CHAPTER 3

Ecosystems

All life depends on healthy ecosystems that can provide the resoures organisms depend on for survival, including clean water, air, and soil, as well as food. Biodiversity is also an important element in maintaining healthy ecosystems. The greater Earth's biodiversity, or abundance of different kinds of life on Earth, the more resources, opportunities for medical discoveries, and adaptive responses to natural disasters and human activities.

In this chapter you will learn about:

Lesson **3. 1: Ecosystems**
An ecosystem is a community of living things adapted to a specific environment. There are a variety of ecosystems on land and in water. Biomes are major ecological communities,identified by where they exist geographically. This lesson discusses the organization of ecosystems and describes the biomes of the world.

Lesson 3. 2: **Carrying Capacity**
Imagine inviting friends to lunch. You prepare enough food and set the table for eight people. Your planned lunch will satisfy the needs of eight people in all. But then each of your friends invites another friend. You don't have enough resources to feed or seat them all. You might say that your lunch community has exceeded its carrying capacity. This lesson talks about carrying capacity, or the environmental limitations that determine how many organisms an ecosystem can support.

Lesson 3.3: **Symbiosis**
The prefix *sym* means "together, " and the prefix *bio* means "life. " As organisms on Earth, we live together with other organisms. But some organisms have special ways of living together. This lesson introduces you to different kinds of symbiotic relationships.

lessen 3. 4: Disruption
Both nature and human activity can lead to environmental disturbances and major disruptions. Fires and floods can alter ecosystems in a short time. So can the introduction of exotic or non-native species to an ecosystem, where the species competes for the same resources as native species. In some cases, humans remove ecosystems entirely to create city structures. This lesson introduces you to natural and unnatural ecological disruptions.

Lesson 3. 5: Environmental. Issues
Controlling pollution and keeping Earth's environment habitable are important issues for everyone. In this lesson, you will learn how human activities affect the environment and investigate the difference between renewable and nonrenewable resources.

Goal Setting

In the particular geographical location in which you live, you may be aware of clues to the original ecosystem.

Explore your environment, or use print and online resources to learn more about the ecosystem that existed before the place in which you live was established. Describe the original ecosystem. Then describe how the ecosystem has been altered.

The original ecosystem:

Alterations to the ecosystem:

LESSON 3.1

Ecosystems

Lesson Overview

You will be able to

- Understand the organization of ecosystems
- Describe interactions between organisms
- Identify biomes of the world

Skills

- **Core Skill:** Analyze Author's Purpose
- **Reading Skill:** Understand Text

Vocabulary

biome
biosphere
ecosystem
environment
food chain
interact
prediction

KEY CONCEPT: Within an ecosystem, organisms interact with one another and with nonliving things in their environment.

Your school is not just a building. It is a community made up of populations such as teachers, students, and custodians, all of whom interact with each other. When you interact with someone, you act in close personal relationship with that person. You have an effect on each other. A population also interacts with nonliving things. Each population at your school has a role in making the school successful.

In nature, all living things interact with other living and nonliving things in their environment.

Communities of Living Things

The part of Earth in which life exists is Called the **biosphere.** The biosphere covers the entire surface of Earth and includes the atmosphere. An **ecosystem** is a smaller part of the biosphere. It is made up of all the living organisms in one area (of any size), as well as the nonliving parts of the environment, such as water and rocks.

Every living thing depends on other living things and many nonliving things. In a healthy ecosystem, all the parts are in balance, meaning the populations of plants and animals are not rising or falling in huge numbers. Even healthy ecosystems are always changing, at least in small ways. When old animals die, they make room for their young to live. When a tree falls, young seedlings begin growing in its place.

Organisms in the Environment

An environment is the living and the nonliving surroundings or an organism. All the organisms in a certain environment make a **community.** The community of living things where you live may include squirrels, birds, trees, and humans. A **population** is all the organisms of one type. So the same community, but to two different populations. Within a community, each population has its own place to live, or **habitat.** It also fills its own role or job, which is called a **niche.**

THINK ABOUT SCIENCE

Directions: Choose the word in column 1 that is described in column 2.

1.	biosphere / niche	where life exists on Earth
2.	ecosystem / habitat	home for living things
3.	environment / community	all the organisms
4.	niche / population	a role or job

ANALYZE AUTHOR'S PURPOSE

An author's purpose is the reason why he or she writes a certain passage of text. Purposes for writing vary. Some authors write to inform or explain. Others write to entertain, persuade, or elaborate upon ideas.

To determine an author's purpose for writing, it is helpful to read titles and subtitles and examine illustrations, photographs, and diagrams. Getting the "big picture" gives you some idea of the author's reason for writing. Predicting an author's purpose *before* reading helps you be more aware as you read. You can look for evidence that either supports your prediction or causes you to revise it.

Brief passages may not include titles, subtitles, and visual clues. In these cases, you must read and then pause to ask yourself *Did the author present facts or opinions? Did the author use words or present ideas aimed at evoking, or bringing out, emotion? Did the author attempt to convince me to do something?*

Read the following passages. Analyze the author's purpose for writing each passage.

1. Feeding relationships are a part of every ecosystem. Green plants make their own food using water, carbon dioxide, and energy from the Sun. Many animals eat these green plants. These animals, in turn, become food for other animals. As long as these feeding relationships are stable, all the animals in the ecosystem have enough food to live and grow.

2. Human actions are always harmful to ecosystems. For example, consider a meadow near a forest. Rabbits may live in the meadow, where they eat grasses and flowers. The rabbits are food for foxes that live in the forest. When humans pave over the meadow, the rabbits die, and the foxes starve. Humans must stop all development of wilderness areas in order to protect fragile ecosystems.

In the first passage, the author explains feeding relationships in an ecosystem. How would you describe the author's purpose for writing this passage?

In the second passage, the author describes the negative effects of human behavior on ecosystems. The author uses the words *always* and *must*. How would you describe the author's purpose for writing this passage?

21st Century Skill
Social and Cross-Cultural Skills

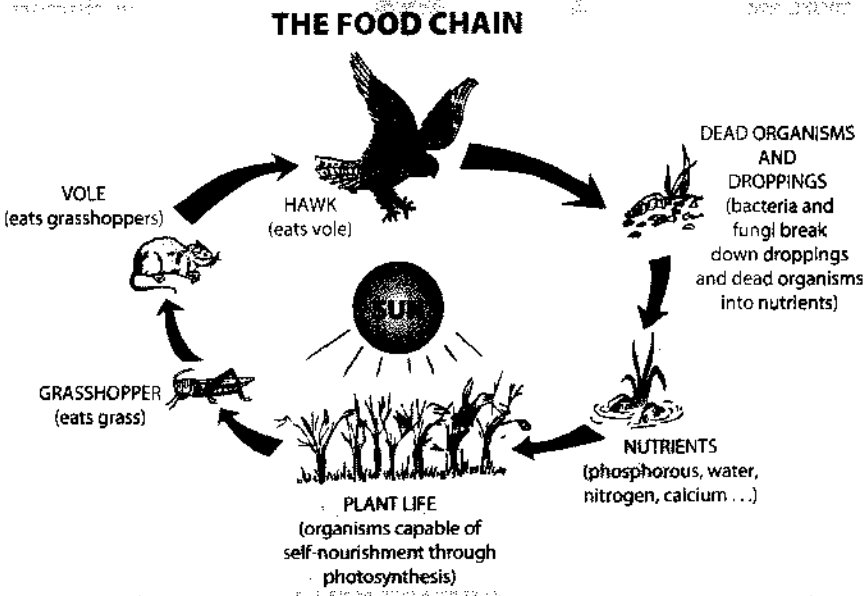
Science bridges cultures. Many scientific investigations are conducted by international teams of researchers with varied backgrounds. For example, the International Space Station is jointly operated by scientists in the United States, Russia, Japan, Europe, and Canada. They live and work together, conducting themselves professionally and respecting cultural differences that influence their work and their interactions.

In what ways would sharing knowledge and experiences help the teams to work creatively and productively?

Energy Cycles

Energy from the Sun is the source of almost all energy on Earth. Green plants (the producers) trap energy during photosynthesis and convert it into glucose. Herbivores, such as cows and deer, eat the green plants. Carnivores, such as bears and falcons, eat other animals. Omnivores, such as humans and raccoons, eat both plants and animals.

The **food chain** is the path that energy follows as it moves through the community. It starts with green plants, the producers, and moves on through herbivores. Large carnivores are usually at the top of the food chain. When an organism dies, decomposers break apart the body, returning the nutrients to the soil. All the many food chains within a community form a **food web.** A change in the population of one organism of the food web will affect every other organism.



As demonstrated in the food chain above, each living thing is food for the next organism. For example, plants become food for grasshoppers, grasshoppers become food for voles, and voles become food for hawks. The hawks' droppings become food for bacteria, which turn it into nutrients for grass.

THINK ABOUT SCIENCE

Directions: Answer the questions below.

1. What type of organism is the basis of any food chain?

2. What would happen if there were no decomposers?

3. The diagram shows one aspect of an ecosystem—the food chain. What would happen if the number of grasshoppers decreased?

Biomes

A large group of ecosystems with similar climates and communities is known as a **biome.** Scientists disagree about exactly where one biome ends and another begins. Most agree, however, that there are at least six distinct biomes throughout the world. These are deserts, tundras, grasslands, tropical tain forests, temperate forests, and oceans.

Deserts

Lack of rainfall is the major characteristic of a desert biome. Most of the southwestern United States is a desert biome. Deserts tend to be hot during the day. At night, however, surface heat is rapidly lost. The desert at night can become quite cool.

Desert plants and animals are adapted to harsh, dry conditions. They have adapted to survive with very little water. Most desert animals are active at night when the temperature is cooler. Many of the plants, such as the cactus, store large amounts of water in their roots or stems. Some desert plants have extra deep roots. Other plants have tiny leaves or a waxy covering to reduce water loss from evaporation.

Tundras

If you were to move a desert to an extremely cold area, the result would be a tundra. There are two kinds of tundras: arctic and alpine. The arctic tundra is in the far northern parts of the world. Alpine tundras are at the tops of high mountains.

In many places on the tundra, ice and snow cover the ground for long periods. The soil may never totally thaw. Polar bears, as well as migrating animals, such as birds, reindeer, and caribous, live in the tundra. Small plants, such as lichens and mosses, grow close to the ground where strong, icy winds will not damage them.

Grasslands

Grasslands get more rainfall than deserts but not enough to support large trees. They have long, hot summers, cold winters, and high winds. The soil is generally fertile. The dominant plants are a wide variety of grasses. Animals tend to be small, but some large grazing animals are also common.

America's prairie is made up of grasslands that once were home to huge herds of bison. Today, there are cattle ranches on these grasslands. This area is also known as "the world's breadbasket" because of the huge quantity of grain produced there.

Tropical Rain Forests

In a tropical rain forest, the weather is mild all the time. Both sunlight and rain are abundant. Surprisingly, the soil is not very fertile. Because of the abundance of sunlight, moisture, and minerals from decomposing plant matter, however, trees grow tall. Vines and other plants grow in the trees. Huge varieties of insects, snails, birds, snakes, frogs, and small mammals are at home in the tropical rain forest.

Core Skill Analyze Author's Purpose

One way to analyze an author's purpose is to look at how the text is structured. In science, the text structure helps the author explain a concept or a process. First, read the main head and the subheads beneath it. These heads can give you clues about the author's purpose. Then read the paragraph below the main head. This paragraph introduces the topic and prepares the reader for the subheads below it. Finally, determine the relationship between the main head and the topics in the subheads below it.

As you read this page and the next page, ask yourself *What are the subheads? How are the subheads related to the text in the opening paragraph under the main head?*

Science writers usually present clear, precise language, supported by data and directly related visuals. Their purpose is usually to educate and inform.

WRITE TO LEARN

Predictions are educated guesses about what will happen in a text based on clues the writer provides and on the reader's own knowledge. Making predictions helps you to focus on what you are reading, because you are interacting with the text.

