Name _____ Date _____ Class _____

SECTION 22-1 SECTION SUMMARY

Living Things and the Environment

Guide for Reading

- **What needs are met by an organism's surroundings?**
- **What are the levels of organization within an ecosystem?**

All the living and nonliving things that interact in a particular area make up an **ecosystem.** Organisms live in a specific place within an ecosystem. **An organism obtains food, water, shelter, and other things it needs to live, grow, and reproduce from its surroundings.** The place where an organism lives and that provides the things the organism needs is called its **habitat.**

An organism interacts with both the living and nonliving things in its environment. The living parts of an ecosystem are called **biotic factors.** The nonliving parts of an ecosystem are called **abiotic factors.** Abiotic factors include water, sunlight, oxygen, temperature, and soil.

A **species** is a group of organisms that are physically similar and can reproduce with each other to produce fertile offspring. All the members of one species in a particular area are referred to as a **population.** All the different populations that live together in an area make up a **community. The smallest unit of organization is a single organism, which belongs to a population of other members of its species. The population belongs to a community of different species. The community and abiotic factors together form an ecosystem.**

The study of how living things interact with each other and with their environment is called **ecology.** Ecologists, scientists who study ecology, look at how all the biotic and abiotic factors in an ecosystem are related. They study how organisms react to changes in their environment. Living things constantly interact with their surroundings, responding to changes in the conditions around them.

Name _____ Date _____ Class _____

SECTION 22-1 REVIEW AND REINFORCE

Living Things and the Environment

◆ Understanding Main Ideas

Respond to the following items in the spaces provided.

1. Complete the diagram below to show the levels of organization in an ecosystem. Start with the smallest unit.

a. ➡ b. ➡ c. ➡ d.

2.a. Name three populations commonly found in a prairie ecosystem.

_____

b. Name four abiotic factors in a prairie ecosystem.

_____

c. Identify two different habitats in a prairie ecosystem. Name one organism found in each habitat.

_____

_____

3. What is ecology?

_____

_____

◆ Building Vocabulary

Write the correct term on the line to complete each sentence below.

4. All the living and nonliving things that interact in a particular area make up a(n) _____.

5. The place where an organism lives and that provides the things the organism needs is called its _____.

6. A(n) _____ is a group of organisms that are physically similar and can reproduce with each other to produce fertile offspring.

7. A(n) _____ includes all the members of one species in a particular area.

8. All the different populations that live together in an area make up a(n) _____.

Name _____ Date _____ Class _____

SECTION 22-2 SECTION SUMMARY

Studying Populations

Guide for Reading

- How do ecologists determine the size of a population?
- What causes populations to change in size?
- What factors limit population growth?

One way to state the size of a population is in terms of **population density**—the number of individuals in a specific area. Population density is calculated by dividing the number of individuals in the population by the total area. The result tells how many individuals there are per unit area.

Some methods of determining the size of a population are direct and indirect observations, sampling, and mark-and-recapture studies. Direct observation involves counting the members of a population one by one. Indirect observation involves counting tracks, nests, or other signs rather than the organisms themselves.

Many times, it is not possible to count every member of a population because the population is too large or spread out or the members are hard to find. Instead, ecologists make an estimate of the population. An **estimate** is an approximation of a number, based on reasonable assumptions. One type of estimating involves counting the number of organisms in a small area (a sample), and then multiplying to find the number in a larger area.

Ecologists sometimes use a technique called mark and recapture. Some animals are first captured, marked, and released into the environment. Then another group is captured. The ecologists count the marked animals in this group. Using a mathematical formula, the ecologists can estimate the total population of those organisms in the area.

Populations can change in size when new members enter the population or when members leave the population. The major way in which new individuals are added to a population is through the birth of new offspring. The **birth rate** of a population is the number of births in a population in a certain amount of time. The major way that individuals leave a population is by dying. The **death rate** is the number of deaths in a population in a certain amount of time. If the birth rate is greater than the death rate, the population will generally increase in size. If the death rate is greater than the birth rate, the population size will generally decrease. The size of a population also can change when individuals move into or out of the population. **Immigration** means moving into a population. **Emigration** means leaving a population. Graphs are useful to show changes in the size of a population over time.

