

# Vaccine: The Battle Within

To create better vaccines, scientists must study the immune system's complex network of cellular guards.

## Searching for the Bad Bugs...

### 1. Spotting the Enemy

Formed in bone marrow, B lymphocytes are the only immune cells that can make antibodies—the first line of immune defense. Antibodies are proteins that detect and bind themselves to pathogens in the blood to neutralize them.

### 2. Exposing the Bad Guys

Often pathogens camouflage themselves against detection by antibodies with proteins called antigens. Antigen-presenting cells (APCs) chop up the proteins. This exposes the pathogens to destruction.

### 3. Sounding the Alarm

Helper T cells recognize and bind to bugs exposed by APCs. Once activated, helper Ts secrete hormones called cytokines. These signal the immune system to send more macrophages, B cells, and T cells to destroy the invaders, as well as more white blood cells containing enzymes that digest antigens.

## ...And Then Destroying Them

### 4. Building the Bombs

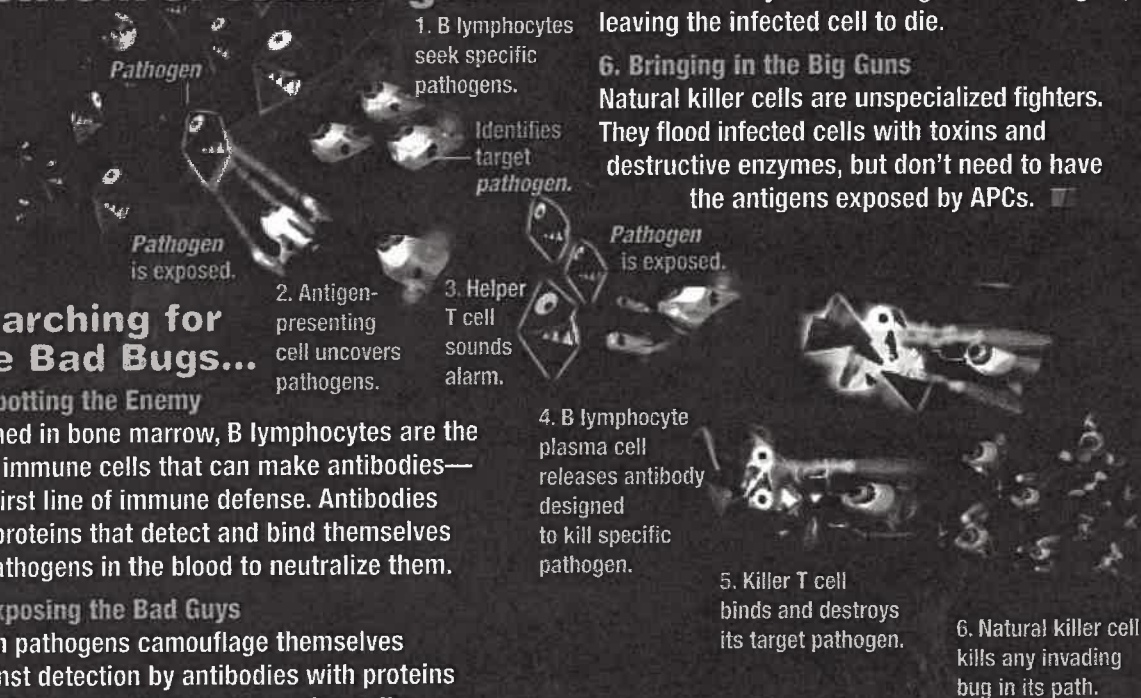
After they encounter antigens in the blood, some B cells retreat to the lymph nodes, where they become plasma cells and churn out antibodies that can bind to the antigens.

### 5. Going in for the Kill

Killer T cells must recognize antigens. Then they mature quickly to perform their second function—destroying pathogens. Killer T cells attach to a pathogen and douse it with a lethal toxin. Then they detach and go off to kill again, leaving the infected cell to die.

### 6. Bringing in the Big Guns

Natural killer cells are unspecialized fighters. They flood infected cells with toxins and destructive enzymes, but don't need to have the antigens exposed by APCs.



1. B lymphocytes seek specific pathogens.

Identifies target pathogen.

Pathogen is exposed.

2. Antigen-presenting cell uncovers pathogens.

3. Helper T cell sounds alarm.

Pathogen is exposed.

4. B lymphocyte plasma cell releases antibody designed to kill specific pathogen.

5. Killer T cell binds and destroys its target pathogen.

6. Natural killer cell kills any invading bug in its path.

TIME  
to THINK...

About  
Vaccines

Every year nearly 2 million children worldwide die from diseases that vaccination could have prevented. Use the Internet or your school's media center to learn what diseases cause the most deaths among unvaccinated children. Why are these children not being vaccinated? Report your findings to the class.

## Lesson 1

# What Are Communicable Diseases?

### VOCABULARY

**communicable disease**  
**pathogen**  
**infection**  
**viruses**  
**bacteria**  
**toxin**  
**vector**

### YOU'LL LEARN TO

- Identify the types of pathogens that cause communicable diseases.
- Analyze the relationship between healthful behaviors and the ways that communicable diseases are spread.
- Develop and analyze strategies related to the prevention of communicable diseases.



Write about the last time you had a cold. Include a list of the symptoms you experienced. Explain how you think you caught the cold and what you did to treat it.



**A** The HIV virus (top), pneumonia virus, and cold virus (bottom), are pathogens.

Most of us don't spend much time thinking about microorganisms, but they often impact our lives. Although most microorganisms—living things too small to be seen without a microscope—are harmless, a few, such as the viruses shown on this page, can cause communicable diseases. A **communicable disease** is a disease that is spread from one living thing to another or through the environment. Knowing how communicable diseases spread can help you choose behaviors to reduce your risk of getting them.

## Causes of Communicable Diseases

An organism that causes disease is called a **pathogen**. Common pathogens include certain viruses, bacteria, fungi, protozoans, and rickettsias (rik-ET-see-uhz). **Figure 24.1** lists some of the diseases caused by pathogens. An **infection** is a condition that occurs when pathogens enter the body, multiply, and damage body cells. If the body is not able to fight off the infection, a disease develops.

## Viruses

You're already familiar with two diseases caused by viruses—the common cold and influenza, or the flu. **Viruses** are *pieces of genetic material surrounded by a protein coat*. By themselves they are inactive. They need living cells to reproduce. Viruses invade all known forms of life—mammals, birds, reptiles, insects, plants, and even bacteria.

