How Are Oatmeal & Carpets Connected?
In the 1850s, the first oatmeal mill began operation in the United States. Over the next few decades, hot, creamy oatmeal became a popular breakfast cereal across the country. By the early 1900s, oatmeal was getting some stiff competition from newly invented cold breakfast cereals such as cornflakes. Hot or cold, cereal had become a breakfast staple. But the processing of oats and corn for cereal leaves behind waste products—oat hulls and corncobs. In 1922, a cereal company discovered it could do something useful with these waste products. The company used oat hulls to make a substance called furfural. Today, furfural also is made from corncobs and other cereal waste products. Manufacturers use furfural in the production of synthetic rubber, plastic, and nylon—including the nylon that goes into carpets.
How do frogs catch insects?

Today is perfect for a field trip to a local stream. Carefully, quietly, you push aside some cattails. You lean in for a closer look when—WHAM! A sticky tongue latches onto a nearby insect and flings it into the waiting mouth of a frog. You jump and the frog leaps into the water. SPLASH! You have just observed a living system in action.

Describe how fallen leaves and insects contribute to the survival of frogs in this system.

Science Journal  Describe how fallen leaves and insects contribute to the survival of frogs in this system.
What is a living system?
A system is any group of things that interact with one another. Living organisms interact with each other and with the environment to form ecosystems. Ecology is the study of these interactions.

1. Choose a small area of grass or weeds near your school. Identify the boundaries of your plot.
2. Carefully observe and record everything in your plot. Be sure to include all parts of your plot, including soil and air.
3. Classify what you observe into two groups—things that are living and things that are not living.
4. Think Critically In your Science Journal, describe how you think the parts of the plot you observed form a system.

Identify Questions Before you read the chapter, write what you already know about ecology under the left tab of your Foldable, and write questions about what you’d like to know under the center tab. After you read the chapter, list what you learned under the right tab.
Take a walk outside and look around. What do you see? Woods? A street? A patch of weeds growing in a sidewalk crack? If you observe one of these areas closely, you may see many different organisms (OR guh nih zumz) living there. In a forest, for instance, there are birds, deer, insects, plants, mushrooms, and trees. In your backyard, you might see squirrels, birds, insects, grass, and shrubs. These organisms, along with the nonliving things in the woods or yard, such as soil, air, and light, make an ecosystem (EE koh sihs tum). An ecosystem is made up of organisms interacting with one another and with nonliving factors to form a working unit. Figure 1 shows an example of a stream ecosystem.
What does it mean to say that an organism interacts with another organism? Think back to the field trip to the stream at the beginning of the chapter. When the frog ate the insect, an interaction occurred between two organisms living in the same ecosystem.

What does it mean to say that an organism interacts with the nonliving parts of an ecosystem? Think about the field trip again. What did the frog do when it spotted your movement? It dove into the stream, probably for safety. The frog uses the stream for shelter. This is an example of an interaction between a living organism and a nonliving part of an ecosystem.

**Figure 1** Let’s identify the living and nonliving parts of this stream ecosystem. Rocks and water are nonliving things. Pond skaters are alive—these insects skim the surface of the water. Algae, fish, crayfish, and mosses covering rocks are other living parts of this ecosystem. **Describe how these living organisms interact with nonliving parts of the ecosystem.**
The Study of Ecosystems When you study the interactions in an ecosystem, you are studying the science of ecology (ih KAH luh jee). Ecology is the study of the interactions that take place among the living organisms and nonliving parts of an ecosystem. Ecologists spend a lot of time outdoors, observing their subject matter up close. Just as you knelt quietly in the cattails on your field trip, an ecologist might spend hours by a stream, watching, recording, and analyzing what goes on there. In addition, like other scientists, ecologists also conduct experiments in laboratories. For instance, they might need to analyze samples of stream water. But, most of the ecologist’s work is done in the field.

The Largest Ecosystem Ecosystems come in all sizes. Some are small, like a pile of leaves. Others are big, like a forest or the ocean. Figure 2 shows the biosphere (BI uh sfihr), the largest ecosystem on Earth. The biosphere is the part of Earth where organisms can live. It includes the topmost layer of Earth’s crust; all the oceans, rivers, and lakes; and the surrounding atmosphere. The biosphere is made up of all the ecosystems on Earth combined.

