

An Interconnected Planet

Key Ideas

- How are humans and the environment connected?
- What is the difference between renewable resources and nonrenewable resources?
- How can the state of the environment affect a person's health and quality of life?

Key Terms

fossil fuel

Why It Matters

The environment provides the resources that we need to live. When the environment is damaged, our resources are damaged.

We depend on the environment for food, water, air, shelter, fuel, and many other resources. However, human actions can affect the quality and availability of these important resources. The study of the impact of humans on the environment is called *environmental science*.

Humans and the Environment

10,000 years ago, there were only about 5 million people on Earth. The development of dependable food supplies, sanitation, and medical care have allowed the population to grow to more than 6 billion. The population will likely exceed 10 billion before it stabilizes. All 10 billion of these people will need a place to live. Humans now live in almost every kind of ecosystem on Earth. **Figure 1** shows one type of ecosystem in which humans live. As human population increases, the impact of humans on the environment increases. ➤ **Humans are a part of the environment and can affect the resilience of the environment.** The more that the human population grows, the more resources from the environment we will need to survive. Today's humans consume more resources than their ancestors did. The environment does not have an infinite amount of resources with which to meet human's demand.

Earth is an interconnected planet: we depend on the environment, and the environment is affected by our actions. Learning about this connectedness helps us care for the environment and ensures that the environment will continue to support us and other species on Earth.

- **Reading check** *How is Earth an interconnected planet? (See the Appendix for answers to Reading Checks.)*

Figure 1 This housing development lies in the marshlands along Myrtle Beach, South Carolina. ➤ **Can you describe another ecosystem that humans live in?**



ACADEMIC VOCABULARY

resource anything that can be used to take care of a need

SCILINKS

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Topic: Renewable and nonrenewable resources

Code: HX81290

fossil fuel a nonrenewable energy resource formed from the remains of organisms that lived long ago; examples include oil, coal, and natural gas

Figure 2 Windmills produce renewable wind energy, while the oil rig extracts a nonrenewable energy resource. ➤ Can you think of another example for each renewable and nonrenewable resource?

Resources

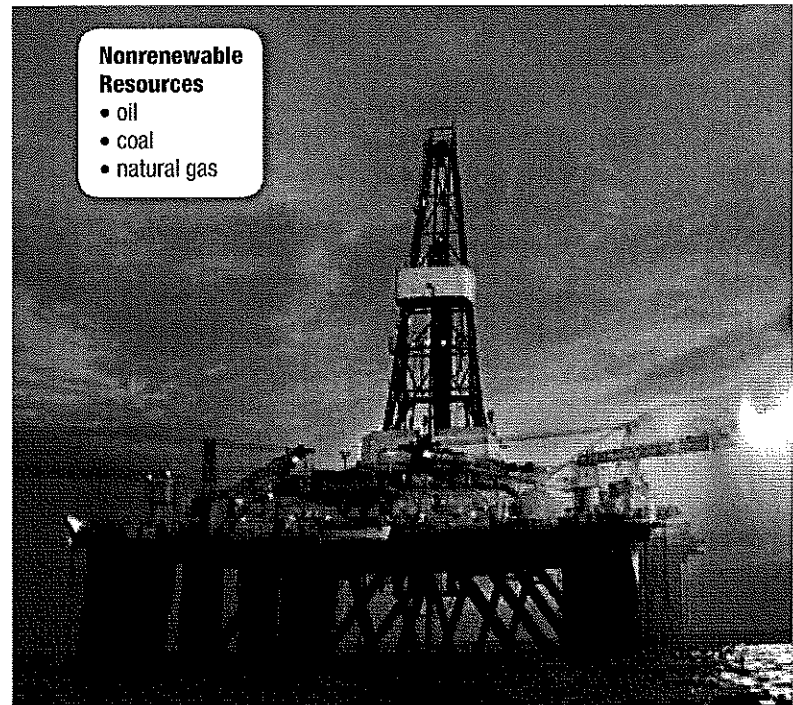
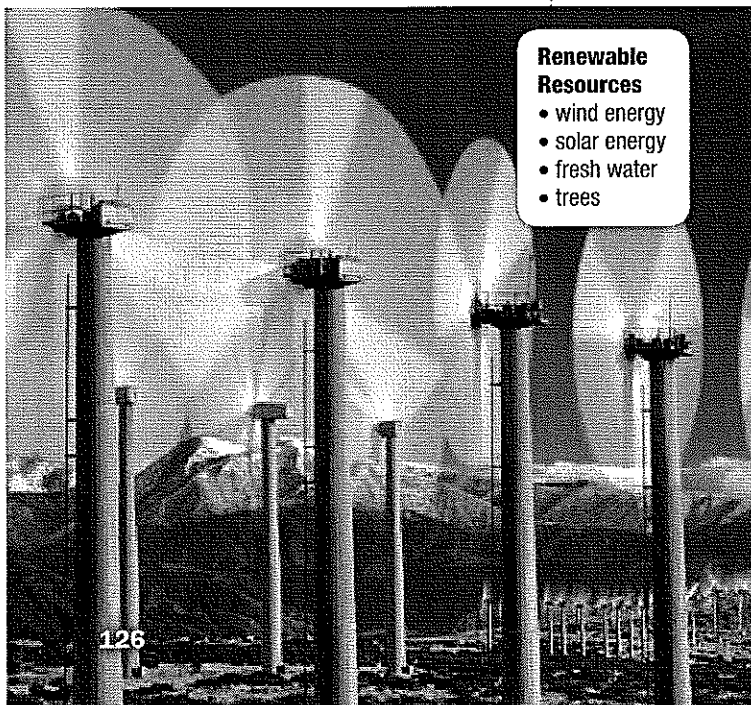
What would your day be like if you didn't have water to drink or electricity to provide lighting and heat? Water and fuel that generates electricity are two of Earth's many resources. Earth's resources are described as renewable or nonrenewable, as shown in **Figure 2**.

