

HOW MIGHT A BAYOU CHANGE OVER TIME?



How do natural and human activities change ecosystems?

Louisiana's Atchafalaya Basin covers about 5665.5 square kilometers. The basin contains hardwood forest, swamp, bayou, and marsh ecosystems. Many organisms listed on state and federal threatened and endangered species lists, such as the pallid sturgeon and ivory-billed woodpecker, live here. Storms, oil exploration, and logging all threaten the basin.

Infer What other events might affect wetlands?



Watch the **Untamed Science** video to learn more about ecosystems.

Balance Within Ecosystems

TN



CHAPTER

5

Tennessee Academic Standards for Science

- 6.LS2.3** Draw conclusions about the transfer of energy through a food web and energy pyramid in an ecosystem.
- 6.LS2.5** Analyze existing evidence about the effect of a specific invasive species on native populations in Tennessee and design a solution to mitigate its impact.
- 6.LS2.6** Research the ways in which an ecosystem has changed over time in response to changes in physical conditions, population balances, human interactions, and natural catastrophes.
- 6.LS4.1** Explain how changes in biodiversity would impact ecosystem stability and natural resources.
- 6.LS4.2** Design a possible solution for maintaining biodiversity of ecosystems while still providing necessary human resources without disrupting environmental equilibrium.
- 6.ESS3.3** Assess the impacts of human activities on the biosphere including conservation, habitat management, species endangerment, and extinction.
- 6.ETS1.1** Evaluate design constraints on solutions for maintaining ecosystems and biodiversity.

Getting Started

Check Your Understanding

1. **Background** Read the paragraph below, then answer the question.

Lavar's science class was having its yearly bird count. The class was going to a nearby marsh, where there was a **population** of snowy egrets. The class might also see another egret **species**, the great egret. When the class arrived at the marsh, they discovered that it had a large **community** of birds, including egrets and other birds.

All the members of one species living in a particular area is a **population**.

A **species** is a group of organisms that can mate with each other and produce offspring that also mate and reproduce.

All the different populations that live in an area make up a **community**.

- What other populations might make up the marsh community?

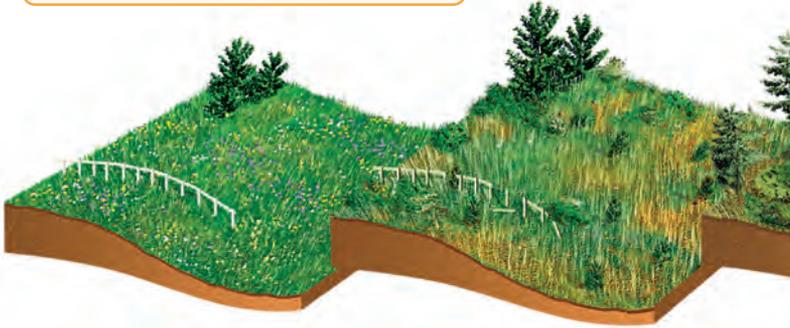
Vocabulary Skill

Latin Word Origins Some key terms in this chapter contain word parts with Latin origins. The table below lists two of the Latin words that key terms come from.

Latin Word	Meaning	Example
<i>habitare</i>	to dwell	habitat, <i>n.</i> the place where an organism lives
<i>extinguere</i>	to wipe out	extinction, <i>n.</i> the disappearance of all members of a species from Earth

2. **Quick Check** The terms *habitat destruction* and *habitat fragmentation* both come from the Latin word *habitare*. Circle the meaning of *habitare* in the table above.

secondary succession



resources



keystone species



dispersal

Chapter Preview

LESSON 1

- succession • primary succession
- pioneer species
- secondary succession

- 🎯 Compare and Contrast
- ▲ Observe

LESSON 2

- resources • greenhouse effect

- 🎯 Relate Cause and Effect
- ▲ Observe

LESSON 3

- biodiversity • keystone species
- extinction • endangered species
- threatened species
- habitat destruction
- habitat fragmentation • poaching
- captive breeding

- 🎯 Compare and Contrast
- ▲ Calculate

LESSON 4

- biogeography
- continental drift • dispersal
- exotic species

- 🎯 Relate Cause and Effect
- ▲ Predict

📌 CCC: Stability and Change

Scenario Investigation

Fantasy Food Chain

 **SEP: Developing and Using Models**

Purpose To investigate the roles of different organisms in a food chain

Materials

- colored index cards (4 different colors)
- colored pencils or markers
- white index cards
- poster board or newsprint
- white copier paper

Scenario

You are an ecologist. Your specialty is ecosystems. Normally that means investigating relationships among the plants and animals that live together in an area. Your work involves food chains and food webs.

Today, you and three of your colleagues were given a different kind of job to do. You have been asked to create three imaginary animals and one imaginary plant for a new children's book.

Stories by Curtis Larking in *The Adventures of Henry Porter* are all set in a fantasy world that the author creates in his mind. After writing fourteen novels, he is looking for some original ideas. That's where you come in. Larking plans to use the three animals and one plant that you invent as he writes about a fictional food chain in his new book.

Larking needs a fictional plant to be the producer and three levels of animal consumers—one species of herbivore, one species of carnivore, and one species of scavenger. Although these organisms are fictional, Larking wants the food chain to be scientifically accurate.

That means the largest amount of available energy should be at the producer level. It also means that as you move up the food chain, the available energy must decrease, so consumer populations will get smaller.

Procedure

- 1. Forming Your Fantasy Team** Your teacher has given each student in your class a card. The cards come in four colors. When your teacher tells you, form a team in which each person on your team has a different color card.
- 2. Who's Inventing What?** Your teacher will tell you which color card represents which organism (plant, herbivore, carnivore, and scavenger).
- 3. Creating an Organism** The organisms your team is creating need to be imaginative—even the plant. (After all, the organisms are going to inhabit an ecosystem in a fantasy world.) You can create an organism that no one has ever seen before, or you can create an organism by combining parts of real animals or real plants. Work together with your partners to make sure your organisms can live together in the same kind of environment. Also, remember that the herbivores will eat the plants, the carnivores will eat both the herbivores and the scavengers, and the scavengers will eat any dead animals (carnivores, herbivores, and even other scavengers).
- 4. Drawing Your Organism** Draw a picture of your organism. Make each picture large enough to fill a sheet of copier paper.

Conclusion

Let's see what you learned about food chains.

- 1.** What role do producers play in an ecosystem?



- 2.** Which level in a food chain has the most available energy?

- 3.** Which level in a food chain has the least available energy?

- 4.** If Curtis Larking asks you to suggest decomposers, what will their role be?

Now mount your group's four organisms on a poster to show the food chain. Arrange them so that producers are on the bottom, carnivores and scavengers are at the top, and herbivores are in the middle. Leave room for labels and arrows to show the relationships that exist in the food chain.

Next to each organism, Larking wants an index card with the following information:

- role in the food chain
- population size (make sure it is appropriate for the role in the food chain)
- litter size (for plants, give the number of germinated seeds it produces)
- life expectancy
- any strange behaviors it exhibits

Once you have added all of the index cards to your poster, add arrows to show the flow of energy through your food chain.



6.LS2.6



-  How Do Ecosystems Change Over Time?
-  How Do Changes in Ecosystems Affect the Survival of Organisms?

my planet DiARY

Fighting Fire With Fire

Wildfires are often reported in the national news. The images associated with these reports show how damaging these fires can be to property and to some ecosystems. What you may not know is that fire can actually help fight wildfires! Controlled burns, or prescribed burns, are fires that are purposely and carefully set by professional foresters. Prescribed burns are used to remove materials such as dead, dry branches and leaves that can fuel wildfires. A wildfire that occurs in an area that has previously been burned would cause less damage and be easier for firefighters to control.

This forester is carefully igniting a controlled burn.



MISCONCEPTION

Communicate Discuss these questions with a classmate. Write your answers below.

1. Why should only professional foresters set prescribed fires?

2. What do you think could be some other benefits to using prescribed burns in an ecosystem?



Do the Inquiry Warm-Up
How Communities Change.

How Do Ecosystems Change Over Time?

Natural disasters can change communities in an ecosystem quickly. Even without a disaster, communities change. The series of predictable changes that occur in a community over time is called **succession**.  **Primary succession and secondary succession are two types of succession.**

Vocabulary

- succession • primary succession
- pioneer species • secondary succession

Skills

- 🎯 Reading: Compare and Contrast
- 🔺 Inquiry: Observe

Primary Succession When a new island is formed by the eruption of an undersea volcano or an area of rock is uncovered by a melting sheet of ice, no living things are present. Over time, living things will inhabit these areas. **Primary succession** is the series of changes that occurs in an area where no soil or organisms exist.

Figure 1 shows how an area might change following a volcanic eruption. Just like the pioneers that first settled new frontiers, the first species to populate an area are called **pioneer species**. They are often carried to the area by wind or water. Typical pioneer species are mosses and lichens. Lichens are fungi and algae growing in a symbiotic relationship. As pioneer species grow, they help break up the rocks and form soil. When organisms die, they provide nutrients that enrich the layer of soil forming on the rocks.

As plant seeds land in the new soil, they begin to grow. The specific plants that grow depend on the climate of the area. For example, in a cool, northern area, early seedlings might include alder and cottonwood trees. Eventually, succession may lead to a community of organisms that does not change unless the ecosystem is disturbed. Reaching this mature community can take centuries.

FIGURE 1
Primary Succession

Primary succession occurs in an area where no soil and no organisms exist.

 **Sequence** In the circles, number the stage of primary succession to show the correct order of events.



Soil Creation

As pioneer species grow and die, soil forms. Some plants grow in this new soil.



Pioneer Species

The first species to grow are pioneer species such as mosses and lichens.



Volcanic Eruption

Shortly after a volcanic eruption, there is no soil, only ash and rock.



