Biodiversity

CHAPTER 10

PRE-READING ACTIVITY

FOLDNOTES

Tri-Fold Before you read this chapter, create the **FoldNote** entitled "Tri-Fold" described in the Reading and Study Skills section of the Appendix. Write what you know about biodiversity in the column labeled "Know." Then, write what you want to know in the column labeled "Want." As you read the chapter, write what you learn about biodiversity in the column labeled "Learn."

How many species are in this photo? Scientists know that this region of Central Texas is home to an unusual number of unique species. However, many more species remain unknown to science, both in faraway jungles and in our own backyards.

SECTION 1

What Is Biodiversity?

Every day, somewhere on Earth, a unique species of organism becomes *extinct* as the last member of that species dies—often because of human actions. Scientists are not sure how many species are becoming extinct or even how many species there are on Earth. How much extinction is natural? Can we—or should we—prevent extinctions? The study of biodiversity helps us think about these questions, but does not give us all the answers.

Objectives

- Describe the diversity of species types on Earth, relating the difference between known numbers and estimated numbers.
- List and describe three levels of biodiversity.
- Explain four ways in which biodiversity is important to ecosystems and humans.
- Analyze the potential value of a single species.

Key Terms

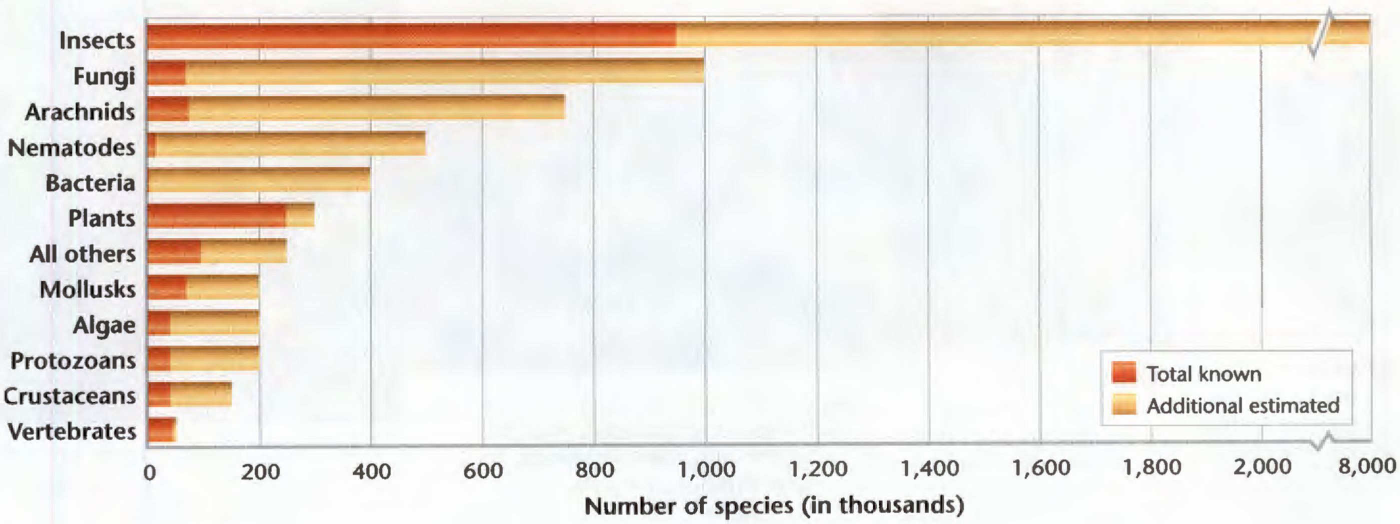
biodiversity
gene
keystone species
ecotourism

A World Rich in Biodiversity

The term **biodiversity,** short for "biological diversity," usually refers to the number and variety of different species in a given area. Certain areas of the planet, such as tropical rain forests, contain an extraordinary variety of species. The complex relationships between so many species are hard to study, but humans may need to understand and preserve biodiversity for our own survival.

Unknown Diversity The study of biodiversity starts with the unfinished task of cataloging all the species that exist on Earth. As shown in **Figure 1,** the number of species known to science is about 1.7 million, most of which are insects. However, the actual number of species on Earth is unknown. Most scientists agree that we have not studied Earth's species adequately, but they accept an estimate of greater than 10 million for the total number of species. New species are considered *known* when they are collected and described scientifically. Unknown species exist in remote wildernesses, deep in the oceans, and even in cities. Some types of species are harder to study and receive less attention than large, familiar species. For example, less is known about insects and fungi than is known about trees and mammals.

Figure 1 ▶ Number of Species on Earth About 1.7 million species on Earth are known to science. Many more species are *estimated* to exist, especially species of smaller organisms. Scientists continue to revise these estimates.



Source: World Conservation Monitoring Center.

Figure 2 ▶ Scientists continue to find and describe new species. Specimens may be stored in collections such as this one, with a small tag that says where and when the specimen was found.

Levels of Diversity Biodiversity can be studied and described at three levels. *Species diversity* refers to all the differences between populations of species, as well as between different species. This kind of diversity has received the most attention and is most often what is meant by *biodiversity*. *Ecosystem diversity* refers to the variety of habitats, communities, and ecological processes within and between ecosystems. *Genetic diversity* refers to all the different *genes* contained within all members of a population. A **gene** is a piece of DNA that codes for a specific trait that can be inherited by an organism's offspring.

Benefits of Biodiversity

Biodiversity can affect the stability of ecosystems and the sustainability of populations. In addition, there are many ways that humans clearly use and benefit from the variety of life-forms on Earth. Biodiversity may be more important than we realize.

Species Are Connected to Ecosystems We depend on healthy ecosystems to ensure a healthy biosphere that has balanced cycles of energy and nutrients. Species are part of these cycles. When scientists study any species closely, they find that it plays an important role in an ecosystem. Every species is probably either dependent on or depended upon by at least one other species in ways that are not always obvious. When one species disappears from an ecosystem, a strand in a food web is removed. How many threads can be pulled from the web before it collapses? We often do not know the answer until it is too late.

Some species are so clearly critical to the functioning of an ecosystem that they are called **keystone species.** One example of a keystone species is the sea otter. **Figure 3** shows how the loss of sea otter populations led to the loss of the kelp beds along the U.S. Pacific coast and how the recovery of otter populations led to the recovery of the kelp communities.

Figure 3 ▶ The sea otters of North America are an example of a keystone species, upon which a whole ecosystem depends.

1. In the 1800s, sea otters were hunted for their fur. They disappeared from the Pacific coast of the U.S.
2. Sea urchins, with no more predators, multiplied and ate all of the kelp. The kelp beds began to disappear from the area.
3. In 1937, a small group of surviving otters was discovered. With protection and scientific efforts, the otter populations grew.
4. The otters once again preyed on the sea urchins. The kelp beds regenerated.

Species and Population Survival The level of genetic diversity within populations is a critical factor in species survival. Genetic variation increases the chances that some members of a population may survive environmental pressures or changes. Small and isolated populations are less likely to survive such pressures. When a population shrinks, its genetic diversity decreases as though it is passing through a *bottleneck*, represented in **Figure 4.** Even if such a population is able to increase again, there will be inbreeding within a smaller variety of genes. Then, members of the population may become more likely to inherit genetic diseases.

Medical, Industrial, and Agricultural Uses People throughout history have used the variety of organisms on Earth for food, clothing, shelter, and medicine. About one quarter of the drugs prescribed in the United States are derived from plants. Almost all antibiotics are derived from chemicals found in fungi. **Table 1** lists some plants from which medicines are derived.

For some industries, undiscovered and poorly studied species represent a source of potential products. New chemicals and industrial materials may be developed from chemicals discovered in all kinds of species. The scientific community continues to find new uses for biological material and genetic diversity, from combating diseases to understanding the origins of life.

