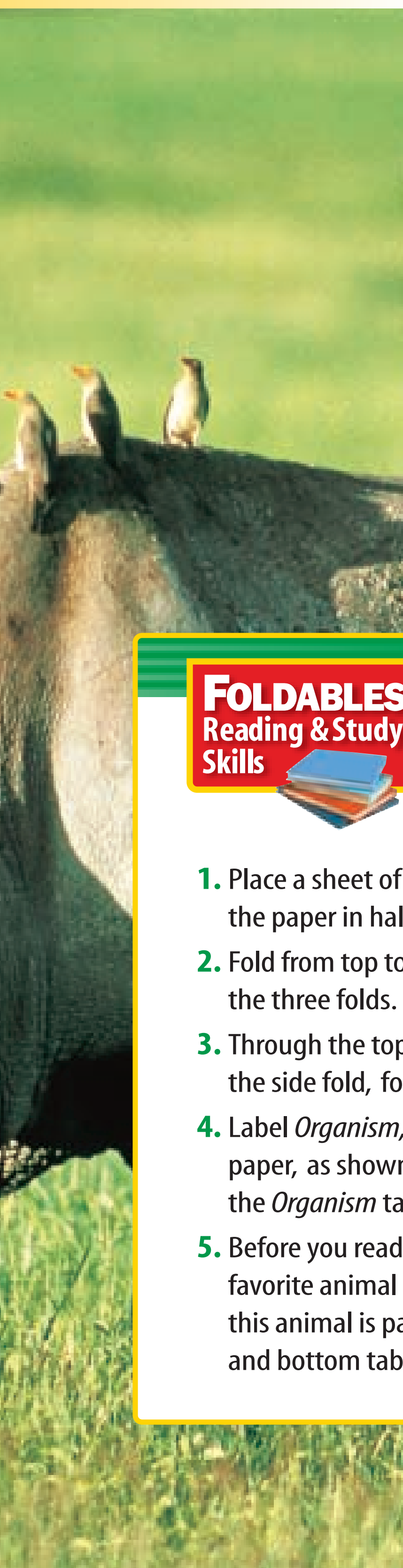
CHAPTER 24

Interactions of Life

Why would a powerful rhinoceros allow birds to perch on its back? Why aren't these birds safely perched in a tree? How do they find food? You don't have to go to Africa to see birds on the back of a rhino. You can see these animals at zoos or wildlife parks, like the one near New Braunfels, Texas. In this chapter, you will learn how living organisms interact with each other and their surroundings. You also will learn about the roles each organism plays in the flow of energy through the environment.

What do you think?

Science Journal Look at the picture below with a classmate. Discuss what you think this might be or what is happening. Here's a hint: *It's a city within a city.* Write your answer or best guess in your Science Journal.



Explore Activity

In your lifetime, you probably have taken thousands of footsteps on grassy lawns or playing fields. If you take a close look at the grass, you'll see that each blade is attached to roots in the soil. How do the grass plants obtain everything they need to live and grow? What other kinds of organisms live in the grass? The following activity will give you a chance to take a closer look at the life in a lawn.

Examine sod from a lawn

1. Examine a section of sod from a lawn.
2. How do the roots of the grass plants hold the soil?
3. Do you see signs of other living things besides grass?

Observe

In your Science Journal, answer the above questions and describe any organisms that are present in your section of sod. Explain how these organisms might affect the growth of grass plants. Draw a picture of your section of sod.

Before You Read

Foldables Reading & Study Skills

Making a Concept Map Study Fold **The following Foldable will help you organize information by diagramming ideas about your favorite wild animal.**

1. Place a sheet of paper in front of you with the short side at the top. Fold the paper in half from the left side to the right side.
2. Fold from top to bottom to divide the paper into thirds, then open up the three folds.
3. Through the top thickness of paper, cut along each of the fold lines to the side fold, forming three tabs.
4. Label *Organism*, *Population*, and *Community* across the front of the paper, as shown. Write the name of your favorite wild animal under the *Organism* tab.
5. Before you read the chapter, write what you know about your favorite animal under the top tab. As you read the chapter, write how this animal is part of a population and a community under the middle and bottom tabs.

SECTION 1

Living Earth

As You Read

What You'll Learn

- **Identify** places where life is found on Earth.
- **Define** ecology.
- **Observe** how the environment influences life.

Vocabulary

biosphere
ecosystem
ecology
population
community
habitat

Why It's Important

All living things on Earth depend on each other for survival.

The Biosphere

What makes Earth different from other planets in the solar system? One difference is Earth's abundance of living organisms. The part of Earth that supports life is the **biosphere** (BI uh sfihr). The biosphere includes the top portion of Earth's crust, all the waters that cover Earth's surface, and the atmosphere that surrounds Earth.

Reading Check *What three things make up the biosphere?*

As **Figure 1** shows, the biosphere is made up of different environments that are home to different kinds of organisms. For example, desert environments receive little rain. Cactus plants, coyotes, and lizards are included in the life of the desert. Tropical rain forest environments receive plenty of rain and warm weather. Parrots, monkeys, and tens of thousands of other organisms live in the rain forest. Coral reefs form in warm, shallow ocean waters. Arctic regions near the north pole are covered with ice and snow. Polar bears, seals, and walruses live in the arctic.

Figure 1
Earth's biosphere consists of many environments, including ocean waters, polar regions, and deserts.

Desert

Arctic

Coral reef

Astronomy INTEGRATION

Life on Earth In our solar system, Earth is the third planet from the Sun. The amount of energy that reaches Earth from the Sun helps make the temperature just right for life. Mercury, the planet closest to the Sun, is too hot during the day and too cold at night to make life possible there. Venus, the second planet from the Sun, has a thick, carbon dioxide atmosphere and high temperatures. It is unlikely that life could survive there. Mars, the fourth planet, is much colder than Earth because it is farther from the Sun and has a thinner atmosphere. It might support microscopic life, but none has been found. The planets beyond Mars probably do not receive enough heat and light from the Sun to have the right conditions for life.

Ecosystems

On a visit to Yellowstone National Park in Wyoming, you might see a prairie scene like the one shown in **Figure 2.** Bison graze on prairie grass. Cowbirds follow the bison, catching grasshoppers that jump away from the bisons' hooves. This scene is part of an ecosystem. An **ecosystem** consists of all the organisms living in an area and the nonliving features of their environment. Bison, grass, birds, and insects are living organisms of this prairie ecosystem. Water, temperature, sunlight, soil, and air are nonliving features of this prairie ecosystem. **Ecology** is the study of interactions that occur among organisms and their environment. Ecologists are scientists who study these interactions.

Reading Check *What is an ecosystem?*

Figure 2
Ecosystems are made up of living organisms and the nonliving features of their environment. In this prairie ecosystem, cowbirds eat insects and bison graze on grass. *What other kinds of organisms might live in this ecosystem?*

Research Visit the Glencoe Science Web site at **science.glencoe.com** and find out the estimated human population size for the world today. In your Science Journal, create a graph that shows the population change between the year 2000 and this year.

Populations

Suppose you meet an ecologist who studies how a herd of bison moves from place to place and how the female bison in the herd care for their young. This ecologist is studying the members of a population. A **population** is made up of all the organisms in an ecosystem that belong to the same species. For example, all the bison in a prairie ecosystem are one population. All the cowbirds in this ecosystem make up a different population. The grasshoppers make up yet another population.

Ecologists often study how populations interact. For example, an ecologist might try to answer questions about several prairie species. How does grazing by bison affect the growth of prairie grass? How does grazing influence the insects that live in the grass and the birds that eat those insects? This ecologist is studying a community. A **community** refers to all the populations in an ecosystem. The prairie community is made of populations of bison, grasshoppers, cowbirds, and all other species in the prairie ecosystem. An arctic community might include populations of fish, seals that eat fish, and polar bears that hunt and eat seals. **Figure 3** shows how organisms, populations, communities, and ecosystems are related.

