

Bio 10 3.1 What Is Ecology?

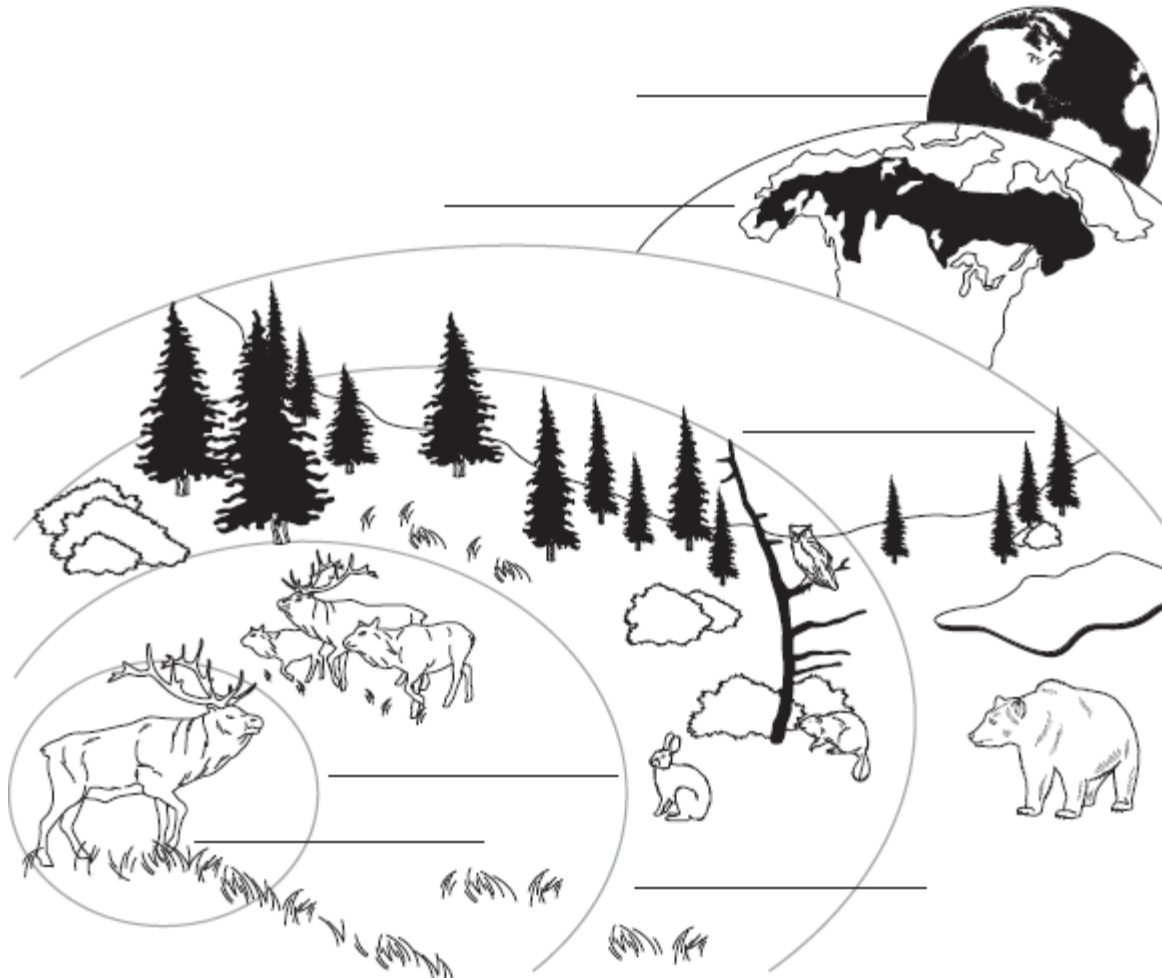
Studying Our Living Planet

1. What is ecology?

2. What does the biosphere contain?

3. How are human economics and ecology linked?

Use the diagram to answer Questions 4–5

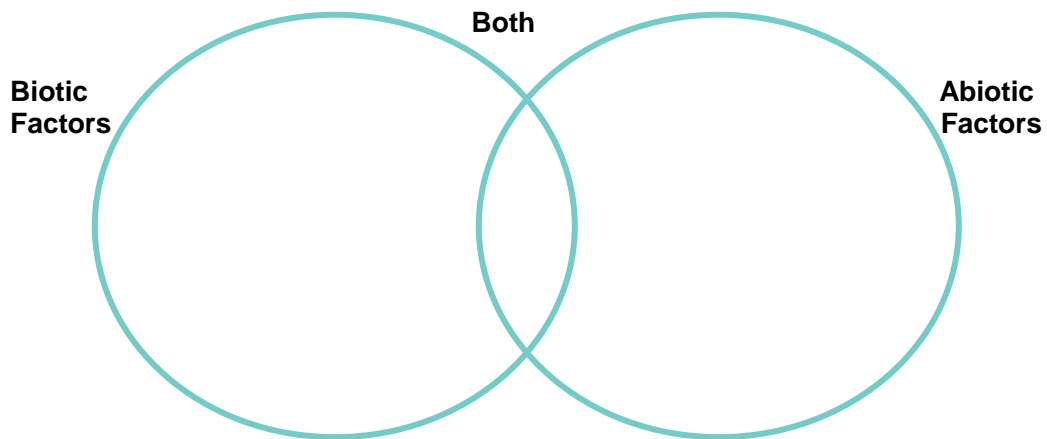


- Label each level of organization on the diagram.
- Explain the relationship between ecosystems and biomes.

Biotic and Abiotic Factors

- Use the terms in the box to fill in the Venn diagram. List parts of the environment that consist of biotic factors, abiotic factors, and some components that are a mixture of both.

air animals bacteria	heat mushrooms plants	precipitation soil sunlight
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Ecological Methods

- Why might an ecologist set up an artificial environment in a laboratory?

- Why are many ecological phenomena difficult to study?

- Why do ecologists make models?

Apply the Big idea

- What makes a planet living? Explain your answer by comparing Earth with Mars.