Fertile Soil and Maturing Plants

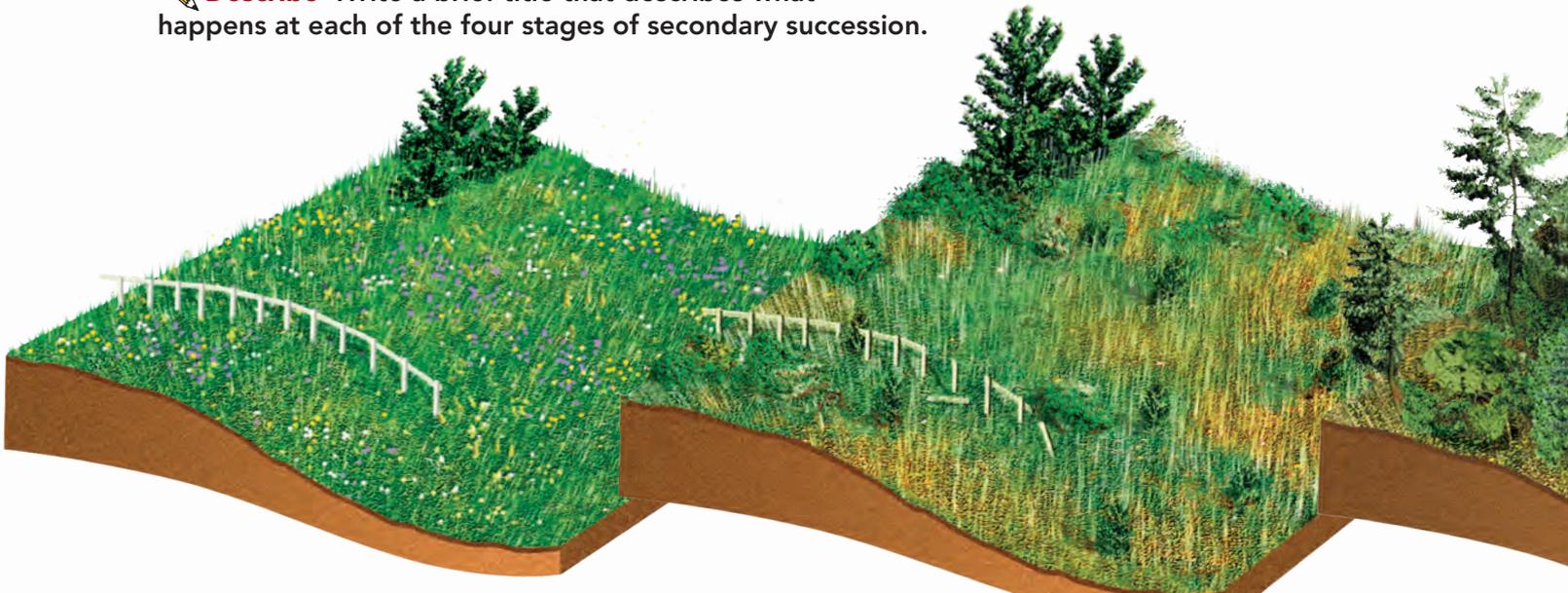
As more plants die, they decompose and make the soil more fertile. New plants grow and existing plants mature in the fertile soil.

FIGURE 2

Secondary Succession

Secondary succession occurs following a disturbance to an ecosystem, such as clearing a forest for farmland.

 **Describe** Write a brief title that describes what happens at each of the four stages of secondary succession.



Increasing time

Title: _____

Grasses and wildflowers have taken over this abandoned field.

Title: _____

After a few years, pine seedlings and other trees replace some of the grasses and wildflowers.

apply it!

 **Compare and Contrast** Based on your reading, complete the table below.

Factors in Succession	Primary Succession	Secondary Succession
Possible Cause	Volcanic eruption	_____
Type of Area	_____ _____ _____	_____ _____ _____ _____
Existing Ecosystem?	_____ _____	_____ _____

Secondary Succession In October 2007, huge wildfires raged across southern California. The changes following the California fires are an example of secondary succession. **Secondary succession** is the series of changes that occurs in an area where the ecosystem has been disturbed, but where soil and organisms still exist. Natural disturbances that have this effect include fires, hurricanes, and tornadoes. Human activities, such as farming, logging, or mining, may also disturb an ecosystem and cause secondary succession to begin.

Unlike primary succession, secondary succession occurs in a place where an ecosystem currently exists. Secondary succession usually occurs more rapidly than primary succession because soil already exists and seeds from some plants remain in the soil. You can follow the process of succession in an abandoned field in **Figure 2**. After a century, a forest develops. This forest community may remain for a long time.



Title: _____
 As tree growth continues, the trees begin to crowd out the grasses and wildflowers.

Title: _____
 Eventually, a forest of mostly oak, hickory, and some pine dominates the landscape.

Lab zone® Do the Quick Lab
 Primary or Secondary.

 **Assess Your Understanding**

- 1a. **Define** _____ succession is the series of changes that occurs where no soil or organisms exist.
- b. **Observe** Is grass poking through a sidewalk crack primary or secondary succession?

- c. **CHALLENGE** Why are the changes during succession predictable?

got it?

- I get it! Now I know that ecosystems can change through _____

- I need extra help with _____

How Do Changes in Ecosystems Affect the Survival of Organisms?

Organisms in an ecosystem experience day-to-day changes in their surroundings that do not affect them much. But when changes occur that are long lasting or extreme, most organisms in the ecosystem do not survive. However, some organisms may survive these changes.  **Organisms that survive a changing ecosystem have adaptations that help them survive in the new conditions.**

FIGURE 3

Adapted to Fire

In the longleaf pine ecosystem, a variety of plants and animals are adapted to survive fire.

 **Complete these tasks.**

- 1. Classify** In each box, write whether the organism's adaptation is a structural or behavioral adaptation.
- 2. Explain** How does a wildfire impact the survival of the population of oak trees?

- 3. Infer** How might a wildfire help the longleaf pine population survive a deadly fungal infection on the needles of seedlings?

Figure 3 shows an ecosystem called the longleaf pine forest. Longleaf pine trees dominate this ecosystem. These trees grow in a pattern that allows plenty of sunlight to shine on the forest floor. The abundant sunlight allows many grasses and other small plants to grow below the trees. However, invasive plants such as oak trees eventually start to grow among the small plants. Without extreme change, the invasive plants crowd out the grasses and pine trees, and eventually dominate the forest.

Wildfires from lightning strikes occur frequently in the longleaf pine forests and change the ecosystem quickly. Although many of the organisms disappear during a wildfire, they reappear a short time after the fires. Most organisms return because they have adaptations that help them survive fire. You can read about these adaptations in **Figure 3**. However, invasive plants such as oak trees are not adapted to survive fire. The seeds of these trees must be carried into the ecosystem before they can grow there again. So, the populations of invasive plants disappear from the longleaf pine forest. The populations of longleaf pine trees, grasses, and other organisms survive the change and again dominate the ecosystem.

Fire burns the blades of bluestem grass, but its underground roots remain unharmed. After the fire new shoots sprout from the roots.

A pine snake escapes fire by seeking shelter in a gopher burrow.