A **limiting factor** is an environmental factor that prevents a population from increasing. **Some limiting factors for populations are food, space, and weather conditions.** The largest population that an environment can support is called the **carrying capacity.**

Name _____ Date _____ Class _____

SECTION 22-2 REVIEW AND REINFORCE

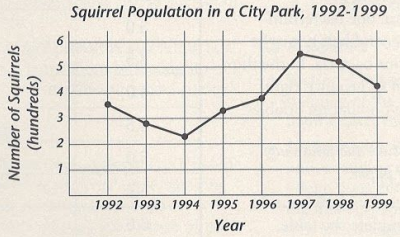
Studying Populations

◆ Understanding Main Ideas

Answer the following questions on a separate sheet of paper.

1. A vegetable garden is 12 meters long by 7 meters wide. In one square meter, you count two toads. Estimate the population of toads in the garden.
2. What are two ways that the size of a population can increase? What are two ways that the size of a population can decrease?

The graph below shows how the size of the squirrel population in a city park changed over time. Use the graph to answer questions 3–5.



3. Over which time period(s) did the squirrel population decrease?
4. Over which time period(s) did the population increase?
5. In which year did the population reach its lowest point? What was the size of the population that year?
6. What causes a population to change in size?
7. Identify three limiting factors that can prevent a population from increasing. Explain how each factor limits a population's size.

◆ Building Vocabulary

On a separate sheet of paper, define each of these terms in your own words.

8. population density
9. carrying capacity
10. immigration

Name _____ Date _____ Class _____

SECTION 22-3 SECTION SUMMARY

Interactions Among Living Things

Guide for Reading

- **How do an organism's adaptations help it to survive?**
- **What are the major types of interactions among organisms?**
- **What are the three forms of symbiotic relationships?**

Every organism has some unique characteristics that enable it to live in its environment. In response to their environment, species evolve, or change over time. The changes that make organisms better suited to their environment occur by a process called **natural selection.** Individuals whose characteristics are best suited for their environment tend to survive and produce offspring. The offspring inherit those characteristics and also live to reproduce. Individuals that are poorly suited to the environment are less likely to survive and reproduce. The poorly suited characteristics may disappear from the population over time. The results of natural selection are adaptations, the behaviors and physical characteristics of species that allow them to live successfully in their environment.

Every organism has a variety of adaptations that are suited to its specific living conditions. These adaptations create a unique role for the organism in its ecosystem. An organism's particular role, or how it makes its living, is called its **niche.** A niche includes the type of food the organism eats, how it obtains this food, which other species use it as food, when and how the organism reproduces, and the physical conditions it requires to survive.

Some adaptations involve how organisms interact. **There are three major types of interactions among organisms: competition, predation, and symbiosis. Competition** is the struggle between organisms to survive in a habitat with limited resources. **Predation** is an interaction in which one organism kills and eats another organism. The organism that does the killing is the **predator.** The organism that is killed is the **prey.** Predators have adaptations that help them catch and kill their prey. Prey organisms have adaptations that help them avoid being caught and eaten. Predation can have a major effect on the size of a population.

Symbiosis is a close relationship between two species that benefits at least one of the species. **The three types of symbiotic relationships are mutualism, commensalism, and parasitism. Mutualism** is a relationship in which both species benefit. **Commensalism** is a relationship in which one species benefits and the other species is neither helped nor harmed. **Parasitism** involves one organism living on or inside another organism and harming it. The organism that benefits is called a **parasite,** and the organism it lives on or in is called a **host.**

Name _____ Date _____ Class _____

SECTION 22-3 REVIEW AND REINFORCE

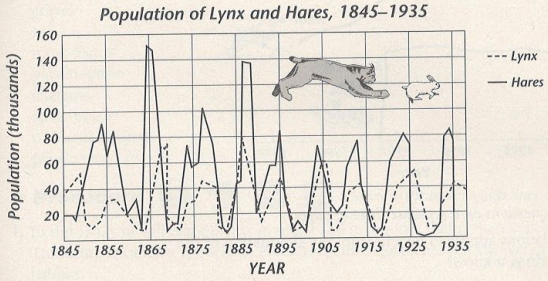
Interactions Among Living Things

◆ Understanding Main Ideas

Answer the following questions on a separate sheet of paper.

1. How does natural selection produce adaptations in a species?
2. What is an organism's niche?
3. How do adaptations enable organisms to reduce competition for food and other resources?

The graph below shows how the population sizes of lynx and snowshoe hares changed over time. Use the graph to answer questions 4–7.