Find a news article about the current condition of one of Earth's biomes. As you read, write predictions about what you think the author will say. When you finish reading the article check to see if your predictions were correct.

Temperate Forests

Temperate forests have distinct seasons. Temperature and rainfall vary with the seasons. Tre in southern temperate forests. Farther north, evergreens are the most common trees. Birds and mammals are abundant throughout the forest, but because so much has been cut to make room for farms and homes, the number of animals has greatly decreased. Much of the United States is now—or once was—temperate forest.

Oceans

The ocean biome covers two-thirds of Earth's surface. Climates vary, depending on location. Most of the plants and animals, such as algae, plankton, fish, and whales, live near the surface of the ocean where sunlight reaches.

Some organisms exist deep below the ocean surface where sunlight cannot penetrate. Most of these animals scour the ocean bottom for organic matter that sinks. Some, however, live near hot vents in volcanic areas. Rather than converting the Sun's energy to produce food, these creatures produce food by converting the energy in chemicals that rise from beneath the ocean floor.

Freshwater Areas

A wide variety of organisms live in lakes, ponds, streams, and rivers. Many, such as algae, can be too tiny to see, whereas seaweed can grow into a thick mass. Animals that live in or near freshwater include insects, amphibians, and fish. Many birds build their nests along the shores and hunt for fish or other animals in the water. A few mammals, such as beavers, also **live** here.

THINK ABOUT SCIENCE

Directions: Match the name of the biome on the left with its description on the right.

_____ 1. desert	A. cold and dry
_____ 2. tundra	**B.** home to algae and plankton
_____ 3. grassland	**C.** distinct seasons, trees
_____ **4.** tropical rain forest	D. infertile, tali trees, rain, sunlight
_____ 5. temperate forest	**E.** hot summers, cold winters, fertile
_____ 6. ocean	F. dry and hot during the day

Protecting Biomes

With the possible exception of deserts, all of the biomes you read about have been greatly changed by human activities. Humans have cut down vast tracts of both temperate forests and tropical rain forests. Wild grasslands have been changed into farms and ranches as well as cities and suburbs. Many freshwater lakes and rivers are being drained, at least partially, so that humans can use the water.

As a result of these and other activities, Earth is losing its wide variety of living things. This variety is called **biodiversity.** Biodiversity is important in every biome and ecosystem. Scientists argue that protecting biodiversity is vital to the health of life across the planet.

Reading Skill
Understand Text

Science texts often use specific words, or jargon. To understand science texts, it is helpful to identify jargon before beginning to read. Skim the text and highlight unfamiliar words. Also highlight words that appear in bold or italic type. Take time before reading to define these words. If possible, write their meanings in your own words directly in the text. Then, as you read, include your definitions in your reading. They will help you understand the text more completely.

Ecology

Ecology is the study of how organisms interact with one another and with the World around them. The predator-prey relationship is one important interaction. **Predators** hunt and kill other organisms—their **prey.** Organisms are often both predator and prey. Consider a snake, for example, being caught by an eagle. The snake may have just eaten a frog, which in turn, had just eaten a mosquito.

One community role is more important than all the others. Plants and green algae are **producers,** meaning they make their own food. Directly or indirectly, producers provide food for all the other organisms in an ecosystem. Animals eat either producers or other animals. They are called **consumers.**

Decomposers and **scavengers** also play an important role. They feed on dead organisms. Without them, the decaying remains of dead organisms would litter the Earth.

Vocabulary Review

Directions: Complete the sentences below using one of the following words:

biome biosphere **ecosystem** environment food **chain** interact

1. A(n)_____ is defined by living organisms interacting with each other and with nonliving things in an area.
2. The_____is the part of Earth where life exists.
3. One way that organisms_____ is a predator-prey relationship.
4. A(n) _____ shows the flow of energy through an ecosystem.
5. The _____ includes the living and nonliving surroundings of an organism.
6. A large group of ecosystems with a similar climate and communities is a(n) _____.

Skill Review

Directions: Read the passage below. Combine the information you find here with what you read in the lesson to choose the best answer to each question.

> The tundra is sometimes thought of as a cold desert. You might guess it would be home to very few living things. During summer, however, the tundra is covered in lichens and small plants, such as mosses and grasses. You also will find traveling herds of caribou and reindeer, as well as some wolves, foxes, and lemmings. Many birds migrate to the tundra for the summer. Bacteria and fungi live in the soil. A few arctic foxes and musk oxen live in the tundra throughout the year.

1. According to the passage, which best describes the tundra?

   A. a cold desert
   B. an ecosystem as diverse as a rain forest
   C. an ecosystem as diverse as a dry desert
   D. a diverse but limited ecosystem

2. Which group of organisms best describes the tundra community?

   A. all of the plants mentioned in the passage
   B. all of the animals mentioned in the passage
   C. all of the plants and animals mentioned in the passage
   D. all of the bacteria mentioned in the passage

Directions: Read the passage below and choose the correct answer to each question that follows.

> Healthy ecosystems stay in balance. One way nature maintains this balance is through predator-prey interactions. In 1972, the Marine Mammal Protection Act made it illegal to kill seals. Now, in areas along the eastern United States, seal populations are increasing dramatically. Seals prey on fish such as cod and halibut. In turn, great white sharks prey upon seals.

3. What do you predict would happen to the population of great white sharks if people began hunting seals again?

   A. Their population would stay the same.
   B. Their population would increase slightly.
   C. Their population would increase greatly.
   D. Their population would decrease.

4. How do you predict the seal populations would change if sharks began hunting them more aggressively?

   A. Their population would stay the same.
   B. Their population would Increase slightly.
   C. Their population would increase greatly.
   D. Their population would decrease.

Skill Practice

Directions: Read the passage below and choose the correct answer to each question that follows.

Native species are those plants and animals that have inhabited an area for a very long period of time. Some native species were a part of their environment long before humans. They are well-established in their particular ecosystem. Each has a vital role, such as a tree providing shelter for small mammals and birds. Each native species is also an important part of the food chain. Through healthy predator-prey relationships, the ecosystem maintains balance.

As humans' ability to travel has advanced, so has their ability to transport different species from one location to another—sometimes across the world. When a plant or animal is transported from another place and introduced into a new area, it can threaten, or even cause the collapse of, the existing balance in an ecosystem. These non-native species often have no effective predators. Without predators, their populations can quickly soar, crowding out the native species as they compete for sunlight, water, food, and space.

In 1859, twenty-four rabbits were transported to Australia and released on private property. In a short time, the property owner could no longer contain the rabbits, and their population increased and spread across the continent. Without any natural predators, the rabbit population grew into the millions. By 1950, their numbers had reached 500 million. The rabbits overgrazed the natural vegetation, leaving nothing for species native to the continent to eat. This reduced Australia's wool and meat production. Despite efforts to control rabbit populations, they remain a serious problem today.

1. According to the passage, what has been the effect of advancements in transportation on native species?
   A. It has destroyed habitats as roads and railways are built.
   B. It has made it easier to introduce non-native species to new areas.
   C. It has created pollution that damages the environment.
   D. It has caused only minimal changes.

2. What type of interaction would help control rabbits in Australia?
   A. native vs. non-native relationships
   B. producer-consumer relationships
   C. interactive relationships
   D. predator-prey relationships

3. Which statement best summarizes the problem that rabbits caused in Australia?
   A. The rabbits competed with native animals for resources.
   B. The rabbits spread disease.
   C. The rabbits were not adapted for their new environment.
   D. The rabbits preyed on native animals.

LESSON 3.2

Carrying Capacity

KEY CONCEPT: A habitat's limited ability to support the living things within it is called its carrying capacity. Carrying capacity is shaped by limiting factors in the environment.

You live in and play a role in an ecosystem. An ecosystem is a community, or collection of populations of different plants and animals that share a physical environment. In an ecosystem, species live together and interact. Terrestrial ecosystems occur on land. Aquatic ecosystems exist in freshwater and salt water. The largest terrestrial ecosystems are called biomes, and they include different kinds of grasslands, deserts, forests, and alpine or mountain biomes. Biomes and aquatic ecosystems have different chemical and physical characteristics. They also have different species of organisms. Think about the plants and animals you see every day in your surroundings. You and they are part of the same ecosystem.

Lesson Objectives

You will be able to

- Identify limiting factors that affect carrying capacity
- Identify different kinds of relationships within a habitat
- Explain the relationship between equilibrium and carrying capacity

Skills

- **Core Skill:** Cite Textual Evidence
- **Reading Skill:** Understand Text

Vocabulary

carrying capacity
exceeded
concept
equilibrium
habitat
jargon
limiting factor
population

Carrying Capacity

Every organism and **population,** or group of organisms of the same kind, has a **habitat**—a place where they live naturally. A habitat, however, can support only a limited number of organisms.

Imagine inviting some relatives to dinner. You prepare enough food for six people, but two aunts and an uncle hear about your dinner party and drop by unexpectedly. There is a limited amount of food to offer to your guests, and if any more relatives appear, there will be even less food for everyone. There are similarities between your experience and a habitat's carrying capacity.

A habitat has a limited number of resources that organisms in that habitat must share, meaning it has a carrying capacity. **Carrying capacity** is the number of organisms within a population that a habitat can support without losing its resources or damaging them severely.

Food, water, shelter, and space are some of the critical resources in every habitat. In fact, each is a limiting factor within a habitat. A **limiting factor** is any factor that limits the growth, the numbers of, or the distribution of organisms within an ecosystem.

Each species, or kind of organism, has a range of **tolerance.** In other words, there are lower and upper limits of any factor that a species can tolerate, or allow, and still survive. For example, all organisms require water for survival. Too little water limits the number of organisms that can survive in a habitat, but too much water can do the same.

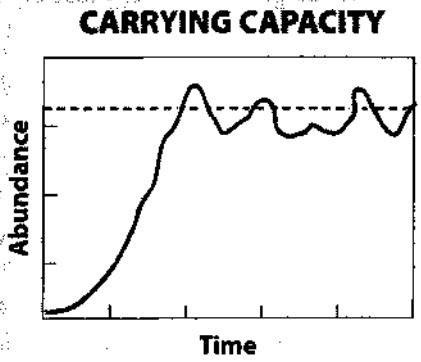
Relationships in a Habitat

Every living organism competes with other living organisms for limited resources, including water, food, shelter, and space. Competition exists among organisms within the same species. It also occurs between species. Take squirrels and blue jays in a forested habitat as an example.

Squirrels and blue jays eat many of the same kinds of food. Acorns are a particular favorite. Each species competes for the acorns. As the acorn supply decreases, both animals must find other food resources, such as berries or seeds. The species will compete for these resources, too. Ultimately, there may not be enough food to support both populations of animals. Some squirrels and blue jays may leave to find food in a different habitat. Others may die. In either case, populations shrink because the habitat's carrying capacity has been **exceeded.** It has gone beyond the natural limits by which all organisms can be sustained.

Other relationships besides competition among species limit a population's growth. Predator-prey relationships are an example. A **predator** hunts for, captures, and eats all or part of its **prey.** The red fox, for example, lives in a variety of habitats, including forests, grasslands, mountains, deserts, and even human neighborhoods. Among other things, red foxes prey upon rodents such as squirrels, rabbits, and mice.

When there is an **abundance** of rodents, meaning the population of rodents is high, food is not a limiting factor, and the fox population grows quickly. The increased pressure on rodents, however, causes their populations to fall. Food supply becomes a limiting factor for the fox population. Foxes must compete for fewer food resources. Some foxes may move elsewhere in search of food. Others may suffer from disease or starvation. Consequently, the fox population declines. It moves toward **equilibrium**, or a balancing point. The fox and rodent populations may increase and decrease a number of times before equilibrium is established.



THINK ABOUT SCIENCE

Directions: If the dashed line in the graph represents equilibrium within a habitat, what does the movement of the line representing abundance over time indicate about equilibrium?