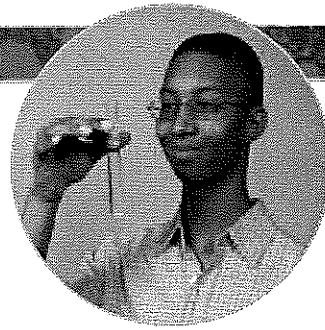
Renewable Resources Fresh water, solar energy, and fish are examples of renewable resources. ➤ **Renewable resources** are natural resources that can be replaced at the same rate at which they are consumed. A renewable resource's supply is either so large or so constantly renewed that it will never be used up. However, a resource can be renewable but still be used up if it is used faster than it can be renewed. For example, trees are renewable. But, some forests are being cut down faster than new forests can grow to replace them.

Nonrenewable Resources Many resources that we depend on, such as minerals, coal and oil, are nonrenewable resources.

➤ **Nonrenewable resources** are resources that form at a rate that is much slower than the rate at which they are consumed. Most of our energy today comes from fossil fuels. **Fossil fuels** are nonrenewable energy resources that formed from the remains of organisms that lived long ago. Examples of fossil fuels are coal, oil, and natural gas. Coal, oil, and natural gas are nonrenewable resources because it takes millions of years for them to form. They form from the remains of organisms that were buried by sediment millions of years ago. As sediment accumulated over the remains, heat and pressure increased. Over time, the heat and pressure caused chemical changes that changed the remains into oil and natural gas. We use fossil fuels at a rate that is faster than the rate at which they form. So, when these resources are gone, millions of years will pass before more have formed.

➤ **Reading check** Explain why natural gas is a nonrenewable resource.





Contaminated Water

In this activity, you will learn how contaminated water can spread an infectious disease.

Procedure

- CAUTION: Do not taste or touch the fluids used in this lab.** Obtain one test tube of fluid from your teacher. Some test tubes contain pure water. One test tube contains water that has been “contaminated”.
- Pour half your fluid into the test tube of a classmate. Your classmate will then pour an equal amount back into your test tube. Exchange water with three classmates in this way.
- Your teacher will now put a small amount of a test chemical into your test tube. If your water turns cloudy, you have been “contaminated.”

Analysis

- CRITICAL THINKING Analyzing Conclusions** Who had the test tube that started the “infection?”
- Identify** a disease that could be spread in water.

The Environment and Health

Our health and quality of life are affected by the state of the environment. ➤ Pollution and habitat destruction destroy the resources we need to live, such as the air we breathe, the water we drink, and the food we eat. Air pollution can cause headaches, sore throats, nausea, and upper respiratory infections. Air pollution has also been connected to lung cancer and heart disease. Some chemical pollutants in drinking water can lead to birth defects and cancer. Many infectious diseases, such as cholera, are spread by water polluted by sewage. Habitat destruction can also affect our safety. The root networks of trees help hold soil in place. Cutting down trees increases the number of landslides and floods, which can cause deaths and injuries.