4. When the hare population increased, what happened to the lynx population? Why?
5. How do you think an increase in the lynx population affected the hare population? Why?
6. What other factors could have caused a decrease in the hare population?
7. Predict what happened to the two populations between 1935 and 1945.

◆ Building Vocabulary

Respond to the following items on a separate sheet of paper.

8. Define the terms *predation, predator,* and *prey* in your own words. Give an example of a predator-prey relationship. Identify the predator and the prey.
9. Name and describe the three types of symbiotic relationships.
10. Define the term *competition.*

Name _____ Date _____ Class _____

SECTION 23-1 SECTION SUMMARY

Energy Flow in Ecosystems

Guide for Reading

- **What energy roles do organisms play in an ecosystem?**
- **How much energy is available at each level of an energy pyramid?**

An organism's energy role is determined by how it obtains energy and how it interacts with the other living things in its ecosystem. **An organism's energy role in an ecosystem may be that of a producer, consumer, or decomposer.**

Plants, algae, and some microorganisms can carry out photosynthesis. In this process, the organism uses the sun's energy to turn water and carbon dioxide into sugar molecules. An organism that can make its own food is a **producer.** Producers are the source of all the food in an ecosystem.

Other organisms cannot make their own food. They depend on producers for food and energy. An organism that obtains energy by feeding on other organisms is a **consumer.** Consumers are classified by what they eat. Consumers that eat only plants are called **herbivores.** Consumers that eat only animals are called **carnivores.** A consumer that eats both plants and animals is called an **omnivore.** A **scavenger** is a carnivore that feeds on the bodies of dead organisms. An organism may play more than one role in an ecosystem.

Organisms that break down wastes and dead organisms and return the raw materials to the environment are called **decomposers.** As decomposers obtain energy for their own needs, they return simple molecules to the environment to be used again by other organisms.

The flow of energy through an ecosystem can be shown in diagrams called food chains and food webs. A **food chain** is a series of events in which one organism eats another and obtains energy. The first organism in a food chain is always a producer. The second organism, called a first-level consumer, eats the producer. The next consumer, called a second-level consumer, eats the first-level consumer. A food chain shows just one possible path of energy through an ecosystem.

Most producers and consumers are part of many food chains. A more realistic way to show the flow of energy through an ecosystem is a food web. A **food web** consists of the many overlapping food chains in an ecosystem.

When an organism makes its own food or eats other organisms, it obtains energy. The organism uses most of this energy for its own life processes. Only some of the energy will be available to the next organism in the food web. A diagram called an **energy pyramid** shows the amount of energy that moves from one feeding level to another in a food web. **The most energy is available at the producer level. At each level in the pyramid, there is less available energy than at the level below.** In general, only about 10 percent of the energy at one level of a food web is transferred to the next higher level. For this reason, most food webs have only three or four feeding levels, with few organisms at the highest level in a food web.

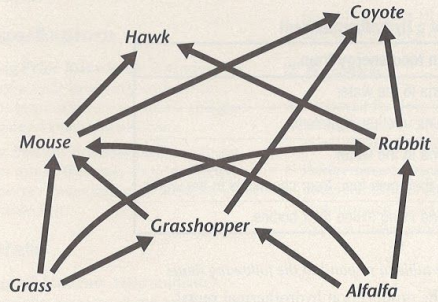
Name _____ Date _____ Class _____

SECTION 23-1 REVIEW AND REINFORCE

Energy Flow in Ecosystems

◆ Understanding Main Ideas

Study the food web shown below. Then answer the questions that follow on a separate sheet of paper.



1. Which organism in the food web above is sometimes a first-level consumer and sometimes a second-level consumer? Explain.
2. Choose one food chain in the web. Name all the organisms in that chain. Start with the producer and end with the top-level consumer.
3. Draw an energy pyramid for the food chain you chose. Label the pyramid to tell how much food energy is available at each level.

◆ Building Vocabulary

On a separate sheet of paper, write the term that fits each definition below.

4. Organisms that make their own food
5. Organisms that obtain energy by feeding on other organisms
6. Organisms that break down wastes and dead organisms and return the raw materials to the environment
7. Consumers that eat only animals
8. Consumers that eat only plants
9. Consumers that eat both plants and animals
10. Consumers that feed on the bodies of dead organisms

Name _____ Date _____ Class _____

SECTION 23-2 SECTION SUMMARY

Cycles of Matter

Guide for Reading

- **What three major processes make up the water cycle?**
- **How is carbon dioxide used by producers?**

Matter is recycled in ecosystems. Matter includes water, oxygen, carbon, nitrogen, and many other substances. Three of the most important cycles of matter are the water cycle, the carbon-oxygen cycle, and the nitrogen cycle.

