

## The Air We Breathe

### Terms to Learn

primary pollutants  
secondary pollutants  
acid precipitation

### What You'll Do

- ◆ Describe the major types of air pollution.
- ◆ Name the major causes of air pollution.
- ◆ Explain how air pollution can affect human health.
- ◆ Explain how air pollution can be reduced.

Air pollution, as shown in **Figure 21**, is not a new problem. By the middle of the 1700s, many of the world's large cities suffered from poor air quality. Most of the pollutants were released from factories and homes that burned coal for energy. Even 2,000 years ago, the Romans were complaining about the bad air in their cities. At that time the air was thick with the smoke from fires and the smell of open sewers. So you see, cities have always been troubled with air pollution. In this section you will learn about the different types of air pollution, their sources, and what the world is doing to reduce them.



**Figure 21** The air pollution in Mexico City is sometimes so dangerous that some people wear surgical masks when they go outside.

### Air Quality

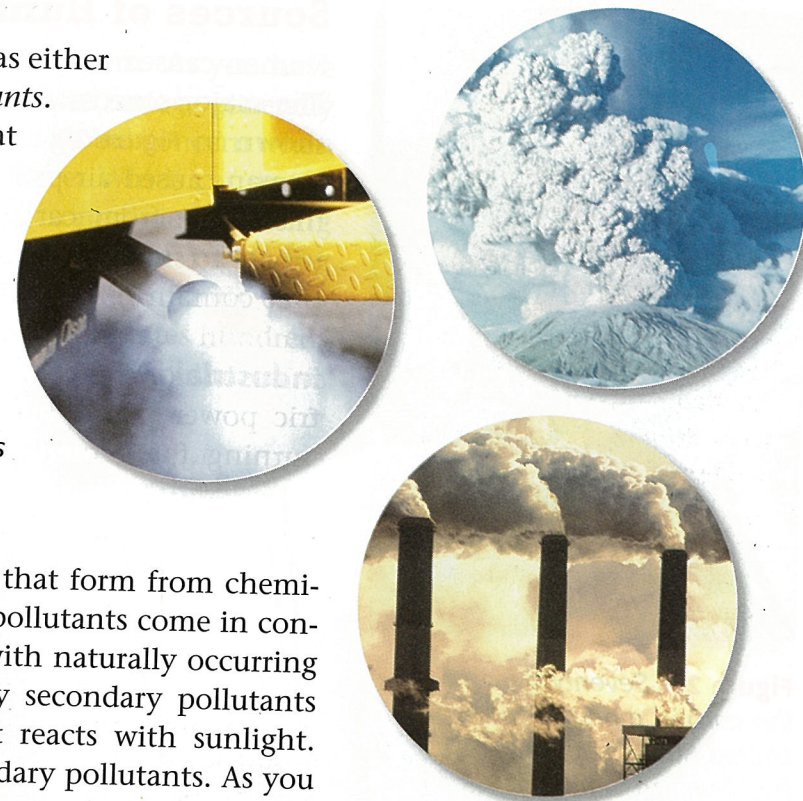
Even "clean" air is not perfectly clean. It contains many pollutants from natural sources. These pollutants include dust, sea salt, volcanic gases and ash, smoke from forest fires, pollen, swamp gas, and many other materials. In fact, natural sources produce a greater amount of pollutants than humans do. But we have adapted to many of these natural pollutants.

Most of the air pollution mentioned in the news is a result of human activities. Pollutants caused by human activities can be solids, liquids, or gases. Human-caused air pollution, such as that shown in Figure 21, is most common in cities. As more people move to cities, urban air pollution increases.

## Types of Air Pollution

Air pollutants are generally described as either *primary pollutants* or *secondary pollutants*.