READING TOOLBOX

Word Parts Look up the suffix *-tion* in the dictionary. Also, look up the words *pollute* and *destroy* in a dictionary. Then, write your own definition for *pollution* and *destruction*.

Section

1

Review

➤ KEY IDEAS

- Explain** how human population affects the environment.
- Describe** the difference between renewable resources and nonrenewable resources.
- State** a nonrenewable resource that you used today.
- State** three ways that environmental problems may affect human health.

CRITICAL THINKING

- Inferring relationships** Events such as floods and landslides are commonly called *natural disasters*. Explain how both natural events and human actions might have contributed to a natural disaster that you have learned about.
- Analyzing data** Consider a 1,000-year-old forest and a 30-year-old tree farm. How do differences between these resources affect how renewable the resources are?

WRITING FOR SCIENCE

- Evaluating viewpoints** A classmate argues that pollution is a necessary evil to produce food, jobs, and a high standard of living. Write a one-page paper describing your opinion of your classmates argument. Support your opinion with facts.

Environmental Issues

Key Ideas

- What are the effects of air pollution?
- How might burning fossil fuels lead to climate change?
- What are some sources of water pollution?
- Why is soil erosion a problem?
- How does ecosystem disruption affect humans?

Key Terms

acid rain
 global warming
 greenhouse effect
 erosion
 deforestation
 biodiversity
 extinction

Why It Matters

In the course of meeting their basic needs, humans can unintentionally damage the global environment.

Human activities can affect every ecosystem on Earth. Understanding these effects and the problems that they can cause is the first step to successfully solving them.

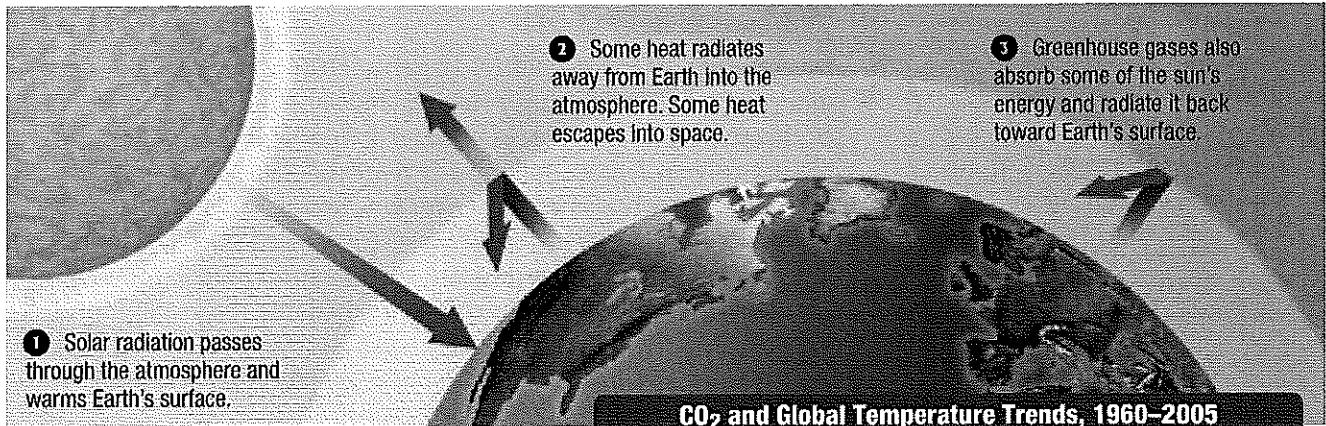
Air Pollution

Have you ever breathed air that smelled bad or made your lungs burn? The bikers in **Figure 3** have. Natural processes, such as volcanic activity, can affect air quality. However, most air pollution is caused by human activities. Industries, power plants, and vehicles must burn fossil fuels for energy. The burning of fossil fuels releases the pollutants carbon dioxide (CO_2), sulfur dioxide (SO_2), and nitrogen oxides (NO_2 and NO_3) into the air. ➤ Air pollution causes respiratory problems for people, results in acid rain, damages the ozone layer, and may affect global temperature.

