



1 FOCUS

Section Objectives

- 4.10** Explain why fresh water is a vital resource.
- 4.11** Recognize why the chemical composition of the atmosphere is important.
- 4.12** Identify Earth's important land resources.

Reading Focus

Build Vocabulary

L2

Paraphrase Before students read the section, have them explain what they think *point source* and *nonpoint source* mean. After they have read the section, ask students to explain the meanings of the terms in their own words, noting how their definitions have changed, if at all.

Reading Strategy

L2

- pollution that does not have a specific point of origin
- runoff, water filtering through piles of waste rock
- water that flows over the land rather than seeping into the ground
- waste oil from streets, pesticides off farm fields
- gases that help maintain a warm temperature near Earth's surface
- carbon dioxide, methane, water vapor

2 INSTRUCT

The Water Planet

Use Community Resources

L2

Have students research the water supply in their community. They should find out where their water comes from and how it is treated to make it safe for human use. The Department of Public Works or the water department will have this information. Students may be able to tour the municipal water treatment plant.

Verbal, Interpersonal

Reading Focus

Key Concepts

- Why is fresh water a vital resource?
- Why is the chemical composition of the atmosphere important?
- What are Earth's important land resources?

Vocabulary

- ◆ point source pollution
- ◆ nonpoint source pollution
- ◆ runoff
- ◆ acid precipitation
- ◆ global warming

Reading Strategy

Building Vocabulary Copy the table below. As you read, add definitions and examples to complete the table.

Definitions	Examples
point source pollution: Pollution that can be traced to a location	factory pipes, sewer pipes
nonpoint source pollution: a. ? b. ?	
runoff: c. ? d. ?	
greenhouse gas: e. ? f. ?	

Water, air, and land resources are essential for life. You need clean air and water every day. What's more, soil provides nutrients that allow plants—the basis of our own food supply—to grow. How do people use—and sometimes misuse—these vital resources?

The Water Planet

Figure 16 shows Earth's most prominent feature—water. Water covers nearly 71 percent of Earth's surface. However, most of this water is salt-water, not fresh water. Oceans have important functions. Their currents help regulate and moderate Earth's climate. They are also a vital part of the water cycle, and a habitat for marine organisms. Fresh water, however, is what people need in order to live. **Each day, people use fresh water for drinking, cooking, bathing, and growing food.** While fresh water is extremely important, Earth's reserves are relatively small. Less than one percent of the water on the planet is usable fresh water.

Freshwater Pollution Pollution has contaminated many freshwater supplies. In general, there are two types of water pollution sources—point sources and nonpoint sources. **Point source pollution** is pollution that comes from a known and specific location, such as the factory pipes in Figure 17. Other examples include a leaking landfill or storage tank.

Figure 16 Oceans cover almost three fourths of Earth surface, making Earth a unique planet.



Nonpoint source pollution is pollution that does not have a specific point of origin. **Runoff**, the water that flows over the land rather than seeping into the ground, often carries nonpoint source pollution. Runoff can carry waste oil from streets. It can wash sediment from construction sites or pesticides off farm fields and lawns. Water filtering through piles of waste rock from coal mines can carry sulfuric acid into rivers or lakes. This contaminated water can kill fish and other aquatic life.

As you can see in Table 2, water pollution has adverse health effects. Pollutants can damage the body's major organs and systems, cause birth defects, lead to infectious diseases, and cause certain types of cancers. Contaminated fresh water can sicken or kill aquatic organisms and disrupt ecosystems. What's more, fish and other aquatic life that live in contaminated waters often concentrate poisons in their flesh. As a result, it is dangerous to eat fish taken from some polluted waters.



What is the difference between a point and non-point water pollution source?



Figure 17 Pollution from point sources, such as these factory pipes, is easy to locate and control.

Table 2 Major Types of Water Pollution

Type	Examples	Sources	Effects
Disease organisms	Bacteria, viruses	Wastes from people and animals	Typhoid, cholera, dysentery, infectious hepatitis
Wastes that remove oxygen from water	Animal manure and plant debris that bacteria decompose	Sewage, animal feedlots	Great amounts of bacteria can remove oxygen from water, killing fish
Inorganic chemicals	Acids, toxic metals	Industrial effluent, urban runoff, household cleaners	Poisons fresh water and can sicken those who drink it
Organic chemicals	Oil, gasoline, plastic, pesticides, detergent	Farm and yard runoff, industrial waste, household cleaners	Some cancers, disorders of nervous and reproductive systems
Plant fertilizer	Water soluble compounds with nitrate, phosphorus ions	Sewage, manure, farm and garden runoff	Spurs rapid growth of algae that decay and deplete water's oxygen; fish die
Sediment	Soil	Erosion	Disrupts aquatic food webs, clogs lakes and reservoirs, reduces photosynthesis of aquatic plants
Radioactive substances	Radon, uranium, radioactive iodine	Nuclear power plants, uranium ore mining and processing	Some cancers, birth defects, genetic mutations

Customize for English Language Learners

Have students use a dictionary to look up the meaning of *acid precipitation*. Ask them to list the different forms that acid precipitation can take. (*acid snow, rain, fog*) Ask students why acid precipitation can take many forms.

