THINK ABOUT

How do you use water?

Think of the number of times you use water every day. Like all living things, you need water. In fact, more than half of the material that makes up your body is water.

No matter where you live, most of the time you can turn on a faucet and clean water flows out the spout. You use water when you take a shower, fix a snack, or wash a dish. If you’ve ever lost water service to your home, you’ve probably been reminded how much you depend upon it. No doubt about it, our need for water is serious.

Humans use many resources.

Throughout history, people around the world have relied on natural resources for survival. Ancient civilizations used stone to create tools and weapons. And wood was an important fuel for cooking and keeping warm. Today, humans continue to rely on the environment and have discovered additional resources to meet their needs. In Section 14.1 you read about sharing natural resources. Scientists classify these resources into two categories:

• renewable resources
• nonrenewable resources

BEFORE, you learned

• Human populations are increasing
• Human population growth causes problems

NOW, you will learn

• How natural resources are classified
• How pollution affects the environment
• How a loss of diversity affects the environment

KEY CONCEPT

Human activities affect the environment.
Renewable Resources

Two hundred years ago, most small towns in the Northeastern part of the United States included farm fields, pasture, and woods. The wooded areas that weren’t farmed were used as wood lots. The wood from these lots supplied firewood for towns and was often exported for income.

Trees are an example of a renewable resource—a resource that can be used over and over again. Energy from sunlight is another important renewable resource. Because the Sun is expected to supply energy for another five billion years, energy from sunlight is considered essentially unlimited. As you read earlier in your study of the water cycle, water can be classified as a renewable resource. Renewable resources can be replaced naturally or by humans in a short amount of time, but they may run out if they are overused or managed poorly.

Nonrenewable Resources

Nonrenewable resources are resources that cannot be replaced. In some cases, they may be replenished by natural processes, but not quickly enough for human purposes. Nonrenewable resources are often underground, making them more difficult to reach. But technology has enabled humans to locate and remove nonrenewable resources from places that used to be impossible to reach.

Renewable Resources

- Trees: Wood from trees is used in many ways, such as for paper and building materials. New trees can be planted to replace trees that were cut down.
- Water: About 70% of Earth is covered by water, but most is salt water. Fresh water is a valuable resource that must be properly managed.

Nonrenewable Resources

- Oil: Oil and oil products are used as sources of energy. Because it takes millions of years to form, oil is considered a nonrenewable resource.
- Coal: Coal is the decayed remains of organisms that lived millions of years ago. It is burned to provide heat and electrical energy.
Coal, petroleum, and natural gas are nonrenewable resources that are removed from underground by mining or drilling. Also called fossil fuels, they are the main energy source for heating, industry, and transportation and are used to make many products. Many minerals, like copper and gold, are also considered nonrenewable resources.

**Pollution endangers biodiversity.**

As you walk along a city street, you may smell exhaust or see litter. These are examples of pollution. Pollution is the addition of harmful substances to the environment. Many of the ways humans use natural resources cause pollution to be released into the soil, air, and water. Pollutants include chemicals, bacteria, and dirt. Even materials that are ordinarily not harmful can cause pollution when they build up in one location.

As pollution becomes common in an ecosystem, living things may be threatened. Plant and animal populations may decrease and biodiversity may decline. Biodiversity is the number and variety of life forms within an ecosystem. Healthy ecosystems support a variety of species. An ecosystem with a variety of organisms can recover more easily from disturbances than an ecosystem that has fewer species.

**INVESTIGATE Particles in the Air**

*Where do you find air pollution?*

**PROCEDURE**

1. Use a hole punch to make holes at the ends of two index cards. Cut two pieces of string 30 cm long and tie one string to each card.
2. Choose a different location for each card. Mark the card with its location and the date.
3. Spread a thin film of petroleum jelly on a 3 cm² area on each card and hang each card at the location you’ve chosen.
4. Collect the cards in one week and examine them with the hand lens.

**WHAT DO YOU THINK?**

- Identify the types of particles collected at each location.
- Do you think of all of the particles collected as pollution?
- Which location had the most pollution?

**CHALLENGE** Hypothesize why certain locations have more particles in the air than others.
Air quality affects entire ecosystems. For example, in 1980, Mount St. Helens erupted on the West Coast of the United States. Hot ash was blown 15 miles up into the air. Three days later some of that ash reached the East Coast. Although natural events occasionally release air pollutants, human activities pollute every day.

Today in the United States, motor vehicles, factories, and power plants are the main sources of air pollution. The fossil fuels they burn release sulfur dioxide, nitrogen dioxide, and carbon monoxide into the air. These pollutants affect humans and animals and are the main cause of acid rain, a serious problem affecting ecosystems.

What air pollutants contribute to acid rain problems in the United States?

Acid rain occurs when air pollutants such as sulfur dioxide and nitrogen dioxide mix with water in the atmosphere to form acid droplets of rain, ice, snow, or mist. Just as the wind carried ash from Mount St. Helens, wind can carry these droplets for very long distances before they fall as rain.