Acid rain is precipitation that has an unusually high concentration of sulfuric or nitric acids, which is caused by pollution. Acid rain damages forests and lakes. The ozone layer protects life on Earth from the sun's damaging ultraviolet (UV) rays. The ozone layer has been damaged by *chlorofluorocarbons* (CFCs). CFCs are human-made chemicals that are used as coolants in refrigerators and air conditioners and as propellants in spray cans. Global temperature may be affected by air pollutants. **Global warming** is the gradual increase in the average global temperature.

Figure 3 Workers leaving the steel mill in Baotou, China, wear masks to avoid breathing in the pollution.





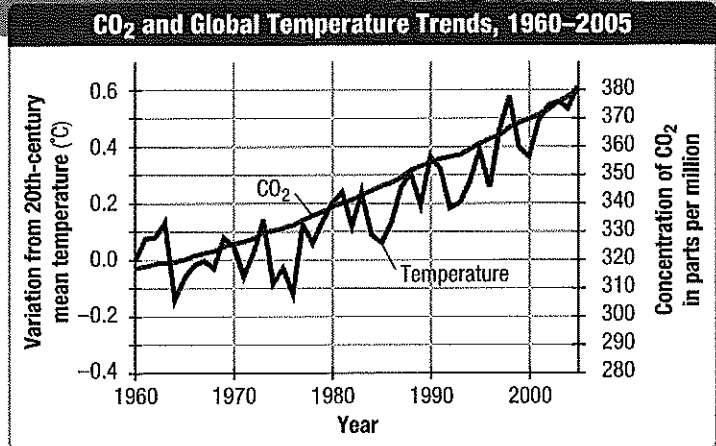
Global Warming

What does it feel like to climb into a car on a hot, sunny day? The inside of the car is hot because the sun's energy passes through the glass windows. The inside of the car absorbs the solar energy and changes it to heat energy. The heat energy cannot easily pass back through the glass windows. Therefore, the heat is trapped and makes the inside of the car hot. The atmosphere traps heat and warms the Earth in a similar way. The **greenhouse effect** is the warming of the surface and lower atmosphere of Earth that happens when greenhouse gases in the air absorb and reradiate heat. Examples of greenhouse gases are CO₂ and water vapor. **Figure 4** shows how this process works.

The greenhouse effect is necessary to keep Earth's temperatures stable. However, Earth's global temperatures have been rising steadily for many decades. Most scientists think that this increase in temperatures is caused by an increase in CO₂. ➤ Burning fossil fuels increases the amount of CO₂ in the atmosphere. Increases in atmospheric CO₂ may be responsible for an increase in global temperatures.

Effects of Global Warming A continued increase in global temperatures has the potential to cause a number of serious environmental problems. For example, ice sheets over Antarctica and Greenland have already started to melt. If these ice sheets continue to melt, they could raise sea levels around the world. Coastal ecosystems would be destroyed. People who live along a coast could lose their homes. Global weather patterns would also be affected. For example, warmer oceans make hurricanes and typhoons more intense and could make such storms more common. Droughts could become more frequent, causing damage to crops. The equilibrium in ecosystems could be altered. Migration patterns of some birds have already changed.

➤ **Reading check** *How might the burning of fossil fuels affect climate?*



Source: Scripps Institute of Oceanography and National Oceanic & Atmospheric Administration.

Figure 4 The greenhouse effect is a natural process that keeps Earth warm.

➤ How does the increase in CO₂ relate to global warming?

acid rain precipitation that has a pH below normal and has an unusually high concentration of sulfuric or nitric acids, often as a result of chemical pollution of the air from sources such as automobile exhausts and the burning of fossil fuels

global warming a gradual increase in the average global temperature

greenhouse effect the warming of the surface and lower atmosphere of Earth that occurs when carbon dioxide, water vapor and other gases in the air absorb and reradiate infrared radiation

SciLINKS

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Topic: Chemical
Pollution

Code: HX80272

Water Pollution

Every person needs 20–70 L (5–18 gal) of clean water each day to meet his or her drinking, washing, and sanitation needs. Unfortunately, many sources of water are polluted. **Figure 5** shows major sources of water pollution. ➤ Water pollution can come from fertilizers and pesticides used in agriculture, livestock farms, industrial waste, oil runoff from roads, septic tanks, and unlined landfills. Pollution enters groundwater when polluted surface water percolates down through the soil. Oil on roads can be washed into the ground by rain. Pesticides, fertilizers, and livestock waste seep into the ground in a similar way. Landfills and leaking underground septic tanks are also major sources of groundwater pollution.