Core Skill
Cite Textual Evidence

For more than 50 years, scientists have studied the relationship between moose and wolves in Isle Royale National Park, an island in Lake Superior. The island supports three packs of wolves, with numbers totaling from 18 to 27. The moose population ranges from 700 to 1, 200.

Moose arrived on the island in the early 1900s. No wolves lived on the island at the time, and the moose population grew rapidly. The only limiting factor was food, and periods of starvation caused the animals' abundance on the island to rise and fall.

Then in the 1940s, wolves reached the island by crossing an ice bridge that stretched from the Canadian mainland.

What do you think happened to the moose population after wolves appeared on the island? Cite evidence from the text "Relationships in a Habitat" on this page to support your answer To cite the textual evidence, first reread the lesson text and look for information on the relationships among species in a habitat. Then, when you find the information you need, highlight it, put a star next to it, or circle it.

Reading Skill
Understand Text

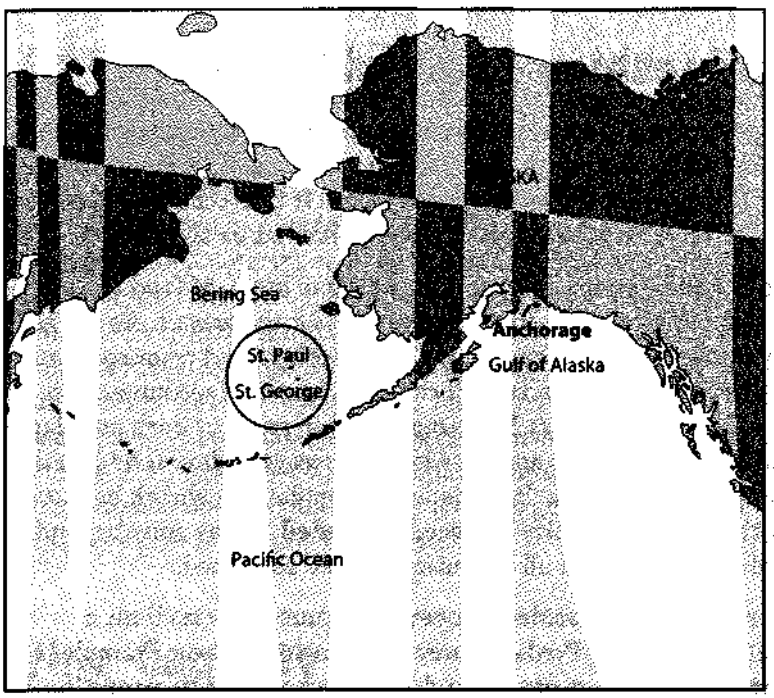
Like you, scientists write to share their ideas and work. Their writing often includes **jargon,** or terms that are specific to a subject area. Reading text that includes jargon can be difficult. However, you can use a special strategy to help you understand what you read.

Parsing is an effective reading strategy. To parse a sentence means to break it into parts and analyze each part to make sense of the whole. To begin, it is helpful to identify the jargon in what you're reading. Define the terms, and if possible, replace the jargon with familiar synonyms or brief descriptions. Then analyze each sentence piece. When you understand its meaning, repeat the process with the remaining pieces. Then reassemble the sentence.

Read the following example of scientific writing. The jargon has been underlined. What would you do first if you were going to use the strategy of parsing to understand the text?

Carrying capacity in oceanic ecosystems has been a topic of renewed vigor as a result of increasing anthropogenic pressure in certain coastal environments. *Increases in coastal populations are correlated to sharp decreases in biodiversity,* suggesting *that the world's carrying capacity is limited.*

Reindeer on the Pribilof Islands



The reindeer of the Pribilof Islands offer a good example of what happens when a population exceeds a habitat's carrying capacity. There are four volcanic islands within the group called the Pribilof Islands. Two of the largest islands are St. Paul and St. George. These rocky islands off the coast of Alaska are covered with **tundra,** which is flat, treeless, Arctic land. Tundra is the coldest and driest of all biomes. Permafrost, or permanently frozen ground, exists most of the year, melting only in summer. So little liquid water arid poor soil limit what grows in the tundra.

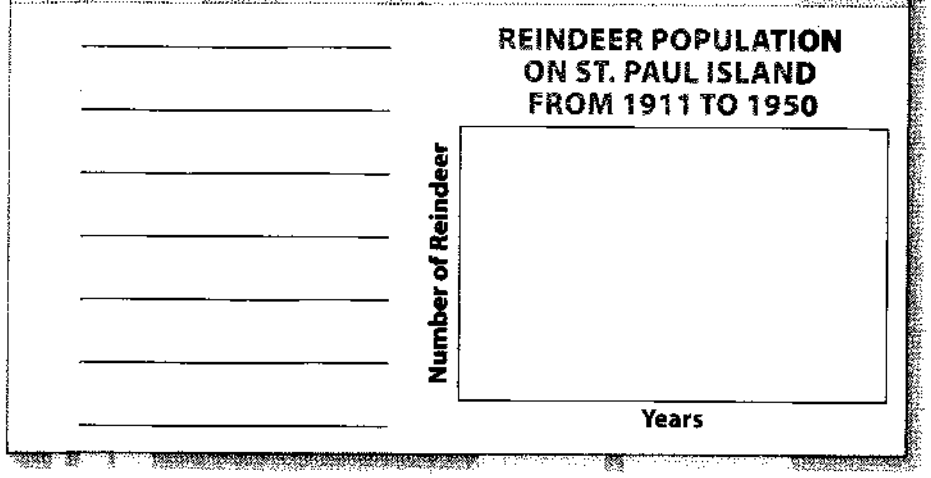
Lichens are among the few organisms that can survive in the tundra. While they are able to colonize bare rock, they grow slowly because they get their nutrients from air, rain, and melted water.

In 1911, government officials introduced 25 reindeer to St. Paul Island. Ten years later, the population had grown to 250 reindeer. The number continued to grow until there were about 2, 000 reindeer on the island in 1938. Then a number of factors combined to reduce the population drastically. Illegal hunting and harsh winter weather affected the population, but lichens proved to be the most important limiting factor.

Lichens are a major source of food for reindeer. As the reindeer population grew, so did the demand for lichens. Lichens did not grow fast enough to continue feeding the reindeer. The reindeer exceeded the island's carrying capacity, and their numbers dropped dramatically. By 1950, only eight reindeer remained alive on St. Paul Island.

THINK ABOUT SCIENCE

Directions: Draw and label a graph to show the change in reindeer population on St Paul Island from **1911** to **1950**. Explain what caused the island's carrying capacity for reindeer to be exceeded.



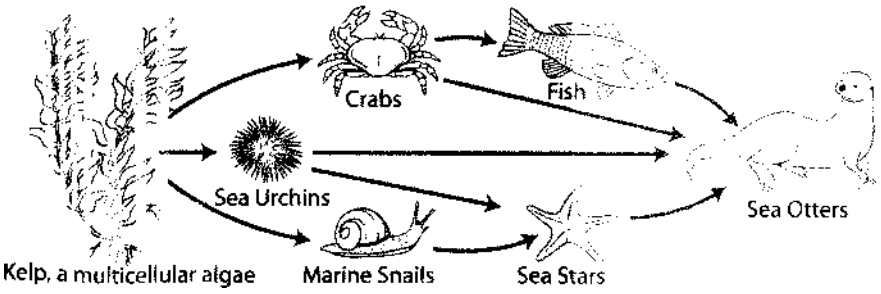
Dietary **Diversity**

Migration and starvation are possible responses to scarce food resources, but so is dietary **diversity,** or variety. Scientists have observed that when a preferred food becomes hard to find, animals usually **diversify,** or broaden their diets to include different kinds of foods. Sea otters living in California's coastal waters are no exception.

In their research, scientists learned that red sea urchins, a favorite food among sea otters, are plentiful in the waters around San Nicolas Island. The sea otters living there feed on these spiny sea animals, as well as marine snails and crabs. Within the population, there is little diversity in the eating habits of individual sea otters.

Fewer red urchins live in the waters off the Central Coast. So it was no surprise to scientists that the diets of sea otters living along the Central Coast were more diversified than those of the San Nicolas sea otters. However, studies of *individuals* in the population show more specialized diets, and that was surprising to scientists. The finding suggests that food webs are more complex than scientists think. Wildlife managers who monitor animal populations may need to change their focus from the dietary habits of the group to the dietary habits of the individual, making their studies of food limitations even more challenging.

KELP FOREST FOOD WEB



WORKPLACE CONNECTION

Wildlife Manage! ment

One of the primary purposes of wildlife management is to maintain the health and size of wildlife populations. Wildlife managers study ecosystems with an eye on balance among wildlife, the environment, and human behaviors.

Because wildlife managers must understand animal populations and the physical environment well, they have extensive academic training. For example, they learn the principles and practices of **conservation biology.** This branch of biology focuses on the preservation and protection of **biodiversity,** or the number of different species of living things. Greater biodiversity is an indication of greater environmental health.

Wildlife managers assume a variety of responsibilities. Within the US National Park Service, for example, wildlife managers take actions to protect the safety of both wildlife and humans, as the two interact in national parks. They also monitor wildlife populations within parks and create plans for dealing with populations that grow too large or too small.

Wildlife biologists also work within the national parks. As part of their research, they may mark and track animal movements. Think about what scientists could learn by tracking such movements.

WRITE TO LEARN

In nature, species tend to reproduce until a limiting factor stops their population growth. Because humans put pressure on environmental resources, they can affect an environment's carrying capacity.

Think about the communities around where you live. How can you apply the **concept,** or general idea, of carrying capacity to urban planning? What ideas related to population and limiting factors do you think should be considered by planners who may be looking at developing a neighborhood or a housing complex?

Vocabulary Review

Directions: Fill in the blank with the correct word.

carrying capacity exceed equilibrium habitat jargon limiting factor population

1. The number of individuals of one kind found in a habitat form a _____ _____.
2. The place where organisms live and interact is called a _____
3. A _____ is food, water, space, or any other thing that restricts population growth.
4. Vocabulary that is specific to areas of study is called _____
5. The maximum population of a species that an environment can support is the environment's _____
6. The balance between a population and the resources it needs for survival is called _____
7. A rise in the number of small rodents can cause the population of owls to _____ its limits.

Skill Review

Directions: Choose the best answer to each question.

1. Which two species represent a competitive relationship?

   A. black bears and lichens
   B. squirrels and field mice
   C. oak trees and blue jays
   D. polar bears and rattlesnakes

2, Which two species represent a predator-prey relationship?

   A. squirrel and acorns
   B. field mouse and grass seeds
   C. fox and rabbit
   D. reindeer and lichens:

Directions: Answer the questions.

3. Give four examples of limiting factors for a squirrel.

   _____, _____, _____, _____

4. Imagine that a small population of beavers lives at a pond near a state highway. There are proposals for a new highway construction project. What questions would you ask for the purpose of an investigation into how the project may affect the beaver population?

   _____

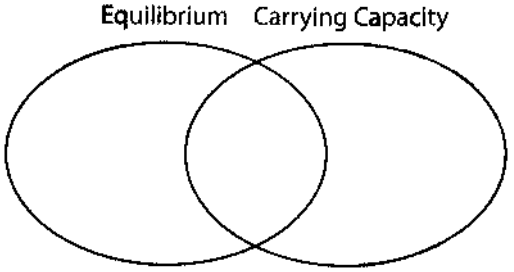
   _____

Skill Review (continued)

Directions: Complete the diagram.

5. Use the Venn diagram to compare and contrast equilibrium and carrying capacity.

COMPARING AND CONTRASTING EQUILIBRIUM AND CARRYING CAPACITY



Skill Practice

Directions: Read the following passage. Answer the questions that follow.

For a period of 4. 5 years, scientists studied Osceola and Okefenokee populations of black bears in north Florida and southeast Georgia. The scientists identified the kinds of natural foods the bears consumed over that period. They also measured the shape and size of the bears' seasonal ranges, or areas they inhabited in different parts of the year.