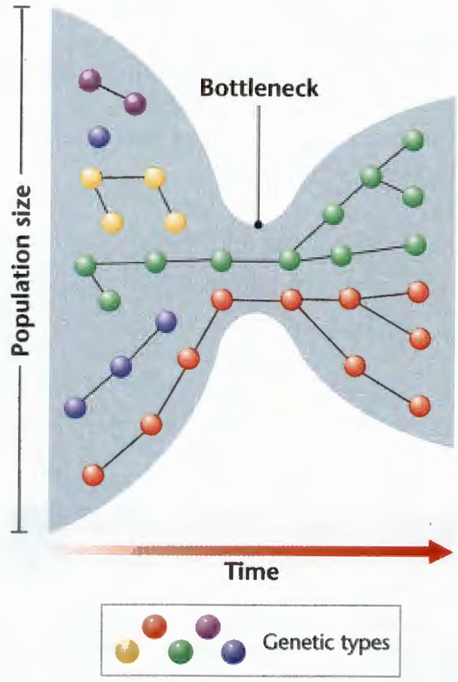


Figure 4 ▶ When a population is reduced to a few members, this creates a *bottleneck* of reduced genetic variation. Even if the population grows again, its chances of long-term survival are lower.

Table 1 ▼

Common Medicines Derived from Plants		
Medicine	**Origin**	**Use**
Neostigmine	calabar bean (Africa)	treatment of glaucoma and basis for synthetic insecticides
Turbocurarine	curare vine (South America)	surgical muscle relaxant; treatment of muscle disorders; and poison for arrow tips
Vincristine, vinblastine	rosy periwinkle (Madagascar)	treatment of pediatric leukemia and Hodgkin's disease
Bromelain	pineapple (South America)	treatment to control tissue inflammation
Taxol	Pacific yew (North America)	anticancer agent
Novacaine, cocaine	coca plant (South America)	local anesthetic and basis for many other anesthetics
Cortisone	wild yam (Central America)	hormone used in many drugs
L-dopa (levodopa)	velvet bean (tropical Asia)	treatment of Parkinson's disease
Reserpine	Indian snakeroot (Malaysia)	treatment to reduce high blood pressure

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Figure 5 ▶ A produce market in Bolivia shows a diversity of native foods. Food crops that originated in the American tropics include corn, tomatoes, squash, and many types of beans and peppers.

Table 2 ▼

Origins of Some Foods
North America, Central America, and South America
• corn (maize), tomato, bean (pinto, green, and lima), peanut, potato, sweet potato, avocado, pumpkin, pineapple, cocoa, vanilla, and pepper (green, red, and chile)
Northeastern Africa, Central Asia, and Near East
• wheat (several types), sesame, chickpea, fig, lentil, carrot, pea, okra, date, walnut, coffee, cow, goat, pig, and sheep
India, East Asia, and Pacific Islands
• soybean, rice, banana, coconut, lemon, lime, orange, cucumber, eggplant, turnip, tea, black pepper, and chicken

Humans benefit from biodiversity every time they eat. Most of the crops produced around the world originated from a few areas of high biodiversity. Some examples of crop origins are shown in **Figure 5** and **Table 2.** Most new crop varieties are *hybrids*, crops developed by combining genetic material from other populations. History has shown that depending on too few plants for food is risky. For example, famines have resulted when an important crop was wiped out by disease. But some crops have been saved from diseases by being crossbred with wild plant relatives. In the future, new crop varieties may come from species not yet discovered.

Ethics, Aesthetics, and Recreation Some people believe that we should preserve biodiversity for ethical reasons. They believe that species and ecosystems have a right to exist whether or not they have any other value. To people of some cultures and religions, each organism on Earth is a gift with a higher purpose.

People also value biodiversity for aesthetic or personal enjoyment—keeping pets, camping, picking wildflowers, or watching wildlife. Some regions earn the majority of their income from **ecotourism,** a form of tourism that supports the conservation and sustainable development of ecologically unique areas.

SECTION 1 Review

1. **Describe** the general diversity of species on Earth in terms of relative numbers and types of organisms. Compare known numbers to estimates.
2. **Describe** the three levels of biodiversity. Which level is most commonly meant by *biodiversity?*
3. **Explain** how biodiversity is important to ecosystems, and give examples of how it is important to humans.

CRITICAL THINKING

4. **Analyzing a Viewpoint** Is it possible to put a price on a single species? Explain your answer.
5. **Predicting Consequences** What is your favorite type of organism? If this organism were to go extinct, how would you feel? What would you be willing to do to try to save it from extinction? Write a short essay describing your reaction. WRITING SKILLS

SECTION 2

Biodiversity at Risk

The last of the dinosaurs died about 65 million years ago, when a series of changes in the Earth's climate and ecosystems caused the extinction of about half the species on Earth. The extinction of many species in a relatively short period of time is called a *mass extinction.* Earth has experienced several mass extinctions, as shown in **Figure 6,** each probably caused by a global change in climate. It takes millions of years for biodiversity to rebound after a mass extinction.

Objectives

- Define and give examples of *endangered* and *threatened species.*
- Describe several ways that species are being threatened with extinction globally.
- Explain which types of threats are having the largest impact on biodiversity.
- List areas of the world that have high levels of biodiversity and many threats to species.
- Compare the amount of biodiversity in the United States to that of the rest of the world.

Key Terms

endangered species
threatened species
exotic species
poaching
endemic species

Current Extinctions

Scientists are warning that we are in the midst of another mass extinction. The rate of extinction is estimated to have increased by a multiple of 50 since 1800. Between 1800 and 2100, up to 25 percent of all species on Earth may have become extinct. The current mass extinction is different from those of the past because humans are the primary cause of the extinctions.

Species Prone to Extinction Cockroaches and rats are not likely to become extinct because they have large populations that adapt easily to many habitats. But species with small populations in limited areas can easily become extinct. Species that are especially at risk of extinction include those that migrate, those that need large or special habitats, and those that are exploited by humans.

An **endangered species** is a species that is likely to become extinct if protective measures are not taken immediately. A **threatened species** is a species that has a declining population and that is likely to become endangered if it is not protected. Additional categories of risk exist for certain legal and biological purposes.

Figure 6 ▶ Biodiversity has generally increased over time, as indicated here by the numbers of families of marine animals. The past five mass extinctions were probably caused by global climate changes.

