

Life Science

UNIT

B

Living Things and Their Environments



A photograph of a lush rain forest. In the foreground, there are large, vibrant green leaves with prominent veins. Some of these leaves show signs of being eaten, with small holes and irregular yellowish-brown edges. In the background, several thick, brown tree trunks stand vertically, surrounded by dense foliage. The overall scene is a typical representation of a tropical rain forest environment.

LOOK!

A tiny leaf-cutter ant carries off a leaf that is much larger than itself. How do leaf-cutter ants interact with other living things in the rain forest?

Living Things and Their Environments

CHAPTER 5

Interactions of
Living Things B2

CHAPTER 6

Ecosystems B46

CHAPTER

5

LESSON 1

Interactions in
an Ecosystem, B4

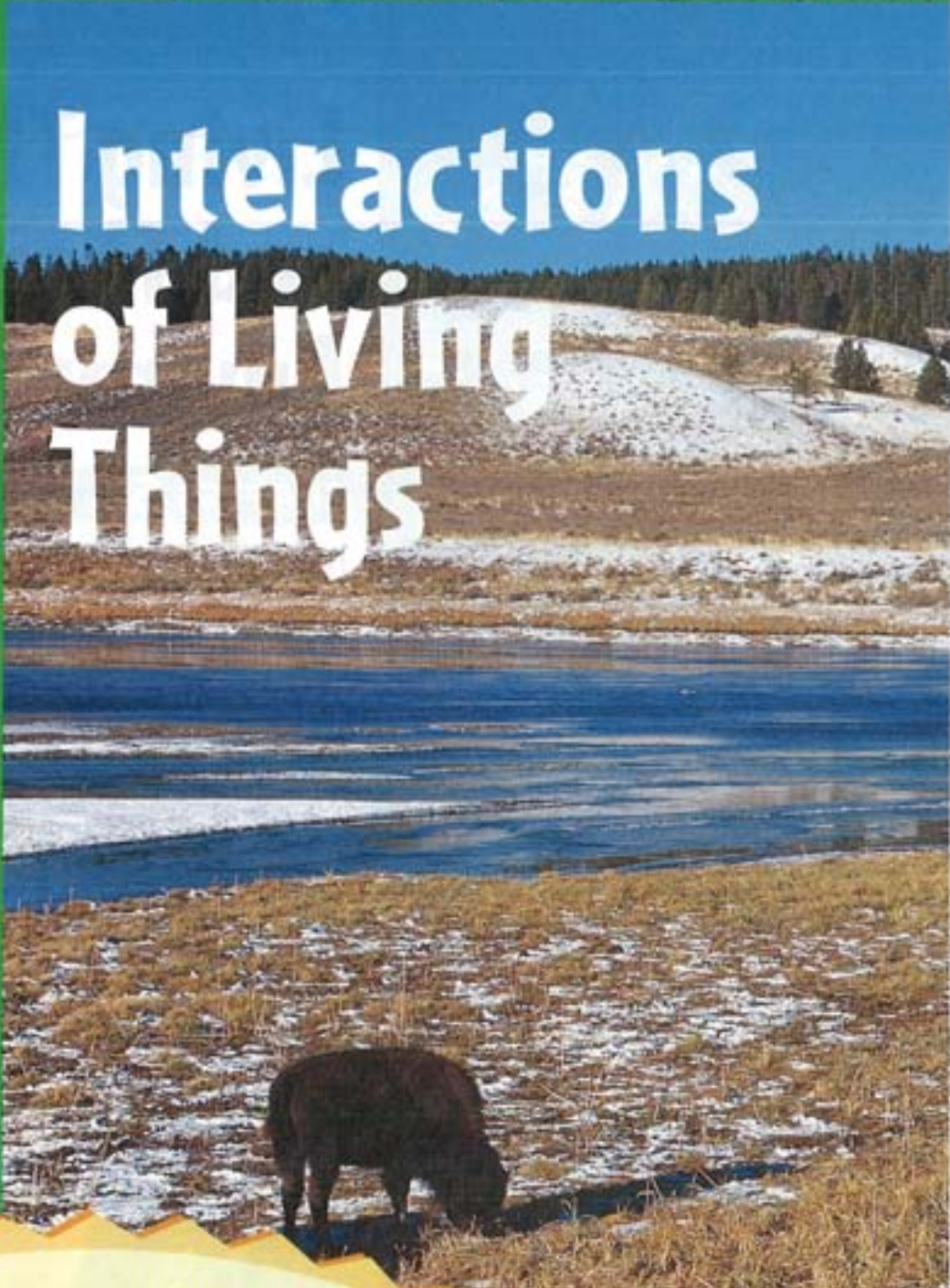
LESSON 2

Interactions Among
Living Things, B16

LESSON 3

How Populations
Survive, B32

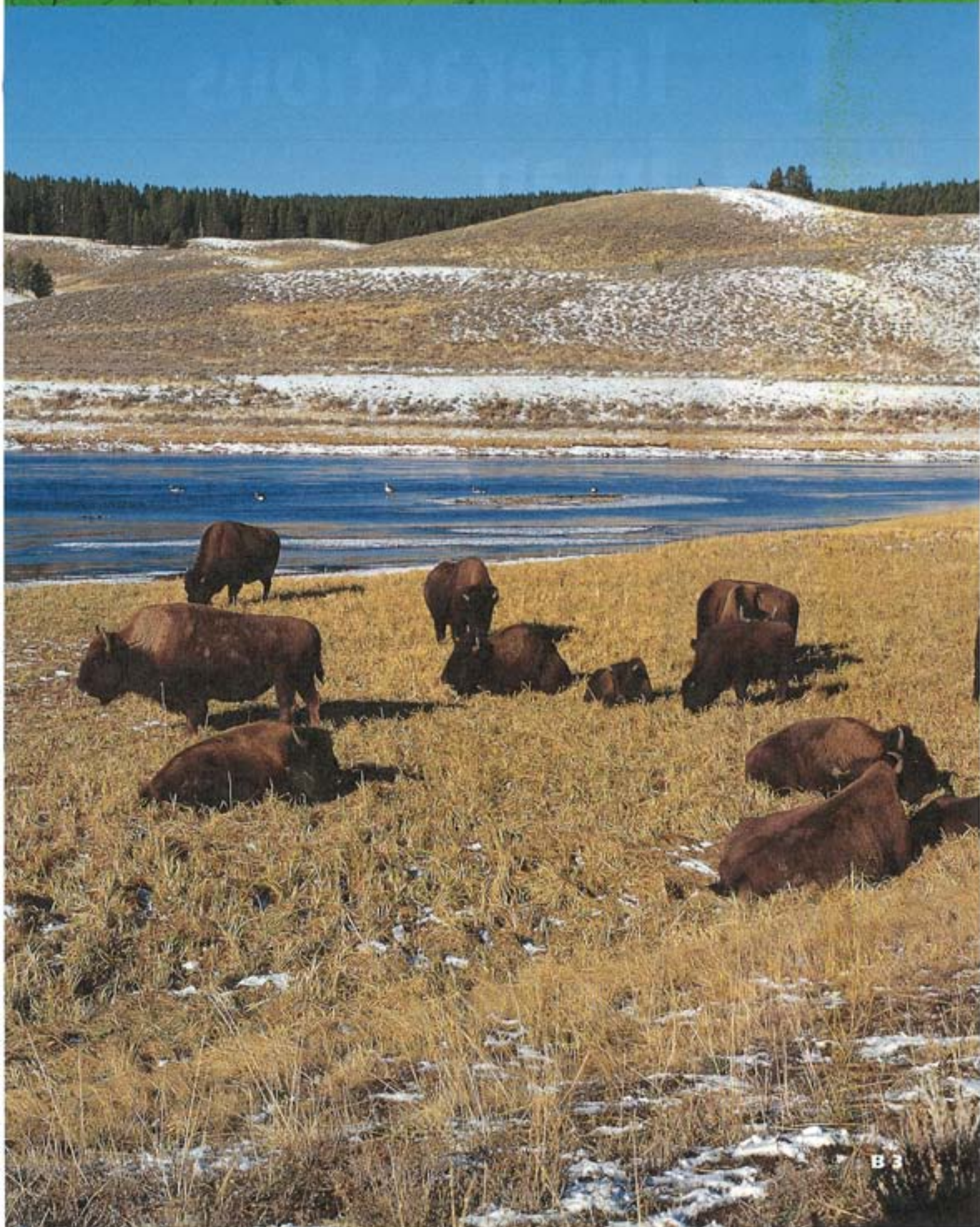
Interactions of Living Things



Did You Ever Wonder?

What happened to the buffalo? The huge herds of buffalo that once roamed the grasslands of the United States were hunted almost to extinction. Today, however, buffalo can once again be seen in places like Yellowstone National Park.

INQUIRY SKILL **Infer** What living and nonliving things affect the life of the buffalo?



Interactions in an Ecosystem

Vocabulary

ecosystem, B6
abiotic factor, B6
biotic factor, B7
population, B11
community, B11
ecology, B11
habitat, B12
niche, B12

Get Ready

What do you need in order to survive? Food? Water? Comfortable temperatures? Shelter?

What kinds of things does the animal shown here need to survive? What kinds of things do the plants need? Where do you think they get these things?

Inquiry Skill

You **experiment** when you perform a test to support or disprove a hypothesis.



Explore Activity

What Do Living Things Need to Survive?

Procedure: Design Your Own

BE CAREFUL! Handle animals and plants gently.

- 1** For a water environment, add thoroughly washed sand or gravel to the jar. Fill the jar with water. Add a few floating plants, rooted plants with floating leaves, and submerged plants. Add water snails.
- 2** For a land environment, place a layer of gravel on the bottom of the jar. Cover the gravel layer with a layer of moistened soil. Add plants, and plant grass seeds. Add earthworms, sow bugs, and snails.
- 3** Place each jar in a lighted area but not in direct sunlight.
- 4** Cover each jar with its own lid or with a piece of plastic wrap. Record the number and types of living things you used.
- 5** **Observe** Examine your jars every other day, and record your observations.

Drawing Conclusions

- 1** **Infer** What are the nonliving parts of your system? What are the living parts of your system?
- 2** **Infer** What do the living things need to survive? How do you know?
- 3** **FURTHER INQUIRY** **Experiment** How could you design an environment that contains land and water areas?

Materials

wide-mouthed, clear container with lid

washed gravel

pond water or aged tap water

water plants

water snails

soil

small rocks

grass seed and small plants

earthworms, land snails, sow bugs, or other small land animals that eat plants



Read to Learn

Main Idea Ecosystems have many parts.

What Is an Ecosystem?

What or whom do you interact with every day? Living things and nonliving things interact in an **ecosystem**. An ecosystem is all the living and nonliving things in an area.

An ecosystem may be very small, such as a backyard or pond. Some ecosystems, like the prairie ecosystem of North America, the deserts of Africa, and the rain forests of Brazil, cover large areas of a country or continent. Freshwater ecosystems cover less space than saltwater ecosystems. Saltwater ecosystems can cover entire oceans. It doesn't matter where they are or what they look like, all ecosystems have the same parts.

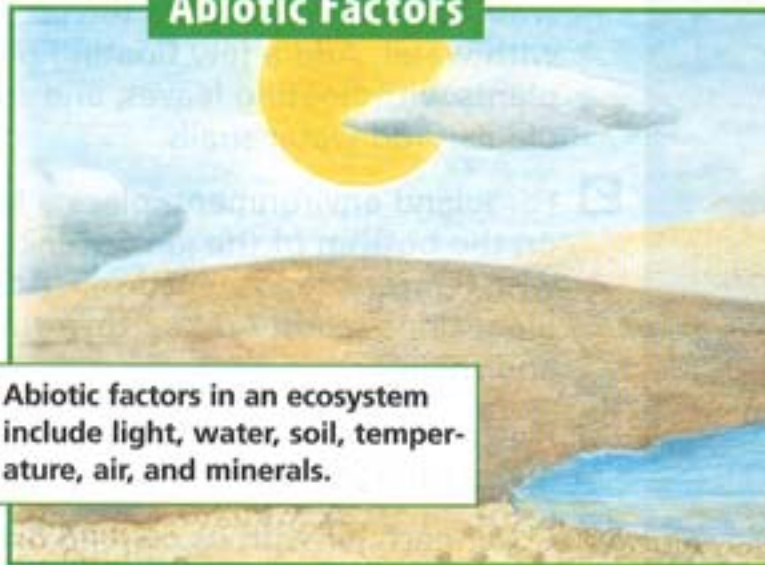
Abiotic Factors

The nonliving parts of an ecosystem are the **abiotic** (ay·bigh·AHT·ik) **factors**. All living things need certain nonliving things in order to survive. Abiotic factors include water, minerals, sunlight, air, climate, and soil.

All organisms, or living things, need water. Their bodies are 50 to 95 percent water. The processes that keep living things alive—like photosynthesis and respiration—can only take place in the presence of water. Living things also need minerals, such as calcium, iron, phosphorus, and nitrogen. Some living things, like plants and algae, need

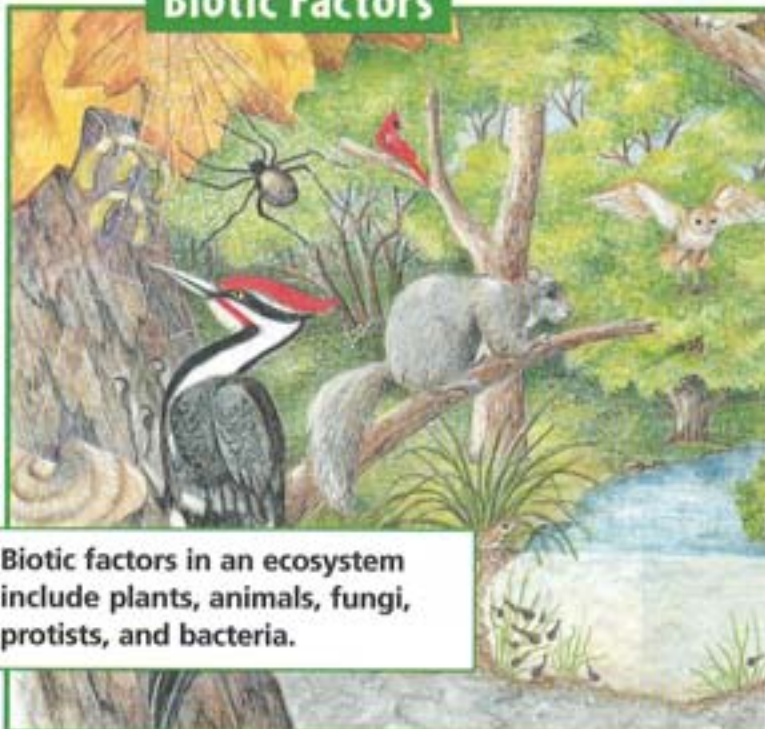
sunlight to make food. Animals need oxygen to produce energy for their bodies. Plants and algae need carbon dioxide. The environment must also have the right temperature for organisms to survive.

Abiotic Factors



Abiotic factors in an ecosystem include light, water, soil, temperature, air, and minerals.

Biotic Factors

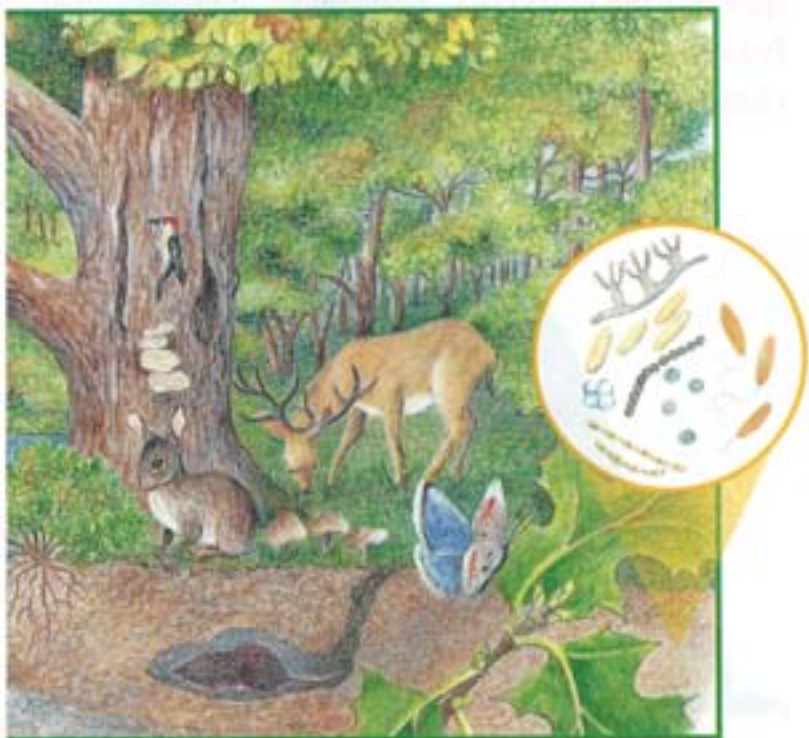
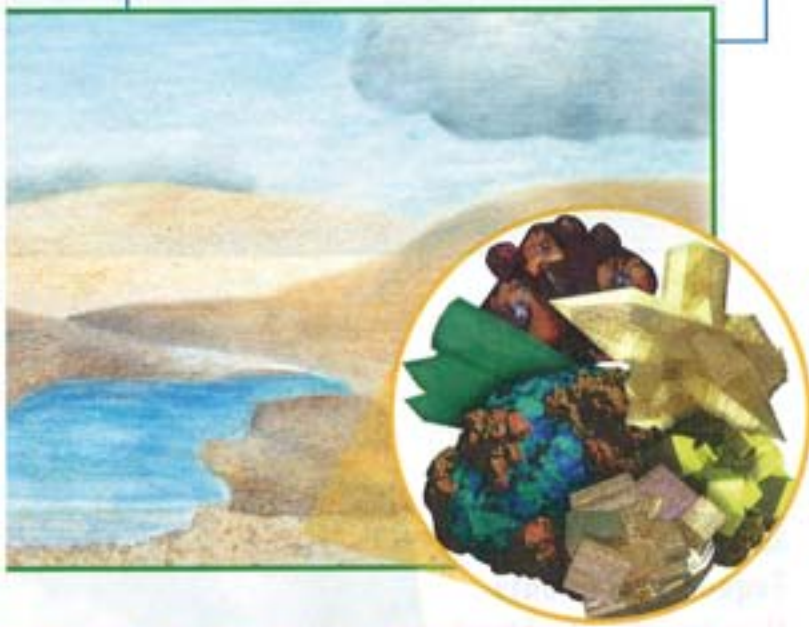


Biotic factors in an ecosystem include plants, animals, fungi, protists, and bacteria.

READING

Diagrams

1. How do these two diagrams differ? What does each diagram show?
2. Which of these two diagrams best shows the abiotic factors in the ecosystem? Explain your answer.



Biotic Factors

The living parts of an ecosystem are animals, plants, fungi, protists, and bacteria. These organisms make up the **biotic** (bigh-AHT-ik) **factors** of an ecosystem.

Plants and algae are *producers*. They produce oxygen and food that animals need. Animals are *consumers*. Animals consume, or eat, algae, plants, or animals. Animals also give off carbon dioxide that plants and algae need to make food.

What do the fungi and bacteria contribute? They are a very important part of any ecosystem. Fungi and bacteria are *decomposers*. They *decompose*, or break down, dead plants and animals into useful things like minerals that enrich soil. Plants need these in order to grow. Each kind of organism has a role that helps the others survive.

There are many ecosystems in the world and each has a unique set of biotic and abiotic factors. These factors determine the kinds of organisms that the ecosystem can support. This is why there are different organisms in different ecosystems. For example, you wouldn't find a buffalo in a desert or a forest ecosystem because it needs grass to survive.

▶ What are five abiotic and five biotic factors in an ecosystem?

What Is a Prairie Ecosystem Like?

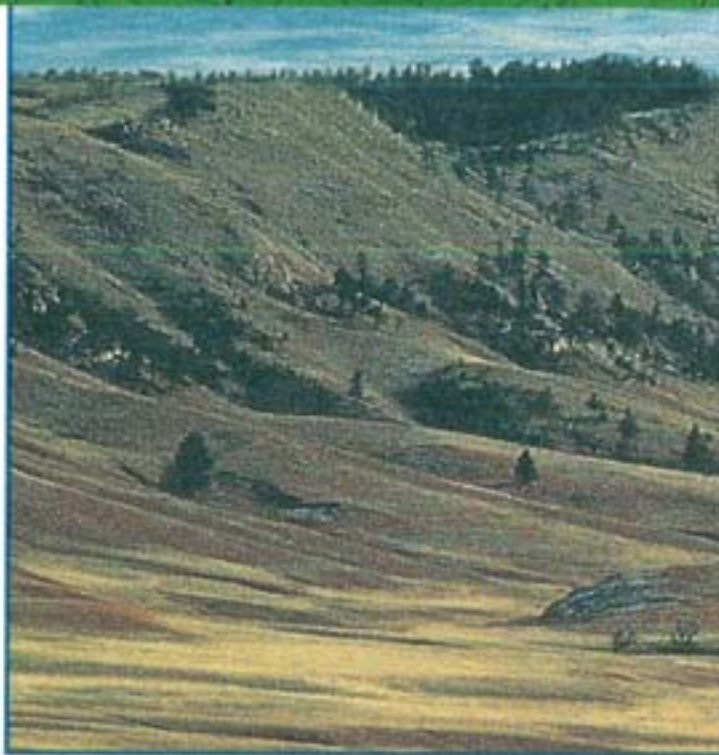
Long ago a “sea of wild grasses” covered North America from central Texas in the south to North Dakota in the north. These were America’s prairie lands, the range of the famous song “Home on the Range.”

The Blackland Prairie is the largest remaining prairie in America. It stretches 483 km (300 mi) across Texas, from Austin to Clarksville. The Blacklands got their name from the rich black soil the early settlers found there. The settlers found that the summers were hot and long, and that there was enough rain to grow profitable crops, like cotton.

Before the land became farms and ranches, huge herds of buffalo grazed on the prairie grasses. Native Americans once hunted the buffalo on this land for food and clothing as a means of survival.

Buffalo were not the prairie’s only inhabitants. Plants and animals of all kinds lived there. At least 50 different kinds of tall and short grasses provided food for plant-eating animals. Many kinds of wildflowers painted the landscape with beautiful colors. These flowers included purple coneflowers, bluebells, yellow sunflowers, and golden daleas. Travelers might have come across oak, hickory, elm, or cedar trees along nearby streams.

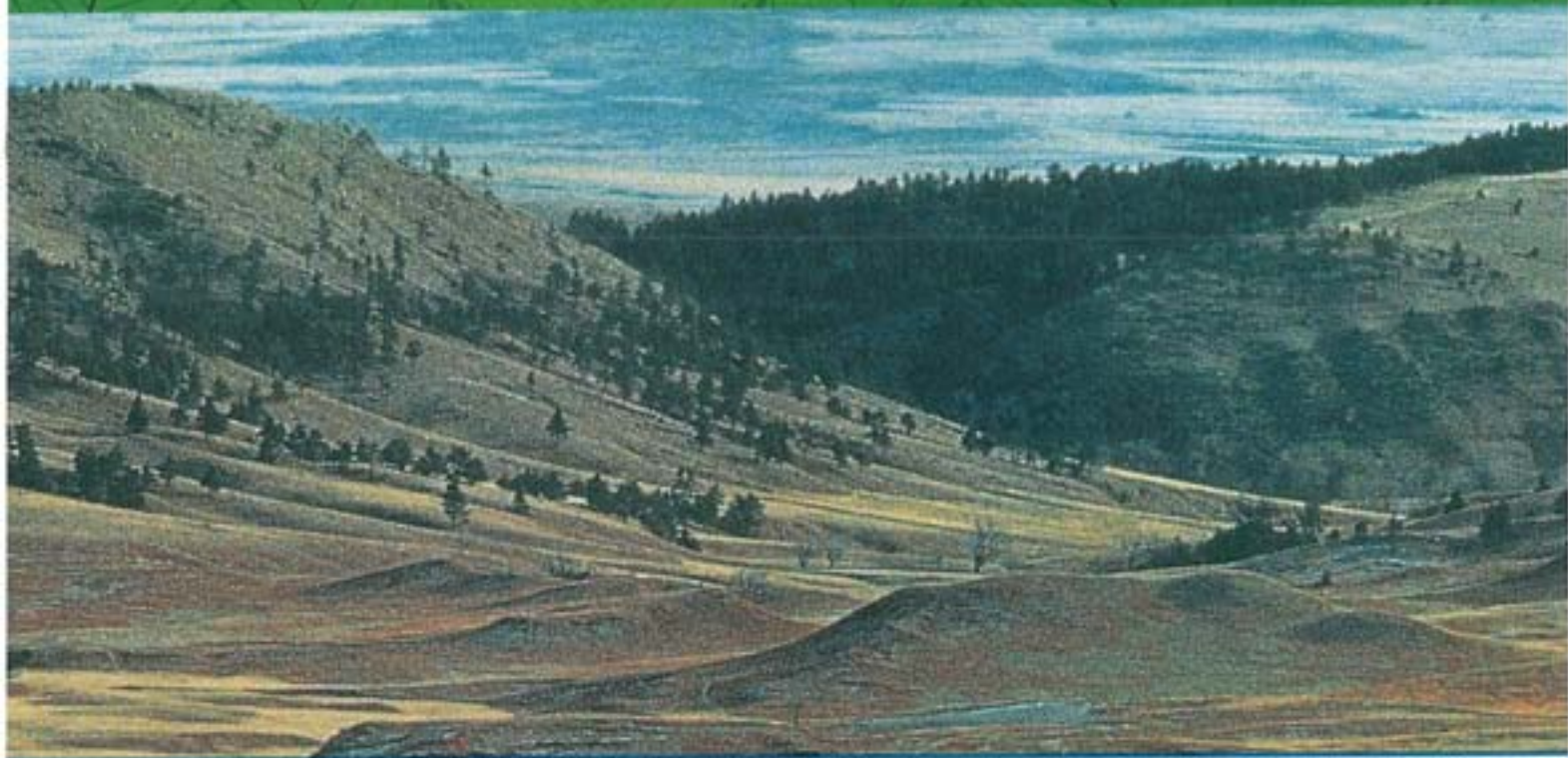
The cattle and crops that provide much of our food live on the prairie today. Ranchers and farmers now graze cattle and plant crops such as corn and wheat on the Blacklands.



READING

Sequence of Events
How has the Blackland Prairie ecosystem changed over time?





What Is the Treasure of the Blackland Prairie?

Have you ever read about a buried treasure? Unlike those stories, the treasure of the Blackland Prairie is not buried underground. The treasure of the Blackland Prairie *is* the ground.

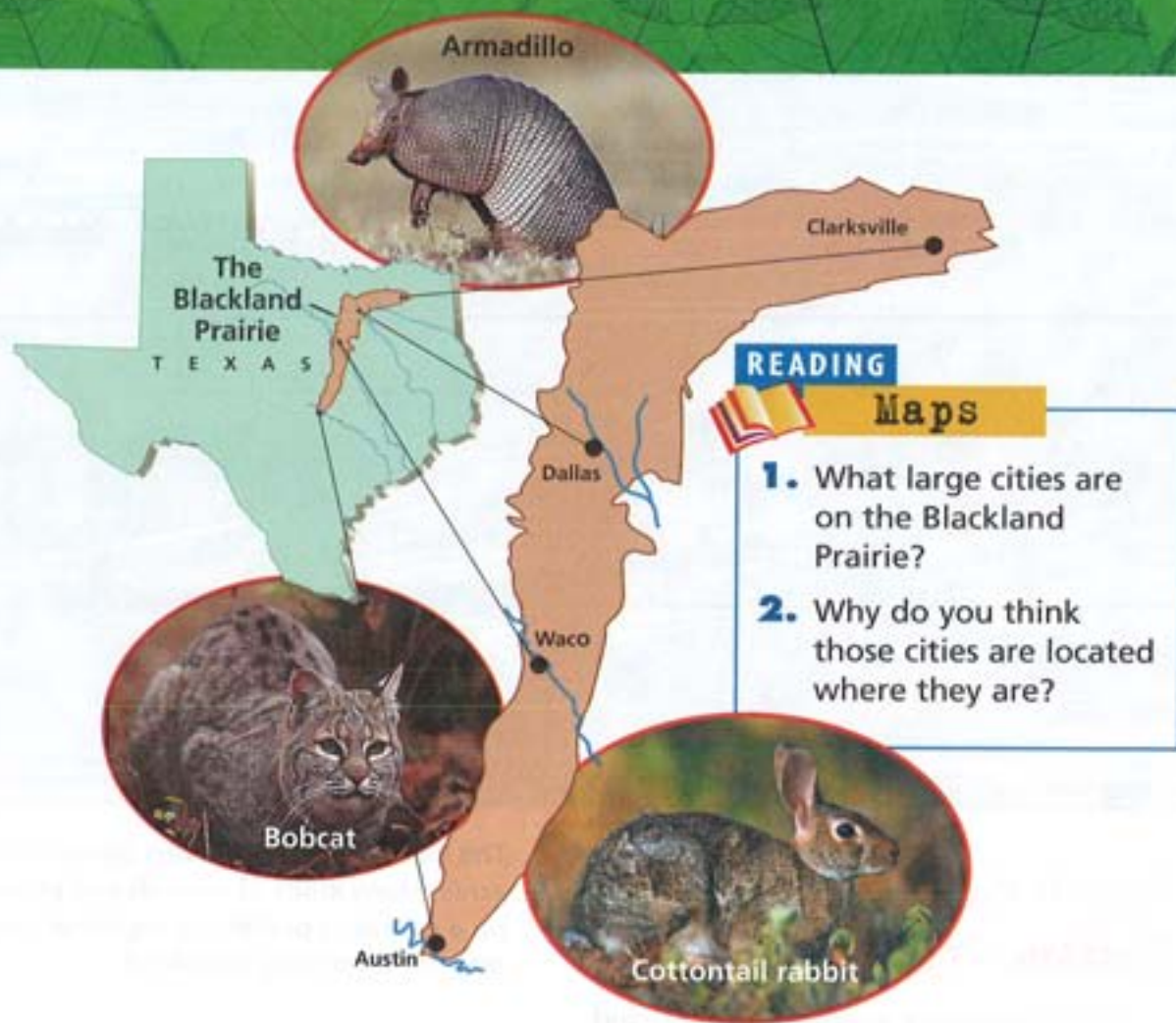
Prairie soils can often be identified by their dark brown to black *topsoil*. Topsoil is the top layer of soil. The dark color shows the presence of *humus*. Humus is partly decayed plant matter. The decay is produced by the bacteria and fungi.