How many different ecosystems are part of the biosphere? Let’s list a few. There are deserts, mountains, rivers, prairies, wetlands, forests, plains, oceans—the list can go on and on, and we haven’t even gotten to smaller ecosystems yet, such as a vacant lot or a rotting tree trunk. The number of ecosystems that make up the biosphere is almost too many to count. How would you describe your ecosystem?

Living Parts of Ecosystems Each of the many ecosystems in the biosphere contains many different living organisms. Think about a rotting tree trunk. It’s a small ecosystem compared to a forest, but the tree trunk may be home to bacteria, bees, beetles, mosses, mushrooms, slugs, snails, snakes, wildflowers, woodpeckers, and worms. The organisms that make up the living part of an ecosystem are called biotic factors. An organism depends on other biotic (bi AH thik) factors for food, shelter, protection, and reproduction. For example, a snake might use a rotting log for shelter. Termites are insects that depend on the same log for food. Figure 3 shows some of the biotic factors in a desert ecosystem.
Hawks, snakes, and many other organisms make up the desert ecosystem's living, or biotic, factors. Rocks, sand, soil, sunlight, air, and water are nonliving factors. The desert is a place where rainfall is scarce. Bright sunshine can cause daytime temperatures to reach 100 degrees or more on many days of the year. Nights, however, can be very cold.

The living and nonliving parts of the desert ecosystem interact in a variety of ways. Organisms must be able to survive long periods with little or no water. For example, cactus plants can store water in their tissues. Other organisms, including insects, obtain water by feeding on cacti. Desert organisms also must find ways to shelter themselves from extreme heat and cold. Kangaroo rats, for example, burrow underground, coming out at night when temperatures have cooled. How might the snake in this picture interact with abiotic factors in this ecosystem?
Earlier, you listed the parts that make up an ecosystem near your school. Was your list limited to the living organisms—the biotic factors—only? No. You included nonliving factors, too, such as air and soil. The nonliving things found in an ecosystem are called **abiotic** (ay bi AH tik) factors. Look for some abiotic factors in the desert shown in Figure 3. Abiotic factors affect the type and number of organisms living in ecosystems. Let’s take a closer look at some abiotic factors.

**Soil** One abiotic factor that can affect which plants and other organisms are found in an ecosystem is soil. It is made up of several ingredients, much like a recipe. Soil is made up of a combination of minerals, water, air, and organic matter—the decaying parts of plants and animals. You know that salt, flour, and sugar are found in many recipes. But not all foods made from these same ingredients taste or look the same. Cakes and cookies look and taste different because different amounts of salt, flour, and sugar are used to make them. It’s the same with soil. Different amounts of minerals, organic matter, water, and air make different types of soil, as shown in Figure 4.
Different soils offer different materials and conditions for organisms. If you’ve ever visited a gardening store, you’ve seen all kinds of products gardeners add to their soil to make it just right for the types of plants they want to grow. The next time you dig a hole, take a close look at the soil. Is it dry? Does it have a lot of dead leaves and twigs in it? Is it tightly packed or loose and airy?

**Temperature** Soil is only one of the factors that affect the organisms that live in an ecosystem. Temperature also determines which organisms live in a particular place. How do the tropical plants shown in Figure 5 compare with the mountainside plants? Predict what would happen if the organisms on the mountainside were moved to a hot climate such as a tropical rain forest.

**Figure 5** Plants have adaptations for their environments. The mountainside wildflowers grow in clusters close to the ground, which protects them from strong winds. The tropical plants have large leaves to absorb as much light as possible in the dim light of the rain forest floor.

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**Observing Soil Characteristics**

**Procedure**

1. Fill two cups with soil. Use different amounts of the materials available to create two different “soil recipes.” Pack the soil equally into each cup.
2. Pour equal amounts of water into each cup.
3. After a minute or so, tip the cups over to see if any water pours out.
4. Observe the characteristics of the soils you made. Record your observations in your Science Journal.