After a virus penetrates a cell, called the host cell, the virus takes control of the cell to manufacture more viruses. The new viruses burst from the cell, usually killing it, and take over other cells. Like other pathogens, viruses usually run their course and eventually are killed by the immune system. Antibiotics do not work against viruses.

## Bacteria

**Bacteria** are *single-celled microorganisms* that live almost everywhere on earth. Most bacteria are harmless, and many types are essential for life. For example, bacteria in your digestive system help digest food and make some of the vitamins you need. When bacteria enter the body, they multiply through cell division. Some bacterial pathogens, such as the ones that cause tetanus, produce a **toxin**, a *substance that kills cells or interferes with their functions*. Like most other microorganisms that enter the body of a healthy individual, bacteria are usually destroyed by the immune system. Most bacterial diseases can be treated with **antibiotics**.

### Did You Know?

In 1993 four children were killed and hundreds of others sickened by undercooked hamburger from a fast-food restaurant. The culprit was *E. coli O157:H7*. This bacteria causes severe damage to the cells lining the human intestines and can lead to kidney failure and death.

Common sources of the bacteria are undercooked, contaminated ground beef and unpasteurized milk and apple cider.

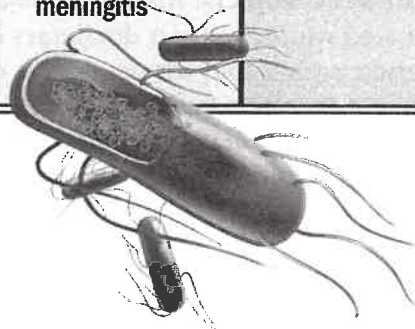
### hotlink

**antibiotics** For more information about antibiotics, see Chapter 23, page 587.

FIGURE 24.1

## DISEASES BY TYPE OF PATHOGEN

Viruses	Bacteria	Fungi	Protozoans	Rickettsias
<ul style="list-style-type: none"> <li>• common cold</li> <li>• influenza (flu)</li> <li>• viral pneumonia</li> <li>• viral hepatitis</li> <li>• polio</li> <li>• mononucleosis</li> <li>• measles</li> <li>• AIDS</li> <li>• viral meningitis</li> <li>• chicken pox</li> <li>• herpes</li> <li>• rabies</li> <li>• smallpox</li> </ul>	<ul style="list-style-type: none"> <li>• bacterial foodborne illness</li> <li>• strep throat</li> <li>• tuberculosis</li> <li>• diphtheria</li> <li>• gonorrhea</li> <li>• Lyme disease</li> <li>• bacterial pinkeye</li> <li>• bacterial pneumonia</li> <li>• bacterial meningitis</li> </ul>	<ul style="list-style-type: none"> <li>• athlete's foot</li> <li>• ringworm</li> <li>• vaginal yeast infection</li> </ul>	<ul style="list-style-type: none"> <li>• malaria</li> <li>• amoebic dysentery</li> <li>• sleeping sickness</li> </ul>	<ul style="list-style-type: none"> <li>• typhus</li> <li>• Rocky Mountain spotted fever</li> </ul>





- ▲ Try to reduce your risk of infection when you participate in outdoor activities where vectors are common. How is this teen protecting himself from deer ticks?

## CHARACTER CHECK

**Respect.** One simple action can demonstrate your respect for your own health and the health of others. Every time you wash your hands properly you reduce the risk of spreading potential pathogens, especially when you prepare food or when you touch objects that others may put in their mouths.

**What other safe food-handling habits can you practice?**

## Other Types of Pathogens

Other types of organisms also can cause communicable diseases.

- ▶ **Fungi** are plantlike organisms, such as molds and yeasts. Some types can cause diseases of the skin, such as athlete's foot; diseases of the mucous membranes; or of the lungs.
- ▶ **Protozoans** are single-celled organisms that are larger and more complex than bacteria. Most are harmless, but some can cause disease, especially in people with weakened immune systems.
- ▶ **Rickettsias** are pathogens that resemble bacteria. Like viruses, they multiply by invading the cells of another life form. Often these organisms enter humans through the bites of insects such as fleas or lice. Rocky Mountain spotted fever is the most frequently reported illness spread by rickettsias.

## How Communicable Diseases Are Transmitted

There are several means of transmitting, or spreading, pathogens. Transmission can occur through direct and indirect contact and through breathing contaminated air. Some diseases can be transmitted in more than one way. If you know how they are spread, you can take precautions and avoid infection.

### Direct Contact

Many pathogens are transmitted by direct contact with an infected person or animal or with something in the environment. Direct contact includes touching, biting, kissing, and sexual contact. Sneezing and coughing can spray infectious droplets of saliva or mucus into a nearby person's eyes, nose, or mouth. A pregnant woman may also transmit an infection to her unborn child through the placenta. A person can get tetanus from a puncture wound by a rusty nail.

### Indirect Contact

Some communicable diseases can be transmitted indirectly, without being close to an infected person. The following are ways diseases can be transmitted through indirect contact:

- ▶ **Contaminated objects.** Inanimate objects can become contaminated with infectious discharges or secretions. Suppose that a person with a cold sneezes onto a table or into his or her hand and then touches the table. The cold viruses can be transmitted to you if you touch the table and then touch your nose or eyes. Use proper handwashing techniques to avoid transmitting infections.



## Strategies for Avoiding Diseases Transmitted by Vectors

Use these strategies where mosquitoes or ticks are common:

- ▶ Wear long-sleeved shirts, long pants, socks, and hats.
- ▶ Tuck shirts in at the waist, and tuck pants into socks.
- ▶ Wear boots, not sandals.
- ▶ Apply repellents to clothing, boots, socks, and all exposed skin.
- ▶ Check yourself and your clothing frequently. Wearing light-colored clothing can help you spot ticks and mosquitoes.

▶ **Vectors.** An organism, usually an arthropod, such as a tick, that carries and transmits pathogens to humans or other animals is known as a **vector**. For example, a mosquito may take in pathogens when it feeds on an infected person. The mosquito then injects some of those pathogens into the next person it bites, thus spreading the disease. Common vectors include flies, mosquitoes, and ticks. Lyme disease and malaria are spread by vectors.

▶ **Water and food.** Careless handling and storage of food are major sources of contamination and illness. For example, salmonella (sal-muh-NE-luh) bacteria in undercooked poultry can cause food poisoning. Water supplies that become contaminated with human or animal feces can cause illnesses such as hepatitis A.