3.2 Energy, Producers, and Consumers

Primary Producers

1. What do autotrophs do during photosynthesis?

2. Can some organisms survive without energy from the sun? Explain your answer.

3. Can organisms create their own energy? Explain your answer. _____

Consumers

4. Complete the table about types of heterotrophs.

Types of Heterotrophs		
Type	Definition	Examples
Herbivore		cows, rabbits
	Heterotroph that eats animals	
Omnivore		humans, bears, pigs
Detritivore		
Decomposer		
	Heterotroph that consumes the carcasses of dead animals but does not typically kill them itself	

5. What is a consumer?

6. How would you categorize a consumer that usually catches and eats prey, but also eats dead animal carcasses? _____

Apply the Big idea

7. What role do producers play in establishing Earth as a living planet? _____

3.3 Energy Flow in Ecosystems

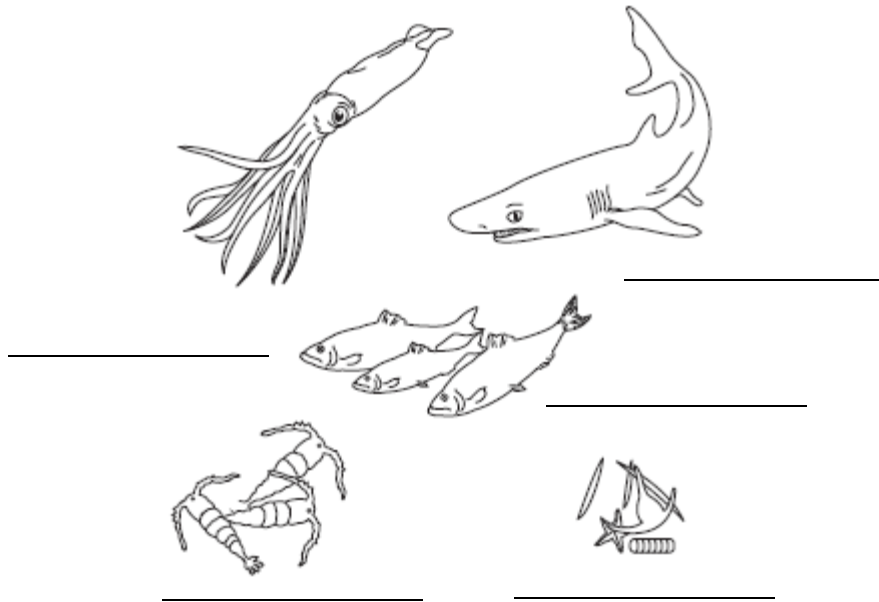
Food Chains and Food Webs

1. Complete the table about feeding relationships.

Feeding Relationships	
Relationship	Description
Food Chain	
Food Web	

Use the food chain to answer Questions 2–4.

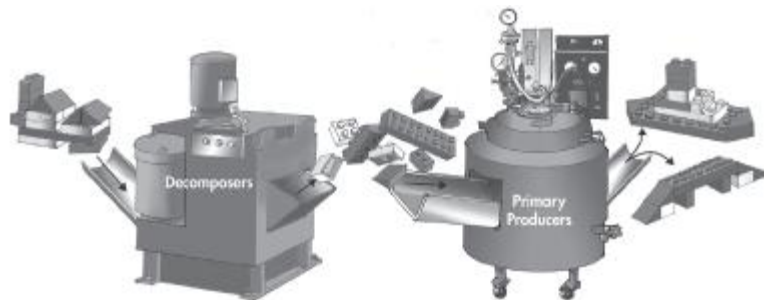
2. Draw arrows between the organisms to show how energy moves through this food chain. Write *producer*, *herbivore*, or *carnivore* under each organism.



3. Explain how energy flows through this food chain. _____

4. What would happen to this food chain if a disturbance caused a serious decline in the shark population? _____

5. **VISUAL ANALOGY** What role does energy play in the diagram, and how is it represented? _____

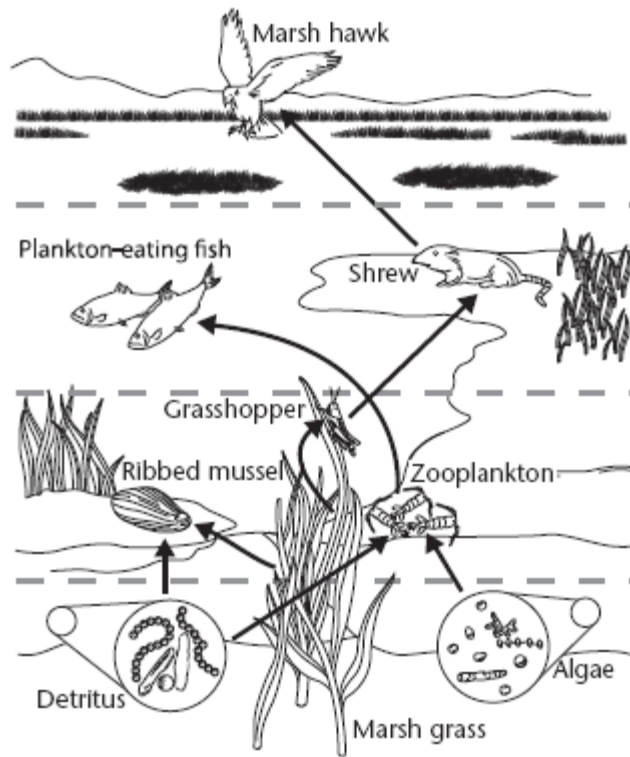


Trophic Levels and Ecological Pyramids

Write True or False on the line provided.

- _____ 6. Primary consumers always make up the first trophic level in a food web.
- _____ 7. Ecological pyramids show the relative amount of energy or matter contained within each trophic level in a given food web.
- _____ 8. On average, about 50 percent of the energy available within one trophic level is transferred to the next trophic level.
- _____ 9. The more levels that exist between a producer and a given consumer, the larger the percentage of the original energy from producers is available to that consumer.

Use the diagram to answer Questions 10–17.



Match the organism with its trophic level. A trophic level may be used more than once.

