LESSON 1

An Overview of Environmental Health

Guiding Question: What is environmental health?

Knowledge and Skills

- List the types of environmental health hazards.
- Compare and contrast epidemiology and toxicology.
- Describe the reasons why individuals respond differently to the same environmental hazards.
- Discuss risk assessment.

Reading Strategy and Vocabulary

Reading Strategy Create a main ideas and details chart for the lesson. As you read, write down the main ideas of the lesson. Fill in important details about each main idea.

Vocabulary environmental health, hazard, pathogen, epidemiology, toxicology, toxicity, dose, response, dose-response relationship, risk, risk assessment

MyEnvironmentalScience.com

9.1 LESSON PLAN PREVIEW

Real World Describe a hazard in your community and its effects on people.

Differentiated Instruction Struggling students make a Venn diagram to compare and contrast epidemiology and toxicology.

Inquiry Use a simple demo to make an analogy of the effects of toxins on adults and children.

9.1 RESOURCES

Lesson 9.1 Worksheets • Lesson 9.1 Assessment • Chapter 9 Overview Presentation

GUIDING QUESTION

FOCUS Ask students to think about the last time a cold or flu was "passed around" the school population. Have students discuss how they as individuals and the school as a population were affected. Then, point out that viruses, like those that cause colds and the flu, are just one part of the environment that can affect health. Tell students that this lesson introduces four categories of health hazards found in the environment.

A LEAKY SEWER pipe can threaten your health in more ways than you can imagine. It pollutes the soil you walk on. It could pollute the water supply. Obvious health concerns like these, however, are only a small fraction of the environmental factors that affect your health every day. Your home, your neighborhood, and even the sun can pose health risks. Because of this, many scientists are trying to figure out just exactly how the environment affects our health and how we can stay healthy in our environment.

Types of Hazards

Environmental health hazards can be biological, social, chemical, or physical.

The study of how environmental factors affect human health and our quality of life is called **environmental health**. Environmental factors include natural ones, such as hurricanes and the sun's rays. They also include human-made factors, such as car exhaust and some liquid detergents. Factors that threaten or are harmful to human health are called **hazards**. Environmental hazards can be biological, social, chemical, or physical, as shown in **Figure 1.**

Biological Hazards Viruses, bacteria, and other organisms in the environment that harm human health are classified as biological hazards. These disease-causing agents, or **pathogens**, infect humans and make us sick. Examples of biological hazards include the flu virus, the bacterium that causes strep throat, and even pet dander that may cause allergies.

Social Hazards Hazards that result from where we live, our jobs, or our lifestyle choices are social hazards. For example, smoking cigarettes is a lifestyle choice. If you choose to smoke, you increase your risk of developing lung cancer. On the other hand, living next to a factory that is illegally releasing harmful chemicals into the air is a social hazard that you do not have control over.

FIGURE 1 Environmental Hazards Environmental hazards include physical hazards, such as fire **(a);** social hazards, such as smoking **(b);** biological hazards, such as the bacterium that causes tuberculosis **(c);** and chemical hazards, such as the products you may use to clean your home **(d).**

Chemical Hazards Chemicals in the environment that harm human health are called chemical hazards. These include both synthetic chemicals and hazardous chemicals produced by organisms. For example, some disinfectants you may use to clean your kitchen and bathroom can be chemical hazards.

Physical Hazards Physical processes that pose health hazards include natural disasters. Earthquakes, fires, tornadoes, and droughts are all physical hazards. Physical hazards also include ongoing natural phenomena, such as ultraviolet (UV) radiation from sunlight. Ultraviolet radiation damages DNA and has been linked to skin cancer.

Epidemiology and Toxicology

Epidemiology is the study of disease in human populations, while toxicology is the study of how poisonous substances affect organisms' health.

Identifying hazards in our environment is just one part of environmental health. Scientists also want to understand how these hazards affect people. Epidemiology and toxicology are two scientific fields that help us understand how, where, and to what extent environmental hazards affect our health.

WHAT DO YOU THINK?

Your world • your turn •

Animal testing is often used to determine the toxicity of a substance. Do you think it is ethical to use animals in this way? Why or why not?

ANSWERS

What Do You Think? Answers will vary.

Reading Checkpoint No; often the response varies with the dose. For example, high doses of radiation can kill an organism, while lower doses may only make the organism sick.

Epidemiology The study of disease in human populations is called **epidemiology**. Epidemiologists are scientists who study how and where diseases occur, as well as how to control them. For example, epidemiologists might try to find out why there are unusually large numbers of cancer cases in a town. Or, they may try to determine how diseases spread through a population.

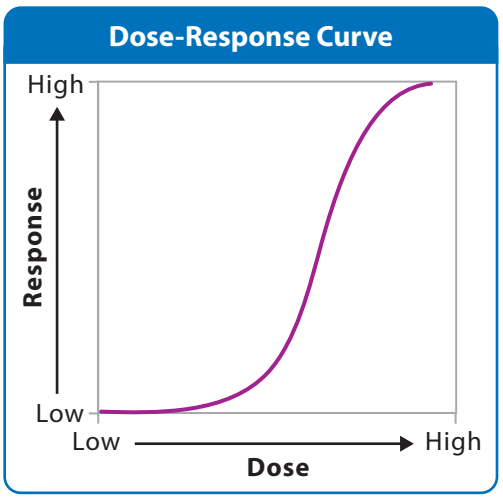
Epidemiological studies often involve studying large groups of people over long periods of time. In many studies, a group of people that has been exposed to a hazard is compared to a control group, or one that has not been exposed. Epidemiologists then track both groups and measure the rate at which death, disease, or other health problems occur in each group. They then analyze the data, looking for statistical differences between the groups. Note that epidemiological studies find statistical associations between a health hazard and an effect. However, they do not confirm that the hazard causes the effect.