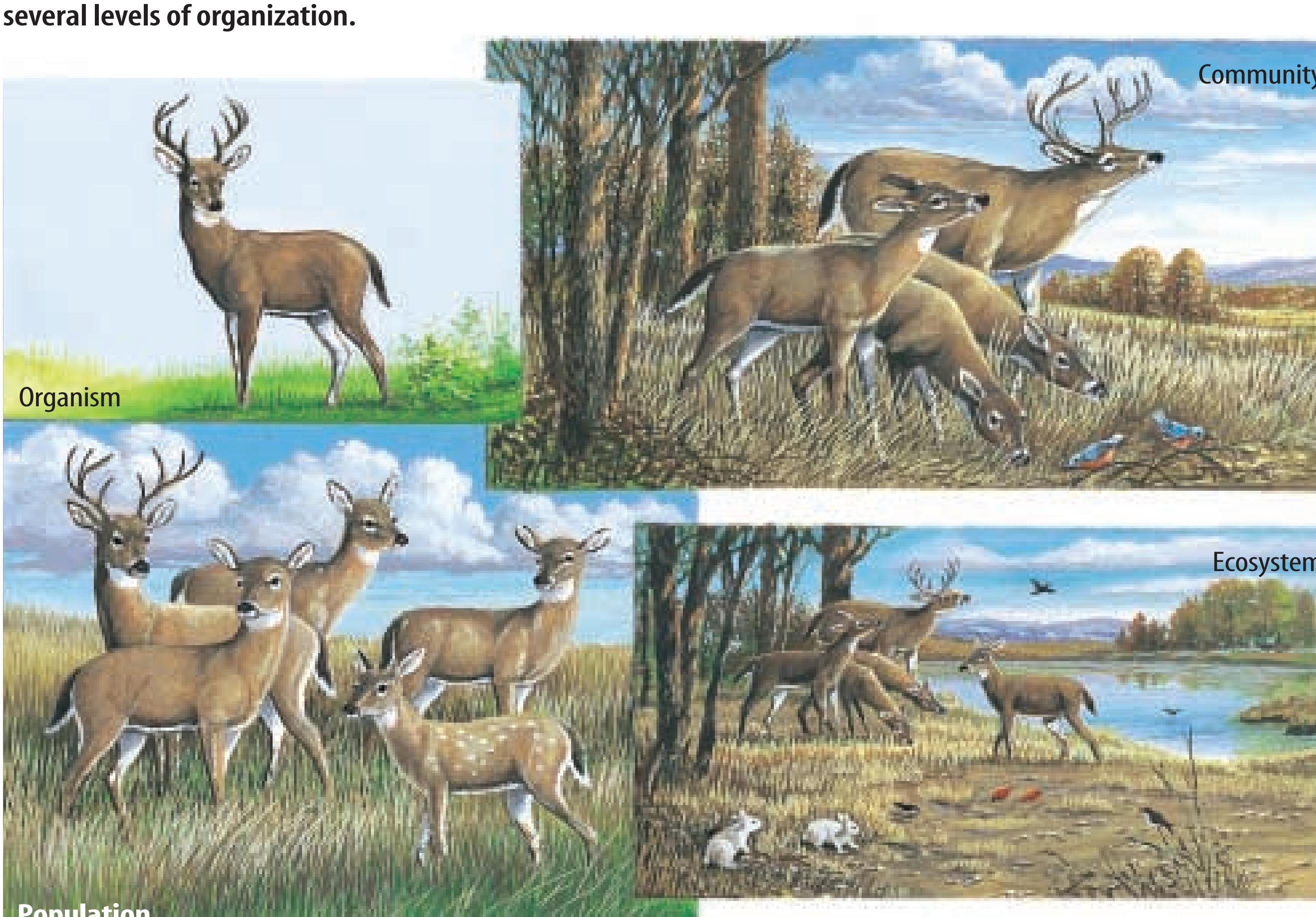


Figure 3
The living world is arranged in several levels of organization.

CONTENTS

Figure 4
The trees of the forest provide a habitat for woodpeckers and other birds. This salamander's habitat is the moist forest floor.

Habitats

Each organism in an ecosystem needs a place to live. The place in which an organism lives is called its **habitat.** The animals shown in **Figure 4** live in a forest ecosystem. Trees are the woodpecker's habitat. These birds use their strong beaks to pry insects from tree bark or break open acorns and nuts. Woodpeckers usually nest in holes in dead trees. The salamander's habitat is the forest floor, beneath fallen leaves and twigs. Salamanders avoid sunlight and seek damp, dark places. This animal eats small worms, insects, and slugs. An organism's habitat provides the kinds of food and shelter, the temperature, and the amount of moisture the organism needs to survive.

Section 1 Assessment

1. What is the biosphere?
2. What is ecology?
3. How are the terms *habitat* and *biosphere* related to each other?
4. What is the major difference between a community and a population? Give one example of each.
5. **Think Critically** Does the amount of rain that falls in an area determine which kinds of organisms can live there? Why or why not?

Skill Builder Activities

6. **Forming Hypotheses** Make a hypothesis about how one nonliving feature of an ecosystem would affect the growth of dandelions in that ecosystem. **For more help, refer to the Science Skill Handbook.**
7. **Communicating** Pretend you are a nonhuman organism in the wild. Describe what you are and list living and nonliving features of the environment that affect you. **For more help, refer to the Science Skill Handbook.**

SECTION

2 Populations

As You Read

What You'll Learn

- **Identify** methods for estimating population sizes.
- **Explain** how competition limits population growth.
- **List** factors that influence changes in population size.

Vocabulary

limiting factor
carrying capacity

Why It's Important

Competition caused by population growth affects many organisms, including humans.

Competition

Some pet shops sell lizards, snakes, and other reptiles. Crickets are raised as a food supply for pet reptiles. In the wild, crickets come out at night and feed on plant material. During the day, they hide in dark areas, beneath leaves or under buildings. Pet shop workers who raise crickets make sure that the insects have plenty of food, water, and hiding places. As the cricket population grows, the workers increase the crickets' food supply and the number of hiding places. To avoid crowding, some of the crickets could be moved into larger containers.

Food and Space Organisms living in the wild do not always have enough food or living space. The Gila woodpecker, shown in **Figure 5,** lives in the Sonoran Desert of Arizona and Mexico. This bird makes its nest in a hole that it drills in a saguaro (suh GWAR oh) cactus. If an area has too many Gila woodpeckers or too few saguaros, the woodpeckers must compete with each other for nesting spots. Competition occurs when two or more organisms seek the same resource at the same time.

Growth Limits Competition limits population size. If the amount of available nesting space is limited, some woodpeckers will not be able to raise young. Gila woodpeckers eat cactus fruit, berries, and insects. If food becomes scarce, some woodpeckers might not survive to reproduce. Competition for food, living space, or other resources can prevent population growth.

In nature, the most intense competition is usually among individuals of the same species, because they need the same kinds of food and shelter. Competition also takes place among individuals of different species. For example, after a Gila woodpecker has abandoned its nesting hole, owls, flycatchers, snakes, and lizards compete for the shelter of the empty hole.

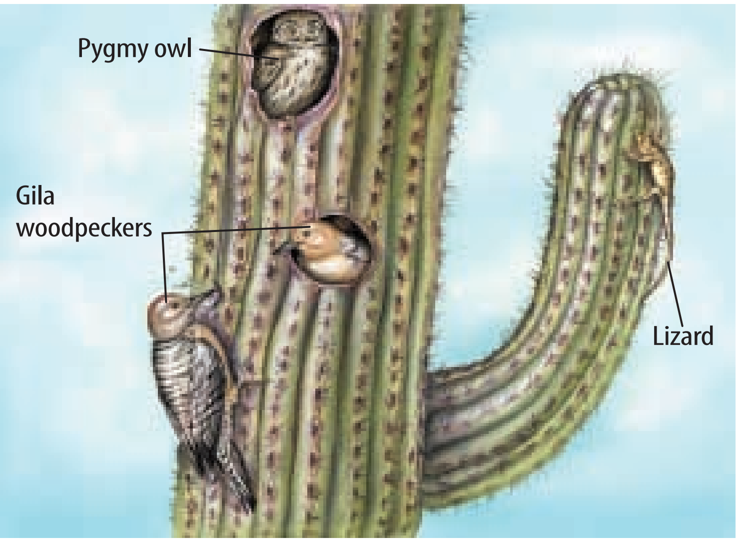


Figure 5
Gila woodpeckers make nesting holes in the saguaro cactus. Many animals compete for the shelter these holes provide.

Population Size

Ecologists often need to measure the size of a population. This information can indicate whether or not a population is healthy and growing. Population counts can help identify populations that could be in danger of disappearing.

Some populations are easy to measure. If you were raising crickets, you could measure the size of your cricket population simply by counting all the crickets in the container. What if you wanted to compare the cricket populations in two different containers? You would calculate the number of crickets per square meter (m^2) of your container. The size of a population that occupies a specific area is called population density. **Figure 6** shows human population density in different places in the world.

Reading Check *What is population density?*

Measuring Populations Counting crickets can be tricky. They look alike, move a lot, and hide. The same cricket could be counted more than once, and others could be completely missed. Ecologists have similar problems when measuring wildlife populations. One of the methods they use is called trap-mark-release. Suppose you want to count wild rabbits. Rabbits live underground and come out at dawn and dusk to eat. Ecologists set traps that capture rabbits without injuring them. Each captured rabbit is marked and released. Later, another sample of rabbits is captured. Some of these rabbits will have marks, but many will not. By comparing the number of marked and unmarked rabbits in the second sample, ecologists can estimate the population size.

