic engineering. The extinction of such species could thus result in the loss of useful products.