

What Causes Infectious Diseases?

When you catch a cold, you may sneeze, cough, and run a fever. You probably feel discomfort but do not think of yourself as having a disease. Yet, the common cold is a type of disease. More specifically, it is an **infectious disease**, a disease caused by organisms that enter and multiply within the human body.

HEALTH TERMS

infectious disease

parasites

virus

transmission

immunity

mucous membranes

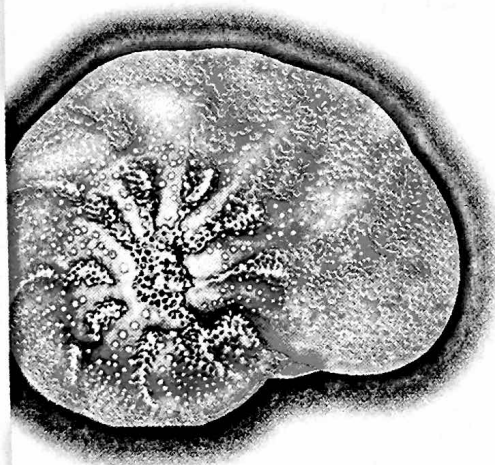
phagocytosis

neutrophils

antibodies

HEALTH CONCEPTS

- Infectious diseases are caused by tiny organisms called *pathogens*.
- Infectious diseases are transmitted, or spread, through contact with a person, an animal, a contaminated object, or the environment at large.
- The body offers several layers of protection against infection by pathogens.
- You can take measures to maintain the health of your immune system.



Protozoan

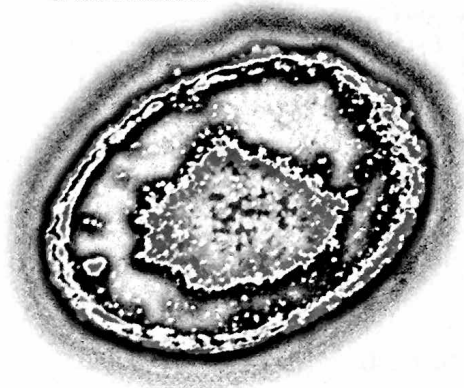
Causes of Infectious Diseases

Every infectious disease is caused by one of several types of small, microscopic organisms (microorganisms) known as *pathogens*. Pathogens invade the body and attack its cells and tissues. Most pathogens are **parasites**, organisms that live in or on another organism and derive nourishment from it. Among the forms pathogens can take are bacteria, viruses, rickettsias (rik-ET-see-uhs), protozoans, and fungi.

Bacteria

A bacterium is a single-celled microorganism. Bacteria can live almost anywhere. They are abundant in the air, soil, and water. Some bacteria produce poisons that are harmful to human cells. If there are enough bacteria and the person is not immune, disease results.

E. coli bacterium



Most diseases caused by bacteria begin when microorganisms not usually present in the body invade it. When bacteria enter the body, they multiply at a rapid rate through cell division. If conditions are perfect—the right temperature and sufficient nourishment—division can take place every 20 minutes. After just 15½ hours, one bacterium can have multiplied into more than 4 billion bacteria! This rarely happens, however. In a healthy individual, the body's immune system destroys the invading bacteria. Also, perfect conditions rarely occur.

"Friendly" Bacteria

Far from harming your body, certain bacteria—known as resident bacteria—live within or on your body and assist its normal functions. Among these "helpful" bacteria are:

- **LACTOBACILLI.** Found in the gastrointestinal tract, these bacteria produce lactic acid from simple carbohydrates, which aids in digestion.
- **COLIFORM BACILLI.** Found in the intestines, these bacteria help break down carbohydrates and combat disease-causing bacteria.

Viruses

A **virus** is *the smallest known type of infectious agent*. Viruses are about one-half to one-hundredth the size of the smallest bacterium. These organisms are also one of our worst enemies. One of the deadliest viruses known today is **HIV**, the virus that causes AIDS.

Viruses are not living cells. They consist of an inner core of genetic material surrounded by a protective protein shell and are entirely dependent on living cells for survival and reproduction. Viruses invade all known forms of life—mammals, birds, reptiles, insects, plants, and even bacteria. Viruses are highly specific in the kinds of cells they invade. Only certain viruses invade animal cells, and these viruses can attack only specific types of cells.

When a virus enters the body, it attaches itself to a cell—called the *host*—and injects its genetic material into that cell. The virus then makes copies of itself, using materials within the host cell. The copies then spread to other body cells, where the process is repeated. Viruses usually run their course and are eventually killed by the immune system.