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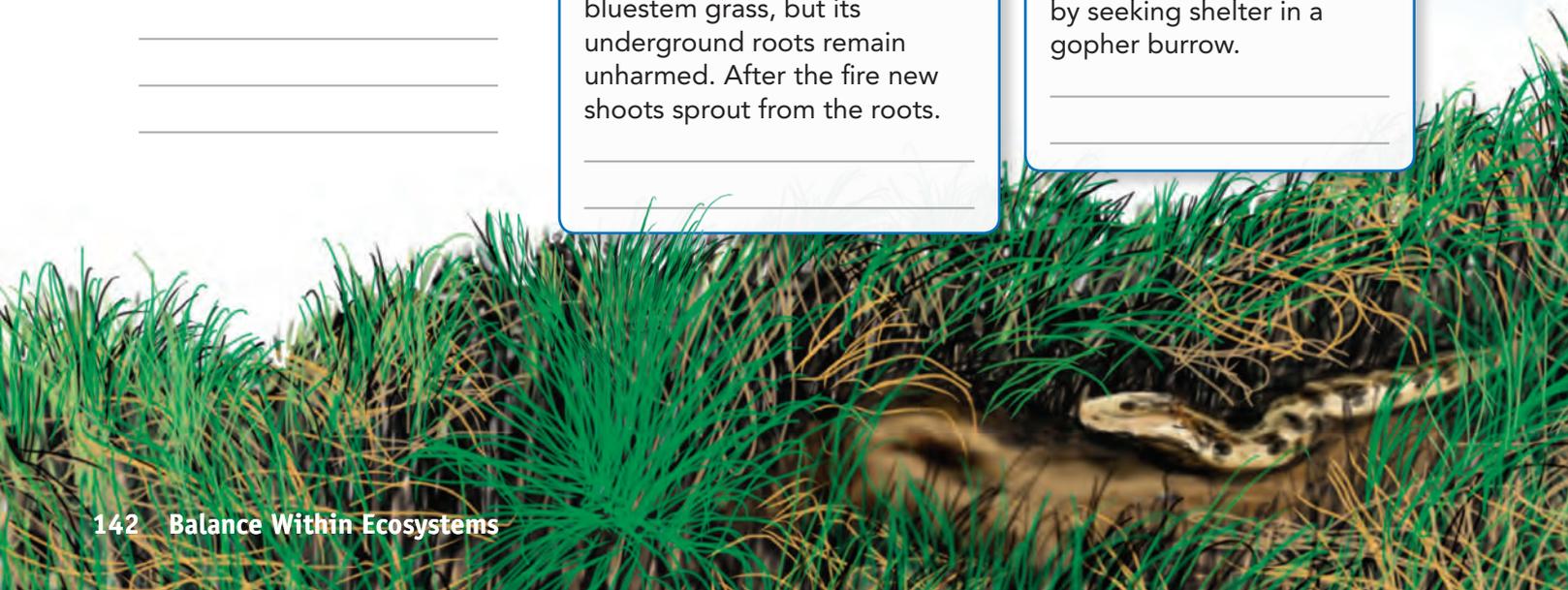
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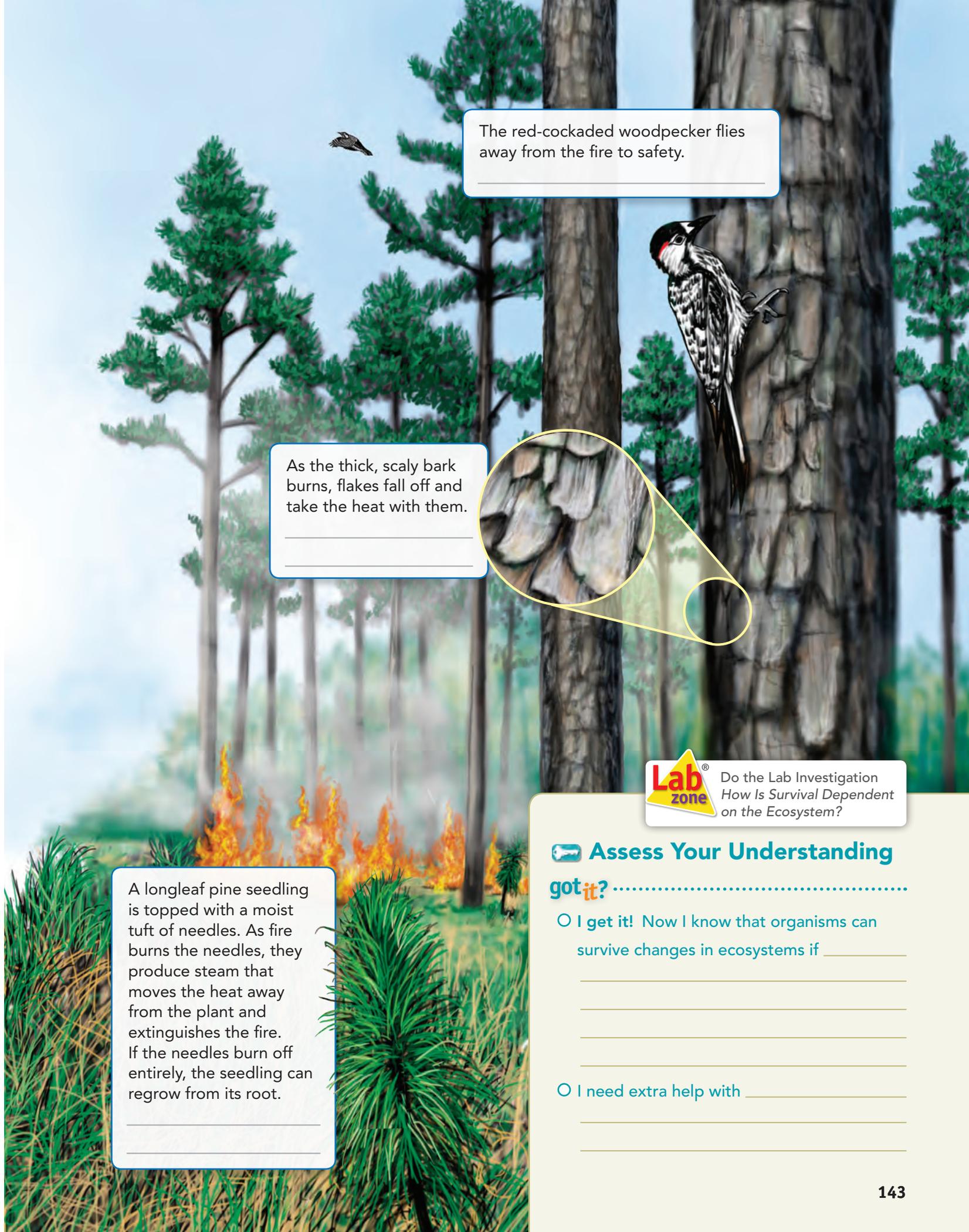
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A pine snake escapes fire by seeking shelter in a gopher burrow.





The red-cockaded woodpecker flies away from the fire to safety.

As the thick, scaly bark burns, flakes fall off and take the heat with them.



A longleaf pine seedling is topped with a moist tuft of needles. As fire burns the needles, they produce steam that moves the heat away from the plant and extinguishes the fire. If the needles burn off entirely, the seedling can regrow from its root.

Lab zone Do the Lab Investigation
How Is Survival Dependent on the Ecosystem?

Assess Your Understanding
got it?

- I get it! Now I know that organisms can survive changes in ecosystems if _____

- I need extra help with _____



6.LS2.5, 6.LS4.1

Humans and the Environment



What Resources Do Humans Obtain From Ecosystems?



How Do Human Activities Affect Ecosystems?



my planet DiARY

The Grass That Invaded Louisiana

In April of 1990, an invader was discovered in a pasture in southeastern Louisiana. This invader had entered the United States in crates shipped from Asia to Alabama back in 1912. Used as packing material, this invader, a grassy weed called cogongrass, began spreading. Today, cogongrass has negatively affected ecosystems in many parts of Louisiana. It is a hardy grass that grows quickly and thickly, preventing the seedlings of native plants such as pine trees to grow. However, scientists have found that ryegrass can compete successfully with cogongrass. So, pastures dominated by cogongrass are being plowed under and planted with ryegrass to control the spread of this invasive grass.



DISCOVERY

Answer the questions.

1. Why do you think grass was used as a packing material in Asia in 1912?

2. How has modern transportation spread foreign organisms?



Do the Inquiry Warm-Up How Do You Interact With Your Environment?

What Resources Do Humans Obtain From Ecosystems?

You live in an ecosystem. The ecosystem provides you with resources. **Resources** are anything in an ecosystem that you need to live. The resources that humans obtain from ecosystems include abiotic resources and biotic resources.

Vocabulary

- resources
- greenhouse effect

Skills

- 🎯 Reading: Relate Cause and Effect
- 🔺 Inquiry: Observe

Abiotic Resources Abiotic resources, or nonliving resources, are found in the air, on Earth's surface, in soil, and beneath Earth's surface. The abiotic resources that humans obtain from ecosystems include water, sunlight, oxygen, and minerals.

How do you and others obtain these abiotic resources? Sources of freshwater provide most of the water that you need. Foods provide some of it, too. You absorb sunlight through your skin. Your body uses it to produce vitamin D, which helps build bones. When you breathe, you take in oxygen from the air. You need oxygen to release the energy from the foods you eat. You get minerals such as iron and calcium, which your body needs to stay healthy, when you eat plants. Plants absorb these minerals from the soil. Other minerals that make up objects you use, such as coins and jewelry, are mined. Use **Figure 1** to identify some abiotic resources you use.

FIGURE 1

Abiotic Resources

This girl is helping the plants in this garden to grow.

 **Interpret Photos** In the chart, write from where in the photo you might get each abiotic resource.



Sunlight	_____
Oxygen	_____
Water	_____
Minerals	_____

Biotic Resources The living things in an ecosystem are important biotic resources. They provide humans with food, materials to build shelter, and fuels. Food is found in many ecosystems. For example, marine ecosystems are a source of fish, aquatic plants, and invertebrates such as clams and mussels. The trees in forests provide lumber for building homes and other structures. **Figure 2** shows another way trees are used. Oil, coal, and natural gas are commonly used fuels. They were formed from the remains of organisms that lived millions of years ago. People use fuels for transportation, heating, cooking, manufacturing, and the production of electricity.

Decomposers are also biotic resources. Decomposers are animals, bacteria, and fungi that break down and recycle the remains of dead organisms. Their activities provide important things that people need, such as a part of soil called humus. Humus is the decayed parts of organisms. It contains nutrients that plants need to grow. Decomposers recycle nutrients from dead plant and animal matter back to the soil in land ecosystems and to the water in aquatic ecosystems.



FIGURE 2

Trees as Resources

Trees provide food for people. Many fruits, seeds, and nuts grow on trees. People also collect the sap from maple trees to produce maple syrup.

 **List** On the notebook paper, list three foods you like to eat that come from trees.



Do the Quick Lab How Do Humans Impact Ecosystems?

 **Assess Your Understanding**

1a. **Identify** A _____ is anything in an ecosystem that you need to live.

b. **Apply Concepts** Give an example of an abiotic and a biotic resource you used today.

got it?

I get it! Now I know that the resources humans obtain from ecosystems are _____

I need extra help with _____

How Do Human Activities Affect Ecosystems?

Human activities can cause changes in ecosystems.  **Human activities may affect the balance in an ecosystem and thereby change the ecosystem.** Some examples of human activities include the introduction of nonnative species, the process of energy production, and the use of resources for habitation and transportation.

Nonnative Species Humans can harm an ecosystem when they introduce a species into it. A species brought to an ecosystem where it is not native is a nonnative species. In the United States, cogongrass is a nonnative plant species.

Animals may also be nonnative species. Animals called nutrias live in the United States. However, nutrias are not native to North America. They are a rodent species from South America. These animals were brought to the United States for their fur and later released into ecosystems to control weeds. But the animals also ate many other types of native wetland plants. As a result, the populations of the native plants have decreased. These native plants are important because their roots hold the soil in place. **Figure 3** shows the damage nutrias can do to a wetland ecosystem.

