Lesson 2

Preventing Communicable Diseases

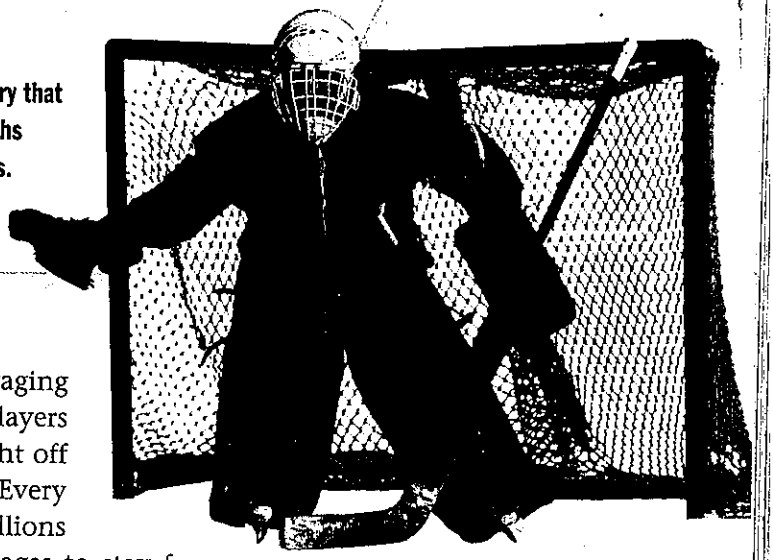
VOCABULARY

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 community health services that provide vaccines and information on 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.**



A 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?*

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 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

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

The Immune System

The immune system has two major defense strate... inflammatory response is general, or nonspecific, ... against all types of pathogens. Specific defenses work aga... ticular pathogens. Together, these defenses work to prevent ...

The Inflammatory Response

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

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.

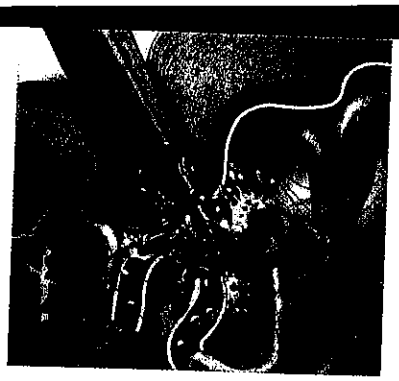
Tears and saliva contain enzymes that destroy or disable many pathogens.

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 or 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?*

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.

HEALTH Online

Find more about how the immune system works in Web Links at **health.glencoe.com**.

Specific Defenses

Specific defenses react to invasion as a result of the b... to recognize certain pathogens and destroy them. Th... by which this happens, the immune response, is de... **Figure 24.3.** During the immune response, certain type... blood cells react to antigens. An **antigen** is *a substance that ... of triggering an immune response.* Antigens are found on the ... of pathogens and in toxins. Macrophages are a type of p... that destroys pathogens by making antigens recognizable ... blood cells. The result of the immune response is **immun...** *state of being protected against a particular disease.*

Lymphocytes

A **lymphocyte** (LIMP-fuh-site) is *a specialized white blood ... coordinates and performs many of the functions of specific imm...* 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. ... all work together to protect against infection.

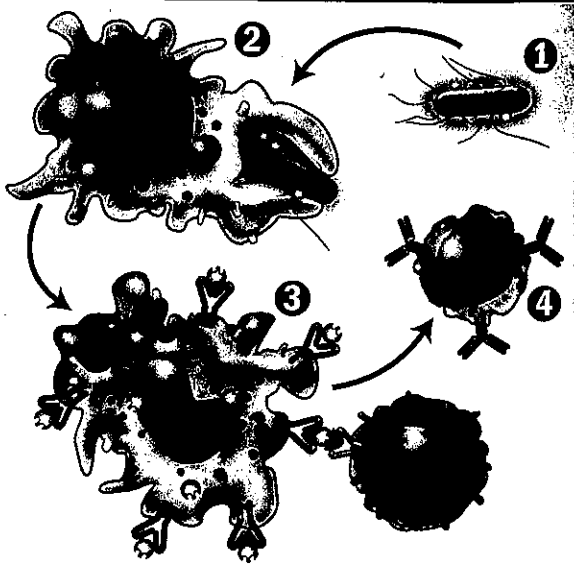
- *Helper T cells* trigger the production of B cells and killer T cell...
- *Killer T cells* attack and destroy infected body cells. Killer T cells don't attack the pathogens themselves, only the infected cells.