The rich topsoil is full of minerals that prairie grasses and crops need. Two of the most important minerals are magnesium and calcium. Plants need magnesium in order to make chlorophyll. Calcium is an important element of cell walls in plants.

The Blackland Prairie covers almost 13 million acres. Many kinds of animals and plants live on a prairie. A prairie is a region of grasses. It may be flat or hilly grassland.

The nutrients in certain prairie soils tend to stay near the surface. That's true because of the low yearly rainfall on prairies. There isn't enough water to carry the nutrients deep into the ground. Farmers take advantage of this by growing crops that have shallow roots, such as corn, wheat, cotton, and sorghum. Sorghum is a grain that is used to feed livestock. What do these crops have in common with the plants that grow naturally on the prairie? They are all classified as grasses.

▶ **How can you describe the soil of the Blackland Prairie?**



READING

Maps

1. What large cities are on the Blackland Prairie?
2. Why do you think those cities are located where they are?

What Animals Live on the Blackland Prairie?

About 500 species, or different kinds, of animals still live on this prairie. The spotted chorus frog sings in the night near the streams and rivers. Rattlesnakes and lizards seek shelter under rocks.

Birds like pipits, longspurs, and horned larks, as well as 300 other kinds of birds, still live on the Blackland Prairie.

Raccoons, opossums, coyotes, white-tailed deer, and striped skunks live on the Blacklands. Cotton rats,

white-footed mice, eastern cottontails, red bats, and bobcats live there, too.

Mountain lions, gray wolves, black bears, and jaguars used to come in search of prey. When people came and built towns, cities, and farms, the buffalo left. The animals that fed on the buffalo left, too. Some animals, however, came to the Blacklands from other places, and stayed. Armadillos arrived from Mexico as the Blacklands' climate warmed up over the past 150 years. Badgers invaded from northwestern Texas when their natural homes were cleared for development.

▶ What are five animals that live on the prairie?

What Are Populations and Communities?

The Blackland Prairie, like all ecosystems, is home to many different organisms. Each kind of organism, whether an animal, plant, fungus, protist, or bacterium, is a member of a different species. All the organisms of a species living in the same area make up a **population**.

The Blackland Prairie has populations of armadillos and badgers. It has populations of little bluestem grass and Indian grass. It has elm trees. It also has populations of pond algae and soil bacteria. All the populations living in an area make up a **community**.

The populations in a community interact with each other in different ways. Scientists who are interested in these interactions are ecologists.

Ecology is the study of how all things in an ecosystem interact.

Ecologists investigate the activities of animals, plants, fungi, protists, and bacteria in the ecosystem. They want to know which animals prey on others. Which animals eat plants? Which insects eat crops? They are interested in how bacteria and fungi make the soil fertile. All these questions need to be answered to understand how an ecosystem stays healthy.

▶ What are populations and communities?



Scientists study the interactions of different populations in an ecosystem's community. This helps them to understand what makes an ecosystem grow.

What Are Niches and Habitats?

The place where an organism lives is called its **habitat**. The chorus frog's habitat is in the scattered ponds of the Blacklands.

Each species in an ecosystem also has a role or place in the activities of its community. The role of an organism in the community is its **niche**.

A species' niche includes many factors. It includes what a species eats and what eats that species. It includes the kind of environment the species needs to live in. It even includes whether the species is active by day or night.

No two populations can have the same niche. Why is this true? To have the same niche, two populations would have to eat the same foods and be eaten by the same predators. They would have to live in the same space and reproduce in the same ways. They would have to grow under the same temperature, moisture, and light conditions, get the same diseases, and look and behave exactly alike. They would have to be identical! No two populations are identical though, so no two populations have the same niche.

Scientists study the habitats and niches of organisms in a community. They do this to see if the community is healthy or in trouble.



The red bat's habitat is above the ground. During the day it hangs from tree branches like a red leaf. At night it streaks through the air looking for food.

▶ **What is the difference between a niche and a habitat?**



The horned lark has its niche on the prairie.

How Do Organisms Change Their Environment?

You have learned how plants and animals adapt to their environment. However, living organisms also change the environment where they live. These changes can be good, neutral, or bad for the ecosystem.

Have you ever seen a beaver pond? Beavers cut down trees by gnawing their way through tree trunks. Then, they use the tree trunks to build dams that back up water into ponds. Beaver ponds filter sediment and organic matter that otherwise would be carried downstream. The filtered organic matter provides nutrients for invertebrates and aquatic plants.

These invertebrates and aquatic plants attract breeding waterfowl and many fish species. Soon fish-eating animals such as otters follow.

Beaver ponds eventually become marshy areas which allow certain trees to grow. Over time, the marshy area becomes a meadow, and later shrubs begin to grow. The shrubs provide shade that allows tree seedlings to get started. The trees eventually grow into a mature forest.

▶ How do beavers change their environment?



QUICK LAB



Changing the Environment

FOLDABLES Make a Shutter Fold. (See p. R 42.) Label the shutters as shown.



1. Select a wild animal that you find interesting. It can be as small as an insect or as large as whale.
2. Do research to find where this animal lives and what it does to survive in its environment.
3. Draw or find a picture of the animal you selected and paste it in the center of the Shutter Fold.
4. **Communicate** How does the animal you selected change the environment where it lives? What living things are affected by these changes? Write your answers on the Shutter Fold.
5. **Infer** How do the living things you listed above adapt to the changes in their environment? Write your answer on the back of your Shutter Fold.

How Do Organisms Survive in Variable Environments?

The world is a place of changes. As you read on the previous page, some of these changes are caused by living organisms. Some other changes are weather related.

One day the weather may be dry and cold. The next day it may be wet and warm. Heavy rains may drench the land one spring and summer. The next year's spring and summer may have cloudless skies day after day. This makes habitats change.

A good habitat for a certain organism at one time may be a threatening one at another time. How do organisms survive difficult times?

Organisms find new habitats or adapt to the changes in their habitat.

The Eastern Spadefoot Toad

The eastern spadefoot toad lives on the Blackland Prairie. This animal reproduces in water and needs water for its daily life. What happens if a drought strikes the Blacklands?

A close look at the toad's hind feet provided scientists with a clue to the answer. Its hind feet are shaped like little spades. They are adapted for digging. That's just what the spadefoot toad does when water is scarce. It digs into the ground and covers itself with soil. This toad can absorb water through its skin. There's a lot of clay in Blacklands soil, and clay holds water well. Usually there is some water in the soil, even though there may not be any water above it. The toad may be able to survive in the soil even during a drought.

▶ **What happens to animals when habitats change?**



The eastern spadefoot toad can survive in a dry, hot habitat by burrowing into the soil and absorbing water through its skin.

Why It Matters

Ecosystems in nature tend to stay in balance. This balance, however, can be upset by the actions of people. Cities are built on the land. Crops are cultivated. The land changes. Its natural inhabitants disappear. People gain certain things but lose others. It is important to make wise decisions when you think of changing an ecosystem. Otherwise you may lose more than you gain.

eJournal Visit our Web site www.science.mmhschool.com to do a research project on an ecosystem of your choice.

Think and Write

1. Describe the structure of an ecosystem.
2. What is the difference between a population and a community?
3. How does an animal's habitat relate to its niche?
4. How do light, temperature, and soil composition affect an ecosystem's capacity to support life?
5. **Critical Thinking** Identify changes caused by human activity in your ecosystem. Explain what was lost and what was gained. Evaluate the results.

ART LINK

Make a poster. Visit a local ecosystem like a park, pond, or even your backyard. Draw all the living and nonliving things you see. Discuss the similarities and differences between the communities and interactions of the ecosystem you visited, and an ecosystem you studied in class.

WRITING LINK

Writing That Compares Research the biotic and abiotic factors of the Blackland Prairie and the Everglades in Florida. Compare these two ecosystems. Tell how the ecosystems are similar. Then write about their differences.

MATH LINK

Problem solving. A group of ecologists has counted 7,522 American Robins, 12,788 Northern Cardinals, and 3,657 Ruby-throated Hummingbirds in the Piedmont area. Order birds from the least number to the greatest.



TECHNOLOGY LINK

LOG ON Visit www.science.mmhschool.com for more links.

Interactions Among Living Things



Vocabulary

food chain, B18
food web, B20
herbivore, B20
carnivore, B20
predator, B21
prey, B21
scavenger, B21
omnivore, B21
symbiosis, B24
mutualism, B25
parasitism, B26
commensalism,
B27

Get Ready

Populations provide energy-rich food for one another. Grasses and other green plants provide food for gazelles. Lions feed on gazelles. What do you think might happen if a drought reduced the number of grasses? How can changes in a population lead to changes in the ecosystem where it lives?

Inquiry Skill

You **predict** when you state possible results of an event or experiment.

Explore Activity

How Do Populations Interact?

Materials

tape
string
population
cards

Procedure

- 1 Cut out the cards representing the plants and animals in the ecosystem.
- 2 Label the top of your paper *Sunlight*.
- 3 Place the plant cards on the paper, and link each to the sunlight with tape and string.
- 4 Link each plant-eating animal to a plant card. Link each meat-eating animal to its food source. Only two animals can be attached to a food source. Record the links you have made.
- 5 Fire destroys half the plants. Remove four plant cards. Rearrange the animal cards. Remove animal cards if more than two animals link to any one food source. Record the changes you have made.

Drawing Conclusions

- 1 **Observe** What has happened to the plant eaters as a result of the fire? To the animal eaters?
- 2 **Infer** Half of the plants that were lost in the fire grow back again. What happens to the animal populations?
- 3 **Experiment** Try adding or removing plant or animal cards. What happens to the rest of the populations?
- 4 **FURTHER INQUIRY Predict** If plants or prey become scarce, their predators may move to a new area. What will happen to the ecosystem the predators move into?

Grasshopper
Food: prairie plants

Meadowlark
Food: crickets,
grasshoppers

Ground Squirrel
Food: prairie plants

Bullsnake
Food: mice, rabbits,
ground squirrels,
birds and eggs.

Red-Tailed Hawk
Food: ground squirrels,
mice, rabbits, snakes,
lizards, small birds

Prairie Plants
Food: made from
water, carbon dioxide,
and sunlight

Coyote
Food: rabbits, ground
squirrels, meadow mice,
other rodents

Read to Learn

Main Idea Food chains and food webs describe the feeding relationship in an ecosystem.

What Is a Food Chain?

How important is a small change in a population? Changes in one population can affect several other populations in the same ecosystem. Every population needs energy in order to survive. Where does that energy come from? The energy in an ecosystem comes from the Sun.

You can feel the Sun's energy as it warms your skin. A meadow mouse scurrying through a Blacklands cornfield and a red-tailed hawk diving to snare the mouse can feel it, too. Neither of these animals can directly use the Sun's energy. However, they must have it to move, to breathe, to keep their hearts beating, and to stay alive.

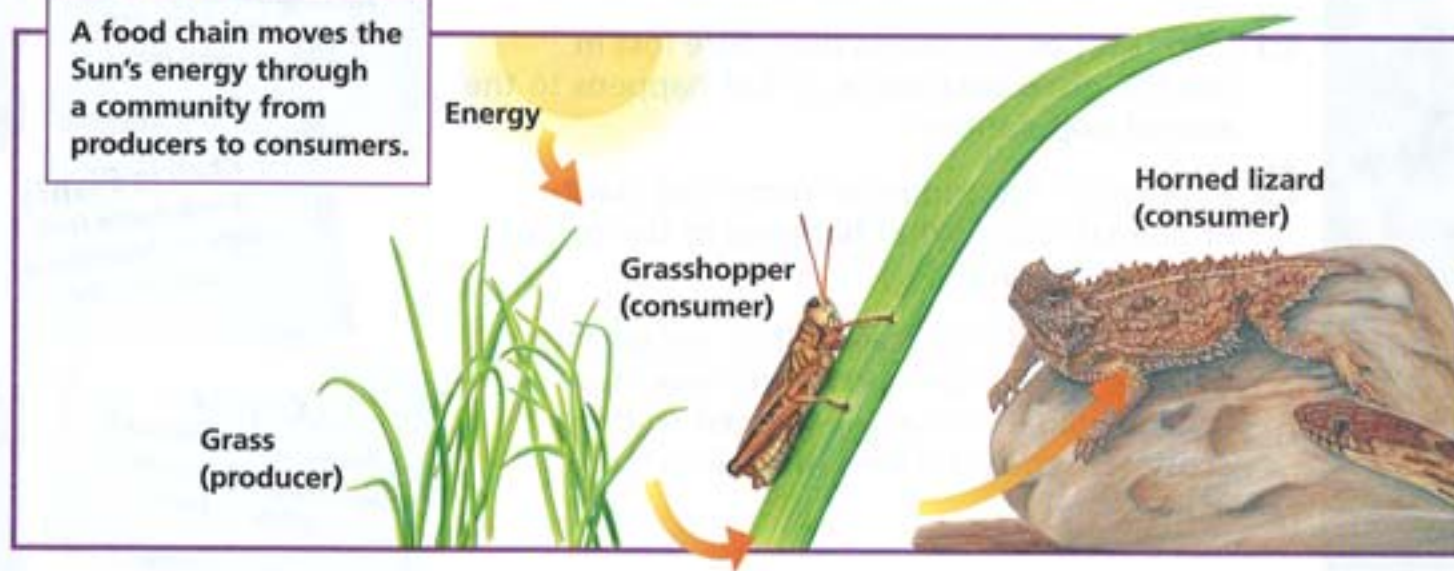
The energy of the Sun is stored in food. The energy in food is passed from one organism to another in a **food chain**. A food chain is the path energy takes from producers to consumers to decomposers.

On the prairie the first organisms in a food chain are plants. Plants capture the Sun's energy during photosynthesis. This energy is stored in foods, or sugars, the plant makes for itself.

What happens when a plant eater such as a grasshopper eats the plant? Animals use the oxygen they breathe to release energy from the energy-rich sugars they eat. Some of the energy is released for the grasshopper to use. Some of the energy is also stored in its tissues. Some is lost as heat. A Texas horned lizard may snap up the grasshopper, and a red-tailed hawk may eat the lizard. In the prairie

A Food Chain

A food chain moves the Sun's energy through a community from producers to consumers.



community, the hawk is one of the organisms at the top of the food chain. It eats snakes, mice, lizards, rabbits, and other birds.

The red-tailed hawk doesn't eat plants. However, because of the food chain, it gets some of the Sun's energy that was originally stored in plants.

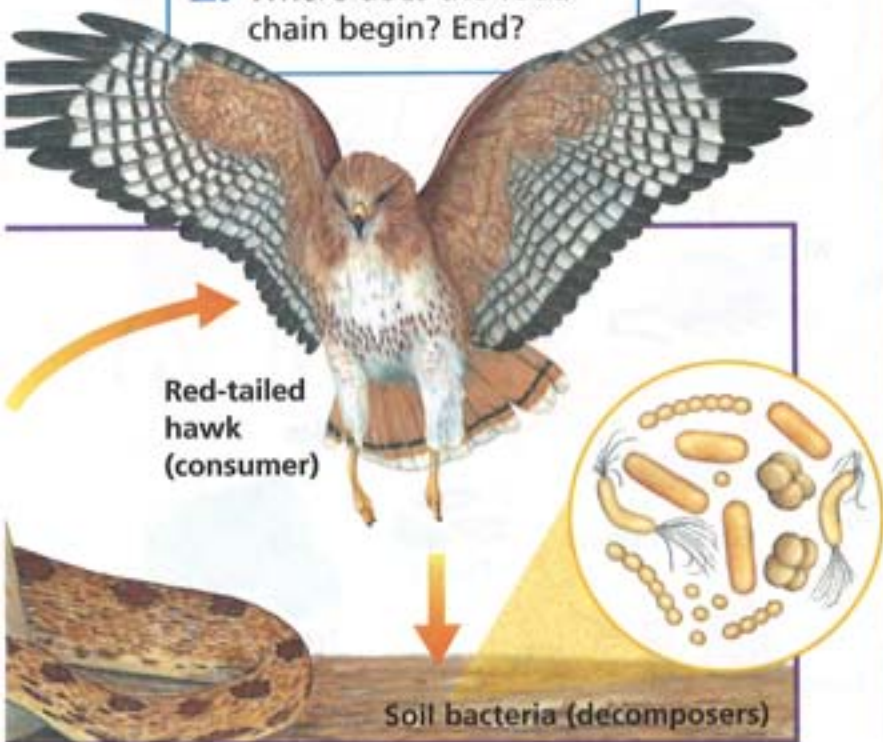
Plants and animals become food for small organisms like crickets and ants when they die. They are also a food source for microscopic organisms like bacteria.

▶ What does a food chain show?

READING

Diagrams

1. What are the members of this food chain?
2. Where does the food chain begin? End?



QUICK LAB

Getting Food

FOLDABLES Make a Shutter Fold. (See p. R 42.) Label the shutters as shown.



1. Take a walk outdoors around your home or school. Choose a community to study. Make a list of the living things you see. Don't include people or domestic animals like dogs, cats, and farm animals. You may want to take photos to complete your observations.
2. **Classify** Divide the organisms into two groups in your Shutter Fold—those that can make their own food (producers) on the left and those that cannot (consumers) on the right.
3. **Classify** Which organisms did you list as producers?
4. **Classify** Which organisms did you list as consumers?
5. **Communicate** Draw one or more food chains in your Shutter Fold to show how energy moves through this community.

What Is a Food Web?

Do all organisms eat only one food? Are all organisms eaten by only one type of animal? No. Animals often eat or are eaten by many different things. How can we study all of the things that an animal eats or is eaten by? A food chain only shows the path of energy as it moves from one organism to another. A **food web** shows the relationship between all of the species in a community. It shows how populations must compete for food. A food web is a map of overlapping food chains.

Producers

All food webs begin with *producers*. The producers on land include grasses, trees, and all other organisms that use the Sun's energy to make their own food. In oceans the main producers are algae.

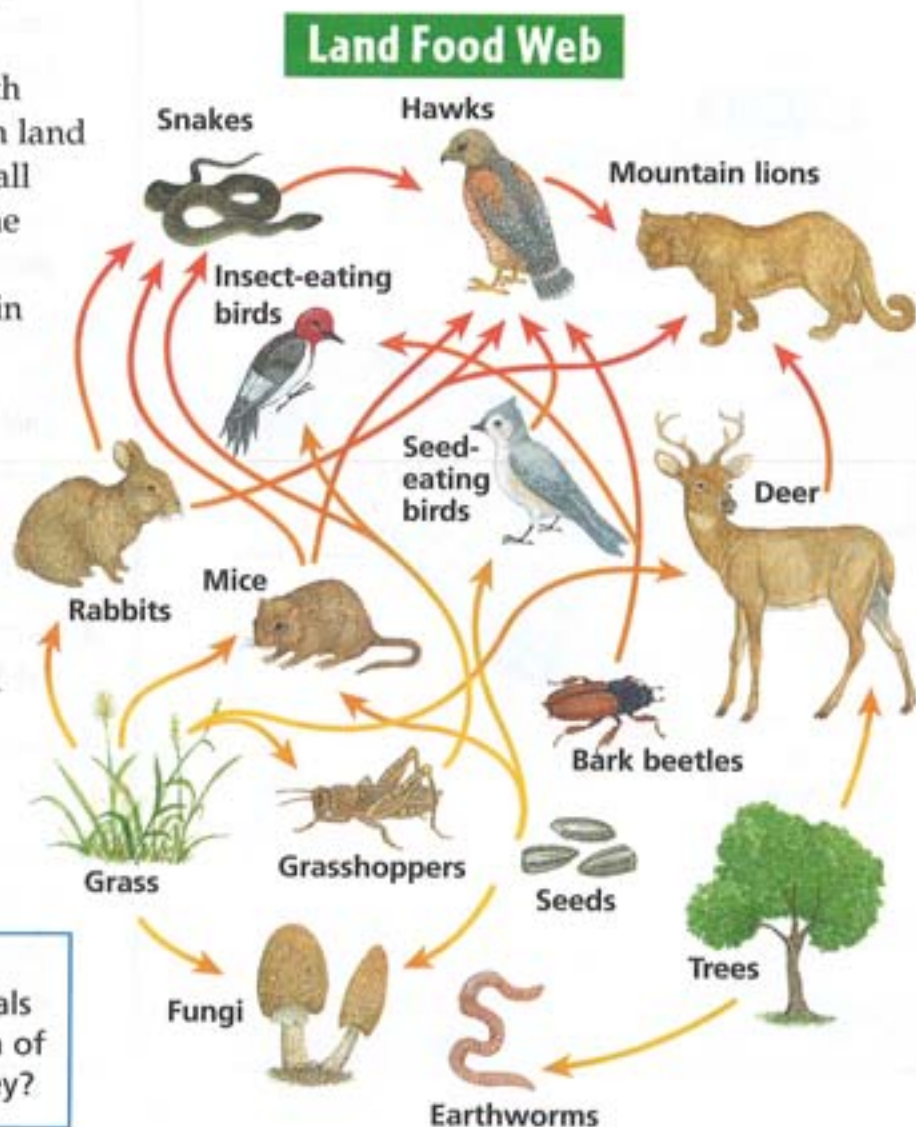
Plant Eaters

Organisms that cannot make their own food are *consumers*. Consumers get energy from the food made by other organisms. Consumers can be grouped according to the type of food they eat. **Herbivores**

(HUR·buh·vawrz) eat producers. Both Earth's land and waters are filled with herbivores—animals that eat plants, algae, and other producers.

Meat Eaters

Herbivores, in turn, are eaten by **carnivores** (KAHR·nuh·vawrz)—animals that eat other animals. All cats, big and small, are carnivores. So are dogs, wolves, foxes, coyotes, and other sharp-toothed animals. The sea also has carnivores. One of the largest of these is the great white shark.

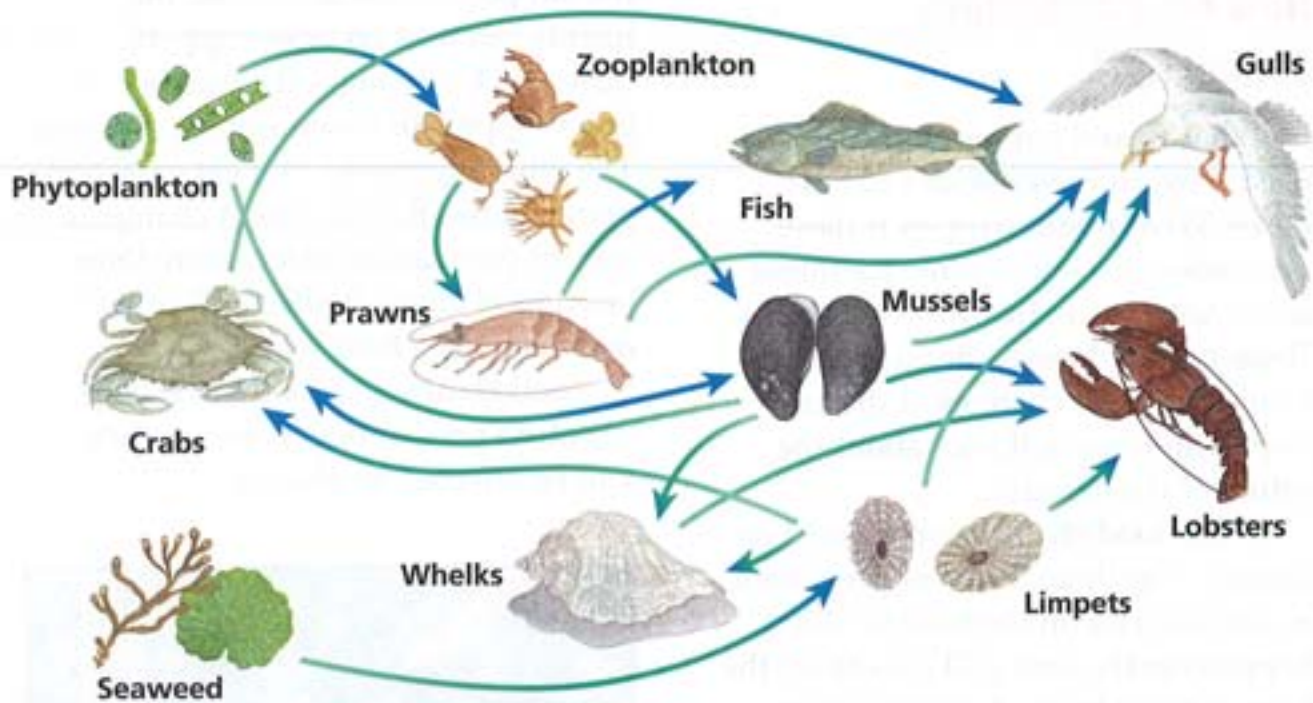


READING

Diagrams

Which of these animals are predators? Which of these animals are prey?

Marine Food Web



Other sea dwellers also eat meat. Seals, dolphins, and whales dine on fish, squid, and even penguins.

Living things that hunt other living things for food are **predators**. The hunted are called **prey**. The relationships between predators and prey are a key part of both food chains and food webs.

However, not all meat eaters are predators. Some animals eat meat but don't hunt it. Such meat eaters are called **scavengers**. They feed on the remains of dead animals. Have you ever seen vultures circling a spot of land? Then you have seen scavengers. Crows are also scavengers. You might see them on a road, pecking at the body of an animal.

The sea is home to many scavengers. One of these is the hagfish. It wanders the ocean floor in search of dead or

dying fish. Some tiny sea creatures also feed on the remains of dead sea animals.

When an animal eats both animals and plants, it is an **omnivore**. You are an omnivore. Bears are omnivores, too, eating things from berries to salmon.

Decomposers

Every food chain and food web ends with *decomposers* such as worms, insects, bacteria, and fungi. These organisms break down dead matter into substances that can be used by producers. Decomposers break down dead organisms and wastes into simpler substances. Some of these substances are absorbed by the decomposers. Some are returned to the soil.

▶ **What are the parts of a food web?**

How Are Populations Connected?

What would happen if farmers used powerful insecticides to kill pests? What might happen if these pesticides also killed some harmless ants? Ants live in the same habitat as Texas horned lizards. Because the lizards eat ants, changes in the ant population may tell a lot about the future of the lizards.

In the food chain, the relationship doesn't stop there. Birds of prey, such as hawks, feed on the lizards. What happens to the ants will also affect the lives of these birds. A change in one population affects all the other organisms in that food chain.

Animals may adapt to changes in their habitats. A varied diet can be useful. Texas horned lizards eat mainly ants. They also eat other insects such as grasshoppers. If



Ant

the ant population decreases, the lizards can feed on grasshoppers instead. This changes the number of grasshoppers in a community, however. The other organisms that eat grasshoppers will be affected, too. A change in the ant population affects more than just a food chain. It affects all of the organisms in a food web.

Food chains and food webs help scientists predict how communities will be affected by change.



Lubber grasshoppers

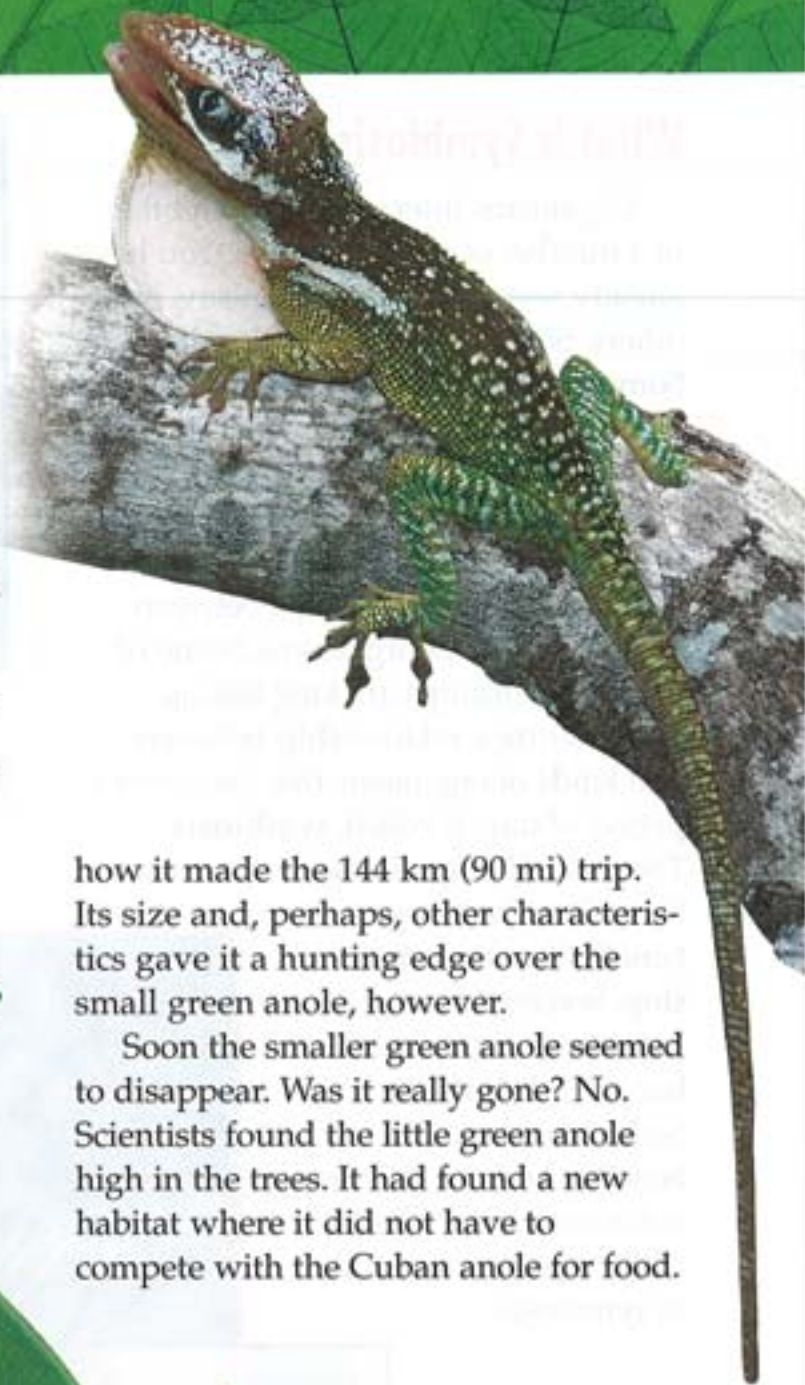
Horned lizard

READING Sequence of Events
How does a change in a food web affect other populations?

