SECTION 2

Air, Noise, and Light Pollution

Air pollution can cause serious health problems. People who are very young or very old and people who have heart or lung problems can be most affected by air pollutants. Decades of research have shown convincing evidence linking air pollution to disease. But because pollution adds to the effects of existing diseases, no death certificates list the cause of death as air pollution. Instead, diseases such as emphysema, heart disease, and lung cancer are cited as causes of death. The American Lung Association has estimated that Americans pay tens of billions of dollars a year in health costs to treat respiratory diseases caused by air pollution.

Short-Term Effects of Air Pollution on Health

Many of the effects of air pollution on people's health are short-term and are reversible if their exposure to air pollution decreases. The short-term effects of air pollution on people's health include headache; nausea; irritation to the eyes, nose, and throat; tightness in the chest; coughing; and upper respiratory infections, such as bronchitis and pneumonia. Pollution can also make the condition of individuals who suffer from asthma and emphysema worse.

Long-Term Health Effects of Air Pollution

Long-term effects on health that have been linked to air pollution include emphysema, lung cancer, and heart disease. Long-term exposure to air pollution may worsen medical conditions suffered by older people and may damage the lungs of children.

Objectives

- Describe three possible short-term effects and long-term effects of air pollution on human health.
- Explain what causes indoor air pollution and how it can be prevented.
- Describe three human health problems caused by noise pollution.
- Describe solutions to energy waste caused by light pollution.

Key Terms

sick-building syndrome
asbestos
decibel (dB)

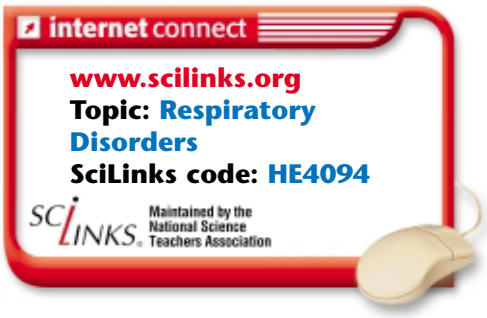


Figure 8 ▶ This police officer wears a smog mask as he directs traffic in Bangkok, Thailand.

Connection to Chemistry

Formaldehyde Formaldehyde is a colorless gas that has a strong odor. It is a very common industrial and commercial chemical that is used to make building materials and household products. In the home, significant amounts of formaldehyde are found in adhesives in plywood, particle board, furniture, and carpet. Other sources of formaldehyde may be foam insulation, gas stoves, tobacco smoke, and dry-cleaned clothing. The health effects of formaldehyde may include eye irritation, burning sensations in the throat, nausea, and difficulty breathing.

Indoor Air Pollution

The quality of air inside a home or a building is sometimes worse than the quality of the air outside. Plastics and other industrial chemicals are major sources of pollution. These compounds can be found in carpets, building materials, paints, and furniture, particularly when these items are new. **Figure 9** shows examples of some indoor air pollutants.

Buildings that have very poor air quality have a condition called **sick-building syndrome.** Sick-building syndrome is most common in hot places where buildings are tightly sealed to keep out the heat. In Florida, for example, a new, tightly sealed county courthouse had to be abandoned. Half of the people who worked there developed allergic reactions to fungi that were growing in the air-conditioning ducts, ceiling tiles, carpets, and furniture.

Identifying and removing the sources of indoor air pollution is the most effective way to maintain good indoor air quality. Ventilation, or mixing outdoor air with indoor air, is also necessary for good air quality. When activities such as renovation and painting, which cause indoor air pollution, are undertaken, ventilation should be increased.

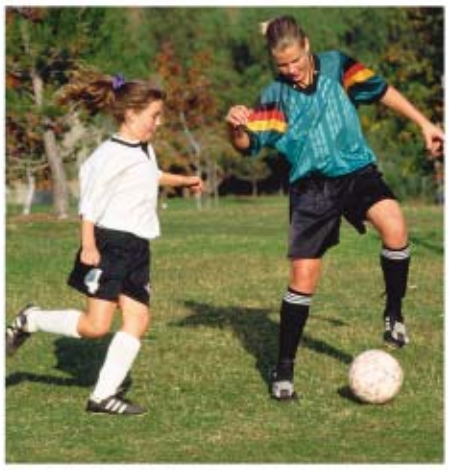
CASE STUDY

The Health Effects of Ground-Level Ozone

You have learned that the ozone layer in the stratosphere shields the Earth from the harmful effects of ultraviolet radiation from the sun. At the surface of the Earth, however, ozone is a human-made air pollutant that at certain concentrations may affect human health.