**Analysis**

1. What was the difference between the soil in the two cups to start with?
2. Was there a difference in how the soil in each cup held water? What could this mean for plants or other organisms living in the soil?
Another important abiotic factor is water. In the field trip to the stream at the beginning of the chapter, maybe you saw a sleek trout dart through the water. Some organisms, such as fish, whales, and algae (AL jee), are adapted for life in water, not on land. But these organisms depend upon water for more than just a home. Water helps all living things carry out important life processes such as digestion and waste removal. In fact, the bodies of most organisms are made up mostly of water. Scientists estimate that two-thirds of the weight of the human body is water, as shown in Figure 6. Do you know how much you weigh? Calculate how much of your weight is made up of water.

Because water is so important to living things, it is also important to an ecosystem. The amount of water available in an ecosystem can determine how many organisms can live in a particular area. It can also serve as shelter and as a way to move from place to place.

The Sun is the main source of energy for most organisms on Earth. Energy from the Sun is used by green plants to produce food. Humans and other animals then obtain their energy by eating these plants and other organisms that have fed on the plants. When you eat food produced by a plant, you are consuming energy that started out as sunlight. You’ll learn more about the transfer of energy in an ecosystem later in this chapter.

Why are water and sunlight important to ecosystems?

Sunlight and water are two abiotic factors essential to ecosystems. Water is important to humans because 66 percent of our bodies is composed of water. Explain why most ecosystems could not exist without sunlight.
A Balanced System

Every ecosystem is made up of many different biotic and abiotic factors working together. When these factors are in balance, the system is in balance, too.

Ecosystems are always changing. Could an ecosystem ever get out of balance? Many events can affect the balance of a system. One example would be a long period of time without rain (called a drought). Predict what would happen if a drought occurred at the stream where you took your field trip. You can see a possible result in Figure 7. Some organisms, like fish, could not survive for long periods of time without water. Other organisms, such as frogs or insects, might have to find new homes.

Organisms that couldn’t survive in a normal stream environment might find the dried-up stream to be just the ecosystem they need. Examples might include trees, flowers, mice, gophers, or earthworms.

Figure 7 Ecosystems are always changing. Some changes are small. Others, such as a stream drying up, are much larger with many more effects.
You may think of ecosystems as large areas. But ecosystems can be any size. You can even make an ecosystem that fits in a plastic bottle.

**Real-World Question**

What are the parts of an ecosystem?

**Goals**
- **Model** an ecosystem.
- **Observe** an ecosystem.

**Materials**
- 2-L bottle
- water
- scissors
- Elodea plants
- sand
- guppy
- aquarium gravel
- fish food
- metric ruler

**Safety Precautions**

**Procedure**

1. Rinse out a 2-L plastic bottle with water. Using scissors, carefully cut off the top of the bottle.
2. Pour a layer of sand 5 to 10 cm deep in the bottom of the bottle.
3. Fill the bottle to within 5 cm of the top with water that has stood in an open container for about two days. Keep a supply of this aged water on hand to replace the water that evaporates from the bottle. The level should always be about the same.
4. Plant the Elodea and add a 2-cm layer of gravel. Place the container in bright light but not direct sunlight.
5. When the water clears, add a guppy.
6. Feed the fish one or two small flakes of food every day.
7. Observe your ecosystem every day and record your observations in your Science Journal. Be sure to include observations about the living and nonliving parts of your ecosystem.

**Conclude and Apply**

1. **Describe** how the parts in the bottle work together to form an ecosystem.
2. **Explain** what is needed to keep the ecosystem healthy.

**Communicating Your Data**

Keep a daily journal explaining what you do each day to take care of your ecosystem and describing any changes that take place over time.
Organizing Ecosystems

Imagine trying to study all of the living things on Earth at once! When ecologists study living things, they usually don’t start by studying the entire biosphere. Remember, the biosphere consists of all the parts of Earth where organisms can live. It’s much easier to begin by studying smaller parts of the biosphere.

To separate the biosphere into smaller systems that are easier to study, ecologists find it helpful to organize living things into groups. They then study how members of a group interact with each other and their environments.

Groups of Organisms  Look at the fish in Figure 8. This particular fish species lives in coral reefs in the warm, shallow waters of the South Pacific. These fish use energy, grow, reproduce, and eventually die. The coral reef is the ecosystem the fish live in. All of the fish that live in this particular coral reef make up a population. A population is a group of the same type of organisms living in the same place at the same time. Some other populations that you might find in a coral reef ecosystem are sponges, algae, sharks, and coral. What are some populations of organisms that live around your school?
**Groups of Populations**  Many populations live in an ecosystem like the coral reef in Figure 9. All of the populations that live in an area make up a **community** (kuh MYEW nuh tee). The members of a community depend on each other for food, shelter, and other needs. For example, a shark depends on the fish populations for food. The fish populations, on the other hand, depend on coral animals to build the reef that they use to hide from the sharks.

