YOU ENCOUNTER biological hazards every day. They are in the air you breathe, the food you eat, and the water you drink. Your body is constantly working to fight these pathogens off. Usually, your body wins—but not always. In fact, diseases caused by biological hazards are the second-leading cause of death worldwide. Because of this, scientists around the globe are working on ways to identify, treat, and prevent these diseases.

Infectious Disease

Infectious diseases are spread by direct human contact, through contaminated food and water, and by animals.

Infectious diseases are diseases caused by a pathogen, such as a virus or a bacterium. Pathogens are biological hazards. Globally, infectious diseases account for about 30 percent of all deaths each year—nearly 18 million people. About three fifths of these deaths result from just five types of diseases. Figure 6 lists these diseases and the estimated number of deaths they caused in 2004.

Disease Transmission  Infectious diseases spread through the human population in different ways. For example, pathogens can be spread by humans, water or food, or by other organisms.

Humans  Some diseases are spread directly from one human to another. For example, touching, biting, sexual intercourse, contact with bodily fluids, and inhaling expelled droplets can all spread disease. HIV—the virus that causes AIDS—can be transmitted when a person comes into contact with the blood or body fluids of an infected person. Tuberculosis (TB) is spread through droplets in the air. People who are infected with TB release bacteria-laden droplets when they cough, sneeze, speak, and spit. If a person nearby breathes in the droplets, he or she may become infected with TB.

FIGURE 6  Global Infectious Disease  The five types of diseases listed killed an estimated 10.8 million people in 2004. AIDS alone killed about 2 million people, roughly equal to the entire population of Arkansas.
Some pathogens spread when people consume contaminated water or food. For example, *Vibrio cholerae*, the bacterium that causes cholera, is a waterborne pathogen. Human feces that contain *Vibrio cholerae* contaminate water supplies. When a person drinks contaminated water, he or she may experience intense diarrhea and vomiting. These symptoms can lead to dehydration and even death.

Disease can also be spread by other organisms. In these cases, the organism carries the pathogen and passes it to a person. These disease-carrying organisms, or vectors, usually do not suffer from the disease themselves. Some vectors, such as ticks and mosquitoes, transmit pathogens when they bite humans. For example, female mosquitoes in the genus *Anopheles* carry pathogens that cause malaria. A mosquito picks up the pathogen when it bites an infected person and transmits it when it bites a non-infected person (Figure 7).

Reducing Risk  Infectious diseases account for almost half of all deaths in developing nations. But, in developed nations, infectious disease is less of a threat because of public health measures, such as better sanitation and access to medicine. For example, developed nations often have effective water treatment facilities. Public water supplies are closely monitored and treated so that high levels of pathogens do not contaminate the water. In addition, developed nations often have adequate wastewater treatment plants. These facilities accept and treat sewage so that human wastes are not released directly into the environment.

**ANSWERS**

**Figure 7** Answers will vary, but students should justify their opinion whether or not DDT should be sprayed to kill mosquitoes.
Cholera is a good example of how wastewater treatment plants help reduce the spread of disease. Because *Vibrio cholerae* gets into waterways through human feces, sewage contamination can lead to cholera epidemics. Treating sewage, therefore, helps reduce the incidence of cholera.

There are many ways you can reduce your risk of catching and spreading infectious diseases. For example, you should cover your nose and mouth with your sleeve or a tissue when you cough or sneeze. Then, throw the tissue in the garbage. You should wash your hands often with soap and water. If soap is not available, use an alcohol-based hand sanitizer. And if you are sick, stay home from school to avoid spreading the disease.

**Reading Checkpoint**

Describe how pathogens can spread directly from one person to another.

**Emerging Diseases**

Since new diseases are continually emerging, it is important to know how, where, and to what extent they are spreading.

Despite our attempts to reduce and avoid disease, we are constantly battling new diseases. An **emerging disease** is a disease that has appeared in the human population for the first time, or that has existed for a while but is increasing rapidly or spreading around the world.

The pathogens that cause emerging disease are particularly dangerous because humans have developed little or no resistance to them. In addition, methods of controlling emerging diseases, such as vaccines, have not been developed.

One good example of an emerging disease is the H1N1 (swine) flu. The current strain first appeared in Mexico in March 2009. By June, it had spread to 70 nations, infecting nearly 30,000 people. At that time, the World Health Organization (WHO) declared it a global pandemic level 6—the highest level. A **pandemic** is an outbreak that becomes widespread and affects a whole region, continent, or the world.

**Quick Lab**

**How Do Diseases Spread?**

1. Your teacher has placed a fluorescent material in the classroom to simulate a virus. Keep track of the people and objects you touch. Then, use a UV flashlight to check for the “virus” on your hands, objects, and people you have touched since entering the classroom. **CAUTION:** Do not look directly at the UV light.
2. Exchange results with your classmates to determine how the “virus” spread throughout the classroom. Wash your hands with soap and warm water before leaving your classroom.