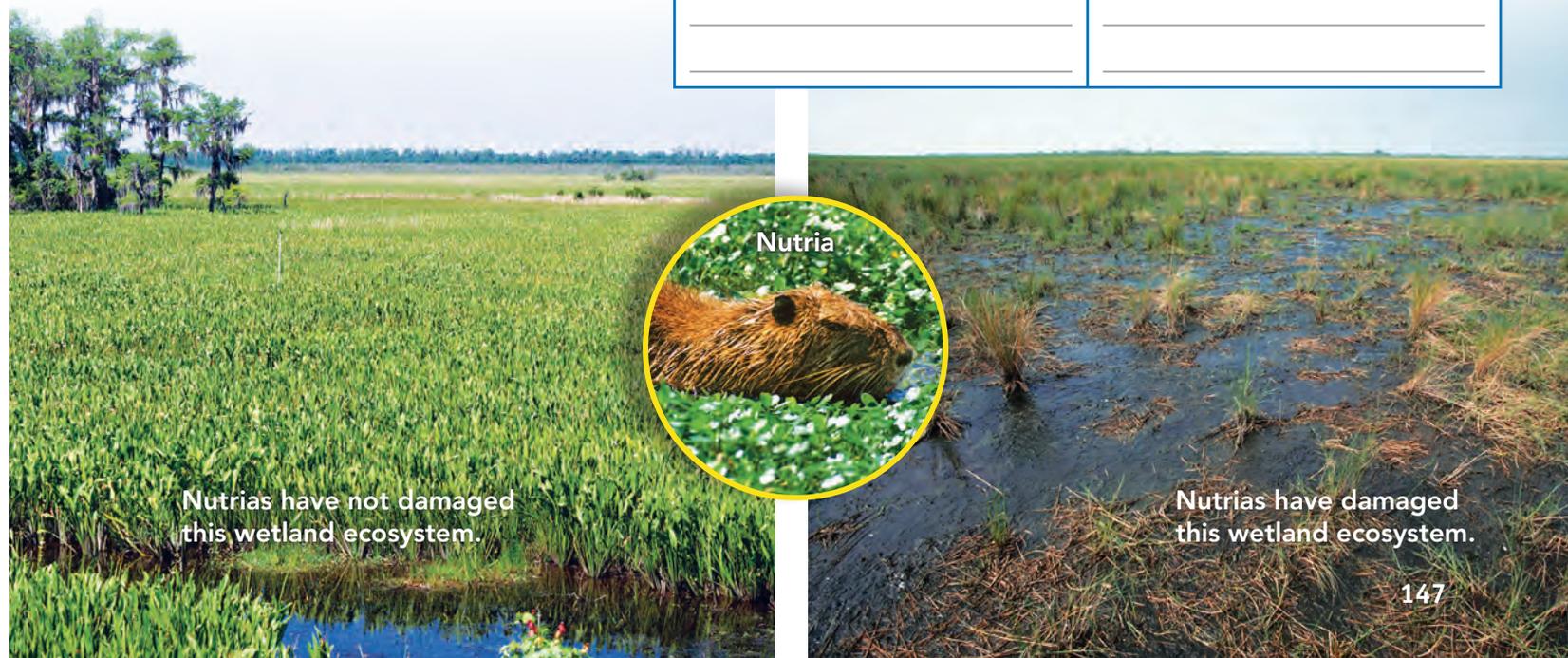
FIGURE 3

Damage by Nutrias

Damage by nutrias in an ecosystem is sometimes irreversible.

 **Observe** In the chart, write three observations about the healthy and damaged ecosystem pictured.

Healthy Wetland	Damaged Wetland
<hr/> <hr/> <hr/>	<hr/> <hr/> <hr/>
<hr/> <hr/> <hr/>	<hr/> <hr/> <hr/>
<hr/> <hr/> <hr/>	<hr/> <hr/> <hr/>



Nutrias have not damaged this wetland ecosystem.

Nutrias have damaged this wetland ecosystem.

Energy Production Technologies have been developed to obtain and process energy resources such as coal and oil. However, these technologies have affected the environment. One mining method involves stripping the rock and soil off mountaintops to obtain coal. During this process, some of the removed material may be deposited in nearby valleys, covering streams and destroying forests. Heavy rains can wash minerals from this material downstream, where they can poison aquatic animals.

Drilling for oil in oceans and transporting oil have resulted in large oil spills. These spills affect the ecosystems where they occur, as shown in **Figure 4**. Processing oil into fuels such as gasoline and burning these fuels add carbon dioxide to the air. Too much carbon dioxide affects the temperature of the atmosphere.

FIGURE 4

Oil Spill

On July 25, 2008, the oil tanker *Tintomara* and a barge collided on the Mississippi River in New Orleans, spilling nearly 1.5 million liters of oil into the water. These workers are using absorption mops to contain the oil spill.

 **Infer** Identify organisms that would be most affected by an oil spill in water.



Human Habitation and Transportation Building homes, towns, and transportation systems requires resources. Forests are an important source of wood for building. To obtain this resource, loggers may clear-cut forests, which damages the ecosystem. Organisms that lived in the forest no longer have food or shelter. Many people also use wood to heat their homes. Trees use carbon dioxide during photosynthesis. With fewer trees to take in carbon dioxide, more carbon dioxide remains in the atmosphere. Also, as wood burns, it releases carbon dioxide into the atmosphere.

Millions of people travel in cars, trains, and airplanes. Most of these vehicles burn gasoline. As gasoline is burned, it releases gases such as carbon dioxide into the air. Some scientists think carbon dioxide is contributing to global warming through the greenhouse effect. The **greenhouse effect** is the process in which certain gases trap the sun's energy in Earth's atmosphere as heat. Look at **Figure 5**.

FIGURE 5

Technology at Home

Different technologies that people use at their homes can impact the environment.

 **Identify** Write two ways that technologies in the picture affect the environment.



Do the Quick Lab *Technology and the Environment*.

 **Assess Your Understanding**

2. **Summarize** How does the burning of fuels affect the amount of carbon dioxide in the atmosphere?

got it?

I get it! Now I know that technologies such as _____

I need extra help with _____



6.LS4.1, 6.LS4.2, 6.ETS1.1

Biodiversity



-  What Is Biodiversity's Value?
-  What Factors Affect Biodiversity?
-  How Do Humans Affect Biodiversity?



my planet DiARY

BLOG

Posted by: Max

Location: Hagerstown, Maryland

I went to summer camp to learn about wildlife and how to protect it. One of the activities that I liked the most was making "bat boxes."

These are wooden homes for brown bats, which often need places to nest. Making these houses is important, because without brown bats, there would be too many mosquitoes. I hope the bats like their new homes as much as I loved making them.



Communicate Discuss the question with a group of classmates. Then write your answers below.

How do you think helping the bats in an area helps other species nearby?



Do the Inquiry Warm-Up
How Much Variety Is There?

What Is Biodiversity's Value?

No one knows exactly how many species live on Earth. As you can see in **Figure 1**, scientists have identified more than 1.6 million species so far. The number of different species in an area is called the area's **biodiversity**. It is difficult to estimate the total biodiversity on Earth because many areas have not been thoroughly studied.

Vocabulary

- biodiversity • keystone species • extinction
- endangered species • threatened species
- habitat destruction • habitat fragmentation
- poaching • captive breeding

Skills

- 🔄 Reading: Compare and Contrast
- 📐 Inquiry: Calculate

There are many reasons why preserving biodiversity is important. One reason to preserve biodiversity is that wild organisms and ecosystems are a source of beauty and recreation. 🗝️ **In addition, biodiversity has both economic value and ecological value within an ecosystem.**

Economic Value Many plants, animals, and other organisms are economically valuable for humans. These organisms provide people with food and supply raw materials for clothing, medicine, and other products. No one knows how many other useful species have not yet been identified. Ecosystems are economically valuable, too. Many companies now run wildlife tours to rain forests, savannas, mountains, and other places. This ecosystem tourism, or ecotourism, is an important source of jobs and money for such nations as Brazil, Costa Rica, and Kenya.

Ecological Value All the species in an ecosystem are connected to one another. Species may depend on each other for food and shelter. A change that affects one species can affect all the others.

Some species play a particularly important role in their ecosystems. A **keystone species** is a species that influences the survival of many other species in an ecosystem. Sea otters, as shown in **Figure 2**, are one example of a keystone species.

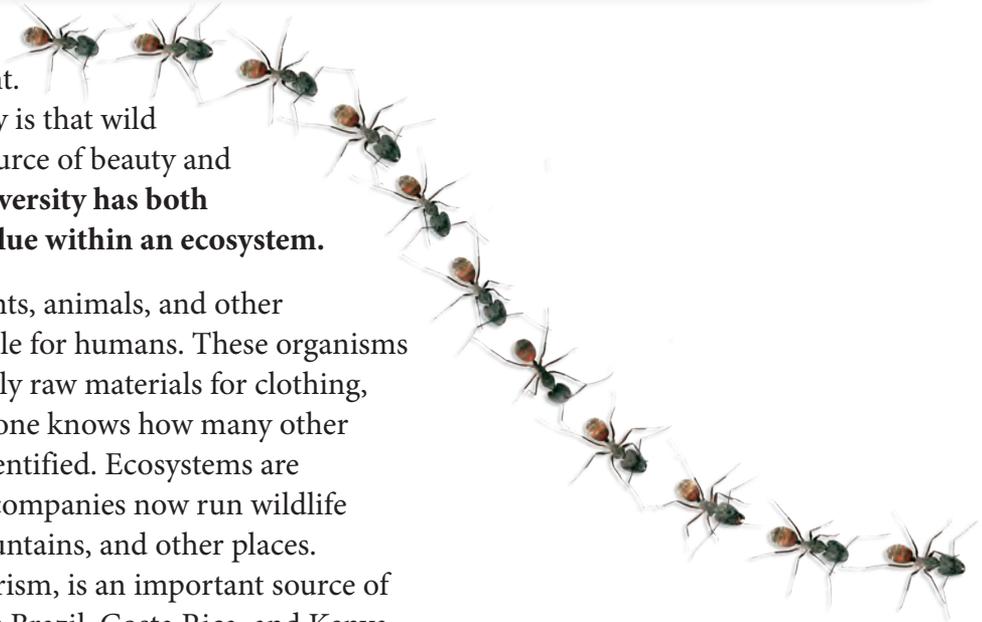


FIGURE 1

Species Diversity

There are many more species of insects than plant or other animal species on Earth!

📐 **Calculate** What percentage of species shown on the pie graph do insects represent? Round your answer to the nearest tenth.