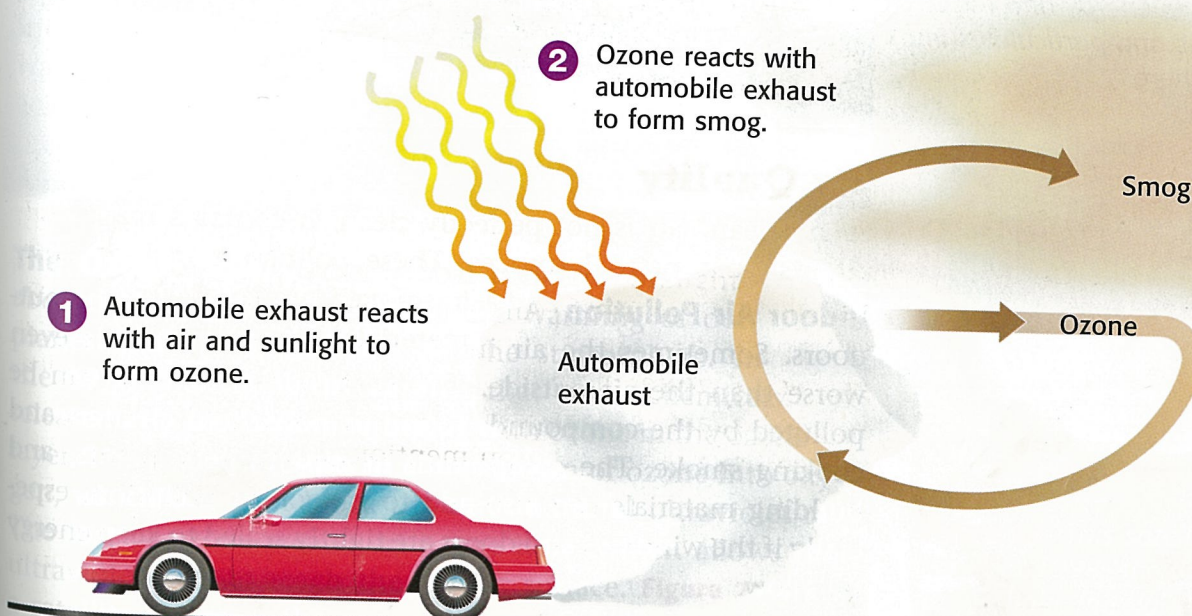
**Primary pollutants** are pollutants that are put directly into the air by human or natural activity. **Figure 22** shows some examples of primary air pollutants.



**Figure 22** Exhaust from vehicles, ash from volcanic eruptions, and soot from smoke are all examples of primary pollutants.

**Secondary pollutants** are pollutants that form from chemical reactions that occur when primary pollutants come in contact with other primary pollutants or with naturally occurring substances, such as water vapor. Many secondary pollutants are formed when a primary pollutant reacts with sunlight. Ozone and smog are examples of secondary pollutants. As you read at the beginning of this chapter, ozone is a gas in the stratosphere that is helpful and absorbs harmful rays from the sun. Near the ground, however, ozone is a dangerous pollutant that affects the health of all organisms. Ozone and smog are produced when sunlight reacts with automobile exhaust, as illustrated in **Figure 23**.

**Figure 23** Many large cities suffer from smog, especially those with a sunny climate and millions of automobiles.







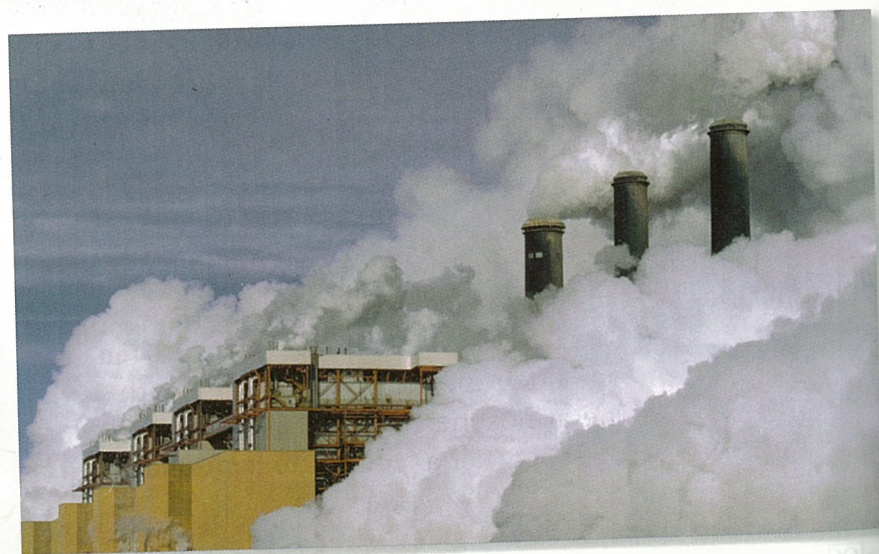
**Figure 24** Seventy percent of the carbon monoxide in the United States is produced by fuel-burning vehicles.

## Sources of Human-Caused Air Pollution

Human-caused air pollution comes from a variety of sources. The major source of air pollution today is transportation, as shown in **Figure 24**. Cars contribute about 60 percent of the human-caused air pollution in the United States. The oxides that come from car exhaust, such as nitrogen oxide, contribute to smog and acid rain. *Oxides* are chemical compounds that contain oxygen and other elements.

**Industrial Air Pollution** Many industrial plants and electric power plants burn fossil fuels to get their energy. But burning fossil fuels causes large amounts of oxides to be released into the air, as shown in **Figure 25**. In fact, the burning of fossil fuels in industrial and electric power plants is responsible for 96 percent of the sulfur oxides released into the atmosphere.