Toxicology The study of how poisonous substances affect an organism's health is called **toxicology**. A substance's **toxicity** determines how harmful a substance is to an organism. Toxicity depends on two things: (1) what the substance is, and (2) how much of the substance is needed to cause harm.

▶ ***Dose-Response Relationship*** Toxicologists determine toxicity by measuring the response a substance produces at different doses. A **dose** is the amount of a substance an organism is exposed to. This includes both the concentration of the substance and the length of time the organism was exposed. The **response** is the effect an organism shows as a result of exposure. For example, if an organism is exposed to an extremely high dose of radiation, the response can be death. If the dose is lower, the organism may get sick, but not die. This relationship between the different doses and the responses they generate is known as a **dose-response relationship**.

Sometimes responses occur only above a certain dose. This is called a *threshold dose*. At doses below the threshold dose, the body's organs are able to break down the substance. But at the threshold dose or above, the body becomes overwhelmed.

FIGURE 2 Dose-Response Curve
Dose-response curves show how an organism's response changes with increasing doses of a toxicant. This is a typical dose-response curve. Dose-response curves vary in shape depending on the substance.



▶ ***Determining Dose-Response Relationships*** Determining a dose-response relationship in humans is difficult. For people who have been accidentally exposed to a hazard, it is often hard to determine the exact doses they may have received. In addition, people are exposed to different environmental hazards daily. How much of and when a person has been exposed to one particular hazard is usually difficult to figure out. Because of this, scientists often use animals as subjects when they study dose-response relationships. Scientists expose animals to different doses of a substance. Then, they observe any health effects the amounts may cause. This data can then be graphed as a dose-response curve, shown in **Figure 2**.

✓ Reading Checkpoint *Will an organism always have the same response to a chemical regardless of the dose it is exposed to? Explain.*

The Role of the Individual

People respond differently to environmental hazards due to individual differences such as age, sex, weight, health issues, and genetic makeup.

Every person is different. In fact, two people can respond very differently to exactly the same hazard. For example, drinking from a contaminated well might make one person sick, while another person may not be affected. Therefore, while scientists try to understand how hazards affect human health, they cannot always predict with certainty how a hazard may affect a particular person.

Sensitivity People with health issues such as asthma and compromised immune systems are often more sensitive to biological and chemical hazards than healthy people. That is, they are more likely to feel the effects of these hazards. Sensitivity can also vary with sex, age, and weight. Fetuses, infants, and young children tend to be more sensitive to harmful chemicals than adults. This is because they are smaller and their organ systems are still developing. For example, fetuses are more sensitive to alcohol than adults. Exposing a fetus to alcohol can cause mental retardation and birth defects **(Figure 3).**

Genetics Many diseases have both genetic and environmental factors. In other words, both a person's genes and the environment he or she lives in can affect the individual's chances of suffering from the disease. For example, certain genetic mutations make it more likely for some women to develop breast cancer than others. But environmental factors can increase the risk of getting breast cancer. If a young girl is exposed to ionizing radiation, her chances of developing breast cancer later in life increases.

FIGURE 3 Environmental Hazards and Sensitivity Environmental hazards are particularly dangerous to fetuses, infants, and young children. When fetuses are exposed to alcohol during development, they may be born with fetal alcohol syndrome.

FIGURE 4 Genetics and Environmental Hazards Breast cancer is one disease that has been traced to genetic factors as well as environmental hazards. If caught early, breast cancer is often curable.

Common Hazards	
Hazard	**Annual Risk of Death per 100,000 People**
Heart Disease	271.0
Motor Vehicle Accident	15.0
Falls	6.0
Illegal Drugs	5.6
Rail Trespassing Accidents	0.15
Being Hit by a Meteorite	0.04
Lightning	0.016

FIGURE 5 Common Hazards Many activities have risks associated with them. Knowing these risks can help people make informed decisions about how they live their lives.

Risk Assessment

Risk assessment is the process of measuring the chance that an environmental hazard will cause harm.

Exposure to an environmental hazard does not always produce a response. Given this, scientists try to determine how likely it is that a given hazard will cause harm. This is called **risk**, or the probability that a hazard will cause a harmful response, such as death or disease. One way to express risk of various activities is to calculate and compare the probability of dying from these hazards. **Figure 5** shows the risks of some common hazards.

The process of measuring risk is called **risk assessment**. To assess risk, scientists need to take many factors into account. These include what the hazard is, how often humans will be exposed to it, and how sensitive individuals are to the hazard.

Risk assessment for a chemical hazard involves several steps. First, scientists identify the potentially hazardous chemical. Then, they determine its toxicity and the extent that humans will be exposed to it. For example, to determine toxicity, scientists may use animal testing to establish a dose-response relationship. To assess exposure, scientists may investigate how often humans have contact with the substance, what concentration of the chemical they will likely encounter, and the length of time people will be exposed.

Scientists use risk assessments to help them make decisions about which hazards may be harmful. Policymakers can use risk assessments to help them shape policies that protect both people and the environment.

ANSWERS

Lesson 1 Assessment For answers to the Lesson 1 Assessment, see page A–13 at the back of the book.

LESSON 1 Assessment

1. **Classify** List the four types of environmental health hazards.
2. **Compare and Contrast** How are epidemiology and toxicology similar? How are they different?
3. **Infer** Suppose two people smoke five cigarettes a day for 20 years. One develops lung cancer. Will the other person definitely develop lung cancer as well? Explain.
4. **Explain** What is risk assessment?
5. **THINK IT *THROUGH*** Both a father and his child drink water that has flowed through lead pipes. There is also lead-based paint on the walls of their home. Over time, the child shows the effects of lead poisoning. The father does not. Explain how this could be possible.