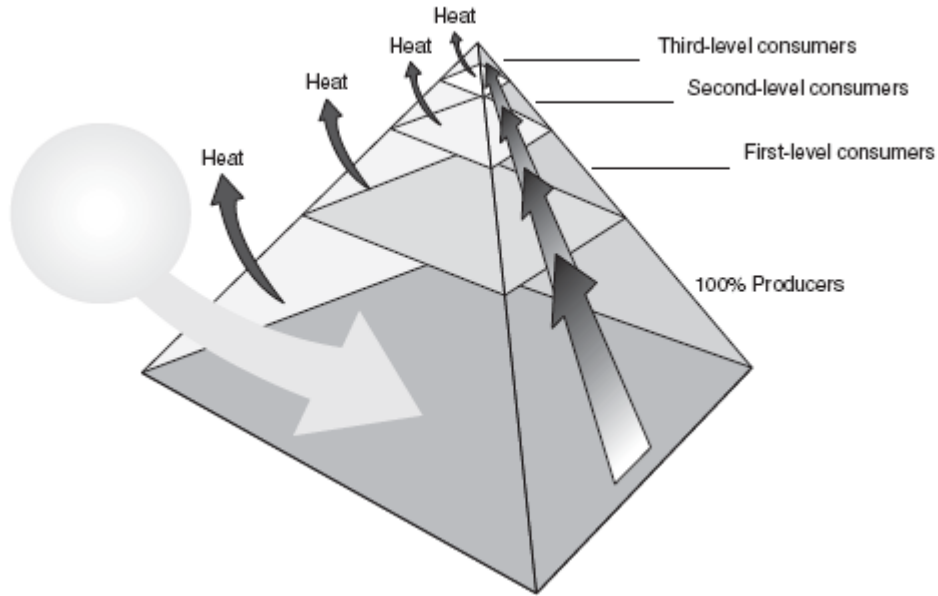
Organism

- _____ 10. algae
- _____ 11. grasshopper
- _____ 12. marsh grass
- _____ 13. marsh hawk
- _____ 14. plankton-eating fish
- _____ 15. ribbed mussel
- _____ 16. shrew
- _____ 17. zooplankton

Trophic Level

- A. primary producer
- B. first-level consumer
- C. second-level consumer
- D. third-level consumer

18. Complete the energy pyramid by writing the source of the energy for the food web and how much energy is available to first-, second-, and third-level consumers.



For Questions 19–21, complete each statement by writing the correct word or words.

- 19. A pyramid of _____ illustrates the relative amount of living organic matter available at each trophic level in an ecosystem.
- 20. A pyramid of _____ shows the relative numbers of individual organisms at the trophic levels in an ecosystem.
- 21. A pyramid of _____ shows the relative amounts of energy available at the trophic levels of a food chain or food web

Apply the Big idea

22. Identify which type of ecological pyramid best traces the flow of matter through an ecosystem. Explain your answer.

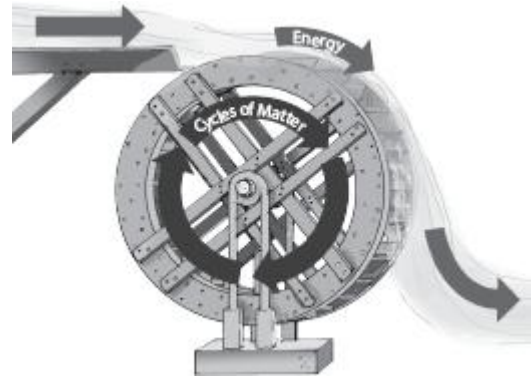
3.4 Cycles of Matter

Recycling in the Biosphere

For Questions 1–3, write *True* if the statement is true. If the statement is false, change the underlined word or words to make the statement true.

- _____ 1. The four elements that make up over 95 percent of the body in most organisms are oxygen, sulfur, nitrogen, and hydrogen.
- _____ 2. Matter moves through an ecosystem in cycles.
- _____ 3. Chemical and physical processes include the formation of clouds and precipitation, "burning" food, and the flow of running water.

4. **VISUAL ANALOGY** The illustration draws an analogy between the way energy drives matter to cycle in an ecosystem and the way water causes a waterwheel to turn. Give an example of another analogy that could be used to show the relationship between energy and the cycles of matter.



5. Explain why Earth is considered a closed system.

6. How might building a new highway affect the cycles of matter?

The Water Cycle

7. What role do plants play in the water cycle?

Name _____ Class _____ Date _____

8. **THINK VISUALLY** Draw a diagram explaining the water cycle. Label the processes involved as biological or physical/chemical.



Nutrient Cycles

9. Complete the chart about the carbon cycle.

Processes That Cause Carbon to Move into the Atmosphere		Processes That Cause Carbon to Move out of the Atmosphere	
Process	Description	Process	Description
Respiration		Photosynthesis	
	the release of CO ₂ and other gases into the atmosphere through vents in Earth's crust		

For Questions 10–12, write the letter of the correct answer on the line at the left.

- _____ 10. The carbon in coal, oil, and natural gas came from
A. the combustion of fossil fuels.
B. the remains of dead organisms.
C. carbon-fixing bacteria in swamp soil.
D. carbon dioxide dissolved in ocean water.
- _____ 11. How does most of the carbon in an organism's body return to the environment after the organism dies?
A. Decomposers break the body down into simpler compounds.
B. Heat from the sun causes the carbon in the body to evaporate.
C. Geological processes cause the body to turn into a fossil fuel.
D. Rainwater dissolves the carbon in the body and carries it to the ocean.
- _____ 12. Human processes mainly contribute to the
A. release of carbon dioxide into the atmosphere.
B. decrease of the total amount of carbon found on Earth.
C. depletion of carbon dioxide reserves in the atmosphere.
D. increase in the amount of carbon contained in rock materials.

Write True if the statement is true. If the statement is false, change the underlined word or words to make the statement true.

- _____ 13. Nitrogen, in the form of ammonia, nitrate, and nitrite, is found in the soil.
- _____ 14. Nitrogen fixation is the process in which certain bacteria convert nitrogen gas into nitrates.
- _____ 15. Denitrification is the process by which some soil bacteria convert nitrates into nitrogen gas.
- _____ 16. All organisms require nitrogen to make amino acids, which in turn are used to build carbohydrates.
- _____ 17. Phosphate is released as rocks and sediments wear down.
- _____ 18. Plants absorb phosphate from the soil or from water.
- _____ 19. Phosphorus is the most abundant gas in the atmosphere.
- _____ 20. Organic phosphate is taken up by producers during photosynthesis and released by cellular respiration.
- _____ 21. Phosphorus forms part of the important life-sustaining molecules such as DNA and RNA.
- _____ 22. Plants absorb phosphorus from the atmosphere or water.

23. List and describe the biological steps in the nitrogen cycle.

24. What is atmospheric nitrogen fixation, and how does it affect organisms?

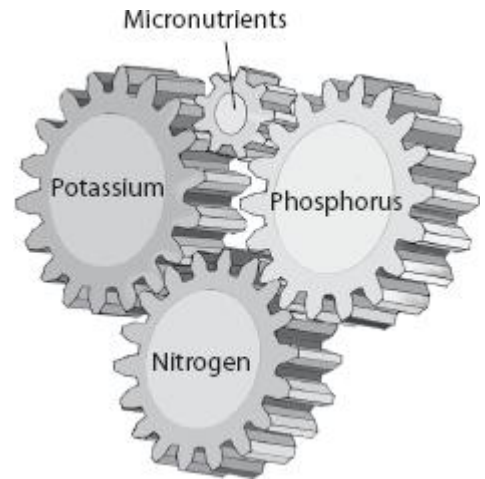
25. How do humans add nitrogen to the biosphere?