No matter where you live, you live in and are part of a community. Make a list of as many of the populations that make up your community as you can. Compare your list with the lists of your classmates. How many populations did the class come up with?

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**Mini LAB**

**Calculating Population Density**

**Procedure**

1. Calculate the total area of your home by multiplying the length times the width of each room and adding all the products together.
2. Count the number of people who live in your home.
3. Divide the number of people living in your home by the total area to determine the population density.

**Analysis**

Calculate what would happen to the population density if the number of people living in your home doubled.

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**Characteristics of Populations**  Look around your classroom. Is the room big or small? How many students are in your class? Are there enough books and supplies for everyone? Ecologists ask questions like these to describe populations. They want to know the size of the population, where its members live, and how it is able to stay alive.

**Population Density**  Think about your classroom. A population of 25 students in a large room has plenty of space. How would the same 25 students fit into a smaller room? Ecologists determine population density (DEN suh tee) by comparing the size of a population with its area. For instance, if 100 dandelions are growing in a field that is one square kilometer in size, then the population density is 100 dandelions per square kilometer.

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**Figure 9**  Many populations make up a coral reef community. **Identify** three populations in this coral reef community.
Studying Populations  Butterflies fluttering over flower beds are a common sight in the summer. Some butterflies live only a short time. Others, such as monarchs, can live for years. Monarchs travel to warm climates for the winter, returning to the same location year after year. This seasonal travel is called migration. Is it possible to study a population that migrates from place to place?

To study migrating monarchs, a “monarch watcher”—often a school student like yourself—carefully catches a monarch and attaches a tag to one of its wings. The tag indicates where the butterfly was caught. Later, someone else who catches the same butterfly can use the tag to figure out how far the butterfly has flown. A butterfly could be tagged in Delaware and captured days later in South Carolina. Information from many butterflies can be combined to build a picture of the monarch’s migration like the one in Figure 10. Similar techniques are used to study populations of birds, wolves, and other animals that travel long distances.

Limits to Populations  Populations cannot grow larger and larger forever. There wouldn’t be enough food, water, living space, and other resources to go around. The things that limit the size of a population, such as the amount of rainfall or food, are called limiting factors. Think back to the stream. One biotic limiting factor in the stream ecosystem is the mosquito population. How can a mosquito population be a limiting factor? If you were a frog, you might know the reason. Frogs eat mosquitoes. If lack of rain caused the mosquito population to go down, then the frog population might not have enough food and its population size might also decline. What are some other limiting factors in a stream ecosystem?

Figure 10  Monarch butterflies can migrate great distances.

ScienceOnline  
Topic: Animal Migration  
Visit red.msscience.com for Web links to information about tracking animal migrations.

Activity  In your Science Journal, draw a map showing the migration route of an animal species.

Compasses  Monarchs may be able to use Earth’s magnetic field as a kind of compass as they fly. Humans have used compasses for centuries. Research the history of compasses and create a time line.
Interactions in Communities

Are frogs the only organisms in the stream community that eat mosquitoes? No, there are many animals that eat them, including some birds and spiders. That means that frogs must compete with birds and spiders for the same food. Feeding interactions such as those in Figure 11 are the most common interactions among organisms in a community.

Imagine a large bowl of popcorn in your classroom. As long as there is enough popcorn to go around, you don’t have to worry that you’ll get your share. But if the bowl of popcorn were small, you would have to compete with your classmates to get some. The greater the population size of an area, the greater the competition for resources such as food. Food isn’t the only resource that organisms compete for. Organisms will compete for any resource that is in limited supply. Space, water, sunlight, and shelter are all resources that may be limited in a particular ecosystem.

What are the most common interactions among organisms in a community?

Eat or Be Eaten  Have you ever heard the phrase “birds of prey”? A falcon is a bird of prey, which means it captures and eats other animals. A falcon, with its razor-sharp talons, will swoop down from the sky to snatch up a field mouse. The falcon is a predator (PRE duh tur). Predation (pre DAY shun) is the act of one organism feeding on another.