How Do Populations Adapt to Competition for Food?

Food webs show that animals compete for food. Fish and gulls must compete for a dinner of prawns, for example. In order to survive, an organism must adapt to competition. Sometimes this competition causes a population to change its habitat. This is what happened to Florida's green anole.

At one time green anoles could be spotted all over Florida, perched on the trunks of trees and the branches of bushes. Then a new and bigger species of anole arrived in Florida from the island of Cuba. Scientists don't know



how it made the 144 km (90 mi) trip. Its size and, perhaps, other characteristics gave it a hunting edge over the small green anole, however.

Soon the smaller green anole seemed to disappear. Was it really gone? No. Scientists found the little green anole high in the trees. It had found a new habitat where it did not have to compete with the Cuban anole for food.

▶ How did the green anole adapt to competition?

The green anole (left), a native of the U.S. southeast, acquired a new habitat when Cuban anoles (above) were introduced.



What Is Symbiosis?

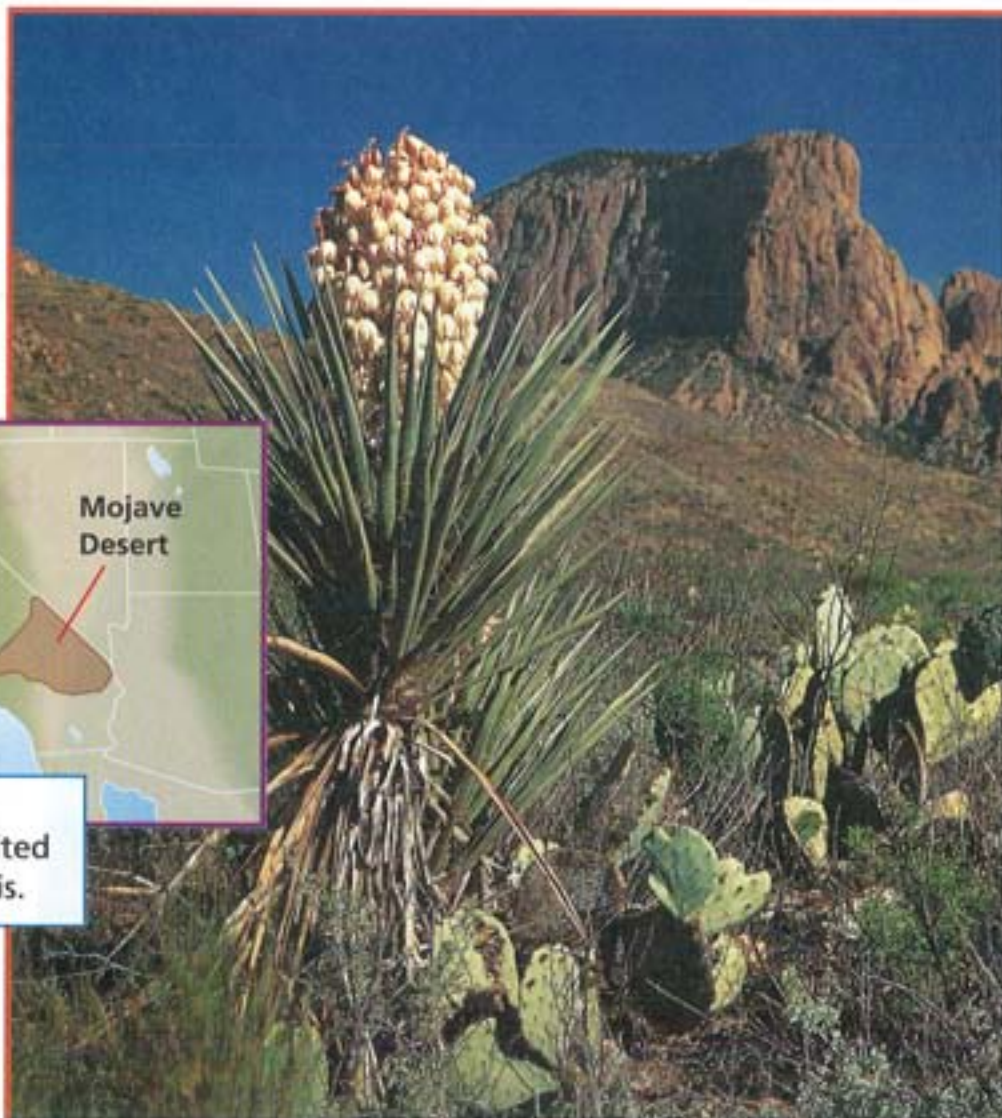
Organisms interact with each other in a number of different ways. You have already seen that some organisms hunt others. Some organisms are predators. Some organisms are prey. You have also seen that organisms may compete with each other for food or territory. Two different kinds of predators may hunt the same prey. However, there are also other kinds of relationships between different kinds of organisms. Some of these relationships are long lasting.

In nature a relationship between two kinds of organisms that lasts over a period of time is called **symbiosis**. There are different kinds of symbiosis. Sometimes both organisms benefit from the relationship. Sometimes one organism benefits while harming the other. Sometimes only one benefits, and the other is not affected. Let's take a closer look at each kind of symbiosis.



Yucca moth

▶ What is symbiosis?



READING

Maps

Describe where in the United States the Mojave Desert is.

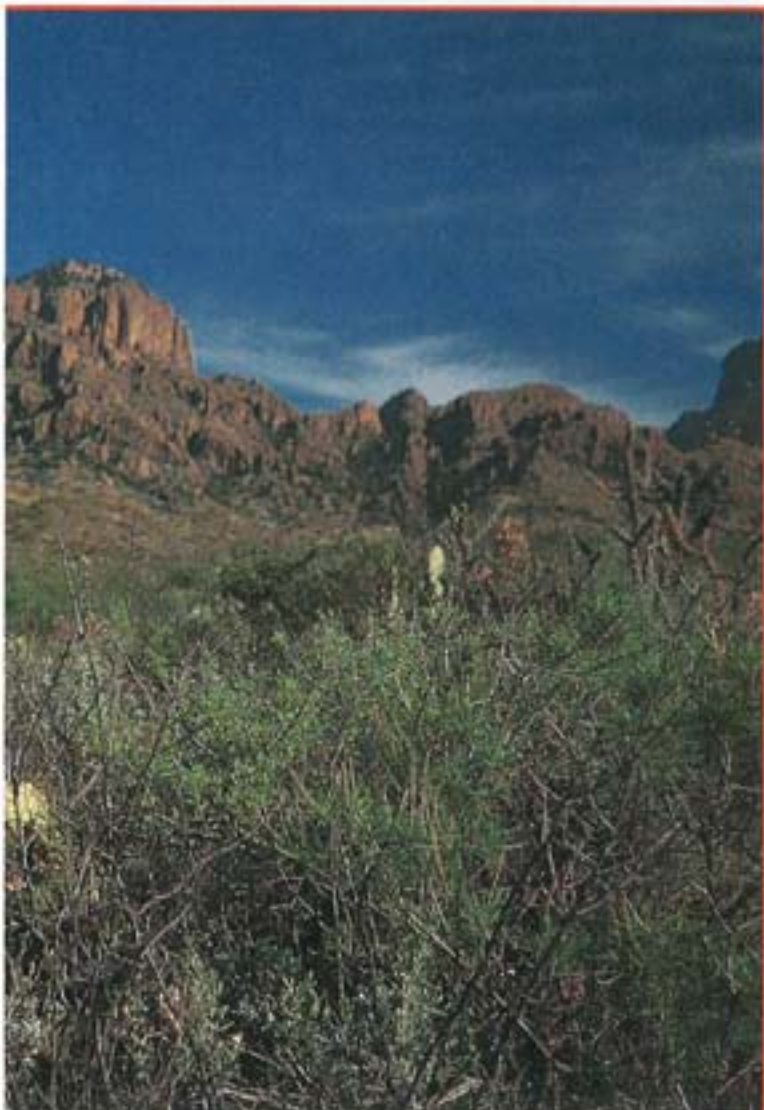
What Is Mutualism?

When a relationship between two kinds of organisms benefits both of them, it is called **mutualism**.

A strange-looking plant grows in the Mojave Desert of southern California. It's called a Joshua tree, or yucca plant.

When this tree's creamy flowers are in bloom, small gray shadows seem to dart from flower to flower. A more careful look reveals that the "shadows" are actually moths. These are yucca moths.

Yucca trees and yucca moths depend on each other for survival. Each helps the other reproduce.



The Yucca Moth and the Yucca Tree

Yucca moths cannot survive without yucca trees. The yucca trees would also quickly become extinct if the moths vanished. The yucca moths and the yucca trees benefit from each other and share a relationship of mutualism. How does this work?

At night a female yucca moth visits a yucca flower. Inside the flower the moth picks up pollen and rolls it up into a ball, which it holds gently in its mouth. Then the moth flutters over to another flower. There it makes a hole in the flower's ovary. The moth injects its eggs through the hole. Finally, it packs the sticky ball of pollen onto the flower's stigma. The stigma and ovary are female reproductive parts of a flower. Pollen holds male sex cells.

In protecting its eggs, the moth has also pollinated the yucca flower. The pollinated flower can then make seeds. Eventually some of the seeds will sprout into new yucca plants. This means yucca plants will continue to grow in the desert.

The moth's eggs and the tree's seeds develop at the same time. When the eggs hatch into larvae, the larvae will feed on some of the seeds. All this is happening inside the protective ovary wall. The larvae are not only getting needed food, they are also safe from predators.

▶ How is mutualism an example of symbiosis?

What Is Parasitism?

A relationship in which one kind of organism lives on or in another organism and may harm that organism is called **parasitism** (PAR-uh-sigh-tiz-uhm). The organisms that live on or in other organisms are called *parasites* (PAR-uh-sights). The organisms they feed on are called *hosts*. The parasites benefit from the relationship. The hosts are harmed by it.

Fleas are parasites of dogs and cats. The fleas live off the blood of these hosts and give nothing back but itching and irritation. Plants also have parasites, which often are other plants.

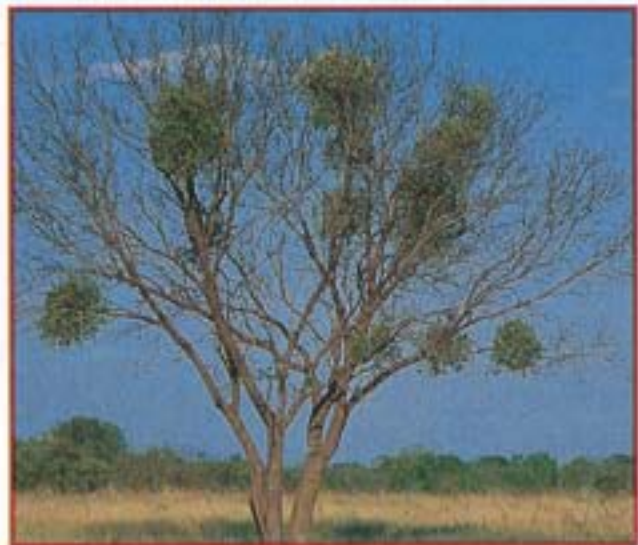
The bright orange dodder plant has little chlorophyll. This means that it can't make enough food to live on. Instead it winds around a plant that can make its own food. The dodder then sends tubes into the stem of the plant it is coiled around. Next, the dodder gets food from the plant through the tubes. Although the plant it lives on usually does not die, it is weakened, grows more slowly, and is not able to easily fight off diseases.

▶ **How does parasitism differ from mutualism?**

Flea



The coiling dodder plant, which can't make enough of its own food, draws food from other plants.



Mistletoe is another parasitic plant. It is an evergreen that grows on the trunk or branches of trees such as hawthorn, poplar, fir, or apple.



The remora picks up the scraps that the loggerhead sea turtle discards.

Orchids benefit from their position on the trunks of trees.



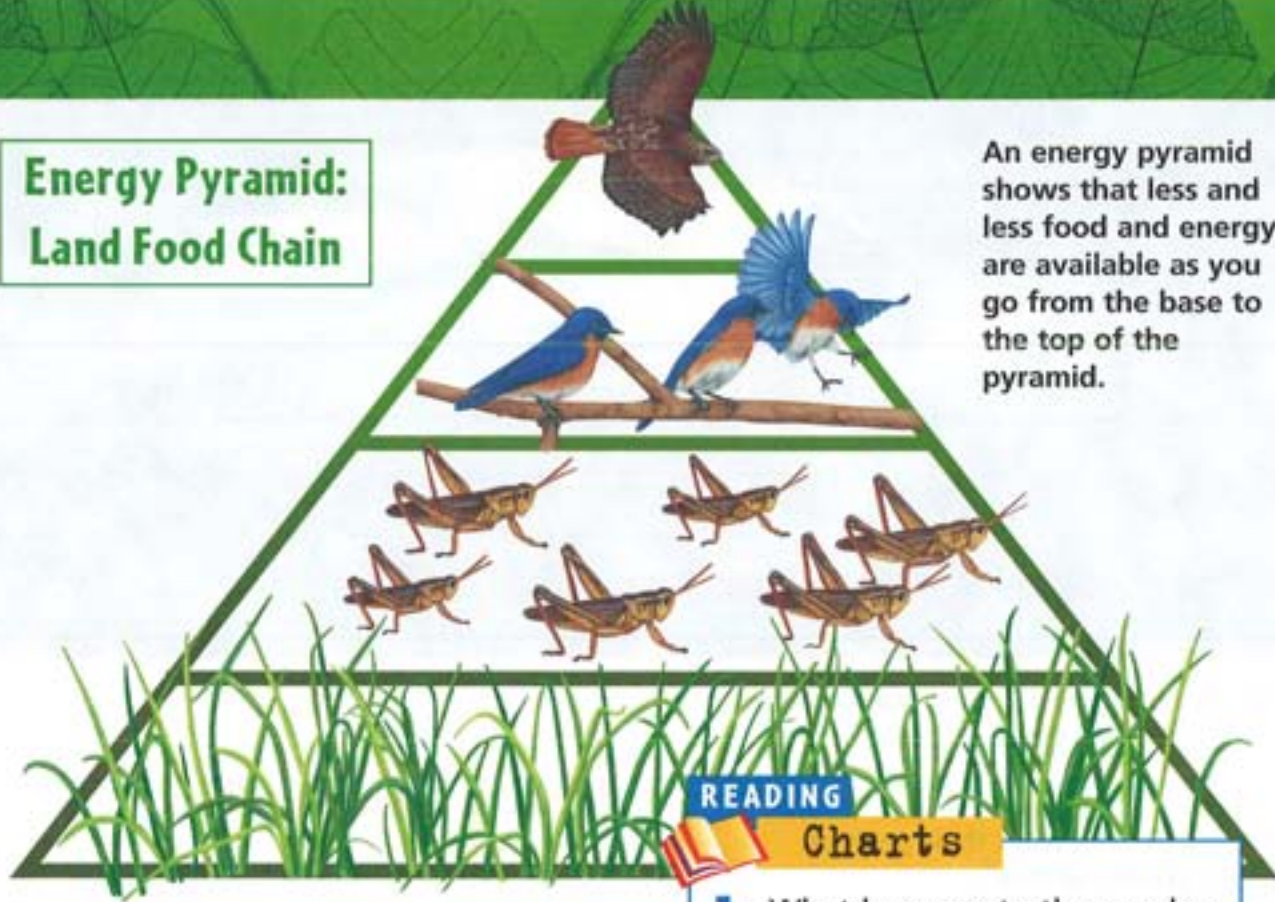
What Is Commensalism?

Few plants can grow on the floor of a rain forest. The thick canopy above keeps light from reaching the ground. Some plants, like orchids, attach themselves to the trunks of trees high above the rain forest floor. The orchids don't take anything from the trees. They simply use the trees to get needed sunlight. This relationship, in which one organism benefits from another without harming or helping it, is called **commensalism** (kuh-MEN-suh-liz-uhm).

Many animals also have this kind of relationship. The remora's dorsal fin is modified into a sucker with which it forms a temporary attachment to the loggerhead sea turtle. When the turtle feeds, the remora picks up scraps. The turtle provides food to the remora. However, the remora neither harms nor helps the loggerhead sea turtle.

▶ **What kind of relationship is commensalism?**

Energy Pyramid: Land Food Chain



An energy pyramid shows that less and less food and energy are available as you go from the base to the top of the pyramid.

How Does Energy Move in a Community?

Plants capture energy from sunlight. When you eat a plant, how much of that energy do you get? All organisms need energy to live. Producers get energy from the Sun. Consumers get it from the foods they eat. However, energy is lost as it passes from one organism to another in a food chain.

You can see the effect of this in the drawing of the energy pyramid on this page. An energy pyramid shows a number of things. It shows that there is less food at the top of the pyramid than at the base. It also shows that there are fewer organisms as you move from bottom to top.

Consumers get their energy from food. The less food there is, the less

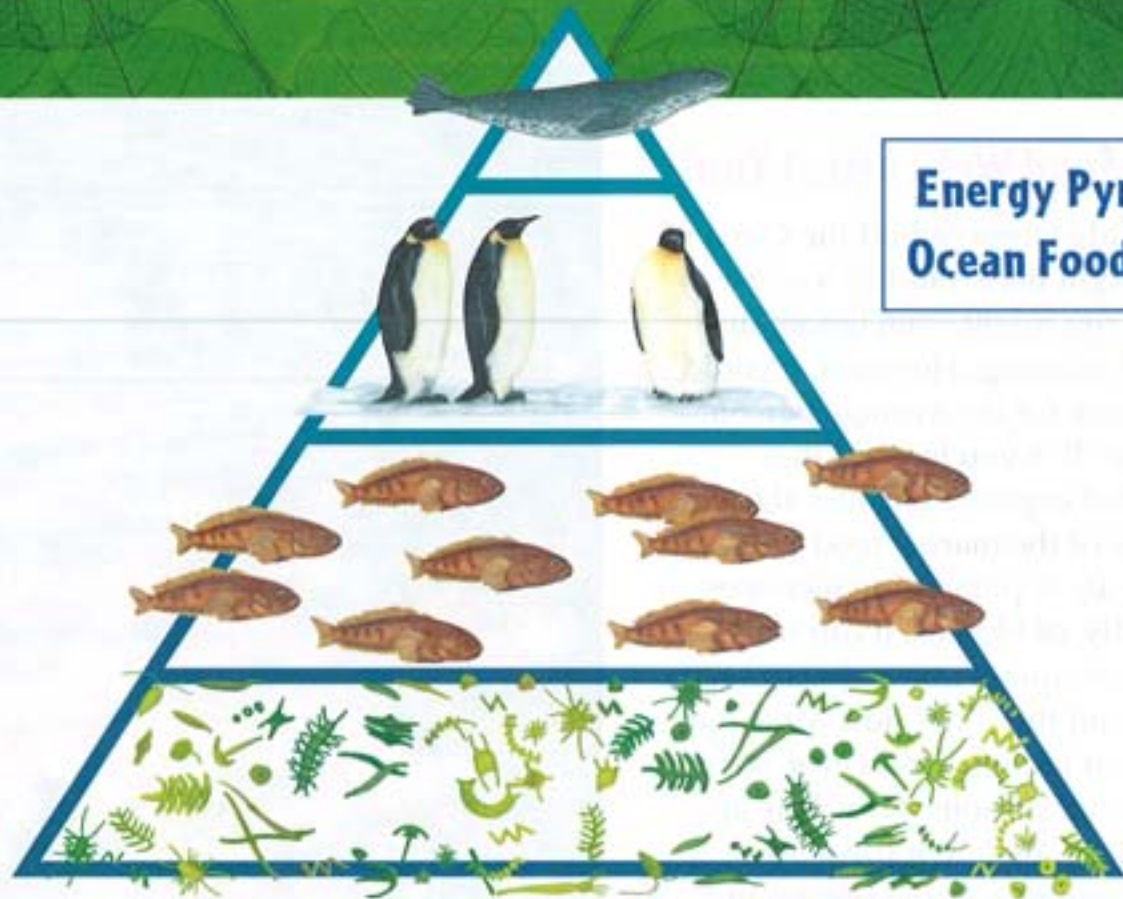
READING

Charts

1. What happens to the number of organisms at each level of the pyramid starting from the base?
2. How much more energy from the Sun was available to the grass than to the bluebirds?

energy is available. Energy decreases from the base to the top of the pyramid.

In an ocean community in the Antarctic, algae form the base. Algae are producers that store energy from the Sun. Small fish that live in the icy waters eat some of these algae. The algae that are not eaten are lost to the community. Their energy is not passed up to the next level of the pyramid. Only some of the energy the fish get is passed up to the next level. The fish use some of the energy in swimming and other activities.



Energy Pyramid: Ocean Food Chain

The penguins dive for the small fish and eat as many as they can catch. Many fish get away. Nevertheless, the penguins have snared some energy-rich fish as food. Some of the energy from the fish is stored in the penguins' tissues. Some of the energy is used to heat their bodies. A dip in the frigid water removes some of this heat from the penguins' bodies. Now they have less energy than they took in from the fish.

Rising from below, a leopard seal clamps its sharp teeth around a helpless penguin and eats it. Does this predator get all the energy that was originally in the algae the fish ate? No. Energy has been lost at each level in the pyramid.

Kilogram for kilogram there are fewer fish than algae. There are fewer

penguins than fish. There are fewer leopard seals than penguins. That's because there is less food and energy available at each higher level in the energy pyramid. The less food and energy there are, the fewer living things that can be supported.

How much energy is lost from one level of an energy pyramid to the next? Scientists have actually measured it. The startling figure is 90 percent! Of all the Sun's energy captured by the algae, the leopard seal gets only one-tenth of one percent.

▶ What does an energy pyramid show?

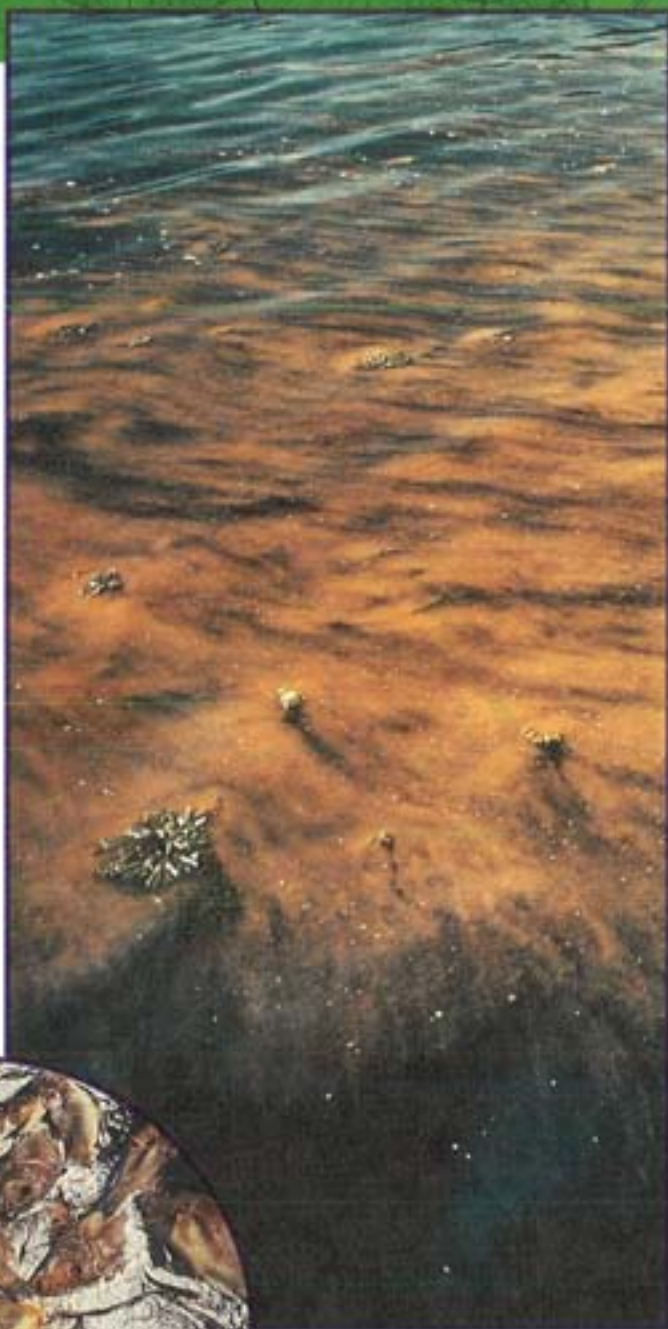
How Do Food Webs Affect You?

“Red Tide Observed off the Coast of Maine” might not seem like a scary headline. You might even ignore this important warning. However, it could mean trouble for the average person.

On page B28 you learned that single-celled organisms called algae are at the base of the marine food web. When the algae population increases very rapidly, or blooms, it can turn hundreds of square miles of ocean red. Scientists call this a red tide. Most red tides are not harmful. However, some algae produce poisons. Fire algae are an example. A bloom of these algae is very dangerous to all the species in a food web.

Small fish and mussels feed on the algae. The algae’s poison may kill or infect the fish. The decline in the fish population reduces the energy available to the consumers that feed on fish.

How does this affect you? People who eat contaminated fish may become very sick. You are part of a food web, too. Humans are at the top of most food webs. Changes in any population may also affect you.



Deadly red tides, like this one, occur when the population of fire algae greatly increases.

▶ How can changes in a food web affect you?

Why It Matters

The lives of all organisms, including humans, are affected by other living things. If the population of one organism in a food chain disappears, the whole food chain is disturbed. If a food chain, food web, or energy pyramid changes, the result will affect humans. By understanding how living things interact with one another people can help preserve the treasures of nature.

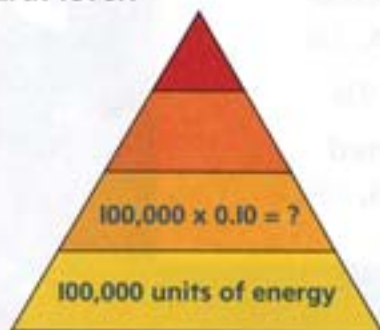
 **Journal** Visit our Web site www.science.mmhschool.com to do a research project on interactions among living things.

Think and Write

1. What is the original source of energy in an ecosystem?
2. Is it possible to have a food chain that has only a producer and a decomposer?
3. What is the relationship between a food chain and a food web?
4. How is mutualism like commensalism? How is it different?
5. **Critical Thinking** Think about human relationships that are symbiotic. Explain what makes the relationship symbiotic. Who is helped? Who is the helper?

MATH LINK

Use percents. An energy pyramid shows that 90 percent of the energy is lost from one level to the next. If you start with 100,000 units of energy, how much energy does the next level get? The fourth level?



WRITING LINK

Writing a Story Stories have a setting, characters, and a sequence of events. They also have a theme, or central idea. Write a story whose theme is a changing ecosystem. Make sure the events in your story involve the lives or activities of your characters.

HEALTH LINK

Investigate parasites. How do parasites affect humans? What do these organisms gain from their host? How do they harm it? Write a paragraph on this topic.

TECHNOLOGY LINK

LOG ON Visit www.science.mmhschool.com for more links.

Vocabulary

limiting factor, B34

carrying
capacity, B35

endangered
species, B36

extinct, B36

threatened
species, B36

How Populations Survive

Get Ready

What affects the size of a population? Some forests are so thick with trees and shrubs that you would have a tough time hiking through them. However, hiking through other forests would be as easy as walking down a country road or the street in front of your house.

What makes some areas crowded and others empty? What do organisms need in an environment in order to survive?

Inquiry Skill

You **communicate** when you share information.

Explore Activity

What Controls the Growth of Populations?

Procedure

- 1** Label the cartons 1 to 4. Fill cartons 1 and 2 with dry potting soil. Fill cartons 3 and 4 with moistened potting soil. Fill the cartons to within 2 cm of the top.
- 2** Plant ten seeds in each carton, and cover the seeds with 0.5 cm of soil.
- 3 Use Variables** Place cartons 1 and 3 in a well-lighted area. Place cartons 2 and 4 in a dark place. Label the cartons to show if they are wet or dry and in the light or in the dark.
- 4 Observe** Examine the cartons each day for four days. Keep the soil moist in cartons 3 and 4. Record your observations.
- 5** Observe the plants for two weeks after they sprout. Continue to keep the soil moist in cartons 3 and 4, and record your observations.

Drawing Conclusions

- 1 Communicate** How many seeds sprouted in each carton?
- 2 Observe** After two weeks how many plants in each carton were still living?
- 3** Why did some seeds sprout and then die?
- 4 FURTHER INQUIRY Infer** Use your observations to explain what is needed for seeds to sprout and what is needed for bean plants to grow. Use evidence to support your explanation.

Materials

4 small, clean milk cartons with the tops removed

40 pinto bean seeds that have been soaked overnight

soil

water



Read to Learn

Main Idea Living and nonliving things interact in ecosystems.

What Controls the Growth of Populations?

How much do living things depend on conditions in their environment in order to survive? Certain factors control the growth and survival of living things. What do these factors include?

A dry wind howls across the prairie. The hot Sun bakes the ground below. No rain has fallen in days. Grasses have withered. Plant-eating insects have gone hungry.

High in the bright, cloudless sky, a hawk flies one way and then another. Its sharp eyes sweep over the barren land below. An unsuspecting deer mouse scurries along the ground in search of an insect.

The mouse's tan fur blends in with the dusty soil, but its movement gives it away. The hawk tucks in its wings and dives like a falling rock. In a flash its talons grab the mouse.

Hidden in this story are clues to how the size of a population is limited. Anything that controls the growth or survival of a population is called a **limiting factor**.

Some limiting factors are nonliving. In the story the sunlight, wind, water, and temperature were nonliving limiting factors. They controlled the population of grasses on the prairie.

The grasses, insects, deer mice, and hawks were living limiting factors. The grasses had withered. There was less food for plant-eating insects, so the number of insects living on the prairie decreased. That meant there was less food for the insect-eating deer mice. The deer mouse population was also limited by the hawks, which are predators.

The number of predators in an ecosystem affects the number of prey. The number of prey in an ecosystem can also determine how many predators the ecosystem can support. If there were few hawks, the deer mouse population



Organisms like coyotes (above) and raccoons (left) compete with each other for resources such as food, water, and territory.

might stay steady or even rise. More hawks, however, mean fewer deer mice.

Hawks compete with other predators, like coyotes and raccoons. Coyotes and raccoons hunt many animals, including small rodents like deer mice. Coyotes and raccoons also compete with each other for food, water, and places to live. The population that wins such competitions is likely to grow.