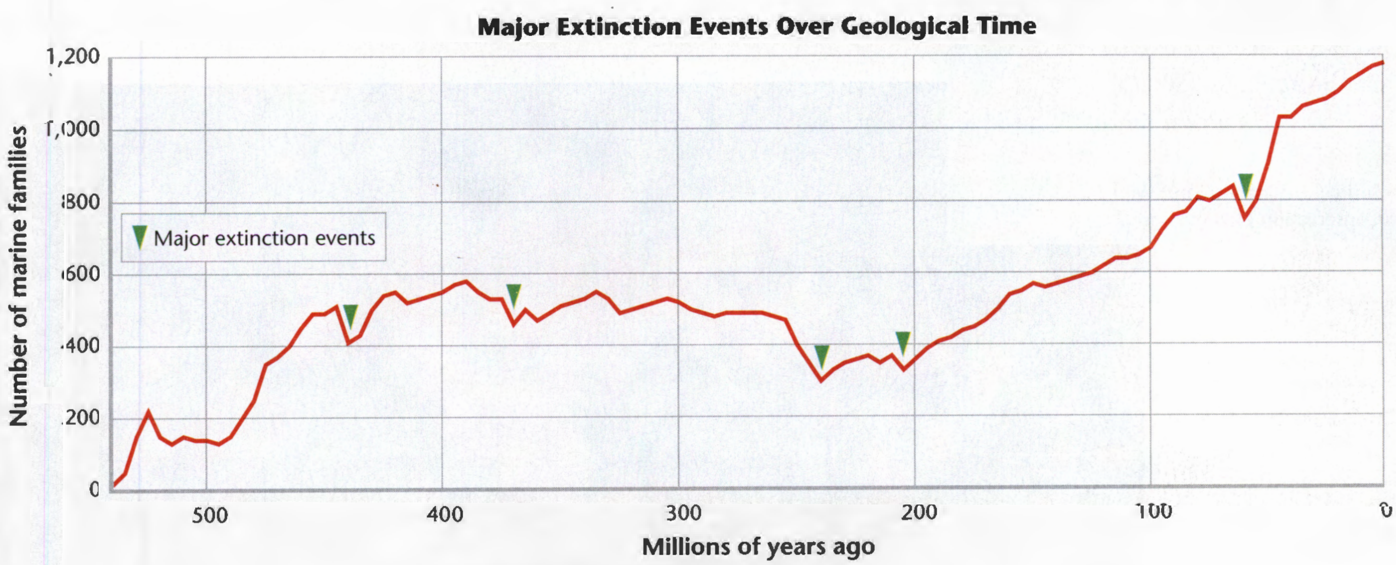


Table 3 ▼

Species Known to Be Threatened or Extinct Worldwide			
Type of species	Number threatened (all categories of risk)	Number extinct (since ~1800)	Percent of species that may be threatened
Mammals	1,130	87	26
Birds	1,183	131	12
Reptiles	296	22	3.3
Amphibians	146	5	3.1
Fishes	751	92	3.7
Insects	555	73	0.054
Other crustaceans	555	73	1.03
Mollusks and worms	944	303	1.3
Plants	30,827	400	0.054

Source: UN Environment Programme.

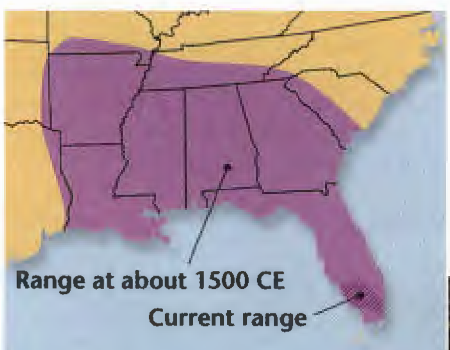
How Do Humans Cause Extinctions?

In the past 2 centuries, human population growth has accelerated and so has the rate of extinctions. The numbers of worldwide species known to be threatened, endangered, or recently extinct are listed in **Table 3.** The major human causes of extinction today are the destruction of habitats, the introduction of nonnative species, pollution, and the overharvesting of species.

Habitat Destruction and Fragmentation As human populations grow, we use more land to build homes and harvest resources. In the process, we destroy and fragment the habitats of other species. It is estimated that habitat loss causes almost 75 percent of the extinctions now occurring.

Due to habitat loss, the Florida panther is one of the most endangered animals in North America. The panther and its historical range are shown in **Figure 7.** Two hundred years ago, cougars—

Figure 7 ▶ Fewer than 80 Florida panthers (right) remain in the wild. Almost all of the habitat (below) of this cougar subspecies has been destroyed or fragmented by commercial and housing development.



Source: Florida Fish and Wildlife Conservation Commission.

a species that includes panthers and mountain lions—ranged from Alaska to South America. Cougars require expansive ranges of forest habitat and large amounts of prey. Today, much of the cougars' habitat has been destroyed or broken up by roads, canals, and fences. In 2001, fewer than 80 Florida panthers made up the only remaining wild cougar population east of the Mississippi River.

Invasive Exotic Species An **exotic species** is a species that is not native to a particular region. Even such familiar organisms as cats and rats are considered to be exotic species when they are brought to regions where they never lived before. Exotic species can threaten native species that have no natural defenses against them. The invasive fire ants in **Figure 8** threaten livestock, people, and native species throughout the southeastern United States.

Harvesting, Hunting, and Poaching Excessive hunting and harvesting of species can also lead to extinction. In the United States in the 1800s and 1900s, 2 billion passenger pigeons were hunted to extinction and the bison was hunted nearly to extinction. Thousands of rare species worldwide are harvested and sold for use as pets, houseplants, wood, food, or herbal medicine.

Many countries now have laws to regulate hunting, fishing, harvesting, and trade of wildlife. However, these activities continue illegally, a crime known as **poaching.** In poor countries especially, local species are an obvious source of food, medicine, or income. Moreover, not all threatened species are legally protected.

Pollution Pesticides, cleaning agents, drugs, and other chemicals used by humans are making their way into food webs around the globe. The long-term effects of chemicals may not be clear until after many years of use. The bald eagle is a well-known example of a species that was endangered because of a pesticide known as DDT. Although DDT is now illegal to use in the United States, it is still manufactured here and used around the world.

Connection to Ecology

Extinction and Global Change
Scientists have worried for some time that environmental pollutants might cause drastic changes in our atmosphere and biosphere. However, it is difficult to draw a direct link from global changes to specific extinctions.

In recent decades, scientists have observed a worldwide decline in amphibian species. Unlike most cases of habitat loss or overhunting, there are no clear causes for these extinctions. But there is growing evidence to indicate two probable causes: the pollution of water sources with hormone-like chemicals and increased UV radiation exposure due to the thinning of the Earth's ozone layer.

Figure 8 ▶ Mounds made by imported fire ants cover many fields in the southeastern United States. As with many invasive exotic species, these ants had no natural predators and little competition from native species when they were first brought into the country by accident.

MATHPRACTICE

Estimating Species Loss
The annual loss of tropical forest habitat is estimated at about 1.8 percent per year. Some scientists estimate that this habitat loss results in a loss of about 0.5 percent of species per year. Given a low estimate of only 5 million species on Earth, how many years would it take for 1 million species to be lost, if current rates of habitat loss continue?

Areas of Critical Biodiversity

Certain areas of the world contain a greater diversity of species than other areas do. An important feature of such areas is that they have a large portion of **endemic species,** meaning species that are native to and found only within a limited area. Ecologists often use the numbers of endemic species of plants as an indicator of overall biodiversity, because plants form the basis of ecosystems on land. Ecologists increasingly point out the importance of biodiversity in oceans, though marine ecosystems are also complex and poorly understood.

Tropical Rain Forests The remaining tropical rain forests cover less than 7 percent of the Earth's land surface. Yet biologists estimate that over half of the world's species live in these forests. Most of these species have never been described. Unknown numbers of species are disappearing as tropical forests are cleared for farming or cattle grazing. Meanwhile, tropical forests are among the few places where some native people maintain traditional lifestyles and an intimate knowledge of their forest homes. The case study below explains the increasing value of such knowledge in the global marketplace.

CASE STUDY

A Genetic Gold Rush in the Rain Forests

How much is a species worth? To some people, there is money to be made in centers of biodiversity such as rain forests. Thus, the Amazonian rain forests are witnessing an increase in foreign visitors—not just tourists, but scientists searching for genes, glory, or enlightenment into the mysteries of these quickly disappearing treasures.

To biologists, the prospect of discovering new species may be a chance at fame. The first scientist to collect and describe a species often gets to choose a name for that species. For other scientists, researching the unknown inner workings of the rain forests is an adventure similar to the adventures of explorers charting new lands.

But like the quests of early European explorers of the Americas, some reasons to venture into the wilderness may be economic. The *biotechnology* industry is based on the application of biological science to create new products such as drugs. This industry depends on Earth's variety of organisms—especially their genetic material—for research and development.

In fact, the Brazilian government has taken notice of the increased international interest in the Amazon's amazing biological assets. The government has claimed the right to tax or patent any genetic material harvested from within its borders.

Other researchers are more interested in another special feature of the Amazon—native peoples. Some Amazonian natives, such as the Yanomamö, are still living a lifestyle of intimate connection to their forest

▶ This botanist is researching the uses of rain-forest plants and other species with the help of local people.