Some industries also produce chemicals that form poisonous fumes. The chemicals used by oil refineries, chemical manufacturing plants, dry-cleaning businesses, furniture refinishers, and auto-body shops can add poisonous fumes to the air.



**Figure 25** This power plant burns coal to get its energy and releases sulfur oxides and particulates into the atmosphere.

**Indoor Air Pollution** Air pollution is not limited to the outdoors. Sometimes the air inside a home or building is even worse than the air outside. The air inside a building can be polluted by the compounds found in household cleaners and cooking smoke. The compounds in new carpets, paints, and building materials can also add to indoor air pollution, especially if the windows and doors are tightly sealed to keep energy bills low.

## The Air Pollution Problem

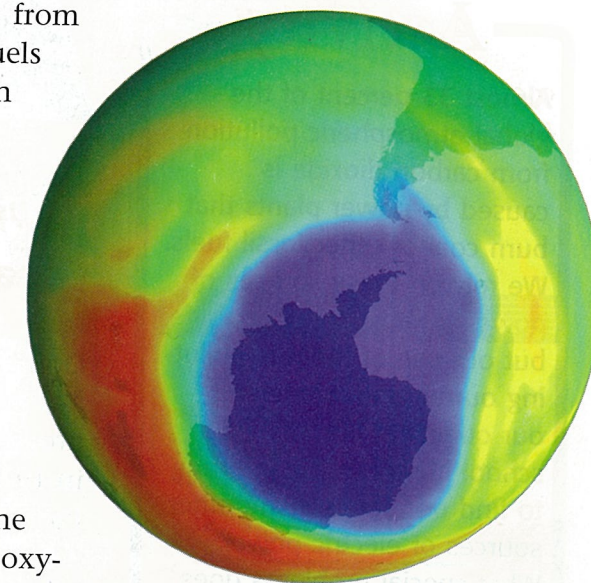
Air pollution is both a local and global concern. As you have already learned, local air pollution, such as smog, generally affects large cities. Air pollution becomes a global concern when local pollution moves away from its source. Winds can move pollutants from one place to another, sometimes reducing the amount of pollution in the source area but increasing it in another place. For example, the prevailing winds carry air pollution created in the midwestern United States hundreds of miles to Canada. One such form of this pollution is acid precipitation.



**Figure 26** Acid precipitation can kill living things, such as fish and trees, by making their environment too acidic to live in.

**Acid Precipitation** Precipitation that contains acids from air pollution is called **acid precipitation**. When fossil fuels are burned, they release oxides of sulfur and nitrogen into the atmosphere. When these oxides combine with water droplets in the atmosphere, they form sulfuric acid and nitric acid, which fall as precipitation. Acid precipitation has many negative effects on the environment, as shown in **Figure 26**.

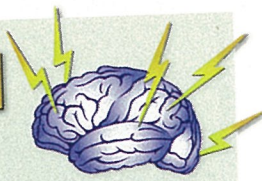
**The Ozone Hole** Other global concerns brought about by air pollution include the warming of our planet and the ozone hole in the stratosphere. In the 1970s, scientists determined that some chemicals released into the atmosphere react with ozone in the ozone layer. The reaction results in a breakdown of ozone into oxygen, which does not block the sun's harmful ultraviolet rays. The loss of ozone creates an ozone hole, which allows more ultraviolet rays to reach the Earth's surface. **Figure 27** shows a satellite image of the ozone hole.