However, even a growing population faces problems. Its size will soon limit its own growth. The organisms in the population will become crowded. They will have to compete with one another for food, water, and shelter. Some will die. Eventually there will be enough resources for the number of organisms that remain. The maximum population size that the resources in an area can support is called the **carrying capacity**.

READING **Sequence of Events** Explain how a change in the coyote population could affect the number of mice in an area.

Overcrowding, as in this group of walruses, limits the growth of any population.

QUICK LAB

Playground Space

FOLDABLES Make a Folded Table. (See p. R 44.) Label it as shown. Record your results in the Folded Table.

| | How Much Space? |
|-------------------|-----------------|
| #3 Use Numbers | |
| #4 Infer | |
| #5 Infer | |

- 1. Measure** Use a meterstick to measure the sides of your playground.
- 2.** Multiply the length by the width to find the area in square meters. If your playground is irregular, use triangles and squares to find the area.
- 3. Use Numbers** To find out how much space each student has, divide the area of the playground by the number of students.
- 4. Infer** What would happen to the space each student had if the number of students doubled?
- 5. Infer** Suppose two other classes with the same number of students as yours used the playground at the same time as your class. What effect might this have on your class?
- 6.** Compare your area and space per student with the results that other groups obtained. Are there any discrepancies? Explain.

What Happens When Habitats Are Changed?

Did you know that American bald eagles were once found in almost every part of the United States? When the first European settlers sailed to American shores, bald eagles roamed the skies of the Atlantic and the Pacific coasts. They inhabited every large river and lake in North America.

Bald eagles need wilderness areas with tall trees to nest and perch in, and clean waters to fish in, to survive. However, as the human population settled all over North America, the bald eagle's natural habitat disappeared, and their food supplies decreased. When this happened, eagles started feeding on chickens and other domestic livestock and large numbers were shot by people. By the late 1800s, the population of bald eagles had sharply declined.

In 1940 the Bald Eagle Act was passed. As a result, eagle populations began to recover. At the same time, however, DDT and other pesticides began to be widely used. Pesticides sprayed on plants were eaten by small animals, which were later eaten by birds of prey. The DDT poison harmed both the adult birds and the eggs that they laid. The egg shells became too thin and were often crushed. Eggs that were not crushed during incubation often did not hatch. Large quantities of DDT were discovered in the bodies of adult bald eagles too.

Bald eagles were once common on the Blackland Prairie.



When the effects of DDT were understood, people all over the country worked to help save the bald eagle. DDT was banned and laws continued to protect our national symbol. In 1976, the U. S. Fish and Wildlife Service officially listed the bald eagle as an **endangered species**. This means that a species is in danger of becoming **extinct**. A species is extinct when it has died out completely.

The bald eagle population responded well to these conservation measures. The number of bald eagles went from less than 850 in 1963 to almost 13,000 in 2000 in the lower 48 states. In 1995, the bald eagle's status was upgraded to **threatened species**. This means that the species may become endangered. Today, about half of the world's 70,000 bald eagles live in Alaska.

▶ **Why did bald eagles start feeding on domestic livestock?**

Inquiry Skill

BUILDER

SKILL**Use Variables**

Vanishing Bald Eagles

The table below shows the average number of bald eagle eggs that hatched in the wild during a 16-year period. It also shows the level of an insecticide in bald eagle eggs during the same period. What is the relationship between these two variables?

Variables are things that can change. In order to determine what caused the results of an experiment, you need to change one variable at a time. The variable that is changed is called the *independent variable*. A *dependent variable* is one that changes because of the independent variable.

Materials
ruler

Bald Eagle Egg-Hatching Data

| Year | 1966 | 1967 | 1968 | 1969 | 1970 | 1971 | 1972* | 1973 | 1974 | 1975 | 1976 | 1977 | 1978 | 1979 | 1980 | 1981 |
|--|------|------|------|------|------|------|-------|------|------|------|------|------|------|------|------|------|
| Average number of young hatched (per nest) | 1.28 | 0.75 | 0.87 | 0.82 | 0.50 | 0.55 | 0.60 | 0.70 | 0.60 | 0.81 | 0.90 | 0.93 | 0.91 | 0.98 | 1.02 | 1.27 |
| Insecticide in eggs (parts per million) | 42 | 68 | 125 | 119 | 122 | 108 | 82 | 74 | 68 | 59 | 32 | 12 | 13 | 14 | 13 | 13 |

*pesticide banned

Procedure

- 1 Infer** What is the independent variable in the study? What is the dependent variable in the study?
- 2 Communicate** Make a line graph showing the average number of young that hatched. Make another line graph showing the amount of insecticide in eggs.

Drawing Conclusions

- 1 Use Variables** Based on the graphs, what appears to be the relationship between the amount of insecticide in eggs and the number of young hatched?
- 2 Hypothesize** Suggest a reason for the relationship.



How Do People Change the Environment?

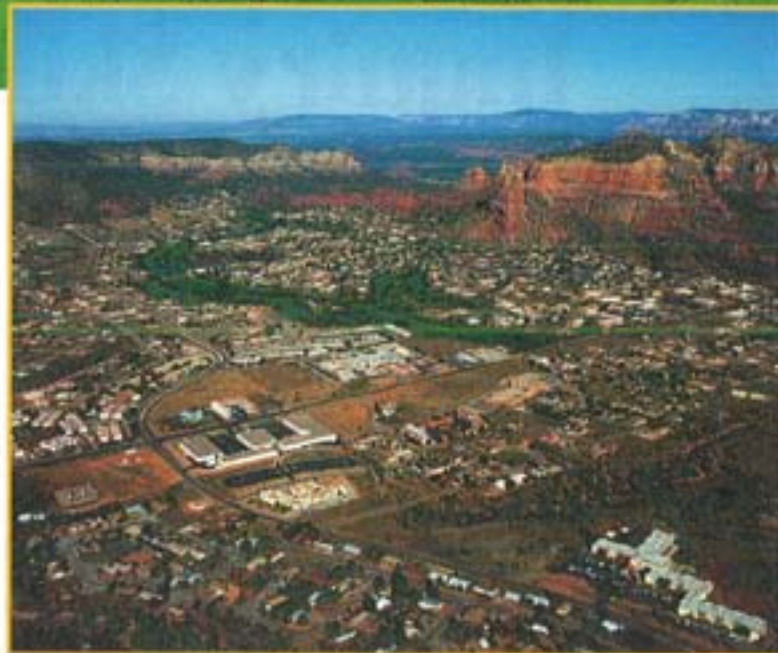
The two competitors face off. There is an enormous silence in the tenseness of the moment. Slowly, silently, heads and shoulders are lowered. Then they charge and their massive weights are crashed together. Finally, one retreats in defeat. No, this is not a football game. It is the grandest rivalry in nature: Two rams fighting for the right to breed and pass along his genes to the next generation.

From the high alpine of the Rocky Mountains to the rocky peaks of the southwestern desert, bighorn sheep have adapted and survived in harsh conditions. However, their once huge numbers are declining due to their fiercest predator. It is not the mountain lion or the bobcat, but the human species.

Humans have the most profound effect on the environment. As our population continues to grow, so do the factors that bring about environmental degradation, including pollution, and urban growth. Environmental degradation is the process by which the environment is reduced in quantity and quality.

Urban Growth

During the westward expansion, around 1860, the human population in the U.S. was 31,443,321 and the population per square mile was 7.9. In 2000 the population was 281,421,906 and the population per square mile



Aerial view of Sedona, Arizona

was 79.6. Since the size of the land is the same, this means that humans are encroaching on more and more land. Humans have the ability to change the course of a river for a new highway or destroy an ecosystem and clear huge tracts of land for apartment complexes and housing developments. However, we also have the ability to make wise land use decisions so we can meet our needs while preserving our natural heritage. This is possible because we understand how ecosystems work and what they need to remain viable.

Pollution

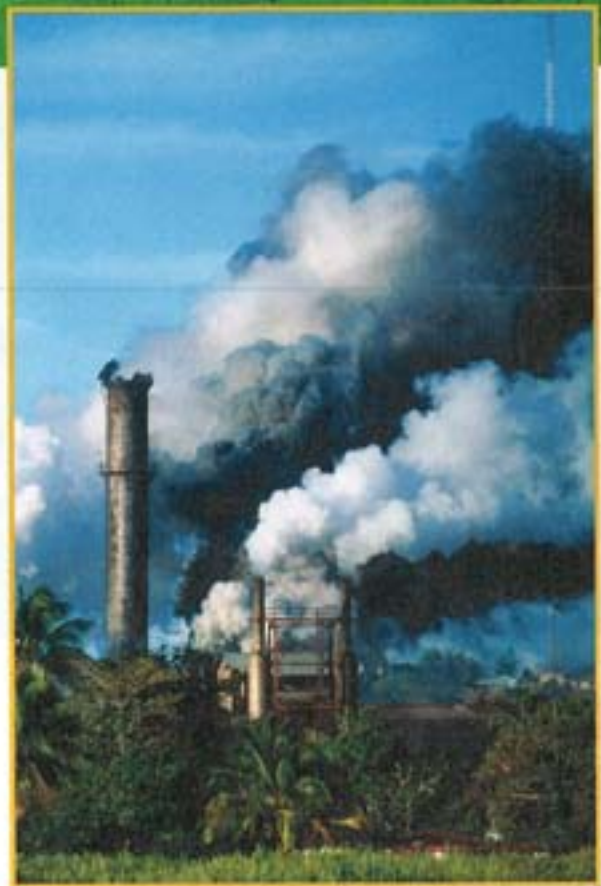
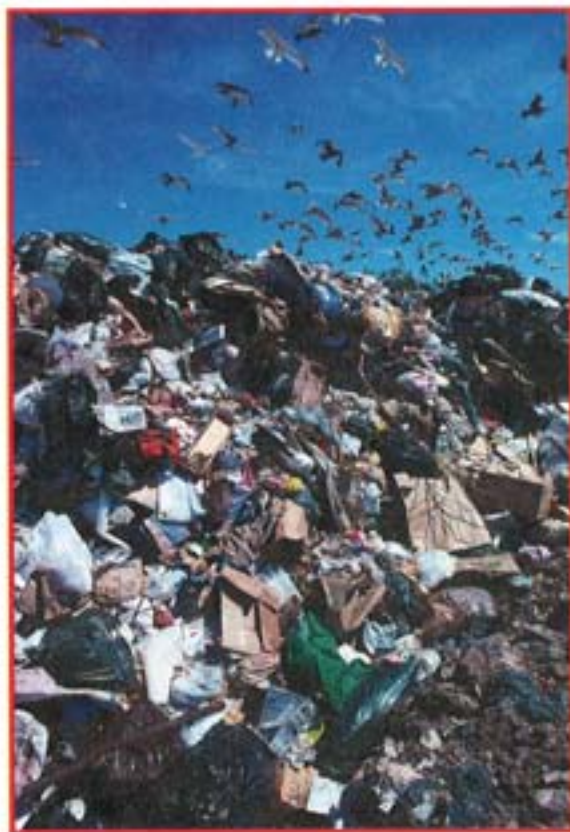
There are different kinds of pollution. Air pollution is produced by fuels that are burned to power industries, transport systems, and homes. To reduce this kind of pollution we should always remember to conserve energy.

Water pollution is caused by different factors. A common problem is

excess fertilizers used in agriculture. Rain carries these excess fertilizers to streams and lakes. The algae in these streams and lakes grows excessively because of the fertilizers. When they die, they sink to the bottom where they decay. The decaying process uses the oxygen that other animals and plants need to survive.

Another kind of pollution is garbage. With more people comes more garbage and new places to put it. Landfills are filling quickly and new sites must be developed to accept the tons of garbage produced every day. When the land cannot sufficiently handle it, garbage is shipped out to sea to be dumped and become part of the food chain. To reduce this problem,

Garbage disposal landfill



Factories produce smoke that pollutes the air.

people can apply the three Rs of conservation: reduce, reuse and recycle. For example, we can reduce the amount of paper we use by using both sides of it, we can reuse things like bags and boxes, and we can take paper, plastic, and glass to the local recycling center.

Our use of the land has a constant effect on our natural resources, plants, animals, air, and water. Humans have done a lot to damage the environment. However, human intervention now helps to rehabilitate, recover, and preserve many areas of land that are vital to the survival of many different populations.

▶ What are some things we can do to conserve the environment?



How Does Mining Change the Environment?

The soil under your feet looks brown. The rocks are mostly gray. However, both hold a treasure chest of glittering colorful metals—gold, silver, aluminum, iron, copper, and many more.

People use these metals in many ways. Gold is made into jewelry and coins. Silver is, too. Silver is also used in photographic film and tableware.

Fly in an airplane. Ride in an automobile. Open a soft drink can. Squeeze a toothpaste tube. Marvel at fireworks. For all these things, you can thank aluminum. It's in each of these products.

Every large building, bridge, ship, train, and piece of machinery has iron in it—usually as part of steel.

Turn on your TV, your home's lights, a CD player. Electricity flowing through copper wires gets them going.

Clearly metals play an important part in our modern society. However, we pay a price for them—and not only

The easiest way to mine metals that are near the surface is to scrape the surface away. However, this leaves the land barren and often covered with dangerous chemicals.

in money. Since metal-containing rocks are buried in the ground, we must change the ground to get at them. If the rocks are near the surface, we simply carve away huge areas of land. This is called surface mining, open-pit mining, or strip mining.

In the United States alone, about 2,331 km² (900 mi²) of land has been cleared for mining. That's about three-fourths of the area of the entire state of Rhode Island.

Surface-mined land is loaded with substances that are harmful to living things. Rainwater flows easily over this kind of land and carries pollutants into nearby streams, rivers, and lakes. The wind picks up dust, which pollutes the air. In both cases, living things are harmed.

▶ What is strip mining?

Why It Matters

In nature, the size of a population is determined by the resources available and competition for those resources. However, populations today are also dependent on human actions.

People can do good and bad things to the environment. They can interfere with an ecosystem by damming up rivers, using pesticides, and cutting down trees. They can also preserve an ecosystem by passing laws that protect its animals and plants.

e-Journal Visit our Web site www.science.mmhschool.com to do a research project on the limiting factors of a species of your choice.

Think and Write

1. Identify two biotic and two abiotic limiting factors.
2. Explain what carrying capacity is using an example.
3. How does the decline in the bald eagle population affect other populations?
4. Make a list of ways you and your community affect your environment.
5. **Critical Thinking** Explain and evaluate some ways that humans affect ecosystems.

LITERATURE LINK

Read *The Eagles Are Back!* to learn about two eaglets named Ross and Betsey who were raised in a safe environment and then were returned to the wild. Try the activities at the end of the book.



MATH LINK

Find the range. Using the data on page B37, determine the range of young hatched and the range of insecticide in eggs from 1966 to 1981.

WRITING LINK

Expository Writing What resources have been exploited in your state? What are the results? Research the topic. Use the facts you find to write an essay. Then use scientific reasoning to end your essay with a recommendation, at the local and global levels, regarding this resource.

TECHNOLOGY LINK



Science Newsroom CD-ROM
Choose *Keep Them Alive* to learn how sea turtles and other species get what they need to survive from their environment.



Visit www.science.mmhschool.com for more links.

Amazing Stories

Coral Reefs



Rain Forests of the Sea


They're sometimes called "rain forests of the sea." That's because they're home for an amazing variety and number of creatures—up to a quarter of all the oceans' animals. They can take thousands of years to form. They grow in shallow, warm waters. Creatures smaller than your thumbnail build them, and they can be over a thousand miles long. What are they? Coral reefs!

A coral reef is built by millions of tiny animals called coral polyps. They live together in colonies, or groups. Coral polyps secrete a substance that hardens into skeletons. The hard skeletons build up reefs over time. Special algae live inside coral polyps. The algae

produce food for the polyps. Coral reefs form only in shallow waters because the algae need sunlight to produce food.

A coral reef often looks like a sea garden because of its beautiful shades of orange, yellow, purple, and green. The colors come from the different algae and sea animals that live among the corals. Coral reefs provide food and shelter for thousands of ocean plants and animals, including hundreds of kinds of fish.

Some of the more unusual inhabitants of coral reefs include small fish and shrimp known as cleaners. Cleaners eat parasites from larger fish, such as barracudas and eels.



Coral reefs are endangered. As humans develop shorelines near the reefs, soil runs into coastal waters and smothers the fragile reefs. Pollution and destructive fishing practices also threaten reefs. Today many countries are trying to protect and save coral reefs.

What Did I Learn?

1. A coral reef is formed by
 - A small pieces of rock.
 - sea shells.
 - tiny animals.
 - sand particles.
2. Coral reefs are endangered because of
 - severe storms.
 - human development along shorelines.
 - lack of sunlight.
 - too many animals.



Red and yellow soft coral



Cleaner shrimp at work



Visit www.science.mmhschool.com for more amazing stories and facts about ecosystems.

Chapter 5 Review

Vocabulary

Fill each blank with the best word or words from the list.

abiotic factor, B6

community, B11

ecology, B11

food chain, B18

mutualism, B25

niche, B12

omnivore, B21

population, B11

predator, B21

symbiosis, B24

1. A consumer that eats both plants and animals is called a(n) _____.
2. Water is an example of a(n) _____.
3. A(n) _____ includes all the members of a single species in a certain place.
4. Corn, elms, and armadillos are part of the _____ of the prairie ecosystem.
5. The study of how living and nonliving things interact in the same place is called _____.
6. All populations have a unique _____ in their habitat.
7. The relationship of _____ means that both populations benefit.
8. A(n) _____ is a consumer that hunts for its food.
9. A relationship between two organisms that lasts over a period of time is called _____.
10. You can trace how energy moves in a community with a(n) _____.

Test Prep

11. All of the following are abiotic factors in an ecosystem EXCEPT
 - A water.
 - B minerals.
 - C bacteria.
 - D soil.
12. A vulture is an example of a
 - F predator.
 - G scavenger.
 - H carnivore.
 - J all of the above
13. One example of a parasitic plant is
 - A mistletoe.
 - B an orchid.
 - C a fir tree.
 - D seaweed.

- 14.** Surface mining can harm the environment when
- F** trees are cut down to clear the land.
 - G** dust from surface-mined land causes air pollution.
 - H** rainwater washes pollutants into nearby streams.
 - J** all of the above
- 15.** A relationship in which one organism benefits from another without helping or harming it is called
- A** parasitism.
 - B** mutualism.
 - C** commensalism.
 - D** symbiosis.

Concepts and Skills

- 16.** **INQUIRY SKILL Use Variables** Study the table below. Suggest a reason for the change in the eagle population.

| Population Size | | | |
|-----------------|-------------------------------|---------|--------|
| Year | Grasslands (mi ²) | Rabbits | Eagles |
| 1960 | 10,200 | 101,000 | 1,050 |
| 1970 | 9,100 | 89,000 | 864 |
| 1980 | 8,200 | 78,000 | 782 |
| 1990 | 5,300 | 42,000 | 386 |
| 2000 | 5,140 | 41,900 | 378 |

17. Reading in Science Describe the sequence by which the Sun's energy is moved through a community.

18. Scientific Methods You discover that two of your ten ferns have a bacterium living on their stalks. If all the ferns are the same size and age, and you care for them all the same way, how do you determine if the fern and the bacterium have a symbiotic relationship? How would you determine if this relationship is an example of parasitism or mutualism?

19. Critical Thinking What is the relationship between herbivores and carnivores? Explain your answer in a paragraph.

20. Product Ads Advertisements for some products claim that the products are environmentally friendly. What does that mean? What are examples of products that are environmentally friendly and products that are not?

Did You Ever Wonder?

INQUIRY SKILL Hypothesize When wildlife are in a limited area and not free to roam, larger animals can be severely affected. What hypothesis explains this?

LOG Visit www.science.mmhschool.com to boost your test scores.

CHAPTER

6

LESSON 4

Cycles of Life, B48

LESSON 5

Biomes, B62

LESSON 6

How Ecosystems
Change, B78

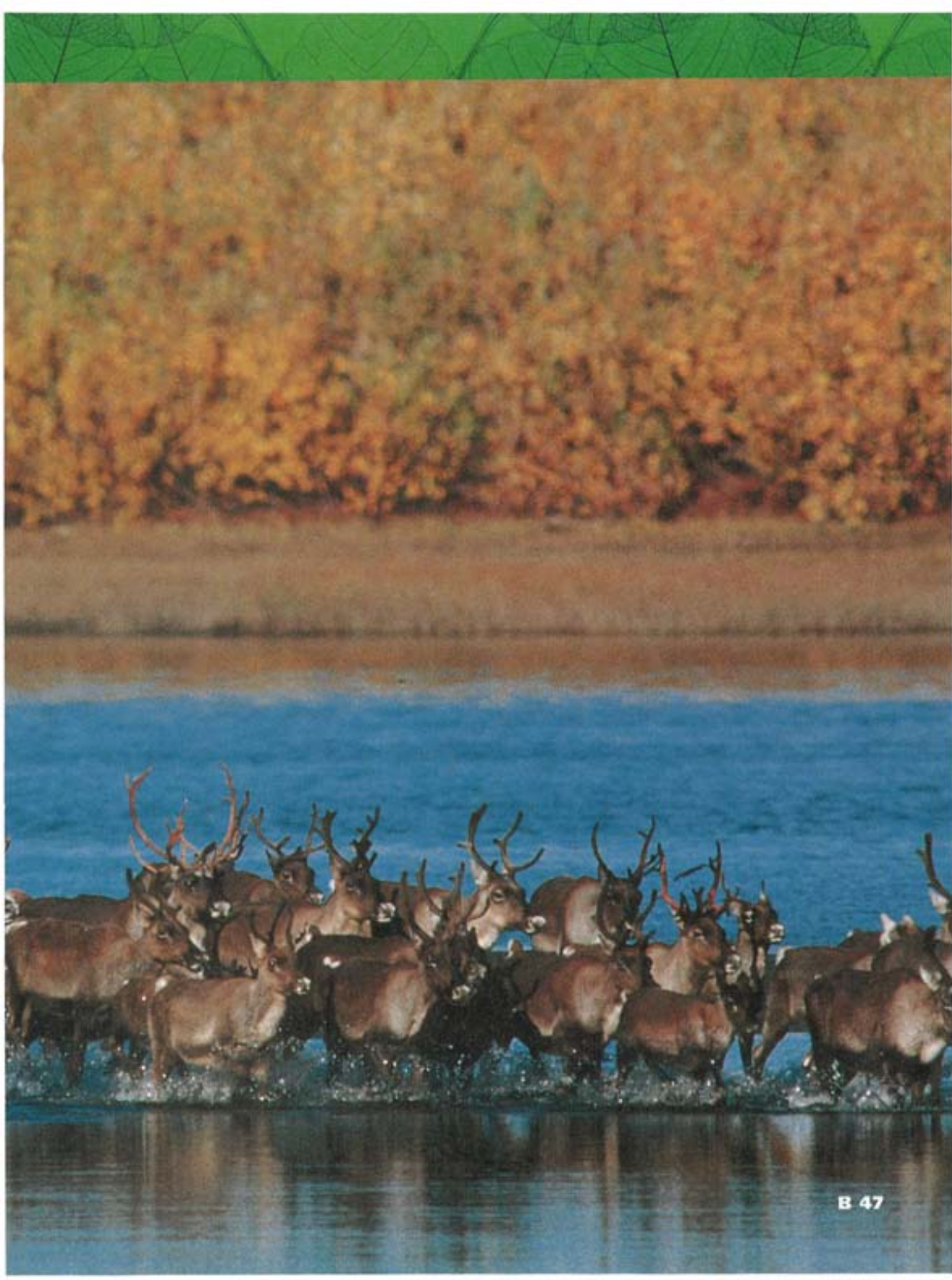
Ecosystems



Did You Ever Wonder?

In winter, these caribou leave their home on the tundra and migrate south, where they can find food and give birth to their young. In the summer they will return and usually find the same landscape they left in the winter.

INQUIRY SKILL **Hypothesis** Why can ecosystems remain unchanged year after year?



Cycles of Life

Vocabulary

evaporation, B50
condensation, B50
precipitation, B51
water cycle, B51
carbon cycle, B53
nitrogen cycle, B54

Get Ready

Have you ever walked in a grassy field early in the morning after a clear night? What did you observe about the grass? It was probably wet with dew.

Where did all this water come from? It hadn't rained in the night. Dew comes from water in the air. How is water stored in the air? How does it change to dew?

Inquiry Skill

You **infer** when you form an idea from facts or observations.

Explore Activity

What Is the Water Cycle?

Procedure

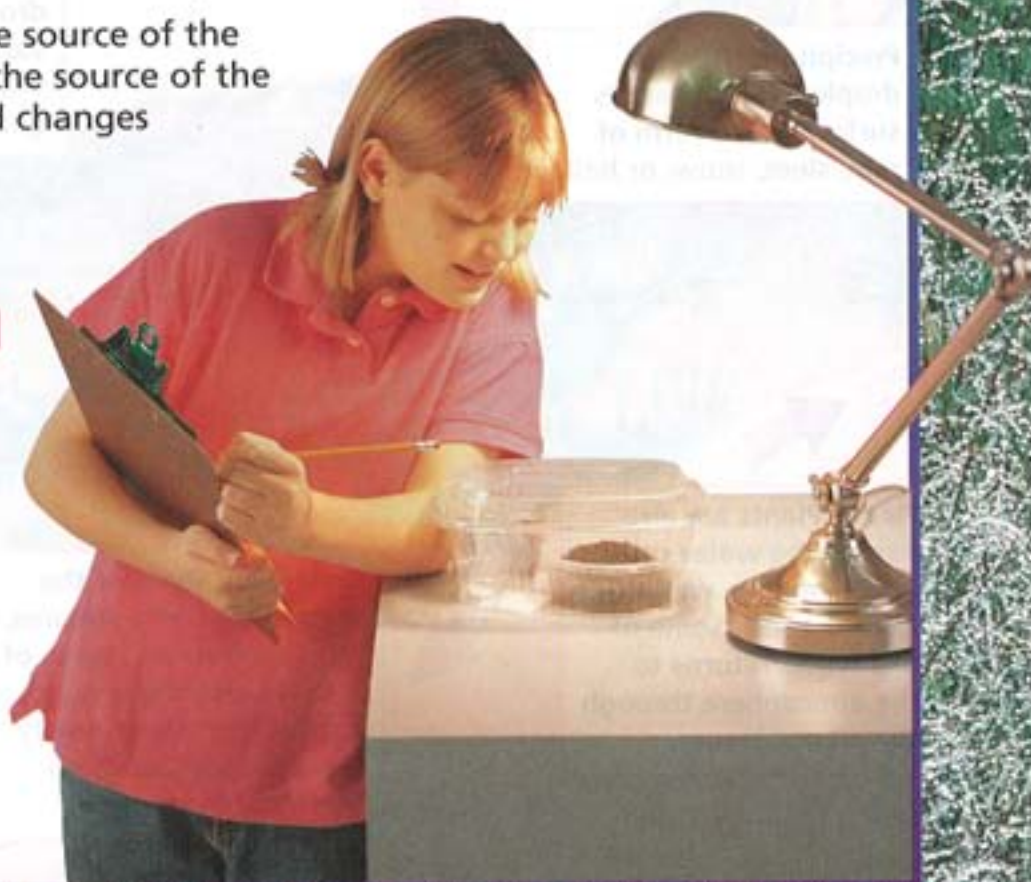
- 1** Place the dry paper towel, the dry soil, and the bowl of water in the plastic container. Close the container with the lid.
- 2** **Observe** Place the container under a lamp or in direct sunlight. Observe every ten minutes for a class period. Record your observations.
- 3** Observe the container on the second day. Record your observations.

Drawing Conclusions

- 1** What did you observe the first day? What did you observe the second day?
- 2** **Infer** What was the source of the water? What was the source of the energy that caused changes in the container?
- 3** What happened to the water?
- 4** **FURTHER INQUIRY**
Infer How did the water move? Use your observations to explain how water is recycled.

Materials

plastic food container with clear cover
small bowl or cup filled with water
small tray filled with dry soil
paper towel
100-W lamp (if available)



Read to Learn

Main Idea Earth's systems recycle materials, such as water, carbon, and nitrogen.

What Is the Water Cycle?

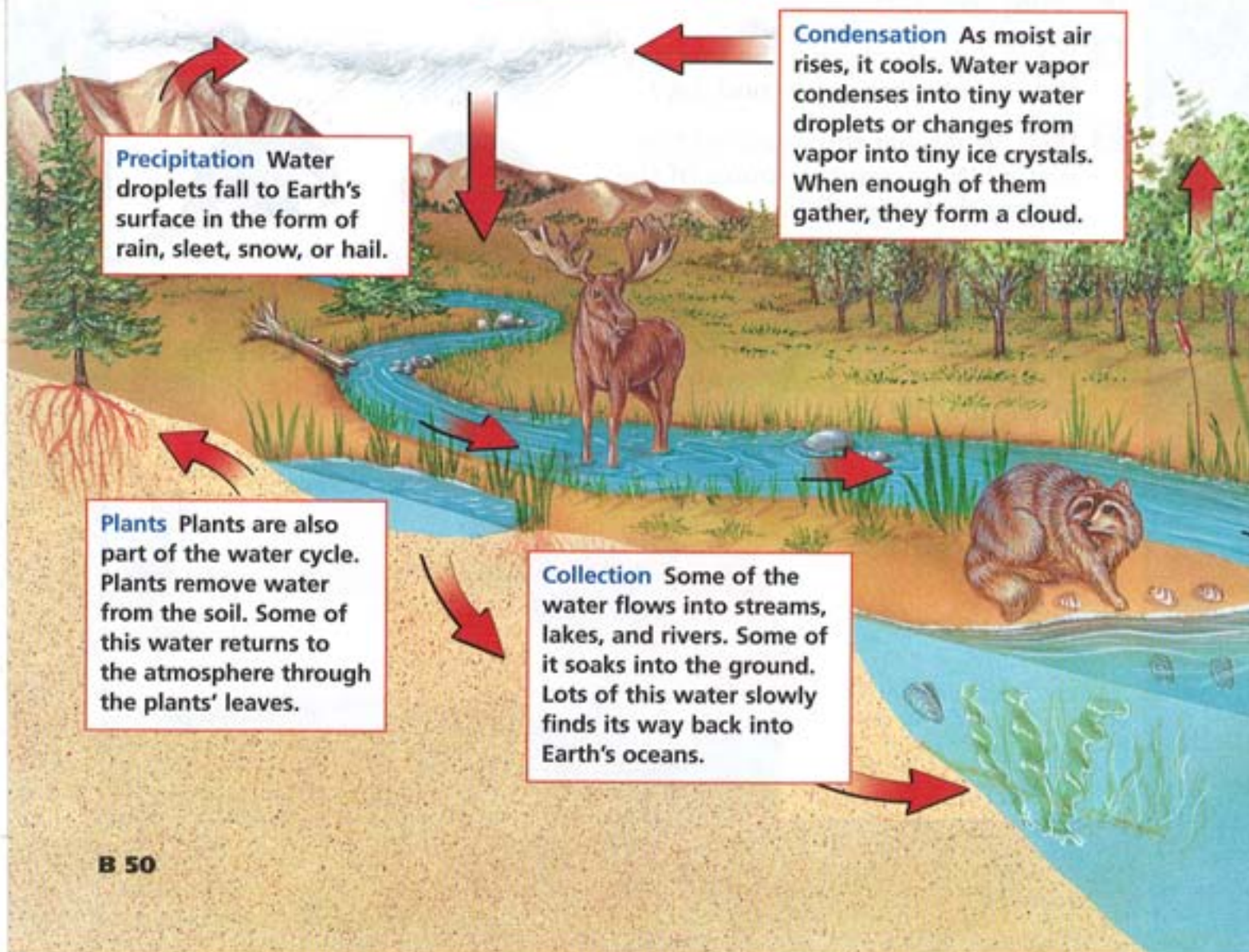
What happens to rainwater after it falls? Does it simply vanish? Water moves from one part of the environment to another. It is not lost from an environment. In other words, water is recycled. How is this possible?