TRY AT HOME Mini LAB

Observing Seedling Competition

Procedure

1. Fill **two plant pots** with **moist potting soil.**
2. Plant **radish seeds** in one pot, following the spacing instructions on the seed packet. Label this pot "Recommended Spacing."
3. Plant radish seeds in the second pot, spaced half the recommended distance apart. Label this pot "Densely Populated." Wash your hands.
4. Keep the soil moist. When the seeds sprout, move them to a well-lit area.
5. Measure the height of the seedlings every two days for two weeks. Record the data in your **Science Journal.**

Analysis

1. Which plants grew faster?
2. Which plants looked healthiest after two weeks?
3. How did competition influence the plants?

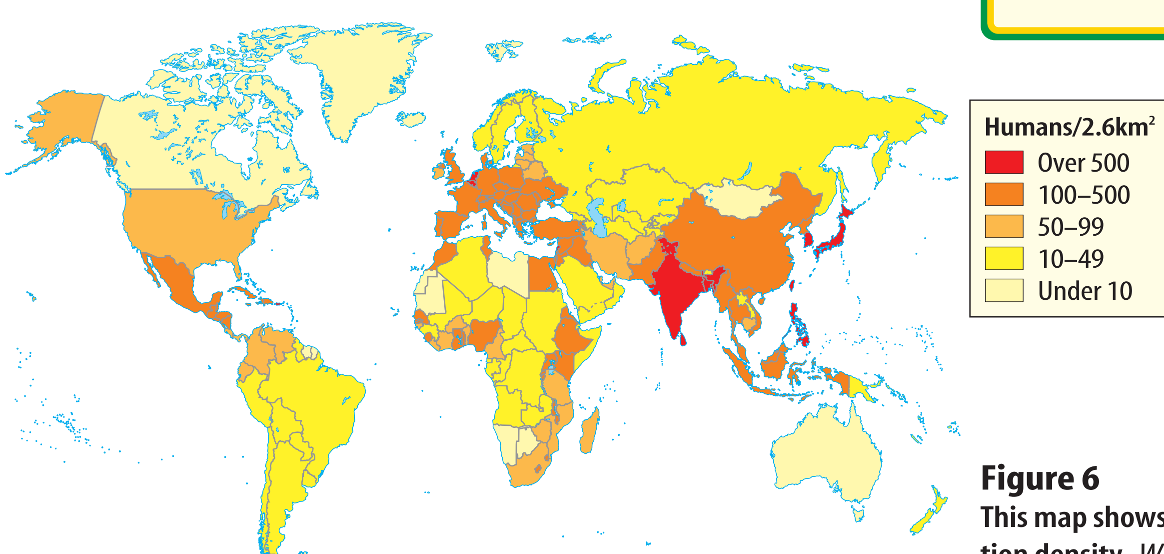


Figure 6
This map shows human population density. *Which countries have the highest population density?*

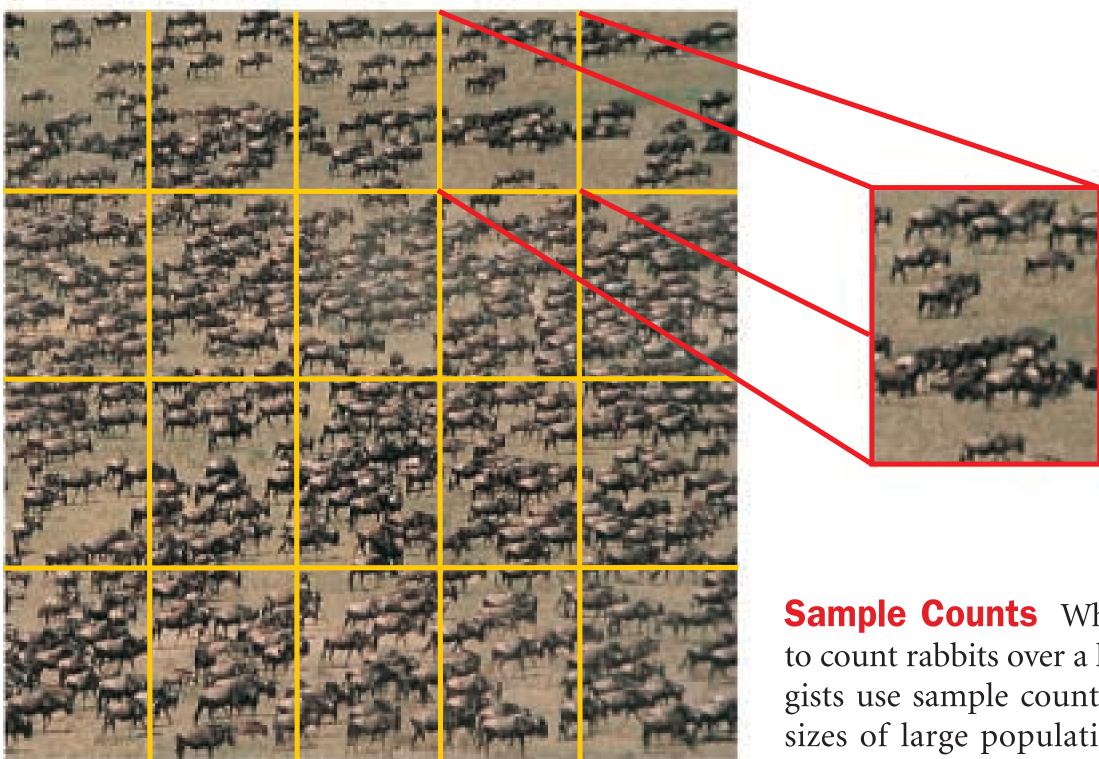


Figure 7
Ecologists can estimate population size by making a sample count. Wildebeests graze on the grassy plains of Africa. *How could you use the enlarged square to estimate the number of wildebeests in the entire photograph?*

Sample Counts

What if you wanted to count rabbits over a large area? Ecologists use sample counts to estimate the sizes of large populations. To estimate the number of rabbits in a 100-acre area, for example, you could count the rabbits in one acre and multiply by 100 to estimate the population size. **Figure 7** shows another approach to sample counting.

Limiting Factors

One grass plant can produce hundreds of seeds. Imagine those seeds drifting onto a vacant field. Many of the seeds sprout and grow into grass plants that produce hundreds more seeds. Soon the field is covered with grass. Can this grass population keep growing forever? Suppose the seeds of wildflowers or trees drift onto the field. If those seeds sprout, trees and flowers would compete with grasses for sunlight, soil, and water. Even if the grasses did not have to compete with other plants, they might eventually use up all the space in the field. When no more living space is available, the population cannot grow.

In any ecosystem, the availability of food, water, living space, mates, nesting sites, and other resources is often limited. A **limiting factor** is anything that restricts the number of individuals in a population. Limiting factors include living and nonliving features of the ecosystem.

A limiting factor can affect more than one population in a community. Suppose a lack of rain limits plant growth in a meadow. Fewer plants produce fewer seeds. For seed-eating mice, this reduction in the food supply could become a limiting factor. A smaller mouse population could, in turn, become a limiting factor for the hawks and owls that feed on mice.

Carrying Capacity A population of robins lives in a grove of trees in a park. Over several years, the number of robins increases and nesting space becomes scarce. Nesting space is a limiting factor that prevents the robin population from getting any larger. This ecosystem has reached its carrying capacity for robins. **Carrying capacity** is the largest number of individuals of one species that an ecosystem can support over time. If a population begins to exceed the environment's carrying capacity, some individuals will not have enough resources. They could die or be forced to move elsewhere, like the deer shown in **Figure 8.**

Figure 8
These deer might have moved into a residential area because a nearby forest's carrying capacity for deer has been reached.

Reading Check *How are limiting factors related to carrying capacity?*

Problem-Solving Activity

Do you have too many crickets?

You've decided to raise crickets to sell to pet stores. A friend says you should not allow the cricket population density to go over 210 crickets/m^2. Use what you've learned in this section to measure the population density in your cricket tanks.

Identifying the Problem

The table on the right lists the areas and populations of your three cricket tanks. How can you determine if too many crickets are in one tank? If a tank contains too many crickets, what could you do? Explain why too many crickets in a tank might be a problem.