26. Which parts of the phosphorus cycle are geological processes?

Nutrient Limitation

Use the diagram of the interlocking nutrients to answer Question 27.

27. **VISUAL ANALOGY** The visual analogy compares interlocking gears to the major nutrients— potassium, phosphorus, and nitrogen. What other “gears” would be affected if these gears stopped working together?



28. If a nutrient were in short supply in an ecosystem, how might it affect an organism?

29. When is a substance a limiting nutrient?

Apply the Big idea

30. Compare and contrast the flow of energy through an environment with the flow of matter through that same environment.

4.2 Niches and Community Interactions

The Niche

1. What is a niche?

2. Give an example of resources a squirrel might need.

3. Three different warbler species live in the same tree. One species feeds at the top of the tree, the second species feeds in the middle part of the tree, and the third species feeds at the bottom of the tree. Do all three species occupy the same niche? Explain.

Competition

For Questions 4–8, write True if the statement is true. If the statement is false, change the underlined word or words to make the statement true.

- _____ 4. Competition occurs when organisms attempt to use the same resources.
- _____ 5. Competition between members of the same species is known as interspecific competition.
- _____ 6. The competitive exclusion principle states that no two organisms can occupy exactly the same niche in exactly the same habitat at exactly the same time.
- _____ 7. If two species of bacteria are grown in the same culture, one species will always outcompete the other.
- _____ 8. Members of the same species tend to divide resources instead of competing over them.

Predation, Herbivory, and Keystone Species

Write the letter of the correct answer on the line at the left.

- _____ 9. A lion eating a zebra is an example of
 - A. herbivory.
 - B. habitat destruction.
 - C. predation.
 - D. a keystone species.
- _____ 10. A cow eating grass is an example of
 - A. herbivory.
 - B. predation.
 - C. habitat destruction.
 - D. a keystone species.
- _____ 11. A keystone species is one that
 - A. eats a mixture of plants and animals.
 - B. is introduced into a community after a major disturbance.
 - C. causes the amount of diversity in a community to decrease.
 - D. helps to stabilize the populations of other species in the community.

Symbioses

12. Complete the table about main classes of symbiotic relationships.

Main Classes of Symbiotic Relationships	
Class	Description of Relationships
Mutualism	
Commensalism	
Parasitism	

Match the example with the type of relationship. A relationship type may be used more than once.

Example

Type of Relationship

- _____ 13. a tick living on the body of a deer
- _____ 14. a bee eating a flower's nectar and picking up the flower's pollen
- _____ 15. a barnacle living on a whale's skin
- _____ 16. a tapeworm living in a person's intestines
- _____ 17. an aphid providing food to an ant in exchange for protection

- A. mutualism
- B. commensalism
- C. parasitism

Apply the Big idea

19. How do keystone species illustrate the interdependence of organisms living in a community? Give an example.

4.3 Succession

Primary and Secondary Succession

1. What is ecological succession?

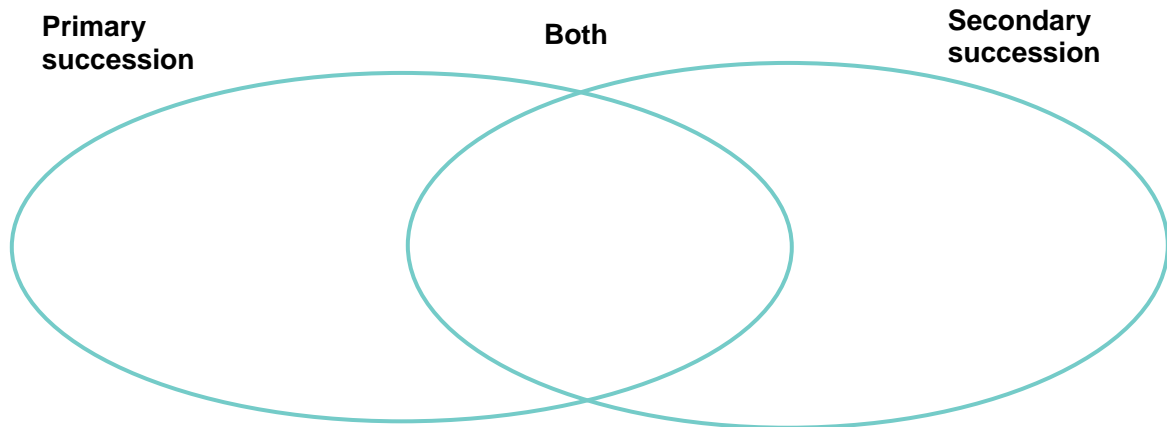
2. What is primary succession?