Measures showed ranges among female Osceola black bears to be similar to the ranges of other North American black bear populations throughout the year. However, the range of Okefenokee females was about twice as large as the range of Osceola females. The greatest change in range occurred each autumn.

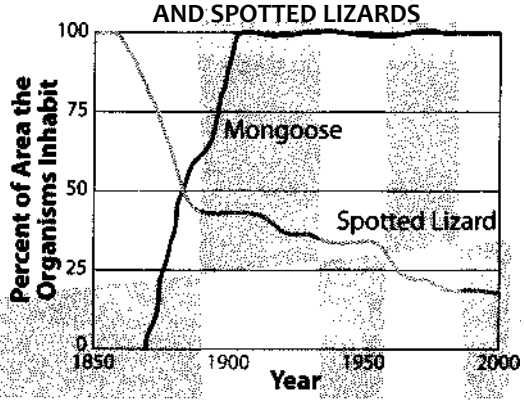
1. Propose an explanation for the greatest seasonal difference in range for female Osceola and Okefenokee bears.

2. If the average yearly range for female Osceola black bears was about **30. 3** square kilometers, what was the average range for female Okefenokee black bears?

Directions: Read the text and graph. Answer the questions that follow.

Sometimes people introduce a species to an environment. This species becomes an invasive species, competing for limited resources and putting pressure on other species. Some invasive species are so successful that competing species die out completely.

POPULATIONS OF MONGOOSES AND SPOTTED LIZARDS



3. How would you describe the relationship between mongooses and spotted lizards? Use the lines on the graph to justify your description.

4. List two research questions that scientists could investigate to learn more about the spotted lizards remaining in the habitat.

LESSON 3.3

Symbiosis

KEY CONCEPT: The term *symbiosis* describes specific kinds of relationships between organisms in the same environment.

Have you ever had an allergic reaction to something, such as pet fur or dust? That was your body reacting to something in your environment. In every ecosystem, there are biotic and abiotic factors in constant states of interaction. Biotic factors are the living organisms that interact with each other and with the abiotic, or nonliving, parts of their environments. Abiotic factors include temperature, sunlight, water, and available nutrients. Each organism within an ecosystem affects the organisms around it. The organism may compete for resources or even prey upon others. It can alter the physical and chemical environment, too, changing the resources that other organisms also depend on.

Lesson Objectives

You will be able to

- Define symbiosis
- Describe mutualism, commensalism, and parasitism
- Give real-world examples of each type of symbiotic relationship

Skills

- **Core Skill:** Identify Hypotheses
- **Reading Skill:** Summarize Text

Vocabulary

antibodies
host
mutualism
parasite
summarize
symbiosis

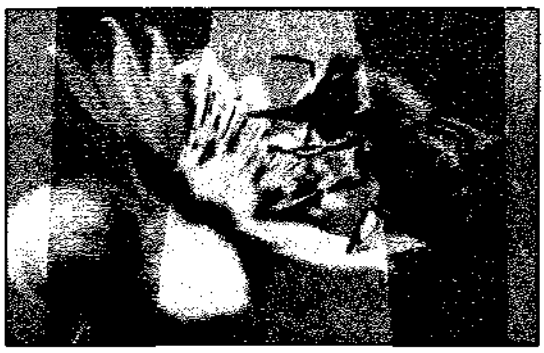
Interactions Among Living Things

Because all living things within an ecosystem interact with each other and with nonliving things in their environment, ecosystems are complex and always changing. Some scientists who study ecosystems focus on specific relationships between organisms. A well-studied example Is the relationship between the Canadian lynx (a species of wildcat) and the snowshoe hare. Two hundred years ago, Canadian trappers observed changes in population between the two animals. As the population of lynx rose, the population of hares fell. The lynx population then fell and hare populations rose. For a long time, scientists believed that the number of lynx determined the fluctuating numbers of hares. But today, scientists know that the density of hares changes regardless of the lynx population. The question is *why.*

Scientists study other kinds of interactions between animals, too. You may be familiar with the word **symbiosis.** The prefix *sym-* means "together, " and the base word *bios* means "life. " *Symbiosis,* then, means "living together. " But all organisms within an environment could be said to be living together. The term *symbiosis* is used in science to describe three special relationships.

Mutual Symbiosis

You may have watched bees buzzing from flower to flower in a summer garden. The bees hover over flowers, extending their long tongues into the heart of flowers to soak up nectar to take home to feed the hive. As bees gather food, pollen sticks to their hairy



Martin Ruegner/Photodisc/Getty Images

legs. The tiny grains of pollen contain cells that are necessary for a plant to reproduce.

As bees move from flower to flower, the pollen attached to their bodies travels, too. Pollen rubs off of the bee's body and falls into flowers. Inside the flowers, changes in the pollen play a special part in the plant's reproductive process. Thus two things happen. First, flowers feed bees, and bees help flowering plants reproduce. The relationship between the two organisms is mutually beneficial—the relationship benefits both species. This is an example of mutual symbiosis, or **mutualism.** A relationship that is **mutual** is one that is directed toward and received by each other equally.

There are many examples of mutualism in the natural world. Some include organisms too small for us to see.

Termites and Bacteria

The cell walls of plants are stiff and strong. This strength comes from the fibers of **cellulose** that form the cell walls. Cellulose is a carbohydrate that most animals ~~even~~ animals that eat only plants—cannot digest. That's because their bodies don't produce the enzyme to do the job. However, some plant-eating organisms, like termites, have a mutualistic relationship with microscopic organisms that can do the job for them.

Termites are the **host** for microscopic bacteria and protists. The host is the organism on which another organism lives or feeds on. Most protists are single-celled, but there are multicellular protists also. These organisms, which are like plants, animals, and fungi in some ways but not in others, are independent organisms that interact with their environments as other living things do.

At first, scientists thought that both bacteria and protists helped termites digest cellulose. Now they know that the protists themselves have a mutualistic relationship with the bacteria. Like the termite, protists can't digest cellulose without assistance. They benefit from their relationship with bacteria but seem to have no effect on termites.

THINK ABOUT SCIENCE

Directions: What is the fundamental condition for a relationship between two organisms to be considered a form of mutualism?

_____

_____

21st Century Skill
Critical Thinking and Problem Solving

Investigation is the foundation of science. It involves asking questions, seeking answers, proposing explanations (hypothesizing), and designing investigations to test hypotheses.

To be successful, an investigation requires a combination of creativity, step-by-step planning, and methodical behavior. A good investigation must also be replicable, meaning that other scientists can conduct the same investigation and expect similar results.

Many universities post descriptions and results of ongoing research on their websites. Choose a university that interests you. Search for information regarding science investigations their faculty and students are conducting. What are their scientific questions? What are their hypotheses? What methods are they using to find the answers?

Core Skill
Identify Hypotheses

Scientists studying acacia trees found that when herbivores, or plant eaters, stopped eating its leaves and branches, the acacia tree stopped producing small spaces inside its thorns that ants could use as homes. It also stopped producing a sweet nectar that the ants eat. Scientists expected the trees to grow faster, since they were not using resources to house and feed the ants. Instead, a different kind of ant appeared, and the trees died twice as often as trees whose leaves were eaten by grazing herbivores like giraffes and elephants.

What hypothesis could you form about the different kind of ant making its home on acacia trees?

Acacia Trees and Ants

Some plants produce chemical defenses, or substances that hungry insects and mammals find distasteful. Other plants, like the acacia tree, do not. Although the trees form nasty thorns, the thorns alone aren't enough to deter hungry pests. The trees attract animals that strip leaves from their branches, slowing tree growth. Slower growth gives a competitive advantage to other vegetation, which can grow faster and taller, blocking sunlight for the acacias.

Acacias, however, have a mutually beneficial relationship with ants that serve as effective defenders. These ants live inside the thorns that grow at the base of a tree's leaves. The thorns provide a home for ants. The ants bite animals that attempt to eat a tree's leaves. Their bites are annoying enough that even elephants avoid acacias that serve as hosts to ants.

Oxpeckers, Rhinos, and Zebras

Imagine having a personal pest-control service. An oxpecker is an African bird that feeds on ticks and other **parasites,** or harmful organisms. It lands on rhinos and zebras, where it feasts on any parasites it finds. This pest-control service is one benefit for rhinos and zebras, but there is another. When it senses danger, an oxpecker screams a warning as it flies upward.

Humans and E. *coli*

Your body has its own mutualistic relationship with bacteria called *Escherichia coli,* or *E. coli,* which live in your digestive system. As a host, you provide these microbes with protection, nutrients, and a means of moving. In return, the bacteria help you digest food and absorb vitamins. They make the walls of your small intestines slightly acidic, which slows or prevents harmful bacteria from colonizing there. *E. coli* also stimulate your immune system to produce **antibodies.** These are proteins that kill harmful microbes or prevent them from colonizing.

Parasitic Symbiosis

The word *predator* may lead you to think of animals you've seen on television sprinting across African savannahs to capture helpless prey. But not all predators are so large or even able to run. Some are microscopic parasites that depend on other organisms for their survival in a kind symbiotic relationship called **parasitism.** These parasites meet their nutritional requirements through their hosts. However, in parasitism, what benefits the parasite harms the host.

There are two kinds of parasites. **Endoparasites** live inside an organism's body. **Ectoparasites** live on the host's skin. There is also a third kind of parasitic relationship, in which an insect lays its eggs on a living host. The eggs hatch, and the young parasites devour the host. Consider the following examples of parasitic symbiosis.

The Tick

Ticks are not insects but **arachnids,** tiny invertebrates related to spiders. They have biting mouthparts that help them attach firmly to a host's skin, sucking blood. A tick may feed for several days. In that time, a variety of **pathogens,** or disease-causing organisms, can pass from the tick into the host's bloodstream.

Ticks cannot run, fly, or jump, but they can crawl. As animals walk through grasses or near shrubs, ticks waiting on the tips of the plants crawl from the plants to the unsuspecting hosts. The American dog tick, also called a wood tick, feeds on humans and a variety of medium — to — large mammals.

The Tapeworm

There are many different kinds of tapeworms that infect both **vertebrate** and **invertebrate** species—animals with and without a spinal column. Among vertebrates, including humans and domestic animals, these endoparasites infect the liver and digestive tract.

A tapeworm has no mouth, but its head has suckers and sometimes hooks, which it uses to attach to the host. Food is absorbed through the worm's outer covering.

The worm, which is self-reproducing, can produce as many as 40, 000 unhatched young, or **embryos.** In a human, these embryos leave the body through waste, or feces. If the infected waste reaches water supplies, other organisms, including humans, ingest the embryos. Once in an organism's digestive tract, the embryos transform into larvae. The larvae bore through the host's intestinal wall and enter a blood vessel. The blood carries it to muscle tissue, where the larvae form a **cyst,** or protective outer covering. If that cyst is eaten, the larvae attach to the new host's intestine and quickly develop into adults. Tapeworm cysts sometimes find their way into the digestive tracts of humans and animals by way of infected or poorly cooked meat.

Not all people infected by tapeworm cysts show symptoms of disease. Some, however, experience many of the same symptoms associated with flu, including vomiting, headache, and weakness. About 70 percent of people with the disease also develop **seizures,** which are temporary electrochemical changes in the brain.

THINK ABOUT SCIENCE

Directions: Read the text and answer the question that follows.

Parasites are commonly foodborne or waterborne. **Foodborne** parasites enter the body through impure food. **Waterborne** parasites enter the body through polluted water. Humans are infected when they drink, bathe in, wash clothes in, or prepare food in contaminated water.

Are waterborne and foodborne parasites classified as endoparasites or ectoparasites? Explain your answer.

Reading Skill
Summarize Text

Orchids and trees represent a commensal relationship. In a tropical forest, trees compete for sunlight. Their leaves form a canopy over the forest floor, blocking sunlight and making it difficult for competing plants to survive. Some plants, like orchids, have adapted to this lightless condition. Orchids attach themselves to trees, close to the top where sunlight penetrates. At these heights, orchids are exposed to sunlight, and they do not need heavy rains for water. Orchids are able to meet their water demands by extracting water moisture from the air. The plants have another adaptation that increases species survival. They produce microscopic seeds. Winds above the canopy carry the seeds away, where they can land and begin to grow new orchids in the canopy.