Cricket Population

Tank	Area (m^2)	Number of Crickets
1	0.80	200
2	0.80	150
3	1.5	315

Solving the Problem

1. Do any of the tanks contain too many crickets? Could you make the population density of the three tanks equal by moving crickets from one tank to another? If so, which tank would you move crickets into?

2. The population density of wild crickets living in a field is 2.4 crickets/m^2. If the field has an area of 250 m^2, what is the approximate size of the cricket population? Why would the population density of crickets in a field be lower than the population density of crickets in a tank?

SCIENCE Online

Data Update For an online update of recent data on human birthrates and death rates around the world, visit the Glencoe Science Web site at **science. glencoe.com** and select the appropriate chapter.

CLICK HERE

Biotic Potential What would happen if no limiting factors restricted the growth of a population? Think about a population that has an unlimited supply of food, water, and living space. The climate is favorable. Population growth is not limited by diseases, predators, or competition with other species. Under ideal conditions like these, the population would continue to grow.

The highest rate of reproduction under ideal conditions is a population's biotic potential. The larger the number of offspring that are produced by parent organisms, the higher the biotic potential of the species will be. Compare an avocado tree to a tangerine tree. Assume that each tree produces the same number of fruits. Each avocado fruit contains one large seed. Each tangerine fruit contains a dozen seeds or more. Because the tangerine tree produces more seeds per fruit, it has a higher biotic potential than the avocado tree.

Changes in Populations

Birthrates and death rates also influence the size of a population and its rate of growth. A population gets larger when the number of individuals born is greater than the number of individuals that die. When the number of deaths is greater than the number of births, populations get smaller. Take the squirrels living in New York City's Central Park as an example. In one year, if 900 squirrels are born and 800 die, the population increases by 100. If 400 squirrels are born and 500 die, the population decreases by 100.

The same is true for human populations. **Table 1** shows birthrates, death rates, and population changes for several countries around the world. In countries with faster population growth, birthrates are much higher than death rates. In countries with slower population growth, birthrates are only slightly higher than death rates. In Germany, where the population is getting smaller, the birthrate is lower than the death rate.

Table 1 Population Growth

	Birthrate*	Death Rate*	Population Increase (percent)
Rapid-Growth Countries			
Jordan	38.8	5.5	3.3
Uganda	50.8	21.8	2.9
Zimbabwe	34.3	9.4	5.2
Slow-Growth Countries			
Germany	9.4	10.8	–1.5
Sweden	10.8	10.6	0.1
United States	14.8	8.8	0.6

*Number per 1,000 people

Figure 9
The mangrove seeds sprout while they are still attached to the parent tree. Some sprouted seeds drop into the mud below the parent tree and continue to grow. Others drop into the water and can be carried away by tides and ocean currents. When they wash ashore, they might start a new population of mangroves or add to an existing mangrove population.

Moving Around Most animals can move easily from place to place, and these movements can affect population size. For example, a male mountain sheep might wander many miles in search of a mate. After he finds a mate, their offspring might establish a completely new population of mountain sheep far from the male's original population.

Many bird species move from one place to another during their annual migrations. During the summer, populations of Baltimore orioles are found throughout eastern North America. During the winter, these populations disappear because the birds migrate to Central America. They spend the winter there, where the climate is mild and food supplies are plentiful. When summer approaches, the orioles migrate back to North America.

Even plants and microscopic organisms can move from place to place, carried by wind, water, or animals. The tiny spores of mushrooms, mosses, and ferns float through the air. The seeds of dandelions, maple trees, and other plants have feathery or winglike growths that allow them to be carried by wind. Spine-covered seeds hitch rides by clinging to animal fur or people's clothing. Many kinds of seeds can be transported by river and ocean currents. Mangrove trees growing along Florida's Gulf Coast, shown in **Figure 9,** provide an example of how water moves seeds.

Mini LAB

Comparing Biotic Potential

Procedure

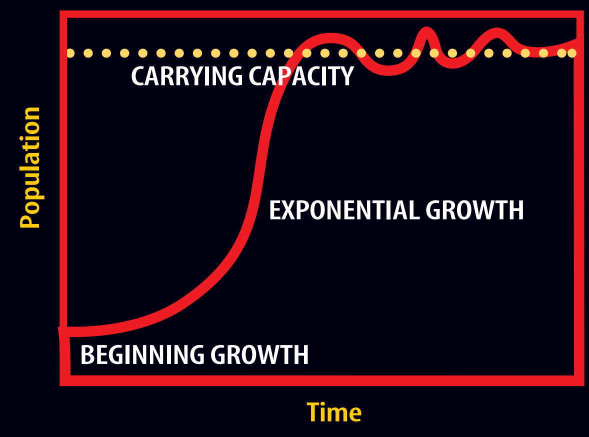
1. Remove all the seeds from a **whole fruit.** Do not put fruit or seeds in your mouth.
2. Count the total number of seeds in the fruit. Wash your hands, then record these data in your Science Journal.
3. Compare your seed totals with those of classmates who examined other types of fruit.

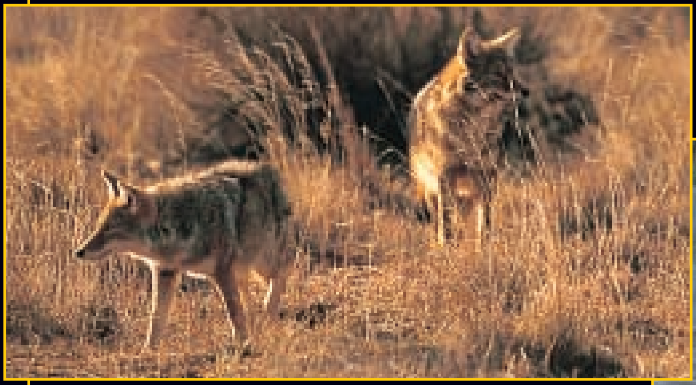
Analysis

1. Which type of fruit had the most seeds? Which had the fewest seeds?
2. What is an advantage of producing many seeds? Can you think of a possible disadvantage?
3. To estimate the total number of seeds produced by a tomato plant, what would you need to know?

Figure 10

When a species enters an ecosystem that has abundant food, water, and other resources, its population can flourish. Beginning with a few organisms, the population increases until the number of organisms and available resources are in balance. At that point, population growth slows or stops. A graph of these changes over time produces an S-curve, as shown here for coyotes.





BEGINNING GROWTH During the first few years, population growth is slow, because there are few adults to produce young. As the population grows, so does the number of breeding adults.

EXPONENTIAL GROWTH As the number of adults in the population grows, so does the number of births. The coyote population undergoes exponential growth, quickly increasing in size.

CARRYING CAPACITY As resources become less plentiful, the birthrate declines and the death rate may rise. Population growth slows. The coyote population has reached the environmental carrying capacity—the maximum number of coyotes that the environment can sustain.

Exponential Growth Imagine what might happen if a pair of coyotes moves into a valley where no other coyotes live. Food and water are abundant, and there are plenty of areas where female coyotes can build dens for their young. This population grows quickly in a pattern called exponential growth. Exponential growth means that the larger a population becomes, the faster it grows.

After several years, the population becomes so large that the coyotes begin to compete for food and den sites. Population growth slows, and the number of coyotes remains fairly constant and reaches equilibrium. This ecosystem has reached its carrying capacity for coyotes. A graph that describes each stage in this pattern of population growth is shown in **Figure 10.** As you can see in **Figure 11,** Earth's human population shows exponential growth. In the year 2000, Earth's human population exceeded 6 billion. By the year 2050, it is estimated that Earth's human population could reach 10 billion.

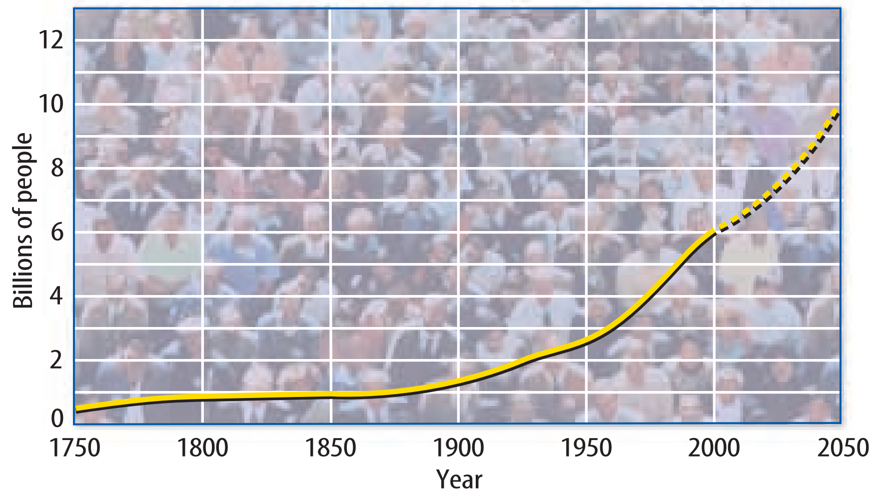


Figure 11
The size of the human population is increasing by about 1.6 percent per year. *What factors affect human population growth?*

Section 2 Assessment

1. How can an ecologist predict the size of a population without counting every organism in the population?
2. Why does competition between individuals of the same species tend to be greater than competition between individuals of different species?
3. How do birthrates and death rates influence the size of a population?
4. How does carrying capacity influence the number of organisms in an ecosystem?
5. **Think Critically** Why does the supply of food and water in an ecosystem usually affect population size more than other limiting factors?

