


Immunity and Disease

chapter preview

sections

- 1 The Immune System**
- 2 Infectious Diseases**
Lab Microorganisms and Disease
- 3 Noninfectious Diseases**
Lab Defensive Saliva

 **Virtual Lab** How does the body protect itself against foreign substances?

Attacked by Bacteria

You may not know it, but there's a war being fought in your body. Every second of your life your body is fighting harmful attacks. Sometimes your white blood cells are strong enough to fight alone. But, sometimes your body needs help from the laboratory—vaccines or medicines.

Science Journal Write a paragraph describing a battle between your white cells and a foreign invader.

Start-Up Activities



How do diseases spread?

Knowing how diseases are spread will help you understand how your body fights disease. You can discover one way diseases are spread by doing the following lab.

1. Wash your hands before and after this lab. Don't touch your face until the lab is completed and your hands are washed.
2. Work with a partner. Place a drop of peppermint food flavoring on a cotton ball. Pretend that the flavoring is a mass of cold viruses.
3. Use the cotton ball to rub an X over the palm of your right hand. Let it dry.
4. Shake hands with your partner.
5. Have your partner shake hands with another student. Then each student should smell their hands.
6. **Think Critically** In your Science Journal, note how many persons your "virus" infected. Write a paragraph describing some ways the spread of diseases could be stopped.

FOLDABLES™ Study Organizer

Classifying Diseases Make the following Foldable to classify human diseases as either infectious or noninfectious.

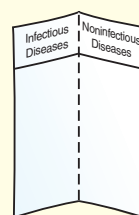
- STEP 1** **Fold** a sheet of paper in half lengthwise.



- STEP 2** **Fold** paper down 2.5 cm from the top. (Hint: From the tip of your index finger to your middle knuckle is about 2.5 cm.)



- STEP 3** **Open and draw** lines along the 2.5-cm fold. **Label** as shown.



Read and Write As you read the chapter, classify human diseases as infectious or noninfectious by listing them on the proper fold.



Preview this chapter's content and activities at bookd.msscience.com

The Immune System

as you read

What You'll Learn

- **Describe** the natural defenses your body has against disease.
- **Explain** the difference between an antigen and an antibody.
- **Compare and contrast** active and passive immunity.

Why It's Important

Your body's defenses fight the pathogens that you are exposed to every day.

Review Vocabulary

enzyme: a type of protein that speeds up chemical reactions in the body

New Vocabulary

- immune system
- active immunity
- passive immunity
- antigen
- vaccination
- antibody

Lines of Defense

The Sun has just begun to peek over the horizon, casting an orange glow on the land. A skunk ambles down a dirt path. Behind the skunk, you and your dog come over a hill for your morning exercise. Suddenly, the skunk stops and raises its tail high in the air. Your dog creeps forward. "No!" you shout. The dog ignores your command. Without further warning, the skunk sprays your dog. Yelping pitifully and carrying an awful stench, your dog takes off. The skunk used its scent to protect itself. Its first-line defense was to warn your dog with its posture. Its second-line defense was its spray. Just as the skunk protects itself from predators, your body also protects itself from harm.

Your body has many ways to defend itself. Its first-line defenses work against harmful substances and all types of disease-causing organisms, called pathogens (PA tuh junz). Your second-line defenses are specific and work against specific pathogens. This complex group of defenses is called your **immune system**. Tonsils, shown in **Figure 1**, are one of the immune system organs that protect your body.

 **Reading Check** *What types of defenses does your body have?*

First-Line Defenses Your skin and respiratory, digestive, and circulatory systems are first-line defenses against pathogens. As shown in **Figure 2**, the skin is a barrier that prevents many pathogens from entering your body. Although most pathogens can't get through unbroken skin, they can get into your body easily through a cut or through your mouth and the membranes in your nose and eyes. The conditions on the skin can affect pathogens. Perspiration contains substances that can slow the growth of some pathogens. At times, secretions from the skin's oil glands and perspiration are acidic. Some pathogens cannot grow in this acidic environment.

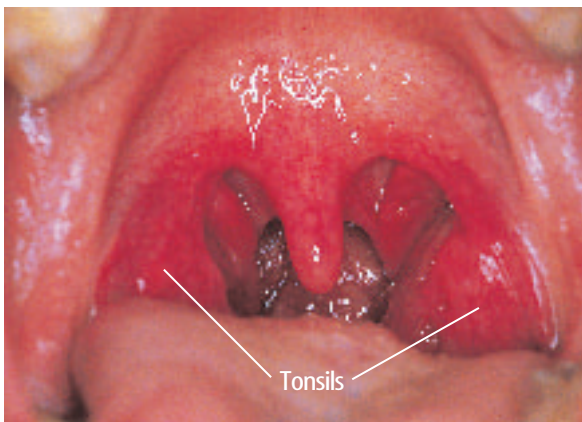
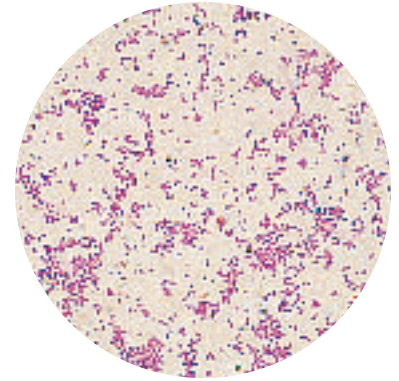


Figure 1 Tonsils help prevent infection in your respiratory and digestive tract.



Stained LM Magnification: 1000×

Internal First-Line Defenses Your respiratory system traps pathogens with hairlike structures, called cilia (SIH lee uh), and mucus. Mucus contains an enzyme that weakens the cell walls of some pathogens. When you cough or sneeze, you get rid of some of these trapped pathogens.

Your digestive system has several defenses against pathogens—saliva, enzymes, hydrochloric acid, and mucus. Saliva in your mouth contains substances that kill bacteria. Also, enzymes (ENZIMEZ) in your stomach, pancreas, and liver help destroy pathogens. Hydrochloric acid in your stomach helps digest your food. It also kills some bacteria and stops the activity of some viruses that enter your body on the food that you eat. The mucus found on the walls of your digestive tract contains a chemical that coats bacteria and prevents them from binding to the inner lining of your digestive organs.

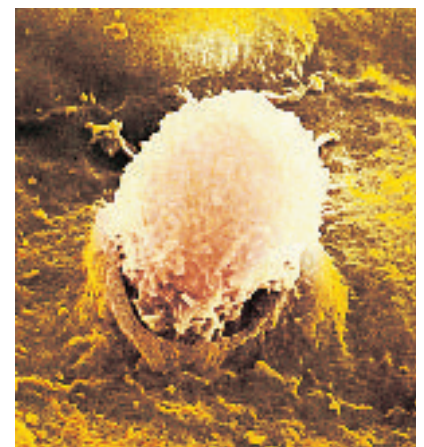
Your circulatory system contains white blood cells, like the one in **Figure 3**, that surround and digest foreign organisms and chemicals. These white blood cells constantly patrol your body, sweeping up and digesting bacteria that invade. They slip between cells of tiny blood vessels called capillaries. If the white blood cells cannot destroy the bacteria fast enough, you might develop a fever. Many pathogens are sensitive to temperature. A slight increase in body temperature slows their growth and activity but speeds up your body's defenses.

Inflammation When tissue is damaged by injury or infected by pathogens, it becomes inflamed. Signs of inflammation include redness, temperature increase, swelling, and pain. Chemical substances released by damaged cells cause capillary walls to expand, allowing more blood to flow into the area. Other chemicals released by damaged tissue attract certain white blood cells that surround and take in pathogenic bacteria. If pathogens get past these first-line defenses, your body uses another line of defense called specific immunity.

Figure 2 Most pathogens, like the staphylococci bacteria shown above, cannot pass through unbroken skin.

Infer what happens if staphylococci bacteria enter your body through your skin.

Figure 3 A white blood cell leaves a capillary. It will search out and destroy harmful microorganisms in your body tissues.



Color-enhanced SEM Magnification: 3450×

Topic: Disease Theory

Visit bookd.msscience.com for Web links to information about one of the historical theories of disease—the four body humors.

Activity Make a picture book describing the humoral theory of disease.

Specific Immunity When your body fights disease, it is battling complex molecules that don't belong there. Molecules that are foreign to your body are called **antigens** (AN tih junz). Antigens can be separate molecules or they can be found on the surface of a pathogen. For example, the protein in the cell membrane of a bacterium can be an antigen. When your immune system recognizes molecules as being foreign to your body, as in **Figure 4**, special lymphocytes called T cells respond. Lymphocytes are a type of white blood cell. One type of T cells, called killer T cells, releases enzymes that help destroy invading foreign matter. Another type of T cells, called helper T cells, turns on the immune system. They stimulate other lymphocytes, known as B cells, to form antibodies.