Here's how it happens. Heat from the Sun is absorbed by oceans, seas, lakes, streams, ponds, and even puddles. This heat makes the water evaporate and go into the air.

Evaporation is the process in which a liquid changes into a gas.

As the *water vapor*, or water in its gas state, rises higher and higher into the atmosphere, it cools. When cooled enough, water vapor condenses into tiny water droplets. **Condensation** is

The Water Cycle



the process in which a gas changes into a liquid.

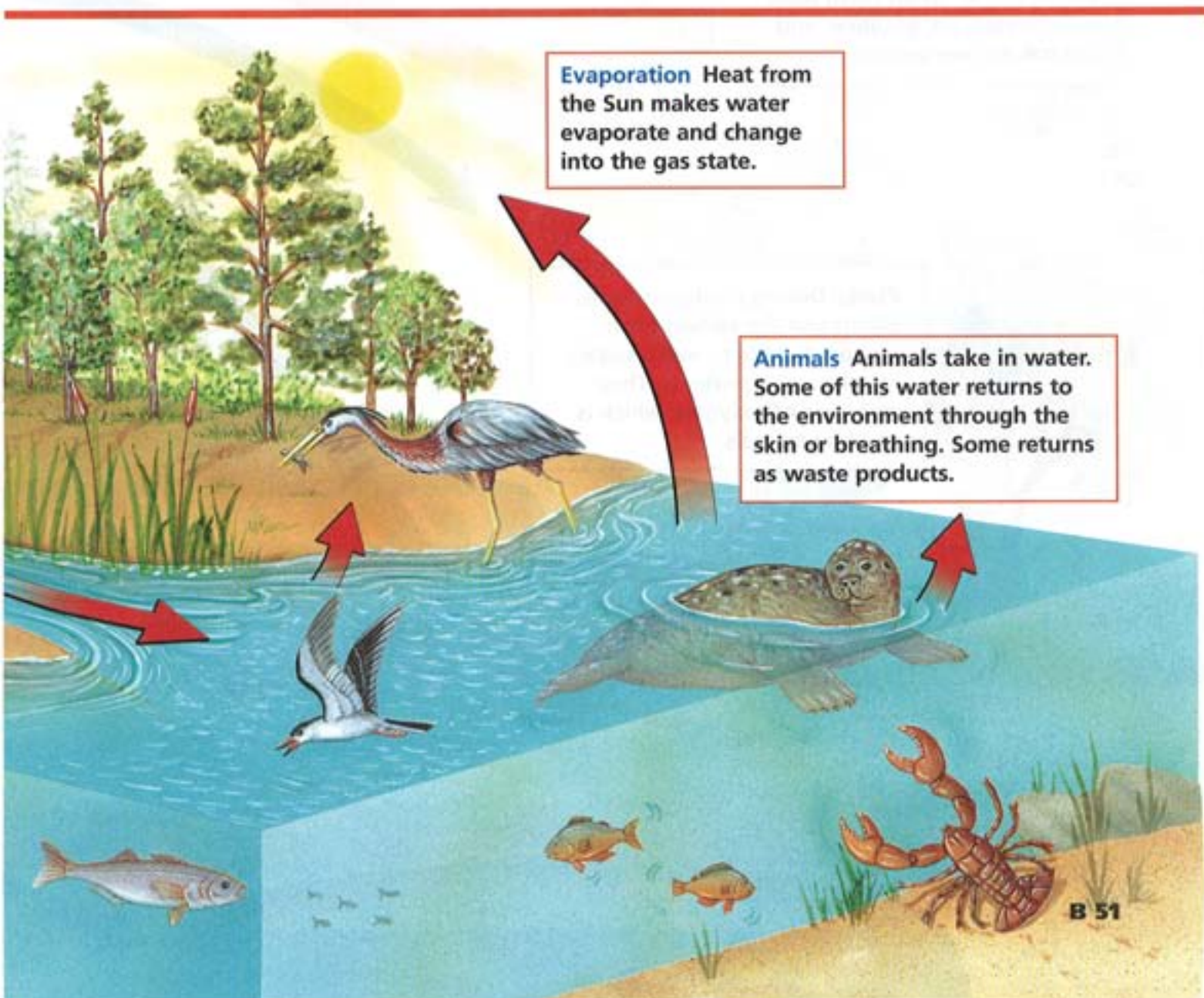
When enough water droplets gather, a cloud is formed. As more and more droplets gather, they become too heavy to stay in the air. They fall to Earth's surface as **precipitation**. Precipitation is any form of water particles—rain, sleet, snow, or hail—that falls to Earth.

On land some of the precipitation seeps into the ground and is stored as *groundwater*. Some of the water, however, lands on the *watershed*.

A watershed is an area on which water flows downhill to a common stream, lake, or river. This water is called *runoff*. It slowly finds its way back to the ocean. Here it absorbs heat and evaporates into the atmosphere again. The **water cycle** is the continuous movement of water between Earth's surface and the air, changing from liquid to gas to liquid.

READING Summarize

What are the stages of the water cycle?



What Is the Carbon Cycle?

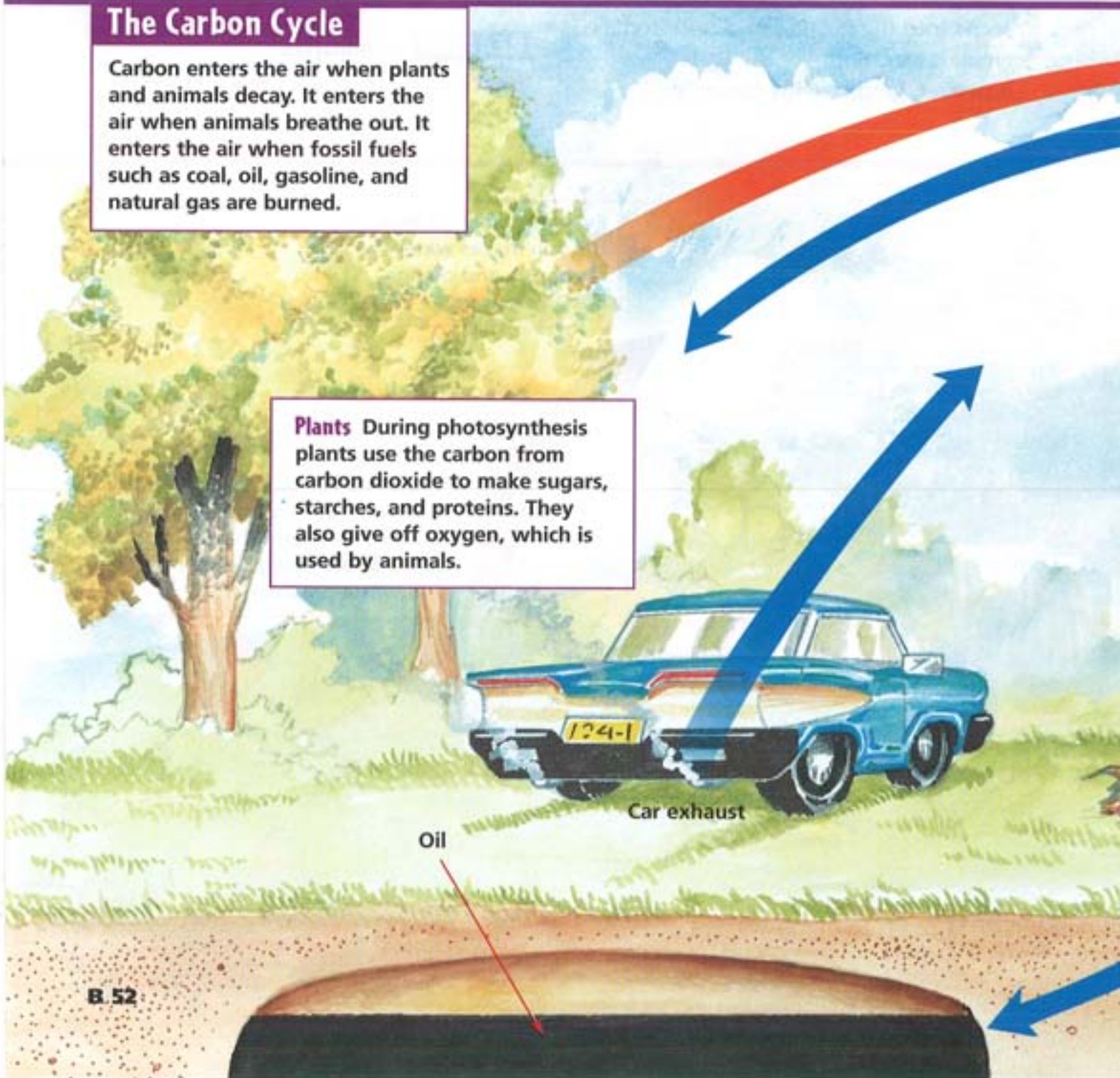
Have you ever roasted marshmallows over a fire until the outsides turned black? Have you ever left bread in the toaster for so long that it burned? The “black” that you observe on burnt food is carbon.

Carbon is a very important element. It is one of the elements that make up all living things. It is found in the air as carbon dioxide and is used by plants in photosynthesis. It is found in many of the things we use every day, from fuel to chairs to nonstick pans.

The Carbon Cycle

Carbon enters the air when plants and animals decay. It enters the air when animals breathe out. It enters the air when fossil fuels such as coal, oil, gasoline, and natural gas are burned.

Plants During photosynthesis plants use the carbon from carbon dioxide to make sugars, starches, and proteins. They also give off oxygen, which is used by animals.



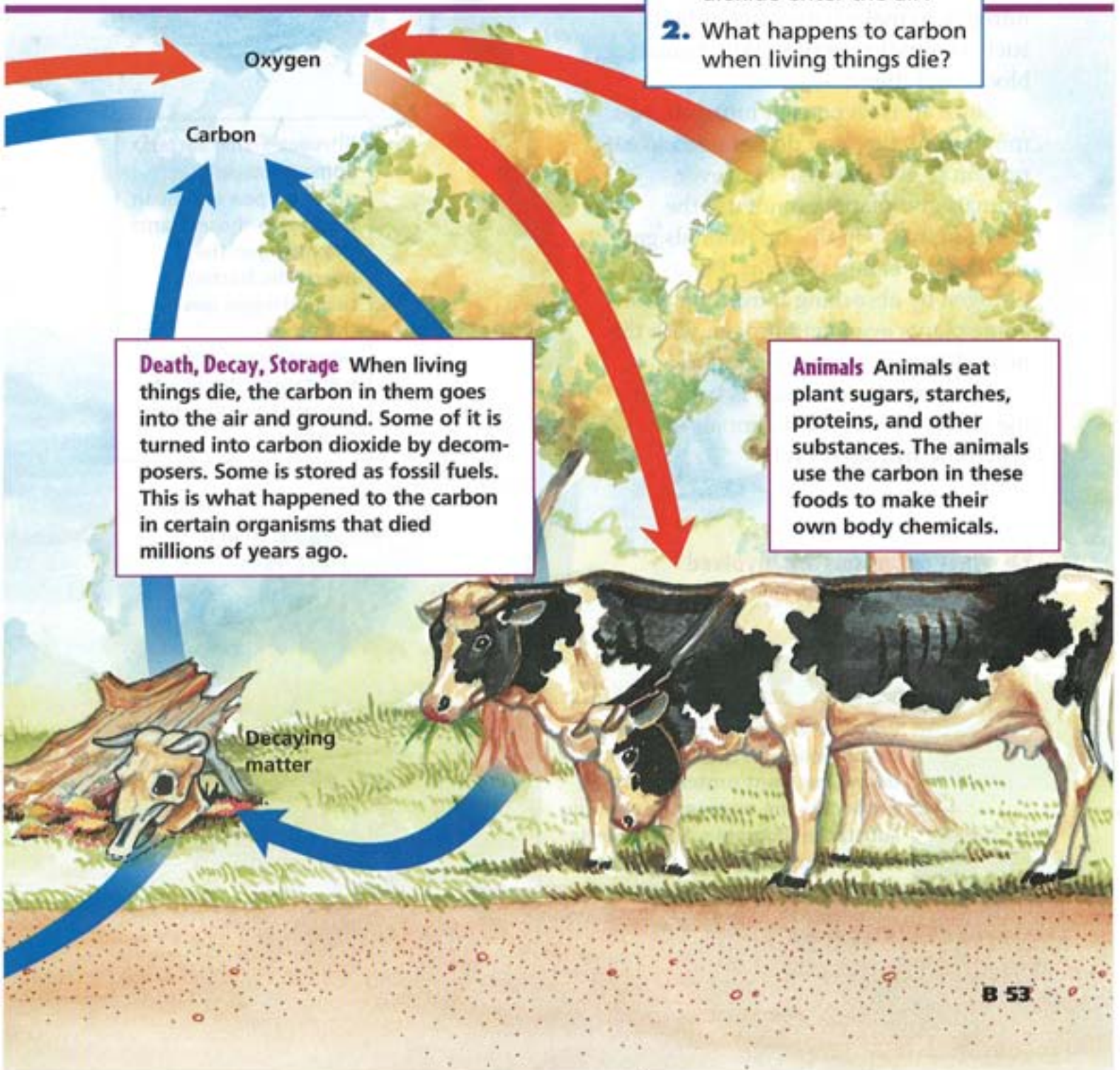
Like water, carbon is recycled by nature. The process is called the **carbon cycle**. The carbon cycle shows the continuous transfer of carbon between the atmosphere and living things. Read the diagram to learn how nature does this.

▶ What does the carbon cycle do?

READING

Diagrams

1. When does carbon dioxide enter the air?
2. What happens to carbon when living things die?



How Is Nitrogen Recycled?

What do you need nitrogen for? When you eat meat, fish, cereal, or vegetables, you are taking in the nutrients that your body needs to make *proteins*. Proteins are a part of your muscles and many cell structures.

Among other things, proteins are rich in the element nitrogen. You need nitrogen to make parts of your body, such as muscles, nerves, skin, bones, blood, and digestive juices.

Since air is 78 percent nitrogen, you might think that you do not need to eat protein to get nitrogen. However, animals and plants cannot use the nitrogen that is in the air. Animals get nitrogen by eating proteins. Plants get nitrogen by absorbing it from the soil. Some plants even get nitrogen with the help of a special group of bacteria.

The way nitrogen moves between the air, soil, plants, and animals is called the **nitrogen cycle**.

The Nitrogen Cycle

Air Air is made up of about 78 percent nitrogen gas.

Nitrogen-Fixing Bacteria

Some bacteria that grow on pea and bean roots give those plants the nitrogen they need. The bacteria turn nitrogen gas in the air to nitrogen-containing substances the plants can use to make their proteins.

▶ **What organisms are involved in the nitrogen cycle?**

Decomposers When plants die, decomposers in the soil break down the plant proteins. One product is the nitrogen-containing substance ammonia. Soil bacteria change ammonia into nitrites.

Ammonia

READING

Diagrams

1. Compare the different ways various kinds of bacteria help in the nitrogen cycle.
2. How do pea and bean plants get the nitrogen they need?

Denitrifying Bacteria Some soil bacteria turn nitrates back into nitrogen gas.

Animals Animals eat plant proteins, or they eat other animals that eat plant proteins. Animal wastes contain nitrogen compounds.

Plants Plants absorb nitrates dissolved in water through their roots. The nitrogen is then used by the plant to make proteins.

Bacteria Certain bacteria can use nitrogen from the air to make nitrogen-containing substances called *nitrites*. Other bacteria can turn nitrites into *nitrates*—another group of nitrogen-containing substances.

Nitrites

Nitrates

Nitrites and ammonia

Nitrogen compounds



This dead tree is being decomposed by fungi, shown here, and microscopic bacteria.

How Are Trees Recycled?

How can a dead tree help living things? Even though the tree is dead, it is being turned into substances other organisms need to survive. Some of these organisms are other trees. The dead tree is providing elements for living trees. When these trees die, they will provide elements that other trees need. The cycling of matter is continuous. How does this happen?

An old, fallen tree is made of wood, bark, and other dead tree tissue. That tissue holds all sorts of complex chemical substances. Most of the chemicals are too complex to be used by other living things. They need to be broken down into simpler chemicals.

This is the job of the decomposers. They are organisms that recycle matter from dead organisms. Worms, crickets, cockroaches, bacteria, and fungi are decomposers. These organisms can

break down dead wood and other dead plant parts into carbon dioxide and ammonia. All living plants need carbon dioxide in order to make sugars. Ammonia is a simple substance that contains the element nitrogen. Nitrogen is extremely important for plants. No plant can live or grow without nitrogen. All organisms need nitrogen in order to make proteins.

Nitrogen is a chemical found in plant *fertilizers*. Fertilizers are substances used to add minerals to the soil. Some fertilizers are natural. These are decaying plants and animals, and animal wastes. Other fertilizers are made in factories. Both natural and artificial fertilizers contain nitrogen. The next time you go to a store that sells fertilizers, read the labels. You're sure to find nitrogen as one of the ingredients.

Composting

You can help nature recycle plant material by composting. Gardeners use compost to make soil more fertile. A good mixture for compost is three parts dry leaves and plant material, one part fresh grass clippings, and one part food scraps. Earthworms, insects, fungi, and bacteria break down the leaves, grass, and food scraps into compost. The compost contains nitrogen, phosphorous, and potassium, which enrich the soil.

As you'll soon discover, like water, nitrogen and carbon have their own cycles in nature. Earth is a closed system. With the exception of energy, almost nothing gets out or gets in. It is recycled.

▶ How do decomposers recycle nutrients?

Fertilizers sold in stores contain nitrogen. Nitrogen is an element plants need to grow and stay healthy.



| Guaranteed Analysis | |
|---|-----|
| Total Nitrogen (N) | 10% |
| Available Phosphate (P_2O_5) | 10% |
| Soluble Potash (K_2O) | 10% |
| The Plant Foods used in Garden Food are Ammonium Sulfate, Triple Superphosphate and Potash. Also contained in Garden Food is the natural mineral limestone. | |

Food 10-10-10 is an agricultural

QUICK LAB



Soil Sample

FOLDABLES Make a Half-Book.
(See p. R 41.)



BE CAREFUL! Do not touch the sharp edges of the can.

1. Go to a wooded area in a park or other location near your school. Find a patch of soft, moist soil.
2. Press a can, open side down, into the soil to get a core sample. You might have to gently rotate the can so it cuts into the soil.
3. **Observe** Carefully remove the core so it stays in one piece. Use your Half-Book to describe and draw the core.
4. **Infer** From top to bottom, what kind of matter does the core hold? In what order did the layers form?
5. **Infer** Which layer holds the most available nutrients? Explain.

Why Recycle?

Have you ever seen a paper bag with a symbol that says "Printed on recycled paper"? Why is this important?

The environment provides the materials people use to make products. Sunlight is an *inexhaustible resource*. The Sun will last for millions, if not billions, of years. Other resources, however, are not inexhaustible. The paper to make books, magazines, newspapers, and containers comes from the wood in trees. Metals mined from the ground are used to make cars,

ships, pots and pans, appliances, and many other things. Glass is made from sand. Plastics are made from chemicals in oil found deep underground.

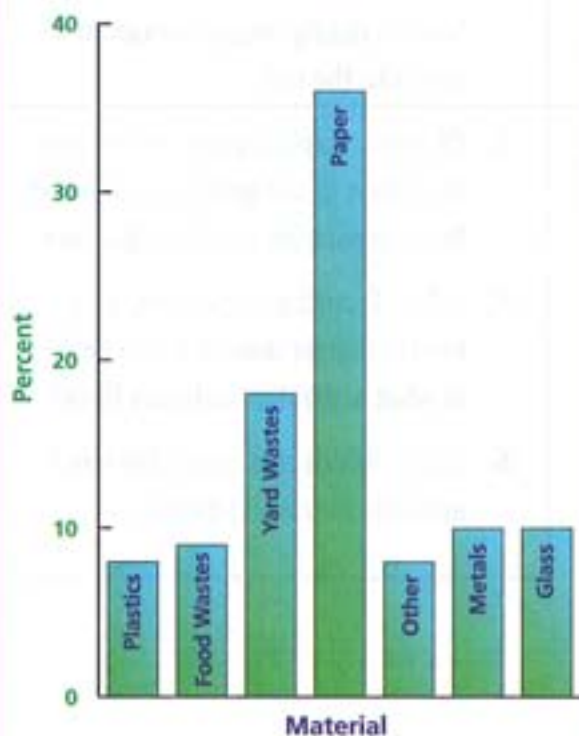
Wood, metals, sand, and oil are called *raw materials*. Raw materials are the building blocks of products.

Many raw materials, such as oil and metals, are *nonrenewable resources*. Earth's oil was formed millions of years ago. There's a limited amount of it. When it's gone, it's gone forever.

Certain other resources, such as plants and animals, are *renewable resources*. If trees are cut down for lumber and paper, more can be planted to replace them. Even so, trees take years to grow. This is why it is important to remember and practice the three Rs of conservation: reduce, reuse, and recycle.

Garbage Thrown Away Daily in the United States

This graph shows the percent of different materials in garbage thrown away each day by each person in the United States.



► Why is it important to recycle both renewable and nonrenewable resources?

READING


Graphs

Let's say there are 280,000,000 people in the United States. Each person throws away 1.8 kg (4 lb) of garbage each day. How much garbage is thrown away by all the people each day?

Why It Matters

The environment will continue to provide all the things we need as long as we let it recycle the substances that make life possible. People can either help or hinder the process.

To help we can conserve raw materials by recycling them—just as nature recycles water, carbon, and nitrogen. Many communities have recycling programs to do this.

 **Journal** Visit our Web site www.science.mmhschool.com to do a research project on the recycling and waste reduction laws in your state.

Think and Write

1. By what process does water move from oceans, lakes, rivers, and streams into the air?
2. What organisms turn a dead tree into substances that can be used by living trees?
3. Describe three ways that carbon dioxide gets into the air.
4. Name two substances that contain nitrogen.
5. **Critical Thinking** Many people use disposable products because they are safe and less expensive. What are the environmental costs of disposable products?

MATH LINK

Make a circle graph. Use the data from page B58. Calculate (in kilograms) how much of each type of garbage Americans produce every day.

ART LINK

Make a collage. Weigh the amount of garbage you throw away each day. Estimate how much of it is paper, glass, plastic, and food scraps. Represent this in a collage.



WRITING LINK

Writing That Compares How can people help save the environment by reducing waste, reusing, and recycling? Choose one product you use regularly and compare the three conservation strategies to see which one you think is the best for this product. Plan your writing in a three-column chart. Label each column with one of these labels: Reducing, Reusing, or Recycling. List the benefits of each for this product. Then use your chart to write an essay that compares.

TECHNOLOGY LINK

LOG Visit www.science.mmhschool.com for more links.





Recycling

Soccer practice just ended, and you're in a hurry. You gulp down your last drop of water. Now what do you do with the plastic bottle?

Your friends are waiting, so you toss the bottle in the nearest trash can. The plastic bottle will make its way to a landfill. There it could decorate the landscape for hundreds of years!

If you recycle the bottle instead, it could take on another life. Like many recycled materials, plastic can be made into other things. In recycling facilities, plastic bottles and jugs are sorted, chopped, and melted. Then the melted plastic is cooled and formed into

beads. The beads can be used to make everything from picnic tables to carpets.



Recycle those water bottles!



We can all do our part. Let's all recycle!



Plastic bottles and jugs arrive at a recycling facility.



What Did I Learn?

| How long does it take trash to decompose? | |
|---|-----------------|
| Paper and newspaper | 4 weeks |
| Banana and orange peels | 5 weeks |
| Plastic bags | 20 years |
| Styrofoam cup | 50 years |
| Aluminum can | 100 years |
| Plastic bottle | 700 years |
| Glass bottle | 1,000,000 years |

But there's something even better than recycling. It's throwing away less trash in the first place! At the grocery store, next time they ask, "Paper or plastic?" say, "Neither. I brought my own canvas bag."

LOG ON Visit www.science.mmhschool.com to learn more about recycling.

1. How are plastic bottles recycled?

- A** They are washed and refilled.
- B** They can't be recycled.
- C** They are chopped, melted, and made into beads.
- D** They are shredded.

2. As responsible citizens, you should do all of the following things. Which one is the most important recycling strategy?

- F** Cut down on waste in the first place.
- G** Recycle bottles and cans.
- H** Buy recycled products.
- J** Compost food scraps.



They are sorted and chopped into small pieces.



Recycled plastic beads come in different colors.

Biomes

Vocabulary

- biome**, B64
grasslands, B66
taiga, B67
tundra, B68
desert, B69
deciduous forest, B70
tropical rain forest, B71

Get Ready

What kinds of plants and animals live in the tropical rain forest? Are they the same as the ones that live in your community? Why do certain plants live in some areas and not others?

Soil varies greatly and is a distinctive factor in each area. Soil content can determine what plants and animals can live there.

Inquiry Skill

You **observe** when you use your senses to learn about an object or event.

Explore Activity

Why Is Soil Important?

Procedure

BE CAREFUL! Wear goggles and an apron.

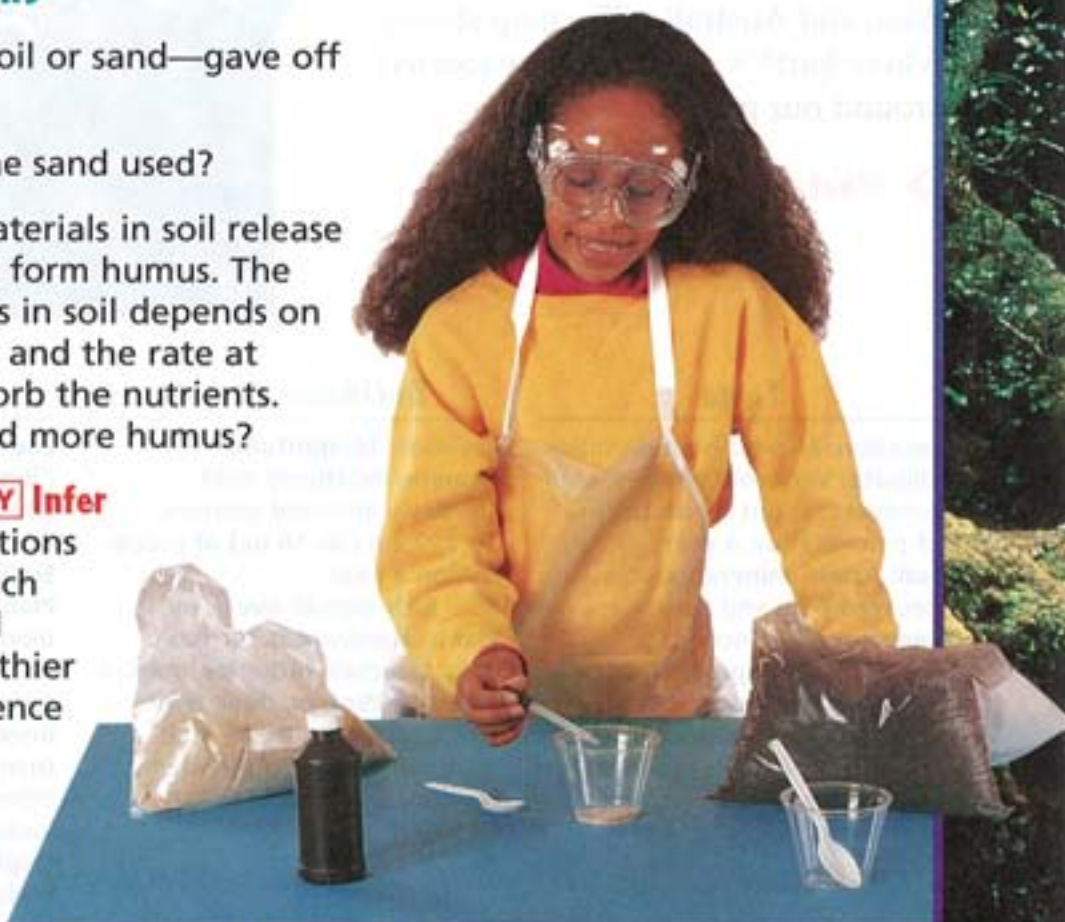
- 1** Place 1 tsp. of washed sand in a plastic cup.
- 2 Observe** Using the dropper, add hydrogen peroxide to the sand, drop by drop. Count each drop. Bubbles will form as the hydrogen peroxide breaks down any decayed matter.
- 3 Communicate** Record the number of drops you add until the bubbles stop forming.
- 4 Experiment** Repeat steps 1–3 using the soil.

Drawing Conclusions

- 1** Which sample—soil or sand—gave off more bubbles?
- 2 Infer** Why was the sand used?
- 3 Infer** Decayed materials in soil release their nutrients to form humus. The amount of humus in soil depends on the rate of decay and the rate at which plants absorb the nutrients. Which sample had more humus?
- 4 FURTHER INQUIRY Infer** Use your observations to identify in which sample you could grow larger, healthier plants. Give evidence to support your answer.