### Airborne Transmission

Pathogens from a sneeze or a cough may float in the air for a long time and travel long distances. Airborne transmission is different from direct contact because the pathogens don't settle quickly on surfaces. You don't have to be close to an infected person to inhale the pathogens. Diseases that are transmitted this way include chicken pox, tuberculosis, and influenza. A person can get inhalation anthrax by inhaling soil containing the bacteria.

## Strategies for Preventing Communicable Disease

**R**educing your risk of communicable diseases isn't complicated. Practicing healthful behaviors is a strategy for preventing communicable diseases.

### Washing Hands


Handwashing is the single most effective strategy for preventing the spread of disease. Wash your hands before you prepare food, before you eat, and after you use the bathroom. Clean hands carefully before inserting contact lenses or putting on makeup. After handling animals, especially reptiles, or animal wastes, make it a habit to wash your hands. When someone in your home is ill, keep hands clean to prevent the spread of pathogens.

### Handling Food Properly

**Foodborne illness** occurs in places where food is handled improperly. Always wash your hands before you handle food. Use paper towels, not dishcloths or sponges, to keep surfaces and equipment clean. Separate raw meat from other foods. Cook food to its proper temperature. Chill cold and leftover foods quickly to the proper temperature.

### hotlink

**foodborne illness** For more information about foodborne illness and proper food preparation, see Chapter 5, page 134.

 **Handwashing is important since your hands easily pick up and transfer bacteria. List other strategies you can use to avoid the spread of disease.**



## Other Prevention Strategies

Here are some other strategies that will help you reduce your risk of getting or spreading communicable diseases.

- ▶ Eat a balanced diet. Participate in regular physical activity. Avoid the use of tobacco, alcohol, and other drugs.
- ▶ Avoid sharing eating utensils, makeup, combs and brushes, and other personal items.
- ▶ Prepare and store food safely—keep hot foods hot and cold foods refrigerated or on ice.
- ▶ Avoid unnecessary contact with people who are ill.
- ▶ Take care of yourself when you're ill. Cover your mouth when you cough or sneeze. Wash your hands after using a tissue.
- ▶ Be sure you are vaccinated against particular diseases as recommended by your physician.
- ▶ Practice abstinence from sexual activity.
- ▶ Learn to manage stress. Stress makes you vulnerable to illness if you do not find ways to manage it effectively.

## Lesson 1 Review

### Reviewing Facts and Vocabulary

1. List five types of common pathogens, and identify one disease each type of pathogen causes.
2. Describe three ways in which pathogens spread and three healthful behaviors to limit their spread.
3. What are five ways you can reduce your risk of getting a communicable disease?

### Thinking Critically

4. **Applying.** The fungus that causes athlete's foot lives in warm, moist places. What can you do to prevent getting this pathogen when you use gym or other common showers?
5. **Analyzing.** You wake up one morning with a headache, body aches, and a fever. You think you might be coming down with something. Analyze the relationship between healthful behaviors you can practice and the ways that communicable diseases are spread. What should you do?

### Applying Health Skills

**Practicing Healthful Behaviors.** Work with a family member to identify ways in which you can reduce your risk of contracting a foodborne illness at home. Develop and analyze strategies related to the prevention of food poisoning.



**PRESENTATION SOFTWARE** You've probably heard the saying "a picture is worth a thousand words." Use presentation software to show your plan for reducing the spread of foodborne illness. For tips on using presentation software, see [health.glencoe.com](http://health.glencoe.com).

## Lesson 2

# Preventing Communicable Diseases

### VOCABULARY

**immune system**  
**inflammatory response**  
**phagocyte**  
**antigen**  
**immunity**  
**lymphocyte**  
**antibody**  
**vaccine**

### YOU'LL LEARN TO

- Examine how the body protects itself against invading pathogens.
- Apply strategies for caring for your immune system and preventing disease.
- Explain how technology has impacted the health status of individuals, families, communities, and the world in the prevention of communicable disease.
- Identify available health-related services in the community that provide vaccines and information related to disease prevention.

### QUICK START


Have you ever had a small cut or other injury that became red or painful or developed pus? Write a few paragraphs describing what the area of injury looked like over several days.

You can't see it, but the teen in the picture is waging a battle. The battle is not against other players who are trying to score a point. It's a battle to fight off the pathogens that constantly attack his body. Every day, 24 hours a day, your body is exposed to millions of pathogens. Most of the time, your body manages to stay free of infection because of your immune system. The **immune system** is a network of cells, tissues, organs, and chemicals that fights off pathogens.

## Physical and Chemical Barriers

Physical and chemical barriers make up your body's first line of defense, as shown in **Figure 24.2** on page 628. They protect



-  Compare the protective equipment worn by this goalie to your physical and chemical barriers. How might behaviors such as wearing appropriate safety equipment help protect you from pathogens?

against a wide variety of invaders. Physical barriers, such as skin and mucous membranes, block pathogens from invading your body. Chemical barriers, such as enzymes in tears, destroy pathogens.

## The Immune System

The immune system has two major defense strategies. The inflammatory response is general, or nonspecific; it works against all types of pathogens. Specific defenses work against particular pathogens. Together, these defenses work to prevent disease.

### The Inflammatory Response

The **inflammatory response** is a reaction to tissue damage caused by injury or infection. Its purpose is to prevent further tissue injury and to halt invading pathogens. Suppose that a splinter enters your finger. Your body immediately reacts to the damage caused by the splinter and to any pathogens on the splinter. If you've ever had the area around an injury become hot, swollen, red, and painful, you've experienced the inflammatory response.

FIGURE 24.2

## PHYSICAL AND CHEMICAL BARRIERS— THE BODY'S FIRST LINE OF DEFENSE

These elements work together as your body's first line of defense to prevent pathogens from entering and causing disease.

**Skin** is the first line of defense against many pathogens. Few pathogens can pass through the tough layer of dead skin cells that surrounds the body.

**Tears and saliva** contain enzymes that destroy or disable many pathogens.

**Mucous membranes** line many parts of the body, including your mouth, nose, and bronchial tubes. Cells in these membranes produce *mucus*, a sticky substance that traps pathogens. The mucus then carries the trapped pathogens to other areas of the body for disposal.