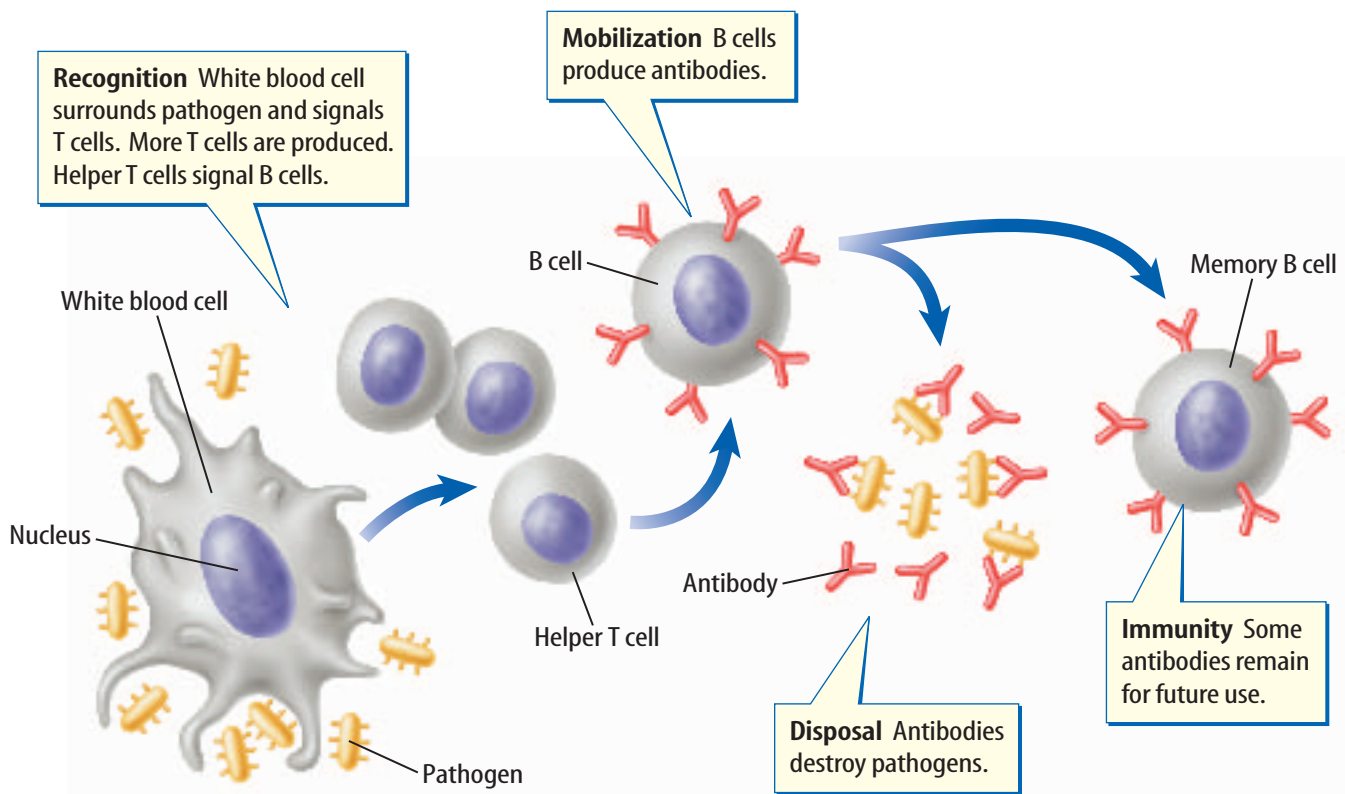
An **antibody** is a protein made in response to a specific antigen. The antibody attaches to the antigen and makes it useless. This can happen in several ways. The pathogen might not be able to stay attached to a cell. It might be changed in such a way that a killer T cell can capture it more easily or the pathogen can be destroyed.

Figure 4 The response of your immune system to disease-causing organisms can be divided into four steps—recognition, mobilization, disposal, and immunity.

Explain the function of B cells.

Reading Check What is an antibody?

Another type of lymphocyte, called memory B cells, also has antibodies for the specific pathogen. Memory B cells remain in the blood ready to defend against an invasion by that same pathogen another time.



Mini LAB

Determining Reproduction Rates

Procedure

1. Place **one penny** on a table. Imagine that the penny is a bacterium that can divide every 10 min.
2. Place **two pennies** below the first penny to form a triangle. These represent the two new bacteria after the first bacterium divides.
3. Repeat three more divisions, placing two pennies under each penny as described above.
4. Calculate how many bacteria you would have after 5 h of reproduction. Graph your data.

Analysis

1. How many bacteria are present after 5 h?
2. Why is it important to take antibiotics promptly if you have an infection?



Active Immunity Antibodies help your body build defenses in two ways—actively and passively. In **active immunity** your body makes its own antibodies in response to an antigen. **Passive immunity** results when antibodies that have been produced in another animal are introduced into your body.

When a pathogen invades your body and quickly multiplies, you get sick. Your body immediately starts to make antibodies to attack the pathogen. After enough antibodies form, you usually get better. Some antibodies stay on duty in your blood, and more are produced rapidly if the pathogen enters your body again. Because of this defense system you usually get certain diseases such as chicken pox only once. Why can you catch a cold over and over? There are many different cold viruses that give you similar symptoms. As you grow older and are exposed to many more types of pathogens, you will build immunity to each one.

Vaccination A vaccine is a form of an antigen that gives you immunity against a disease. A vaccine only can prevent a disease, not cure it. The process of giving a vaccine by injection or by mouth is called **vaccination**. If a specific vaccine is injected into your body, your body forms antibodies against that pathogen. If you later encounter the same pathogen, your bloodstream already has antibodies that are needed to fight and destroy it. Vaccines have helped reduce cases of childhood diseases, as shown in **Table 1**.

Table 1 Annual Cases of Disease Before and After Vaccine Availability in the U.S.

Disease	Before	After
Measles	503,282	89
Diphtheria	175,885	1
Tetanus	1,314	34
Mumps	152,209	606
Rubella	47,745	345
Pertussis (whooping cough)	147,271	6,279

Data from the National Immunization Program, CDC



Figure 5 The Td vaccine, which protects against tetanus and diphtheria, usually is injected into the arm.

production to tetanus toxin. You should continue to get vaccines or boosters every ten years to maintain protection. Booster shots for diphtheria, which is a dangerous infectious respiratory disease, are given in the same vaccine with tetanus.

Passive Immunity Passive immunity does not last as long as active immunity does. For example, you were born with all the antibodies that your mother had in her blood. However, these antibodies stayed with you for only a few months. Because newborn babies lose their passive immunity in a few months, they need to be vaccinated to develop their own immunity.

Tetanus Tetanus is a disease caused by a common soil bacterium. The bacterium produces a chemical that paralyzes muscles. Puncture wounds, deep cuts, and other wounds can be infected by this bacterium. Several times in early childhood you received active vaccines, as shown in **Figure 5**, that stimulated antibody

section 1 review

Summary

Lines of Defense

- Your body's immune system protects you from harmful substances called pathogens.
- First-line defenses work against harmful substances and all types of pathogens.
- Second-line defenses work against specific pathogens.
- Antibodies help protect your body against specific foreign molecules called antigens.
- Your body gets antibodies through active immunity and passive immunity.
- Vaccines help you develop active immunity against a disease.
- You need to receive booster shots for some vaccines to maintain protection.

Self Check

1. **Describe** how harmful bacteria cause infections in your body.
2. **List** the natural defenses your body has against disease.
3. **Explain** how your immune system reacts when it detects an antigen.
4. **Compare and contrast** active and passive immunity.
5. **Think Critically** Several diseases have symptoms similar to those of measles. Why doesn't the measles vaccine protect you from all of these diseases?

Applying Skills

6. **Make Models** Create models of the different types of T cells, antigens, and B cells from clay, construction paper, or other art materials. Use them to explain how T cells function in the immune system.

Infectious Diseases

Disease in History

For centuries, people have feared outbreaks of disease. The plague, smallpox, and influenza have killed millions of people worldwide. Today, the causes of these diseases are known, and treatments can prevent or cure them. But even today, there are diseases such as the Ebola virus in Africa that cannot be cured. Outbreaks of new diseases, such as severe acute respiratory syndrome (SARS), shown in **Table 2**, also occur.