Coral Reefs and Coastal Ecosystems Like rain forests, coral reefs occupy a small fraction of the marine environment yet contain the majority of the biodiversity there. Reefs provide millions of people with food, tourism revenue, coastal protection, and sources of new chemicals. One study in 1998 estimated the value of these services to be $375 billion per year. But reefs are poorly studied and not as well protected by laws as terrestrial areas are. Nearly 60 percent of Earth's coral reefs are threatened by human activities, such as development along waterways, overfishing, and pollution. Similar threats affect coastal ecosystems, such as swamps, marshes, shores, and kelp beds. Coastal areas are travel routes for many migrating species as well as links to ecosystems on land.

Islands When an island rises from the sea, it is colonized by a limited number of species from the mainland. These colonizing species may then evolve into several new species. Thus, islands often hold a very distinct but limited set of species. For example, the Hawaiian Islands have 28 species of an endemic family of birds called *honeycreepers*. However, honeycreepers and many other island species are endangered because of invasive exotic species.

Geofact

The World's Largest Reef The Great Barrier Reef of Australia is the largest and probably the oldest reef system in the world. It stretches for 2,000 km (1,250 mi) and consists of 3,400 individual reefs.

▶ The Yanomamö are among the few native peoples of the tropical rain forests who still live traditional lifestyles and use their knowledge of the forests to meet all of their needs.

home, in much the same way as they have for thousands of years.

An important value of such native peoples is their vast knowledge of the variety of species in the ecosystems where they live. Their knowledge includes more than just being able to recognize or name species. For example, the Yanomamö make use of thousands of plants, fungi, and animals for food, drugs, weapons, and art. Amazonian natives such as the Yanomamö are probably best known for their use of the skin excretions of poison dart frogs for hunting.

Often, researchers originally learned of a useful species from a local shaman, or medicine man. Biochemistry researchers have been amazed by the complex combinations of new chemicals they have discovered in many rain-forest species. Some of these chemicals are already being used in research and medicine.

CRITICAL THINKING

1. Expressing Viewpoints To whom do you think the genetic material of the rain forests should belong? What are some ways this benefit of biodiversity might be shared with the whole world?

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Biodiversity Hotspots The most threatened areas of high species diversity on Earth have been labeled *biodiversity hotspots*. Twenty-five of these areas, shown in **Figure 9**, have been identified by international conservationists. The hotspot label was developed by ecologists in the late 1980s to identify areas that have high numbers of endemic species but that are also threatened by human activities. Most of these hotspots have lost at least 70 percent of their original natural vegetation. The hotspots include mostly tropical rainforests, coastal areas, and islands. In Madagascar, for example, only 18 percent of the original forests remain. More than 80 percent of Madagascar's 10,000 flowering plant species are endemic, as are 91 percent of its 300 reptile species. All 33 species of lemur, which make up a tenth of the world's primate species, are found only in Madagascar.

Figure 9 ▶ Conservationists have identified these 25 *biodiversity hotspots* (green). Examples of endangered species from some areas are shown.

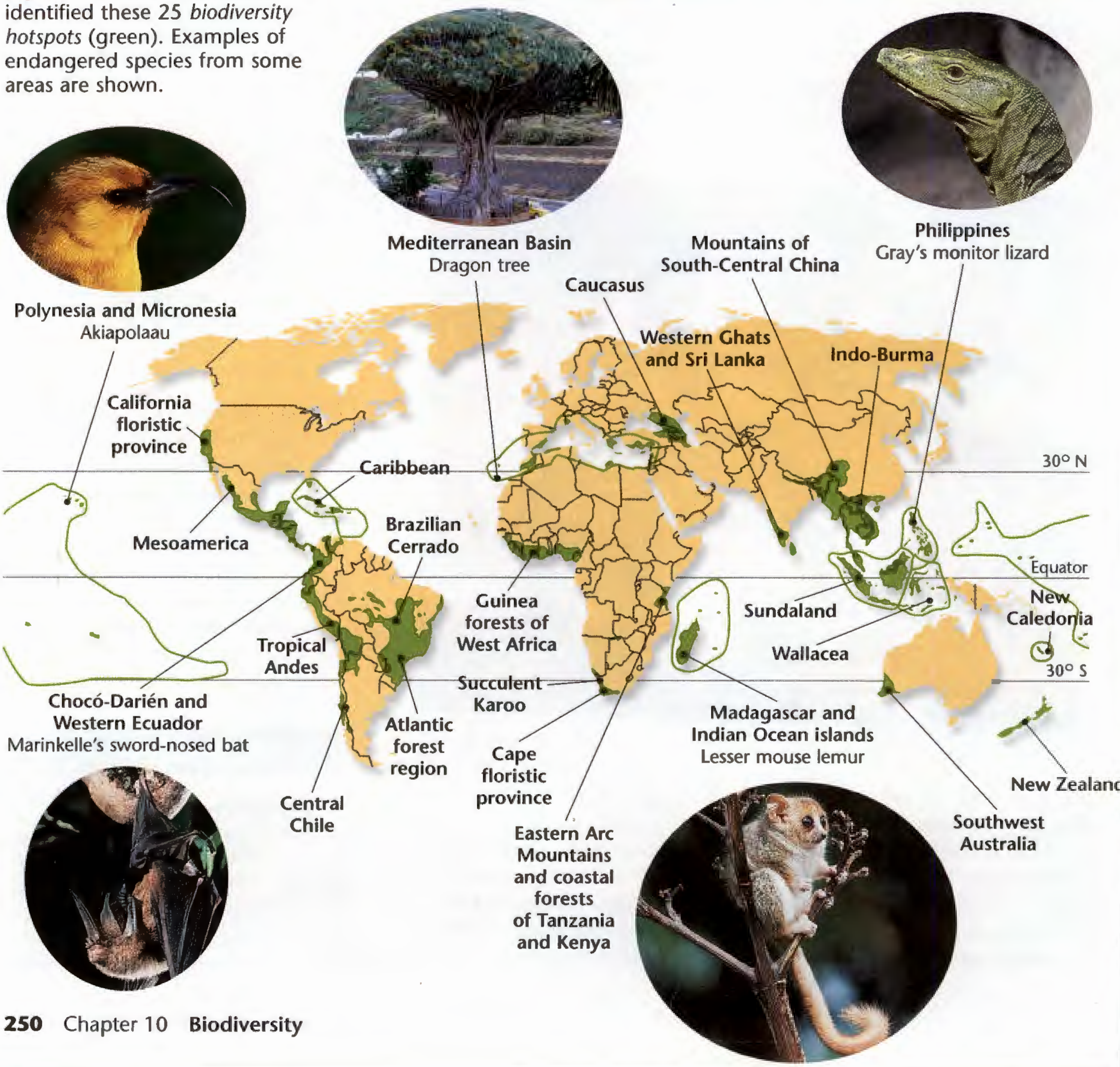

Figure 10 ▶ Examples of endemic species of the United States include ❶ the cecropia moth, (declining populations), ❷ the tulip poplar tree (limited distribution), ❸ the crayfish *Cambarus mongalensis* (limited distribution), ❹ the desert pupfish (endangered), and ❺ the northern spotted owl (threatened).

Biodiversity in the United States You may notice that three of the biodiversity hotspots in **Figure 9** are partly within U.S. borders. The United States includes a wide variety of unique ecosystems, including the Florida Everglades, the California coastal region, Hawaii, the Midwestern prairies, and the forests of the Pacific Northwest. The United States holds unusually high numbers of species of freshwater fishes, mussels, snails, and crayfish. Species diversity in the United States is also high among groups of land plants such as pine trees and sunflowers. Some examples of the many unique native species are shown in **Figure 10.**

The California Floristic Province, a biodiversity hotspot, is home to 3,488 native plant species. Of these species, 2,124 are endemic and 565 are threatened or endangered. The threats to this area include the use of land for agriculture and housing, dam construction, overuse of water, destructive recreation, and mining—all stemming from local human population growth.

SECTION 2 Review

1. **Describe** four ways that species are being threatened with extinction globally.
2. **Define** and give examples of *endangered species* and *threatened species.*
3. **List** areas of the Earth that have high levels of biodiversity and many threats to species.
4. **Compare** the amount of biodiversity in the United States to that of the rest of the world.