Skill Builder Activities

6. **Making and Using Tables** Construct a table using the following data on changes in the size of a deer population in Arizona. In 1910 there were 6 deer; in 1915, 36 deer; in 1920, 143 deer; in 1925, 86 deer; and in 1935, 26 deer. Propose a hypothesis to explain what might have caused these changes. **For more help, refer to the Science Skill Handbook.**
7. **Solving One-Step Equations** A vacant lot that measures 12 m × 12 m contains 46 dandelion plants, 212 grass plants, and 14 bindweed plants. What is the population density, per square meter, of each species? **For more help, refer to the Math Skill Handbook.**

SECTION 3

Interactions Within Communities

As You Read

What You'll Learn

- **Describe** how organisms obtain energy for life.
- **Explain** how organisms interact.
- **Recognize** that every organism occupies a niche.

Vocabulary

producer
consumer
symbiosis
mutualism
commensalism
parasitism
niche

Why It's Important

How organisms obtain food and meet other needs is critical for their survival.

Obtaining Energy

Just as a car engine needs a constant supply of gasoline, living organisms need a constant supply of energy. The energy that fuels most life on Earth comes from the Sun. Some organisms use the Sun's energy to create energy-rich molecules through the process of photosynthesis. The energy-rich molecules, usually sugars, serve as food. They are made up of different combinations of carbon, hydrogen, and oxygen atoms. Energy is stored in the chemical bonds that hold the atoms of these molecules together. When the molecules break apart—for example, during digestion—the energy in the chemical bonds is released to fuel life processes.

Producers Organisms that use an outside energy source like the Sun to make energy-rich molecules are called **producers.** Most producers contain chlorophyll (KLOR uh fihl), a chemical that is required for photosynthesis. As shown in **Figure 12,** green plants are producers. Some producers do not contain chlorophyll and do not use energy from the Sun. Instead, they make energy-rich molecules through a process called chemosynthesis (kee moh SIHN thuh sus). These organisms can be found near volcanic vents on the ocean floor. Inorganic molecules in the water provide the energy source for chemosynthesis.

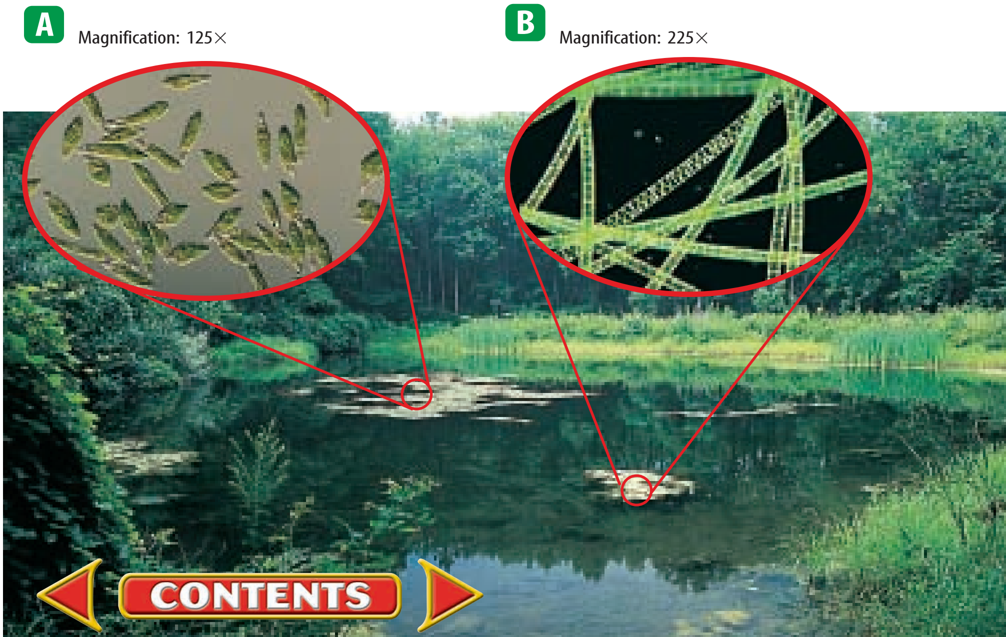


Figure 12
Green plants, including the grasses that surround this pond, are producers. The pond also contains many other producers, including microscopic organisms like A *Euglena* and B simple plantlike organisms called algae.

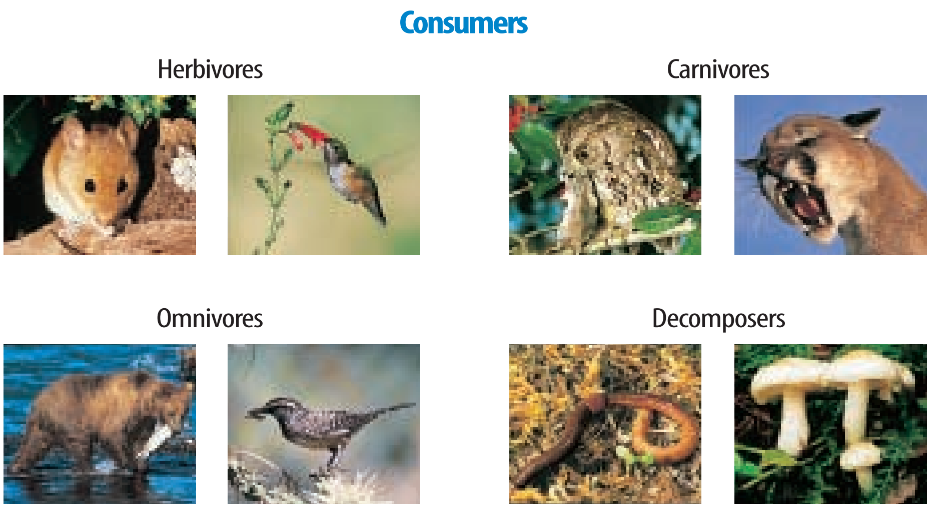


Figure 13
Four categories of consumers are shown. *What kind of consumer is a cactus wren? A mushroom?*

Consumers Organisms that cannot make their own energy-rich molecules are called **consumers.** Consumers obtain energy by eating other organisms. **Figure 13** shows the four general categories of consumers. Herbivores are the vegetarians of the world. They include rabbits, deer, and other plant eaters. Carnivores are animals that eat other animals. Frogs and spiders are carnivores that eat insects. Omnivores, including pigs and humans, eat mostly plants and animals. Decomposers, including fungi, bacteria, and earthworms, consume wastes and dead organisms. Decomposers help recycle once-living matter by breaking it down into simple, energy-rich substances. These substances might serve as food for decomposers, be absorbed by plant roots, or be consumed by other organisms.