Ozone forms from the reaction of volatile organic compounds (VOCs) and nitrogen oxides (NO_x) in the presence of heat and sunlight. High concentrations of ozone form in the atmosphere on sunny days that have high temperatures in the late spring, summer, and early fall. The sources of VOCs and NO_x emissions are largely motor vehicles, power plants, gasoline vapors, and chemical solvents. Most ozone pollution forms in urban and suburban areas. However, pollutants may be transported hundreds of kilometers from their source.

As ozone concentrations in the atmosphere increase, greater numbers of people may experience harmful health effects of ozone on the lungs. Some of the short-term effects of ozone on health include irritation of the respiratory system, a reduction in lung function, the aggravation of asthma, and inflammation to the lining of the lungs. Scientists believe that ozone may have other damaging effects on human health. Lung diseases such as bronchitis and emphysema may be aggravated by ozone. Scientists



▶ Children who engage in vigorous outdoor activities where pollutant concentrations are often high may have a greater risk of developing asthma or other respiratory illnesses.

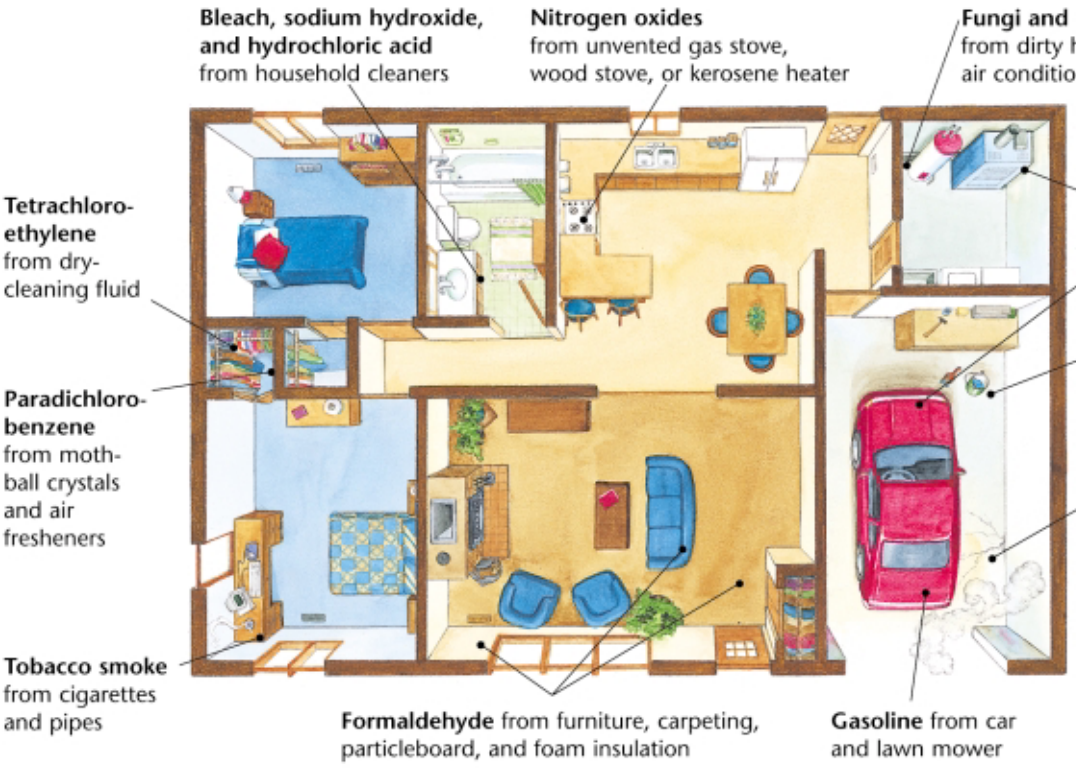


Figure 9 ▶ Some indoor air pollutants and their sources are shown here.

▶ A therapist performs a lung-function test on a patient by using a machine that measures various aspects of lung function.

believe that permanent lung injury may result from repeated short-term exposure to ozone pollution. Children who are regularly exposed to high concentrations of ozone may have reduced lung function as adults. Exposure to ozone may also accelerate the natural decline in lung function that is part of the aging process.

Those who are most at risk from ozone include children, adults who exercise or work outdoors, older people, and people who suffer from respiratory diseases. In addition, there are some healthy individuals who have unusually high susceptibility to ozone.