CRITICAL THINKING

5. **Interpreting Graphics** The biodiversity hot spots shown in Figure 9 share several characteristics besides a great number of species. Look at the map, and name as many shared characteristics as you can.
6. **Expressing Opinions** Which of the various threats to biodiversity do you think will be most difficult to stop? Which are hardest to justify? Write a paragraph to explain your opinion. WRITING SKILLS

SECTION 3

The Future of Biodiversity

Objectives

- List and describe four types of efforts to save individual species.
- Explain the advantages of protecting entire ecosystems rather than individual species.
- Describe the main provisions of the Endangered Species Act.
- Discuss ways in which efforts to protect endangered species can lead to controversy.
- Describe three examples of worldwide cooperative efforts to prevent extinctions.

Key Terms

germ plasm
Endangered Species Act
habitat conservation plan
Biodiversity Treaty

Slowing the loss of species is possible, but to do so we must develop new approaches to conservation and sensitivity to human needs around the globe. In this section, you will read about efforts to save individual species and to protect entire ecosystems.

Saving Species One at a Time

When a species is clearly on the verge of extinction, concerned people sometimes make extraordinary efforts to save the last few individuals. These people hope that a stable population may be restored someday. Methods to preserve individual species often involve keeping and breeding the species in captivity.

Captive-Breeding Programs Sometimes, wildlife experts may attempt to restore the population of a species through *captive-breeding* programs. These programs involve breeding species in captivity, with the hope of reintroducing populations to their natural habitats. One example of a captive-breeding program involves the California condor, shown in **Figure 11.**

Condors are scavengers. They typically soar over vast areas in search of dead animals to eat. Habitat loss, poaching, and lead poisoning brought the species near extinction. In 1986, the nine remaining wild California condors were captured by wildlife experts to protect the birds and to begin a breeding program. As of 2002, 58 condors had been returned to the wild and 102 were living in captivity. The question remains whether the restored populations will ever reproduce in the wild.

Preserving Genetic Material One way to save the essence of a species is by preserving its genetic material. **Germ plasm** is any form of genetic material, such as that contained within the reproductive, or germ, cells

Figure 11 ▶ The California condor (above) nearly became extinct in the 1980s. A captive-breeding program (right) is returning some condors to the wild.

of plants and animals. Germ-plasm banks store germ plasm for future use in research or species-recovery efforts. Material may be stored as seeds, sperm, eggs, or pure DNA. Germ plasm is usually stored in special controlled environments, such as that shown in **Figure 12,** to keep the genetic material intact for many years. Farmers and gardeners also preserve germ plasm when they save and share seeds.

Zoos, Aquariums, Parks, and Gardens The original idea of zoos was to put exotic animals on display. However, in some cases, zoos now house the few remaining members of a species and are perhaps the species' last hope for survival. Zoos, wildlife parks, aquariums, and botanical gardens are living museums of the world's biodiversity. Botanical gardens, such as the one shown in **Figure 13,** house about 90,000 species of plants worldwide. Even so, these kinds of facilities rarely have enough resources or knowledge to preserve more than a fraction of the world's rare and threatened species.

More Study Needed Ultimately, saving a few individuals does little to preserve a species. Captive species may not reproduce or survive again in the wild. Also, small populations are vulnerable to infectious diseases and genetic disorders caused by inbreeding. Conservationists hope that these strategies are a last resort to save species.

Figure 12 ▶ This scientist is handling samples of genetic material that are preserved in controlled conditions. The samples may be able to reproduce organisms many years from now.

Figure 13 ▶ This botanical garden is contained within a clear dome in Queen Elizabeth Park in Vancouver, Canada. The dome houses over 500 species of plants from all over the world as well as over 100 species of tropical birds.

Graphic Organizer

Spider Map Create the **Graphic Organizer** entitled "Spider Map" described in the Appendix. Label the circle "Conservation Efforts." Create a leg for each kind of conservation effort. Then, fill in the map with details about each of the ways people today are trying to preserve diversity.

Figure 14 ▶ Another conservation strategy is to promote more creative and sustainable land uses. This coffee crop is grown in the shade of native tropical trees instead of on cleared land. This practice is restoring habitat for many migrating songbirds.

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QuickLAB

Design a Wildlife Preserve

Procedure

1. Imagine you have enough money and political support to set aside some land in your community to be habitat for local wildlife. Your goal is to decide which areas to preserve.
2. Find out which species in your area would need this protection the most, where they currently exist, and what their habitat needs are.
3. Use a **colored pencil** to draw some proposed preserve areas on a copy of a **local map.**

Analysis

1. Explain why you chose the areas you did. Can you connect or improve any existing areas of habitat? How could you reduce various threats to the species?

Preserving Habitats and Ecosystems

The most effective way to save species is to protect their habitats. But setting aside small plots of land for a single population is usually not enough. A species confined to a small area could be wiped out by a single natural disaster. Some species require a large range to find adequate food, find a suitable mate, and rear their young. Therefore, protecting the habitats of endangered and threatened species often means preserving or managing large areas.

Conservation Strategies Most conservationists now give priority to protecting entire ecosystems rather than individual species. By protecting entire ecosystems, we may be able to save most of the species in an ecosystem instead of only the ones that have been identified as endangered. The general public has begun to understand that Earth's biosphere depends on all its connected ecosystems in ways we may not yet fully realize or be able to replace.

To protect biodiversity worldwide, conservationists focus on the hotspots described in the previous section. However, they also support additional strategies. One strategy is to identify areas of native habitat that can be preserved, restored, and linked into large networks. Another promising strategy is to promote products that have been harvested with sustainable practices, such as the shade-grown coffee shown in **Figure 14**.

More Study Needed Conservationists emphasize the urgent need for more serious study of the workings of species and ecosystems. Only in recent decades has there been research into such basic questions as, How large does a protected preserve have to be to maintain a certain number of species? How much fragmentation can a particular ecosystem tolerate? The answers may be years or decades away, but decisions affecting biodiversity continue to be made based on available information.

Legal Protections for Species

Many nations have laws and regulations designed to prevent the extinction of species, and those in the United States are among the strongest. Even so, there is controversy about how to enforce such laws and about how effective they are.

U.S. Laws In 1973, the U.S. Congress passed the **Endangered Species Act** and has amended it several times since. This law, summarized in **Table 4,** is designed to protect plant and animal species in danger of extinction. Under the first provision, the U.S. Fish and Wildlife Service (USFWS) must compile a list of all endangered and threatened species in the United States. As of 2002, 983 species of plants and animals were listed as endangered or threatened. Dozens more are considered for the list each year. The second main provision of the act protects listed species from human harm. Anyone who harms, buys, or sells any part of these species is subject to a fine. The third provision prevents the federal government from carrying out any project that jeopardizes a listed species.

Recovery and Habitat Conservation Plans Under the fourth main provision of the Endangered Species Act, the USFWS must prepare a *species recovery plan* for each listed species. These plans often propose to protect or restore habitat for each species. However, attempts to restrict human uses of land can be controversial. Real-estate developers may be prohibited from building on their own land because it contains critical habitat for a species. People may lose income when land uses are restricted and may object when their interests are placed below those of another species.

Although battles between developers and environmentalists are widely publicized, in most cases compromises are eventually worked out. One form of compromise is a **habitat conservation plan**—a plan that attempts to protect one or more species across large areas of land through trade-offs or cooperative agreements. The region of California shown in **Figure 15** is part of a habitat conservation plan.

Table 4 ▼

Major Provisions of the Endangered Species Act
• The U.S. Fish and Wildlife Service (USFWS) must compile a list of all endangered and threatened species.
• Endangered and threatened animal species may not be caught or killed. Endangered and threatened plants on federal land may not be uprooted. No part of an endangered and threatened species may be sold or traded.
• The federal government may not carry out any project that jeopardizes endangered species.
• The U.S. Fish and Wildlife Service must prepare a species recovery plan for each endangered and threatened species.