Organisms That Live Together  Predation doesn’t sound like a good deal for the field mouse, does it? The falcon population, however, is limited by the size of the mouse population. There are other types of relationships among organisms. In one type of interaction, both organisms in the relationship benefit. The African tickbird, for instance, gets its food by eating insects off the skin of zebras. The tickbird gets food, while the zebra gets rid of harmful insects. In another type of relationship, only one organism benefits. The other organism doesn’t benefit, but is not harmed. A bird building a nest in a tree is an example of this. The bird gets protection from the tree, but the tree isn’t harmed. In still another relationship, one organism is helped while the other is harmed. The insects on the zebra’s skin, for example, benefit from the zebra. However, these insects can harm the zebra. Have you ever been bitten by a mosquito? That’s a firsthand experience of this type of relationship.
Where and How Organisms Live

How can a small ecosystem such as a classroom aquarium support a variety of different organisms? It’s possible because each type of organism has a different role to play in the ecosystem. A typical classroom aquarium may contain snails, fish, algae, and bacteria. The role of snails is to feed on algae. The glass of an aquarium can become clouded by the growth of too much algae. Snails eat the algae, helping keep the glass clear so light can get in. The role of the algae is to provide food for snails and fish, and to provide oxygen for the system through photosynthesis. The role of an organism in an ecosystem is called the organism’s niche (NICH).

What do you think the role of the fish might be in an aquarium ecosystem? The niche of the fish includes adding nutrients to the ecosystem through its waste products that encourage the growth of algae. All the interactions in which an organism takes part make up its niche.

How would you describe your niche? Perhaps you help dispose of wastes by recycling, or obtain food by grocery shopping. What other activities does your niche include?

**Graph Populations**

One way to understand more about relationships among organisms in an ecosystem is to keep track of, or monitor, and graph populations. Use the information below to make a graph of population size over time for barn owls and field mice. Then, answer the questions that follow.

**Identifying the Problem**

Set up your graph with months on the x-axis and numbers of organisms on the y-axis. Use two colors to plot your data. For more help, refer to the Math Skill Handbook. Use your graph to infer how the population of field mice affects the population of barn owls.

**Solving the Problem**

1. Predict how the next two months of the graph will look.
2. Field mice eat green plants and grains. What do you think would happen to the population of barn owls if there were no rain in the area for a long time?
The place where an organism lives is called its **habitat** (HA buh tat). The habitat of a catfish is the muddy bottom of a lake or pond. The habitat of a penguin is the icy waters of the Antarctic. How would you describe the habitat of the pet reptile shown in Figure 12?

Different species of organisms often live in the same habitat. Resources, such as food, living space, and shelter, are shared among all the species living in a habitat. For example, the branches of an apple tree provide a habitat for spiders, fruit flies, beetles, caterpillars, and birds. How can all these organisms share the same home? They have different ways of feeding, seeking shelter, and using other resources. In other words, they have different niches. For example, spiders feed on beetles and other insects. Caterpillars eat leaves. Fruit flies feed on apples. Birds eat spiders, caterpillars, or flies. Each species has a different niche within the same habitat.

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**Figure 12** Each organism in an ecosystem has its own job, or niche. **Explain how the reptile and the plant can share the same habitat.**

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**Self Check**

1. **Identify** a population that lives in your community.
2. **Explain** how the number of trees in a forest could affect the size of a bird population.
3. **Design an experiment** to identify a limiting factor that prevents the snail population in a home aquarium from growing larger.
4. **Think Critically** Ladybug beetles help gardeners control insect pests called aphids. What kind of interaction might take place between ladybug beetles and aphids?
5. **Calculate** the population density of buttercups in a meadow. There are 550 buttercups in a meadow that measures 100 m by 66 m.

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**Applying Math**

red.msscience.com/self_check_quiz
It’s All About Food

Think about the interactions that we’ve talked about so far. The frog and the mosquito, the falcon and the mouse—most of the interactions involve food. Energy moves through an ecosystem in the form of food.

Producers and Consumers Many different populations interact in a backyard ecosystem, including plants, birds, insects, squirrels, and rabbits, as shown in Figure 13. The plants in the ecosystem produce food through photosynthesis. An organism that makes its own food, like a plant, is called a producer. The grasshopper that nibbles on the plants is a consumer. A consumer eats other organisms.