Acid rain has been very harmful in areas without rich soil to help correct the rain’s acidity. In New York’s Adirondack Mountains, acid rain has killed all the fish in some lakes. The photograph below shows the impact of acid rain on trees in the Adirondacks. Where acid rain falls, it damages leaves and soil. This damage destroys both habitats and food sources for many animals, eventually reducing biodiversity.
Water Quality

Water quality is another factor that affects biodiversity in ecosystems. Forty years ago, newspaper headlines announced that Lake Erie was “dead” because of pollution. Almost every living thing in the lake had died. Lake Erie suffered for years from pollution by neighborhoods, industries, and farms along its banks. Rivers that emptied into the lake also carried pollution with them.

The pollution found in Lake Erie is common in communities across the United States. Chemicals or waste that drain off of farm fields, animal feedlots, and landfills all cause water pollution. So do oil spills, soil erosion, and the discharging of wastewater from towns and industries.

Like air pollution, water pollution affects entire ecosystems. One river that suffers from heavy pollution is the Duwamish River in Washington. Over 600 million gallons of untreated waste and storm water drain off the land into the river. As a result, large amounts of bacteria and harmful chemicals contaminate the water, killing fish and putting humans at risk.

When fish and amphibians in aquatic ecosystems are exposed to pollution, the entire food web is affected. If fish become scarce, some birds may no longer find enough food. The bird population may decrease as birds die or move to a new habitat. The result is that biodiversity in the ecosystem decreases.

CHECK YOUR READING

Name four different sources of water pollution.
Pollution Across Systems

As you have learned, pollution can be spread among ecosystems by abiotic factors. For example, wind carried ash from Mount St. Helens to different ecosystems. Wind also carries acid rain to forest ecosystems. Pollution can also move between air and water. For example, some chemical pollutants can run off land and into a body of water. These pollutants, like the water itself, can evaporate from the water’s surface and cycle into the air, moving into the atmosphere.

Habitat loss endangers biodiversity.

Scientists know that an ecosystem with many different species of plants and animals can withstand the effects of flooding, drought, and disease more effectively than an ecosystem with fewer species. But for biodiversity to be maintained, a habitat must be able to support a large number of different species. If living space is limited or a food source is removed, then the number of species in a biological community will be reduced.

Removing Habitat

One way human activities affect habitats is by reducing the amounts of natural resources available to living things. When this occurs, populations that rely on those resources are less likely to survive. For example, if you trim all the dead branches off the trees in your yard and remove them, insects that live in rotting wood will not settle in your yard. As a result, woodpeckers that may have nested in the area will lose their source of food. By removing this food source, you might affect the biodiversity in your backyard.

Now consider altering an ecosystem much larger than your backyard. Instead of removing a single resource, imagine removing a large area of land that is a habitat to many different species. Disturbing habitats removes not only food but space, shelter, and protection for living things.
Because of land development, forests that once stretched for hundreds of miles have been fragmented, or broken apart into small patches. Organisms that depend on trees cannot live in woods that have large areas that have been clear-cut. Their habitat is removed or reduced so there is a greater risk of attack by predators. Skunks, raccoons, and crows, which eat the eggs of forest songbirds, will not travel deep into large forests. However, they can reach nests more easily when forests are broken into small areas.

**CHECK YOUR READING** Why is biodiversity important and how can human activities affect it?

### Changing Habitat

Another kind of habitat loss occurs when humans move species into new habitats, either on purpose or by accident. Some species, when released in a new place, successfully compete against the native species, crowding them out. Over time, these species, called invasive species, may replace the native species.

One example of an invasive plant is purple loosestrife. In the 1800s loosestrife from Europe was brought to the United States to use as a garden plant and medicinal herb. One loosestrife plant can make about 2 million seeds a year. These seeds are carried long distances by wind, water, animals, and humans. Loosestrife sprouts in wetlands, where it can fill in open-water habitat or replace native plants such as goldenrod. Most ducks and fish do not feed on purple loosestrife.
Habitat loss occurs when purple loosestrife fills in open water or crowds out goldenrod.

Invasive Species  Purple loosestrife fills in wetlands and crowds out native species, disturbing organisms that rely on native species for food or living space.

Native Species  Goldenrod is a native species that is a food source for many wetland populations.

When the native plants that wetland animals depend on are crowded out by loosestrife, the animals disappear, too.

Scientists estimate that Earth supports more than 10 million different species. They also estimate that thousands of species are threatened, and over a hundred species of plants and animals become extinct every year. By protecting biodiversity we can help ecosystems thrive and even recover more quickly after a natural disturbance such as a hurricane. And biodiversity directly benefits humans. For example, many medications are based on natural compounds from plants that only grow in certain types of ecosystems.

14.2 Review

KEY CONCEPTS
1. List some renewable and nonrenewable resources that you need to survive.
2. Describe two ways in which pollution can move through ecosystems.
3. Explain what scientists mean by biodiversity.

CRITICAL THINKING
4. Explain Under some circumstances, valuable natural resources can be considered pollutants. Explain this statement, giving two examples.
5. Compare Identify two natural habitats in your area, one with high biodiversity and one with low biodiversity. Describe the biodiversity of each.

CHALLENGE
6. Hypothesize When lakes are polluted by acid rain, the water appears to become clearer, not cloudier. Why do you think this is the case?