Microorganisms With the invention of the microscope in the latter part of the seventeenth century, bacteria, yeast, and mold spores were seen for the first time. However, it took almost 200 years more to discover the relationship between some of them and disease. Scientists gradually learned that microorganisms were responsible for fermentation and decay. If decay-causing microorganisms could cause changes in other organisms, it was hypothesized that microorganisms could cause diseases and carry them from one person to another. Scientists did not make a connection between viruses and disease transmission until the late 1800s and early 1900s.

Country	Number of Cases	Number of Deaths
Canada	251	38
China	7,756	730
Singapore	206	32
United States	73	0
Vietnam	63	5
Other countries	90	7

Data from the World Health Organization

as you read

What You'll Learn

- **Describe** the work of Pasteur, Koch, and Lister in the discovery and prevention of disease.
- **Identify** diseases caused by viruses and bacteria.
- **List** sexually transmitted diseases, their causes, and treatments.
- **Explain** how HIV affects the immune system.

Why It's Important

You can help prevent certain illnesses if you know what causes disease and how disease spreads.

Review Vocabulary

protist: a one- or many-celled organism that lives in moist or wet surroundings

New Vocabulary

- pasteurization
- virus
- infectious disease
- biological vector
- sexually transmitted disease (STD)



INTEGRATE History

Disease Immunity Edward Jenner demonstrated that a vaccine could be produced to prevent smallpox. However, it wasn't until Louis Pasteur applied his germ theory to the process that the mechanism of vaccinations was understood. Pasteur demonstrated that germs cause diseases and that vaccines, which contained small amounts of disease organisms, could cause the body to build immunity to that disease without causing it. Research Jenner and write a summary in your Science Journal about his discovery of the smallpox vaccine.

Disease Organisms The French chemist Louis Pasteur learned that microorganisms cause disease in humans. Many scientists of his time did not believe that microorganisms could harm larger organisms, such as humans. However, Pasteur discovered that microorganisms could spoil wine and milk. He then realized that microorganisms could attack the human body in the same way. Pasteur invented **pasteurization** (pas chuh ruh ZAY shun), which is the process of heating a liquid to a specific temperature that kills most bacteria.

Today, it is known that many diseases are caused by bacteria, certain viruses, protists (PROH tihsts), or fungi. Bacteria cause tetanus, tuberculosis, strep throat, and bacterial pneumonia. Malaria and sleeping sickness are caused by protists. Fungi are the pathogens for athlete's foot and ringworm. Viruses are the cause of many common diseases—colds, influenza, AIDS, measles, mumps, smallpox, and SARS.

Many harmful bacteria that infect your body can reproduce rapidly. The conditions in your body, such as temperature and available nutrients, help the bacteria grow and multiply. Bacteria can slow down the normal growth and metabolic activities of body cells and tissues. Some bacteria even produce toxins that kill cells on contact.

A **virus** is a minute piece of genetic material surrounded by a protein coating that infects and multiplies in host cells. The host cells die when the viruses break out of them. These new viruses infect other cells, leading to the destruction of tissues or the interruption of vital body activities.



Reading Check

What is the relationship between a virus and a host cell?

Pathogenic protists, such as the organisms that cause malaria, can destroy tissues and blood cells or interfere with normal body functions. In a similar manner, fungus infections can cause athlete's foot, nonhealing wounds, chronic lung disease, or inflammation of the membranes of the brain.

Koch's Rules Many diseases caused by pathogens can be treated with medicines. In many cases, these organisms need to be identified before specific treatment can begin. Today, a method developed in the nineteenth century still is used to identify organisms.

Pasteur may have shown that bacteria cause disease, but he didn't know how to tell which specific organism causes which disease. It was a young German doctor, Robert Koch, who first developed a way to isolate and grow one type of bacterium at a time, as shown in **Figure 6**.

Figure 6

In the 1880s, German doctor Robert Koch developed a series of methods for identifying which organism was the cause of a particular disease. Koch's Rules are still in use today. Developed mainly for determining the cause of particular diseases in humans and other animals, these rules have been used for identifying diseases in plants as well.



Anthrax bacteria

A In every case of a particular disease, the organism thought to cause the disease—the pathogen—must be present.



B The suspected pathogen must be separated from all other organisms and grown on agar gel with no other organisms present.



C When inoculated with the suspected pathogen, a healthy host must come down with the original illness.



Anthrax bacteria

D Finally, when the suspected pathogen is removed from the host and grown on agar gel again, it must be compared with the original organism. Only when they match can that organism be identified as the pathogen that causes the disease.



Figure 7 Antiseptics and strictly followed rules of cleanliness have made surgical procedures safer than they once were.

Describe the differences you see in the two operating scenes shown.

Keeping Clean Washing your hands before or after certain activities should be part of your daily routine. Restaurant employees are required to wash their hands immediately after using the rest room. Medical professionals wash their hands before examining each patient. However, hand washing was not always a routine, even for doctors. Into the late 1800s, doctors such as those in **Figure 7** regularly operated in their street clothes and with bare, unwashed hands. A bloody apron and well-used tools were considered signs of prestige for a surgeon. More patients died from the infections that they contracted during or after the surgery than from the surgery itself.

Joseph Lister, an English surgeon, recognized the relationship between the infection rate and cleanliness. Lister dramatically reduced the number of deaths among his patients by washing their skin and his hands with carbolic (kar BAH lihk) acid, which is a liquid that kills pathogens. Lister also used carbolic acid to clean his instruments and soak bandages, and he even sprayed the air with it. The odor was strong and it irritated the skin, but more and more people began to survive surgical procedures.

Modern Operating Procedures Today antiseptics and antiseptic soaps are used to kill pathogens on skin. Every person on the surgical team washes his or her hands thoroughly and wears sterile gloves and a covering gown. The patient's skin is cleaned around the area of the body to be operated on and then covered with sterile cloths. Tools that are used to operate on the patient and all operating room equipment also are sterilized. Even the air is filtered.

Reading Check

What are three ways that pathogens are reduced in today's operating room?

Mini LAB

Observing Antiseptic Action

Procedure

1. Place a few grains of **dried yeast** onto a **glass plate** or a saucer.
2. Add two drops of **hydrogen peroxide** to the yeast. Observe.
3. Clean up and wash hands before removing goggles.

Analysis

1. How does the action of hydrogen peroxide mechanically clean a wound?
2. Explain why hydrogen peroxide is classified as an antiseptic.

How Diseases Are Spread

You walk into your kitchen before school. Your younger sister sits at the table eating a bowl of cereal. She has a fever, a runny nose, and a cough. She coughs loudly. “Hey, cover your mouth! I don’t want to catch your cold,” you tell her. A disease that is caused by a virus, bacterium, protist, or fungus and is spread from an infected organism or the environment to another organism is called an **infectious disease**. Infectious diseases are spread by direct contact with the infected organism, through water and air, on food, by contact with contaminated objects, and by disease-carrying organisms called **biological vectors**. Examples of vectors that have been sources of disease are rats, birds, cats, dogs, mosquitoes, fleas, and flies, as shown in **Figure 8**.

People also can be carriers of disease. When you have influenza and sneeze, you expel thousands of virus particles into the air. Colds and many other diseases are spread through contact. Each time you turn a doorknob, press the button on a water fountain, or use a telephone, your skin comes in contact with bacteria and viruses, which is why regular handwashing is recommended. The Centers for Disease Control and Prevention (CDC) in Atlanta, Georgia, monitors the spread of diseases throughout the United States. The CDC also tracks worldwide epidemics and watches for diseases brought into the United States.



Figure 8 When flies land on food, they can transport pathogens from one location to another.

Applying Science

Has the annual percentage of deaths from major diseases changed?

Each year, many people die from diseases. Medical science has found numerous ways to treat and cure disease. Have new medicines, improved surgery techniques, and healthier lifestyles helped decrease the number of deaths from disease? By using your ability to interpret data tables, you can find out.

Identifying the Problem

The table to the right shows the percentage of total deaths due to six major diseases for a 50-year period. Study the data. Can you see any trends in the percentage of deaths?

Solving the Problem

1. Has the percentage increased for any disease that is listed?
2. What factors could have contributed to this increase?

Percentage of Deaths Due to Major Disease				
Disease	Year			
	1950	1980	1990	2000
Heart	37.1	38.3	33.5	29.6
Cancer	14.6	20.9	23.5	23.0
Stroke	10.8	8.6	6.7	7.0
Diabetes	1.7	1.8	2.2	2.9
Pneumonia and flu	3.3	2.7	3.7	2.7

Sexually Transmitted Diseases

Infectious diseases that are passed from person to person during sexual contact are called **sexually transmitted diseases (STDs)**. STDs are caused by bacteria or viruses.