Energy Through the Ecosystem

What You’ll Learn

■ Explain how organisms get the energy they need.
■ Describe how energy flows through an ecosystem.

Why It’s Important

The energy most living things require comes directly or indirectly from the Sun.

Figure 13 In any community, energy flows from producers to consumers.

Review Vocabulary

recycling: reuse of an item or natural resource that requires changing or reprocessing it

New Vocabulary

• producer • decomposer • consumer
Decomposers  Some of the consumers in an ecosystem are so small that you might not notice them, but they have an important role to play. They are the decomposers, such as bacteria and fungi. Decomposers use dead organisms and the waste material of other organisms for food.

Modeling the Flow of Energy

The food chain in Figure 11 is a simple model that shows how energy from food passes from one organism to another. Each organism is linked by an arrow. The arrows show that energy moves from one organism to another in the form of food.

What does a food chain model?

Can you spot any problems with using a food chain to model the feeding relationships in a community? A food chain does not show every species in the community. We need a more complex model to show all the feeding interactions in an ecosystem.

Food chains often overlap. For instance, a bird may eat seeds and in turn be eaten by a cat. However, a cat might also eat a rabbit or a mouse. One food chain cannot model all these overlapping relationships. Scientists use a more complicated model, called a food web, to show the transfer of energy in an ecosystem. A food web like the one in Figure 14 is a series of overlapping food chains that shows all the possible feeding relationships in an ocean ecosystem.

Figure 14  This ocean food web is made up of many overlapping food chains. Identify the organisms eaten by an orca.
Cycling of Materials

What happens when you recycle a soda can? The can is taken to a processing plant and melted so that the aluminum can be used again. This is an example of a simple cycle. The same aluminum can be used over and over again. Cycles are important to ecosystems. Instead of aluminum cans, however, it’s the materials that make up organisms that get recycled in an ecosystem.

The bodies of living things are made up of matter, including water and chemicals like nitrogen and carbon. To get the matter needed to build bones, muscles, and skin, you need to eat food made of the right kinds of matter, as the horse in Figure 15 is doing. In an ecosystem, matter cycles through food chains. The amount of matter on Earth never changes. So matter in ecosystems is recycled, or used again and again.

Living organisms depend on these cycles for survival. Organisms also depend on one another for food, shelter, and other needs. All the different things that make up the biosphere—from a tiny insect to a raging river—have a unique role to play.

Figure 15  Horses get the materials they need to grow and maintain their bodies by eating food such as grass. Infer where you think the grass gets the materials it needs for growth.
Real-World Question

How many blades of grass are in a park? It may seem to you like there’s no limit to the number of blades of grass that can grow there. However, as you’ve discovered, there are many factors that organisms like the plants in the park need to live and grow. By experimenting with these factors, you can see how they limit the size of the population. How do space, light, water, and temperature limit plant populations?

Form a Hypothesis

Think about what you already know about the needs of plants. As a group, form a hypothesis to explain how one abiotic factor may limit the number of bean plants that can grow in a single pot.

Test Your Hypothesis

Make a Plan

1. Decide on a way to test your group’s hypothesis. Make a complete materials list as you plan the steps of your experiment.
2. What is the one abiotic factor you will be testing? How will you test it? What factors will you need to control? Be specific in describing how you will handle the other abiotic factors.

3. How long will you run your experiment? How many trials of your experiment will you run?

4. Decide what data you will need to collect. Prepare a data table in your Science Journal.

5. Read over your entire experiment and imagine yourself doing it. Make sure the steps are in logical order.

Follow Your Plan
1. Make sure your teacher has approved your plan and your data table before you proceed.
2. Carry out your plan.
3. Record your observations during the experiment.

Analyze Your Data
1. Make a graph to show your results. Use a bar graph to compare the number of seedlings that grew in the experimental containers with the number of seedlings that grew in the control containers.
2. Identify the variables in your experiment.
3. Identify the controls in your experiment.

Conclude and Apply
1. Explain how the abiotic factor you tested affected the bean plant population.
2. Predict what would happen to your plant population if you added another kind of plant or animal to the containers.