Reread the passage above and then write a summary of the passage. To **summarize,** choose the most important ideas of the passage and restate these ideas in your own words. As you read a second time, ask questions, such as *what, why,* and *how.* Identify key words and the most important ideas. Then state the main idea of the passage clearly in two or three summarizing statements.

Commensal Symbiosis

Commensal symbiosis, better known as **commensalism,** occurs when one species benefits from a host, but the host is unaffected. In other words, the host is neither helped nor harmed by the relationship. Here are some examples of commensalism.

The Pseudoscorpion and Beetles

The pseudoscorpion (soo-doh-SKOR-pe-uhn) is a small eight-legged invertebrate, like its distant relative, the scorpion. But unlike a scorpion, the pseudoscorpion has no tail. To move from place to place, this tiny animal attaches itself to the underside of a beetle's wings. When the beetle flies, the pseudoscorpion hitches a ride to new territory.

Cattle Egrets and Livestock

Cattle egrets are small white birds that follow grazing cattle, horses, and even farm tractors. As livestock or machinery move through grassy fields, they disturb insects. Cattle egrets, which move among the feet of livestock or perch upon their backs, catch these insects. The egret gets food, but the livestock receive no benefit.

Sharks and Remoras

A remora is also called a suckerfish. It has a flat **appendage,** or external structure, on the top of its head. The appendage works somewhat like a vacuum, allowing the remora to attach itself snugly to the underside of a swiftly moving shark. Although a remora is capable of swimming, hitching a ride with a shark or other fish larger than itself has benefits. The remora uses its tiny, sharp teeth to eat whatever food debris falls from its host's mouth without causing any harm or benefit to the host.

THINK ABOUT SCIENCE

Directions: Read the text and answer the question that follows.

For successful reproduction, plants must spread their seeds. Burdocks are weeds that grow along roadsides. The Great Burdock has large, spiny seed heads called burs. The spines are tipped with hooks that snag the fur, hair, or clothing of passing organisms, such as dogs, deer, or humans. When the burs fall off or the animal pulls them off, the seeds may have opportunities to grow.

What makes the burs of the Great Burdock and some animals a good example of commensalism?

_____

David Littschwager/National Geographic/Getty Images

Vocabulary Review

Directions: Match the word to its correct definition.

1. _____antibodies	A.	living together
2. _____host	B.	an organism that harms or kills the host
3. _____mutualism	C.	proteins that fight off or destroy pathogens
4. _____parasite	D.	a relationship that benefits both organisms
5. _____symbiosis	E.	an organism that supports another organism

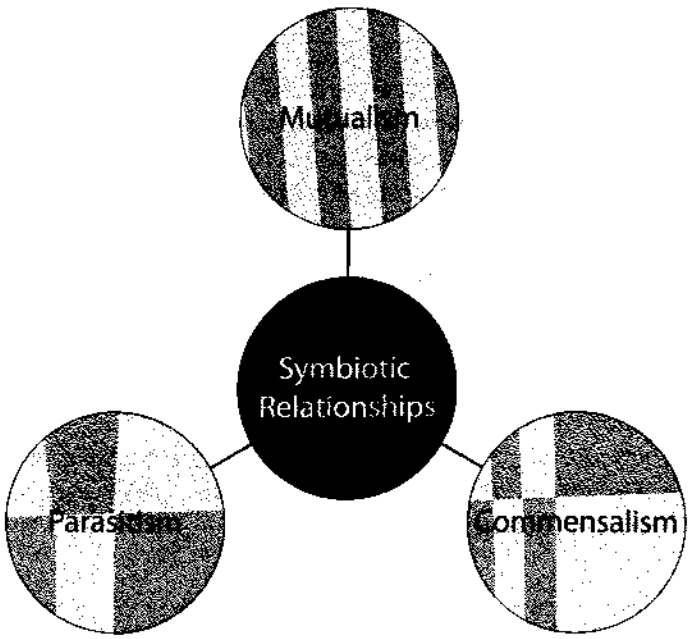
WRITE TO LEARN

Directions: A female dog and newborn puppy have a specific kind of symbiotic relationship. Think about the needs of both the mother and the puppy. What kind of symbiotic relationship do they have? Justify your answer.

Skill Review

Directions: Read the description. Then complete the activity.

1. In this chapter, you learned about three kinds of symbiosis. Use the concept map to describe the different kinds of symbiosis. Give examples of each relationship.



Skill Review (continued)

Directions: Read the passage. Then answer the questions that follow.

> As larvae, barnacles are free-floating organisms, but they attach themselves to a surface and soon change into adult form. As adults, they are sedentary, meaning they are unable to move independently. They remain attached to rocks, boats, the shells of other organisms, and even the bodies of whales.

2. What two benefits exist for barnacles that attach themselves to a whale?

3. Different kinds of barnacles live on the bodies of different kinds of whales. What conclusion can you draw from this information?

Skill Practice

Directions: Read the passage. Then answer the questions that follow.

> Given the size of the ocean, scientists puzzle over how barnacle larvae find their whale hosts. Some scientists think that the larvae attach during whale breeding season, when whales collect in groups and remain in the same space for an extended time. The larvae, floating in the water, may pick up chemical signals that indicate the presence of whales.

1. Barnacles are choosy about which whales they attach to. What question could you ask in an investigation into the chemical signals whales produce?

2. Barnacles are also choosy about where on a whale's body they attach. Which part of the body do you think attracts the most barnacles? Explain why.

3. Scientific research on the barnacle and whale relationship is scarce. What could make it difficult for scientists to investigate questions about the relationship?

4. A fungus grows on part of the roots of an orchid plant, where it eats food the plant makes during photosynthesis. The fungus also absorbs nutrients from the soil that it passes to the plant. What kind of relationship do the orchid and fungus have? Use text evidence to support your answer.

5. Leaf-cutter ants chew off bits of leaves and carry them to their dens. In the den, ants chew the leaves into a paste. They release a small amount of fecal matter, or body waste, on the paste. Afterward, a fungus grows on the paste. Note: The fungus is the only food the ants eat. What kind of relationship do the ants and fungus have? Use text evidence to support your answer.

6. Hummingbirds suck nectar, a sugary liquid that plants such as the trumpet vine, trumpet honeysuckle, and the firecracker plant produce. What benefit comes to plants that produce nectar to attract birds?

7. Scientists have found a nectar-sucking species of mites in the nasal cavities of hummingbirds. What kind of relationship do you think these mites and hummingbirds have? Explain your answer.

8. What additional information would you need to determine if your answer in Question 7 is correct?

LESSON 3.4

Disruption

Lesson Objectives

You will be able to

Identify laws of ecology

- Give examples of environmental disruptions
- Explain the consequences of disruptions

Skills

- **Core Skill: Determine** Meaning of Terms
- **Core Skill:** Cite Textual **Evidence**

Vocabulary

abiotic
biodiversity
biotic
degradation
destruction
endangered
fragmentation
invasive species
threatened

KEY CONCEPT: A disruption is a change that greatly alters an environment. Disruptions transform environments. In some cases, one ecosystem can temporarily or permanently replace another. In other cases, an ecosystem can become degraded, making it unfit for living things. Still other ecosystems are destroyed altogether.

Take a walk outside and look around. No matter where you live, no matter where you are, the organisms that surround you make up an ecosystem. You may see plants, animals, rocks, soil, and water. An ecosystem also includes microorganisms that you don't see. Within an ecosystem, organisms interact with one another and with their physical and chemical environment. Although no ecosystem remains static, or unchanging, a healthy ecosystem maintains equilibrium, meaning it keeps balance among its species. These species depend on the stable functions of each other and the water, gases, and essential chemicals that cycle through every ecosystem.

The Laws OF Ecology

An ecosystem is composed of biotic and abiotic factors. **Biotic** factors include all living organisms, from single-celled microbes to huge land and water mammals. **Abiotic** factors are the nonliving components of an ecosystem, including water, gases in the air, and minerals in rocks and soil. **Ecologists** are scientists who study the interactions between the biotic and abiotic factors within an ecosystem.

Decades ago, ecologist Barry Commoner described four basic laws of ecology that apply to all ecosystems.

1. Everything is connected to everything else. What happens to one organism within an ecosystem affects all organisms in some way.
2. Everything goes somewhere. Nature doesn't create waste, and it doesn't throw things away. What exists remains in existence in one form or another.
3. Nature knows more than humankind. Things are always changing within nature. When humans cause those changes, however, the changes are likely to be harmful to the system.
4. Everything has limits. That is, there is only so much nature that humans can exploit, or take advantage of. When humans use natural resources, those resources eventually change from useful to useless forms.

Responding to Change

As Commoner's third law of ecology tells us, nature is always changing. And as his first law says, all living and nonliving elements within an ecosystem are connected. What happens to one affects all.

Within an ecosystem, organisms live in equilibrium, or balance, responding to the natural changes that are constantly occurring within any system. Some changes, however, are larger than others. All ecosystems respond to **disruptions,** which are breaks or interruptions in normal events. Nature causes some of these disruptions. Humans cause others.

Fire and Floods as Disruptions

Raymond Gehman/Corbis

Fire, both natural and caused by human behavior, is a common disruption. Natural fires can both harm and help a forest ecosystem. For example, after a wildfire, soils absorb nutrients from the charcoal and ash left after vegetation burns. The soil is warmer, too, encouraging microbial activity. However, intense heat can also cause soil particles to repel, or shed, water instead of allowing the water to soak in. After a fire, the water-resistant soil causes soil **erosion,** as rainwater carries soil away.

Some animals are affected more than others during a fire. Small animals, insects, and sick or old organisms may die. Larger animals are normally able to flee to safety. The fires, which destroy food resources, make it impossible for these animals to return immediately after the fire. This, however, gives other organisms opportunities for survival. **Scavengers,** or organisms that feed on dead plant and animal matter, take advantage of new food resources. Also, areas once thick with trees are laid bare, making it easier for predators to find prey.

Core Skill
Determine Meaning of Terms

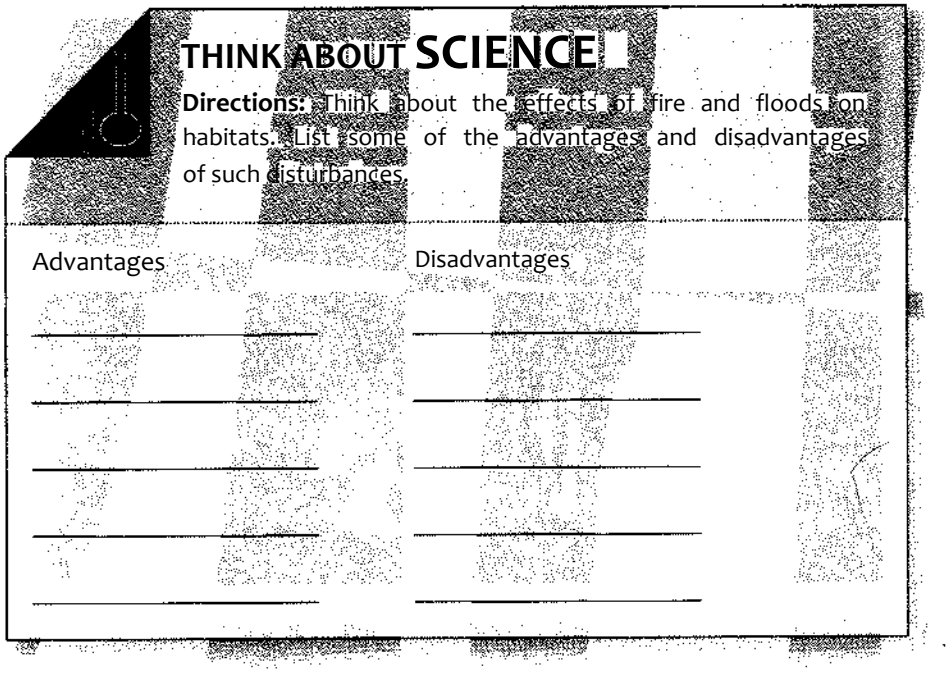
Every area of study has its own collect of vocabulary terms. Professionals within those areas of study rely on those terms to communicate their work in writing, to ask questions, and exchange ideas. to Science is rich with specialized vocabulary. Many of its terms have Greek or Latin origins, or include roots, prefixes, or suffixes that can help you break down and determine a word's meaning. For example, the prefix *eco-* can mean habitat or environment. The Greek word *logos* means "knowledge". The suffix *-logy* or, which means "the study of or a branch of knowledge" Literally, the, the word **ecology** can be interpreted to mean the "the study of the environment."
Read the common prefixes and suffixes in the chart. As your read the lesson, circle or highlight words that use these roots to help you understand their meaning.