Bacterial STDs Gonorrhea (gah nuh REE uh), chlamydia (kluh MIH dee uh), and syphilis (SIH fuh lus) are STDs caused by bacteria. The bacteria that cause gonorrhea and syphilis are shown in **Figure 9**. A person may have gonorrhea or chlamydia for some time before symptoms appear. When symptoms do appear, they can include painful urination, genital discharge, and genital sores. Antibiotics are used to treat these diseases. Some of the bacteria that cause gonorrhea may be resistant to the antibiotics usually used to treat the infection. However, the disease usually can be treated with other antibiotics. If they are untreated, gonorrhea and chlamydia can leave a person sterile because the reproductive organs can be damaged permanently.

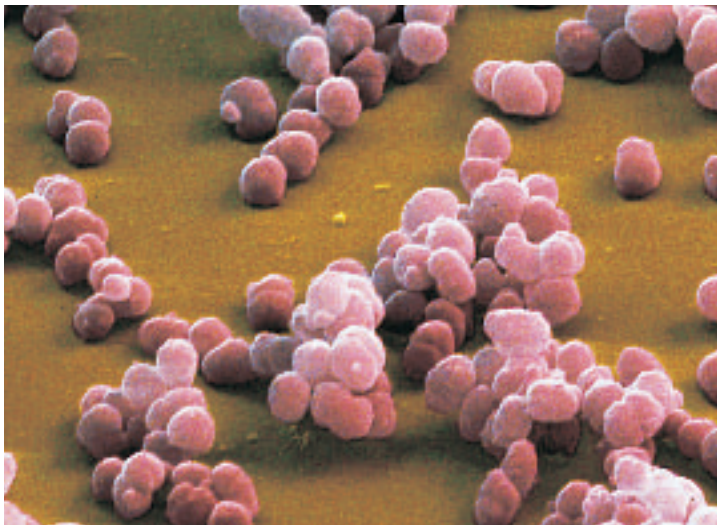
Syphilis has three stages. In stage 1, a sore that lasts 10 to 14 days appears on the mouth or genitals. Stage 2 may involve a rash, fever, and swollen lymph glands. Within weeks to a year, these symptoms usually disappear. The person with syphilis often believes that the disease has gone away, but it hasn't. If he or she does not seek treatment, the disease advances to stage 3, when syphilis may infect the cardiovascular and nervous systems. In all stages, syphilis is treatable with antibiotics. However, the damage to body organs in stage 3 cannot be reversed and death can result.

Genital herpes, a lifelong viral disease, causes painful blisters on the sex organs. This type of herpes can be transmitted during sexual contact or from an infected mother to her child during birth. The herpes virus hides in the body for long periods of time and then reappears suddenly. Herpes has no cure, and no vaccine can prevent it. However, the symptoms of herpes can be treated with antiviral medicines.

Figure 9 Bacteria that cause gonorrhea and syphilis can be destroyed with antibiotics.

Explain why a person might not get treatment for a syphilis infection.

Gonorrhea bacteria



Color-enhanced TEM Magnification: 12000×

Syphilis bacteria



Color-enhanced SEM Magnification: 45000×

HIV and Your Immune System

Human immunodeficiency virus (HIV) can exist in blood and body fluids. This virus can hide in body cells, sometimes for years. You can become infected with HIV by having sex with an HIV-infected person or by reusing an HIV-contaminated hypodermic needle for an injection. However, a freshly unwrapped sterile needle cannot transmit infection. The risk of getting HIV through blood transfusion is small because all donated blood is tested for the presence of HIV. A pregnant female with HIV can infect her child when the virus passes through the placenta. The child also may become infected from contacts with blood during the birth process or when nursing after birth.

Reading Check

What are ways that a person can become infected with HIV?

HIV cannot multiply outside the body, and it does not survive long in the environment. The virus cannot be transmitted by touching an infected person, by handling objects used by the person unless they are contaminated with body fluids, or from contact with a toilet seat.

AIDS An HIV infection can lead to Acquired Immune Deficiency Syndrome (AIDS), which is a disease that attacks the body's immune system. HIV, as shown in **Figure 10**, is different from other viruses. It attacks the helper T cells in the immune system. The virus enters the T cell and multiplies. When the infected cell bursts open, it releases more HIV. These infect other T cells. Soon, so many T cells are destroyed that not enough B cells are stimulated to produce antibodies. The body no longer has an effective way to fight invading antigens. The immune system then is unable to fight HIV or any other pathogen. For this reason, when people with AIDS die it is from other diseases such as tuberculosis (too bur kyuh LOH sus), pneumonia, or cancer.

From 1981 to 2001, more than 816,000 cases of AIDS were documented in the United States. At this time the disease has no known cure. However, several medications help treat AIDS in some patients. One group of medicines interferes with the way that the virus multiplies in the host cell and is effective if it is used in the early stages of the disease. Another group of medicines that is being tested blocks the entrance of HIV into the host cell. These medicines prevent the pathogen from binding to the cell's surface.

Scienceonline

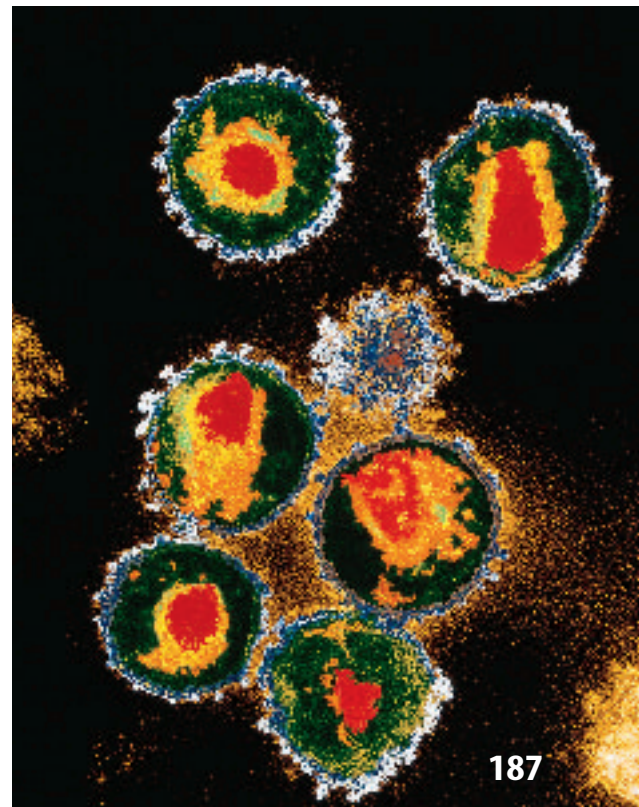
Topic: AIDS

Visit bookd.msscience.com for Web links to information about the number of AIDS cases worldwide.

Activity Make a graph showing the number of AIDS cases in seven countries.

Figure 10 A person can be infected with HIV and not show any symptoms of the infection for several years.
Infer why this characteristic makes the spread of AIDS more likely.

Color-enhanced TEM Magnification: 40000×





Fighting Disease

Washing a small wound with soap and water is the first step in preventing an infection. Cleaning the wound with an antiseptic and covering it with a bandage are other steps. Is it necessary to wash your body to help prevent diseases? Yes! In addition to reducing body odor, washing your body removes and destroys some surface microorganisms. In medical facilities, hand washing, shown in **Figure 11**, is important to reduce the spread of pathogens. It is also important for everyone to wash his or her hands to reduce the spread of disease.

In your mouth, microorganisms are responsible for mouth odor and tooth decay. Using dental floss and routine tooth brushing keep these organisms under control.

Figure 11 Proper hand washing includes using warm water and soap. The soapy lather must be rubbed over the hands, wrists, fingers, and thumbs for 15–20 s. Thoroughly rinse and dry with a clean towel.

Exercise and good nutrition help the circulatory and respiratory systems work more effectively. Good health habits, including getting enough rest and eating well-balanced meals, can make you less susceptible to the actions of disease organisms such as those that cause colds and flu. Keeping up with recommended immunizations and having annual health checkups also can help you stay healthy.

section 2 review

Summary

Disease in History

- Pasteur, Koch, and Lister played key roles in disease discovery and prevention.

How Diseases Are Spread

- Diseases are spread by air, water, food, animals, and through contact with pathogens.

Sexually Transmitted Diseases

- STDs, such as gonorrhea and herpes, are caused by either bacteria or viruses.