Communicating Your Data
Compare your results with other groups. Explain how different factors affected the plants grown by each group.
When you think about Florida, you probably picture sandy beaches and palm trees. But do you think about alligators? Alligators are among the best-known animals that live in Florida. They can grow to be 13 feet long and weigh more than 600 pounds.

Endangered Alligators

By the 1960s, the number of alligators was greatly reduced in Florida due to hunting and habitat loss. The numbers became so low that alligators were placed on the endangered species list. A species is listed as endangered when so few of its members are living that the entire species is in danger of becoming extinct. In the United States, it became illegal to hunt alligators. Gradually the number of alligators went up. By 1977, they were renamed as a threatened species. A threatened species still needs to be protected but is not in immediate danger of becoming extinct. Now, more than a million alligators live on farms and in the wild. Good news, right? Think again. There are problems—big problems from big alligators.

Alligator Problems

Today more people live, work, and play in areas where alligators live. Alligators have been found in swimming pools and on golf courses. Many people believe that the size of Florida’s alligator population should be tightly controlled. They fear that more alligators will lead to more encounters with humans and increase the possibility of alligator attacks.

Other people point out that, as the number of houses, roads, and shopping centers in Florida increases, alligators are left with fewer and fewer places to live and hunt. These people suggest that more wilderness areas must be set aside for alligators and other predators.

Write Alligators are not the only predators people fear. Some parts of the country also have problems with bears, wolves, cougars, or other animals. Write a short paper about encounters between people and predators in your area.
Reviewing Main Ideas

Section 1  What is an ecosystem?

1. An ecosystem is made up of organisms interacting with each other and with the nonliving factors in the system.
2. The biosphere is made up of all the ecosystems on Earth.

Section 2  Relationships Among Living Things

1. A population is made up of the same type of organisms living together in the same place at the same time.

Section 3  Energy Through the Ecosystem

1. Energy is transferred through an ecosystem in the form of food.
2. The feeding relationships in an ecosystem can be illustrated by food chains and food webs.

Visualizing Main Ideas

Copy and complete this concept map about ecosystems.
Using Vocabulary

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

1. abiotic factor—biotic factor
2. biosphere—ecology
3. community—population
4. ecosystem—limiting factor
5. niche—habitat
6. producer—consumer
7. consumer—decomposer

Checking Concepts

Choose the word or phrase that completes the sentence.

8. Which of the following is NOT a biotic factor?
   A) raccoons
   B) sunlight
   C) pine trees
   D) mushrooms

9. Ponds, streams, and prairies are examples of what parts of the environment?
   A) niches
   B) producers
   C) populations
   D) ecosystems

10. What is a group of the same type of organism living in the same place at the same time?
    A) habitat
    B) population
    C) community
    D) ecosystem

11. Which of the following is an example of a producer?
    A) grass
    B) horse
    C) fungus
    D) fish

12. What is the diagram shown above an example of?
    A) food chain
    B) food web
    C) ecosystem
    D) population

13. All of the following are abiotic factors except
    A) sunlight
    B) water
    C) bacteria
    D) temperature

14. All ecosystems on Earth make up the
    A) atmosphere
    B) biosphere
    C) lithosphere
    D) hydrosphere

15. All the populations in an ecosystem make up a
    A) community
    B) niche
    C) habitat
    D) limiting factor

16. In a meadow ecosystem, hawks feed mostly on mice. When the mice population is small, there is less food for hawks, so the hawk population becomes smaller. When the mice population grows, the number of hawks also grows. For the hawk population, the number of mice in this meadow is an example of a
    A) niche
    B) habitat
    C) producer
    D) limiting factor

17. A food web is a model that shows how
    A) energy moves through an ecosystem
    B) ecosystems change over time
    C) producers use sunlight
    D) abiotic factors affect populations
18. **Infer** why it is correct to say that decomposers are also consumers.

19. **List** examples of foods you would eat if you were eating low on the food chain.

20. **Draw and label** a diagram of an ecosystem. Label biotic and abiotic factors. Describe three interactions among organisms in the ecosystem.

21. **Identify** three possible limiting factors for an aquarium ecosystem. Describe how each factor can limit population growth.

22. **Describe** your own habitat and niche.

23. **Classify** each of your ten favorite foods as coming from a producer, consumer, or decomposer. Write a short explanation of your classification of each item.

Use the graph below to answer question 24.