The **water cycle** is the continuous process by which water moves from Earth's surface to the atmosphere and back. **The processes of evaporation, condensation, and precipitation make up the water cycle. Evaporation** is the process by which molecules of liquid water absorb energy and change to the gas state. Water evaporates from Earth's surface and forms water vapor, a gas, in the atmosphere. The process by which a gas changes to a liquid is called **condensation.** When water vapor in the atmosphere cools, it turns back into tiny droplets of liquid water. As more water vapor condenses, the drops grow larger and heavier. Eventually, the heavy drops fall back to Earth as a form of **precipitation**—rain, snow, sleet, or hail.

Carbon is the building block for the matter that makes up the bodies of living things. Producers take in carbon dioxide from the atmosphere during photosynthesis. **In this process, the producers use carbon from the carbon dioxide to produce other carbon-containing molecules.** These molecules include sugars and starches. Consumers obtain energy from these molecules by breaking them down into simpler molecules. The consumers release water and carbon dioxide as waste products of the process. At the same time, producers release oxygen during photosynthesis. Other organisms take in oxygen from the atmosphere and use it in their life processes.

Like carbon, nitrogen is a necessary building block in the matter that makes up living things. Most organisms cannot use nitrogen gas in the air. Nitrogen gas is called "free" nitrogen because it is not combined with other kinds of atoms. Most organisms can use nitrogen only when it has been "fixed," or combined with other elements to form nitrogen-containing compounds. The process of changing nitrogen gas into a usable form of nitrogen is called **nitrogen fixation.** Most nitrogen fixation is performed by certain kinds of bacteria. Some of these bacteria live in bumps called **nodules** on the roots of certain plants. Once the nitrogen has been fixed, it can be used by organisms to build proteins and other complex substances. Decomposers break down these complex compounds in animal wastes and dead organisms. Decomposition returns simple nitrogen compounds to the soil. Certain types of bacteria break down the nitrogen compounds completely. These bacteria release free nitrogen back into the air, and the cycle starts again.

Name _____ Date _____ Class _____

SECTION 23-2 REVIEW AND REINFORCE

Cycles of Matter

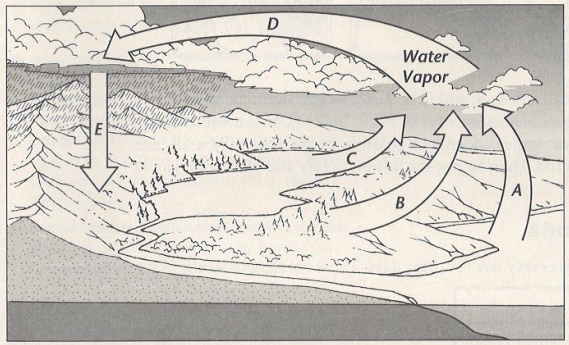
◆ Understanding Main Ideas

Answer the following questions on a separate sheet of paper.

1. What is the source of energy for the process of evaporation?
2. What happens to rainwater that falls on land?
3. How are oxygen and carbon cycled between plants and animals?
4. Why are nitrogen-fixing bacteria so important to other organisms?

◆ Building Vocabulary

Study the diagram and answer the questions that follow.



5. Which cycle is shown in the diagram?

_____

6. Identify each process labeled in the diagram.

a. _____ b. _____

c. _____ d. _____

e. _____

Name _____ Date _____ Class _____

SECTION 23-4 SECTION SUMMARY

Earth's Biomes

Guide for Reading

- **What determines the type of biome found in an area?**
- **Where can photosynthesis occur in water biomes?**

A **biome** is a group of ecosystems with similar climates and organisms. **In fact, it is mostly the climate conditions—temperature and rainfall—in an area that determine its biome.** The climate limits distribution of plants. In turn, the types of plants determine the kinds of animals that live there.

Tropical rain forests are warm and humid. Tropical rain forests are found near the equator. The tall trees form a leafy roof called a **canopy.** A second layer of shorter trees and vines form an **understory.** Temperate rain forests are found farther north. They also receive a lot of rain but are cooler than tropical rain forests.

A **desert** is an area that receives less than 25 centimeters of rain each year. Deserts have large shifts in temperature during the day. Desert organisms are adapted to the lack of rain and to the extreme temperatures.