3. When a disturbance changes a community without removing the soil, what type of succession follows?

4. Describe the process of succession in an ecosystem.

5. Why does secondary succession typically proceed faster than primary succession?

6. Use the Venn diagram to compare the two types of ecological succession.



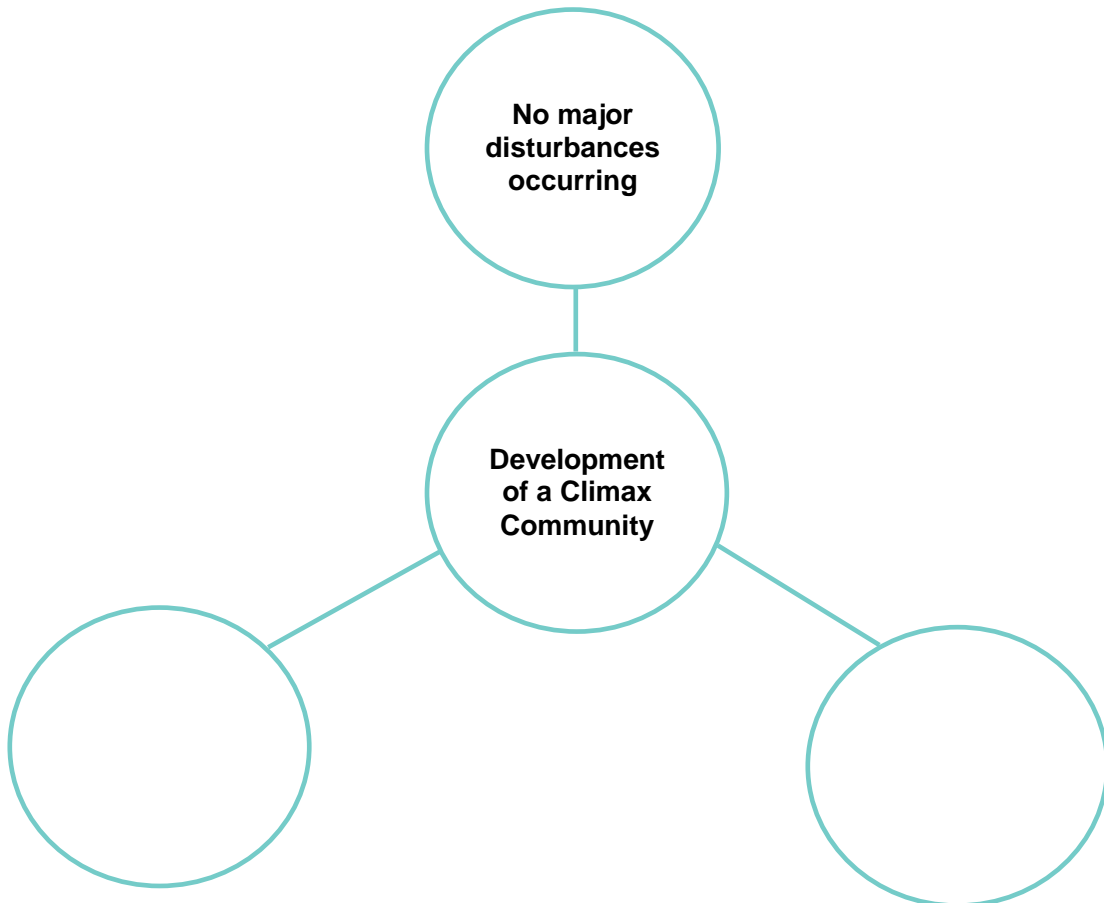
Climax Communities

For Questions 8–10, complete each statement by writing the correct word or words.

8. After a natural disaster occurs in a healthy ecosystem, secondary succession will cause the ecosystem to return to its original _____.
9. The clearing of a rain forest is the example of a(n) _____ drastic enough to prevent the original climax community from reforming.
10. During primary succession, _____ plays a large role in determining which pioneer species arrives in an area first.
11. What are the two kinds of disturbances that change ecosystems? Give an example of each.

Apply the Big idea

12. Many biotic and abiotic factors determine how quickly ecological succession can cause a climax community to develop in an area. Complete the graphic organizer by adding two factors that contribute to the development of a climax community.



4.4 Biomes

The Major Biomes

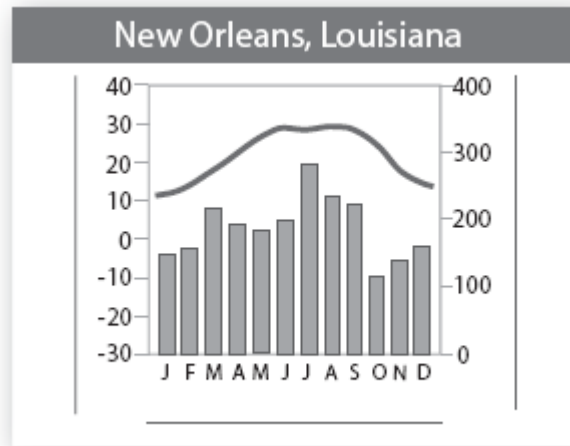
For Questions 1–4, complete each statement by writing the correct word or words.

1. The side of a mountain range that faces the wind often receives more _____ than the downwind side of the same range.
2. A(n) _____ is a group of terrestrial communities that covers a large area and is characterized by certain soil and _____ conditions and particular types of plants and animals.
3. Organisms within each biome can be characterized by _____ that enable them to live and reproduce successfully in the environment.
4. In a tropical rain forest, the layer formed by the leafy tops of tall trees is called the _____ and the layer of shorter trees and vines is called the _____.
5. **THINK VISUALLY** In the box below, draw and label a diagram showing how a coastal mountain range can affect a region's climate.



Name _____ Class _____ Date _____

Use the graph to answer Questions 6–9.



6. Complete the climate diagram by adding labels to the bottom and both sides of the graph to show what the variables are.

7. Describe what a climate diagram summarizes.

8. Explain what the line plot on a climate diagram shows.

9. Explain what the vertical bars on a climate diagram show.

10. Complete the table about some of Earth's major biomes.

Some Major Biomes		
Biome	Climate and Soil	Plants and Animals
	warm year-round with wet and dry seasons; rich soil	plants: tall, deciduous trees; succulents animals: undergo estivation or migration
Tropical rain forest		
	cold, dark winters and short, soggy summers; permafrost	plants: ground-hugging plants animals: birds and mammals that can tolerate the harsh conditions
Temperate grassland		
	low precipitation with variable temperatures	plants: short growth cycles, cacti animals: adaptations to quickly lose body heat and regulate body temperature
Boreal forest		

4.5 Aquatic Ecosystems

Conditions Underwater

1. What are the four main factors that affect aquatic ecosystems?

2. What does the depth of the water determine?

3. What distinguishes the photic zone from the aphotic zone in an aquatic ecosystem?

Freshwater Ecosystems

For Questions 4–10, complete each statement by writing the correct word or words.

4. The three main categories of freshwater ecosystems are _____, _____, and _____.
5. Flowing-water ecosystems originate from underground water sources in _____.
6. Circulating water in lakes and ponds distributes _____, _____, and _____ throughout the system.
7. Plankton is a general term that includes both _____ and _____.
8. An ecosystem in which water either covers the soil or is present at or near the surface of the soil is called a(n) _____.
9. Freshwater wetlands purify water by _____ pollutants.
10. The three types of freshwater wetlands are _____, _____, and _____.

Estuaries

Write the letter of the correct answer on the line at the left.

- _____ 11. Estuaries form where

- A. a lake evaporates.
- B. a river meets the sea.
- C. a river becomes dammed.
- D. a wetland becomes filled in.