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 or 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.

FIGURE 24.4

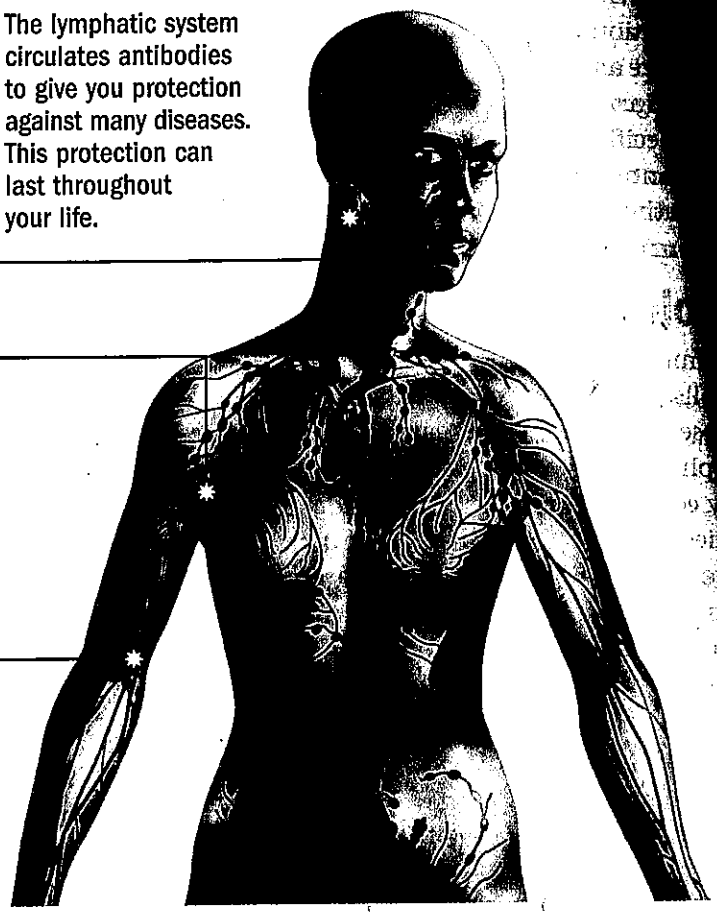
IMMUNITY AND THE LYMPHATIC SYS

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-dense 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, or 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.

hot link

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

Vaccines to Aid the Body's Defenses

When 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. 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 by 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 benefit more people than just those who re... If you are vaccinated against a particular disease... spread that disease to others. In this way vaccination no... tects you but also helps protect those around you, espe... family and friends. One exception is tetanus, which is t... through the environment, not from person to person. Th... vaccine protects only the individual who receives it.

You should have up-to-date immunizations, including t... tetanus, diphtheria, measles, mumps, rubella, and hep... Vaccination against chicken pox is recommended if you h... had this disease. Some vaccines require more than one do... time, or "booster shots." Your family physician or your local ... department can advise you on the immunizations you nee... provide them for you. Most high schools and colleges requ... students show proof of current immunizations before adm... Each state has its own laws governing immunizations and s... 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 the development of vaccines for more than 20 communicable diseases has affected the average human life span in areas where these vaccines are available?
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.

TECHNOLOGY APPLICATION

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** for information on how to create a spreadsheet.

Name Class Date

Activity 89

Guided Reading Activity

FOR USE WITH CHAPTER 24, LESSON 2

Directions: Briefly answer the following questions in the space provided.

1. What is the immune system? 1pt.

2. How do physical barriers protect the body from pathogens? How do chemical barriers protect the body from pathogens? 2 pts

3. How is the inflammatory response involved in fighting pathogens? 3 pts.

4. Complete the following outline of the body's specific defenses. 1 pt. each

   I. Lymphocytes

   A. T cells

   1. Helper T cells—_____
   2. _____—attack and destroy infected body cells
   3. _____—coordinate T cell activity, turn off helper T cells

   B. B cells—produce _____

   C. _____—circulate in blood stream for years, provide long-term immunity

5. What is the difference between active and passive immunity?

A.I. Where do antibodies come from?
Occurs Naturally-
Occurs Artificially
A.I. Last how long?
Pass.I. Where do antibodies come from?
Occurs Naturally-
Occurs Artificially-
Last how long?

6. List five behaviors that will help you maintain a healthy immune system.