When pollutants run off land and into rivers, both aquatic habitats and public water sources may be contaminated. For example, the pesticide, DDT, harmed many species, such as the bald eagle. The bald eagle was in danger of becoming extinct until the U.S. restricted the use of DDT in 1972. Pollution can also affect ecosystems. Fertilizers from farms, lawns, and golf courses can run off into a body of water, which increases the amount of nutrients in the water. An increase in some nutrients in a body of water can lead to an excessive growth of algae called a “bloom.” Algal blooms can deplete the dissolved oxygen in a body of water. Fish and other organisms then suffocate in the oxygen-depleted water.

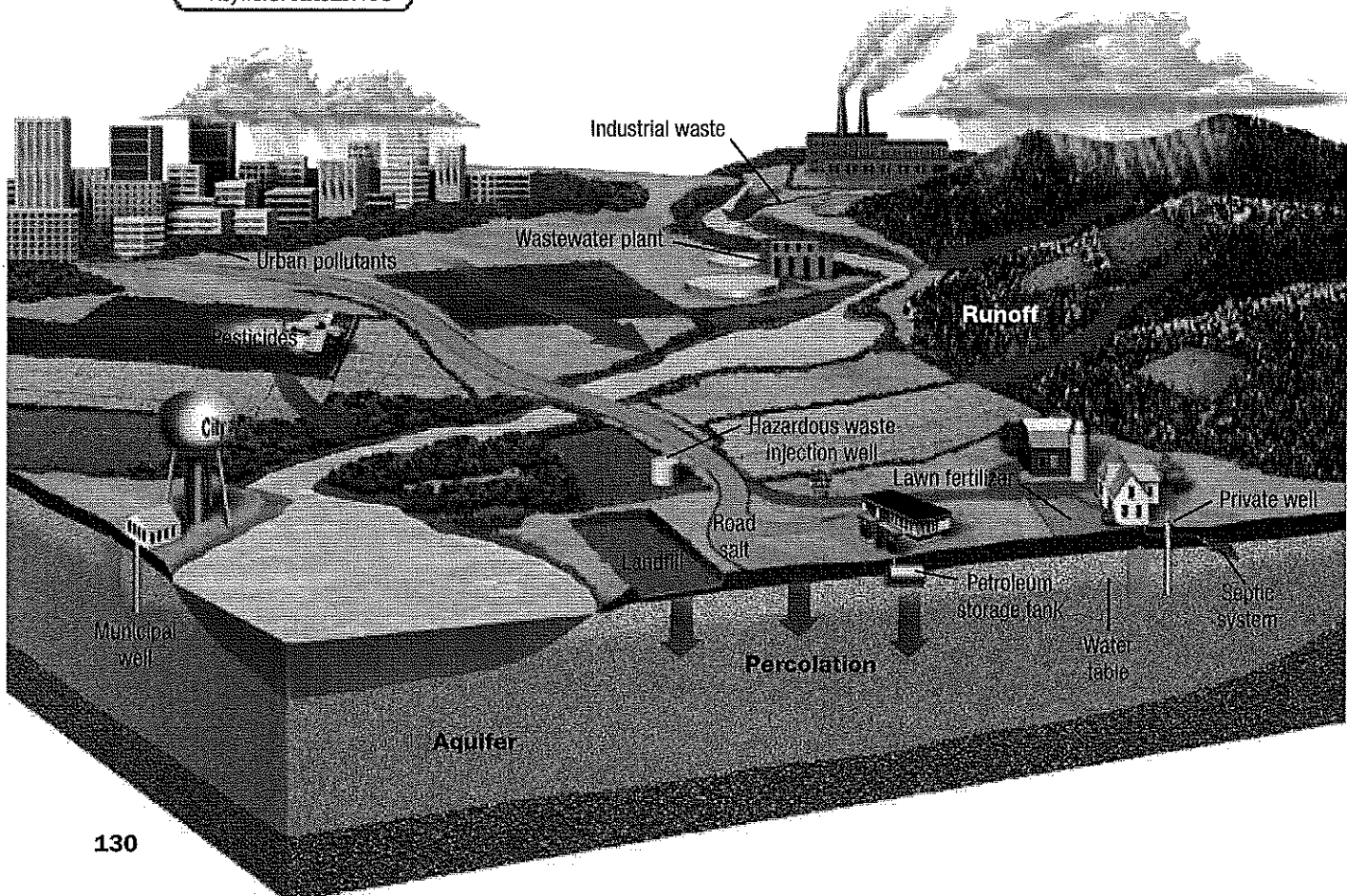
Figure 5 Pollutants on Earth’s surface run off the land and into ground water and other water systems. ➤ List the sources of water pollution that might occur in your neighborhood.