Materials

washed sand
soil
hydrogen peroxide
2 plastic cups
2 plastic teaspoons
dropper
goggles
apron



Read to Learn

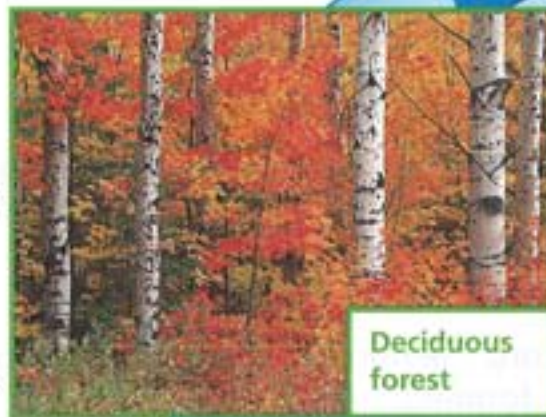
Main Idea The world has six major biomes.

What Is a Biome?

The land on Earth is divided into six major kinds of large ecosystems, called **biomes** (BIGH-ohmz). Each biome has its own kind of climate, soil, plants, and animals. Each biome can be found in different parts of the world. A desert biome is found in North America. Another is found in Africa. Still others are found in South America, Asia, and Australia. The map shows where Earth's six biomes are located around our planet.

▶ **What are the six major biomes?**

Taiga



Deciduous forest



Tropical rain forest

Taiga

Location: Mid- to high latitudes

Climate: Very cold winters, cool summers; about 50 cm (20 in.) of precipitation a year

Soil: Acidic, mineral-poor, decayed pine and spruce needles on surface

Plants: Mostly spruce, fir, and other evergreens

Animals: Rodents, snowshoe hares, lynx, sables, ermine, caribou, bears, wolves, birds in summer

Deciduous Forest

Location: Midlatitudes

Climate: Relatively mild summers and cold winters, 76–127 cm (30–50 in.) of precipitation a year

Soil: Rich topsoil over clay

Plants: Hardwoods such as oaks, beeches, hickories, maples

Animals: Wolves, deer, bears, and a wide variety of small mammals, birds, amphibians, reptiles, and insects

Tropical Rain Forest

Location: Near the equator

Climate: Hot all year round, 200–460 cm (80–180 in.) of rain a year

Soil: Nutrient-poor

Plants: Greatest diversity of any biome; vines, orchids, ferns, and a wide variety of trees

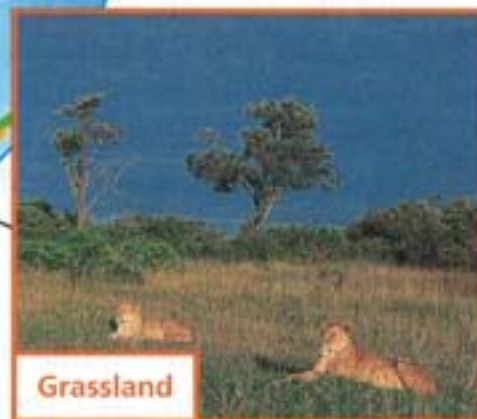
Animals: More species of insects, reptiles, and amphibians than any place else; monkeys, other small and large mammals, including in some places elephants, all sorts of colorful birds



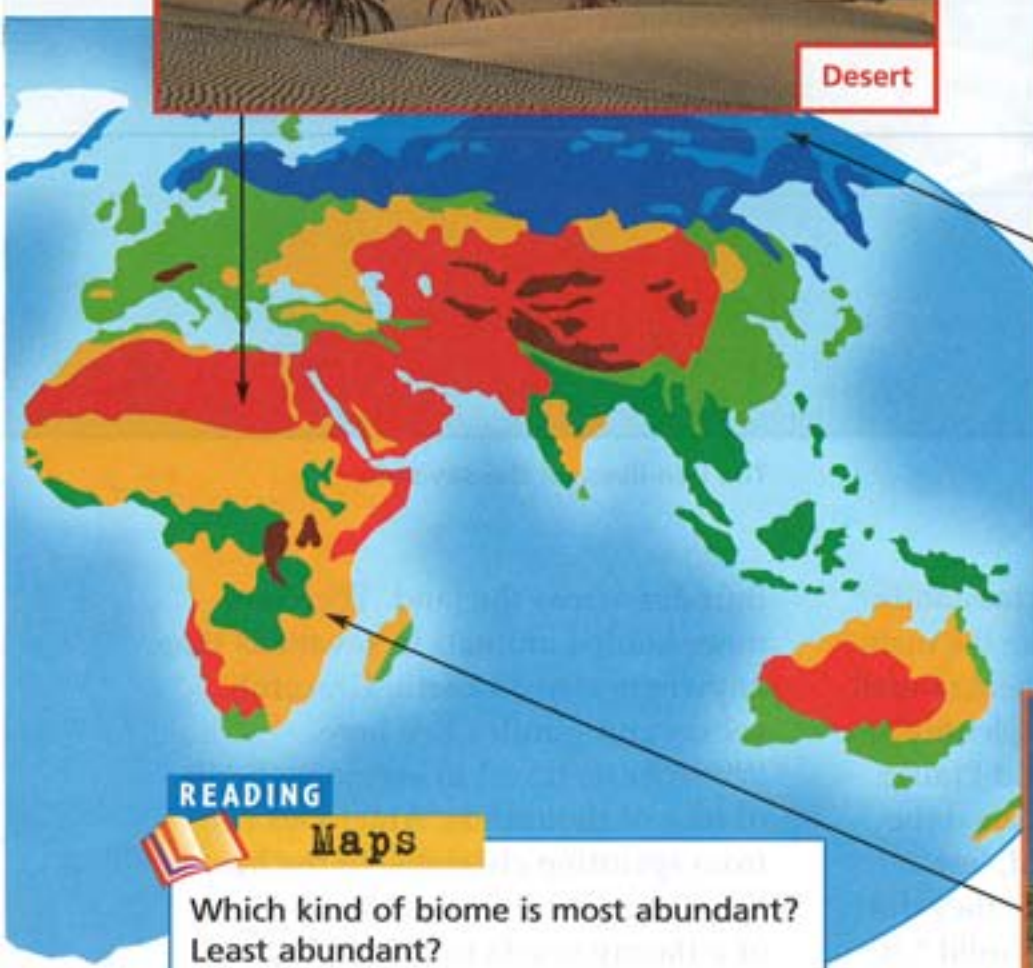
Desert



Tundra



Grassland



READING

Maps

Which kind of biome is most abundant?
Least abundant?

Desert

Location: Midlatitudes

Climate: Generally very hot days, cool nights; precipitation less than 4 cm (10 in.) a year

Soil: Poor in animal and plant decay products but often rich in minerals

Plants: None to cacti, yuccas, bunch grasses, shrubs, and a few trees

Animals: Rodents, snakes, lizards, tortoises, insects, and some birds. The Sahara in Africa is home to camels, gazelles, antelopes, small foxes, snakes, lizards, and gerbils.

Tundra

Location: High northern latitudes

Climate: Very cold, harsh, and long winters; short and cool summers; 10–25 cm (4–10 in.) of precipitation a year

Soil: Nutrient-poor, permafrost layer a few inches down

Plants: Grasses, wildflowers, mosses, small shrubs

Animals: Musk oxen, migrating caribou, arctic foxes, weasels, snowshoe hares, owls, hawks, various rodents, occasional polar bears

Grassland

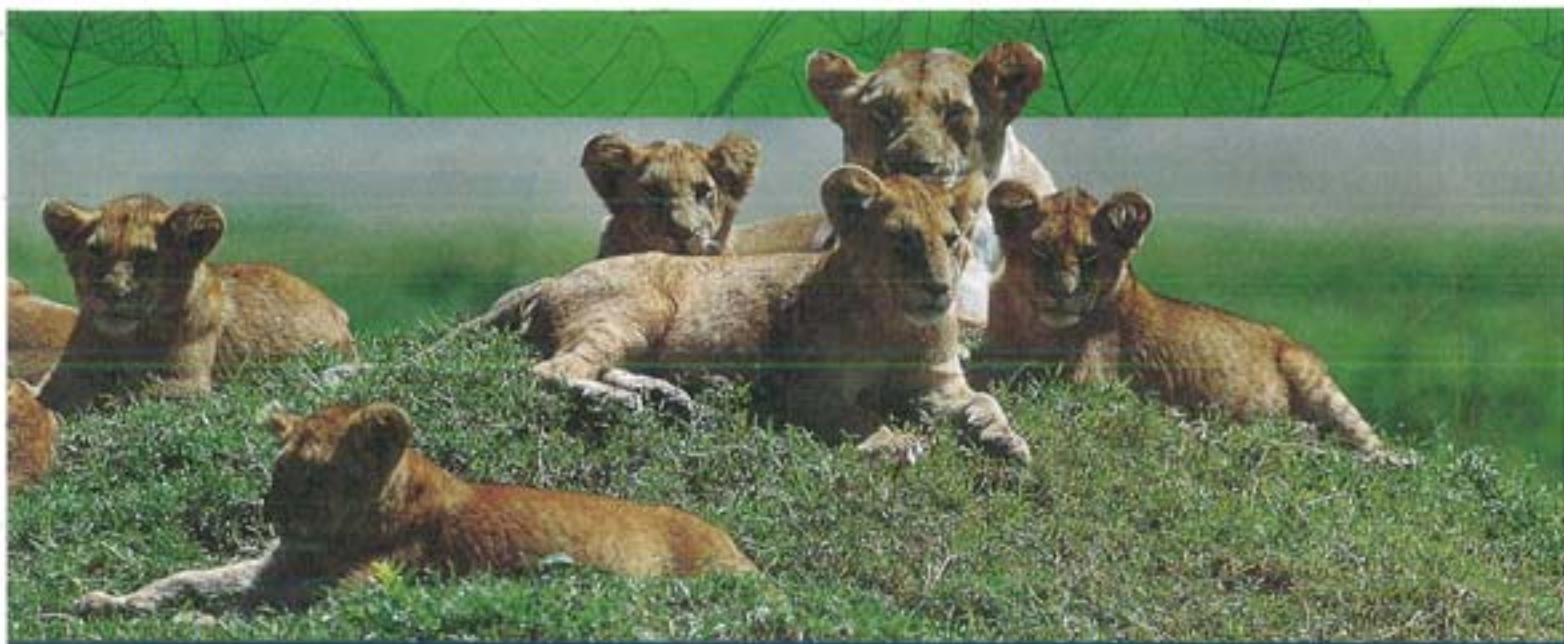
Location: Midlatitudes, interiors of continents

Climate: Cool in winter, hot in summer; 25–75 cm (10–30 in.) of precipitation a year

Soil: Rich topsoil

Plants: Mostly grasses and small shrubs, some trees near sources of water

Animals: American grasslands include prairie dogs, foxes, small mammals, snakes, insects, various birds. African grasslands include elephants, lions, zebras, giraffes.



The lion lives on the savanna.

What Are Grasslands?

As the name tells you, **grasslands** are biomes where grasses are the main plant life. They are areas where rainfall is irregular and not usually plentiful.

Prairies, like the Blackland Prairie, are one kind of grassland. Called the "bread baskets" of the world, few temperate grasslands look as they did years ago. *Temperate* means "mild." It refers to grasslands such as those in the United States and Ukraine. Today many of these grasslands are covered with crops such as wheat, corn, and oats.

However, large parts of the world's tropical grasslands still look much as they have for hundreds of years. *Savannas* are grasslands that stay warm all year round. Their soil is not as fertile as that of temperate grasslands. However, they get more rain—about 86–152 cm (34–60 in.) a year.

The most famous savanna covers the middle third of Africa. Here the dust rises as countless hoofed animals

thunder across the land. There are more hoofed animals in savannas than anywhere else on Earth. Graceful zebras and giraffes live here.

Wildebeests travel in awesome herds of tens of thousands. Antelopes run from sprinting cheetahs. In the heat of the afternoon, lions rest in the shade of a thorny acacia tree. Nearby, hyenas prowl through the low grasses in search of dead or weak animals.

If you want to get a glimpse of a savanna while it still looks like this, you'd better do so soon. The land on savannas is being used more and more to graze domestic cattle. It won't be long until they replace the native animals, at least in unprotected parts of the savanna.

▶ **What are two types of grasslands? How are they different?**

What Is the Taiga Like?

Evidence indicates that about 15,000 years ago, huge fingers of ice, called glaciers, inched down from Earth's arctic regions. The ice was hundreds of feet thick. As it moved southward, it gouged great chunks of land out of northern Europe, Asia, and North America.

Some of the sediment carried by the glaciers dammed up streams, forming ponds and lakes. More lakes formed when the ice began to pull back. Holes dug by the glaciers filled with fresh water. These are the lakes and ponds of a cool, forested biome called the **taiga** (TIGH-guh).

Taigas are mostly conifer forests. They spread out over 11 percent of Earth's land. They are located in the

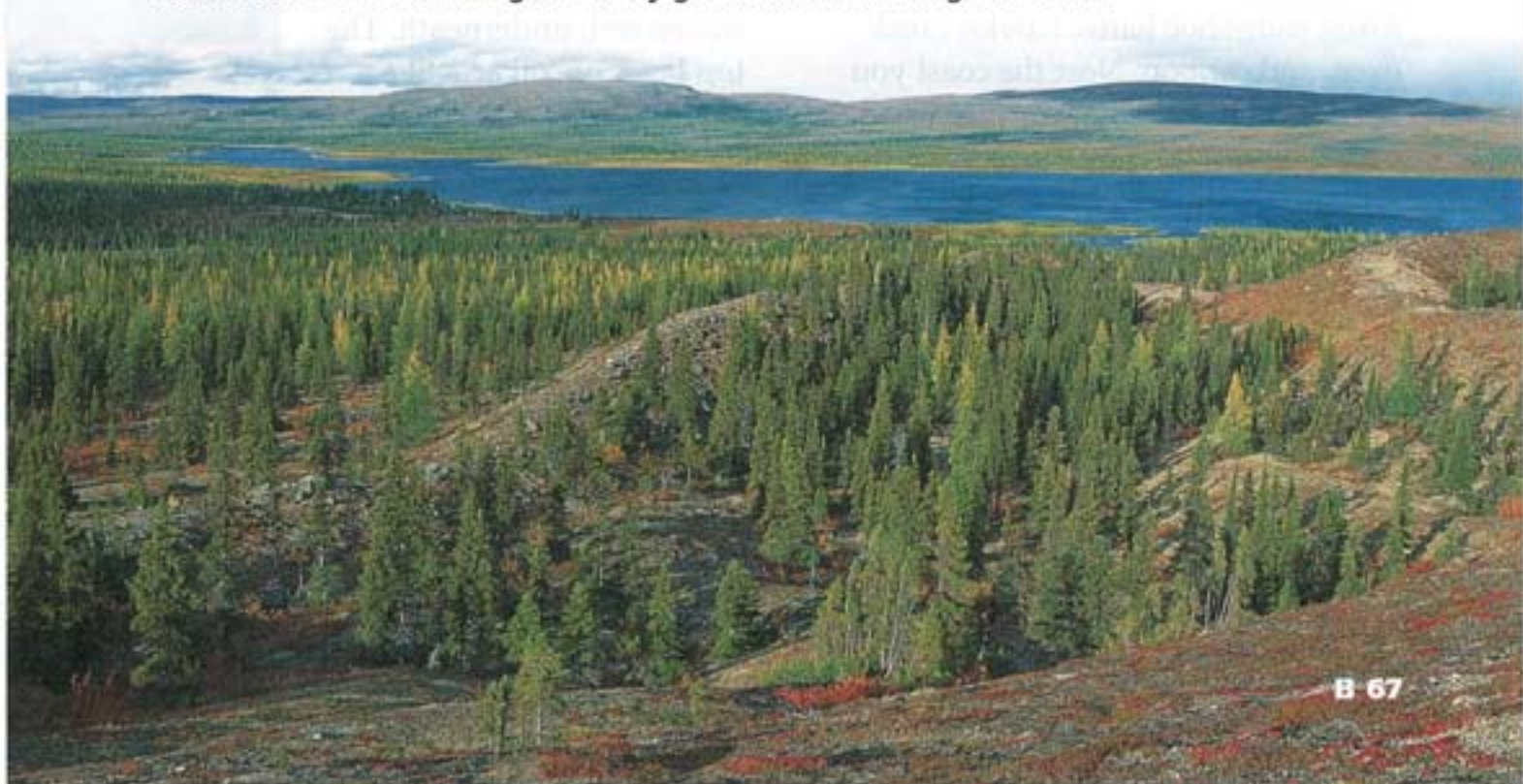
upper latitudes of the Northern Hemisphere—in Alaska, Canada, Norway, Sweden, Finland, and Russia.

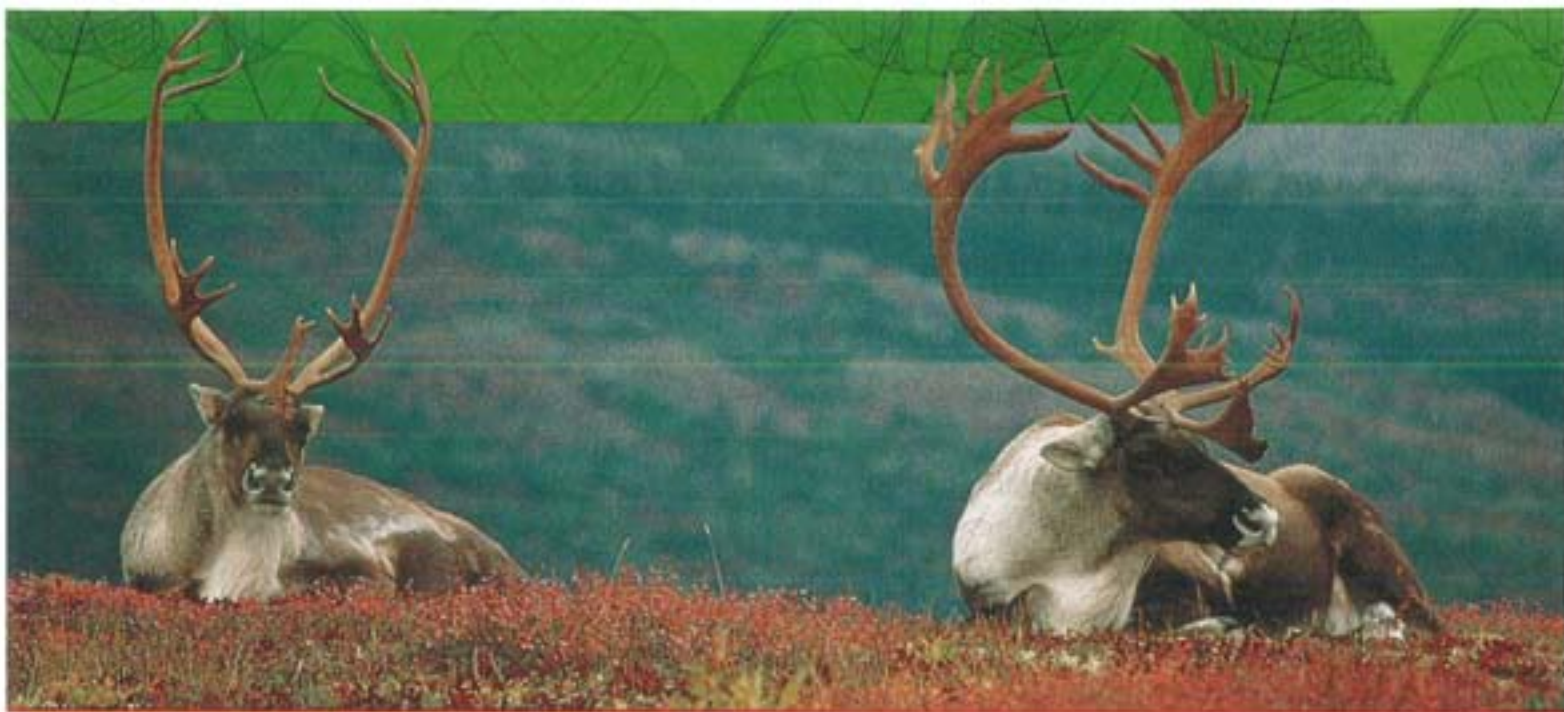
If you visit the taiga in the summer, you may hear the pleasant songs of birds. Many different kinds migrate to the taiga in summer. However, they head for warmer regions in the fall. You might also hear the whining sound of chain saws. That's because the taiga is a major source of lumber and pulpwood. Much of the lumber is used for making houses for the world's growing population. The pulpwood is turned into paper products of all kinds, such as the pages of this book.

READING Summarize

What are the main characteristics of the taiga?

Thousands of years ago, moving sheets of ice dug away the land of the taiga. The dug-out land would become some of its lakes and ponds. Today these bodies of water are guarded by great stands of evergreen trees.





The caribou, a member of the deer family, is among the large animals of the tundra.

What Is the Tundra?

Where is the ground frozen even in summer? Only 10–25 cm (4–10 in.) of precipitation fall here each year. Winters are long and icy cold. Summers are short and cool. Just a few inches below the surface, the ground is frozen all the time.

You can't find many plants taller than about 30 cm (12 in.). However, you have no trouble spotting weasels, arctic foxes, snowshoe hares, hawks, musk oxen, and caribou. Near the coast you see a polar bear. When warmer weather comes, mosquitoes by the millions buzz through the air. Where are you?

You are in the far north. You're between the taiga and the polar ice sheets. It could be northern Alaska or northern Canada. It could be Greenland or frigid parts of Europe or Asia. No matter which of these places you are in, you are in the same biome. This cold biome of the far north is the **tundra**.

Why is it so cold? Even in summer the Sun's rays only strike the tundra at a low, glancing angle. The Sun melts ice in the top layer of the soil. However, this water is kept from flowing downward by a layer of *permafrost*, or permanently frozen soil, underneath. The top layer of soil acts like a vast sponge for the melted ice.

Many tundra plants are wildflowers and grasses. The permafrost keeps large plants from developing the deep root systems they need. The growing season is very short—as little as 50 days in some places. The tundra soil is poor in nutrients, so the tundra cannot support large plants.



▶ **What are conditions in the tundra like?**

What Is the Desert Biome Like?

Sahara, Gobi, and Atacama stir up thoughts of adventures in strange, dangerous places. These are among the world's greatest **deserts**. A desert is a sandy or rocky biome, with little precipitation and little plant life.

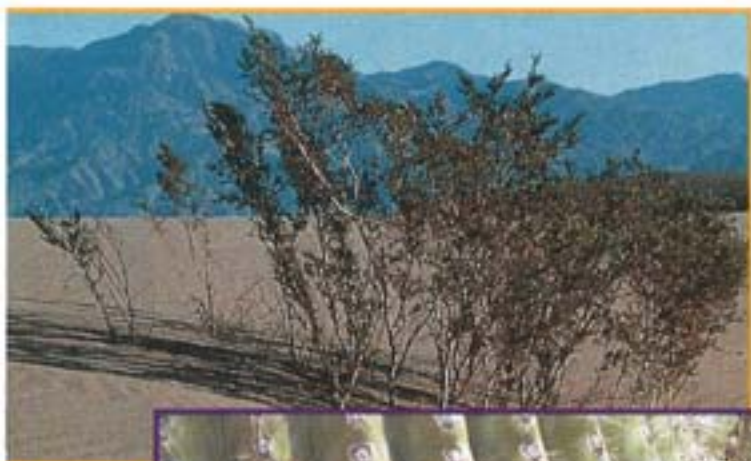
Every continent has at least one desert. Africa has an enormous desert called the Sahara. Its sands dip down to the Atlantic Ocean in the west, the Mediterranean Sea to the north, and the Red Sea to the east. It is the largest desert on Earth, with an area of about

9,000,000 km² (3,500,000 mi²). It is so large that it could cover all of the United States south of Canada. Picture those 48 states covered with sand and you get an idea of the size of the Sahara.

The Gobi Desert in China and Mongolia is the world's second largest desert. It is about 1,300,000 km² (500,000 mi²). That's about twice the size of Texas.

You'll find the Atacama Desert in South America. It runs 968 km (600 mi) from the southern tip of Peru down through Chile. It lies between the Andes Mountains to the east and the Pacific Ocean in the west. The driest place on Earth is found in Arica, Chile. It averages only about 0.08 cm (0.03 in.) of rain a year. That's about the depth of six sheets of paper.

Few animals and plants live in deserts. Those that do are very hardy. They are well adapted to living in the desert.



▶ How is the desert similar to and different from the tundra?

To reach water, the roots of the mesquite plant (above) have been known to grow more than 79 m (260 ft) deep. That's the height of a 26-story building. Elf owls (left) build nests in cacti.

What Is a Deciduous Forest?

Have you ever seen leaves on trees change color in the fall? If you have, you have seen the **deciduous** (di-SIJ-ew-uhs) **forest** biome. This is a forest biome with many trees that lose their leaves each year.

This is where broad-leaved trees grow. Each autumn the leaves turn shades of yellow, orange, and red, giving the land beautiful colors. Then the leaves fall to the ground—which is what *deciduous* means—and decay. The dead leaves help make the soil rich and fertile.

Deciduous forests once covered most of the United States east of the Mississippi River and almost all of western Europe. Much has been cut down to make room for towns, cities, farms, and factories.

Many animals that once lived in deciduous forests still live on the land that was cleared for suburbs, farms, and towns. Chipmunks dart around bushes. Squirrels leap from branch to branch. Raccoons turn over trash cans. Skunks meander through the underbrush.

Birds like cardinals, robins, crows, and hawks, and insects such as bees still live in deciduous forests. Turn over a rock and you might discover a salamander or garter snake.

Many deciduous forests in the United States and Europe are now part of national parks or are in places where few people live. As long as they stay that way, people will be able to see the changing seasons.

▶ What are the main characteristics of the deciduous forest?

The trees of a deciduous forest shed their leaves each autumn, painting the land yellow, orange, and red.



Although you'd probably not enjoy an encounter with this family, it's an important part of the deciduous forest biome.



What Are Tropical Rain Forests?

In areas along and near Earth's equator are **tropical rain forests**. These biomes are hot and humid, with much rainfall. They support a wide variety of life.

The canopy of a tropical rain forest spreads like a huge umbrella. It is so thick that little sunlight ever reaches the ground. With little light few plants can grow on the ground. Most of the life is up high in the branches, where howler monkeys and purple orchids cling.

There are no tropical rain forests in North America or Europe. They are too far from the tropics. However, Central America, South America, India, Africa, Southeast Asia, Australia, and many Pacific Islands have rain forests. Each has its own kinds of plants and animals.

Millions of species of animals live in the world's tropical rain forests. Many species have yet to be discovered.

In Africa you might see a silverback gorilla or a troop of playful chimpanzees.

On the island of Borneo, you might see a red-haired, long-armed orangutan (uh-RANG-oo-tan) swinging through the trees.

Some of the most colorful birds on Earth, like this toucan, live in tropical rain forests like those of South America.

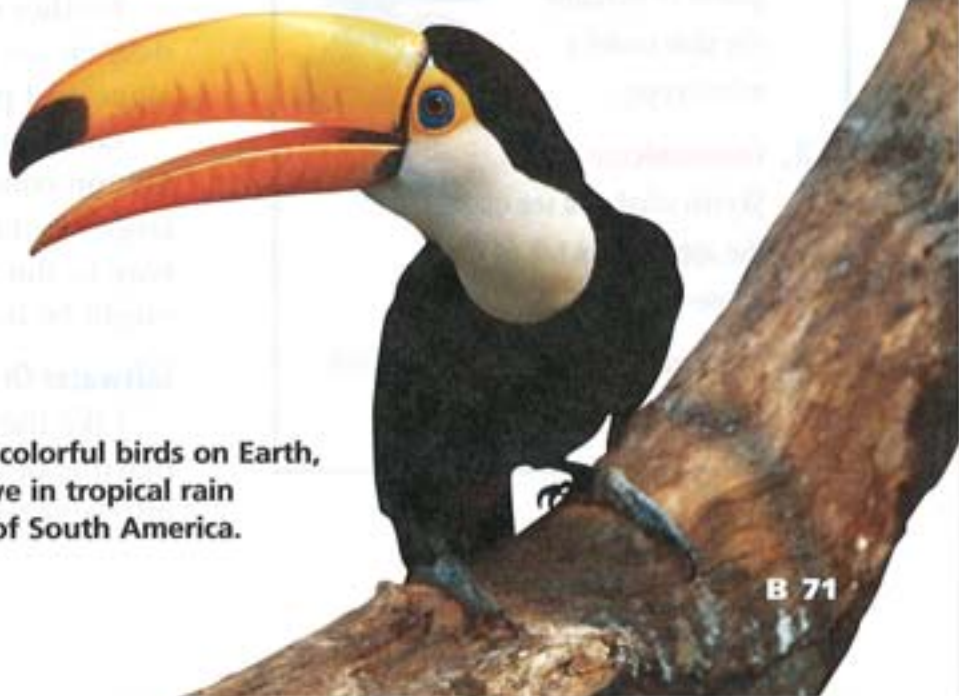


The anaconda is the largest snake on the planet.

The world's most colorful birds—such as toucans (TEW·kanz) and quetzals (ket-SAHLZ)—live in tropical rain forests. Giant snakes like the 9 m (30 ft), 136 kg (300 lb) South American anaconda also live in tropical rain forests.

The world's tropical rain forests have been victims of people's needs for lumber, farmland, and minerals. Fortunately, people are now replanting and restoring tropical rain forests. Still, some of their millions of undiscovered plant and animal species may become extinct before they are discovered.

▶ **What are some characteristics of the tropical rain forest?**



QUICK LAB



Freshwater Communities

FOLDABLES Make a Three-Tab Book.
(See p. R 43.) Label the tabs as shown.



1. Obtain from your teacher samples of pond, lake, or stream water taken at different locations. Use a different container for each sample. Record on the container the location each sample came from.
2. **Observe** Place a drop of water on a slide, and carefully place a coverslip over it. Use low power and high power to examine the slide under a microscope.
3. **Communicate** Sketch what you see under the appropriate tab of your Three-Tab Book.
4. **Interpret Data** What does this tell you about aquatic ecosystems?



What Are Water Ecosystems Like?

Temperature and precipitation differ among ecosystems on land. For Earth's watery ecosystems, the main difference is saltiness.

Lakes, streams, rivers, ponds, and certain marshes, swamps, and bogs tend to have little salt in them. They're all freshwater ecosystems. Oceans and seas are saltwater ecosystems.

In fresh water or salt water, organisms can be divided into three main categories. *Plankton* (PLANGK-tuhn) are organisms that float on the water. *Nekton* (NEK-tahn) are organisms that swim through the water. *Benthos* (BEN-thahs) are bottom-dwelling organisms.