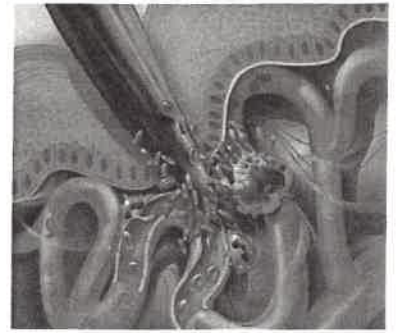
**Cilia**, the hairlike projections that line parts of the respiratory system, sweep mucus and pathogens to the throat, where they can be swallowed or coughed out.

**Gastric juice** in the stomach destroys many pathogens that enter the body through the nose and mouth.





In response to invasion by microorganisms and to tissue damage, blood vessels near the site of an injury expand to allow more blood flow to the area. As blood vessels expand, fluid and cells from the bloodstream leak into the area. The collection of fluid and white blood cells causes swelling and pain because of pressure on nerve endings. One type of cell that responds to injury is called a **phagocyte** (FA-guh-site), *a white blood cell that attacks invading pathogens*. Phagocytes engulf pathogens and then destroy them with chemicals. Pus, a collection of dead white blood cells and damaged tissue, may collect at the site of inflammation as a response to bacteria. After the pathogens are killed and tissue damage is under control, tissue repair can begin. However, regardless of whether pathogens survive the inflammatory response, specific defenses are activated. This activation is an effort to prevent this same infection from occurring again.



**▲ Injury and infection caused by this splinter may trigger an inflammatory response. What immediately happens in the body as a response to injury?**

## Health Skills Activity

### Decision Making: Caring for Your Immune System

Aaron has been getting a lot of colds lately. Today he woke up with a bad sore throat. Aaron knows that he should stay home and rest, both for his own health and to avoid infecting others at school. However, Aaron plays the lead saxophone in the marching band, and today is the last band practice before the big game. This practice will even be a full-dress rehearsal to make sure everything goes right for the half-time show.

Saturday's game will be the playoff, and everyone is sure the school will win. If Aaron doesn't show up, he thinks he will be letting the band down. Besides, he doesn't want to admit that he is getting sick because then he won't be there on Saturday when the team wins.

Aaron wonders what he should do.



#### What Would You Do?

Apply the six steps of the decision-making model to Aaron's situation.

1. State the situation.
2. List the options.
3. Weigh the possible outcomes.
4. Consider values.
5. Make a decision and act.
6. Evaluate the decision.

**TOPIC The Immune System**

Go to [health.glencoe.com](http://health.glencoe.com) and click on Web Links to find out more about how the immune system works.

**ACTIVITY** Using the information you find at these links, write a short story about an immune system fending off an infection, from the point of view of a lymphocyte.

## Specific Defenses

**S**pecific defenses react to invasion as a result of the body's ability to recognize certain pathogens and destroy them. The process by which this happens, the immune response, is described in **Figure 24.3**. During the immune response, certain types of white blood cells react to antigens. An **antigen** is a substance that is capable of triggering an immune response. Antigens are found on the surfaces of pathogens and in toxins. Macrophages are a type of phagocyte that destroys pathogens by making antigens recognizable to white blood cells. The result of the immune response is **immunity**, the state of being protected against a particular disease.

### Lymphocytes

A **lymphocyte** (LIMP-fuh-site) is a specialized white blood cell that coordinates and performs many of the functions of specific immunity. There are two types of lymphocytes: T cells and B cells.

#### T CELLS AND B CELLS

There are different types of T cells with different functions. They all work together to protect against infection.

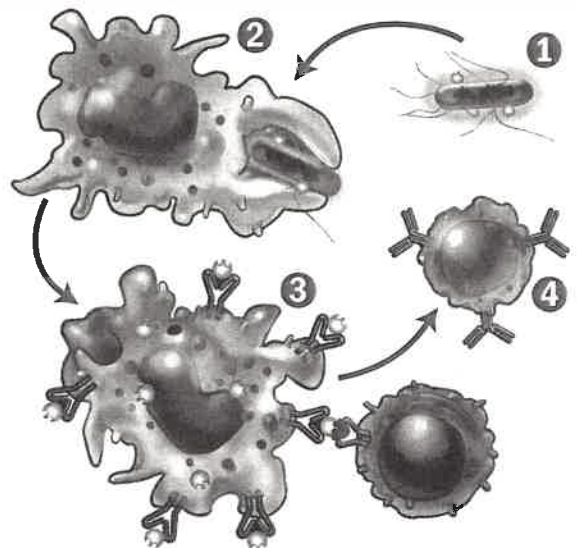
- ▶ *Helper T cells* trigger the production of B cells and killer T cells.
- ▶ *Killer T cells* attack and destroy infected body cells. Killer T cells don't attack the pathogens themselves, only the infected cells.

FIGURE 24.3

## THE IMMUNE RESPONSE

The immune response is a complex interaction between your body and an invading pathogen. It can be broken down into eight distinct stages.

1. Pathogens invade the body.
2. Macrophages engulf the pathogen.
3. Macrophages digest the pathogen and T cells recognize antigens of the pathogen as an invader.
4. T cells bind to the antigens.
5. B cells bind to antigens and helper T cells.
6. B cells divide to produce plasma cells.
7. Plasma cells release antibodies into the bloodstream.
8. Antibodies bind to antigens to help other cells identify and destroy the pathogens.



- *Suppressor T cells* coordinate the activities of other T cells. They “turn off” or suppress helper T cells when the infection has been cleared.

In conjunction with the work of T cells, lymphocytes called B cells produce antibodies. An **antibody** is a *protein that acts against a specific antigen*. Each B cell is programmed to make one type of antibody, specific to a particular pathogen. Some antibodies attach to foreign antigens to mark them for destruction. Some destroy invading pathogens. Others block viruses from entering body cells.

## The Role of Memory Lymphocytes

Your immune system actually has a “memory.” Some T cells and B cells that have been activated by antigens become *memory cells*. These memory cells circulate in your bloodstream and through the lymphatic system, shown in **Figure 24.4** on page 632. When memory cells recognize a former invader, the immune system uses antibodies and killer T cells in a quick defense to stop it. For example, if you have had measles or an immunization against measles, your immune system remembers the antigens for the measles virus. If it enters your body again, antibodies will attack the virus immediately, protecting you from becoming ill.

### Active Immunity

The immunity your body develops to protect you from measles and from other diseases is called *active immunity*. Naturally acquired active immunity develops when your body is exposed to antigens from invading pathogens. Artificially acquired active immunity develops in response to a **vaccine**, a *preparation of dead or weakened pathogens that are introduced into the body to stimulate an immune response*. In this way vaccines cause your body to produce antibodies without actually causing the disease. Today, more than 20 serious human diseases can be prevented by vaccination. Active immunity to many diseases can last a lifetime, but some immunizations need to be repeated to maintain immunity.