Affix	Origin	Meaning
a-	from the Greek *a* or *an*	not, without
inter-	from French and Latin *inter*	between among
cyt-/ cyto	from Greek *kytos*	hollow vessel (cell)

New plants begin to grow, and increased quantities of seeds on the forest floor encourage birds to feed. The burning of trees and other plants make more nutrients, light, and water available to survivors. With such resources suddenly available, new and surviving plants grow more quickly. Among the benefits of fire is the destruction of harmful plant parasites, like mistletoe, that rob trees of essential nutrients. Another benefit is seed production, as some plants require the heat of wildfires to open their seeds.

Like fire, flooding can cause both harmful and beneficial consequences. Those consequences depend on where floods occur, how long they last, how deep and swift the waters are, and how sensitive the environment is to such disruption.

Floods can lead to the loss of plant and animal life, as well as loss of soils. They can also lead to n**ew** life. Some plant seeds remain dormant, or inactive, until heavy rains occur. Then these seeds sprout, leading to new growth. Some insects and reptiles that remain inactive during periods of hot or dry weather emerge from their resting state.



THINK ABOUT SCIENCE

Directions: Think about the effects of fire and floods on habitats. List some of the advantages and disadvantages of such disturbances.

Advantages	Disadvantages

Introduced Species as a Disruption

Since the 1700s, about 40 percent of the species on Earth have become extinct, meaning they have died out completely. Scientists think that the human introduction of foreign species into environments that are not natural to these species has probably contributed to the massive extinction over recent centuries.

An **invasive species** is an organism that humans move from its natural environment to a new, foreign environment in which it causes harm. Sometimes, the introduction of an invasive species is accidental. At other times, it is done for a purpose.

An example of an accidental introduction comes from shortly after World War II, when military troops shipped cargo from Papua New Guinea to the

Pacific island of Guam. Until then, Guam had no snakes other than a kind of blind, worm-like snake that fed on termites and ants. However, it is likely that a brown tree snake hitched a ride with the cargo. By the early 1960s, tree snakes inhabited more than half of the island. After only a few more years, they had colonized the entire island. As the tree snake population grew, native bird populations shrank. By the time the US Fish and Wildlife Service began listing species as endangered or threatened in 1984, most of the native forest bird species were extinct.

In the late 1800s, a group of Americans organized a club for the purpose of bringing birds mentioned in the plays of William Shakespeare to the United States. In 1890 and 1891, the dub's members released about 100 starlings into Central Park. The species flourished. Today, their population exceeds 200 million, and the birds live across the country. Scientists continue to study their effect on native species.

In the 1930s, the US Department of Agriculture imported a Japanese plant called kudzu, and they paid southern farmers to plant it as a means of controlling soil erosion. At first, the plant's rapid growth was considered a success story. However, today some people call kudzu "the plant that ate the South." Able to grow as much as two feet per day, kudzu blankets other vegetation, blocking sunlight. The plants beneath the kudzu die, eliminating potential food and shelter for native animals. Kudzu roots also penetrate the soil, where they affect water levels throughout ecosystems. Kudzu is such a successful invasive species that it has been labeled as one of the 100 worst invasive species on Earth.

THINK ABOUT SCIENCE

Directions: Answer the question below.

What makes human beings an example of an invasive species?

Habitat Loss as a Disruptive Force

Some scientists identify the disruptive effect of human activity on natural habitats as the greatest threat to Earth's **biodiversity** *Diversity* means "variety, " so biodiversity refers to various forms of life, including the variety of species and genes. Agriculture, forestry, mining, urban growth, and the pollution that comes with these human efforts have led to massive habitat loss. The International Union for Conservation reports that human interference has caused the rate of species extinction to increase 1, 000 times its natural rate.

21st Century Skill
Media Literacy

Scientists began associating starlings with the decline of native biro species as early as 1921. They blamed starlings for the decline of the Eastern bluebird that builds nests in tree cavities. Research has continued, but it hasn't ail come to the same conclusion.

For example, in one report, scientists state that the starling actually has had little effect on native bird species, including the Eastern bluebird. The only declining bird population, they say, that can be attributed to the presence of starlings is that of the sapsucker.

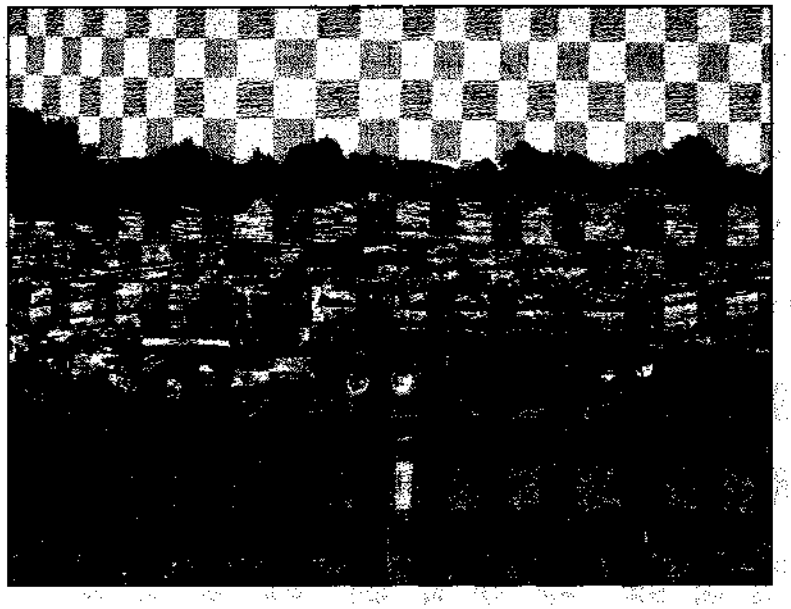
Among the skills linked to media literacy is the ability to analyze and evaluate media. With the wealth of available media growing daily, it is critical that readers accept that not all information is reliable. Some information, as in the example in the first paragraph, may be based on incomplete or outdated research. Only further research and analysis can lead to conclusions that are more likely to be accurate.

What are some media sources you could use to gather more information about the effects of European starlings on native bird species?

Core Skill
Cite Textual Evidence

The International Union for conservation of Nature and Natural **Resources (IUCN)** has produced the Red List of Threatened Species. **threatened** species remains abundant but is likely to become **endangered,** or on the verge of extinction, if not protected. Currently, the IUCN identifies habitat loss as the main threat to **85** percent of threatened and endangered species on the list.
Cite the textual evidence from this lesson that most strongly supports their conclusion. To do this, first reread the lesson text, and then look for page numbers and paragraphs where information on threatened and endangered species can be found. Then, when you find the information, highlight it, put a star next to it, or circle it.

Habitat loss includes habitat degradation, or the loss of habitat due to pollution or the introduction of invasive species. In habitat fragmentation, remaining wildlife areas are separated and divided into sections by roads, dams, and other structures. The remaining sections are often too small or they restrict access to larger areas where species can find food and mates. Fragmentation also makes it less likely that migratory animals will have the places they need to rest and feed along their routes.



In habitat **destruction,** habitats are destroyed. People use machines to cut or knock down trees, to fill wetlands with soil in preparation for building, and to scoop sediments and soils from river bottoms for the purpose of building waterways and dams and reclaiming land. Some powerful examples of habitat destruction are found in the United States. According to the US Fish and Wildlife Service, more than 85 percent of forest habitats have been permanently destroyed or logged. More than 75 percent of forests growing along waterways such as streams have been destroyed. In Michigan, 99 percent of mature oak and beech-maple forests are gone. In Oregon, nearly all of the state's temperate rain forest has been destroyed. Across the country's prairies, 95 percent of grasslands have been planted with crops or destroyed. In the Southwest, where desert conditions exist, cattle have overgrazed more than 90 percent of sagebrush habitats.

Leading causes of habitat destruction include agriculture, the conversion of land to building sites and parking lots, and water-development projects, such as dams. They also include pollution, particularly of freshwater resources. In some places, untreated sewage and other human waste enter water resources. So do metals and acids from mines and fertilizers and pesticides from farms.

Photodisc/Getty Images

Vocabulary Review

Directions: Fill in the blanks with the word that best fits the sentence.

abiotic **biodiversity** biotic degradation **destruction** **endangered** **fragmentation** invasive species threatened

1. A species that is presently abundant in its native habitat but is likely to become extinct without protection is classified as_____
2. Rocks, minerals, soil, and water are examples of _____ factors in an ecosystem.
3. An_____ is accidentally or deliberately introduced to a non-native ecosystem.
4. Species may be unsuccessful in finding enough space and food, as well as finding mates in a habitat that has undergone _____
5. Rodents, mammals, and bushes are examples of_____ factors in an ecosystem.
6. Paving land to make parking lots is an example of habitat _____
7. _____ describes the variety of all forms of life on the planet.
8. When human waste enters freshwater, it can cause habitat _____, making it unfit for living things.
9. A species with so few members that an ecological disturbance could cause it to disappear entirely is _____

WRITE TO LEARN

The IUCN produces Biodiversity Indicators, or mathematical measures of biodiversity. People can use these measures to understand factors that affect biological and genetic diversity. Explain how such information could be helpful to decision makers in government.

Skill Review

Directions: Read the passage. Then answer the questions that follow.

In 1859, Thomas Austin released about one dozen European rabbits from his property in Australia. Today, the descendants of these rabbits **live** throughout the continent, from coastal plains to deserts. The rabbits compete with native species for food and other resources, perhaps causing the extinction of several ground-dwelling mammals. They also damage vegetation, stripping bark from trees and eating seeds and Seedlings, preventing regrowth. In some places, rabbits have eliminated all vegetation, leaving only bare rock behind.

1. Use the example of wild European rabbits in Australia to explain the term invasive species to someone unfamiliar with the concept.

_____

_____

_____

Skill Review (continued)

2. Describe the relationship between wild European rabbits and habitat loss.

3. Officials have undertaken a number of steps to control the populations of wild European rabbits, including the use of poisons. Use Commoner's second law of ecology to write an argument opposing the use of poisons.

4. Write two questions you might ask officials in charge of controlling the movement of species in and out of Australia today.

Skill Practice

Directions: Read the passage. Then answer the questions that follow.

The glassy-winged sharpshooter is a successful invasive species. This leaf-hopping insect, a native to the southeastern United States, may have accompanied a delivery of ornamental or agricultural plants to California. In its new, non-native home, the sharpshooter threatens the health of a number of plants, including grapes. That is because the insect carries disease-causing bacteria that it injects into plant fluids as it's feeding. Another sharpshooter feeds from the same plant and ingests the bacteria, which multiply in its mouthparts. When the second insect feeds on a new leaf, it spreads the bacteria, and the process continues. It takes very few insects to spread the disease, and at present, there is no cure for the disease or effective way of controlling the insect population.

1. Imagine you are speaking to a group of wine producers, who grow grapes for making wine. Explain the problem to them in terms they will understand.

2. Given that there is no cure for the disease spread by the glassy-winged sharpshooter, what solution would you propose to a wine producer who found a few insects on grape leaves?