HIV and Your Immune System

- HIV can lead to AIDS, a disease of the immune system.

Fighting Disease

- Cleanliness, exercise, and good health habits can help prevent disease.

Self Check

1. **Explain** how the discoveries of Pasteur, Koch, and Lister help in the battle against the spread of disease.
2. **Identify** three infectious diseases caused by a virus and three caused by a bacterium.
3. **Define** sexually transmitted diseases. How are they contracted and treated?
4. **Describe** the way HIV affects the immune system and how it is different from other viruses.
5. **Think Critically** In what ways does Koch's procedure demonstrate the use of scientific methods?

Applying Skills

6. **Recognize Cause and Effect** How is poor cleanliness related to the spread of disease? Write your answer in your Science Journal.

MICROORGANISMS AND DISEASE

Microorganisms are everywhere. Washing your hands and disinfecting items you use helps remove some of these organisms.

Real-World Question

How do microorganisms cause infection?

Goals

- **Observe** the transmission of microorganisms.
- **Relate** microorganisms to infections.

Materials

fresh apples (6)	paper towels
rotting apple	sandpaper
rubbing alcohol (5 mL)	cotton ball
self-sealing plastic bags (6)	soap and water
labels and pencil	newspaper
gloves	

Safety Precautions



WARNING: Do not eat the apples. When you complete the experiment, give all bags to your teacher for disposal.

Procedure

1. **Label** the plastic bags 1 through 6. Put on gloves. Place a fresh apple in bag 1.
2. Rub the rotting apple over the other five apples. This is your source of microorganisms.
WARNING: Do not touch your face.
3. Put one apple in bag 2.
4. Hold one apple 1.5 m above a newspaper on the floor and drop it. Put it in bag 3.
5. Rub one apple with sandpaper. Place this apple in bag 4.

6. Wash one apple with soap and water. Dry well and put it in bag 5.
7. Use a cotton ball to spread alcohol over the last apple. Let it air dry. Place it in bag 6.
8. Seal all bags and put them in a dark place.
9. Copy the data table below. On days 3 and 7, compare all apples without removing them from the bags. **Record** your observations.

Apple Observations

Condition	Day 3	Day 7
1. Fresh		
2. Untreated		
3. Dropped		
4. Rubbed with sandpaper	Do not write in this book.	
5. Washed with soap and water		
6. Covered with alcohol		

Conclude and Apply

1. **Infer** how this experiment relates to infections on your skin.
2. **Explain** why it is important to clean a wound.

Communicating Your Data

Prepare a poster illustrating the advantages of washing hands to avoid the spread of disease. Get permission to put the poster near a school rest room.

Noninfectious Diseases

as you read

What You'll Learn

- **Define** noninfectious diseases and list causes of them.
- **Describe** the basic characteristics of cancer.
- **Explain** what happens during an allergic reaction.
- **Explain** how chemicals in the environment can be harmful to humans.

Why It's Important

Knowing the causes of noninfectious diseases can help you understand their prevention and treatment.

Review Vocabulary

gene: a section of DNA on a chromosome that carries instructions for making a specific protein

New Vocabulary

- noninfectious disease
- allergy
- allergen
- chemotherapy

Figure 12 Allergic reactions are caused by many things.



Hives are one kind of allergic reaction.

Chronic Disease

It's a beautiful, late-summer day. Flowers are blooming everywhere. You and your cousin hurry to get to the ballpark before the first pitch of the game. "Achoo!" Your cousin sneezes. Her eyes are watery and red. "Oh no! I sure don't want to catch that cold," you mutter. "I don't have a cold," she responds, "it's my allergies." Not all diseases are caused by pathogens. Diseases and disorders such as diabetes, allergies, asthma, cancer, and heart disease are **noninfectious diseases**. They are not spread from one person to another. Many are chronic (KRAH nihk). This means that they can last for a long time. Although some chronic diseases can be cured, others cannot.

Some infectious diseases can be chronic too. For example, deer ticks carry a bacterium that causes Lyme disease. This bacterium can affect the nervous system, heart, and joints for weeks to years. It can become chronic if not treated. Antibiotics will kill the bacteria, but some damage cannot be reversed.

Allergies

If you've had an itchy rash after eating a certain food, you probably have an allergy to that food. An **allergy** is an overly strong reaction of the immune system to a foreign substance. Many people have allergic reactions, such as the one shown in **Figure 12**, to cosmetics, shellfish, strawberries, peanuts, and insect stings. Most allergic reactions are minor. However, severe allergic reactions can occur, causing shock and even death if they aren't treated promptly.



Some common substances stimulate allergic responses in people.

Allergens Substances that cause an allergic response are called **allergens**. Some chemicals, certain foods, pollen, molds, some antibiotics, and dust are allergens for some people. Some foods cause hives or stomach cramps and diarrhea. Pollen can cause a stuffy nose, breathing difficulties, watery eyes, and a tired feeling in some people. Dust can contain cat and dog dander and dust mites, as shown in **Figure 13**. Asthma (AZ muh) is a lung disorder that is associated with reactions to allergens. A person with asthma can have shortness of breath, wheezing, and coughing when he or she comes into contact with something they are allergic to.

When you come in contact with an allergen, your immune system usually forms antibodies. Your body reacts by releasing chemicals called histamines (HIHS tuh meenz) that promote red, swollen tissues. Antihistamines are medications that can be used to treat allergic reactions and asthma. Some severe allergies are treated with repeated injections of small doses of the allergen. This allows your body to become less sensitive to the allergen.



What does your body release in response to an allergen?

Diabetes

A chronic disease associated with the levels of insulin produced by the pancreas is diabetes. Insulin is a hormone that enables glucose to pass from the bloodstream into your cells. Doctors recognize two types of diabetes—Type 1 and Type 2. Type 1 diabetes is the result of too little or no insulin production. In Type 2 diabetes, your body cannot properly process the insulin. Symptoms of diabetes include fatigue, excessive thirst, frequent urination, and tingling sensations in the hands and feet.

If glucose levels in the blood remain high for a long time, health problems can develop. These problems can include blurred vision, kidney failure, heart attack, stroke, loss of feeling in the feet, and the loss of consciousness (diabetic coma). Patients with Type 1 diabetes, as shown in **Figure 14**, must monitor their intake of sugars and usually require daily injections of insulin to control their glucose levels. Careful monitoring of diet and weight usually are enough to control Type 2 diabetes. Since 1980, there has been an increase in the number of people with diabetes. Although the cause of diabetes is unknown, scientists have discovered that Type 2 diabetes is more common in people who are overweight and that it might be inherited.



Color-enhanced SEM Magnification: 245×

Figure 13 Dust mites are smaller than a period at the end of a sentence. They can live in pillows, mattresses, carpets, furniture, and other places.

Figure 14 Type 1 diabetes requires daily monitoring by either checking the amount of glucose in blood or the amount excreted in urine.



Chemicals and Disease



Chemicals are everywhere—in your body, the foods you eat, cosmetics, cleaning products, pesticides, fertilizers, and building materials. Of the thousands of chemical substances used by consumers, less than two percent are harmful. Those chemicals that are harmful to living things are called toxins, as shown in **Figure 15**. Toxins can cause birth defects, cell mutations, cancers, tissue damage, chronic diseases, and death.

The Effects The amount of a chemical that is taken into your body and how long your body is in contact with it determine how it affects you. For example, low levels of a toxin might cause cardiac or respiratory problems. However, higher levels of the same toxin might cause death. Some chemicals, such as the asbestos shown in **Figure 15**, can be inhaled over a long period of time. Eventually, the asbestos can cause chronic diseases of the lungs. Lead-based paints, if ingested, can accumulate in your body and eventually cause damage to the central nervous system. Another toxin, ethyl (EH thul) alcohol, is found in beer, wine, and liquor. It can cause birth defects in the children of mothers who drink alcohol during pregnancy.

Manufacturing, mining, transportation, and farming produce chemical wastes. These chemical substances interfere with the ability of soil, water, and air to support life. Pollution, caused by harmful chemicals, sometimes produces chronic diseases in humans. For example, long-term exposure to carbon monoxide, sulfur oxides, and nitrogen oxides in the air might cause a number of diseases, including bronchitis, emphysema (em fuh ZEE muh), and lung cancer.

Figure 15 Toxins can be in the environment.

Chemical spills can be dangerous and might end up in groundwater.



These scientists are testing the contents of barrels found in a dump.



Asbestos, if inhaled into the lungs over a long period of time, can cause chronic diseases of the lungs. Protective clothing must be worn when removing asbestos.