A **grassland** receives between 25 and 75 centimeters of rain each year and is populated by grasses. Grasslands that are located close to the equator are called **savannas.** Savannas receive as much as 120 centimeters of rain each year.

The trees found in deciduous forests, called **deciduous trees,** shed their leaves and grow new ones each year. These forests receive at least 50 centimeters of rain each year. Temperatures vary during the year. Some of the mammals in deciduous forests enter a low-energy state similar to sleep, called **hibernation.**

Boreal forests contain **coniferous trees,** which produce their seeds in cones and have leaves shaped like needles. Winters are long, very cold, and snowy. Summers are rainy and warm enough to melt all the snow.

The **tundra** is extremely cold and dry, often with no more precipitation than a desert. Most of the soil is frozen all year long. The frozen soil is called **permafrost.** Plants include low-growing mosses, grass, and shrubs.

Freshwater biomes include ponds, lakes, streams, and rivers. **Because water absorbs sunlight, there is only enough light for photosynthesis near the surface or in shallow water.** Algae are the most common producers in freshwater biomes.

The ocean has different zones. An **estuary** is found where the fresh water of a river meets the salt water of the ocean. The part of the shore between the highest high-tide line and the lowest low-tide line is called the **intertidal zone.** Below the low-tide line is the **neritic zone,** a region of shallow water over the continental shelf. Floating algae are the producers in most open-ocean food webs. Below the open ocean's surface zone is the deep zone, which is completely dark.

Name _____ Date _____ Class _____

SECTION 23-4 REVIEW AND REINFORCE

Earth's Biomes

◆ Understanding Main Ideas

Answer the following questions on a separate sheet of paper.

1. How does climate affect the type of biome found in an area?
2. What are two adaptations that enable mammals to survive cold winters?
3. Why are estuaries such rich habitats for organisms?
4. What are sunlight conditions like in each of the four ocean zones?

◆ Building Vocabulary

Name each biome described in the table below.

Biome	Climate and Organisms
5. _____	Warm summers, cold winters; receives at least 50 cm of precipitation per year; trees shed their leaves and grow new ones each year
6. _____	Hot in daytime, cool or cold at night; very dry; organisms are adapted to extreme temperatures and dry conditions
7. _____	Warm, rainy summers; very cold winters with heavy snow; trees produce cones with seeds that are eaten by many animals
8. _____	Warm temperatures do not vary much throughout the year; very wet and humid; greater variety of species than any other biome
9. _____	Extremely cold winters, warmer summers; windy; very dry; no trees, only low-growing plants
10. _____	Receives between 25 and 75 centimeters of rain each year; populated by grasses and many large herbivores

Name _____ Date _____ Class _____

SECTION 23-5 SECTION SUMMARY

Succession

Guide for Reading

- **How are primary and secondary succession different?**

Fires, floods, volcanoes, hurricanes, and other natural disasters can change communities in a short period of time. Even without a disaster, communities change. The series of predictable changes that occur in a community over time is called **succession.**

Primary succession is the series of changes that occur in an area where no ecosystem previously existed. The area might be a new island formed by the eruption of an undersea volcano or an area uncovered by a melting sheet of ice. When the land is first exposed, there is no soil. The first species to populate the area are called **pioneer species.** Pioneer species are usually lichens and mosses, which can grow on bare rocks. As they grow, the lichens and mosses help break up the rocks to form soil. When these organisms die, they provide nutrients that enrich the developing soil. Over time, seeds of plants land in the new soil and begin to grow. The specific plants that grow depend on the biome of the area. In time, as the soil grows older and richer, a mature forest may develop.

Secondary succession is the series of changes that occur after a disturbance in an existing ecosystem. Natural disturbances include fires, hurricanes, and tornadoes. Human activities, such as farming, logging, or mining, also may disturb an ecosystem. **Unlike primary succession, secondary succession occurs in a place where an ecosystem has previously existed.** Secondary succession occurs more rapidly than primary succession. The particular plant species that appear and then are replaced in the process of succession depend on the biome.