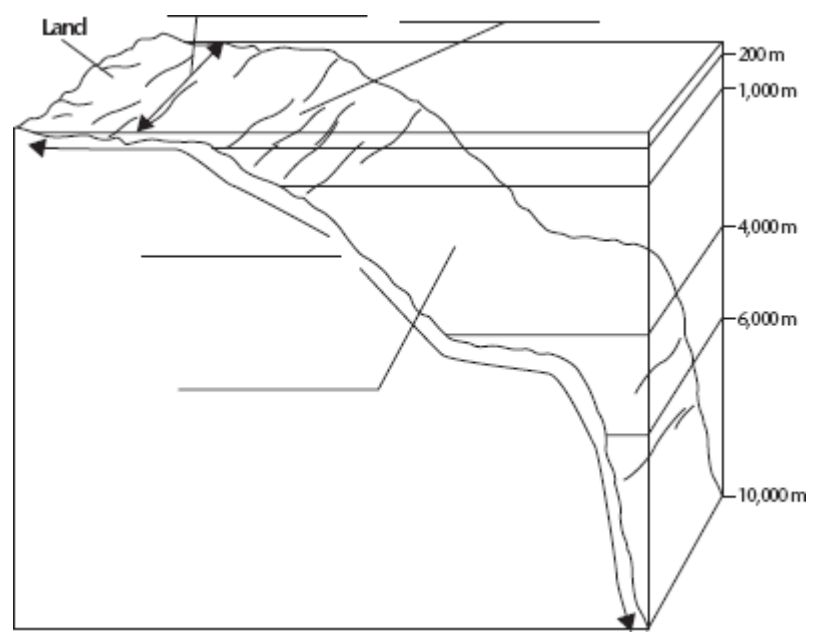
- _____ 12. The salinity of estuary water is

- A. equal to the salinity of river water.
- B. less than the salinity of river water.
- C. less than the salinity of ocean water.
- D. greater than the salinity of ocean water.

- _____ 13. Shallow estuaries allow
- A. freshwater wetlands to merge with the estuary.
 - B. large marine mammals to hibernate in the estuary.
 - C. sunlight to reach the benthos to power photosynthesis.
 - D. salt to sink to the bottom of the estuary.
- _____ 14. Temperate estuaries characterized by salt-tolerant grasses above the low-tide line and seagrasses below water are called
- A. bogs.
 - B. salt marshes.
 - C. mangrove swamps.
 - D. freshwater wetlands.

Marine Ecosystems

15. Complete the diagram by adding labels for each marine zone. Then shade in the aphotic zone.



16. Complete the table about the type of organisms living in each ocean zone.

Marine Life by Ocean Zone	
Zone	Life Forms
	kelp forests, coral reefs
	barnacles, seaweed, starfish
	large marine mammals such as whales, chemosynthetic bacteria

Apply the Big idea

17. Which type of marine ecosystem do you think supports the least life? Explain your answer.

5.1 How Populations Grow

Describing Populations

For Questions 1–5 complete each statement by writing the correct word or words.

1. The _____ is the area in which a population lives.
2. Population density is the _____ of individuals per unit area.
3. How the individuals are spaced in their range is a population's _____.
4. Growth rate is how quickly a population _____ in size.
5. To find the _____ of a population, count the number of males and females of each age.

Population Growth

For Questions 6–10, write True if the statement is true. If the statement is false, change the underlined word or words to make the statement true

- _____ 6. If the death rate is less than the birthrate, the population is likely to shrink.
- _____ 7. Immigration increases population size.
- _____ 8. Young animals may immigrate from the place where they were born to establish new territories.
- _____ 9. A high birthrate and immigration decrease population size.
- _____ 10. Populations grow if more individuals are born than die in a period of time.

11. **THINK VISUALLY** The dots in the box represent individuals in a population with a random pattern of distribution. Use arrows and dots to show what will happen to this population if emigration is greater than immigration. (Assume birthrate and death rate are equal.) On the lines below, explain your drawing.



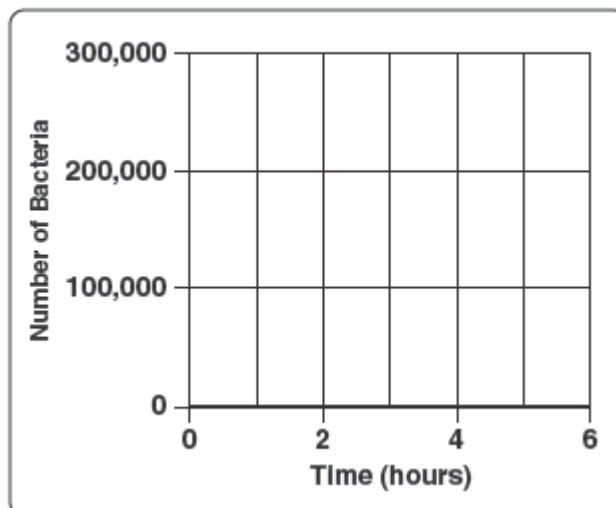
Exponential Growth

12. Describe the conditions in which exponential growth occurs.

13. Can exponential growth occur in a population of organisms that take a long time to reproduce? Why or why not?

14. Complete the graph by drawing the characteristic shape of exponential population growth.

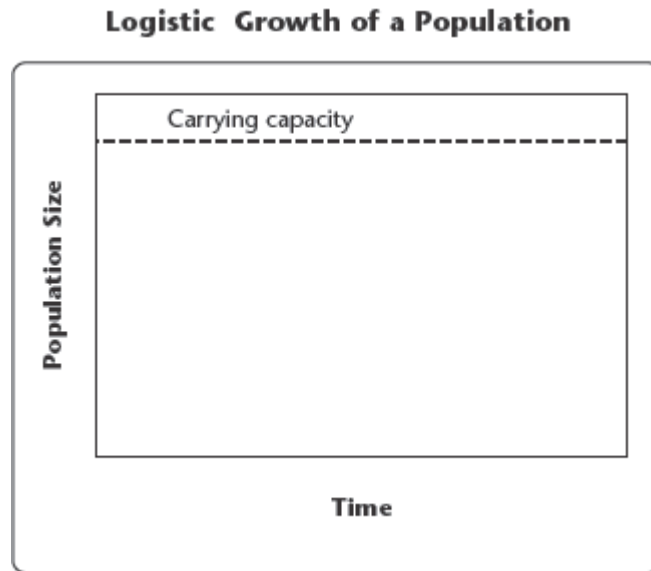
Exponential Growth of Bacterial Population



15. What letter is used to refer to the characteristic shape of an exponential growth curve?

Logistic Growth

16. Complete the graph by drawing the characteristic shape of logistic population growth.



17. What letter is used to refer to the characteristic shape of the logistic growth curve?

18. When real-world populations of plants and animals are analyzed, why do they most often have the logistic growth curve?