Table 3 Characteristics of Cancer Cells

Cell growth is uncontrolled.

These cells do not function as part of your body.

The cells take up space and interfere with normal bodily functions.

The cells travel throughout your body.

The cells produce tumors and abnormal growths anywhere in your body.

Cancer

Cancer has been a disease of humans since ancient times. Egyptian mummies show evidence of bone cancer. Ancient Greek scientists described several different kinds of cancers. Even medieval manuscripts report details about the disease.

Cancer is the name given to a group of closely related diseases that result from uncontrolled cell growth. It is a complicated disease, and no one fully understands how cancers form. Characteristics of cancer cells are shown in **Table 3**. Certain regulatory molecules in the body control the beginning and ending of cell division. If this control is lost, a mass of cells called a tumor (TEW mur) results from this abnormal growth. Tumors can occur anywhere in your body. Cancerous cells can leave a tumor, spread throughout the body via blood and lymph vessels, and then invade other tissues.

 **Reading Check** *How do cancers spread?*

Types of Cancers Cancers can develop in any body tissue or organ. Leukemia (lew KEE mee uh) is a cancer of white blood cells. The cancerous white blood cells are immature and are no longer effective in fighting disease. The cancer cells multiply in the bone marrow and crowd out red blood cells, normal white blood cells, and platelets. Cancer of the lungs often starts in the bronchi and then spreads into the lungs. The surface area for air exchange in the lungs is reduced and breathing becomes difficult. Colorectal cancer, or cancer of the large intestine, is one of the leading causes of death among men and women. Changes in bowel movements and blood in the feces may be indications of the disease. In breast cancer, tumors grow in the breast. The second most common cancer in males is cancer of the prostate gland, which is an organ that surrounds the urethra.



Dioxin Danger Dioxin is a dangerous chemical found in small amounts in certain herbicides. It can cause miscarriages, cancers, and liver disorders. Research to find out about the dioxin contamination in Times Beach, Missouri. Write a brief report in your Science Journal.



Figure 16 Tobacco products have been linked directly to lung cancer. Some chemicals around the home are carcinogenic.

Explain why labels should not be removed from cleaning products.

Causes In the latter part of the eighteenth century, a British physician recognized the association of soot to cancer in chimney sweeps. Since that time, scientists have learned more about causes of cancer. Research done in the 1940s and 1950s related genes to cancer.

Although not all the causes of cancer are known, many causes have been identified. Smoking has been linked to lung cancer. Lung cancer is the leading cause of cancer deaths for males in the United States. Exposure to certain chemicals also can increase your chances of developing cancer. These substances, called carcinogens (kar SIH nuh junz), include asbestos, various solvents, heavy metals, alcohol, and home and garden chemicals, as shown in **Figure 16**.

Exposure to X rays, nuclear radiation, and ultraviolet radiation of the Sun also increases your risk of getting cancer. Exposure to ultraviolet radiation might lead to skin cancer. Certain foods that are cured, or smoked, including barbecued meats, can give rise to cancers. Some food additives and certain viruses are suspected of causing cancers. Some people have a genetic predisposition for cancer, meaning that they have genes that make them more susceptible to the disease. This does not mean that they definitely will have cancer, but if it is triggered by certain factors they have a greater chance of developing cancer.

Treatment Surgery to remove cancerous tissue, radiation with X rays to kill cancer cells, and chemotherapy are some treatments for cancer. **Chemotherapy** (kee moh THER uh pee) is the use of chemicals to destroy cancer cells. However, early detection of cancer is the key to any successful treatment.

Research in the science of immune processes, called immunology, has led to some new approaches for treating cancer. For example, specialized antibodies produced in the laboratory are being tested as anticancer agents. These antibodies are used as carriers to deliver medicines and radioactive substances directly to cancer cells. In another test, killer T cells are removed from a cancer patient and treated with chemicals that stimulate T cell production. The treated cells are then reinjected into the patient. Trial tests have shown some success in destroying certain types of cancer cells with this technique.

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Prevention Knowing some causes of cancer might help you prevent it. The first step is to know the early warning signs, shown in **Table 4**. Medical attention and treatments such as chemotherapy or surgery in the early stages of some cancers can cure or keep them inactive.

A second step in cancer prevention concerns lifestyle choices. Choosing not to use tobacco and alcohol products can help prevent mouth and lung cancers and the other associated respiratory and circulatory system diseases. Selecting a healthy diet without many foods that are high in fats, salt, and sugar also might reduce your chances of developing cancer. Using sunscreen lotions and limiting the amount of time that you expose your skin to direct sunlight are good preventive measures against skin cancer. Before using harmful home or garden chemicals, carefully read the entire label and precisely follow precautions and directions for use.

Inhaling certain air pollutants such as carbon monoxide, sulfur dioxide, and asbestos fibers is dangerous to your health. To keep the air cleaner, the U.S. Government has regulations such as the Clean Air Act. These laws are intended to reduce the amount of these substances that are released into the air.

Table 4 Early Warning Signs of Cancer

Changes in bowel or bladder habits
A sore that does not heal
Unusual bleeding or discharge
Thickening or lump in the breast or elsewhere
Indigestion or difficulty swallowing
Obvious change in a wart or mole
Nagging cough or hoarseness

Provided by the National Cancer Institute

section 3 review

Summary

Chronic Disease

- Chronic diseases last for a long time.
- Allergies are strong reactions to foreign substances.
- Diabetes is a chronic disease associated with your body's insulin levels.

Chemicals and Disease

- Harmful chemicals can cause birth defects, cancers, chronic diseases, and death.

Cancer

- Cancer results from uncontrolled cell growth.
- Early detection and healthy lifestyle choices can help in the treatment or prevention of some cancers.

Self Check

1. **Infer** why diabetes is classified as a noninfectious disease.
2. **Describe** how toxins in the environment can be harmful to your body.
3. **Explain** how cancer cells affect body organ functions.
4. **Identify** some ways your body can respond to allergens.
5. **Think Critically** Joel has an ear infection. The doctor prescribes an antibiotic. After taking the antibiotic, Joel breaks out in a rash. What is happening to him?

Applying Math

6. **Make and Use Tables** Make a table that relates several causes of cancer and their effects on your body.

Defensive Saliva

Goals

- **Design** an experiment to test the reaction of a bicarbonate to acids and bases.
- **Test** the reaction of a bicarbonate to acids and bases.

Possible Materials

head of red cabbage
 cooking pot
 coffee filter
 drinking glasses
 clear household ammonia
 baking soda
 water
 spoon
 white vinegar
 lemon juice
 orange juice

Safety Precautions



WARNING: *Never eat or drink anything used in an investigation.*

Real-World Question

What happens when you think about a juicy cheeseburger or smell freshly baked bread? Your mouth starts making saliva. Saliva is the first line of defense for fighting harmful bacteria, acids, and bases entering your body. Saliva contains salts, including bicarbonates. An example of a bicarbonate found in your kitchen is baking soda. Bicarbonates help to maintain normal pH levels in your mouth. When surfaces in your mouth have normal pH levels, the growth of bacteria is slowed and the effects of acids and bases are reduced. In this activity, you will design your own experiment to show the importance of saliva bicarbonates. How do the bicarbonates in saliva work to protect your mouth from harmful bacteria, acids, and bases?



Form a Hypothesis

Based on your reading in the text, form a hypothesis to explain how the bicarbonates in saliva react to acids and bases.



Test Your Hypothesis

Make a Plan

1. **List** the materials you will need for your experiment. Red cabbage juice can be used as an indicator to test for acids and bases. Vinegar and citrus juices are acids, ammonia is a base, and baking soda (bicarbonate of soda) is a bicarbonate.
2. **Describe** how you will prepare the red cabbage juice and how you will use it to test for the presence of acids and bases.
3. **Describe** how you will test the effect of bicarbonate on acids and bases.
4. **List** the steps you will take to set up and complete your experiment. Describe exactly what you will do in each step.
5. Prepare a data table in your Science Journal to record your observations.
6. Examine the steps of your experiment to make certain they are in logical order.



Follow Your Plan

1. Ask your teacher to examine the steps of your experiment and data table before you start.
2. Conduct your experiment according to the approved plan.
3. **Record** your observations in your data table.

Analyze Your Data

1. **Compare** the color change of the acids and bases in the cabbage juice.
2. **Describe** how well the bicarbonate neutralized the acids and bases.
3. **Identify** any problems you had while setting up and conducting your experiment.