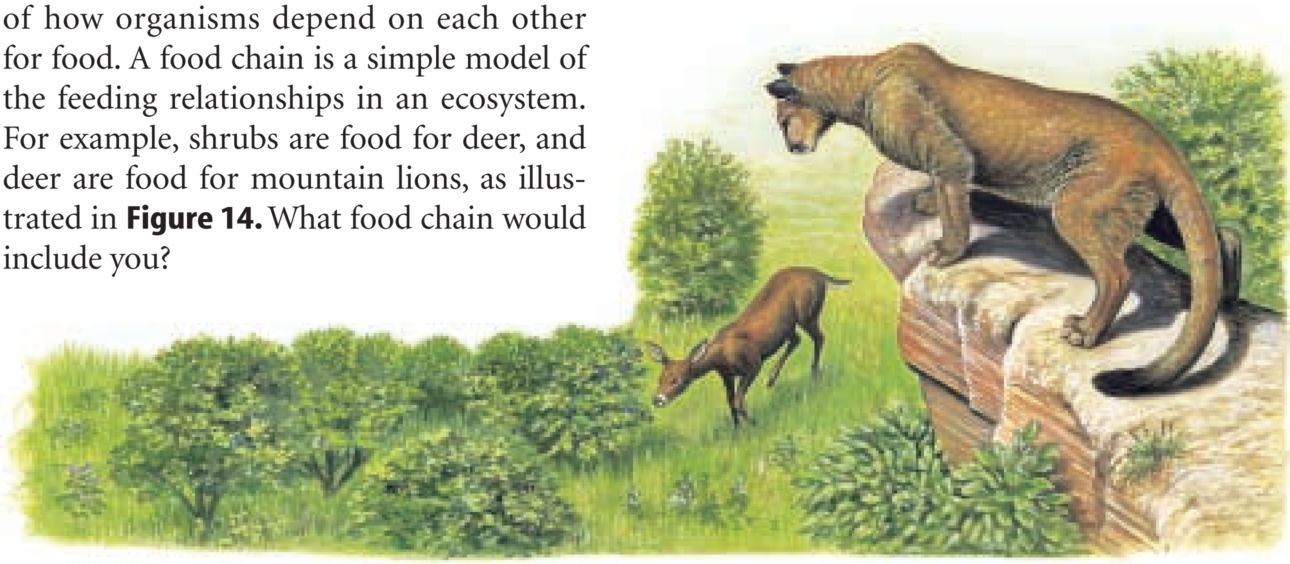
Chemistry INTEGRATION

Glucose is a nutrient molecule produced during photosynthesis. Look up the chemical structure of glucose and draw it in your Science Journal.

✔ Reading Check *How are producers different from consumers?*

Food Chains Ecology includes the study of how organisms depend on each other for food. A food chain is a simple model of the feeding relationships in an ecosystem. For example, shrubs are food for deer, and deer are food for mountain lions, as illustrated in **Figure 14.** What food chain would include you?

Figure 14
Food chains illustrate how consumers obtain energy from other organisms in an ecosystem.



Symbiotic Relationships

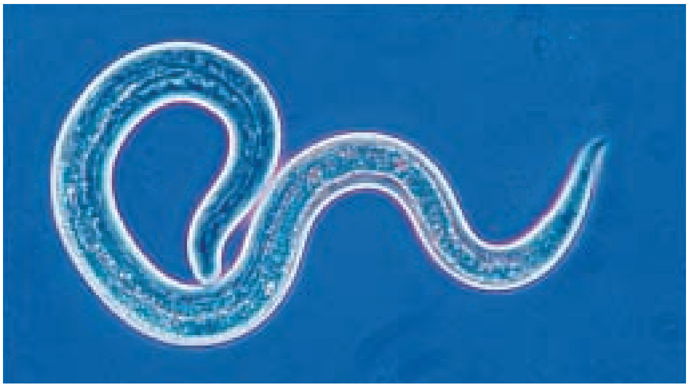
Not all relationships among organisms involve food. Many organisms live together and share resources in other ways. Any close relationship between species is called **symbiosis.**

Figure 15
Many examples of symbiotic relationships exist in nature.

A Lichens are a result of mutualism.

B Clown fish and sea anemones have a commensal relationship.

Magnification: 128×



C Some roundworms are parasites that rob nutrients from their hosts.

Mutualism You may have noticed crusty lichens growing on fences, trees, or rocks. Lichens, like those shown in **Figure 15A,** are made up of an alga or a cyanobacterium that lives within the tissues of a fungus. Through photosynthesis, the cyanobacterium or alga supplies energy to itself and the fungus. The fungus provides a protected space in which the cyanobacterium or alga can live. Both organisms benefit from this association. A symbiotic relationship in which both species benefit is called **mutualism** (MYEW chuh wuh lih zum).

Commensalism If you've ever visited a marine aquarium, you might have seen the ocean organisms shown in **Figure 15B.** The creature with gently waving, tubelike tentacles is a sea anemone. The tentacles contain a mild poison. Anemones use their tentacles to capture shrimp, fish, and other small animals to eat. The striped clown fish can swim among the tentacles without being harmed. The anemone's tentacles protect the clown fish from predators. In this relationship, the clown fish benefits but the sea anemone is not helped or hurt. A symbiotic relationship in which one organism benefits and the other is not affected is called **commensalism** (kuh MEN suh lih zum).

Parasitism Pet cats or dogs sometimes have to be treated for worms. Roundworms, like the one shown in **Figure 15C,** are common in puppies. This roundworm attaches itself to the inside of the puppy's intestine and feeds on nutrients in the puppy's blood. The puppy may have abdominal pain, bloating, and diarrhea. If the infection is severe, the puppy might die. A symbiotic relationship in which one organism benefits but the other is harmed is called **parasitism** (PER uh suh tih zum).

Niches

One habitat might contain hundreds or even thousands of species. Look at the rotting log habitat shown in **Figure 16.** A rotting log in a forest can be home to many species of insects, including termites that eat decaying wood and ants that feed on the termites. Other species that live on or under the rotting log include millipedes, centipedes, spiders, and worms. You might think that competition for resources would make it impossible for so many species to live in the same habitat. However, each species has different requirements for its survival. As a result, each species has its own niche (NIHCH). A **niche** refers to how an organism survives, how it obtains food and shelter, how it finds a mate and cares for its young, and how it avoids danger.

Reading Check *Why does each species have its own niche?*

Special adaptations that improve survival are often part of an organism's niche. Milkweed plants contain a poison that prevents many insects from feeding on them. Monarch butterfly caterpillars have an adaptation that allows them to eat milkweed. Monarchs can take advantage of a food resource that other species cannot use. Milkweed poison also helps protect monarchs from predators. When the caterpillars eat milkweed, they become slightly poisonous. Birds avoid eating monarchs because they learn that the caterpillars and adult butterflies have an awful taste and can make them sick.

Health INTEGRATION

The poison in milkweed is similar to the drug digitalis. Small amounts of digitalis are used to treat heart ailments in humans, but it is poisonous in large doses. Look up digitalis and explain in your Science Journal how it affects the human body.

Figure 16
Different adaptations enable each species living in this rotting log to have its own niche. A Termites eat wood. They make tunnels inside the log. B Millipedes feed on plant matter and find shelter beneath the log. C Wolf spiders capture insects living in and around the log.

Predator and Prey When you think of survival in the wild, you might imagine an antelope running away from a lion. An organism's niche includes how it avoids being eaten and how it finds or captures its food. Predators, like the one shown in **Figure 17,** are consumers that capture and eat other consumers. The prey is the organism that is captured by the predator. The presence of predators usually increases the number of different species that can live in an ecosystem. Predators limit the size of prey populations. As a result, food and other resources are less likely to become scarce, and competition between species is reduced.

Figure 17
The alligator is a predator. The turtle is its prey.

Cooperation Individual organisms often cooperate in ways that improve survival. For example, a white-tailed deer that detects the presence of wolves or coyotes will alert the other deer in the herd. Many insects, such as ants and honeybees, live in social groups. Different individuals perform different tasks required for the survival of the entire nest. Soldier ants protect workers that go out of the nest to gather food. Worker ants feed and care for ant larvae that hatch from eggs laid by the queen. These cooperative actions improve survival and are a part of the species' niche.

Section 3 Assessment

1. Explain why all consumers ultimately depend on producers for food.
2. Draw a food chain that models the feeding relationships of three species in a community. Choose a food chain other than the one shown in **Figure 14.**
3. Make up two imaginary organisms that have a mutualistic relationship. Give them names and explain how they benefit from the association.
4. What is the difference between a habitat and a niche?
5. **Think Critically** A parasite can obtain food only from a host organism. Most parasites weaken but do not kill their hosts. Why?

Skill Builder Activities

6. **Manipulating Variables and Controls** You are sure that Animal A benefits from a relationship with Plant B, but you are not sure if Plant B benefits, is harmed, or is unaffected by the relationship. Design an experiment to compare how well Plant B grows on its own and when Animal A is present. **For more help, refer to the Science Skill Handbook.**
7. **Using Graphics Software** Use graphics software to make three different food chains. Represent each organism with a shape that resembles it. For example, you could use a leaf shape to represent a plant. Label each shape. **For more help, refer to the Technology Skill Handbook.**

Activity

Feeding Habits of Planaria

You probably have watched minnows darting about in a stream. It is not as easy to observe organisms that live at the bottom of a stream, beneath rocks, logs, and dead leaves. Countless stream organisms, including insect larvae, worms, and microscopic organisms, live out of your view. One such organism is a type of flatworm called a planarian. In this activity, you will find out about the eating habits of planarians.

What You'll Investigate

What food items do planarians prefer to eat?

Materials

small bowl
planarians (several)
lettuce leaf
raw liver or meat
guppies (several)
pond or stream water
magnifying lens

Goals

- **Observe** the food preference of planarians.
- **Infer** what planarians eat in the wild.