3. How has a global economy led to problems such as the glassy-winged sharpshooter?

Directions: Think about what you learned about the kinds of habitat loss.

4. Use the following table to identify, define, and give one example of each kind of habitat loss.

Kind of Loss	Definition	Example

LESSON 3.5

Environmental Issues

Lesson Overview

You will be able to

- Distinguish between nonrenewable and renewable resources
- Identify types of pollution
- Understand the effects of human activities on the environment

Skills

- **Reading Skill:** Distinguish Between Facts and Speculation
- **Core Skill:** Cite Textual Evidence

Vocabulary

climate
conservation
fact
natural resources
pollution
speculation

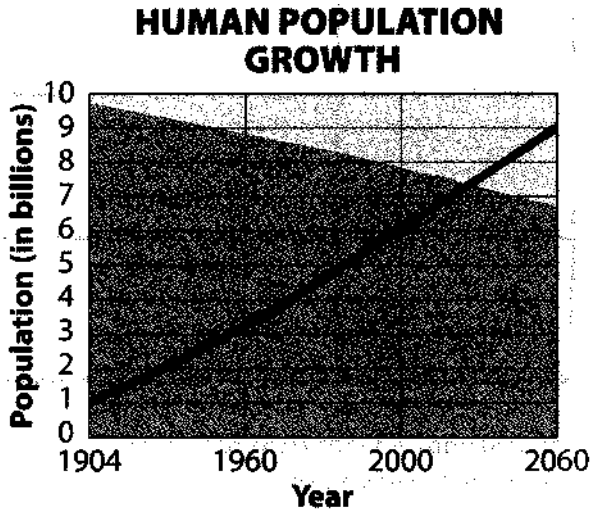
KEY CONCEKey Concept: Increased human population makes increased demands on Earth's resources and adds to pollution in the environment.

In a system, different parts interact to make something work as a whole. You have first-hand knowledge of a system—you! The human body is a system made up of parts working together. When one part is harmed or diseased, it can make the whole person ill.

Ecosystems are also made up of parts working together. When one part of an ecosystem is harmed by pollution or overuse, the effects can be widespread. Today, the demands of an increasing human population are adding stress and causing damage to ecosystems around the world.

Environmental **Problems**

At the end of the Roman Empire in the year 550, there were only about 250 million people living on Earth. Now there are more people than that just in the United States. As of 2009, the world population was more than 6. 7 billion.



In the past, famine or disease killed people at an early age. Many children died young. The death rate was high, and the birthrate was low. With today's advances in health care, agriculture, and sanitation, human life spans have increased. The death rate has decreased, while birth rates have increased. The result has been an enormous increase in population.

Many people have become concerned about the human impact on ecosystems. Humans depend on the environment to supply everything they need to stay alive. Unfortunately, people have not always recognized this dependence. Today, there is a greater need for food, water, land, and resources than ever before. These increased needs have put a serious strain on our environment. People must learn what they can do to protect the planet and its resources, the materials that people use, for the future.

DISTINGUISH BETWEEN FACTS AND SPECULATION

It is important to distinguish between **facts** and **speculation** when you read. A **fact** is something that is known to be true. **Speculation** is an opinion or guess about something based on incomplete evidence.

Facts are usually presented in a very straightforward manner. They can sometimes be distinguished by their mathematical statistics or references to trusted sources.

Speculation is sometimes more difficult to distinguish. The author may present his or her speculation in a straightforward way as if it were fact. To identify speculation in a passage, ask yourself: Is *there a lack of examples, statistics, or references? Does the material seem to contain generalizations rather than specific information? Does the author share an opinion or a specific point of view?* If the answer to any of these is yes, it is possible that the material is presenting speculation instead of facts.

Read the following passages. Then, identify whether the passage presents facts or speculation.

1. Human population is increasing. As the population increases, the demand for resources increases as well. Some resources are considered renewable. Others are nonrenewable. Conservation is a way that we can help protect the resources we need for life.

2. Most people are far too wasteful with resources. There is not enough awareness about environmental issues. At the rate at which humans are using up resources, there won't be any left for the next generation.

The first passage presents _____.

The second passage presents _____.

Limited Natural Resources

Natural resources are those things in the environment that we use to survive. The air we breathe, the water we drink, and the food we eat are natural resources. The products we use to build our homes, stay warm, and make all the things we use every day are also natural resources. All these resources are in limited supply and must be used by everyone on Earth. Many scientists fear that because of our rapidly growing population and wasteful habits, we are using Earth's resources too quickly.

21st Century Skill
Information, Communications, and Technology Literacy

Satellite technology plays an important role in helping us monitor the environment. Information provided by satellites helps us understand current weather conditions and make long- range forecasts, too. Satellite images taken repeatedly over long periods of time can help scientists understand where pollution is most affecting the oceans, which habitats are changing because of human development, and how much polar ice caps and glaciers are melting. Do some research to find out how long scientists have been using satellite technology to study the glaciers. Include information about how the technology has improved and what scientists have learned.

Scientists divide resources into two categories. **Renewable resources** are those that can be replaced within an average lifetime. Trees, animals, and crops are renewable r **Nonrenewable resources** cannot be replaced easily, Topsoil and fuels, such as coal and oil, for fuels like coal and oil to form. When they are gone, they are gone forever.

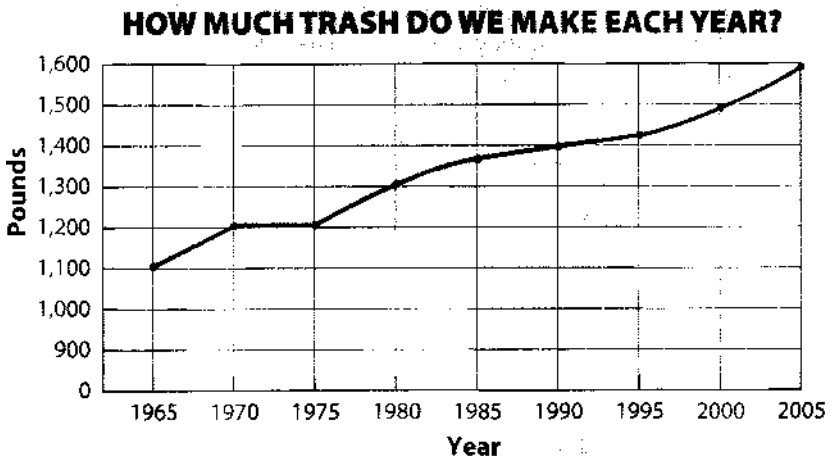
Conservation is a method of using nonrenewable resources in ways that do not waste them. Forests, water, soil, and any other resources can be conserved by recycling, reusing, or reducing our use of products containing these resources.

Pollution

Human activities not only use up our natural resources, they also pollute, or contaminate, the environment. **Pollution,** man-made waste that contaminates the environment, takes many forms. Solutions can be as simple as picking up litter or as complex as reducing the output of pollutants from industrial plants.

Garbage

Solid waste is all the garbage that comes from homes, businesses, mines, farms, and even schools and hospitals. The chart below shows that the amount of trash we produce has greatly increased. In the 1960s, we produced trash at the rate of about 2. 5 pounds of trash per person each day. Now we produce about 4. 6 pounds of waste per person per day. Most of that waste ends up in landfills. Some waste is burned. But helpfully, more waste than ever before is recycled into other products.



Hazardous **Wastes**

Hazardous wastes come from the hundreds of chemicals that we produce and use in the United States. These chemicals include house paints and automotive oils and fluids, as well as many poisons used by farmers. Safely disposing of these wastes is an enormous problem. More and more states are trying to control how these hazardous wastes are handled.

Air Pollution

Some air pollution is invisible. Compounds called chlorofluorocarbons (CFCs) cannot be seen, but they have caused a lot of damage. CFCs are now banned, but they once were released from aerosol spray cans. They damaged the ozone layer in the upper atmosphere. Ozone protects Earth from harmful radiation from the Sun.

Smog is a visible form of air pollution. It forms when water droplets in the air mix with compounds of nitrogen and sulfur, both of which are released when fossil fuels are burned.

Today, the US government tries to limit air pollution. Laws set air-quality standards for cars, factories, and power plants.

Water Pollution

Earth's water collects in ponds, lakes, rivers, and oceans. Water also collects between soil particles and cracks in rocks underground, where it is called groundwater. Any of these supplies of water can become polluted. Moreover, because water flows from place to place, pollutants can spread many miles from their original source.

Water pollution can come from mines, factories, and power plants. It can come from sewage that is improperly treated. Fertilizers from farms and lawns can also pollute the water. When fertilizers wash into a lake, they help algae and other plants grow too quickly. This can begin a process that kills fish and slowly drains the lake.

Pollutants can also travel from the air into the water. Gases from burning coal can mix with water droplets in the air. The droplets fall to Earth's surface as acid rain. Acid rain can kill plants when it mixes into the soil. It kills fish when it mixes into lakes and rivers.

Reading Skill
Distinguish Between Facts and Speculation

Many people have strong feelings about environmental issues, such as conservation, pollution, endangered species, and climate change. When reading about these topics, look for clues to tell you whether the author is presenting facts or speculation. Are statistics provided? Are specific examples given? If so, the material is likely factual. Does the text contain opinions or generalizations? If so, then the author is likely presenting his or her speculations.

THINK ABOUT SCIENCE

Directions: Answer the questions below.

1. **What** What are two reasons for increased population growth?

_____

2. Compare and contrast nonrenewable and renewable resources.

_____

_____

Core Skill
Cite Textual Evidence

There are five species of rhinoceros worldwide. All five species are considered to be threatened or endangered. Their numbers are falling quickly because of poaching, or illegal hunting. Based on the text on this page, what will happen to the rhinoceros species if poaching continues? Explain some ways that these species could be saved.

Uses of Land and Water

Like all other living things, humans need food, water, air, and a place to live. As the human population grows, so does its need for these resources. Three hundred years ago, for example, North America was home to only a tiny fraction of its human population today. Vast forests and open grasslands covered much of the land. Today, most of these tracts of forest and grasslands have been replaced by cities, suburbs, farms, and ranches. Water has been channeled out of lakes and rivers for human use.

Changes like these help humans live and grow. But they have unwanted effects, too. Sometimes these effects take many years to observe. Cutting down trees from a hillside makes room for new houses, hut the soil may eventually wash away and carry the houses with it.

In the United States, many laws affect how people use land and water. Often these laws and policies are controversial. Should a farmer be allowed to sell his land for a new housing development? Where can one build new factories or power plants? The opinions and interests of businesses, landowners, and community members can all be different.

Endangered Species

In the mid-1800s, about sixty million bison lived on the grasslands of North America. By the year 1900, there were fewer than one thousand. Hunters with rifles were the cause. The bison were overhunted, meaning they were killed much faster than their numbers could increase.

Overhunting is one way that a species can become endangered. Many species are endangered because their habitats, or natural homes, are being destroyed. An **endangered species** has very few individuals left alive, and the species could die out completely. Species with no members still alive are described as **extinct.**

The current list of endangered species is very long. It includes animals of all shapes and sizes, from tiny snails to large elephants, tigers, and gorillas. Some of these species live only in zoos. Others are on the verge of extinction, meaning they could be lost forever.

Yet the American bison has recovered, as has the bald eagle and other species that were once endangered. They have been helped by nature preserves, conservation programs, and the Work of scientists and citizens.

WRITE TO LEARN

Recall that a cause is an event, person, or action that makes something happen. An effect is what happens because of that event, person, or action. In a notebook, write about a time when you or someone you know was late for an important appointment or event. Describe the cause for being late—bad weather, a traffic jam—and the effect that resulted from the cause.

THINK ABOUT SCIENCE

Directions: Match the effects in the column on the left with their cause listed on the right.