19. What does the term carrying capacity refer to?

Name _____ Class _____ Date _____

20. Complete the table to name and explain three phases of logistic growth. Use the terms *growth rate*, *population size*, and *carrying capacity* in your explanations.

Phases of Logistic Growth		
Phase	Phase name	Explanation
1		
2		
3		

Apply the Big idea

21. What is an example of a limiting factor that humans use to control the carrying capacity of an environment for a particular type of organism? Explain your answer.

5.2 Limits to Growth

Limiting Factors

For Questions 1–6, write True if the statement is true. If the statement is false, change the underlined word to make the statement true

- _____ 1. Limiting factors determine the immigration capacity of a population.
- _____ 2. A limiting factor controls the growth of a population.
- _____ 3. Limiting factors operate when growth is exponential.
- _____ 4. Populations grow too large in the absence of limiting factors.
- _____ 5. Competition is an example of a limiting factor.
- _____ 6. Population size can be limited by factors such as predation.

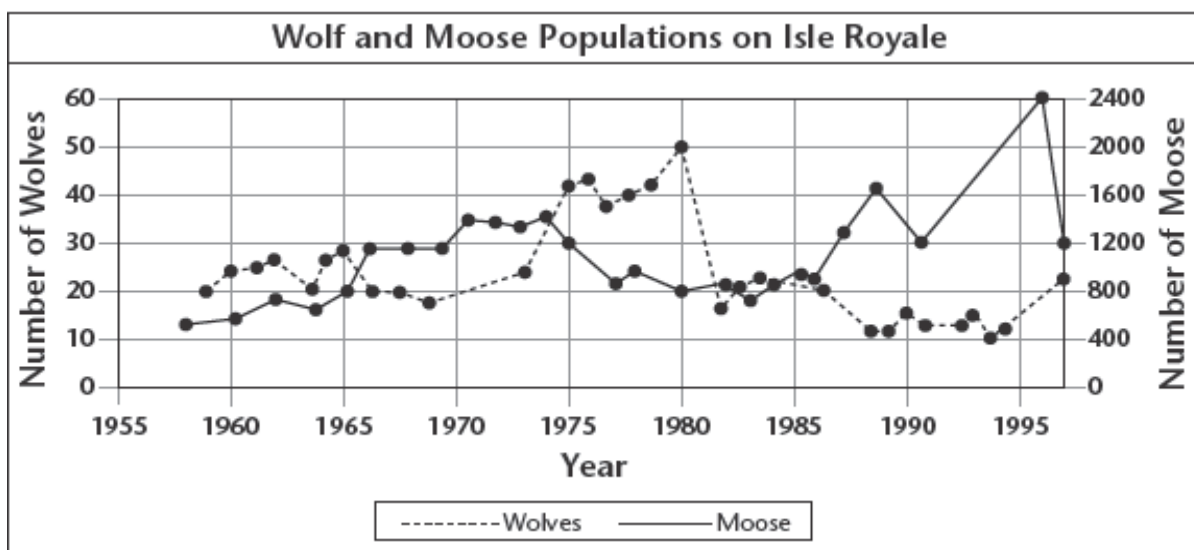
Density-Dependent Limiting Factors

7. What is a density-dependent limiting factor?

8. When do density-dependent factors operate most strongly?

9. What are four density-dependent limiting factors?

Use the graph to answer Questions 10–13.



10. What happened to the number of wolves on Isle Royale between 1975 and 1985?

11. What happened to the moose population when the number of wolves was low?

Name _____ Class _____ Date _____

12. What is the relationship between the moose and the wolves on Isle Royale?

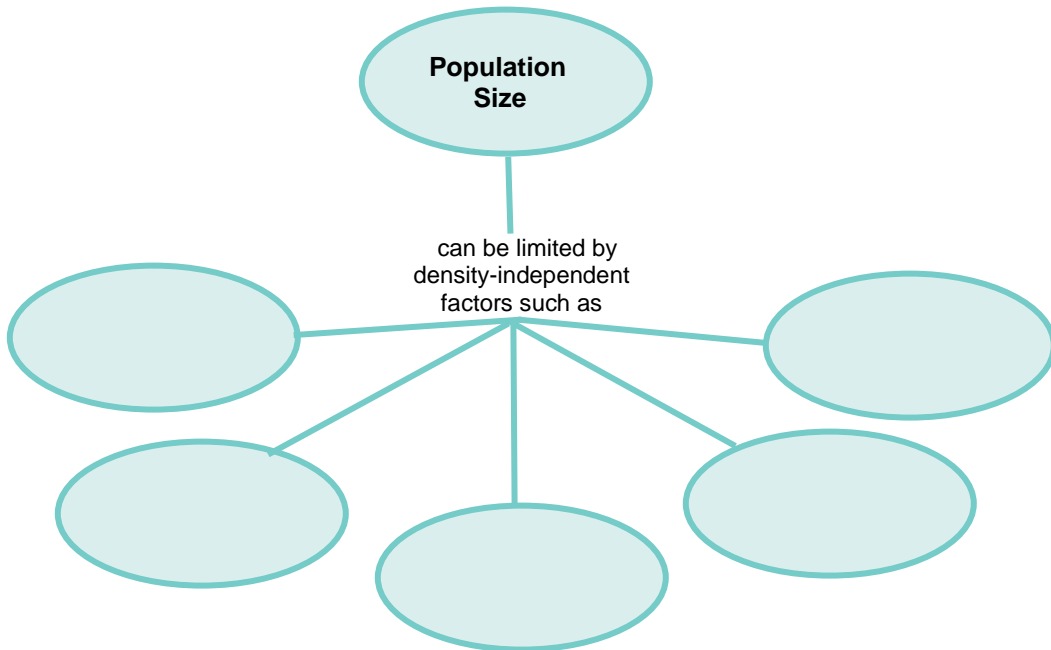
13. Is the number of moose on the island a density-dependent or density-independent limiting factor for the wolf? Explain your answer.

Density-Independent Limiting Factors

14. What term describes a limiting factor that affects all populations in similar ways, regardless of population size?

15. What is the usual response in the population size of many species to a density-independent limiting factor?

16. Complete the graphic organizer with examples of density-independent limiting factors.



Apply the Big idea

17. A population continues at a stable size for many years. Suddenly, in a single season, the population size drops by half. Is the cause more likely to be density-dependent, density-independent, or both? Explain your answer.