**Analyze and Conclude**

1. **Infer** What can you infer about how the “virus” spread through the classroom?
2. **Apply Concepts** How does thorough hand washing help prevent the spread of diseases?
3. **Design an Experiment** Suggest a way to model the spread of a vector-borne disease.

**ANSWERS**

**Quick Lab**

1. The “virus” was spread throughout the classroom by students as they touched contaminated objects with their hands.
2. Thorough hand washing washes viruses off hands. Therefore, frequent hand washing may prevent the spread of diseases.
3. Answers will vary, but should outline a procedure to model a vector-borne disease.

**Reading Checkpoint** Pathogens can spread from one person to another by touching, biting, sexual intercourse, contact with body fluids, and inhaling expelled droplets.
Lesson 2

The Spread of Emerging Diseases

Emerging diseases may quickly spread to new regions or population centers. Therefore, it is important to understand some of the ways diseases emerge and spread.

▶ Increasing Mobility

Many diseases are spreading as people become more mobile. A virus for influenza can move across continents in just a few hours if an infected person takes a long airplane flight. Whenever people or other animals move around Earth, they may be taking pathogens along with them.

▶ Antibiotic Resistance

Other diseases, such as tuberculosis, are becoming resistant to our antibiotics. That is, they can survive and grow even when we take medicines that have previously killed them. Antibiotic resistance is a result of natural selection. If a few pathogens in a population are either naturally resistant or develop resistance to an antibiotic, they will survive when exposed to the drug. The rest of the population will die, but a few resistant organisms may then reproduce and create new populations of resistant pathogens.

▶ A Changing Environment

By altering their environment, people may spread emerging diseases. For example, when people cut down forests, they may come into contact with animals that carry pathogens. These animals, and their pathogens, may have been previously contained inside the forest environment.

BIG QUESTION

What is the relationship between environmental health and our own health?

Interpretation

Have students read the information about the spread of emerging diseases. Then have students write a short story that involves human actions that affect or are affected by the spread of an emerging disease.
Climate change is another way our changing environment may encourage the spread of disease. If global temperatures continue to rise, tropical diseases such as malaria and cholera could expand into new, formerly cooler areas.

**Responding to Emerging Diseases** Emerging diseases can surface and spread quickly. As a result, having a reliable response system in place is a necessary step toward maintaining global health. Currently, international and government agencies and organizations work together to help monitor, respond to, and control the spread of emerging diseases.

**International Response** The World Health Organization (WHO) is an international group that helps respond to emerging diseases. It has networks of organizations, agencies, labs, and medical centers that monitor world health events. When an emerging disease is identified, WHO posts the information on the World Wide Web. Within 24 hours, a team goes to the site to assess the situation. If needed, WHO will then help coordinate an international response.

**National Response** Individual nations also help respond to emerging diseases. In the United States, the Centers for Disease Control and Prevention (CDC) is the primary national center for responding to emerging diseases. It works with international as well as other federal, state, and local organizations to develop and apply disease prevention and control measures.

For example, the CDC has taken many steps to help contain the spread of the H1N1 virus. The CDC has worked with states to develop pandemic plans. The CDC has also performed lab testing of the virus and assisted with training workshops on viral identification techniques. In conjunction with the companies that develop the seasonal flu vaccine, it has developed a vaccine against the H1N1 virus.

**Reading Checkpoint**

*What are three factors that influence the spread of emerging diseases?*

*Increased travel, antibiotic resistance, and a changing environment*
Social Hazards

Some social hazards result from lifestyle choices a person makes, while other social hazards cannot be controlled.

Where you live, your job, and the choices you make every day affect your health. When these factors harm your health, they are called social hazards. Some social hazards can be easily avoided, while others are more difficult. For example, you might live near an old toxic waste site that is leaking harmful chemicals into the soil. Or your job could put you into contact with harmful chemicals.

Smoking is a social hazard that can cause lung cancer. A person can avoid this risk by not smoking. Cigarette smoke irritates a person’s eyes, nose, and throat and can make asthma worse. But tobacco smoke can also affect the health of a nonsmoker when he or she breathes in secondhand smoke. Secondhand smoke is the exhaled smoke from nearby smokers mixed with smoke from a burning cigarette, pipe, or cigar. Secondhand smoke exposure has been linked to lung cancer and respiratory tract infections. While you can choose not to smoke, how much secondhand smoke you breathe in may be difficult to control, especially if you live with a smoker.

You may not think of potato chips as a hazard. But if your diet consists primarily of fatty foods, this is considered a social hazard. A high-fat diet can put you at risk for heart attack and stroke. The good news is that diet, along with many other social hazards, can be reduced simply by changing your behavior. You can choose to eat healthful foods. You can also choose to stay active by exercising regularly. By staying active, and eating healthfully, you may be able to avoid obesity, heart disease, and high blood pressure.

FIGURE 11 Healthy Lifestyle Choices You can exercise regularly to avoid the dangers of a sedentary lifestyle.