Freshwater Organisms

Many plants live in the shallow waters of lakes, ponds, and other bodies of fresh water. If you were to wade here, you might get your feet tangled in cattails, bur reeds, wild rice, and arrowheads. You might also spot a frog, a turtle, or maybe a crayfish.

Farther out, where the water gets deeper, are microscopic plankton like algae and protozoa.

Look beneath the surface, and nekton come into view. There might be large trout or other game fish. All the way to the bottom, an aquatic worm might be burrowing into the mud.

Saltwater Organisms

Like the freshwater ecosystem, the marine, or ocean, ecosystem is divided into several sections.

The shallowest is the *intertidal zone*. There the ocean floor is covered and uncovered as the tide goes in and out. Crabs burrow into the sand so they won't be washed away. Mussels and barnacles attach themselves to rocks.

The open ocean is divided into two regions. The first region is up to 200 m (656 ft) deep. In this upper region are many kinds of fish and whales. The world's largest animals—the 150-ton blue whales—live here.

The lower region goes from 200 m (656 ft) to the ocean bottom—perhaps 10.5 km (6.5 mi) down. At depths greater than about 1,000 m (3,281 ft), there is no sunlight. It is completely black!

Photosynthetic organisms, like algae, can only live where there is sunlight. They are found in the intertidal zone and in waters up to about 100 m (328 ft) deep. Many fantastic creatures live on the dark ocean bottom. Some of these fish "light up" like underwater fireflies. Other bottom-dwelling fish are blind. There are even bacteria that live in boiling water where fiery lava seeps out of the sea floor.

**▶ What are two-water ecosystems?
How do they differ?**

The types of animals you see in the ocean change as you go deeper.





Will the remaining whale populations survive? Will the eerie song of the humpback no longer be heard?

Can Humans Change Water Ecosystems?

People started hunting whales for their meat and oil at least 4,000 years ago. However, back then oceans held so many whales that hunting didn't have much effect on their populations.

As the centuries passed, however, whale hunting increased. So did the technology of finding and killing these gentle mammals. By 1850 American whalers alone accounted for the killing of 10,000 a year.

Over the next 100 years, new technologies made whale hunting easier and more efficient. In 1962 alone 66,000 whales were killed. The whales could not reproduce fast enough to replace those that were being killed. Many species, like blue whales, humpbacks,

bowheads, and right whales, became threatened with extinction.

The whales were being used for human and animal food, oil for lamps, and fertilizer. However, there were other sources of such products. Recognizing this and the danger to whale populations, the major whaling countries formed the International Whaling Commission (IWC) in 1946.

In 1971 the United States banned its citizens from whaling for profit or even buying products made from whales. By the 1990s the IWC had succeeded in getting whaling countries to reduce or stop hunting threatened whales.

▶ **How have humans affected the whale population?**

Why It Matters

The world's biomes remain constant as long as their climates and populations do not change greatly. However, climates and populations change naturally. Also, human activity has affected both populations and climates. Changes in a biome can affect the kinds of plants and animals that can live there. It can also affect people's lifestyles. It is important to know if, how, and why these factors are changing before we make irreversible changes.

 **eJournal** Visit our Web site www.science.mmhschool.com to do a research project on climate changes caused by human activity.

Think and Write

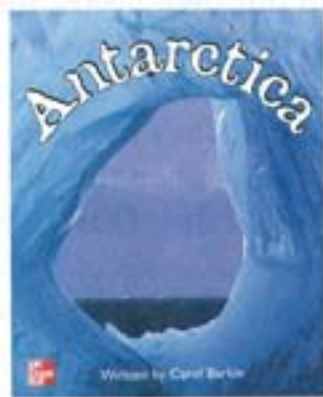
1. Describe the taiga biome in terms of its climate, soil, and inhabitants.
2. How do organisms found in desert and tundra biomes adapt to their environments?
3. Explain why few plants live on the floor of tropical rain forests.
4. Briefly describe the two types of aquatic ecosystems.
5. **Critical Thinking** Choose one biome, and explain how a change in its climate might affect its populations.

MATH LINK

Find the range. The monthly precipitation in a tropical rain forest in a year is 9 in., 6 in., 4 in., 21 in., 17 in., 8 in., 0 in., 3 in., 7 in., 25 in., 15 in., and 15 in. What is the range of the annual precipitation?

LITERATURE LINK

Read *Antarctica*, the story of the coldest continent on Earth. Try the activities at the end of the book.



WRITING LINK

Personal Narrative What would you do if the biome where you lived suddenly got warmer or colder? How would you adapt if the precipitation suddenly increased or decreased? Write a personal narrative about an adventure you might have if the biome where you lived suddenly changed. Use the "I" point of view to tell your story.

TECHNOLOGY LINK

 Visit www.science.mmhschool.com for more links.

Agriculture

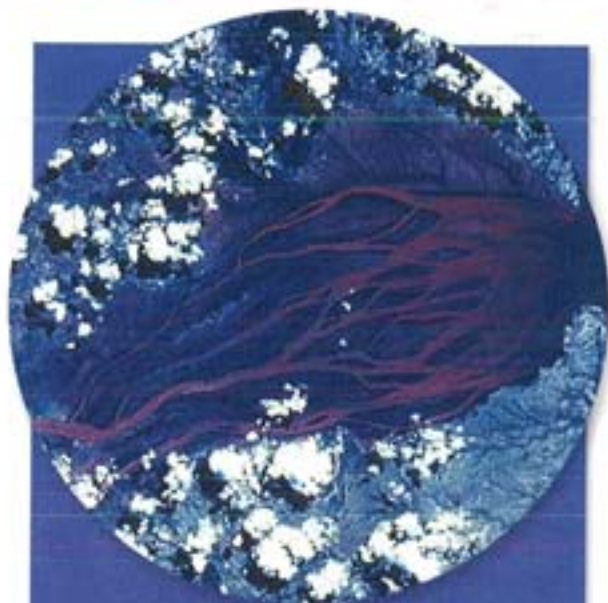
Humans have adapted to living in every biome on Earth, from the tropical rain forests to the deserts. But we have adapted our environment to fit our own needs, too.

Until about ten thousand years ago, our ancestors were continually on the move. They relied on the food they could gather and the animals they could hunt. Then they learned how to take the seeds of plants and grow their own food. Agriculture was born.

After that, humans began to settle down in one place and to domesticate animals. Attaching plows to horses and oxen let us farm larger areas and grow more crops.

Growing the same plant in the same area year after year exhausts the soil, draining its nutrients. Cutting down forests to make room for crops causes soil to erode. Planting the same plant in large areas encourages certain species of insects and weeds. These opportunists quickly become pests, harming other species, sometimes to the point of extinction.

New computerized irrigation systems use less water and chemicals. This saves money. It also reduces the amount of chemicals seeping into the ground.



It takes centuries for soil to become fertile. When too many trees are cut down in a forest, the soil washes off the land into rivers like this one.





To make farming easier, we invented steel plows and then tractors to help plant and harvest crops. We cleared forests, filled wetlands, and let cattle graze on grasslands.

We redirected rivers to bring water to dry deserts, destroying natural habitats. We also began to use chemicals to fertilize crops and kill the bugs and weeds. These chemicals seep into the soil and groundwater, and many pests become immune to the toxins.

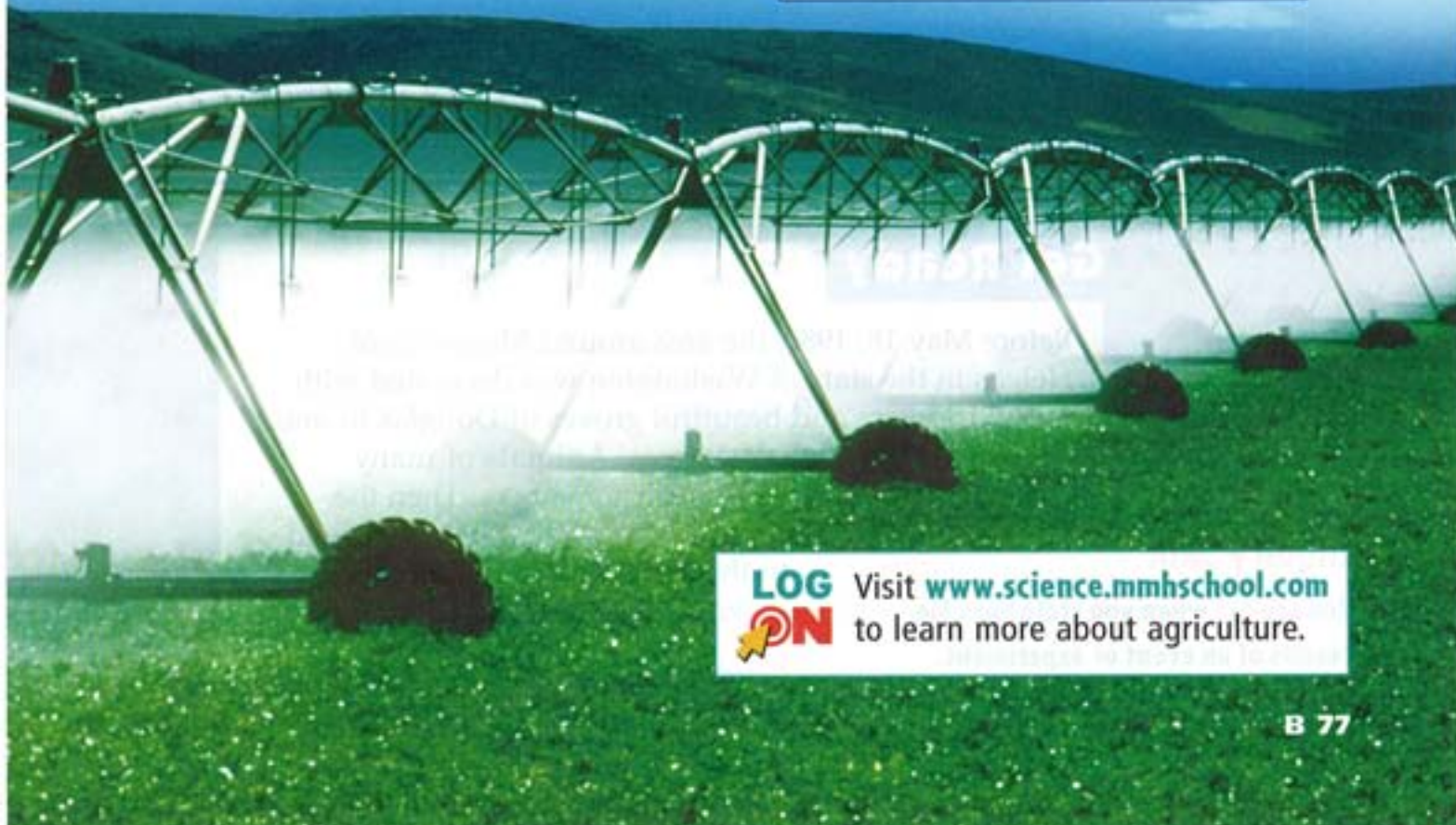
Today, agricultural practices are changing. Some farmers are using organic, or chemical-free, methods to grow crops. These methods are safer, even though an acre will only produce half as many organic crops

as regular ones. Some farmers are using natural pest control that uses insect predators such as spiders and ladybugs to kill pests.

Computerized irrigation systems are cutting down on the amount of water and chemicals used. These techniques and new ones are letting us grow food in smarter ways—ways that are protecting our planet.

Write About It

1. What are two technological advancements in agriculture, and how have they changed farming?
2. How can farming damage the land?



LOG Visit www.science.mmhschool.com
ON to learn more about agriculture.

Vocabulary

ecological
succession, B82

pioneer species, B83

pioneer
community, B83

climax
community, B84

How Ecosystems Change

Get Ready

Before May 18, 1980, the area around Mount Saint Helens in the state of Washington was decorated with wildflowers and beautiful groves of Douglas fir and western hemlock trees. Animals of many kinds made their home here. Then the mountain exploded. What happened to the community? How did this ecosystem change?

Inquiry Skill

You **predict** when you state possible results of an event or experiment.

Explore Activity

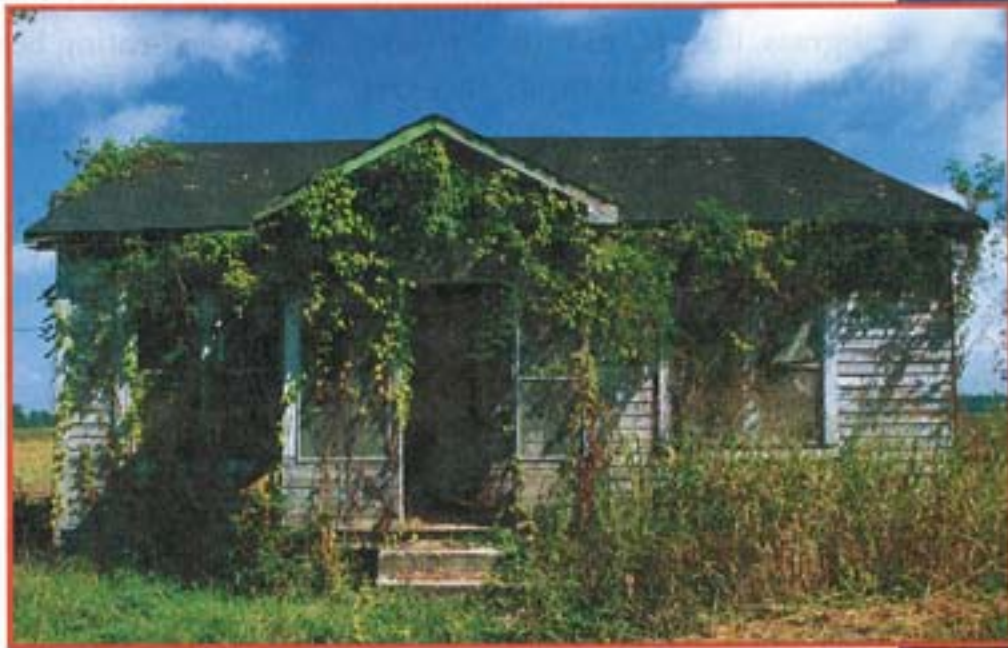
How Do Ecosystems Change?

Procedure

- 1 Observe** Examine the photograph.
- 2 Communicate** Describe what you see.

Drawing Conclusions

- 1 Infer** What happened to this farm after the owner left and moved to the city?
- 2 Infer** Think about how this farm might have looked ten years ago. What kinds of plants lived there then?
- 3 Interpret Data**
How can one ecosystem be changed into another?
- 4** Compare what you think will happen to the abandoned farm with what happened at Mount Saint Helens. In what ways would the changes in ecosystems be similar? In what ways would they be different?
- 5 FURTHER INQUIRY Predict** Think of another ecosystem that might be changed by nature. Think of an ecosystem that might be changed by humans. Describe how such ecosystems might continue to change over time.



Read to Learn

Main Idea Ecosystems go through both slow and sudden changes.

How Do Ecosystems Change?

Changes happen everywhere on Earth. They can occur in your backyard. They can happen in an empty city lot or on one of its abandoned streets. If given a chance, nature will change an existing ecosystem or produce a new one. How does nature change an abandoned farm's field into a flourishing forest?

In the first year, a community of crabgrass, insects, and mice invades the field where corn or another crop once grew.



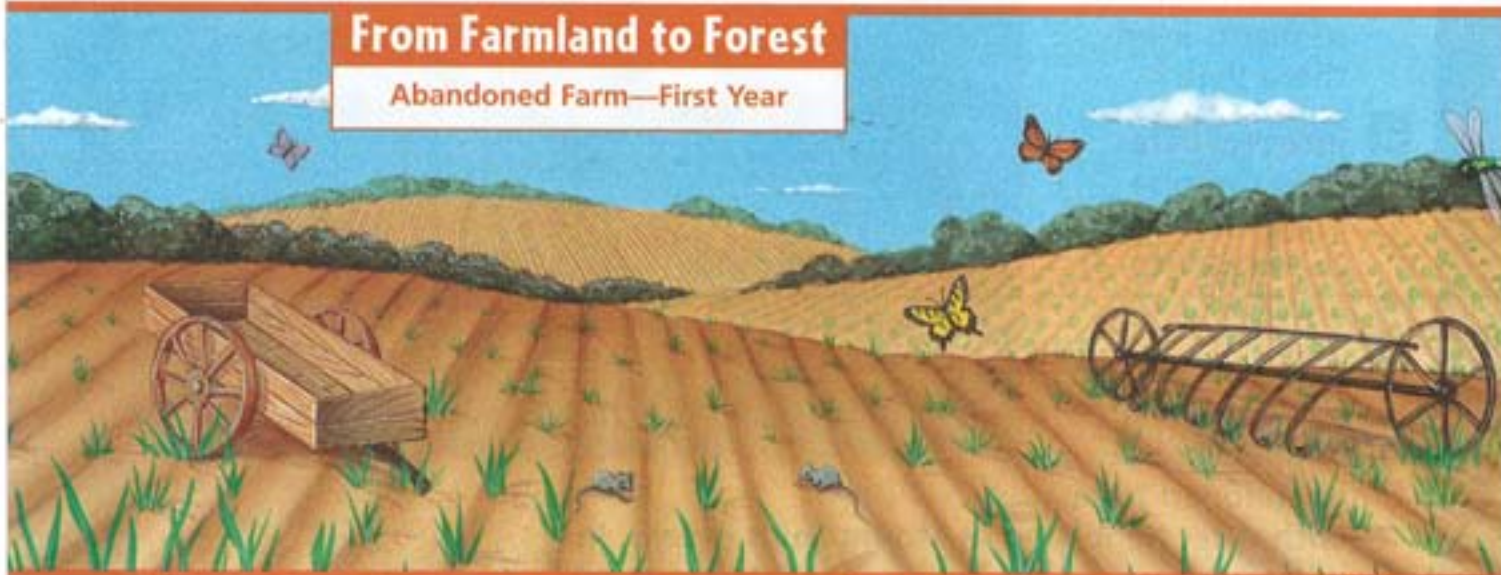
Abandoned cities of Angkor in Cambodia became covered by jungle.

Tall weeds, such as asters, ragweed, and goldenrod, and tall grasses grow among the crabgrass. The crabgrass can't easily survive in the shade cast by the taller weeds. It begins to die out in the second and third year. Rabbits and seed-eating birds move in.

The hot, dry field of tall weeds provides a perfect environment for

From Farmland to Forest

Abandoned Farm—First Year



Second and Third Years



pine seeds to sprout. By the fourth year, pine trees begin to grow and shade the weeds, which begin to die out. More birds join the community, as do small mammals like opossums and skunks.

A pine forest has replaced the old farm field within twenty-five years. The number of new pine seedlings drops, however, because they can't grow in the shade. Seeds of deciduous

trees, such as maple, hickory, and oak, sprout and take root. Larger animals like raccoons and foxes begin to visit.

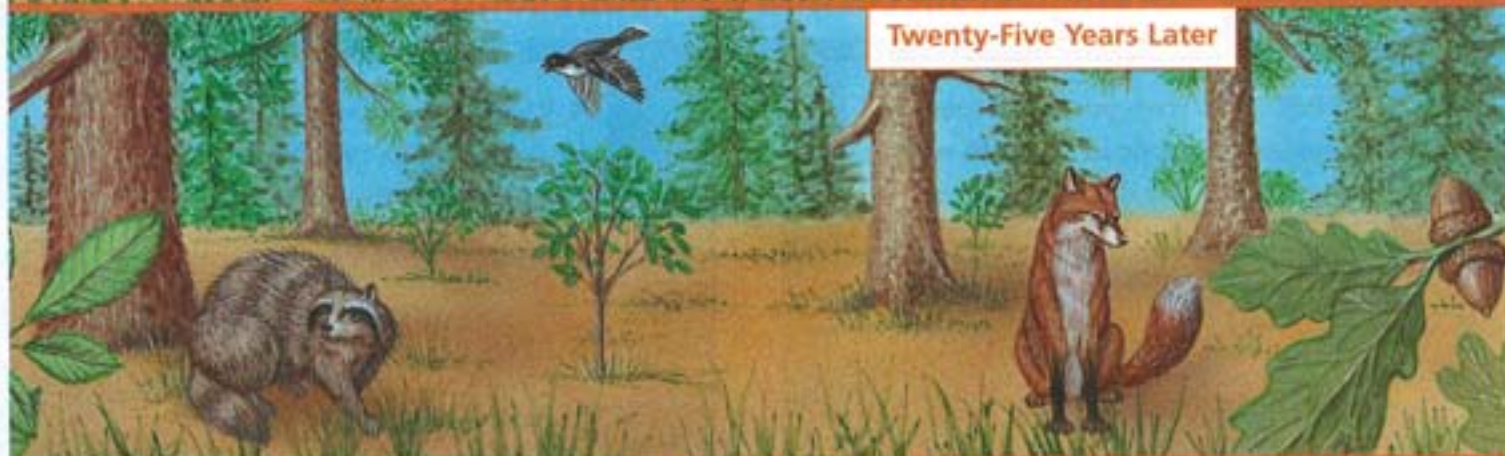
The forest is now mostly deciduous trees. These trees are the habitats of many different kinds of birds and small animals, such as squirrels. Deer, raccoons, and foxes also live in the forest.

▶ **How can an abandoned farm become a deciduous forest ecosystem?**

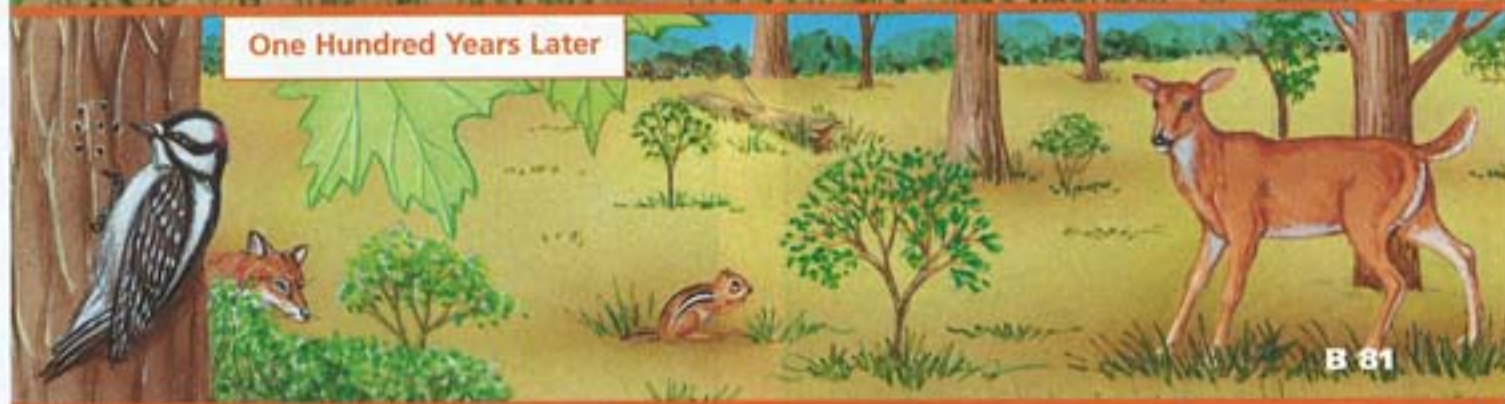
Four to Six Years Later



Twenty-Five Years Later



One Hundred Years Later



How Do Communities Change?

The abandoned farm field you just read about gave way to short crabgrass, then tall grasses and shrubs. Later, pine trees and, finally, deciduous trees grew there. Scientists call the gradual replacement of one community by another **ecological succession**.

Ecological succession can begin in two different kinds of places. It can begin where a community already exists—such as in an abandoned farm field. Ecological succession in a place where a community already exists is called *secondary succession*.

Ecological succession can also happen where there are few, if any, living things. This is called *primary succession*. Primary succession can begin where communities were wiped

out. Such places would include land swept clean by a volcanic eruption or forest fire. It can also begin where communities never existed before, such as on a new island that rises out of the sea.

Mount Saint Helens

Explore what happened to Mount Saint Helens in the state of Washington shortly after May 18, 1980.

Mount Saint Helens had just erupted. The blast from the volcano knocked down thousands of trees. The whole area was covered knee-deep with hot volcanic ash and finely smashed-up rock.

The landscape was different shades of gray as far as you could see. No spot of green greeted your eyes, not even a blade of grass. If you didn't

Ecological Succession on Mount Saint Helens

1 year The rose-purple flowers of fireweed announced that life was returning to the destroyed land.

4 years Seedlings of Douglas fir trees began to take root in the rubble of the volcano.

know better, you might have thought you were on the Moon.

A year passes. You return to the slopes of Mount Saint Helens expecting to see unbroken stretches of rock and stumps of dead trees. However, something has happened in the year you were gone. Wind and rain have cleared some of the ash and dust, especially from steep slopes. The wind has also blown in some seeds and fruits from nearby forests. You see a scattering of rose-purple objects among the charred and fallen tree trunks. They are the flowers of a plant called fireweed. It gets its name from the fact that it is often the first plant to grow after a forest fire.

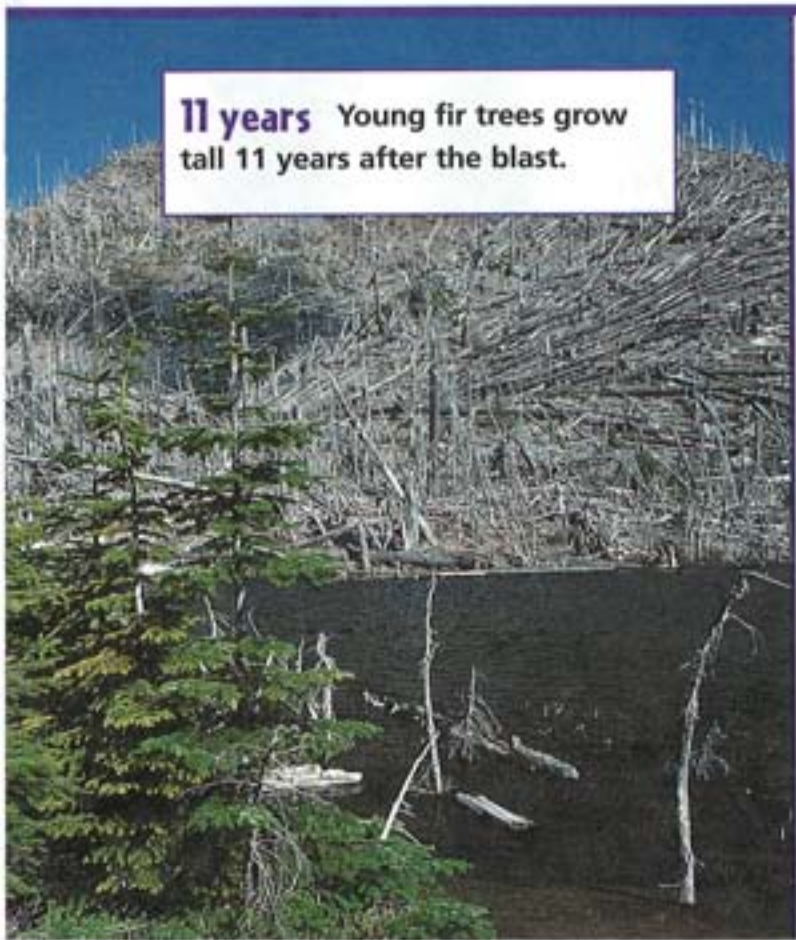
Scientists would call the fireweed a **pioneer species**. That's because it is the first species to be living in an otherwise lifeless area. You notice that the blooming of fireweed has

attracted animals, such as insects and an occasional insect-eating bird. A new community, called a **pioneer community**, is beginning to thrive around Mount Saint Helens.

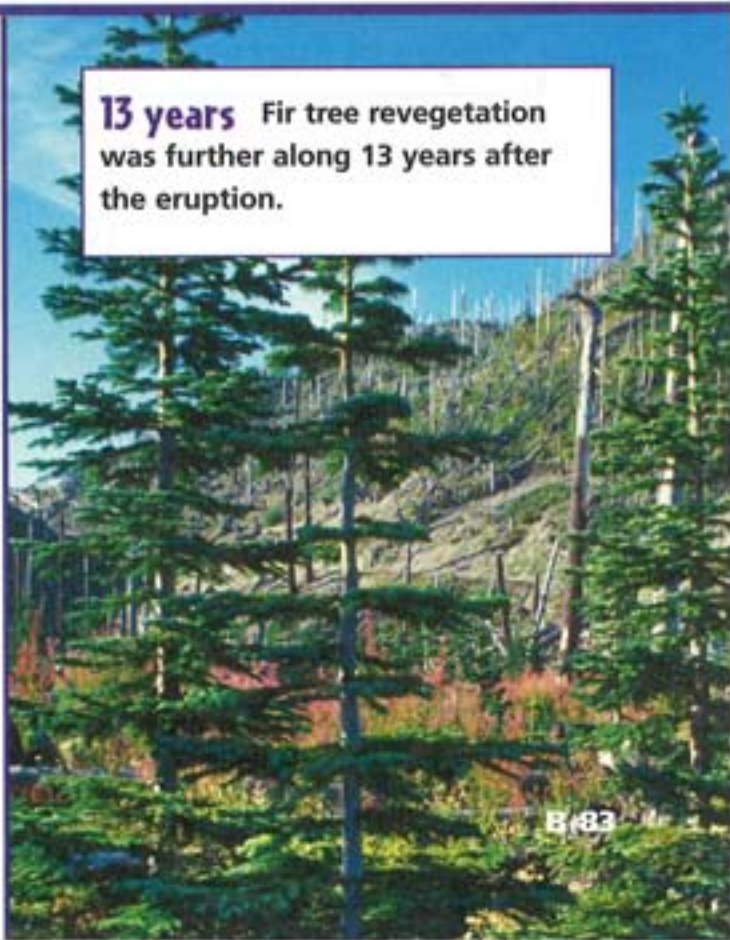
You return in 1984 and almost step on a little green shoot. You bend down and take a closer look. The shoot has little needlelike leaves. It is the sprout of a Douglas fir tree. Its seed was probably blown here from a forest miles away.

Now picture the land around Mount Saint Helens 100 or 200 years in the future. It is covered with a dense forest of evergreens. The forest is much like the one that spread around it before that explosive day in 1980.

▶ **How does ecological succession change communities?**



11 years Young fir trees grow tall 11 years after the blast.



13 years Fir tree revegetation was further along 13 years after the eruption.

What Happens to Pioneer Communities?