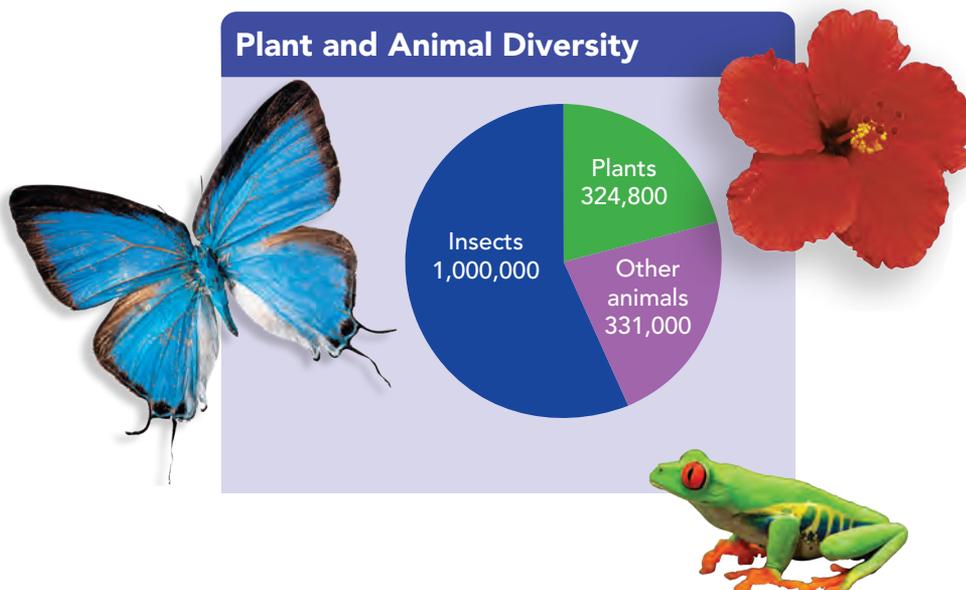
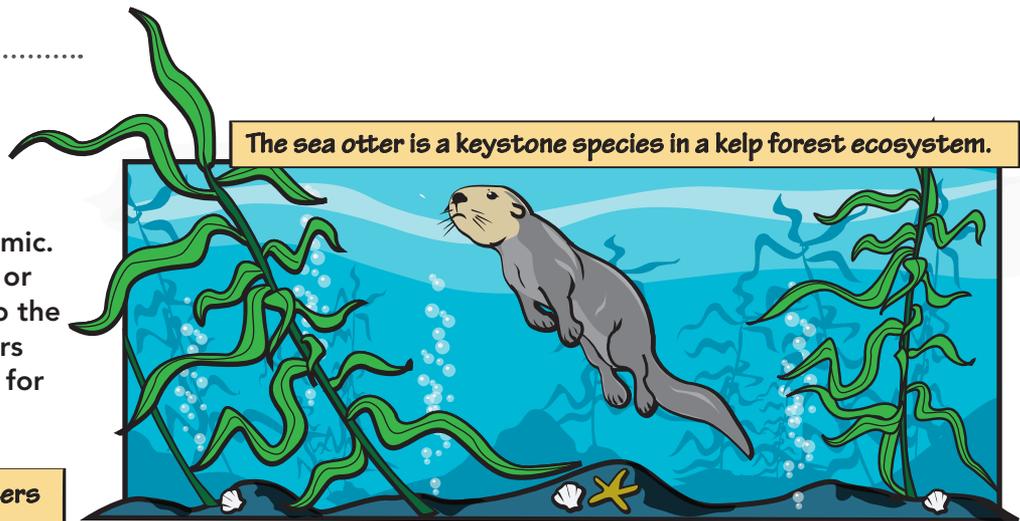


FIGURE 2

Keystone Otters

Sea otters are a keystone species in the kelp forest ecosystem.

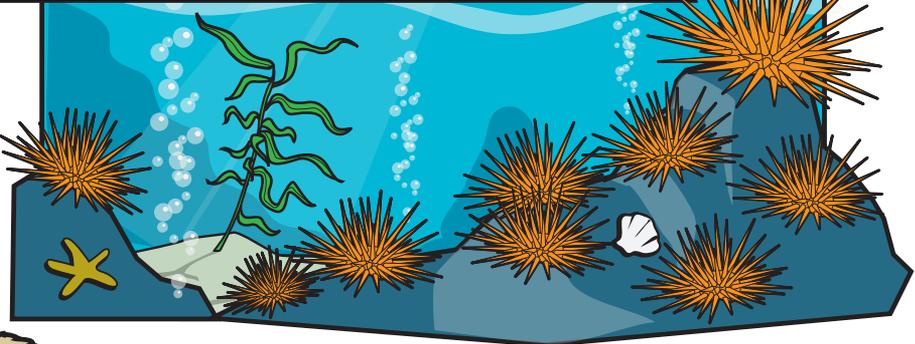
 **Describe** Read the comic. In the empty panel, draw or explain what happened to the kelp forest when the otters returned. Write a caption for your panel.



In the 1800s, many otters were killed for their fur.



Without otters preying on them, the population of kelp-eating sea urchins exploded, destroying kelp forests.



Under new laws that banned the hunting of sea otters, the sea otter population grew again.



Assess Your Understanding

got it?

I get it! Now I know that biodiversity has _____

I need extra help with _____



Do the Quick Lab
Modeling Keystone Species.

What Factors Affect Biodiversity?

Biodiversity varies from place to place on Earth.  **Factors that affect biodiversity in an ecosystem include climate, area, niche diversity, genetic diversity, and extinction.**

Climate The tropical rain forests of Latin America, southeast Asia, and central Africa are the most diverse ecosystems in the world. The reason for the great biodiversity in the tropics is not fully understood. Many scientists hypothesize that it has to do with climate. For example, tropical rain forests have fairly constant temperatures and large amounts of rainfall throughout the year. Many plants grow year-round. This continuous growing season means that food is always available for other organisms.

Area See **Figure 3**. Within an ecosystem, a large area will usually contain more species than a small area. For example, you would usually find more species in a 100-square-meter area than in a 10-square-meter area.

did you know?

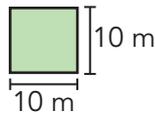
Rain forests cover only about seven percent of the Earth's land surface. But they contain more than half of the world's species, including the chimpanzee!



FIGURE 3

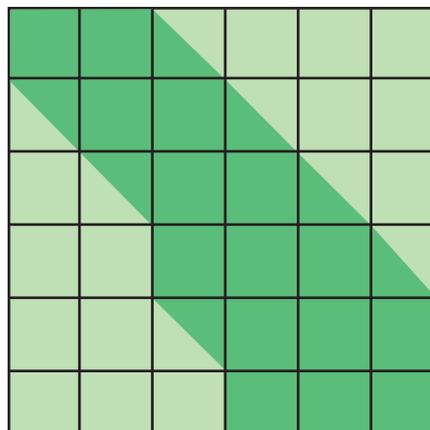
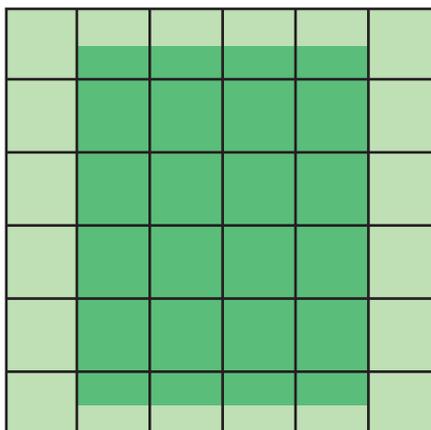
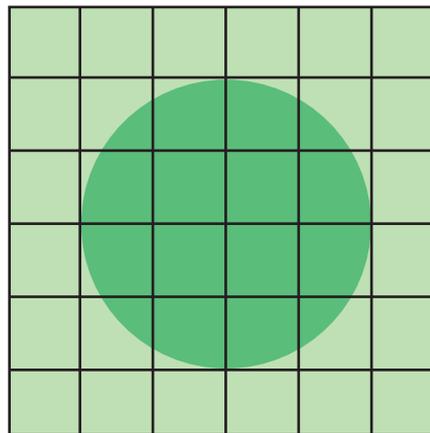
Park Size

A park manager has received three park plans. The dark green area represents the park.



 **Complete each task.**

- Identify** Circle the plan the manager should choose to support the most biodiversity.
- Calculate** Suppose that 15 square meters of the park could support seven species of large mammals. About how many species could the park you circled support?



Niche Diversity Coral reefs are the second most diverse ecosystems in the world. Found only in shallow, warm waters, coral reefs are often called the rain forests of the sea. A coral reef supports many different niches. Recall that a niche is the role of an organism in its habitat, or how it makes its living. A coral reef enables a greater number of species to live in it than a more uniform habitat, such as a flat sandbar, does.

Genetic Diversity Diversity is very important within a species. The greatest genetic diversity exists among species of unicellular organisms. Organisms in a healthy population have diverse traits such as color and size. Genes are located within cells and carry the hereditary information that determines an organism's traits. Organisms inherit genes from their parents.

The organisms in one species share many genes. But each organism also has some genes that differ from those of other individuals. Both the shared genes and the genes that differ among individuals make up the total gene pool of that species. Species that lack a diverse gene pool are less able to adapt to and survive changes in the environment.

apply it!

New potato plants are created from pieces of the parent plant. So a potato crop has the same genetic makeup as the parent plant. In 1845, Ireland was struck by a potato famine. A rot-causing fungus destroyed potato crops, which were an important part of the Irish diet. Many people died of starvation, and many more left the country to find food.

1 Apply Concepts How did a potato crop without a variety of different genes lead to the Irish potato famine of 1845?

2 CHALLENGE What could farmers do to prevent another potato famine?



Extinction of Species Many species that once lived on Earth have disappeared. The disappearance of all members of a species from Earth is called **extinction**. While some changes to an ecosystem are naturally occurring, we must search for solutions to maintain biodiversity to ensure its stability for the changes that we can control.

Environmental factors such as climate change, disease, and volcanic eruptions may result in extinction. **Figure 4** shows the effects of environmental factors on two populations. Once a population drops below a certain level, the species may not recover. Also, human habitat destruction, hunting, or other activities affect the survival of populations, which can lead to extinction.

Species in danger of becoming extinct in the near future are called **endangered species**. Species that could become endangered in the near future are called **threatened species**. Endangered and threatened species are found everywhere on earth.

Less winter ice than usual forms in the polar bear's environment as ocean temperatures warm. Polar bears use winter ice to hunt seals. With less ice, polar bears may starve.



About 65 million years ago, dinosaurs became extinct. Evidence suggests that a massive asteroid struck Earth, sending debris into the atmosphere that blocked sunlight for a long time.

FIGURE 4
Environmental Factors
Environmental factors affect populations.

Read the boxes and answer the questions.

- Identify** In each box, underline the environmental factor affecting the population.
- CHALLENGE** Why did the blocking out of sunlight affect dinosaurs?

Assess Your Understanding

got it?

I get it! Now I know that the factors that affect biodiversity include _____

I need extra help with _____



How Do Humans Affect Biodiversity?