Figure 15 ▶ This region of San Diego, California, is home to several endangered species. A habitat conservation plan attempts to protect these species by managing a large group of lands in the area.

Figure 16 ▶ Scenes like this one of elephant tusk poaching were common before the worldwide ban on the sale of ivory as part of CITES.

International Cooperation

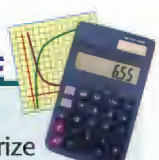
At the global level, the International Union for the Conservation of Nature and Natural Resources (IUCN) facilitates efforts to protect species and habitats. This organization is a collaboration of almost 200 government agencies and over 700 private conservation organizations. The IUCN publishes *Red Lists* of species in danger of extinction around the world. The IUCN also advises governments on ways to manage their natural resources, and works with groups like the World Wildlife Fund to sponsor conservation projects. The projects range from attempting to stop poaching in Uganda to preserving the habitat of sea turtles on South American beaches.

International Trade and Poaching One product of the IUCN has been an international treaty called *CITES* (the Convention on International Trade in Endangered Species). The CITES treaty was the first effective effort to stop the slaughter of African elephants. Elephants were being killed by poachers who would sell the ivory tusks. Efforts during the 1970s and 1980s to limit the sale of ivory did little to stop the poaching. Then in 1989, the members of CITES proposed a total worldwide ban on all sales, imports, and exports of ivory, hoping to put a stop to scenes like those in **Figure 16.**

Some people worried that making ivory illegal might increase the rate of poaching instead of decrease it. They argued that illegal ivory, like illegal drugs, might sell for a higher price. But after the ban was enacted, the price of ivory dropped, and elephant poaching declined dramatically.

The Biodiversity Treaty One of the most ambitious efforts to tackle environmental issues on a worldwide scale was the United Nations Conference on Environment and Development, also known as the first *Earth Summit.* More than 100 world leaders and 30,000 other participants met in 1992 in Rio de Janeiro, Brazil.

MATHPRACTICE



Measuring Risk There are many ways to categorize a species' degree of risk of extinction. The IUCN and the Nature Conservancy have multiple ranks for species of concern, ranging from "presumed extinct" to "secure." According to one study of 20,500 species in the United States, 1,400 of those species were at some risk. Calculate this number of species at risk as a percentage. Use this percentage to estimate how many species may be at risk around the world.

An important result of the Earth Summit was an international agreement called the Biodiversity Treaty. The treaty's goal is to preserve biodiversity and ensure the sustainable and fair use of genetic resources in all countries. However, the treaty took many years to be adopted into law by the U.S. government. Some political groups objected to the Treaty, especially to the suggestion that economic and trade agreements should take into account any impacts on biodiversity that might result from the agreements. The international community will thus continue to have debates like those that have surrounded the Endangered Species Act in the United States.

Figure 17 ▶ These Greenpeace activists are blocking the path of a Japanese whaling ship. Do you think this is an effective way to protect species?

Private Conservation Efforts Many private organizations work to protect species worldwide, often more effectively than government agencies. The World Wildlife Fund encourages the sustainable use of resources and supports wildlife protection. The Nature Conservancy has helped purchase millions of hectares of habitat preserves in 29 countries. Conservation International helps identify biodiversity hotspots and develop ecosystem conservation projects in partnership with other organizations and local people. Greenpeace International organizes direct and sometimes confrontational actions, such as the one shown in **Figure 17**, to counter environmental threats.

Balancing Human Needs

Attempts to protect species often come into conflict with the interests of the world's human inhabitants. Sometimes, an endangered species represents a source of food or income. In other cases, a given species may not seem valuable to those who do not understand the species' role in an ecosystem. Many conservationists feel that an important part of protecting species is making the value of biodiversity understood by more people.

FIELD ACTIVITY

Simple Biodiversity Assessment Discover the diversity of weeds and other plants in a small area. Yards, gardens, and vacant lots are good places to conduct such a study. Mark off a 0.5 m^2 section. Use a field guide to identify every plant species that you can. At least identify how many different kinds of plants there are. You may want to sketch or photograph some of the plants. Then count the number of each kind of plant you identified. Record your results in your ***EcoLog.***

SECTION 3 Review

1. **Describe** four types of efforts to save individual species.
2. **Explain** the advantages of protecting entire ecosystems rather than individual species.
3. **Describe** the main provisions of the Endangered Species Act.
4. **Give** examples of worldwide cooperative efforts to prevent extinctions.

CRITICAL THINKING

5. **Analyzing Methods** Read the headings in this section. Which type of effort to preserve species do you think is most worthwhile? READING SKILLS
6. **Comparing Viewpoints** Discuss ways in which efforts to protect species can lead to controversy.
7. **Inferring Relationships** Why was a complete ban of ivory sales more effective than a limited ban?

CHAPTER 10

Highlights

1 What Is Biodiversity?

Key Terms

biodiversity, 241
gene, 242
keystone species, 242
ecotourism, 244

Main Ideas

▶ Biodiversity usually refers to the number and variety of different species in a given area, but it can also describe genetic variation within populations or variation across ecosystems.

▶ The study of biodiversity starts with the unfinished task of identifying and cataloging all species on Earth. Although scientists disagree about the probable number of species on Earth, they do agree that we need to study biodiversity more thoroughly.

▶ Humanity benefits from biodiversity in several ways and perhaps in some unknown ways.

2 Biodiversity at Risk

endangered species, 245
threatened species, 245
exotic species, 247
poaching, 247
endemic species, 248

▶ Many scientists are now concerned that loss of biodiversity is the most challenging environmental issue we face.

▶ The most common cause of extinction today is the destruction of habitats by humans. Unregulated hunting and the introduction of nonnative species also contribute to extinctions.

▶ Certain areas of the world contain a greater diversity of species than other areas. An important feature of such areas is that they have a large portion of endemic species.

▶ The United States has a very important role in preserving biodiversity.

3 The Future of Biodiversity

germ plasm, 252
Endangered Species Act, 255
habitat conservation plan, 255
Biodiversity Treaty, 257

▶ Most major conservation efforts now concentrate on protecting entire ecosystems rather than individual species.

▶ The Endangered Species Act establishes protections for endangered and threatened species in the United States. The act has generated some controversy and has been amended several times.

▶ International cooperation has led to increased recognition and protection of biodiversity worldwide.

▶ The desire to protect biodiversity often conflicts with other human interests.

CHAPTER 10 Review

Using Key Terms

Use each of the following terms in a separate sentence.

1. *keystone species*
2. *ecotourism*

For each pair of terms, explain how the meanings of the terms differ.

3. *hunting* and *poaching*
4. *endemic species* and *exotic species*
5. *endangered species* and *threatened species*
6. *gene* and *germ plasm*
7. *CITES* and *Biodiversity Treaty*

STUDY TIP

Use a Map As you review the chapter, refer to an atlas, to the maps in the Appendix, or to previous chapters about biomes to compare information. Draw your own map or make a list of the locations of some of the interesting species and ecosystems that you learn about.