24. **Make and Use Graphs** The graph above shows the changes in the size of a population of insects living on roses over the course of a year. During what month is the insect population the smallest? During what month is the population the largest?

25. **Predict** what would happen to an ecosystem if its decomposers were removed.

26. **Develop Multimedia Presentations** Find slides or photographs that show different ecosystems. Arrange a slide presentation or photo display of these images. Use titles or captions to identify each one.

27. **Research Information** Choose an ecosystem to research. Find out what plant and animal species are found there and how they interact. Make a poster illustrating a food web in this ecosystem.

Use the table below to answer question 29.

28. **Population Density** The population density of rabbits living along the banks of a stream is about one rabbit per 100 m². How many rabbits are likely to be found in a 900-m by 25-m section of the stream bank?

Use the table below to answer question 29.

29. **Changes in Population Size** Use the data from the table above to make a graph of population size over time for rabbits and bobcats. Based on your graph, infer how the size of the rabbit population affects the size of the bobcat population.

<table>
<thead>
<tr>
<th>Year</th>
<th>Rabbit Population (100s)</th>
<th>Bobcat Population (100s)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1970</td>
<td>100</td>
<td>39</td>
</tr>
<tr>
<td>1975</td>
<td>133</td>
<td>80</td>
</tr>
<tr>
<td>1980</td>
<td>94</td>
<td>61</td>
</tr>
<tr>
<td>1985</td>
<td>65</td>
<td>63</td>
</tr>
<tr>
<td>1990</td>
<td>80</td>
<td>45</td>
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</tbody>
</table>
Record your answers on the answer sheet provided by your teacher or on a sheet of paper.

Use the picture below to answer questions 1 and 2.

1. The shelf-like organism growing on this tree is a fungus. What term best describes this organism?
   A. producer  
   B. consumer  
   C. predator  
   D. decomposer

2. What kinds of organisms are shown in the photo?
   A. producers and consumers  
   B. consumers and decomposers  
   C. predators and prey  
   D. decomposers and producers

3. What kind of scientist would study the interactions taking place between the predators and prey living in a community?
   A. geneticist  
   B. ecologist  
   C. botanist  
   D. geologist

4. What term best describes the place in which an organism lives?
   A. niche  
   B. habitat  
   C. biosphere  
   D. community

5. What term best describes a population that has so few members that it could become extinct?
   A. endangered  
   B. threatened  
   C. consumer  
   D. decomposer

6. What is the largest ecosystem on Earth?
   A. ocean  
   B. tundra  
   C. Asia  
   D. biosphere

7. There are 48 dogs in 100 households covering 16 square kilometers. What is the population density of dogs?
   A. 2 dogs per household  
   B. 3 dogs per household  
   C. 3 dogs per square kilometer  
   D. 2 dogs per square kilometer

8. What term best describes populations that live together in an area?
   A. niche  
   B. habitat  
   C. population density  
   D. community

Use the graph below to answer questions 9 and 10.

9. In which month was the prey population the highest?
   A. March  
   B. April  
   C. June  
   D. December

10. What was the approximate population density of the prey population in February and April?
    A. 10 per km²  
    B. 8 per km²  
    C. 12 per km²  
    D. 7 per km²
11. Why is water an important abiotic factor in any ecosystem?

12. What does the biosphere have in common with an aquarium?

13. Explain the flow of energy in an ecosystem using these terms—consumer, producer, Sun, and decomposer.

14. How are the terms population, community, and ecosystem related?

15. In what ways is the meadow ecosystem shown here similar to a desert ecosystem?

16. What abiotic factors might affect organisms living in the meadow ecosystem?

17. Frogs feed on mosquitoes and other insects. Explain how mosquitoes are a limiting factor for frogs. What happens to the frog population if the mosquitoes rapidly increase or decrease? What happens to the mosquitoes if the frogs disappear?

18. What kinds of organisms might have lived in this stream when water was flowing in it? What might have happened to them as the stream dried up?

19. Describe a new habitat that might have appeared after the stream dried up. What kinds of organisms could live in that habitat?

20. Describe at least three ways in which one organism can interact with other organisms in the same community.

21. Compare and contrast an endangered species and a threatened species.

22. Explain whether a food web or a food chain is a better model for the flow of energy in an ecosystem.

23. Why is the cycling of materials important for an ecosystem?