Rickettsias

Rickettsias are organisms that resemble small bacteria but, like viruses, are able to multiply only by invading the cells of another life form. Most rickettsias are found in the intestinal tracts of insects— notably fleas—as well as in mice, ticks, and mites. Rickettsias are passed on to human and animal hosts through bites or through feces deposited on the skin. Human diseases caused by rickettsias include typhus, mentioned in the chapter-opening paragraph, and Rocky Mountain spotted fever.

Protozoans

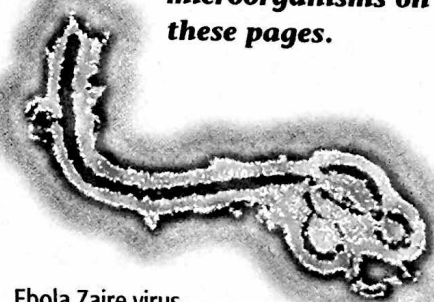
Protozoans are single-celled organisms that are larger than bacteria and have a more complex cell structure. Most protozoans are harmless, but about 30 different types cause disease in humans. Disease-producing protozoans are most common in tropical areas that have poor sanitation.

hot link

HIV For more information on HIV, the virus that causes AIDS, see Chapter 30, page 656.

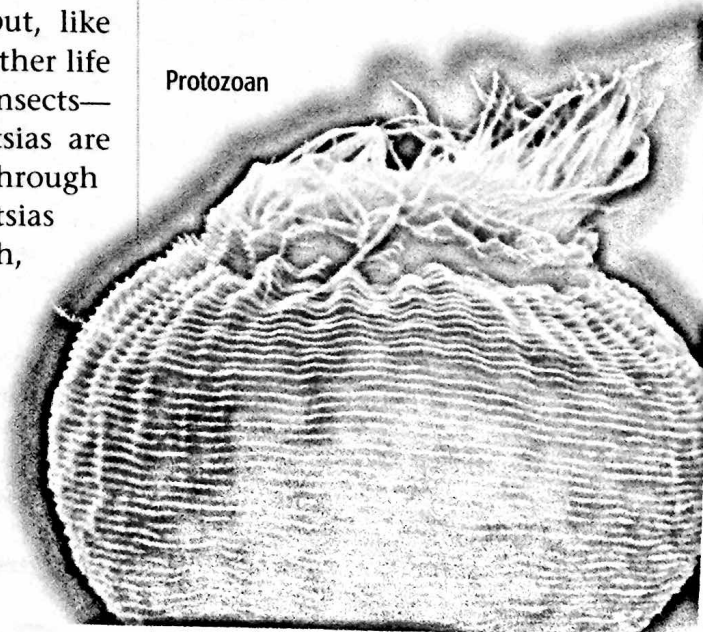
▼ *The smallest forms of life on earth, these microorganisms can be the most threatening to your health.*

ACTIVITY Describe the differences that you see among the microorganisms on these pages.



Ebola Zaire virus

Protozoan



Did You Know?

- Water particles expelled through a sneeze can travel at speeds up to 100 miles an hour (161 km).
- Your toothbrush should be discarded after a cold or sore throat.
- Antibiotics work well against bacteria because both bacteria and antibiotics work outside of the body's own cells.
- Viruses pass inside cells where antibiotics can't reach them; therefore, antibiotics have no effect on curing viral infections.

Fungi

Fungi are simple organisms that cannot make their own food. Many are *saprophytes* (SAP-ruh-fyts)—organisms that feed off dead animals, insects, and leaves. Fungi prefer dark, damp environments. The most common disease-causing fungi invade mainly deep tissues of the hair, nails, and skin and cause infections of the scalp or feet, such as ringworm and athlete's foot.

How Infectious Diseases Are Spread

There are several well-defined means of **transmission**, or *spread*, of infectious pathogens. Transmission can occur through direct contact with an infected person, an animal, or a contaminated object. Some pathogens can also reside in the environment at large.

People

Many infectious diseases are spread as a result of direct or indirect contact with an infected person.

- **Direct Contact.** Pathogens may be spread when an uninfected person comes into physical contact with an infected person. Sexually transmitted diseases are spread in this way. The human

Building Health Skills

Goal Setting: Reducing Infectious Disease Risk

SOME OF THE COMMON bacteria associated with food poisoning are *Salmonella*, *Staphylococcus aureus*, and *Clostridium perfringens*. Although home kitchens are breeding grounds for these potentially life-threatening microorganisms, the risk of infection exists outside the home as well. There are precautions you as a health-literate consumer can take to protect yourself. Exercise care when:

1. **Eating out.** Avoid restaurants that do not look clean or that you think might not practice safe cooking and food storage procedures. Refuse any food that does not smell right or tastes bad.
2. **Cooking out.** If you are camping or planning a cookout at the beach or park, remember to keep all perishable foods chilled. Cook meats thoroughly and place them on a clean platter, not one that held raw meat.
3. **Buying prepared foods.** Although you might expect fresh-cut deli meats, mayonnaise-based salads, and other such foods to be free of bacteria, they are not always. Many local newspapers publish lists of food sellers that fail to pass periodic health inspections. Learn to consult such lists from time to time, and avoid establishments that "make the list."