5.3 Human Population Growth

Historical Overview

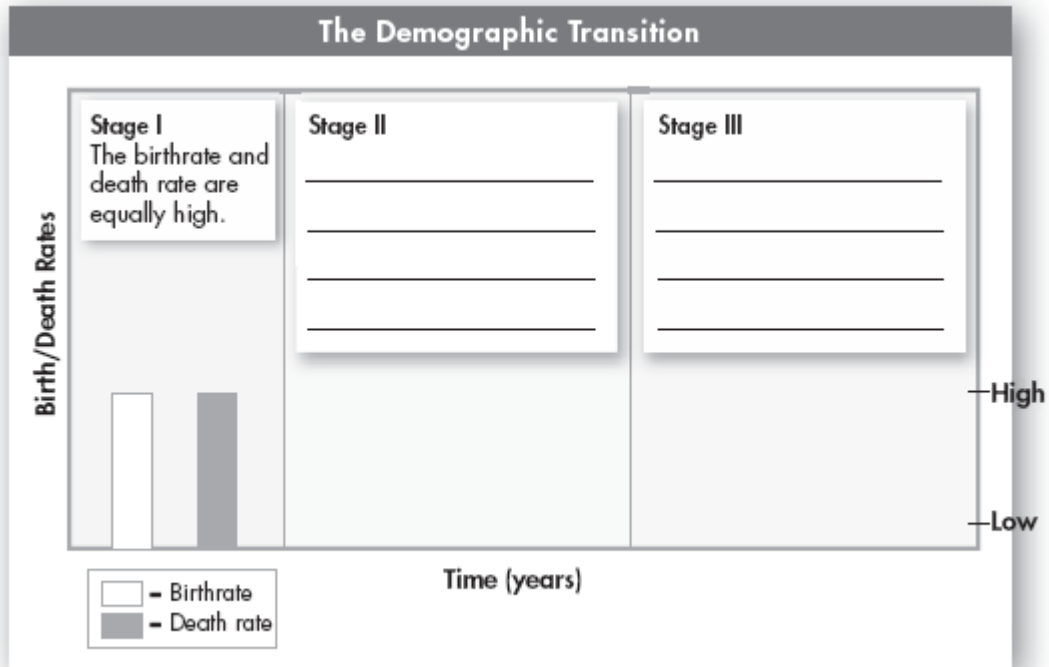
For Questions 1–5, write *True* if the statement is true. If the statement is false, change the underlined word or words to make the statement true.

- _____ 1. Over the last 1000 years, the size of the human population has decreased.
- _____ 2. Since the 1800s, human population growth has been logistic.
- _____ 3. The human population has increased because birthrates have dropped.
- _____ 4. The combination of low death rates and high birthrates led to exponential growth.
- _____ 5. Charles Darwin suggested that human populations are regulated by war, famine, and disease.
6. Complete the table below to explain how each factor affected the size and growth rate of the human population over the last 10,000 years.

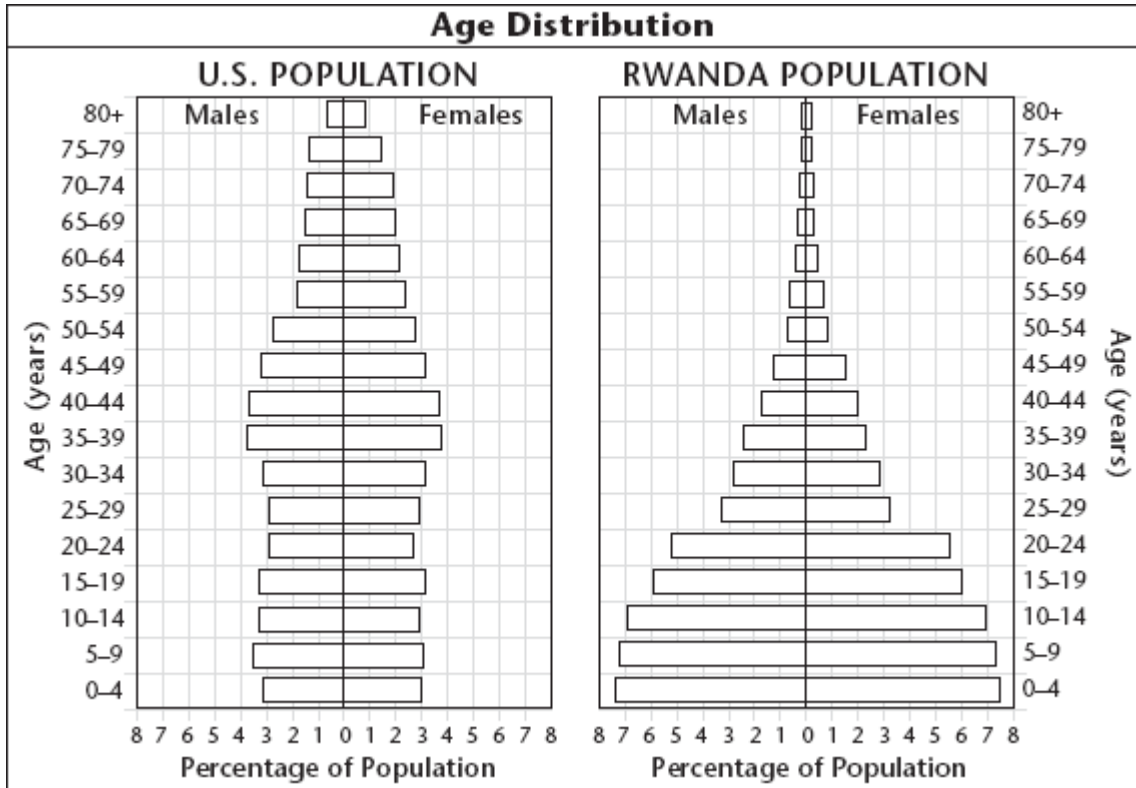
Factors That Affected Human Population Growth	
Cause	Effect
Agriculture	
Improved health care and medicine	
Improved sanitation	
Bubonic plague	
Industrial Revolution	

Patterns of Human Population Growth

7. **THINK VISUALLY** Complete the diagram below by adding the information for stages II and III of the demographic transition. Draw bars to represent the birthrate and the death rate and describe the stages on the lines provided. Stage I is done for you.



Use these age structure diagrams to answer Questions 8–11.



8. Which country has gone through the demographic transition? How do you know?

9. Which country do you predict will experience a slow and steady growth rate in the near future? Why?

10. Which country is most likely to grow exponentially in the near future? Why?

11. Suggest three factors that might slow population growth in Rwanda.

Apply the Big idea

12. Explain why human population size is likely to increase in the twenty-first century, but not as rapidly as it did in the twentieth century.