Conclude and Apply

1. **Conclude** whether or not your results support your hypothesis.
2. **Explain** why your saliva contains a bicarbonate based on your experiment.
3. **Predict** how quickly bacteria would grow in your glass containing acid compared to another glass containing acid and the bicarbonate.
4. **Describe** how saliva protects your mouth from bacteria.
5. **Predict** what would happen if your saliva were made of only water.

Communicating Your Data

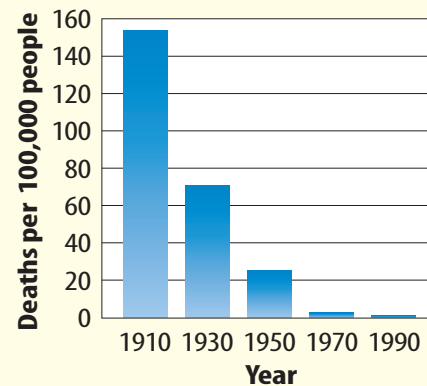
Using what you learned in this experiment, create a poster about the importance of good dental hygiene. Invite a dental hygienist to speak to your class.

Battling Bacteria

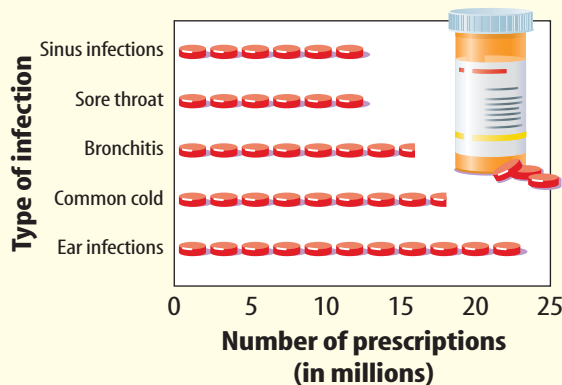
Did you know...

... The term **antibiotic** was first coined by an American microbiologist. The scientist received a Nobel prize in 1952 for the discovery of streptomycin (strep toh MY suhn), an antibiotic used against tuberculosis.

United States Death Rates from Tuberculosis



Antibiotics Prescribed Each Year in the United States



...In recent decades many bacteria have become resistant

to antibiotics. For example, one group of bacteria that cause illnesses of the stomach and intestines—*Shigella* (shih GEL uh)—became harder to control. In 1985, less than one third of *Shigella* were resistant to the antibiotic ampicillin (am puh SI luhn). By 1991, however, more than two thirds of *Shigella* were resistant to the drug.

Applying Math

It is believed that 30 percent of the antibiotics prescribed for ear infections are unnecessary. Using the graph, calculate the number of unnecessary prescriptions.

...People have long used **natural remedies** to treat infections. These remedies include garlic, *Echinacea* (purple coneflower), and an antibiotic called squalamine, found in sharks' stomachs.

Find Out About It

Visit bookd.msscience.com/science_stats to research the production of four antibiotics. Create a graph comparing the number of kilograms of each antibiotic produced in one year.



Reviewing Main Ideas

Section 1 The Immune System

1. Your body is protected against most pathogens by the immune system.
2. Active immunity is long lasting, but passive immunity is not.
3. Antigens are foreign molecules in your body. Your body makes an antibody that attaches to an antigen, making it harmless.

Section 2 Infectious Diseases

1. Pasteur and Koch discovered that microorganisms cause diseases. Lister learned that cleanliness helps control microorganisms.
2. Pathogens can be spread by air, water, food, and animal contact. Bacteria, viruses, fungi, and protists can cause infectious diseases.

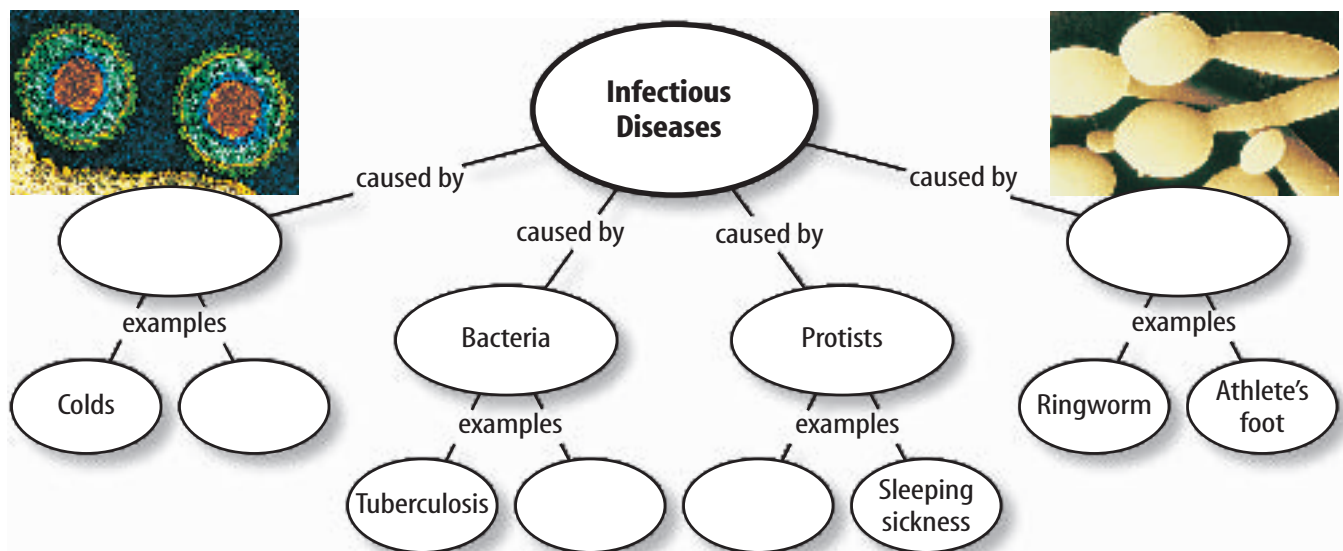
3. Sexually transmitted diseases can be passed between persons during sexual contact.
4. HIV damages your body's immune system.

Section 3 Noninfectious Diseases

1. Causes of noninfectious diseases, such as diabetes and cancer, include genetics, chemicals, poor diet, and uncontrolled cell growth.
2. An allergy is a reaction of the immune system to a foreign substance.
3. Cancer results from uncontrolled cell growth, causing cells to multiply, spread through the body, and invade normal tissue.
4. Cancer is treated with surgery, chemotherapy, and radiation. Early detection can help cure or slow some cancers.

Visualizing Main Ideas

Copy and complete the following concept map on infectious diseases.



Using Vocabulary

active immunity p. 179	infectious disease p. 185
allergen p. 191	noninfectious disease p. 190
allergy p. 190	passive immunity p. 179
antibody p. 178	pasteurization p. 182
antigen p. 178	sexually transmitted disease (STD) p. 186
biological vector p. 185	vaccination p. 179
chemotherapy p. 194	virus p. 182
immune system p. 176	

Fill in the blanks with the correct vocabulary words.

- A(n) _____ can cause infectious diseases.
- A disease-carrying organism is called a(n) _____.
- Measles is an example of _____.
- Injection of weakened viruses is called _____.
- _____ occurs when your body makes its own antibodies.
- A(n) _____ stimulates histamine release.
- Heating a liquid to kill harmful bacteria is called _____.
- Diabetes is an example of a(n) _____ disease.
- How can infectious diseases be caused?
 - heredity
 - allergies
 - chemicals
 - organisms
- How do scientists know that a pathogen causes a specific disease?
 - It is present in all cases of the disease.
 - It does not infect other animals.
 - It causes other diseases.
 - It is treated with heat.
- What is formed in the blood to fight invading antigens?
 - hormones
 - allergens
 - pathogens
 - antibodies
- Which of the following is one of your body's general defenses against some pathogens?
 - stomach enzymes
 - HIV
 - some vaccines
 - hormones
- Which of the following is known as an infectious disease?
 - allergies
 - asthma
 - syphilis
 - diabetes
- Which disease is caused by a virus that attacks white blood cells?
 - AIDS
 - measles
 - flu
 - polio
- Which of the following is a characteristic of cancer cells?
 - controlled cell growth
 - help your body stay healthy
 - interfere with normal body functions
 - do not multiply or spread
- Which of the following is caused by a virus?
 - AIDS
 - gonorrhea
 - ringworm
 - syphilis
- How can cancer cells be destroyed?
 - chemotherapy
 - antigens
 - vaccines
 - viruses

Checking Concepts

Choose the word or phrase that best answers the question.

- Which of the following has not been found to be a biological vector?