Name _____ Date _____ Class _____

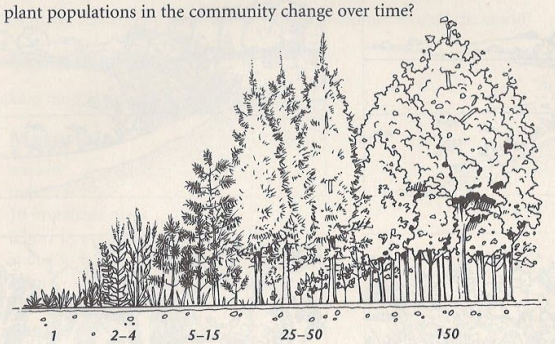
SECTION 23-5 REVIEW AND REINFORCE

Succession

◆ Understanding Main Ideas

Answer the following questions on a separate sheet of paper.

1. What organisms are usually the pioneer species in a new area? How do these organisms prepare the area for other species?
2. The illustration below shows succession in an abandoned field. How did the plant populations in the community change over time?



Years After Field Was Abandoned

◆ Building Vocabulary

Identify each of the following as an example of primary succession or secondary succession. Write your answers in the spaces provided.

3. An old house was torn down. Small weeds and grasses grew in the vacant lot. Over the next few years, bushes and tree seedlings began to grow.

_____

4. An undersea volcano erupted and formed a small island. Mosses and lichens began to grow on the bare volcanic rock.

_____

5. A logging company cut down all the large spruce trees in an area of forest. After the area was cleared, spruce seedlings began to sprout. Rabbits, birds, and deer returned to the area.

_____

Name _____ Date _____ Class _____

SECTION 24-3 SECTION SUMMARY

Biodiversity

Guide for Reading

- **What factors affect an area's biodiversity?**
- **Which human activities threaten biodiversity?**
- **How can biodiversity be protected?**

Having a number of different species in an area is called **biodiversity. Factors that affect biodiversity in an ecosystem include area, climate, and diversity of niches.** Tropical rain forests are the most diverse ecosystems in the world. The climate makes food available for organisms year-round. Tropical coral reefs are the second most diverse ecosystems in the world. A reef provides many different niches for organisms.

There are many reasons why preserving biodiversity is important. First, wild organisms and ecosystems are a source of beauty and recreation. Second, organisms provide food, oxygen, and raw materials for clothing, medicine, and other products. And third, all the species in an ecosystem are connected to one another. A species that influences the survival of many other species in an ecosystem is called a **keystone species.**

A healthy species has a variety of traits, which are determined by genes. Genes are the structures in an organism's cells that carry its hereditary information. Each organism in a species has some genes that differ from the genes of other individuals in that species. These differences make up the gene "pool" of that species. A species with a diverse gene pool is better able to resist diseases and parasites and survive disturbances such as drought.

The disappearance from Earth of all members of a species is called **extinction.** Species in danger of becoming extinct in the near future are considered **endangered species.** Species that could become endangered in the near future are considered **threatened species.** Natural events such as earthquakes can cause species to become extinct. **Human activities can also threaten biodiversity. These activities include habitat destruction, poaching, pollution, and introduction of exotic species.** The leading cause of extinction is **habitat destruction,** the loss of a natural habitat. Breaking larger habitats into smaller, isolated pieces or fragments is called **habitat fragmentation. Poaching** is the illegal killing or removal of wildlife species. Some species are endangered because pollutants build up in organisms through the food chain. Introducing exotic species into an ecosystem can also threaten biodiversity.

Many programs to protect biodiversity combine scientific and legal approaches. One scientific approach is **captive breeding,** which is the mating of animals in zoos or wildlife preserves. Laws and treaties can help protect species by making it illegal to sell endangered species or products made from them. The most effective way to preserve biodiversity is to protect whole ecosystems.

Name _____ Date _____ Class _____

SECTION 24-3 REVIEW AND REINFORCE

Biodiversity

◆ Understanding Main Ideas

Answer the following questions on a separate sheet of paper.

1. What three factors affect the biodiversity of an ecosystem?
2. What is one reason coral reefs are such diverse ecosystems?
3. How does having a diverse gene pool help a species survive?

Species	Year Taken Off Endangered List
Aleutian Canada goose	1990
Greenback cutthroat trout	1978
Pacific gray whale	1994
Utah prairie dog	1984

4. The table above lists four animals that the U.S. government has removed from its list of endangered species. Why do you think these species were taken off the list?
5. Name and describe three ways to protect the world's biodiversity.

◆ Building Vocabulary

Define each of the following terms in the spaces provided.

6. keystone species _____
7. extinction _____
8. endangered species _____
9. habitat fragmentation _____
10. poaching _____