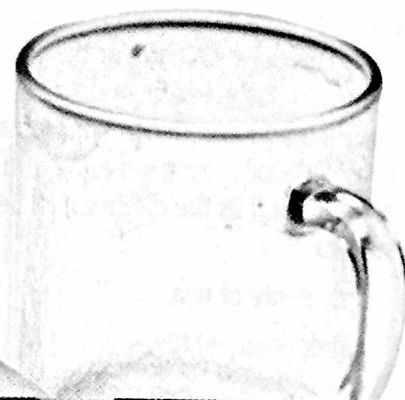


bite is another, and especially dangerous, mode of transmission. A pregnant woman may also transmit an infection to her unborn child.

- **Indirect Contact.** Both bacteria and viruses can enter the body through the lungs if droplets—exhaled, coughed, or sneezed out by an infected person—are inhaled. The common cold, influenza, and tuberculosis are spread in this way.

Animals

Animals, including insects, spread many infectious diseases. The bite of an infected dog or other animal can spread rabies, a disease that can be fatal. When a bloodsucking insect, such as a mosquito, ingests blood from an infected person or animal, the insect may take pathogens into its own body. When the insect later takes blood from an uninfected person, it injects some of the pathogens into that person's body, thus spreading the disease. Malaria and dengue fever, infectious diseases common to tropical regions, are spread in this fashion.

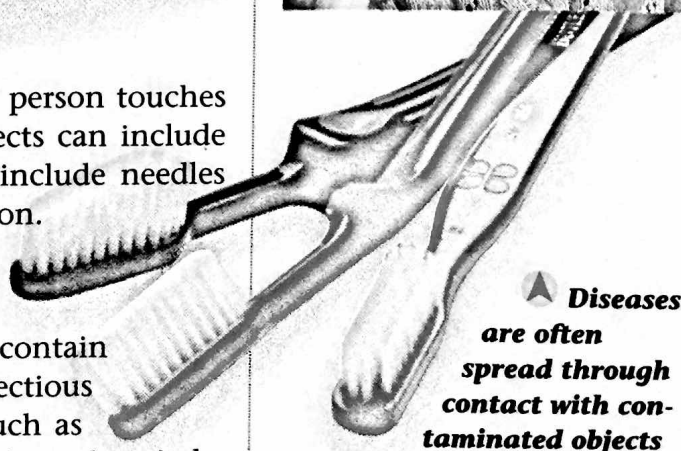


Contaminated Objects

Certain pathogens are spread when an uninfected person touches objects that an infected person has used. These objects can include eating utensils, glasses, or toothbrushes. They also include needles used to inject drugs that are shared with another person.

The Environment

Food, water, soil, and even the air we breathe contain potentially harmful pathogens. Some forms of infectious disease are the direct result of human negligence, such as the careless disposal of infectious waste materials from hospitals, which constitutes a form of toxic dumping. This form of pollution can be deadly. Yet another way in which pathogens in the environment are spread is through the careless handling of food, which is a main source of food poisoning.



▲ **Diseases are often spread through contact with contaminated objects such as eating utensils and even pens and pencils.**

ACTIVITY Name ways the items pictured should be handled to prevent the spread of diseases.



Common (Cold) Sense

Colds, though they are minor inconveniences for most people other than those with chronic respiratory conditions, are nothing to sneeze at. Colds are caused by any number of viruses, all of which, like the deadly HIV, continue to change their genetic “fingerprint” as they move from host to host. This is why a cure for the common cold has never been discovered.

When you experience symptoms of a cold—mild fever, sneezing, runny nose—treat it as the disease it is. Be sure to

- get plenty of rest.
- drink plenty of fluids.
- maintain proper nutrition.

Keeping your body healthy will also make it more resistant to infection, possibly reducing the number of colds you get. Again, good nutrition, combined with regular physical activity and adequate rest, is the cornerstone of a prevention plan. Controlling stress levels and not smoking are other steps a person can take.

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cilia For more information on the role cilia play in resisting infection, see Chapter 17, page 402.

How Your Body Defends Against Infectious Disease

Pathogens are everywhere in numbers beyond comprehension. If they are so widespread, why are we not constantly sick? This question can be answered in one word: *immunity*. **Immunity** is *the body's natural defenses against infection*.