Humans interact with their surroundings every day. The many choices people make impact the environment and affect species.

 **Biodiversity can be negatively or positively affected by the actions of humans.**

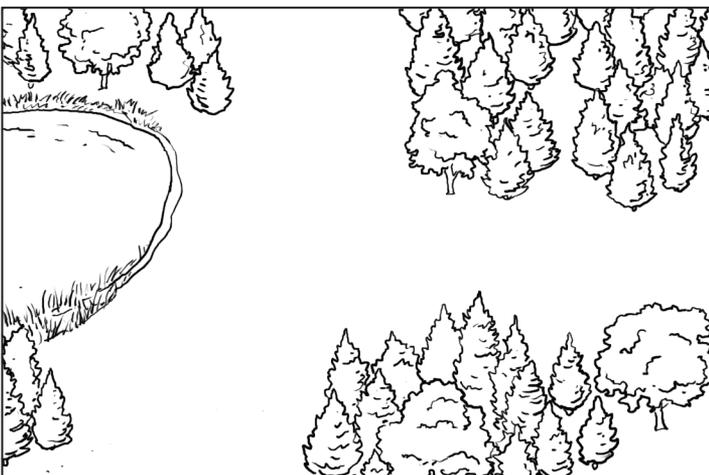
Damaging Biodiversity A natural event, such as a hurricane, can damage an ecosystem, wiping out populations or even entire species. Human activities can also threaten biodiversity and cause extinction. These activities include habitat destruction, poaching, pollution, and the introduction of exotic species.

FIGURE 5

Habitat Fragmentation

Breaking habitats into pieces can have negative effects on the species that live there.

 **Interpret Diagrams** In the first diagram below, a road divides a habitat in two. On the second diagram, redraw the road so it divides the habitat's resources equally.



Habitat Destruction The loss of a natural habitat is referred to as **habitat destruction**.

Clearing forests or filling in wetlands changes an ecosystem. Breaking larger habitats into smaller, isolated pieces, or fragments, is called **habitat fragmentation**. See **Figure 5**. Some species may not survive such changes to their habitats. The removal of natural resources from an ecosystem can increase topsoil erosion, leading to habitat loss, a decrease in plant production, and increased sedimentation of rivers and streams, which can affect water quality.

Poaching The illegal killing or removal of wildlife from their habitats is called **poaching**. Animals can be sold as pets or used to make jewelry, coats, belts, or shoes. Plants can be sold as houseplants or used to make medicines.

Pollution Pollution may reach animals through the water they drink, the air they breathe, or the food they eat. Pollutants may kill or weaken organisms or cause birth defects.

Exotic Species Introducing exotic species into an ecosystem can threaten biodiversity as the exotic species can outcompete and damage native species. The gypsy moth was introduced into the United States in 1869 to increase silk production. Gypsy moth larvae have eaten the leaves off of millions of acres of trees in the northeastern United States.

Protecting Biodiversity People who preserve biodiversity can focus on protecting individual endangered species or entire ecosystems. Three methods of protecting biodiversity are captive breeding, laws and treaties, and habitat preservation.

Captive Breeding **Captive breeding** is the mating of animals in zoos or on wildlife preserves. For example, much of the sandhill crane habitat in the United States has been destroyed. To help the population, some cranes have been taken into captivity. The young are raised and trained by volunteers to learn the correct behaviors, such as knowing how and where to migrate. They are then released into the wild.

Natural Resource Management Natural resources can be removed from an ecosystem, as long as the processes by which they are removed are carefully monitored. By properly managing the methods of extraction of a natural resource and managing how much of the resource is removed, scientists can ensure the protection of all species within the ecosystem.



Compare and Contrast

The photos on top show young sandhill cranes being raised by their parents. The photos on the bottom show humans copying this process to increase the crane population. What is a possible disadvantage of the human approach?





Life in a Coral Reef

How do natural and human activities change ecosystems?

FIGURE 6
This photo shows the diversity of the organisms in a coral reef ecosystem. The coral and sponges provide living space for algae and shelter for crabs, fishes, and other animals. Some fishes eat the algae.

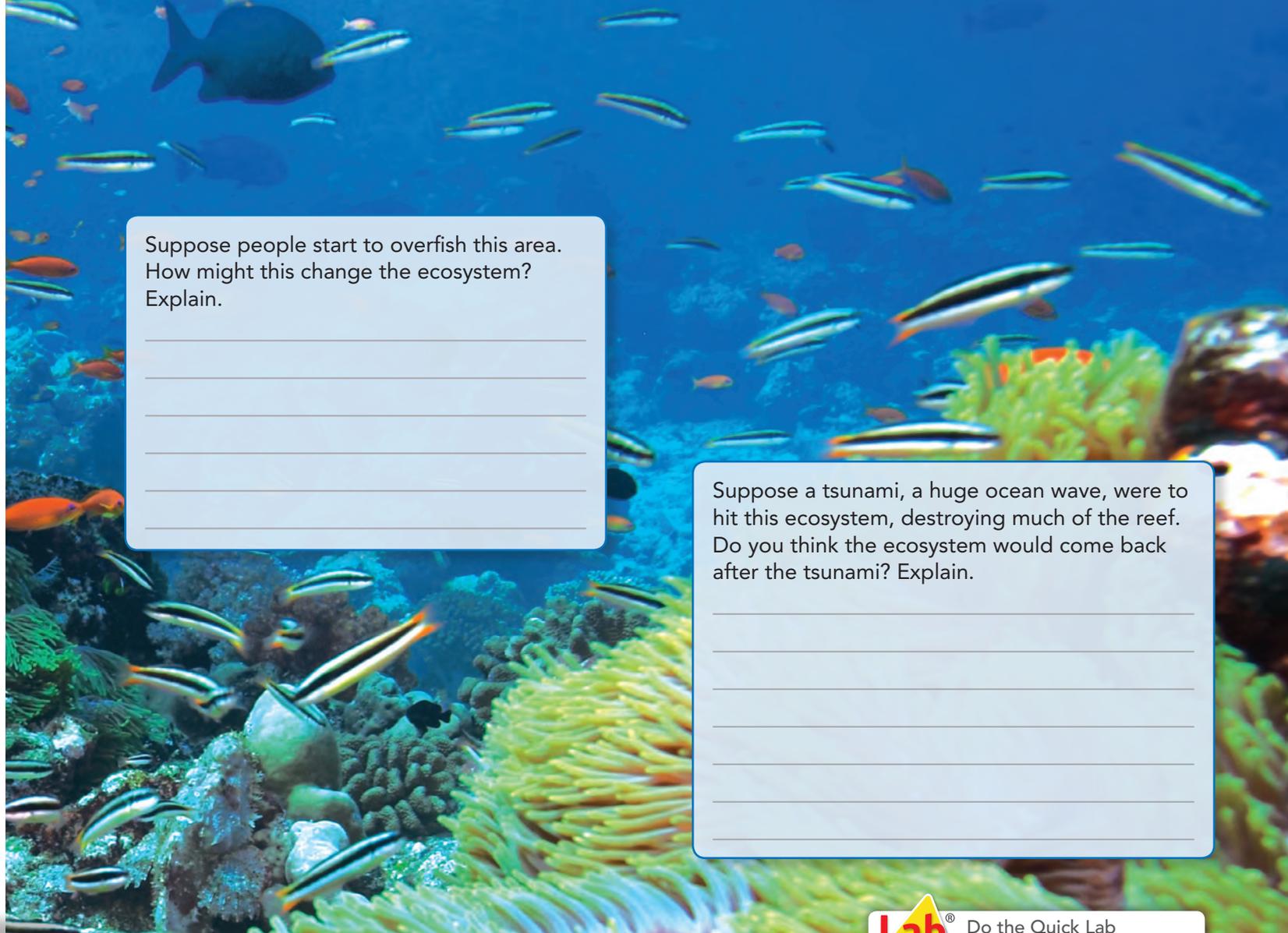
 **Predict** Answer the questions in the boxes.

Suppose many more orange fish immigrate to this ecosystem, doubling the species' population. How might the increased numbers of orange fish impact other populations in the ecosystem? Explain.

Laws and Treaties In the United States, the Endangered Species Act prohibits trade of products made from threatened or endangered species. This law also requires the development of plans to save endangered species. The Convention on International Trade in Endangered Species is an international treaty that lists more than 800 threatened and endangered species that cannot be traded for profit or other reasons anywhere in the world.

Habitat Preservation The most effective way to preserve biodiversity is to protect whole ecosystems. Protecting whole ecosystems saves endangered species, the species they depend upon, and those that depend upon them. Many countries have set aside wildlife habitats as parks and refuges. Today, there are about 7,000 nature parks, preserves, and refuges in the world.

Scientists monitor the biodiversity of a variety of ecosystems, including preserved habitats. Generally, ecosystems with high biodiversity are considered healthier than ecosystems with low biodiversity. The completeness of an ecosystem's biodiversity is one measure of its health.



Suppose people start to overfish this area. How might this change the ecosystem? Explain.

Suppose a tsunami, a huge ocean wave, were to hit this ecosystem, destroying much of the reef. Do you think the ecosystem would come back after the tsunami? Explain.



Do the Quick Lab
Humans and Biodiversity.

Assess Your Understanding

1a. **Define** What is poaching?

b.  How do natural and human activities change ecosystems?

got it?

I get it! Now I know that humans affect biodiversity _____

I need extra help with _____



6.LS2.4

Biogeography



What Factors Affect Species Dispersal?



my planet DiARY

Australia's Animals

When you think of Australia, what animal comes to mind? Most likely, you think of a kangaroo or a koala. Did you know that these animals are marsupials, mammals that carry their young in a pouch? You might be surprised to learn that most marsupials exist only in Australia. Now, can you name any monotremes, or mammals that lay eggs? The only monotremes that exist are platypuses and echidnas, both native to Australia. Lots of unique animals are native to Australia because it is completely surrounded by water.

FUN FACT

Communicate Answer the following questions with a classmate.

1. What are two types of mammals that are common in Australia?

2. Would you ever expect a platypus to move from Australia to the United States? Explain.



Do the Inquiry Warm-Up
How Can You Move a Seed?