**Figure 27** This satellite image, taken in 1998, shows that the ozone hole, the dark blue area, is still growing.

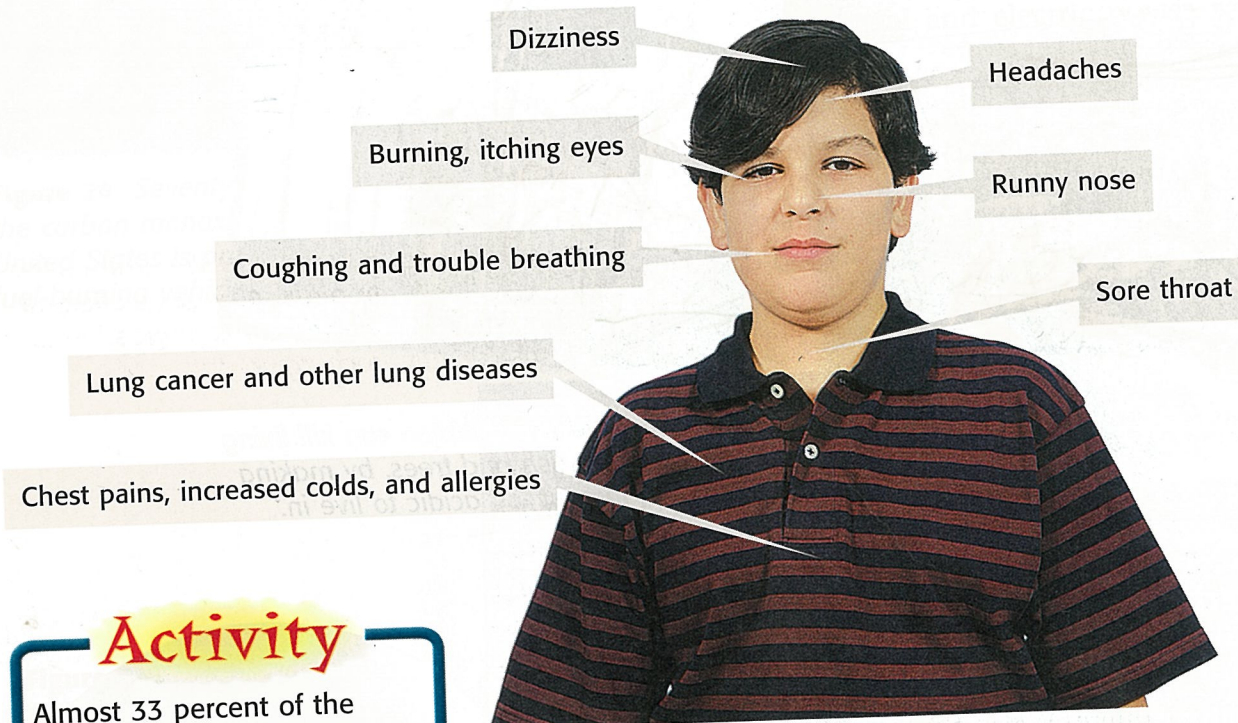


## BRAIN FOOD



Nonsmoking city dwellers are three to four times more likely to develop lung cancer than nonsmoking people in rural areas.

**Effects on Human Health** You step outside and notice a smoky haze. When you take a deep breath, your throat tingles and you begin to cough. Air pollution like this affects many cities around the world. For example, on March 17, 1992, in Mexico City, all children under the age of 14 were prohibited from going to school because of extremely high levels of air pollution. This is an extreme case, but daily exposure to small amounts of air pollution can cause serious health problems. Children, elderly people, and people with allergies, lung problems, and heart problems are especially vulnerable to the effects of air pollution. **Figure 28** illustrates some of the effects that air pollution has on the human body.



**Figure 28** The Environmental Protection Agency blames air pollution for at least 2,000 new cases of cancer each year.

## Activity

Almost 33 percent of the global atmospheric pollution from carbon dioxide is caused by power plants that burn coal or other fossil fuels. We rely on these sources of power for a better way of life, but our use of them is polluting our air and worsening our quality of life. Use your school library or the Internet to find out about some other sources of electric power. What special problems does each source of energy bring with it?

Try at HOME

## Cleaning Up Our Act

Is all this talk about bad air making you a little choked up? Don't worry, help is on the way! In the United States, progress has been made in cleaning up the air. One reason for this progress is the Clean Air Act, which was passed by Congress in 1970. The Clean Air Act is a law that gives the Environmental Protection Agency (EPA) the authority to control the amount of air pollutants that can be released from any source, such as cars and factories. The EPA also checks air quality. If air quality worsens, the EPA can set stricter standards. What are car manufacturers and factories doing to improve air quality? Read on to find out.

**Controlling Air Pollution from Vehicles** The EPA has required car manufacturers to meet a certain standard for the exhaust that comes out of the tailpipe on cars. New cars now have devices that remove most of the pollutants from the car's exhaust as it exits the tailpipe. Car manufacturers are also making cars that run on fuels other than gasoline. Some of these cars run on hydrogen and natural gas, while others run on batteries powered by solar energy. The car shown in **Figure 29** is electric.



**Figure 29** Instead of having to refuel at a gas station, an electric car is plugged in to a recharging outlet.

**Controlling Air Pollution from Industry** The Clean Air Act requires many industries to use scrubbers. A scrubber is a device that attaches to smokestacks to remove some of the more harmful pollutants before they are released into the air. One such scrubber is used in coal-burning power plants in the United States to remove ash and other particles from the smokestacks. Scrubbers prevent 22 million metric tons of ash from being released into the air each year.

Although we have a long way to go, we're taking steps in the right direction to keep the air clean for future generations.

## REVIEW

1. How can the air inside a building be more polluted than the air outside?
2. Why might it be difficult to establish a direct link between air pollution and health problems?
3. How has the Clean Air Act helped to reduce air pollution?
4. **Applying Concepts** How is the water cycle affected by air pollution?

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