Understanding Key Ideas

8. The term *biodiversity* refers to
   - **a.** the variety of species on Earth.
   - **b.** the extinction of the dinosaurs.
   - **c.** habitat destruction, invasive exotic species, and poaching.
   - **d.** the fact that 40 percent of prescription drugs come from living things.
9. Most of the living species known to science
   - **a.** are large mammals.
   - **b.** live in deserts.
   - **c.** live in the richer countries of the world.
   - **d.** are insects.
10. Some species are so important to the functioning of an ecosystem that they are called
    - **a.** threatened species.
    - **b.** keystone species.
    - **c.** endangered species.
    - **d.** extinct species.
11. A mass extinction is
    - **a.** a rapid increase in biodiversity.
    - **b.** the introduction of exotic species.
    - **c.** the extinction of many species in a short period of time.
    - **d.** a benefit to the environment.
12. When sea otters disappeared from the Pacific coast of North America,
    - **a.** the area became overrun with kelp.
    - **b.** the number of fish in the kelp beds increased.
    - **c.** the number of sea urchins in the kelp beds increased.
    - **d.** the area became overrun with brown seaweed.
13. Which of the following statements about the Endangered Species Act is *not* true?
    - **a.** Parts of an endangered animal, such as feathers or fur, may be traded or sold but only if the animal is not killed.
    - **b.** A species is considered endangered if it is expected to become extinct in the near future.
    - **c.** The federal government cannot carry out a project that may jeopardize an endangered plant.
    - **d.** A recovery plan is prepared for all animals that are listed as endangered.
14. Because of efforts by the Convention on International Trade in Endangered Species (CITES),
    - **a.** the poaching of elephants increased.
    - **b.** the cost of ivory worldwide increased.
    - **c.** the international trade of ivory was banned worldwide.
    - **d.** a captive-breeding program for elephants was established.
15. Emphasizing the preservation of entire ecosystems will
    - **a.** cause the economic needs of farmers to suffer in order to save a single species.
    - **b.** decrease biodiversity, especially in tropical rain forests, coral reefs, and islands.
    - **c.** throw the food webs of many ecosystems out of balance.
    - **d.** save many unknown species from extinction.

CHAPTER 10 Review

Short Answer

16. When was hunting a major cause of extinctions in the United States?

17. What are exotic species, and how do they endanger other species?

18. Why do biologists favor using an ecosystem approach to preserve biodiversity?

19. Describe three ways that preserving biodiversity can come into conflict with human interests.

Interpreting Graphics

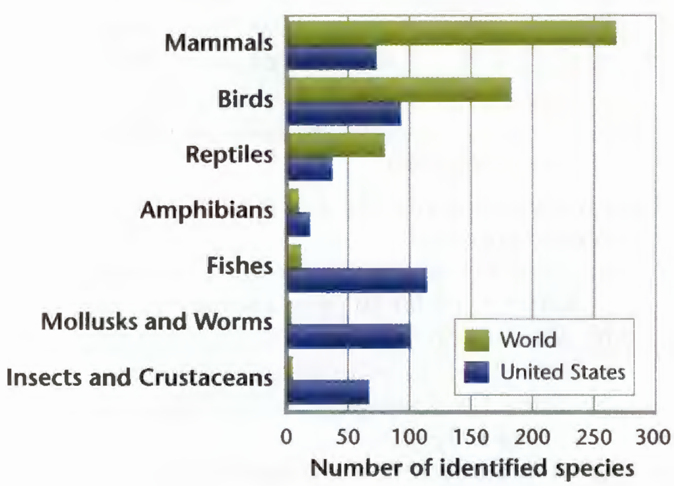
The graph below shows the numbers of various types of species that are officially listed as endangered or threatened in the United States and internationally. Use the graph to answer questions 20–23.

20. Do these numbers necessarily reflect *all* species that may be in danger? Explain your answer.

21. Which types of species might be underrepresented here?

22. Compare the United States and world listings. What trends do you see in the types of species listed?

23. Given this information, which types of species might need further research worldwide?



Concept Mapping

24. Use the following terms to create a concept map: *biodiversity, species, gene, ecosystem, habitat loss, poaching, exotic species, germ plasm, captive breeding programs,* and *habitat preservation.*

Critical Thinking

25. Comparing Processes Read the passage in this chapter that describes current extinctions. How are the extinctions that are occurring currently different from most extinctions in the past? READING SKILLS

26. Analyzing Methods With unlimited funding, could zoos and captive-breeding programs restore most endangered animal populations? Explain your answers.

27. Determining Cause and Effect How might the loss of huge tracts of tropical rain forests have an effect on other parts of the world?

Cross-Disciplinary Connection

28. Literature Try to remember or find some children's stories that include wild animals that are currently endangered, threatened, or extinct. Write a description of how these animals are portrayed in the stories. Also compare the animals in the stories to what you know about the real animals. WRITING SKILLS

29. Geography Obtain a list of the plants and animals that are endangered in your state. Find out where these species live, and mark the locations on a map of your state. Research the effects of habitat loss on species in your county or in surrounding areas.

Portfolio Project

30. Endangered Species Outreach Create a special project about one endangered species of your choice. Consider using a poster, an oral presentation, or a video to inform your classmates about your chosen species or to persuade them of the importance of saving the species.

MATH SKILLS

Use the table below to answer questions 31–32.

31. **Analyzing Data** Which of the types of species in the table below are most accurately described? What do the numbers indicate about how well various species are studied?

32. **Applying Quantities** Which of the types of species may represent the greatest unknown loss of biodiversity? Which type of species is probably least important for further research into biodiversity?

Estimates of Knowledge of Earth's Species

Type of species	Number of species described	Described species as % of total	Number threatened or extinct	Accuracy of estimates
Bacteria	4,000	0.40	(unknown)	very poor
Vertebrates	52,000	94.55	3,843	good
Crustaceans	40,000	26.67	628	moderate
Plants	270,000	84.38	31,277	good

WRITING SKILLS

33. **Writing Persuasively** Write a letter to the editor of a publication or to an elected representative in which you express your opinion regarding protections of endangered species that might affect your local area.

34. **Outlining Topics** Outline the major strategies for protecting biodiversity that have been described in this chapter. List pros and cons of each strategy.

STANDARDIZED TEST PREP

For extra practice with questions formatted to represent the standardized test you may be asked to take at the end of your school year, turn to the sample test for this chapter in the Appendix.

READING SKILLS

Read the passage below, and then answer the questions that follow.

Excerpt from M. Reaka-Kudla, D. Wilson, and E. Wilson, eds., Biodiversity II, *1996.*

Aside from the academic tradition of biodiversity, another powerful influence, related to biodiversity, brought our culture to its current level of technological development: the exploration of the New World. From the thirteenth to the nineteenth centuries, technological developments in navigation allowed European voyagers to embark on an unprecedented exploration of the globe. These expeditions revolutionized knowledge of the geography, human culture, and biology of the world at the time. This ultimately led to a reevaluation of human society's place in the world and an understanding of the evolution of all living things. But the exploration also allowed the acquisition of untold wealth in living and nonliving natural resources, which was brought back from the New World and invested in the culture of western Europe.

1. What do the authors probably mean by the term *influence*?
   a. a force of cultural change
   b. a new type of scientific discovery
   c. a source of geographic information
   d. a form of navigation

2. Which of the following are not mentioned by the authors as factors in our current level of technological development?
   a. geographical information
   b. knowledge of a variety of species
   c. new forms of government
   d. evolutionary theory

3. Which of the following did the authors most likely discuss in the paragraph just *before* this passage?
   a. natural resources of the New World
   b. religious beliefs of native peoples
   c. academic tradition of European biology
   d. history of European expeditions

CHAPTER 10

Exploration Lab: FIELD ACTIVITY

Objectives

- **USING SCIENTIFIC METHODS** **Observe and measure** differences in species diversity between two locations.
- **USING SCIENTIFIC METHODS** **Graph and analyze** data collected to reflect differences in species diversity.
- **Evaluate** the possible reasons for observed differences in biodiversity.
- **USING SCIENTIFIC METHODS** **Infer** other human activities that may influence local biodiversity.

Materials

graph paper
hand lens
meterstick or tape measure
pen or pencil
string or chalk line

optional materials: **local-area field guides for plants, animals, and soil organisms; shovel or trowel**

▶ **Step 2** Measure and mark off sample areas for your observation and counts of species diversity.

Differences In Diversity

Biodiversity is most obvious and dramatic in tropical rain forests and coral reefs, but you do not have to travel that far to observe differences in species diversity or to see the effects that humans can have on biodiversity.