Safety Precautions

Procedure

1. Fill the bowl with stream water.
2. Place a lettuce leaf, piece of raw liver, and several guppies in the bowl. Add the planarians. Wash your hands.
3. **Observe** what happens inside the bowl for at least 20 minutes. Do not disturb the bowl or its contents. Use a magnifying lens to look at the planarians.
4. **Record** all of your observations in your Science Journal.

Conclude and Apply

1. Which food did the planarians prefer?
2. **Infer** what planarians might eat when in their natural environment.
3. Based on your observations during this activity, what is a planarian's niche in a stream ecosystem?
4. **Predict** where in a stream you might find planarians. Use references to find out whether your prediction is correct.

Communicating Your Data

Share your results with other students in your class. Plan an adult-supervised trip with several classmates to a local stream to search for planarians in their native habitat. **For more help, refer to the** **Science Skill Handbook.**

Activity

Design Your Own Experiment

Population Growth in Fruit Flies

Populations can grow at an exponential rate only if the environment provides the right amount of food, shelter, air, moisture, heat, living space, and other factors. You probably have seen fruit flies hovering near ripe bananas or other fruit. Fruit flies are fast-growing organisms often raised in science laboratories. The flies are kept in culture tubes and fed a diet of specially prepared food flakes. Can you improve on this standard growing method to achieve faster population growth?

Recognize the Problem

Will a change in one environmental factor affect the growth of a fruit fly population?

Form a Hypothesis

Based on your reading about fruit flies, state a hypothesis about how changing one environmental factor will affect the rate of growth of a fruit fly population.

Goals

- **Identify** the environmental factors needed by a population of fruit flies.
- **Design** an experiment to investigate how a change in one environmental factor affects in any way the size of a fruit fly population.
- **Observe** and **measure** changes in population size.

Possible Materials

fruit flies
standard fruit fly culture kit
food items (banana, orange peel, or other fruit)
water
heating or cooling source
culture containers
cloth, plastic, or other tops for culture containers
hand lens

Safety Precautions

Test Your Hypothesis

Plan

1. As a group, decide on one environmental factor to investigate. Agree on a hypothesis about how a change in this factor will affect population growth. Decide how you will test your hypothesis, and identify the experimental results that would support your hypothesis.
2. **List** the steps you will need to take to test your hypothesis. Describe exactly what you will do. List your materials.
3. **Determine** the method you will use to measure changes in the size of your fruit fly populations.
4. Prepare a data table in your Science Journal to record weekly measurements of your fruit fly populations.
5. Read the entire experiment and make sure all of the steps are in a logical order.
6. **Research** the standard method used to raise fruit flies in the laboratory. Use this method as the control in your experiment.
7. **Identify** all constants, variables, and controls in your experiment.

Do

1. Make sure your teacher approves your plan before you start.
2. Carry out your experiment.
3. **Measure** the growth of your fruit fly populations weekly and record the data in your data table.

Analyze Your Data

1. What were the constants in your experiment? The variables?
2. **Compare** changes in the size of your control population with changes in your experimental population. Which population grew faster?
3. Using the information in your data table, make a line graph that shows how the sizes of your two fruit fly populations changed over time. Use a different colored pencil for each population's line on the graph.

Draw Conclusions

1. Did the results support your hypothesis? Explain.
2. **Compare** the growth of your control and experimental populations. Did either population reach exponential growth? How do you know?

Communicating Your Data

Compare the results of your experiment with those of other students in your class. **For more help, refer to the Science Skill Handbook.**

YOU CAN COUNT

The Census gives a snapshot of the people of the United States

The doorbell rings and you hear someone at the door say to your mom, "I'm working for the U.S. Census Bureau, doing follow-up interviews. Do you have a few minutes to answer some questions?" What does this person—and the U.S. government—want to know about your family?

Counting people is important to the United States and to many other countries around the world. It helps governments determine the distribution of people in the various regions of a nation. To obtain this information, the government takes a census—a count of how many people are living in their country on a particular day at a particular time, and in a particular place. A census is a snapshot of a country's population. The time at which the count occurs is called the "census moment." Some countries close their borders for a day or two so everyone will "sit still" for the census camera at the census moment, as was done in Nigeria in 1991.

Counting on the Count

When the United States government was formed, its founders set up the House of Representatives based on population. Areas with more people had more government representatives, and areas with fewer people had fewer representatives. In 1787, the requirement for a census became part of the Constitution. A census must be taken every ten years so the proper number of representatives for each state can be calculated.

Over the years, the U.S. Census Bureau has added questions to obtain more information than just a population count. In 1810, questions about manufacturing were added. In 1850, as more immigrants began coming to the United States, a new question about where people were born was added. In 1880, census takers asked people whether or not they were married. And in 1950, the first electronic computers were used to add up the census results.

Next, read on to find out more about the census.

ON IT

Growing by the Numbers

Chances are you just blinked your eyes. While you did it, three people were added to the world's population. There, you blinked again—that's another three people! It may seem impossible, but that's how quickly the world's population is growing. It adds up to 184 people every minute, 11,040 every hour, 264,960 every day, and 97 million every year! On October 12, 1999, the official number of people on the planet reached a record 6 billion.

The Short Form

Before 1970, United States census data was collected by field workers. They went door to door to count the number of people living in each household. Since then, the census has been done mostly by mail. People are sent a form they must fill out. The form asks for the number of people living at an address and their names, races, ages, and relationships. Answers to these and other questions are confidential. Census workers visit some homes to check on the accuracy of the information. The census helps the government to figure out how the population is aging. Census data are also important in deciding how to distribute government services and funding.

The 2000 Snapshot

One of the findings of the 2000 Census is that the U.S. population is becoming more equally spread out across age groups. By analyzing the data from the census, officials estimate that by 2020 the population of children, middle-aged people, and senior citizens will be about equal. It's predicted also that there will be more people who are over 100 years old than ever before.

Martha F. Riche researches population changes in the United States. She was also a director of the Census Bureau. Riche thinks that the more equal distribution in age will lead to challenges for the nation. How will we meet the demands of more people who are living longer? Will we need to build more hospitals to care for them? Will more children mean a need to build more schools? Federal, state, and local governments will be using the results of the 2000 Census for years to come as they plan our future.

Martha F. Riche studies population changes.

CLICK HERE

CONNECTIONS Class Census Develop a school census. What questions will you ask? (Don't ask questions that are too personal.) Who will ask them? How will you make sure you counted everyone? Using the results, can you make any predictions abou… ou… …s c…rent students?

SCIENCE Online
For more information, visit science.glencoe.com

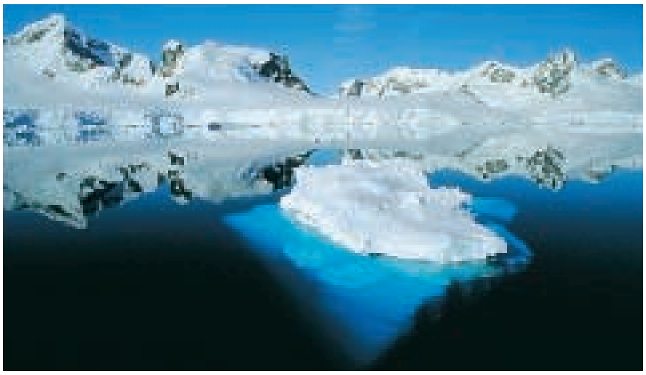
CONTENTS

Chapter 24 Study Guide

Reviewing Main Ideas

Section 1 Living Earth

1. Ecology is the study of interactions that take place in the biosphere. *Is ice-covered Antarctica a part of Earth's biosphere? Why or why not?*



2. Populations are made up of all organisms of the same species living in an area.
3. Communities are made up of all the populations of different species of organisms living in one ecosystem.
4. Living and nonliving factors affect an organism's ability to survive in its habitat.

Section 2 Populations

1. Population size can be estimated by counting a sample of a total population.
2. Competition for limiting factors can restrict the size of a population. *What limiting factors might influence the size of a rabbit population?*

3. Population growth is affected by birthrate, death rate, and the movement of individuals into or out of a community.
4. Exponential population growth can occur in environments that provide a species with plenty of food, shelter, and other resources.