_____ 1. damage to the ozone layer	A. building of cities and farms
_____ 2. acid rain	B. over-hunting
_____ 3. bison loss during the 1800s	C. CFCs and burning fuels
_____ 4. loss of forests and grasslands	D. pollutants released by industry

Global Climate Change

According to many scientists, the most significant environmental issue is **global climate change.** This issue is sometimes called *global warming* because it involves rising temperatures across Earth.

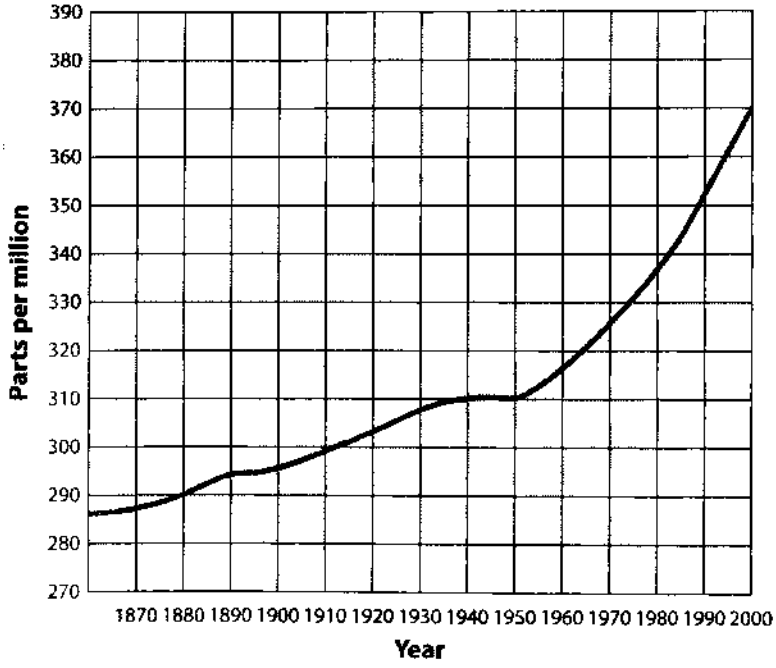
Climate is the average weather conditions from year to year. In a stable climate, the weather changes in a predictable way every year. Living things depend on these changes. The weather often determines the growing season for plants and the breeding season for animals.

Yet in recent years, scientists have been observing evidence of warming temperatures and climate change. In places across Earth, record high temperatures are being recorded more frequently. Traditional winter weather is lasting a shorter time and is not as cold.

The most dramatic changes are occurring near the North and South Poles. Glaciers are melting and ice sheets are thinning. Yet important changes are happening everywhere. In the western United States, wildfires resulting from dry summer weather are more common. In the southern Atlantic Ocean, hurricanes are more numerous than in the past.

What is causing climate change? Some scientists argue that the cause is the burning of coal, oil, and other fossil fuels. These fuels release a gas called: carbon dioxide. Carbon dioxide is a natural part of Earth's atmosphere. It helps trap heat in the atmosphere. Carbon dioxide levels appear to be rising, causing Earth's temperatures to rise as well.

LEVELS OF ATMOSPHERIC CARBON DIOXIDE, 1861–2000



THINK ABOUT SCIENCE

Directions: Answer the questions below.

1. What is climate and how is it different from daily weather?

   _____

2. What is global climate change?

   _____

Vocabulary Review

Directions: Complete the sentences using one of the following words:

conservation **natural resources** **pollution** **speculation**

1. Air, water, and other substances that make up the environment are _____
2. Any contamination of the environment is _____
3. An opinion or guess based on incomplete evidence is _____
4. Using nonrenewable resources in a way that does not waste them is _____

Skill Review

Directions: Read the passage below and answer the questions.

> Antarctica, located at the South Pole, is covered by ice sheets that are thousands of feet thick. Over the years, different countries have sent expeditions to explore this area. Early expeditions investigated the potential for whaling in the region. Since 1945, Antarctica has experienced a warming trend. Huge ice shelves have disintegrated or collapsed, and penguin populations have declined.

1. What is the most reasonable cause for the loss of ice shelves in Antarctica?
   - A. numerous expeditions sent to explore the region
   - **B.** warming trends
   - **C.** lack of snowfall
   - **D.** ice shelves break off

2. What is the most reasonable cause for the decline of penguin populations?
   - A. They have been over-hunted.
   - B. They are prey for whales.
   - **C.** Whaling has reduced their food supply.
   - **D.** Warmer temperatures have caused loss of habitats.

Directions: Answer the questions below.

3. Can a human activity cause multiple environmental problems at the same time? Give an example to support your answer.

_____

_____

4. How can a lake become polluted even if humans never visit it?

_____

_____

Skill Practice

Directions: Read the passage below and choose the correct answer to each question that follows.

In an international study, scientists researched whether dangerous chemicals pass from farm crops to the people who eat them. The chemicals they searched for—DDT, HCH, and PCB—are all used in farming. In humans, these chemicals are stored in fat cells and are seldom shed. However, nursing mothers shed fat cells in breast milk. The scientists found that the mothers' milk contained chemicals that were commonly used on farms of their region. In China, India, and Mexico, mothers pass on DDT and HCH to their babies. In West Germany, the United States, and Japan, they pass on PCBs.

Women who were exposed to any of these chemicals at their jobs were excluded from the study. This allowed the researchers to assume that the chemical contamination came from diet, not the work environment.

The study shows that toxic chemicals can be passed from mother to child. However, the scientists do not want to discourage breastfeeding. They say that the infant's exposure exceeds daily intake guidelines. However, the exposure is only for a short time and the daily intakes are still within acceptable limits for a lifetime.

1. How do DDT, HCH, and PCB enter the environment?

   A. They are used by farmers to grow food.
   B. Women use them to prevent nausea while pregnant.
   C. They are by-products of the petrochemical industry.
   D. Farmers use them to store their crops.

2. Why were women who may have been exposed to the chemicals on their jobs excluded from this study?

   A. The goal of the research was to show diet as a cause.
   B. The women were sick from the high concentrations of the chemicals.
   C. The women's food sources contained the chemicals.
   D. The women were too busy for the study.

3. Why were PCB levels higher in the breast milk of mothers from the United States and Japan than they were in the milk of mothers from China and India?

   A. Mothers in China and India breast-feed more often than mothers in the United States and Japan.
   B. PCBs have been used more in China and India.
   C. PCBs were used only in meat production in China and India, and these women had little or no meat in their diets.
   D. PCBs are used more in the United States and Japan.

Review

Directions: Choose the best answer to each question.

1. Which question would an ecologist most likely investigate?

   A. What is the maximum length of human life?
   B. How are Emerald ash borers, a type of beetle from Asia, changing forests in North America?
   C. What caused dinosaurs to become extinct?
   D. Why are some tomatoes red, while others are yellow or orange?

2. Which of these biomes can be thought of as a "cold desert? "

   A. grassland
   B. tundra
   C. tropical forest
   D. temperate forest

3. The number of organisms within a population that a habitat can support without losing its resources or damaging them severely is the habitat's

   A. tolerance.
   B. limiting factor.
   C. carrying capacity.
   D. population.

4. Which of these is an example of mutualism?

   A. a bee pollinating a flower
   B. a tick sucking blood from a dog
   C. a remora eating debris from a shark's mouth
   D. an orchid attaching itself to a tree

5. In which of these types of symbiosis is the host neither harmed nor helped?

   A. predation
   B. parasitism
   C. mutualism
   D. commensalism

6. Which of these is an abiotic factor?

   A. a bacterium
   B. sunlight
   C. a dead tree
   D. an insect

7. Which outcome best describes the future of an endangered species?

   A. The species will soon become extinct.
   B. The species might become extinct, or might recover.
   C. The species will thrive again someday.
   D. The species will live only in zoos, not the wild.

Review

Questions 8-10 refer to the following passage.

Hardly anyone in Minamata, Japan, noticed when fish were found floating in the water and shellfish frequently died. Two years later, seagulls were dropping out of the sky. Yet, fishermen continued to fish. People continued to eat the fish. Then a six-year-old girl was admitted to the hospital with brain damage. Within a year, fifty-two people were affected. Twenty-one died.

Before long, 103 people had died, and 700 more had been seriously and permanently damaged. Severe mental retardation, tremors, and limb deformities were among the symptoms.

This is the story of mercury poisoning through man-made environmental pollution. Mercury in industrial wastes was dumped into the ocean and polluted the feeding grounds of shellfish and fish. The poisoned fish were eaten by animals and humans.

Mercury must accumulate in cells before there is enough to become toxic. As a result, smaller animals were affected first. (They weighed less, so they needed less mercury accumulation in their bodies to display symptoms.) Eventually, enough mercury accumulated in the brain cells of humans to cause damage. The symptoms of this tragedy were first noticed among small children.

8. What caused the tragedy in Minamata?

A. poisoned seagulls
B. mercury poisoning
C. climate changes
D. poor diet

9. Why were people affected by the industrial wastes dumped in the ocean?

A. They swam in the polluted waters.
B. The mercury got into their drinking water.
C. They ate the fish and shellfish that were poisoned by mercury.
D. They lived near the polluted waters.

10. Why were seagulls "dropping out of the sky? "

A. They died from eating poisoned fish.
B. They died from drinking contaminated water.
C. The fishermen decided to hunt seagulls instead of catching fish.
D. The seagulls died from a virus.

CHAPTER 3

Review

11. Differentiate between the seven different types of biomes: deserts, tundras, grasslands, tropical forests, temperate forests, oceans, and freshwater areas.

12. Compare the relationship between predator and prey to the relationship between parasite and host

13. Explain how limiting factors influence the carrying capacity of a habitat.

14. Draw an example of one of the types of biomes, including at least three biotic and three abiotic factors. Label the biotic and abiotic factors. Then describe why each factor is biotic or abiotic.

Review

15. Classify each of these as either renewable or nonrenewable resources. Place each resource under the correct label at right

cattle
coal
crops
minerals
natural gas
oil
sunlight
topsoil
trees
wind

Renewable

Nonrenewable

Check Your Understanding

On the following chart, circle the number of any item you answered incorrectly. Next to each group of item numbers, you will see the pages you can review to learn how to answer the items correctly. Pay particular attention to reviewing those lessons in which you missed half or more of the questions.

Chapter 3 Review

Lesson	Item Number	Review Pages
Ecosystems	1, 2, 11, 14	88-95
Carrying Capacity	3, 12, 13	96-101
Symbiosis	4, 5, 12	102-109
Disruption	6, 14	110-117
Environmental Issues	7, 8, 9, 10, 15	118-125

CHAPTER 3

Application of Science Practices

CHAPTER 3: ECOSYSTEMS

Question

What are the relationships between the components of an ecosystem?

Background Concepts

An ecosystem is a group of living organisms that interact with each other and the nonliving components in their environment. The living components of an ecosystem can include plants, animals, and microbial life. The nonliving components of an ecosystem can include water, soil, rocks, air, and sunlight.

An ecosystem is in dynamic equilibrium, meaning that conditions within the system stay more or less balanced over time. This balance is achieved by a self-correcting negative feedback system. For example, say there is plenty of plant material to feed a herd of deer. A drought occurs, reducing the food supply. Now there is too little food to support the herd. Some deer migrate to find food elsewhere, or they die. Equilibrium is restored.

Investigation

1. Do some research to learn about different ecosystems and select one that you find interesting. Or select an ecosystem in or near where you live. Remember, an ecosystem is a system formed by the interactions among organisms, and also between organisms and their environment. An ecosystem can be as vast as an ocean or as small as a compost pile.
2. Draw and label the parts of the ecosystem you chose. Draw and label examples of producers, consumers, and detritivores, or microorganisms that feed on or break down organic waste. Also draw and label examples of nonliving components in the ecosystem.

Application of Science Practices

Critical Thinking

1. Imagine that you removed one of the living components from the ecosystem you chose. Predict and describe how this would affect the other organisms in the ecosystem.

2. Now imagine that you removed one of the nonliving components of the ecosystem you chose. Predict and describe how this would affect the living components in the ecosystem.

Evidence

Do research or contact a local expert to find evidence to test your predictions. What evidence did you find?