(Precipitation occurs when water vapor condenses in the atmosphere. The form of precipitation depends on temperature, altitude, and other physical conditions.)

Use Visuals

L1

Table 2 Have students study the table. Ask: **Why is fertilizer considered a pollutant if it is needed by plants?** (*It causes rapid growth of algae that decay and deplete water's oxygen.*) **What are some sources of water pollution from organic chemicals?** (*farm and yard runoff, industrial waste, and household cleaners*) **Where do disease organisms that pollute water come from?** (*wastes from people and animals*) **What two types of water pollution can cause cancers in humans?** (*organic chemicals and radioactive substances*)

Visual

Build Science Skills

L2

Applying Concepts Have students explain how fish and other aquatic life that live in polluted water can concentrate poisons in their flesh. (*Fish and other aquatic organisms pass large amounts of water through their bodies as they extract oxygen from the water. If pollutants are also extracted from the water, they will accumulate in the fish's flesh in increasing concentration. This process is similar to that of a strainer concentrating material from the water that is poured through it.*)

Verbal

Answer to . . .



Point source pollution is pollution that comes from a known and specific location. Nonpoint source pollution is pollution that does not have a specific point of origin.

Earth's Blanket of Air

Use Visuals

L1

Figure 19 Have students examine the graphs. Ask: **What makes up almost half of all air pollution?** (*carbon monoxide*) **What fraction of pollution sources are industrial processes?** (*about 15 percent*) **What do you think is the source of most carbon monoxide pollution?** (*vehicle exhaust and fuel combustion*)

Visual, Logical

Address Misconceptions

L2

Ask students if there is a hole in the ozone layer high above Earth. If they say yes, they may hold the misconception that there is an actual hole in the sky that lets UV radiation through. Show students NASA satellite photos of ozone distribution so they can read the ozone concentration in the “hole.” Explain that ozone is being depleted around the globe but is particularly severe in certain areas, notably above Antarctica. This depletion is actually a temporary depletion of ozone in September and October of each year. In December and January, the “hole” is repaired. The reason for concern is the fact that each year, more ozone is being depleted and less is being repaired. Ask: **What happens during periods of ozone depletion?** (*More UV radiation reaches Earth's surface.*) **Why are scientists concerned if the “hole” is repaired each year?** (*The hole is not completely repaired, and increasing amounts of ozone are being destroyed.*)

Logical



Figure 18 Cars, trucks, and buses are the biggest source of air pollution. Laws that control motor vehicle emissions have helped make the air cleaner in many areas.

Earth's Blanket of Air

Earth's atmosphere is a blanket of nitrogen, oxygen, water vapor and other gases. 🌍 **The chemical composition of the atmosphere helps maintain life on Earth.** First and foremost, people and other animals could not live without the oxygen in Earth's atmosphere. But the atmosphere is also part of several other cycles, such as the carbon cycle, that make vital nutrients available to living things.

The atmosphere also makes life on land possible by shielding Earth from harmful solar radiation. There is a layer of protective ozone high in the air. Ozone is a three-atom form of oxygen that protects Earth from 95 percent of the sun's harmful ultraviolet (UV) radiation.

Certain greenhouse gases in the atmosphere—such as carbon dioxide, methane, and water vapor—help maintain a warm temperature near Earth's surface. When solar energy hits Earth, the Earth gives off some of this energy as heat. The gases absorb the heat Earth emits, keeping the atmosphere warm enough for life as we know it.



Reading Checkpoint What is the role of ozone in the atmosphere?

Pollution in the Air Pollution can change the chemical composition of the atmosphere and disrupt its natural cycles and functions. Fossil-fuel combustion is the major source of air pollution. Most of this pollution comes from motor vehicles and coal or oil-burning power plants. Motor vehicles, like those in Figure 18, release carbon monoxide, nitrogen oxide, soot, and other pollutants. Some of the pollutants react to form smog. Power plants release sulfur dioxide and nitrogen oxides. These pollutants combine with water vapor in the air to create acid precipitation. Figure 19 shows the primary air pollutants and the sources of those pollutants.