Vocabulary

- biogeography
- continental drift
- dispersal
- exotic species

Skills

- 🎯 Reading: Relate Cause and Effect
- 🚩 Inquiry: Predict

What Factors Affect Species Dispersal?

Do you think all of the people who live in your hometown were born there? Some of them may have come from different cities, states, or countries. Just as humans do, different plants and animals live in different parts of the world. The study of where organisms live and how they got there is called **biogeography**. Biogeographers also study factors that have led to the worldwide distribution of species that exist today.

The movement of the Earth's continents is one factor that has affected how species are distributed. The continents are parts of huge blocks of solid rock, called plates, that make up Earth's surface. These plates have been moving very slowly for millions of years. As the plates move, the continents move with them in a process called **continental drift**. **Figure 1** shows how the continents have moved over time. Notice that about 225 million years ago, all of the continents were part of one huge landmass, called Pangaea.

Continental drift has had a great impact on species distribution. For example, Australia drifted away from the other landmasses millions of years ago. Organisms from other parts of the world could not reach the isolated island and unique Australian species developed in this isolation.

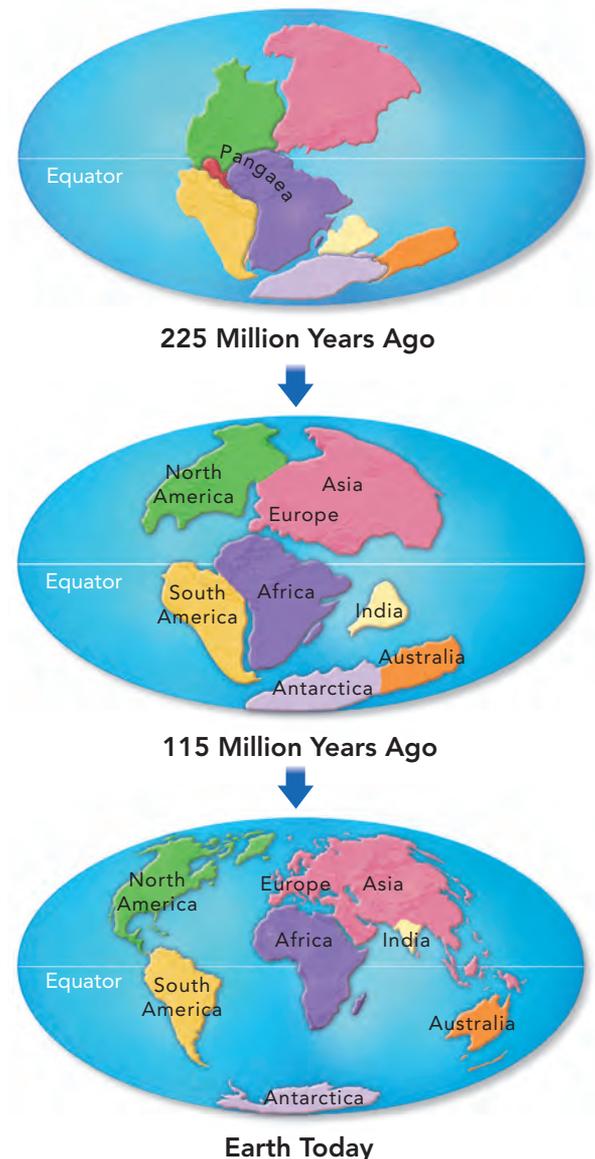
 **Continental drift, wind, water, and living things are all means of distributing species. Other factors, such as physical barriers, competition, and climate, can limit species dispersal.**

FIGURE 1

Continental Drift

The movement of landmasses is one factor affecting the distribution of organisms.

 **Observe** How has Australia's location changed over time?





Means of Dispersal The movement of organisms from one place to another is called **dispersal**. Dispersal can be caused by gravity, wind, water, or living things, such as the Tennessee Warbler in **Figure 2**.

Wind and Water Many animals move into new areas on their own. But plants and small organisms need help in moving from place to place. Wind can disperse seeds, fungi spores, tiny spiders, and other small, light organisms. Birds use the wind to fly to new locations. Similarly, water transports objects that float, such as coconuts and leaves. Small animals, such as insects or snails, may get a ride to a new home on top of these floating rafts. Water also transports organisms like fish and marine mammals.

FIGURE 2

Means of Dispersal

As the Tennessee warbler feeds off of the flowers, it can dislodge fertilized seeds. The wind will then help disperse the seeds once they become dislodged from the plant.

Other Living Things Organisms can also be dispersed by other living things. If your dog or cat has ever come home covered with sticky plant burs, you have seen an example of dispersal. Humans have sped up the dispersal of organisms, both intentionally and unintentionally, as they travel around the world. An **exotic species** is an organism that is carried into a new location by people. Exotic species have contributed to the decline or elimination of native species.



apply it!

In 1780, a Japanese ship ran aground on one of Alaska's uninhabited Aleutian Islands. Rats from the ship swam to the island. Since then, the rats on this island, now called Rat Island, have preyed upon and destroyed seabird populations and the overall ecosystem. "Rat spills" from ships are one of the leading causes of seabird extinctions on islands worldwide.

1 Communicate With a partner, identify ways in which sailors can control rats on board their ships and prevent them from going ashore.

2 Predict Do you think the role of humans in the dispersal of species will increase or decrease in the next 50 years? Defend your answer.

Limits to Dispersal With all these means of dispersal, you might expect to find the same species in many places around the world. Of course, that's not so. Three factors that limit distribution of a species are physical barriers, competition, and climate.

Physical Barriers Water and mountains form barriers that are hard to cross. These features can limit the movement of organisms. For example, once Australia became separated from the other continents, organisms could not easily move to or from Australia.

Competition When an organism enters a new area, it must compete for resources with the species that already live there. To survive, the organism must find a unique niche, or role. Existing species may outcompete the new species. In this case, competition is a barrier to dispersal. Sometimes, in certain situations, new species outcompete and displace the existing species.

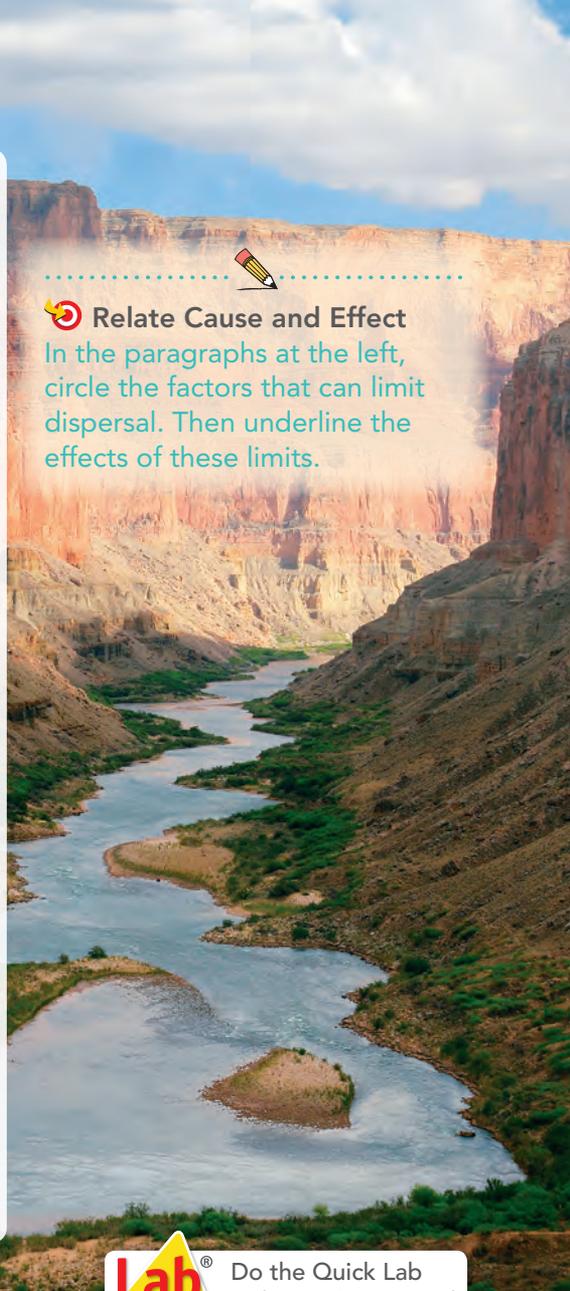
Climate The typical weather pattern in an area over a long period of time is the area's climate. Climate differences can limit dispersal. For example, the climate changes greatly as you climb a tall mountain. The warm, dry mountain base, the cooler and wetter areas higher up, and the cold, windy top all support different species. Those species that thrive at the base may not survive at the top.

FIGURE 3

Limits to Dispersal

Physical barriers, like the Grand Canyon and the Colorado River, can make it difficult for species to move around.


Relate Cause and Effect
In the paragraphs at the left, circle the factors that can limit dispersal. Then underline the effects of these limits.



 Do the Quick Lab
Relating Continental
Drift to Dispersal.

 **Assess Your Understanding**

1a. **Explain** What role do humans play in the dispersal of species?

b. **CHALLENGE** Suppose that a new species of insect were introduced to your area. Explain how competition might limit its dispersal.

got it?

I get it! Now I know that species dispersal is affected by _____

I need extra help with _____

Study Guide



A species that cannot adapt to natural or human activities can become _____.

LESSON 1 Changing Ecosystems

Primary succession and secondary succession are two types of succession.

Organisms that survive a changing ecosystem have adaptations that help them survive in the new conditions.

Vocabulary

- succession • primary succession
- pioneer species • secondary succession

LESSON 2 Humans and the Environment

The resources that humans obtain from ecosystems include abiotic resources and biotic resources.

Human activities may affect the balance in an ecosystem and thereby change the ecosystem.

Vocabulary

- resources • greenhouse effect

LESSON 3 Biodiversity

Biodiversity has both economic value and ecological value within an ecosystem.

Factors that affect biodiversity in an ecosystem include climate, area, niche diversity, genetic diversity, and extinction.

Biodiversity can be negatively or positively affected by the actions of humans.

Vocabulary

- biodiversity • keystone species • extinction • endangered species
- threatened species • habitat destruction • habitat fragmentation
- poaching • captive breeding



LESSON 4 Biogeography

Continental drift, wind, water, and living things are all means of distributing species. Other factors, such as physical barriers, competition, and climate, can limit species dispersal.