### Passive Immunity

In active immunity your body produces its own antibodies. You also can be protected from pathogens by *passive immunity*—receiving antibodies from another person or an animal. This immunity is short-lived; it usually lasts only weeks to months. Natural passive immunity occurs when antibodies pass from mother to child during pregnancy or while nursing. Artificial passive immunity results from the injection of antibodies produced by an animal or a human who is immune to the disease.



#### Is there a vaccine to prevent colds?

Developing a vaccine to prevent colds is difficult. More than 200 different viruses can cause the common cold. This means that more than 200 different vaccines would have to be developed to prevent this illness.

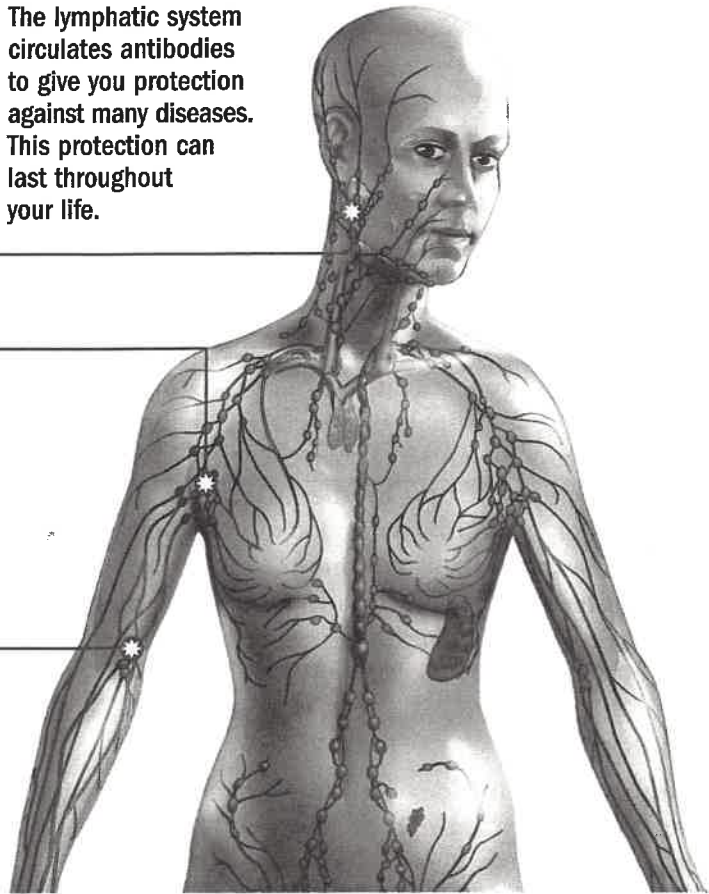
## IMMUNITY AND THE LYMPHATIC SYSTEM

The lymphatic system circulates antibodies to give you protection against many diseases. This protection can last throughout your life.

The lymphatic system is part of your immune system. It includes your tonsils, lymph nodes, and a network of vessels, similar to blood vessels, that transport lymph, or tissue fluid.

Lymph nodes can become enlarged when your body is fighting an infection because of the increased number of lymphocytes. If swelling lasts for three days, see your health care professional.

Lymphocytes are produced by lymph nodes. These nodes occur in groups and are concentrated in the head and neck, armpits, chest, abdomen, and groin.



## Care of the Immune System

Your health behaviors can greatly reduce your chance of contracting a disease or getting an infection. When you keep your body strong and healthy, your immune system is better able to fight off pathogens. Taking positive steps in every area of your health will give you the boost needed to reduce your chance of illness.

- ▶ Follow a sensible eating plan to maintain your overall health and keep your immune system strong. Include whole grains and nutrient-rich foods such as fruits and vegetables, and reduce intake of fats, sugar, and salt. Drink six to eight 8-ounce glasses of water each day.
- ▶ Get plenty of rest. Fatigue reduces the effectiveness of the immune system. To function at their best, teens should average nine hours of restful sleep each night.

- ▶ Get about an hour of physical activity each day. This is especially important to relieve stress.
- ▶ Avoid sharing personal items such as towels, toothbrushes, hairbrushes, and makeup.
- ▶ Avoid tobacco, alcohol, and other drugs.
- ▶ Avoid sexual contact. Some **STDs**, such as HIV, actually destroy the immune system.
- ▶ Keep your immunizations up to date.

### hotlink

**STDs** For more information on sexually transmitted diseases, including HIV/AIDS, see Chapter 25, page 646.

## Vaccines to Aid the Body's Defenses

**W**hen a new disease emerges or a familiar one becomes a greater health threat than in the past, health care workers begin to look for ways to prevent the disease. Research and advances in medical technology have allowed scientists to develop vaccines. Today, vaccines prevent diseases that once claimed millions of lives around the world. Vaccines can be one of four types.



- ▶ **Live-virus vaccines** are made from pathogens grown under special laboratory conditions to make them lose most of their disease-causing properties. Although weakened, the organism can still stimulate the production of antibodies. The vaccines for measles, mumps, and rubella (MMR) and for chicken pox are produced in this way.
- ▶ **Killed-virus vaccines** use inactivated pathogens. Even though they are dead, the organism still stimulates an immune response and antibodies are produced. Flu shots, the Salk vaccine for polio, and the vaccines for hepatitis A, rabies, cholera, and plague are all killed-virus vaccines.
- ▶ **Toxoids** are inactivated toxins from pathogens. They are used to stimulate the production of antibodies. Though many pathogens are not harmful themselves, the toxins they produce cause sickness. Toxoids can be used to protect the body against such illnesses. Both tetanus and diphtheria immunizations use toxoids.
- ▶ **New and second-generation vaccines** are being developed by scientists using new technologies. An example is the vaccine for hepatitis B, which is made from genetically altered yeast cells.

▲ **These and many other common diseases can be prevented with vaccines:**

- Chicken pox
- Hepatitis B
- Measles
- Mumps
- Whooping cough (pertussis)
- Tetanus
- Diphtheria
- Polio
- Rubella

*Check with your parents or your health care professional to find out how many of these diseases you have been vaccinated against.*

## Immunization for All

Vaccines impact more people than just those who receive them. If you are vaccinated against a disease, you can't spread that disease to others. In this way vaccination not only protects you but also helps protect the health status of those around you, including other individuals, your family, and your community. One exception is tetanus, which is transmitted through the environment. The tetanus vaccine protects only the individual who receives it.