CRITICAL THINKING

1. Making Decisions Write a brief paragraph explaining whether or not lung-function tests should be mandatory for children who live in urban areas where high concentrations of ozone are frequent.
WRITING SKILLS

2. Making Decisions If lung-function tests become mandatory, who will pay for these tests, and who will provide the equipment? Would these tests be performed at school, in a doctor's office, or at a hospital?

Figure 10 ▶
Asbestos (right) forms in long, thin fibers. The worker above is removing debris from a structure that was built with asbestos.

Radon Gas Radon gas is colorless, tasteless, and odorless. It is also radioactive. *Radon* is one of the elements produced by the decay of uranium, a radioactive element that occurs naturally in the Earth's crust. Radon can seep through cracks and holes in foundations into homes, offices, and schools, where it adheres to dust particles. When people inhale the dust, radon enters their lungs. In the lungs, radon can destroy the genetic material in cells that line the air passages. Such damage can lead to cancer, especially among people who smoke. Radon is the second-leading cause of lung cancer in the United States.

Asbestos Several minerals that form in long, thin fibers and that are valued for their strength and resistance to heat are called **asbestos.** Asbestos is primarily used as an insulator and as a fire retardant, and it was used extensively in building materials. The U.S. government banned the use of most asbestos products in the early 1970s. Exposure to asbestos in the air is dangerous. Asbestos fibers that are inhaled can cut and scar the lungs, which causes the disease asbestosis. Victims of the disease have more and more difficulty breathing and may eventually die of heart failure. Schools in the United States have taken this threat seriously. Billions of dollars have been spent to remove asbestos from school buildings. **Figure 10** shows asbestos fibers and asbestos removal from a building.

Table 2 ▼

Intensity of Common Noises

Noise	Intensity (dB)
Rocket engine	180
Jet engine	140
Rock-and-roll concert	120
Car horn	110
Chainsaw	100
Lawnmower	90
Doorbell	80
Conversation	60
Whisper	30
Faintest sound heard by the human ear	0

Noise Pollution

A sound of any kind is called a noise. However, some noises are unnecessary and can cause noise pollution. Noise is a pollutant that affects human health and the quality of human life. Airplanes, construction equipment, city traffic, factories, home appliances, and lawnmowers are some of the examples of things that make unnecessary sounds that commonly travel through the air. Health problems that can be caused by noise pollution include loss of hearing, high blood pressure, and stress. Noise can also cause loss of sleep, which may lead to decreased productivity at work and in the classroom.

The intensity of sound is measured in units called **decibels (dB).** The lowest point on the decibel scale is 0 dB and the highest point is 180 dB. For each increase in decibel intensity, the decibel level is 10 times higher than the previous level. For example, 20 dB is 10 times the intensity of 10 dB, 30 dB is 100 times the intensity of 10 dB, and 40 dB is 1,000 times the intensity of 10 dB. **Table 2** shows the intensity of some common sounds. A sound of 120 dB is at the threshold of pain. Permanent deafness may come as a result of continuous exposure to sounds over 120 dB.

Figure 11 ▶ This view of Seattle shows how lighting in urban areas can cause skyglow, which is an effect of light that can dramatically reduce our view of the night sky.

Light Pollution

Unlike air or water pollution, light pollution does not present a direct hazard to human health. However, light pollution does negatively affect our environment. The use of inefficient lighting in urban areas is diminishing our view of the night sky. In urban areas, the sky is often much brighter than the natural sky.

A more important environmental concern of inefficient lighting is energy waste. For example, energy is wasted when light is directed upward into the night sky and lost to space, as shown in **Figure 11.** Examples of inefficient lighting are billboards and other signs that are lit from below, the lighting of building exteriors, and poor-quality street lights. One solution to energy waste includes shielding light so it is directed downward. Using time controls so that light is used only when needed and using low-pressure sodium sources—the most energy-efficient source of light—wherever possible are two other solutions.

FIELD ACTIVITY

Light Pollution At night, in your neighborhood or from your front porch, note any efficient or inefficient uses of light that you see, and write down your observations in your ***EcoLog.***

SECTION 2 Review

1. **Describe** the long-term effects and the short-term effects of air pollution on health.
2. **Describe** two ways in which indoor air pollution can be prevented.
3. **Describe** some of the human health problems caused by noise pollution.
4. **Describe** several solutions to the energy waste associated with light pollution.

CRITICAL THINKING

5. **Making Comparisons** Read the descriptions of noise and light pollution in this section. Explain ways in which noise pollution and light pollution are similar and ways they are different. READING SKILLS
6. **Analyzing Relationships** Molds can grow in new, tightly sealed buildings where the humidity is high and the ventilation is poor. Explain how you would control the growth of mold in this type of environment.