Vocabulary

- biogeography • continental drift
- dispersal • exotic species



Review and Assessment

LESSON 1 Changing Ecosystems

1. The series of predictable changes that occur in a community over time is called
 - a. natural selection.
 - b. ecology.
 - c. adaptations.
 - d. succession.

2. _____ are the first species to populate an area.

3. **Analyze Cost and Benefits** How do wildfires affect the ability of longleaf pine trees to survive?

4. **Compare and Contrast** Describe one scenario that would result in primary succession and one scenario that would result in secondary succession. Explain your reasoning.

LESSON 2 Humans and Ecosystems

5. An example of a biotic resource that people obtain from ecosystems is
 - a. oxygen.
 - b. sunlight.
 - c. wood.
 - d. minerals.

6. An example of an abiotic resource that people obtain from ecosystems is

- a. bacteria.
- b. fish.
- c. water.
- d. trees.

7. **Relate Cause and Effect** What impact might nutria have on the native animals living in an ecosystem?

8. **Predict** Students living in a heavily deforested area are working to plant new trees. What effect might this program have on the atmosphere?

TNReady Prep

6.LS2.5, 6.LS2.6, 6.LS4.1, 6.LS4.2, 6.ETS1.1

Read each question and choose the best answer.

1. How does primary succession differ from secondary succession?
 - A Primary succession occurs where no soil exists.
 - B Primary succession follows a disturbance in an ecosystem.
 - C Primary succession is a natural process.
 - D Primary succession takes a short amount of time.
2. Which organism introduced to the United States has caused populations of native wetland plants to decrease?
 - A gypsy moth
 - B nutria
 - C cogongrass
 - D ryegrass
3. Which of the following are biotic resources that humans obtain from marine ecosystems?
 - A fish, shells, aquatic plants
 - B shells, sand, invertebrates
 - C fish, water, clams
 - D clams, mussels, aquatic plants
4. Organisms can be dispersed in all of the following ways except by
 - A wind.
 - B water.
 - C temperature.
 - D other organisms.

Short Answer

Write your answers to questions 5 and 6 on another sheet of paper.

5. Why are decomposers useful to people?

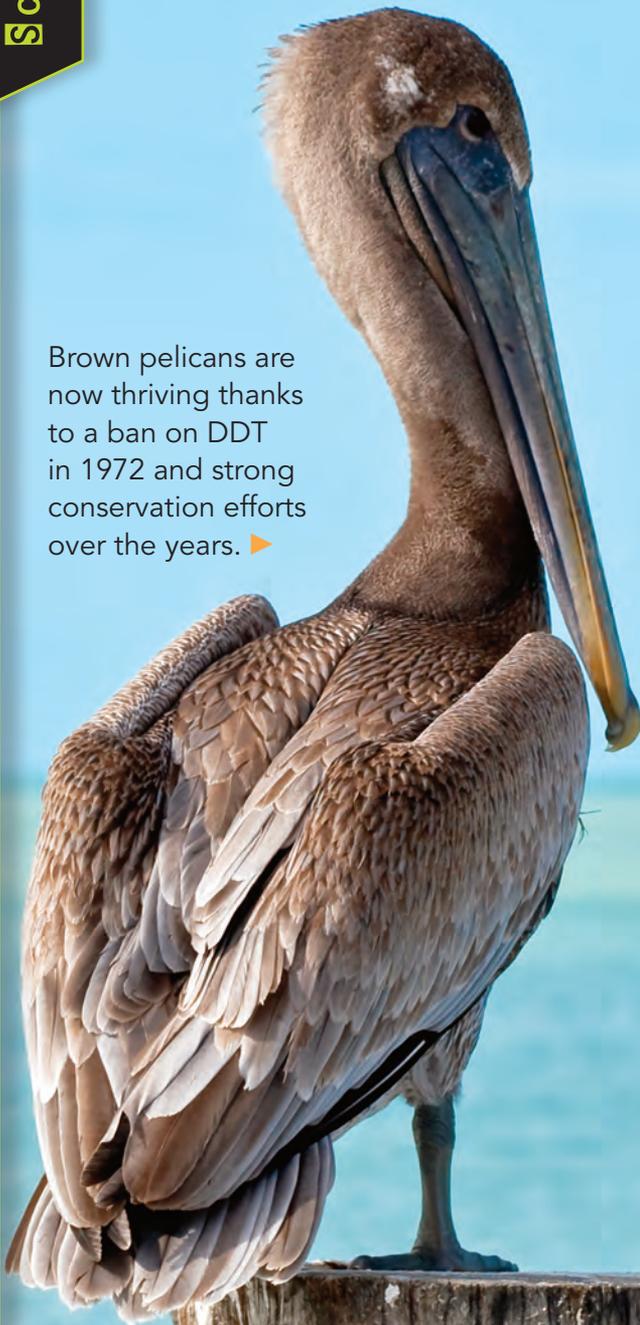
Use the table below to answer question 6.

Reasons Mammals and Birds Become Endangered or Threatened		
Reason	Mammals	Birds
Poaching	31%	20%
Habitat loss	32%	60%
Exotic species	17%	12%
Other	20%	8%

6. Make a bar graph comparing the reasons why mammals and birds become endangered or threatened. Show reasons on the horizontal axis and percentages of animal groups on the vertical axis. Then suggest two explanations for the differences between the data for mammals and birds.

ENDANGERED NO MORE

Brown pelicans are now thriving thanks to a ban on DDT in 1972 and strong conservation efforts over the years. ▶



In 1970, the brown pelican was placed on the endangered species list. Today, it is officially off the list and flying high.

What endangered the brown pelican? Scientists learned that a chemical pesticide called DDT caused the number of pelicans to decrease. DDT was widely used from the mid-1940s through the late 1960s to kill insects that destroyed crops. After being sprayed on crops, DDT washed into the soil. Plant roots absorbed DDT from the soil. Then, fish fed on contaminated plants growing in waterways and along their banks. So, when brown pelicans ate fish, they also took in DDT.

DDT affected the way pelicans absorbed calcium, which is a mineral in their eggshells. As a result, pelicans laid eggs with weak shells. When they sat on their eggs, the eggs broke. So birthrates dropped dramatically.

Banning DDT use was the first step in protecting brown pelicans. Recovery efforts involved protecting their habitats and releasing 1,276 pelicans from Florida into Louisiana. Since recovery efforts began, more than 24,000 young birds have been born in Louisiana. That's enough to keep the state's brown pelican population thriving for many years.

Research It Identify an endangered species and write about the environmental factors affecting its survival. Include information on changes that could help the species survive. Present your ideas to a classmate, family member, or friend.

Recovering
from the

Dust Bowl

Today the Kiowa National Grasslands, located in northeast New Mexico, is one of 20 National Grasslands that are protected by the federal government. These lands are managed to protect the native plant and animal species. In the late 1920s, however, this area was part of the southwestern Great Plains, an area that was devastated by the Dust Bowl.

The plant species native to the grasslands can survive with little rain and can endure droughts. In the late 1800s, however, settlers began farming the grasslands. They plowed up the soil and replaced the grasses with crops that needed more water to thrive. When a severe drought hit, the crops could not survive, and there were no grasses to hold the topsoil in place. Winds blew away the soil, creating massive dust storms. The farmers experienced great hardship, and the ecosystem was in ruins.

The key to restoring this habitat is the native grasses. They are well suited to the soil, range of temperatures, and

available rainfall. These grasses hold the soil in place. Rain can soak into the soil and drain into streams without taking the soil with it. As a result, more ground water is available to support the plants, and the streams can provide clean water for wildlife and cattle. The grasses also help to cycle nutrients, such as carbon and nitrogen, through the ecosystems as they grow and decompose. In doing so, the grasses make energy and other resources available to the animals in the grasslands.

The large areas of healthy native habitat allow multiple uses. With proper management, crops and cattle can be raised while native plant and animal populations thrive.

Library of Congress

Without grass to hold the soil in place, large dust clouds blew across the Great Plains.



Research It The key to the success of the Kiowa National Grasslands is proper management of the available resources. Research the management practices used by the National Grasslands. Write a short report describing how resources and physical factors, such as water and soil, are managed to protect the grasslands. Describe also how water, carbon, and nitrogen cycles contribute to a healthy ecosystem.

Invasive Species in Tennessee

An invasive species is an introduced plant or animal that is not native to an area. Because these organisms are not part of the naturally-occurring food web in that area, their population numbers are not kept in balance like where the organisms normally live. As a result, these invasive species can cause harm to their new ecosystem because they may outcompete other organisms in the ecosystem for food and other basic needs. Invasive species are often a threat to many ecosystems in the world.

Tennessee has many invasive species of both plants and animals that have been introduced into the state. Scientists from the state government and the University of Tennessee work to identify and control invasive species.

Zebra mussels are an example of an invasive species that affects Tennessee and many other parts of the United States. Zebra mussels were first found in the Great Lakes in 1988 and had spread along the Mississippi River to Tennessee by 1994. Once zebra mussels reach an area, they reproduce quickly. They grow faster than the native mussel species and often completely replace them in an ecosystem. Zebra mussels filter plankton out of the water and their large numbers can reduce the plankton to the point that much of the ecosystem can collapse.

Research It Find out more information about invasive plants and animals in Tennessee. Select an invasive plant or animal and learn more about it. Write a report about the invasive species that you selected. Include information about where the invasive species came from, when and how it was introduced, and the threat it causes to native species. As part of your report, design a solution to control that particular invasive species without harming native species in the ecosystem.



A common sight in Tennessee is the mimosa tree. The tree has become common along waterways and disturbed land in the Tennessee Valley. The mimosa was introduced to the United States from Asia as an ornamental tree in 1745. People planted the tree because it is fast growing and has pink, silky flowers. The tree can reach a height of 6 to 12 meters. When the tree first starts growing, it may grow 1 meter per year. The mimosa produces long seedpods with many seeds. The seeds can lie dormant for 50 years. The fast-growing tree can shade slower growing native plants and keep them from growing. If cut down, the mimosa quickly starts growing again from stump.