You should have up-to-date immunizations, including those for tetanus, diphtheria, measles, mumps, rubella, and hepatitis B. Vaccination against chicken pox is recommended if you have not had this disease. Some vaccines require more than one dose over time, or "booster shots." Your family physician and your local health department can advise you on the immunizations you need and provide them for you. Most high schools and colleges require that students show proof of current immunizations before admission. Each state has its own laws governing immunizations and school attendance. Some schools may have additional requirements.

### Lesson 2 Review

#### Reviewing Facts and Vocabulary

1. List three physical and chemical barriers that pathogens encounter when they try to enter the human body.
2. What is the difference between active immunity and passive immunity?
3. Where can you go to find out which immunizations you need?

#### Thinking Critically

4. **Analyzing.** How do you think vaccines have impacted the health status of individuals, families, communities, and the world?
5. **Evaluating.** What would you say to someone who says that he or she is careful never to come into contact with pathogens and therefore will not become ill?

#### Applying Health Skills

**Accessing Information.** Research those vaccinations suggested for someone your age, and make a table of this information. Work with a parent or guardian to determine which of your immunizations are current, and fill in the information on the table. Plan to get any immunizations you lack. Use this table to track when you should update your immunizations.



**SPREADSHEETS** Use spreadsheet software to create a chart showing the immunizations suggested for different age groups. You might also include a column listing facilities in the area that offer these vaccinations. See [health.glencoe.com](http://health.glencoe.com) for information on how to create a spreadsheet.

## Lesson 3

# Common Communicable Diseases

### VOCABULARY

**pneumonia**  
**jaundice**  
**emerging**  
**infection**

### YOU'LL LEARN TO

- Identify the causes, transmission, symptoms, and treatment of several communicable diseases.
- Analyze strategies to reduce the risk of contracting some communicable diseases.
- Explain how technology impacts world health status.

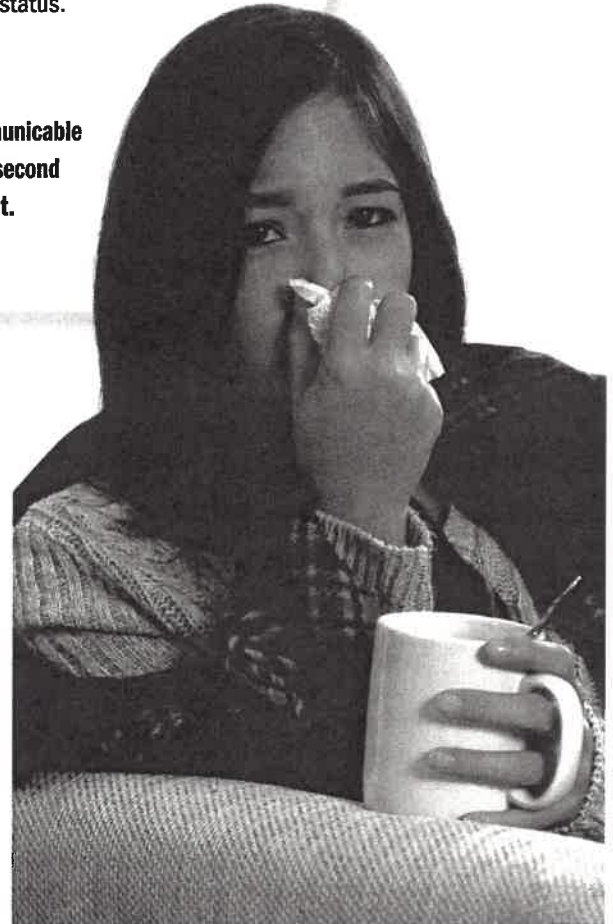
### QUICK START

Make a two-column chart. In the first column, list communicable diseases with which you are familiar and write one fact about each. In the second column, list communicable diseases you have heard of but know little about.

You probably have experienced a fever or the stuffy or runny nose of a cold. In this lesson you'll learn about some common communicable diseases, their symptoms, and how they are treated. Most important, you will learn ways to reduce your risk of contracting these diseases.

## Respiratory Infections

The most common communicable diseases are those of the respiratory tract. These infections can occur anywhere from the nose to the alveoli of the lungs. Most are caused by viruses or bacteria. You can reduce your risk of most respiratory illnesses by avoiding close contact with people who are infected, washing your hands often, keeping your hands away from your eyes and nose, and keeping your immune system healthy. Smoking can contribute to illness by damaging cilia and irritating respiratory passages. In addition, symptoms of these diseases may be more severe in smokers. Smoking has also been shown to suppress the immune system.



- ▲ When you have a cold, the best thing to do is rest, eat nutritious foods, and drink plenty of fluids such as water or fruit juice. How might these strategies help your body fight cold viruses?

## hot link

**analgesics** For more information about analgesics, see Chapter 23, page 588.



Is It a Cold  
or the Flu?

### Cold symptoms include:

- ▶ Runny or stuffy nose
- ▶ Sneezing
- ▶ Sore throat
- ▶ Headache

### Flu symptoms include:

- ▶ High fever
- ▶ Chills
- ▶ Dry cough
- ▶ Muscle and joint pain
- ▶ Runny nose
- ▶ Sore throat
- ▶ Extreme fatigue

## Common Cold

The common cold is a viral infection that causes inflammation of the mucous membranes that line the nose and throat. Symptoms include a runny nose, sneezing, and sore throat. The most common way of getting a cold is from rubbing your eyes or nose after picking up the virus directly through hand-to-hand contact or indirectly by handling a contaminated object.

There is no cure for the common cold. Treatment is for relief of symptoms, and most colds clear up in a week or so. Often treatment includes the use of **analgesics**. It's important to note that anyone under 20 years of age should avoid use of medications containing salicylates, such as aspirin. Such use is linked to Reye's syndrome, a condition that can be fatal. Avoid these products no matter what disease you might have. Use acetaminophen or ibuprofen instead.

## Influenza

Influenza, or the flu, is a viral infection of the respiratory tract. It is most often spread through airborne transmission but also may spread through direct or indirect contact. Symptoms of flu include high fever, fatigue, headache, muscle aches, and cough. The flu can lead to **pneumonia** (noo-MOH-nyah), *an infection of the lungs in which the air sacs fill with pus and other liquid*. This is a serious disease that is more likely to occur in the elderly and people with lung and heart problems.