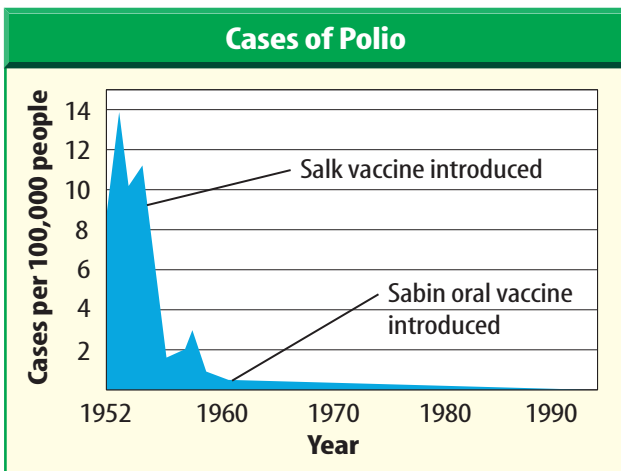
A) B) C) D)



Thinking Critically

- 19. **Explain** if it is better to vaccinate people or to wait until they build up their own immunity.
- 20. **Infer** what advantage a breast-fed baby might have compared to a formula-fed baby.
- 21. **Describe** how your body protects itself from antigens.
- 22. **Explain** how helper T cells and B cells work to eliminate antigens.
- 23. **Compare and contrast** antibodies, antigens, and antibiotics.

Use the graph below to answer question 24.



- 24. **Interpret Data** Using the graph above, explain the rate of polio cases between 1952 and 1965. What conclusions can you draw about the effectiveness of the polio vaccines?
- 25. **Concept Map** Make a network-tree concept map that compares the various defenses your body has against diseases. Compare general defenses, active immunity, and passive immunity.

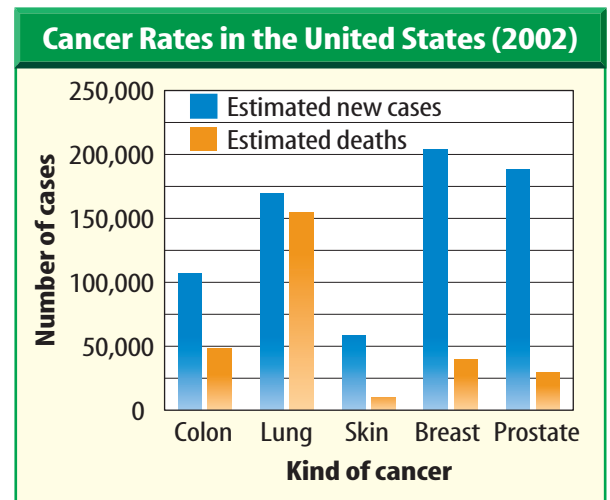
Performance Activities

- 26. **Poster** Design and construct a poster to illustrate how a person with the flu could spread the disease to family members, classmates, and others.

Applying Math

- 27. **Antibiotic Tablets** You have an earache and your doctor prescribes an antibiotic to treat the infection. The antibiotic can be taken as a tablet at dosages of 400 mg or 1,000 mg. How many 400 mg tablets are needed to equal one 1,000 mg tablet?

Use the graph below to answer questions 28 and 29.



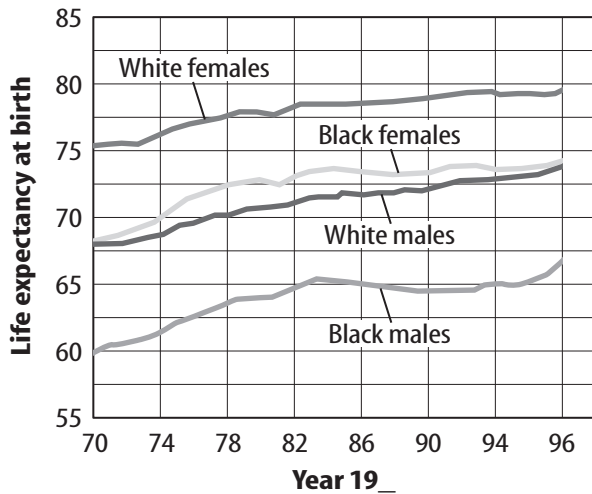
- 28. **Cancer Cases** The graph above shows the estimated number of new cases and estimated number of deaths for various cancers in the year 2002. Which cancer occurs most frequently? Most infrequently? Estimate the difference between new cases of colon cancer and new cases of skin cancer.
- 29. **Cancer Deaths** Estimate the difference between deaths from lung cancer and deaths from prostate cancer.

Part 1 Multiple Choice

Record your answers on the answer sheet provided by your teacher or on a sheet of paper.

Use the graph below to answer questions 1 and 2.

Life Expectancy by Race and Sex, 1970–1997



- According to the information in the graph, which group had the lowest life expectancy in both 1975 and 1994?
 - white males
 - black females
 - white females
 - black males
- A reasonable hypothesis based on the information in the graph is that life expectancy
 - decreased for black males between 1970 and 1984.
 - is longer for females than for males.
 - decreased for white males between 1970 and 1980.
 - is longer for males than for females.
- Which of the following is NOT a sign of inflammation?
 - redness
 - pain
 - bleeding
 - swelling

Use the table below to answer questions 4–6.

Disease	Average Number of Cases per Year Before Vaccine Available	Cases in 1998 After Vaccine Available
Measles	503,282	89
Diphtheria	175,885	1
Tetanus	1,314	34
Mumps	152,209	606
Rubella	47,745	345
Pertussis (whooping cough)	147,271	6,279

Data from the National Immunization Program, CDC

- Which of the following diseases had the highest number of cases before vaccine?
 - diphtheria
 - mumps
 - rubella
 - pertussis
- Which of the following diseases had the highest number of cases after vaccine?
 - measles
 - tetanus
 - mumps
 - rubella
- Which of the diseases in the table are caused by bacteria?
 - measles, rubella, mumps
 - measles, tetanus, mumps
 - mumps, pertussis, rubella
 - tetanus, pertussis, diphtheria

Test-Taking Tip

Missing Information Questions will often ask about missing information. Notice what is missing as well as what is given.

Question 6 Base your answer on choices that can be found in the text, such as *measles* and *tetanus*.

Part 2 Short Response/Grid In

Record your answers on the answer sheet provided by your teacher or on a sheet of paper.

- What are some health practices that can help fight infectious disease?
- How does mucus help defend your body?
- Why are the body's second-line defenses called specific immunity?

Use the table below to answer questions 10–12.

Teen Opinions on Smoking			
All numbers are percentages	Agree	Disagree	No opinion or don't know
Seeing someone smoke turns me off	67	22	10
I'd rather date people who don't smoke	86	8	6
It's safe to smoke for only a year or two	7	92	1
Smoking can help you when you're bored	7	92	1
Smoking helps reduce stress	21	78	3
Smoking helps keep your weight down	18	80	2
Chewing tobacco and snuff cause cancer	95	2	3
I strongly dislike being around smokers	65	22	13

Data from CDC

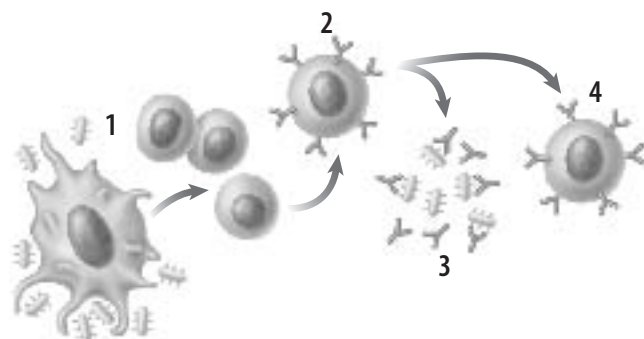
- According to the table, which statement had the highest percentage of teen agreement?
- According to the table, which pairs of statements had the same percentages of teen disagreement?
- According to the information in the table, do teens generally have positive or negative opinions about smoking? Explain.

Part 3 Open Ended

Record your answers on a sheet of paper.

- Which is longer lasting—active immunity or passive immunity? Why?
- Dr. Cavazos has isolated a bacterium that she thinks causes a recently discovered disease. How can she prove it? What steps should she follow?
- Compare and contrast infectious and noninfectious diseases.
- Would a vaccination against measles be helpful if a person already had the disease a year ago? Explain.
- Compare and contrast Type 1 and Type 2 diabetes.

Use the illustration below to answer questions 18 and 19.



- Explain the four steps of the immune system response.
- Sometimes a person is born without the cells labeled 2 in the illustration above. If this person was given a vaccination for tetanus, what results would be expected? Explain.