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➤ **Reading check** List three sources of water pollution.





Soil Erosion

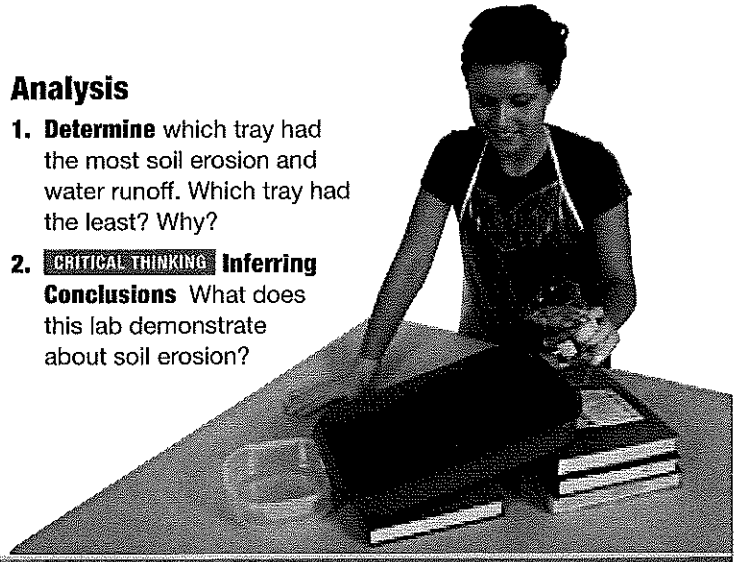
In this lab you will investigate factors that affect erosion.

Procedure

1. Fill three trays: one with sod, one with topsoil, and one with a type of mulch.
2. Place each tray at an angle on a “hill” of stacked textbooks. Place the same type of large bowl at the bottom of each tray to catch the runoff.
3. Pour 2 L of water slowly and evenly on each tray to simulate heavy rainfall.
4. Use a scale to weigh the runoff of soil and water that collected in each bowl.

Analysis

1. **Determine** which tray had the most soil erosion and water runoff. Which tray had the least? Why?
2. **CRITICAL THINKING** **Inferring**
Conclusions What does this lab demonstrate about soil erosion?



Soil Damage

Fertile soil allows agriculture to supply the world with food. The United States is one of the most productive farming countries, largely because of its fertile soils. Fertile soil forms from rock that is broken down by weathering. Nutrients that make soil fertile come from the weathered rock as well as from bacteria, fungi and the remains of plants and animals. The processes that form just a few centimeters of fertile soil can take thousands of years. Without fertile soil, we cannot grow crops to feed ourselves or the livestock we depend on.

Soil Erosion The greatest threat to soil is soil erosion. **Erosion** is a process in which the materials of Earth’s surface are worn away and transported from one place to another by wind, gravity, or water. **➤ Soil erosion destroys fertile soil that we need in order to produce food.** Roots from plants and trees help hold soil together and protect it from erosion. When vegetation is removed, soil is left vulnerable to erosion. Many farming methods can lead to soil erosion. Plowing loosens the topsoil and removes plants that hold the soil in place. The topsoil can then be washed away by wind or rain.

Soil Conservation Sustainable agricultural practices can help conserve fertile soil. For example, *terracing* changes a steep field into a series of flat steps that stop gravity from eroding the soil. Planting a *cover crop*, such as soybeans, restores nutrients to the soil. *Crop rotation*, or planting a different crop every year, slows down the depletion of nutrients in the soil. In *contour plowing*, rows are plowed in curves along hills instead of in straight lines. The rows then act as a series of dams, which prevent water from eroding the soil.

➤ Reading check *How does erosion damage soil?*

erosion a process in which the materials of Earth’s surface are loosened, dissolved, or worn away and transported from one place to another by a natural agent, such as wind, water, ice, or gravity

READING TOOLBOX

Hypothesis or Theory? A lake in your state has had hundreds of dead fish wash up on shore. Write your own hypothesis that might explain why so many fish in the lake died.