The burning of fossil fuels also produces carbon dioxide, an important greenhouse gas. The amount of carbon dioxide in the atmosphere has increased since industrialization began in the nineteenth century. This increase has altered the carbon cycle and contributed to the unnatural warming of the lower atmosphere, known as **global warming**. Global warming could lead to enormous changes in Earth's environment. These changes could include the melting of glaciers, which would contribute to a rise in sea level and in the flooding of coastal areas.

Chlorofluorocarbons (CFCs) once used in air conditioners and plastic foam production destroy ozone in the stratosphere layer of the atmosphere. Researchers say that a significant loss of ozone could result in an increased incidence of health problems like cataracts and skin cancers because more of the sun's UV radiation would reach Earth's surface.

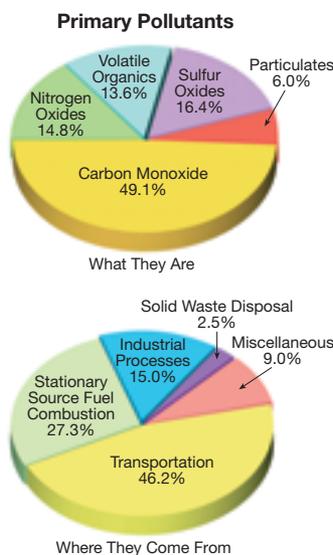


Figure 19 Major Primary Pollutants and Their Sources Percentages are calculated on the basis of weight.

Using Graphs What are the three major primary pollutants? What is the major source of air pollution?

Facts and Figures

Primary pollutants are those emitted by identifiable sources. They immediately pollute the air when they are emitted. Primary pollutants are also dangerous because they form secondary pollutants when chemical reactions take place among

the primary pollutants. The mixture of gases and particles that make up urban smog is a good example of a secondary pollutant. Smog forms when unstable organic compounds and nitrogen oxides from vehicle exhaust react in the presence of sunlight.

Air pollution is a major public health problem. It can cause coughing, wheezing, headaches, as well as lung, eye, and throat irritation. Long-term health effects include asthma, bronchitis, emphysema, and lung cancer. The U.S. Environmental Protection Agency estimates that as many as 200,000 deaths each year are associated with outdoor air pollution.

Land Resources

 **Earth's land provides soil and forests, as well as mineral and energy resources.** How do land resources impact your daily life? Soil is needed to grow the food you eat. Forests provide lumber for your home, wood for furniture, and pulp for paper. Petroleum provides energy and is in the plastic of your computer and CD boxes. Minerals such as zinc, copper, and nickel make up the coins in your pocket. Removing and using resources from Earth's crust can take a heavy environmental toll.

Damage to Land Resources There are an estimated 500,000 mines in the United States. Mines are essential because they produce many of the mineral resources we need. But mining tears up Earth's surface and destroys vegetation, as you can see in Figure 20. It can also cause soil erosion and create pollution that contaminates surrounding soil and water and destroys ecosystems.

Agriculture has many impacts on the land as well. Today, farmers can produce more food per hectare from their land. Extensive irrigation also has allowed many dry areas to be farmed for the first time. But heavy pumping for irrigation of dry areas is depleting the groundwater. And over time, irrigation causes salinization, or the build-up of salts in soil. When irrigation water on the soil evaporates, it leaves behind a salty crust. Eventually, the soil becomes useless for plant growth.



Figure 20 Surface mining destroys vegetation, soil, and the contours of Earth's surface. However, laws now require mine owners to restore the surface after mining operations cease.



For: Links on environmental toxins

Visit: www.SciLinks.org

Web Code: cjn-1043

Land Resources



Motion Accelerates Erosion

L2

Purpose Students demonstrate how the motion of water increases the long-term effects of erosion.

Materials 2 identical clean 1-L jars with lids, marking pen, water, 2 identical pieces of hard candy, measuring cup

Procedure Label the jars A and B. Place a piece of candy in each jar. Pour 500 mL of water into each jar. Cover both jars. Place them in a location where both can be seen. Shake jar A once or twice a day. Do not disturb jar B.

Expected Outcome After only 2 days, students should be able to see that the disturbed candy has dissolved much more than the undisturbed candy.

Kinesthetic, Visual

Build Reading Literacy

L1

Refer to p. 246D in Chapter 9, which provides the guidelines for relating cause and effect.

Relate Cause and Effect Have students think about the build-up of salts in soil. Ask: **Why can salts build up in soil used for intensive farming?** (In order to grow large amounts of crops in an area, farmers add heavy applications of fertilizers to support the additional plants. Salts from the fertilizer eventually build up in the soil.)

Logical



Download a worksheet on environmental toxins for students to complete, and find additional teacher support from NSTA SciLinks.

Answer to . . .