Section 3 Interactions Within Communities

1. All life requires energy.
2. Most producers use the Sun's energy to make food in the form of energy-rich molecules. Consumers obtain their food by eating other organisms.
3. Mutualism, commensalism, and parasitism are the three kinds of symbiosis.
4. Every species has its own niche, which includes adaptations for survival. *What adaptations are involved in the relationship between the milkweed plant and the caterpillar of the monarch butterfly?*

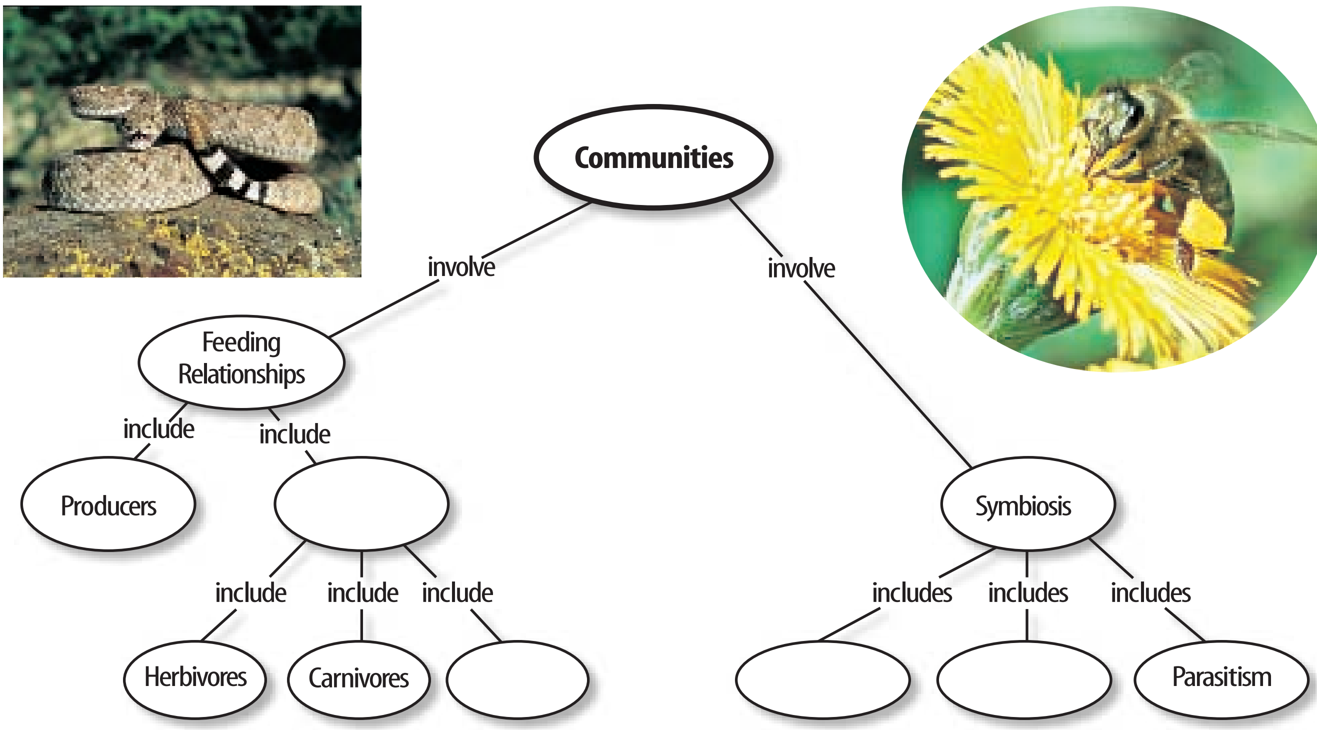
After You Read

FOLDABLES Reading & Study Skills

Under the population tab of your Concept Map Study Fold, write what would happen if there were an increase in the population of your animal.

Visualizing Main Ideas

Complete the following concept map on communities.



Vocabulary Review

Vocabulary Words

a. biosphere
b. carrying capacity
c. commensalism
d. community
e. consumer
f. ecology
g. ecosystem
h. habitat
i. limiting factor
j. mutualism
k. niche
l. parasitism
m. population
n. producer
o. symbiosis

Using Vocabulary

Explain the difference between the vocabulary words in each of the following sets.

1. niche, habitat
2. mutualism, commensalism
3. limiting factor, carrying capacity
4. biosphere, ecosystem
5. producer, consumer
6. population, ecosystem
7. community, population
8. parasitism, symbiosis
9. ecosystem, ecology
10. parasitism, commensalism

THE PRINCETON REVIEW

Study Tip

Get together with a friend to study. Quiz each other about specific topics from your textbook and class material to prepare for a test.

Chapter 24 Assessment

Checking Concepts

Choose the word or phrase that best answers the question.

1. Which of the following is a living factor in the environment?
A) animals
B) air
C) sunlight
D) soil

2. What is made up of all the populations in an area?
A) niches
B) habitats
C) community
D) ecosystem

3. What does the number of individuals in a population that occupies an area of a specific size describe?
A) clumping
B) size
C) spacing
D) density

4. Which of the following animals is an example of an herbivore?
A) wolf
B) moss
C) tree
D) rabbit

5. What term best describes a symbiotic relationship in which one species is helped and the other is harmed?
A) mutualism
B) parasitism
C) commensalism
D) consumerism

6. Which of the following conditions tends to increase the size of a population?
A) births exceed deaths
B) population size exceeds the carrying capacity
C) movements out of an area exceed movements into the area
D) severe drought

7. Which of the following is most likely to be a limiting factor in a population of fish living in the shallow water of a large lake?
A) sunlight
B) water
C) food
D) soil

8. An ecologist wants to know the size of a population of wild daisy plants growing in a meadow. The meadow measures 1,000 m^2. The ecologist counts 30 daisy plants in a sample area that is 100 m^2. What is the estimated population of daisies in the entire meadow?
A) 3
B) 30
C) 300
D) 3,000

9. Which of these organisms is a producer?
A) mole
B) owl
C) whale
D) oak tree

10. Which pair of words is incorrect?
A) black bear—carnivore
B) grasshopper—herbivore
C) pig—omnivore
D) lion—carnivore

Thinking Critically

11. Why does a parasite have a harmful effect on the organism it infects?

12. What factors affect carrying capacity?

13. Describe your own habitat and niche.

14. The female cowbird lays eggs in the nest of another bird. The other birds care for and feed the cowbird chicks when they hatch. Which type of symbiosis is this?

15. Explain how several different niches can exist in the same habitat.

Developing Skills

16. Making Models Place the following organisms in the correct sequence to model a food chain: grass, snake, mouse, and hawk.

17. Predicting Dandelion seeds can float great distances on the wind with the help of white, featherlike attachments. Predict how a dandelion seed's ability to be carried on the wind helps reduce competition among dandelion plants.

18. Classifying Classify the following relationships as parasitism, commensalism, or mutualism: a shark and a remora fish that cleans and eats parasites from the shark's gills; head lice and a human; a spiny sea urchin and a tiny fish that hides from predators by floating among the sea urchin's spines.

19. Comparing and Contrasting Compare and contrast the diets of omnivores and herbivores. Give examples of each.

20. Making and Using Tables Complete the following table.

Types of Symbiosis

Organism A	Organism B	Relationship
Gains	Doesn't gain or lose	
Gains		Mutualism
Gains	Loses	

Performance Assessment

21. Poster Use photographs from old magazines to create a poster that shows at least three different food chains. Display your poster for your classmates.

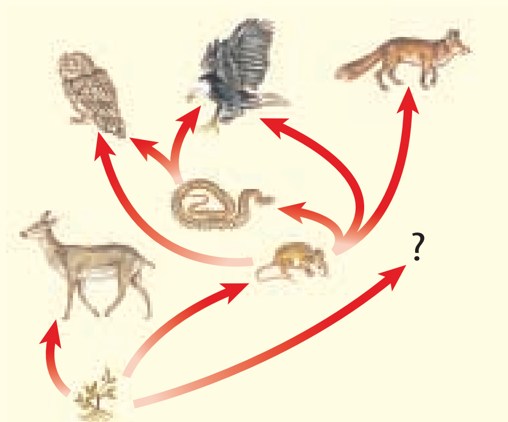
Technology

Go to the Glencoe Science Web site at **science.glencoe.com** or use the **Glencoe Science CD-ROM** for additional chapter assessment.

THE PRINCETON REVIEW

Test Practice

A food web shows how organisms in a particular ecosystem depend on each other for food. The food web below shows how the plants and animals in a grassland ecosystem obtain energy from each other.



Study the picture and answer the following questions.

1. Other organisms also live in this habitat. Which of the following organisms could fill in the blank space in this food web?

A) tree
B) bison
C) alligator
D) hawk

2. Suppose all the snakes were removed from this ecosystem. Which of the following statements represents the most reasonable prediction of what could happen in this ecosystem?

F) The plants would die.
G) The owls would start eating foxes.
H) There would be no more predators to eat the mice.
J) The eagles would start eating more mice.