Recall that biodiversity is most often defined as the number of different species that are present in a given area. This measure can be estimated by making a sample count of species within a representative area. It is often easiest and most effective to collect or observe small organisms, such as insects and soil dwellers, or stationary organisms, such as plants and trees. In this activity, you will investigate the differences in species diversity in two areas that are close to each other, but that are affected differently by humans. You may work in teams or groups.

Procedure

1. Choose two sites for your analysis. Site 1 should be an area that has been greatly affected by humans, such as your school building and the surrounding sidewalks, parking area, or groomed lawns. Site 2 should be an area within view of site 1 but that is less affected by humans, such as a wooded area or a vacant lot overgrown with weeds. If directed by your teacher, you may choose more than two sites. Also ask your teacher about your sample square size.
2. At each site, measure a 5 m × 5 m square area using the meterstick or tape measure. You might use the edge of a building as a side of your square, or you might use trees as the corners. Mark the measurement of the area with string or a chalk line, as shown in the photograph.
3. Observe each site carefully, and record a detailed description of each site. Include as many features as possible, such as location, soil condition, ways the area is used, amount of sun or rain exposure, and other factors that might affect the organisms that exist there.
4. For each site, create a table like the table below.

Species Counts Per Site		
Species type	**Site number ___**	**Site number ___**
Animals		
Plants		
Fungi and other soil organisms		

5. Using your hand lens, find as many different species as possible within the site. Record each new species by placing a slash or tick mark in the column for each different species identified in each general category. You do not need to identify every organism by scientific name, but using field guides may help you have an idea of what you are finding. You may also make more specific categories (such as birds, insects, grasses, and trees) if you are able. Be careful not to disturb the area unnecessarily.
6. Repeat steps 2–5 for each site. If directed by your teacher, compare your data with those of other groups.
7. After you have made and recorded all of your observations, put away your materials and restore anything you disturbed at the sites.

▶ **Step 5** Observe and record how many different types of organisms you find within each sample area.

Analysis

1. **Constructing Graphs** Create a bar graph of the number of species counted at each site. As directed by your teacher, you may combine all species counts into one total per site or graph each category of organisms separately.
2. **Analyzing Results** Based on your observations of the organisms found at the sites, which area reflected a higher level of biodiversity?
3. **Interpreting Results** What factors may have contributed to the differences in biodiversity at the sites?

Conclusions

4. **Drawing Conclusions** What can you conclude about the effect of human activities on biodiversity?
5. **Applying Conclusions** What other human activities, besides those you observed directly, could have affected the biodiversity present at your sites?
6. **Evaluating Methods** Do you feel that the method used in this lab was an effective way to identify biodiversity in an area? Why or why not? How could it have been improved?

Extension

1. **Research and Communications** If you were able to use local field guides, what can you generalize about the organisms that you were able to identify? Pay attention to aspects such as how easily recognized each organism is, how common it is in your local area, where it is found outside of your area, or what other unique facts are known about the biology or habitat needs of the organism.

Making a difference

DR. E. O. WILSON: CHAMPION OF BIODIVERSITY

Dr. Edward Osborne Wilson deserves some of the credit for the fact that this book includes a chapter called "Biodiversity." A few decades ago, the word *biodiversity* was used by few scientists and was found in few dictionaries. Dr. Wilson has helped make the concept and value of biodiversity widely recognized, through his extensive research, publishing, organizing, and social advocacy.

Since his early career as a pioneer in the fields of entomology and sociobiology, Dr. Wilson has gained recognition for many additional accomplishments. He has written two Pulitzer Prize-winning nonfiction books, and has received the National Medal of Science and dozens of other scientific awards and honors. Wilson is widely recognized as one of the most influential scientists and citizens of our time.

It All Started with Bugs

Even before his scientific career, Wilson developed a fascination with insects and the natural world. He always had high expectations of himself but made the best of circumstances. Although his parents were divorced and his father's government career required frequent moves, Wilson found companionship in the woods of the southern United States or the museums of Washington, D.C. After injuries damaged his vision and hearing, Wilson focused his scientific skills on the smaller forms of life.

By the time he earned his master's degree at the University of Alabama at the age of 20, Wilson was well known as a promising *entomologist*—an expert on the insect world. His specialty is the study of ants and their complex social behaviors. So it makes sense that Wilson next went to study at Harvard University, home to the world's largest ant collection. While at Harvard, he earned his Ph.D., conducted field research around the world, collected more than 100 previously undescribed species, and wrote several books on insect physiology and social organization. He eventually became curator of the Museum of Entomology at Harvard.

Clearly, Wilson has a passion for insects. "There is a very special pleasure in looking in a microscope and saying I am the first person to see a species that may be millions of years old," he says. Some of Wilson's research has focused on the social behavior of ants. Among other important scientific findings, Wilson was the first to demonstrate that ant behavior and communication is based mostly on chemical signals.

► Dr. Wilson with one of his favorite subjects—ants.

From Insects to Humans

In 1971, Wilson published *The Insect Societies,* which surveyed the evolution of social organization among wasps, ants, bees, and termites. Wilson began to extend his attempts to understand the relationship of biology and social behavior to other animals, including humans. In 1975, Wilson published a controversial book exploring these new ideas, called *Sociobiology*. Now an accepted branch of science, sociobiology is the study of the biological basis of social behavior in animals, including humans.

During Wilson's studies of the behavior of ants and other social insects, he became interested in the insects' role in the ecosystems where he studied them. Some of his research involved camping for months at a time in a remote wilderness such as the Amazon basin, carefully studying the activities of certain species. His writings include amazing tales of watching huge colonies of "driver" ants swarm out over an area, capturing and killing a great many other species in their path.

If you have ever played the popular computer game *SimAnt*™, Dr. Wilson again deserves credit for providing the inspiration. In 1990, Wilson received his second Pulitzer Prize for co-authoring *The Ants,* an enormous encyclopedia of the ant world. In addition to describing 8,800 known species of ants, the book details the great variations among ant species in terms of anatomy, biochemistry, complex social behaviors, and especially their critical role in many ecosystems. Wilson reminds us that ants "are some of the most abundant and diverse of the Earth's 1.4 million species. They're among the little creatures that run the earth. If ants and other small animals were to disappear, the Earth would rot. Fish, reptiles, birds—and humans—would crash to extinction."

▶ Dr. Wilson (center) speaks to politicians and the public about the need to conserve our planet's biodiversity.

Onward to Biodiversity

As with many great scientists, each thing Dr. Wilson studies leads him to new questions and new ideas. During his research in remote lands, Wilson spent time reflecting and writing on the nature of ecosystems, the importance of biodiversity, and the role of humans in relation to these. In 1992, he put many of these ideas into another popular book called *The Diversity of Life*. This book combined Wilson's engaging writing style and personal expertise with the latest ecological research. The book showed both how such incredible biodiversity has evolved on the Earth and how this asset is being lost because of current human activities. The book clearly explained for the general public many of the problems and potential solutions regarding biodiversity that we have studied in this chapter.

Urgent Work

Despite his fame, Wilson is a soft-spoken fellow who would prefer to live a quiet life with his research and with his family in their home in the woods of Massachusetts. But the urgent problem of species loss makes Wilson willing to face the public. "Humanity is entering a bottleneck of overpopulation and environmental degradation unique in history. We need to carry every species through the bottleneck . . . Along with culture itself, they will be the most precious gift we can give future generations."

In 1986, Wilson served as one of the leaders of the first National Forum on Biodiversity, and then as editor of *Biodiversity,* the resulting collection of reports. Wilson continues to engage in public and private meetings with scientists and policy makers around the globe, urging them to support conservation efforts based on sound science.

Dr. Wilson recently began promoting the need for a global biodiversity survey. This project would involve an international scientific effort on par with the Human Genome Project. Wilson states that "to describe and classify all of the species of the world deserves to be one of the great scientific goals of the new century."

What Do You Think?

Do you find insects interesting? Could you imagine yourself as an entomologist? Do you think that Dr. Wilson made a goal early in his life to be an internationally famous conservationist? What has led him to take on this role?