Ecosystem Disruption

We share Earth with about 5 million to 15 million species. We depend on many of these species for fulfillment of our basic needs. We get food, clothing, medicines, and building material from many plants and animals. Yet as the human population has grown and affected every ecosystem, this wondrous diversity of life has suffered.

➤ Ecosystem disruptions can result in loss of biodiversity, food supplies, potential cures for diseases, and the balance of ecosystems that supports all life on Earth. We cannot avoid disrupting ecosystems as we try to meet the needs of a growing human population. But we can learn about how our actions affect the environment so that we can create ways to conserve it.

Habitat Destruction Over the last 50 years, about half of the world's tropical rain forests have been cut down or burned. The forests have been cleared for timber, pastureland, or farmland, as shown in **Figure 6**. This process of clearing forests is called **deforestation**. Many more thousands of square miles of forest will be destroyed this year. Some of the people who cut down the trees are poor farmers trying to make a living. The problem with deforestation is that as the rain forests and other habitats disappear, so do their inhabitants. In today's world, habitat destruction and damage cause more extinction and loss of biodiversity than any other human activities do.

Loss of Biodiversity Ecosystem disruption decreases the number of Earth's species. Biodiversity affects the stability of ecosystems and the sustainability of populations. **Biodiversity** is the variety of organisms in a given area. Every species plays an important role in the cycling of energy and nutrients in an ecosystem. Each species either depends on or is depended on by at least one other species. When a species disappears, a strand in a food web disappears. If a keystone species disappears, other species may also disappear. The species that disappears may be one that humans depend on.

There are many ways in which humans benefit from a variety of life forms on Earth. Humans have used a variety of organisms on Earth for food, clothing, shelter, and medicine. At least one-fourth of the medicines prescribed in the world are derived from plants. Fewer species of plants could mean fewer remedies for illnesses.

deforestation the process of clearing forests

biodiversity the variety of organisms in a given area, the genetic variation within a population, the variety of species in a community, or the variety of communities in an ecosystem

extinction the death of every member of a species

ACADEMIC VOCABULARY

sustain to maintain or keep in existence

Figure 6 This forest in Brazil was slashed and burned to provide land for cattle and crops. ➤ How does deforestation decrease biodiversity?





Figure 7 The zebra mussel (left) is an invasive species that has disrupted the ecosystems of the Great Lakes region. The red panda (right) is an endangered species because its habitat, located in China and Myanmar, is being disrupted. ► Name another example of an invasive species. Name three other endangered species.

Invasive Species Humans have disrupted ecosystems by intentionally and unintentionally introducing nonnative species. One example of an invasive species is the zebra mussel, shown in **Figure 7**. In the 1980s, the zebra mussel was unintentionally introduced to the Great Lakes by ships traveling from the Black and Caspian Seas. The zebra mussel disrupted the Great Lakes ecosystem, causing some species to struggle while others flourished. Zebra mussels have also had a negative impact on humans. Zebra mussels clog the pipes of water treatment facilities which costs the public millions of dollars a year.

Extinction Many species are on the edge of extinction. **Extinction** is the death of every member of a species. One species that is at risk of extinction is the red panda. A red panda is shown in **Figure 7**. When a species becomes extinct, we lose forever the knowledge and benefits that we might have gained from the species. For example, two anticancer drugs have been developed from the rosy periwinkle, a flower in Madagascar that is threatened by deforestation. If this flower becomes extinct, a possible source of new drugs is gone.

► **Reading Check** *How has the introduction of the zebra mussel into the Great Lakes affected humans?*

Section

2

Review

► **KEY IDEAS**

1. **Identify** the affects of air pollution.
2. **Explain** how the burning of fossil fuels, such as oil, might lead to climate change.
3. **Identify** five sources of water pollution.
4. **Explain** why soil erosion is a problem.

5. **List** four ways ecosystem disruption affects humans.

CRITICAL THINKING

6. **Evaluating Viewpoints** A classmate asserts that extinction is not a problem because everything goes extinct eventually. Explain how extinction can be both a natural process and a current problem for society.

USING SCIENCE GRAPHICS

7. **Predicting Patterns** Using the chart, "CO₂ and Global Temperature Trends, 1960–2005," predict temperature and CO₂ levels for the year 2020. Describe how the temperature you predict would affect humans.