Antiviral drugs for treatment of the flu are available but need to be given as soon as the illness arises. Persons who have the flu should get proper nutrition and plenty of rest and fluids. Older adults and persons of any age with chronic health problems should get a flu shot every year. However, anyone who wants to avoid the flu can be given the vaccine.

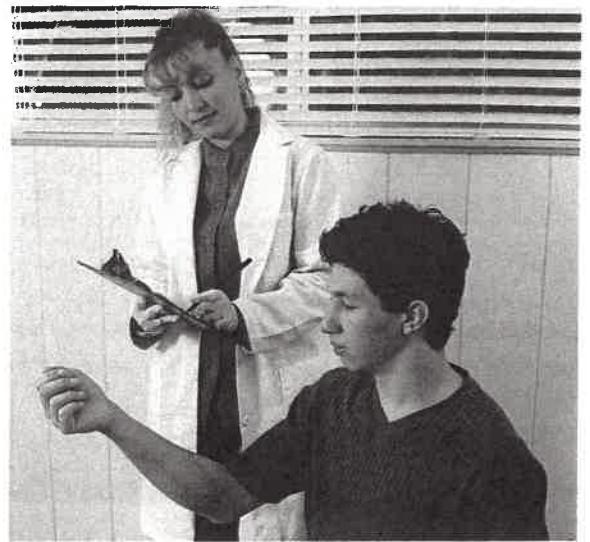
## Pneumonia

Along with influenza, pneumonia is one of the top ten causes of death in the United States. Viral pneumonia is relatively short-lived and produces symptoms similar to those of influenza. Antiviral drugs are used in some cases. Bacterial pneumonia can be treated with antibiotics if diagnosed early. The bacteria that cause pneumonia are often present in healthy throats. When body defenses are weakened in some way, the bacteria can get into the lungs and multiply. For example, if a person is elderly or has influenza, he or she may be more at risk for complications leading to pneumonia.



## Strep Throat

Strep throat is a bacterial infection spread by direct contact, often through droplets that are coughed or sneezed into the air. Symptoms of strep throat include a sore throat, fever, and enlarged lymph nodes in the neck. Untreated, strep throat can lead to serious complications, including inflammation of the kidneys and rheumatic fever, which can cause permanent heart damage. Strep throat can be treated with antibiotics. A doctor cannot always diagnose strep by examination. If a sore throat lasts more than three days, a culture is taken to identify the bacteria.



## Tuberculosis

Tuberculosis, or TB, is a bacterial disease that usually attacks the lungs. TB is spread through the air when a person with the disease coughs or sneezes. Most people who are infected carry the bacteria in their lungs but never develop the disease because the body's defenses prevent the bacteria from multiplying and spreading to others. People with weakened immune systems are more likely to develop the active disease with symptoms that include fatigue, coughing (sometimes coughing up blood), fever, night sweats, and weight loss. People with the active disease can spread TB. Prolonged or repeated exposure is usually required for infection. Some strains have developed resistance to antibiotics. Physicians may have to prescribe several antibiotics at one time until tests are conducted to determine which are effective for a particular person.

**▲** Many employers in the health care industry require applicants to show proof of a negative TB test. Why may patients in hospitals or in long-term care facilities be at increased risk for tuberculosis?

## Hepatitis

**H**epatitis is inflammation of the liver and can be caused by chemicals, including drugs and alcohol, and by many different pathogens. The hepatitis A, B, and C viruses are some of the most common causes of this type of liver damage, and there is no cure for them. However, vaccines for hepatitis A and B are available.

### Hepatitis A

Hepatitis A is another of the top ten communicable diseases reported in the United States. About 1.5 million people worldwide are newly infected each year. The hepatitis A virus is most commonly spread through contact with feces of an infected person. Infected persons who do not wash their hands properly may contaminate inanimate objects or food or spread the virus through direct contact.

### Did You Know?

Many people mistakenly believe that tuberculosis is no longer a problem, but experts estimate that about 10 million people in the United States are currently infected with TB bacteria and that about 10 percent of these people will develop the disease.

TB is increasingly a worldwide problem. In 1999, 2 million deaths were attributed to TB; 100,000 of those deaths were of children. The CDC estimates that by 2020 nearly 1 billion people worldwide will become infected with tuberculosis.



**A** About 30 to 40 percent of people with hepatitis B don't know how they got the infection. *How can you protect yourself from exposure to hepatitis B?*

Symptoms of hepatitis A are generally mild and may include fever, nausea, vomiting, fatigue, abdominal pain, and **jaundice**, a yellowing of the skin and eyes. Most infected individuals recover completely. Chronic, or long-lasting, infection is rare. The best way to reduce your risk of hepatitis A is to practice careful handwashing and avoid close contact with people who are infected.

## Hepatitis B

Hepatitis B is a more serious disease than hepatitis A. The hepatitis B virus (HBV) is found in most bodily fluids of an infected person, especially blood. It is most often transmitted through sexual contact. It also can be transmitted through needles shared by infected drug users. Though most people who are infected never experience symptoms, the hepatitis B virus frequently causes severe liver damage, including liver failure and cirrhosis, or scarring, of the liver. Hepatitis B may be responsible for up to 80 percent of all cases of liver cancer worldwide. More than 2 billion people worldwide have been infected with HBV. About 1.25 million people in the United States have chronic HBV infection.

You can reduce your risk of hepatitis B by practicing abstinence from sexual contact and from illegal drug use. Do not share personal items, such as toothbrushes and razors, which could have trace amounts of saliva or blood. Body piercing and tattooing using contaminated needles can spread the disease. The CDC recommends that all children and teens receive the hepatitis B vaccine.

## Hepatitis C

Hepatitis C is the most common chronic bloodborne infection in the United States; about 4 million Americans are infected. It is most often transmitted by direct contact with infected blood through contaminated needles shared by drug users. Hepatitis C can lead to chronic liver disease, liver cancer, and liver failure. It is the leading reason for liver transplants in the United States. Up to 90 percent of those infected with the hepatitis C virus (HCV) don't realize they have the disease until years later when routine tests show liver damage. You can reduce your risk of hepatitis C by practicing abstinence from illegal drug use. In addition, don't share personal care items such as razors and toothbrushes. As with other viral infections, there is no cure for hepatitis. Treatment includes rest, proper nutrition, and drinking plenty of fluids.

## Other Diseases

Several other communicable diseases are common among adolescents and young adults. **Figure 24.5** on page 640 provides a summary of these diseases.