Are the first organisms in a pioneer community always plants? In some places the answer is no. This is usually the case in newly formed, fiery volcanic islands that rise from the sea. Here the pioneer community is often made up of bacteria, fungi, and algae. Over many years these organisms slowly break down the volcanic rock into soil.

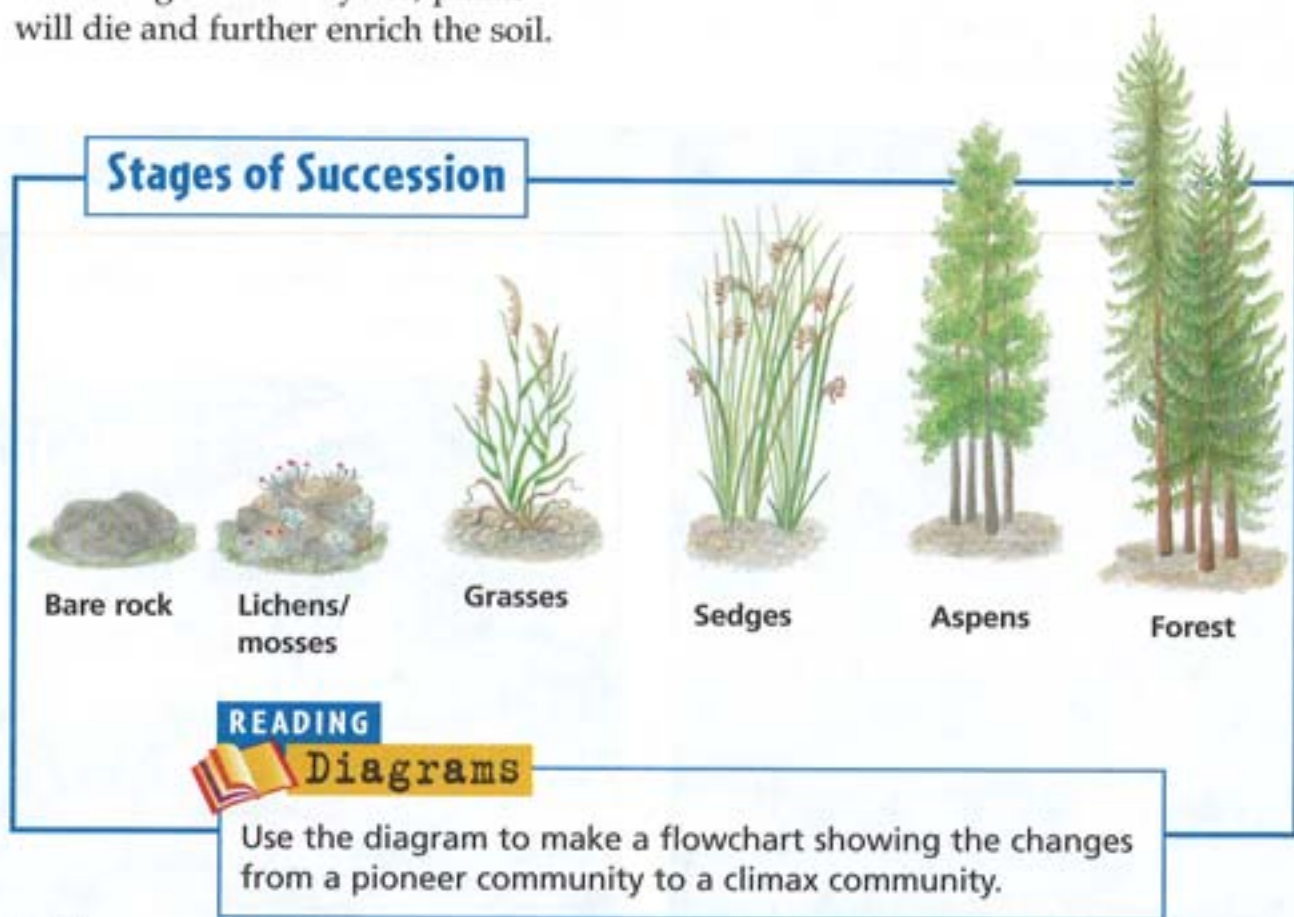
What happens when there is enough soil, and other conditions are right for plants to grow? A seed blown to the island by the wind or dropped by a passing bird will take root. The new plant, and others like it, will gradually spread over the land.

During their life cycles, plants will die and further enrich the soil.

Perhaps a coconut will drift ashore. When it germinates, its roots will find a good supply of nutrients. A coconut palm will spring up, and a new island paradise will be created.

Climax Communities

More years will pass—perhaps hundreds of them. The climate of the island will remain almost unchanged. Its community will grow. Its populations will become balanced and stable. Few new animals and plants will arrive. Few will leave. Ecological succession will slow down or stop altogether. This is a **climax community**, a final stage of succession. This community will stay largely unchanged unless some major event occurs.



What kind of event could change an entire ecosystem? A hurricane may sweep across the island. The volcano that created it might erupt again. People might come and build hotels or introduce new plants or animals. The climate might change. Then the processes of ecological succession would begin all over again. Another climax community would eventually develop. It might—or might not—be the same as the earlier climax community.

▶ What is the difference between a pioneer community and a climax community?



The volcano Kilauea erupting on the island of Hawaii.

QUICK LAB



Predicting Succession

FOLDABLES Make a Four-Tab Book. (See p. R 44.) Label the tabs as shown. Record your answers on your Four-Tab Book.

| K2 | K3 | K4 | K5 |
|-------------|-------|---------|-------------|
| Communicate | Infer | Predict | Communicate |
| | | | |
| | | | |



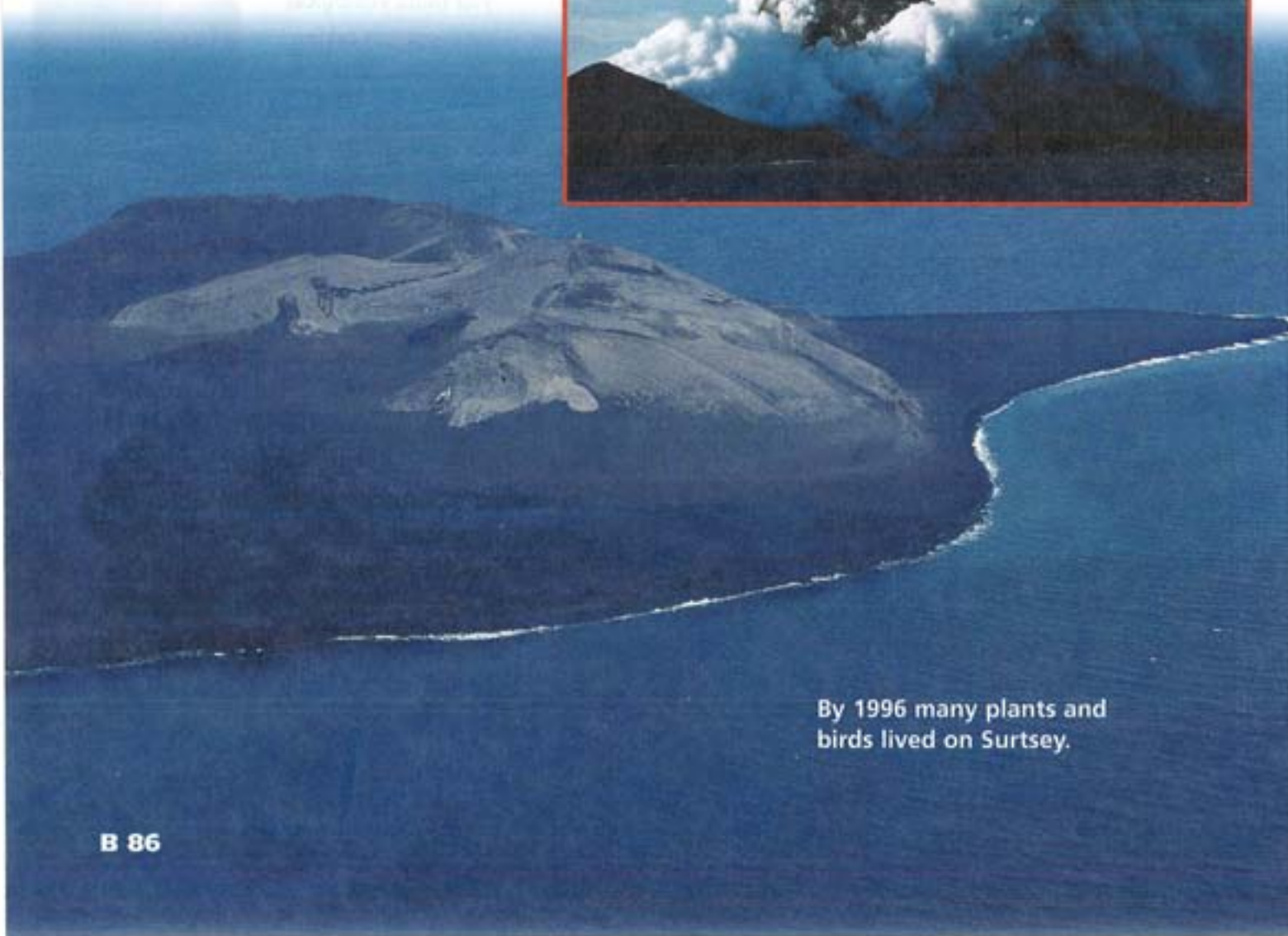
- 1. Observe** Identify an area near you where you think ecological succession is taking place.
- 2. Communicate** Describe the area. List the evidence you have that indicates ecological succession is taking place.
- 3. Infer** Do you think the succession will be primary or secondary? Explain.
- 4. Predict** In what order do you think new species will colonize the area? Explain the reasons for your predictions.
- 5. Communicate** Describe the climax community that you think will eventually live in the area. Give reasons for your conclusion.

What's Living on Surtsey?

In 1963 the island of Surtsey, near Iceland, was formed from a volcano. Between 1963 and 1996, at least 45 types of plants were seen growing there. Several kinds of birds, such as snow buntings, were also found raising their young on the island. Flying insects have also been found there. Scientists expect that more types of plants and birds will live on Surtsey in the future.

▶ How is Surtsey an example of ecological succession?

Surtsey, a volcanic island, rose from the sea near Iceland in 1963.



By 1996 many plants and birds lived on Surtsey.

Inquiry Skill

BUILDER

SKILL

Infer

Comparing Ecosystems in Volcanic Areas

In this activity you will collect data and infer about the ecosystems of two volcanic areas.

Data are different kinds of facts. They might include observations, measurements, calculations, and other kinds of information. Scientists collect data about an event to better understand what caused it, what it will cause, and how it will affect other events.

What do these data tell the scientist? The scientist first organizes the data in some way—perhaps a table, chart, or graph. The scientist then studies the organized data and makes inferences. To infer means to form an idea from facts or observations. In this case you will infer about which plants will return to a volcanic area.

Materials

research books

Internet

Procedure

- 1** Collect data on two volcanic areas, such as Mount Saint Helens and the Soufriere Hills volcano on the island of Montserrat or the active volcanoes of Hawaii. Organize the data.
- 2** **Communicate** Describe the sequence of events that has taken place.
- 3** **Interpret Data** Draw a conclusion about why certain plants return when they do.

Drawing Conclusions

- 1** In what ways is succession in the two areas alike? In what ways is it different?
- 2** **Infer** Why is the succession in these two areas similar or different?
- 3** **Infer** What abiotic factors must you consider when drawing conclusions? What biotic factors must you consider?



How Do Populations Survive Earth's Changes?

Earth is constantly changing. About 18,000 years ago, great sheets of ice moved deep into the heartland of what is now the United States. Vast ice sheets also covered much of Europe and parts of South America. Sea levels dropped as more and more water froze. New land was exposed. Earth was a cold place.

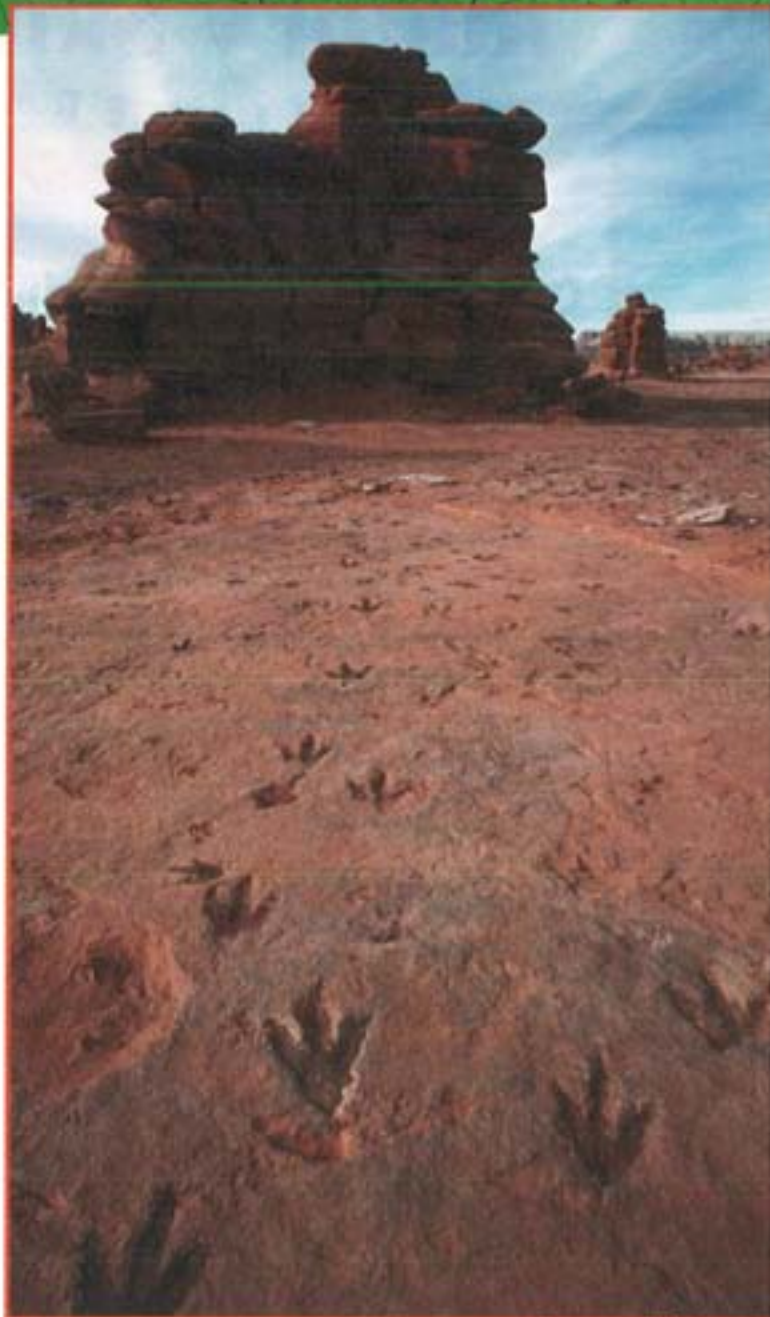
Slowly Earth began to warm up. The ice melted. Sea levels rose. Coastal land became flooded.

These kinds of changes have occurred no fewer than seven times during the past 700,000 years. Scientists call these cold periods *ice ages*.

Earth has also changed in other ways. Over millions of years, continents have moved north and south, east and west. Huge mountain-sized rocks have crashed into Earth. Volcanoes have poured gases and dust into the air.

Each of these events has had an effect on living things. Some organisms have survived these changes, while others have died out, or become extinct. Why have some of these organisms vanished while others survived?

To answer this, let's look at the age of the dinosaurs. Fossils from about 65 million years ago suggest that dinosaurs shared the land with many other animals. These animals included frogs, snails, insects, turtles, snakes, and some small furry mammals. Plants of all kinds grew everywhere. The seas were full of organisms like fish, sea urchins, clams, and algae.



Dinosaur footprints

Scientific evidence suggests that a meteorite up to 10 km (6 mi) in diameter struck Earth from outer space. One theory states that the impact created a huge explosion. It gouged out a crater 64 km (40 mi) across and threw huge amounts of

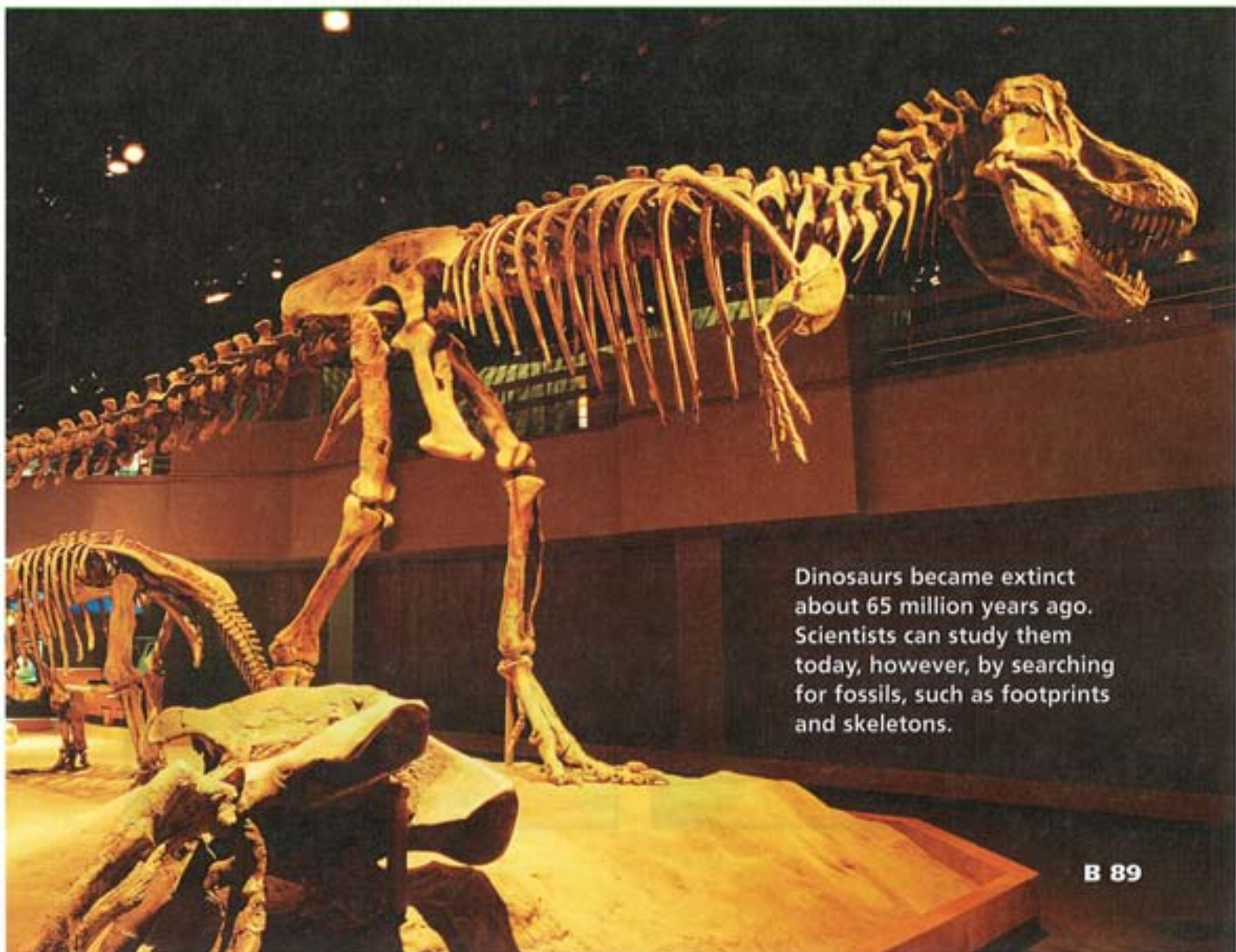


dust into the sky. The dust may have hung in the sky for months, even years. Sunlight was probably blocked from reaching the ground.

Plants needing lots of sunlight may have died out. That means that the large plant-eating dinosaurs could not get enough food. They would have died out. The large dinosaurs preying on plant eaters would have also died out. It may have been that every animal weighing more than about 55 kg (121 lb) became extinct.

However, many of the smaller animals could have survived. They needed less food to live. They could have moved more easily from habitat to habitat. They would no longer have been in competition with the dinosaurs. They would have been free to grow in size and variety. Possibly this is how a world once ruled by dinosaurs became ruled by mammals.

▶ **How do changes on Earth affect organisms?**



Dinosaurs became extinct about 65 million years ago. Scientists can study them today, however, by searching for fossils, such as footprints and skeletons.

What Do Fossils Tell Us About Changes in the Environment?

Scientists have developed hypotheses to solve the following mystery.

- Scientists gathering fossils in Italy make a discovery. About six million years ago, fish and other sea creatures disappeared from the Mediterranean Sea.
- Other fossils from a slightly later period reveal that horselike animals from Africa arrived in Europe.
- The fossil of an ancient African hippopotamus is found on an island in the middle of the Mediterranean.
- Fossil palm trees of the same age are dug up in Switzerland.
- Then there is another surprising discovery. Five-million-year-old fossils of fish turn up in the Mediterranean area.

What could have gone on back then to have these clues make sense? One theory is called *plate tectonics*.

Earth's crust is made up of moving plates—pieces of crust. About six

million years ago, two plates—the African and the Eurasian—collided. The continents of Africa and Europe bumped into each other. This happened at what is now the Strait of Gibraltar. This collision created a natural dam between the Atlantic Ocean and the Mediterranean Sea.

Without a source of water from the ocean, the sea dried up in perhaps as little as 1,000 years. The Mediterranean Sea became a desert. The sea's fish and other marine life died out. Animals from Africa migrated across the desert to Europe. Palm trees sprouted in Switzerland.

Then about five million years ago, the dam began to crumble. A gigantic waterfall poured water into the desert. It carried many kinds of marine life from the Atlantic Ocean. The Mediterranean became a sea again.

READING Summarize


How did changes in the Mediterranean affect populations?



Why It Matters

Once an ecosystem is disturbed it begins to change until a stable climax community is reached. A climax community is an area where biotic and abiotic factors interact to maintain a stable environment.

Ecosystems change and recover from natural disasters and human activities in predictable ways. Understanding of succession and climax communities can prevent human-made ecological disasters and can help us set the right conditions to help environments recover faster.

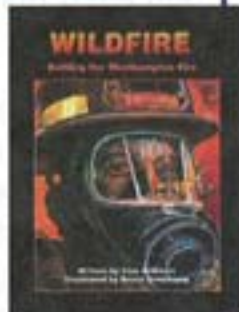
 **Journal** Visit our Web site www.science.mmhschool.com to do a research project on what fossils can tell us about environmental changes. Find a specific example.

Think and Write

1. Describe how an abandoned farm field becomes a deciduous forest.
2. Give an example of a pioneer and a climax community.
3. List the evidence that supports the conclusion that the Mediterranean Sea once dried up.
4. **Infer** How might a volcanic eruption affect an ecosystem?
5. **Critical Thinking** How would succession be affected if animals did not return to an area after a fire?

LITERATURE LINK

Read *Wildfire* to learn about the true story of a wildfire that destroyed 5,000 acres of land in New York. Try the activities in the back of the book.



WRITING LINK

Expository Writing

How do ecosystems change over time? Research what happened to Angkor. What was the culture like? Why did the people leave their city? Write a research report on your findings.



MATH LINK

Divide by one-digit numbers. Iceland has an area of 39,756 mi. Surtsey has an area of 2 mi. How many times larger is Iceland than Surtsey?

TECHNOLOGY LINK



Science Newsroom CD-ROM Choose *From the Ground Up* to learn how ecosystems change.



Visit www.science.mmhschool.com for more links.

Chapter 6 Review

Vocabulary

Fill each blank with the best word or words from the list.

biome, B64
carbon cycle, B53
climax community, B84
desert, B69
ecological succession, B82
evaporation, B50
pioneer community, B83
precipitation, B51
taiga, B67
tundra, B68

- Part of the soil of the _____ is frozen all year round.
- The gradual change from one community to another is called _____.
- The _____ shows the continuous transfer of carbon between living and nonliving things.
- The _____ has many evergreen trees.
- A(n) _____ is made up of the first organisms to colonize an area.
- Sleet and snow are examples of _____.
- When ecological succession slows down, a(n) _____ has formed.
- A deciduous forest is an example of a(n) _____.
- The process in which a liquid becomes a gas is called _____.
- The Gobi and Mojave are examples of _____.

Test Prep

- All of the following are abiotic factors in an ecosystem EXCEPT
 - water.
 - minerals.
 - bacteria.
 - soil.
- A vulture is an example of a
 - predator.
 - scavenger.
 - carnivore.
 - all of the above
- Plants absorb nitrogen
 - from the soil.
 - from the atmosphere.
 - from the Sun.
 - from insects.
- A _____ is an example of a biome.
 - pond
 - bacteria
 - grassland
 - mammal

15. Scientists call _____ a pioneer species.

- A** grasses
- B** fir trees
- C** fireweed
- D** fallen tree trunks

Concepts and Skills

16. Reading in Science Summarize the steps in the nitrogen cycle.

17. Scientific Methods You discover that there are no fossils of dinosaurs above a certain layer of rock, but there are below it. The rock in this layer has more in common with rocks from space than with Earth rocks. Hypothesize how these two discoveries may be linked.

18. INQUIRY SKILL Infer What can you infer from the data below?

Pond Populations and Acid Content

| Acid | Yellow Perch | Brown Trout | Salamanders | Mayflies |
|--------|--------------|-------------|-------------|----------|
| High | 23 | 6 | 2 | 0 |
| Medium | 28 | 11 | 7 | 2 |
| Low | 36 | 18 | 10 | 14 |

19. Critical Thinking How might a change in the biome you live in affect your way of life?

20. Decision Making Is it important to recycle the waste you produce? Why or why not?

Did You Ever Wonder?

INQUIRY SKILL Observe Choose an area near your school or in your neighborhood. Determine how materials in this area are recycled by nature. Would you add or remove any elements to help the natural recycling process?

LOG Visit www.science.mmhschool.com to boost your test scores.

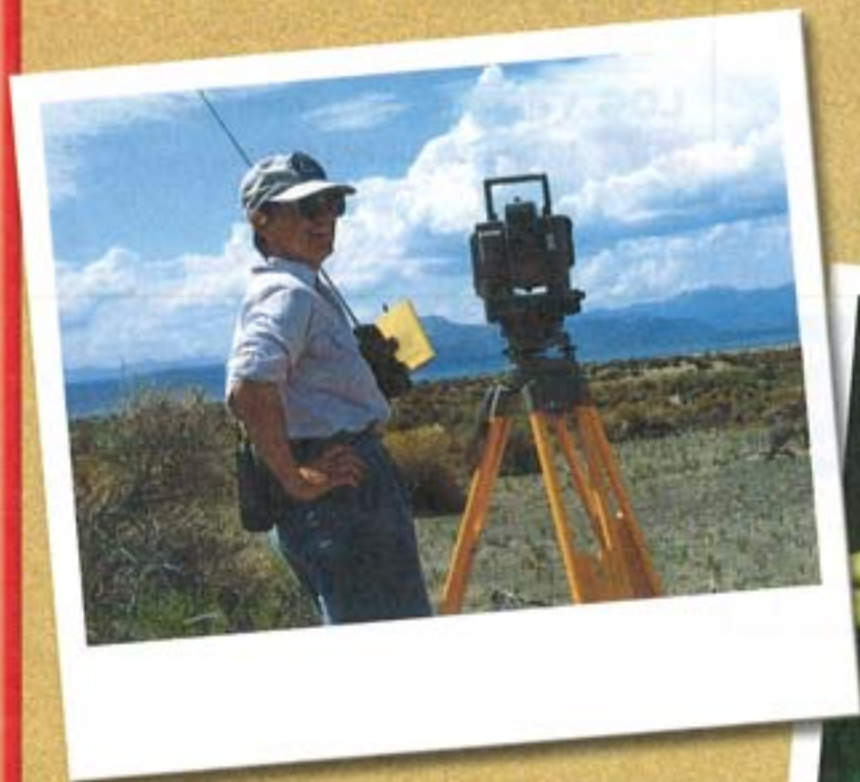
Meet a Scientist

Dr. Catherine Toft

POPULATION ECOLOGIST

Dr. Catherine Toft is a population ecologist. Population ecology is the study of populations in nature. "It focuses on how numbers of individuals in a population change through time or vary from place to place," Dr. Toft says. Toft explains that a population is a group of individuals of the same type that mate within the group and produce offspring.

Desert bee fly



Desert Bee Fly



Dr. Toft loves discovering new things about nature. She spends most of her time in the field. She studies her subjects in their natural environments. "I study desert plants and desert insects," Dr. Toft says.

One of Dr. Toft's favorite subjects is the desert bee fly. The males gather in groups, called leks, to fight over the females. "These leks are in the same place every year even though the male flies live only one season. It is a mystery how the flies know to come to the same place every year, which looks like any other place in the sand dunes where they live."

Dr. Toft's work can help change the way we think about nature. "I hope that I can help people live lives that are more environmentally healthy."

TOP
5

Longest-Living Animals

Do you want to work with living things? A population ecologist such as Dr. Toft studies how long organisms live. Here are the animals that live the longest and the oldest known age for each.

1. Giant tortoise: 200 years
2. Human: 122 years
3. Sturgeon (a type of fish): 100 years
4. Blue whale and golden eagle: 80 years
5. African elephant: 77 years

Write About It

1. What is a lek?
2. Why do leks fascinate Dr. Toft?



LOG Visit www.science.mmhschool.com to learn more about the work of population ecologists.

Performance Assessment

Ecosystem Discovery

Your goal is to invent and describe a new ecosystem.

What to Do

1. Imagine you are an explorer. You have found the world's last unexplored ecosystem. Give your ecosystem a name.
2. Describe this new ecosystem. Write about the plants and animals there. Tell what each one needs to survive.
3. Draw a picture of your ecosystem.

Analyze Your Results

1. Tell how each plant and animal gets what it needs to survive in your ecosystem.
2. What nonliving things help plants and animals survive in your ecosystem?
3. Draw an energy pyramid to show how energy moves in your ecosystem. What belongs at the bottom of the pyramid? At the top?

Will Succession Succeed?

Your goal is to identify a place where ecological succession is taking place.

What to Do

1. Write a short paragraph describing what ecological succession is.
2. Think of an area you have visited where succession is taking place. If you can't think of an area near you, describe a place you have read about. Write down the name of the place or tell its location. Draw a picture.

Analyze Your Results

1. List evidence that succession is taking place in your area.
2. In what order will new species come to live in your area? Explain.
3. What could happen to prevent succession in your area?