Figure 19 The major primary pollutants are carbon monoxide, sulfur and nitrogen oxides, and volatile organics. The major source of air pollution is fossil-fuel combustion.



Ozone absorbs harmful ultraviolet radiation from the sun, thus protecting life.

Section 4.3 (continued)

MAP MASTER™ Skills Activity

Answers

Identifying Effects The amount of virgin forest was much greater in 1620. The eastern half of the United States has lost almost all of its virgin forest. There are now more virgin forests in the western half of the country than in the eastern half.

3 ASSESS

Evaluate Understanding

L2

To assess students' knowledge of section content, have them write a short paragraph explaining how ozone can be essential to life when it is in the upper stratosphere, yet a serious pollutant when it is closer to Earth's surface.

Reteach

L1

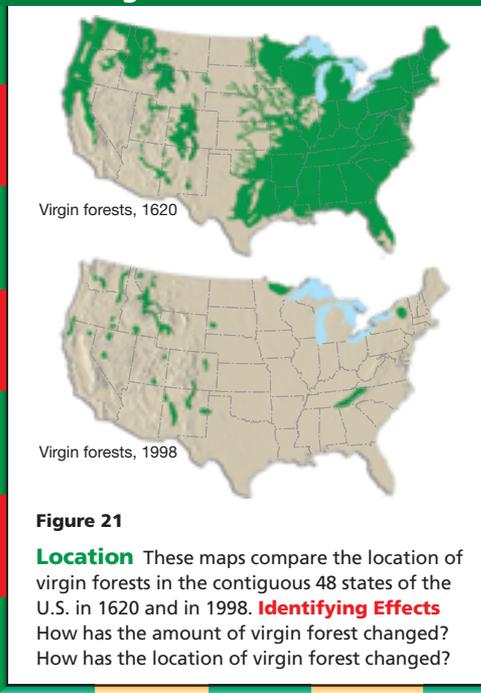
Have students summarize their knowledge of water, land, and air resources by making an outline of the section. They can use the heads as a guide and add information under each head.

Connecting Concepts

Student paragraphs should suggest that wasting paper causes more trees to be cut down, resulting in a loss of species due to elimination of their habitat. When trees are clear-cut, the forest eventually will be replaced by a second-growth forest that has greater area but less diversity than the original forest.

MAP MASTER™ Skills Activity

Virgin Forests 1620–1998



Trees must be cut to supply our need for paper and lumber. But the removal of forests, especially through clear-cutting, can damage land. Clear-cutting is the removal of all trees in an area of forest. Cleared areas are susceptible to soil erosion. Forest removal also destroys ecosystems and wildlife habitat. The United States actually has more hectares of forest today than it did a century ago. That's because much of the virgin forest (forest that had never been cut down) that was cut long ago has regrown as second-growth forest. The forest is not as diverse as the virgin forest—it does not contain as much variety of plant species. Some forestland has also become tree plantations, with even fewer species. As you see in Figure 21, the United States has lost most of its virgin forest during the last few centuries.

Finally, land serves as a disposal site. You may have seen landfills and other waste facilities. When disposal is done correctly, there is minimal impact on land. But many old landfills leak harmful wastes that get into soil and underground water. The same is true of buried drums of chemicals, which were often disposed of illegally. Waste is inevitable. But there is a need for ways to reduce it and make the disposal safer.

Section 4.3 Assessment

Reviewing Concepts

1. Why is fresh water a vital resource?
2. Why is the chemical composition of Earth's atmosphere important?
3. What is the difference between point source pollution and nonpoint source pollution?
4. What do Earth's land resources provide?

Critical Thinking

5. **Applying Concepts** How would Earth be different if there were no greenhouse gases?
6. **Classifying** Which of the following is a nonpoint source pollution of water: rainwater pouring from an eroded bank into a river, a

boat emptying a waste tank into a lake, or a sewage plant sending sewage into a river through a pipe?

7. **Relating Cause and Effect** How would the removal of sulfur from coal affect the type of air pollution in a local area? Explain your answer.

Connecting Concepts

Write a brief paragraph that connects the following: waste of paper, loss of species diversity of forests, and the increase in second-growth forest area.

Section 4.3 Assessment

1. People need fresh water for drinking, cooking, bathing, and growing food.
2. The chemical composition of Earth's atmosphere helps to maintain life on Earth.
3. Point source pollution has a known and specific location. Nonpoint source pollution does not have a specific point of origin.
4. soil, forests, mineral and energy resources
5. Earth would be too cold to sustain life.
6. rainwater pouring from an eroded bank into a river
7. Removing sulfur from coal would decrease the amount of sulfur oxides in the air. Sulfur oxides combine with water vapor to form acid precipitation, so the acidity of the precipitation both locally and in more distant areas would decrease.