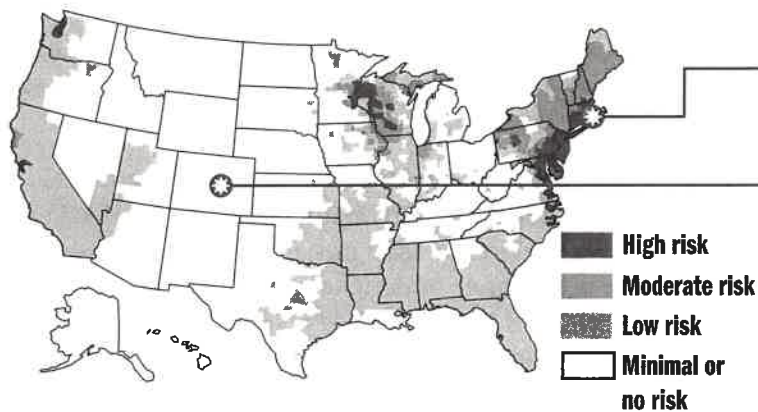
## Emerging Infections

Some diseases have been effectively controlled with the help of modern technology such as antibiotics and vaccines. Yet new diseases, such as AIDS and Lyme disease, are constantly appearing. Others, such as malaria and tuberculosis, are occurring in forms

# Real-Life Application

## Reducing Your Risk of Lyme Disease

In 1982 fewer than 1,000 cases of Lyme disease were reported in the United States. Today, more than 16,000 cases are reported each year. Lyme disease is transmitted to humans by the bite of an infected deer tick. Ticks favor a moist, shaded environment, such as forests. Coastal ticks thrive in areas of high rainfall. Ticks are most active in the spring and summer. Study the graph to help you analyze the environmental and geographical factors that influence the distribution and rate of disease in the United States. Use this information to develop a plan to reduce your risk.



What does the concentration of cases here tell you about the environment in which ticks live?

What is different about this part of the country that could account for the lower incidence of Lyme disease?

What human activities (leisure and industrial) could have influenced the increase in cases from 1982 to the present?

### ACTIVITY

Work with a small group of students. Together, analyze the graph and discuss the questions. Use what you've learned to develop an action plan to decrease your risk of contracting Lyme disease. Include specific steps to protect yourself. Consider clothing, insect repellents, where you live or travel, and the time of year.

FIGURE 24.5

## OTHER COMMON COMMUNICABLE DISEASES

Disease	Cause/Transmission	Symptoms	Treatment/Prevention
Mononucleosis	Virus attacks lymphocytes; spreads through direct contact, including sharing eating utensils and kissing	Chills, fever, sore throat, fatigue, and swollen lymph nodes	Rest if tired
Measles	Virus spreads when an infected person coughs, sneezes, or talks; highly contagious	High fever, red eyes, runny nose, cough, bumpy red rash usually starting on head or face	No definite treatment; vaccine for prevention
Encephalitis	A virus usually carried by mosquitoes; causes inflammation of the brain	Headache; fever; hallucinations; confusion; paralysis; and disturbances of speech, memory, behavior, and eye movement	If caused by herpes simplex virus, antiviral medicine; if caused by another virus, no known treatment
Meningitis	Virus or bacteria cause inflammation of the membranes that cover the brain	Fever, severe headache, nausea, vomiting, sensitivity to light, stiff neck	Viral meningitis: antiviral medicine if severe; bacterial meningitis: antibiotics; vaccine is available

that are resistant to drug treatments. These diseases are known as “emerging” diseases. An **emerging infection** is a communicable disease whose incidence in humans has increased within the past two decades or threatens to increase in the near future. Many factors are contributing to the development of emerging infections:

- ▶ **Transport across borders.** Infected people and animals carry pathogens from region to region, often to places where those pathogens previously were not a problem. Two examples of this are the appearance of dengue fever and West Nile encephalitis, which is caused by West Nile virus. Dengue fever is found mostly in South and Central America and parts of Asia and has appeared in the southwestern United States. West Nile encephalitis appears in Asia, Africa, and Europe and is now expanding across the Western Hemisphere, including parts of the United States. Both diseases are carried by mosquitoes.
- ▶ **Population movement.** A factor in the increase in Lyme disease is the movement of people into heavily wooded areas where ticks are prevalent. Symptoms include a rash, fatigue, fever, headache, stiff neck, sore muscles, and joint pain. Lyme disease can be treated with antibiotics.

- ▶ **Resistance to antibiotics.** The widespread use of antibiotics has resulted in pathogens that have become resistant. The pathogens that cause tuberculosis, gonorrhea (a sexually transmitted disease), and a type of pneumonia all have developed resistance to one or more antibiotics.
- ▶ **Changes in food technology.** Mass production and distribution of food increases the chance that contaminated food will infect a great number of people. *E. coli* has been responsible for outbreaks affecting thousands.
- ▶ **Agents of bioterrorism.** Because of the ease and frequency of travel, a contagious bioterrorist agent such as smallpox can spread rapidly from country to country.

Public health officials in the United States are addressing infectious diseases elsewhere in the world because pathogens can emerge in one region and spread. Information on emerging diseases is widely available—on the Internet, in books and magazines, and through news reports. With health information readily available, individuals can become more proactive and responsible for reducing their risk of communicable diseases, including emerging infections.

**Precautions to avoid emerging or reemerging infections:**

- ▶ Take all of the antibiotics prescribed by your doctor.
- ▶ Eat only fully cooked eggs.
- ▶ Avoid swallowing water at water parks.
- ▶ Take precautions to prevent bites by vectors such as ticks and mosquitoes.

## Lesson 3 Review

### Reviewing Facts and Vocabulary

1. Compare and contrast the common cold and the flu.
2. What are three ways you can reduce your risk of getting influenza?
3. What are emerging infections?

### Thinking Critically

4. **Synthesizing.** What healthful behaviors can students in your class practice to reduce everyone's risk of respiratory infection?
5. **Analyzing.** Why might emerging infections be an important area to receive funding for research? How can technology impact the reduction of diseases worldwide?

### Applying Health Skills

**Advocacy.** Choose one emerging infection to research. Prepare a script for a public service announcement describing this disease. Be sure to include information on how the disease is transmitted and what the symptoms are. Urge individuals who suspect they may be infected to seek medical attention immediately. Share your script with the class.



**PRESENTATION SOFTWARE** Use presentation software to present the information you found on the disease you chose to investigate. Find help in using presentation software at [health.glencoe.com](http://health.glencoe.com).