The Immune Response

Although you cannot see them, your body is exposed each day to millions of pathogens. Pathogens are in the air you breathe, and they cling to the surfaces you touch. Your body is constantly fighting pathogens that enter it. When they enter your body, pathogens attack your body cells and use these cells to grow and multiply. The end result of such an attack is an infection.

Most of the time, your body manages to stay free of infection because of your immune system. Your immune system includes two main types of defenses. The *innate immune system*—your inborn defenses—provides nonspecific resistance. The *adaptive immune system* provides specific resistance. Both types work together to protect your body against pathogens that could harm you.

Nonspecific Resistance

Each of us has lines of inborn, nonspecific—or “general”—defenses against infection. Body defenses that are nonspecific respond in the same way each time your body is invaded by a foreign substance. Your body's nonspecific defenses include physical and chemical barriers, body cells, and the inflammatory response.

- **Physical Barriers.** Your body's first line of defense against invading pathogens consists of physical barriers, the main barrier being your skin. Unbroken skin helps prevent pathogens from entering body tissues. The tough dead cells that make up the outer layer of skin form an effective barrier. **Mucous membranes**—*the soft, skinlike lining of many parts of the body*—in your mouth, nose, and bronchial tubes produce a sticky substance called *mucus* that traps pathogens. Some mucous membranes have **cilia**, tiny hairs, that also trap pathogens, which are then expelled when you cough or sneeze.
- **Chemical Barriers.** Enzymes in tears and saliva are chemical barriers that can destroy bacteria. The acidic digestive juices of the stomach are also chemical barriers. These juices destroy pathogens that are swallowed with food. Other chemicals cause body changes that help cells inside the body fight pathogens.
- **Body Cells.** Once pathogens reach your bloodstream, certain types of white blood cells, called *phagocytes*, travel through the blood and group together to destroy them. *The process by which*

phagocytes engulf and destroy pathogens is called **phagocytosis** (FAG-uh-suh-TOH-suhs). **Neutrophils** (NOO-truh-filz) are the chief type of phagocyte involved in the process of phagocytosis.

■ **Inflammatory Response.** If pathogens break through the body's outermost barriers, your body then goes into a "red alert" stage known as the *inflammatory response*. Chemical mediators are released that cause the blood vessels to dilate and allow increased blood flow. This permits phagocytes to leave the blood and enter the body tissues. This process continues until the pathogens are destroyed. Once the pathogens are destroyed, tissues can be repaired. Symptoms of inflammation confined to a specific area include heat, redness, and swelling, which result from increased blood flow.

Specific Resistance

The general response of your nonspecific defenses is not always enough to protect your body from disease. The adaptive immune system mounts specific attacks against particular types of pathogens. When this happens, another body defense goes to work in the form of cells called *lymphocytes*.

HEALTH Online



Examine microscopic images and learn about the cell activities of streptococcus and other infectious diseases. At health.glencoe.com link to animations that show how the body defends itself against infectious diseases.

THE BODY'S BARRIERS AGAINST DISEASE

INNATE IMMUNE SYSTEM

mucous membranes
unbroken skin
digestive juices
enzymes in tears and saliva
white blood cells

A healthy body routinely repels pathogens with a variety of defenses.

ADAPTIVE IMMUNE SYSTEM

lymphocytes:
T cells
B cells



Unbroken skin, mucous membranes, enzymes in tears and saliva, digestive juices, and white blood cells all help keep unwanted bacteria at bay. But when a pathogen does elude these stalwarts of the innate immune system, the adaptive immune system provides further aid by sending out lymphocytes, cells that stalk and neutralize invading pathogens.

hot link

lymphatic system For more information on the lymphatic system and its other functions, see Chapter 17, page 394.

hot link

ultraviolet rays For more information on protecting yourself against the sun's ultraviolet rays, see Chapter 7, page 163.

LYMPHOCYTES

Lymphocytes are a type of white blood cell that fights pathogens. Lymphocytes travel through your body along two networks of vessels. One of these networks is your blood vessels. The other network is your lymph vessels, which are a part of your **lymphatic system**. There are two main types of lymphocytes—B cells and T cells.

- **B Cells.** When B cells encounter pathogens, they are stimulated to enlarge and multiply. The B cells turn into cells called *plasma cells*, which in turn produce **antibodies**—*proteins that destroy or neutralize invading pathogens*. The antibodies for a particular pathogen remain in your blood to become active if you encounter the specific pathogen again.
- **T Cells.** There are two main groups of T cells—killer cells and helper cells. Killer T cells are stimulated to multiply by the presence of abnormal body cells. They attach to these cells and release toxins that help destroy the abnormal cells. Helper T cells aid the activity of the B cells and killer T cells and control other aspects of the body's immune system.

Care of the Immune Response

The ability of your immune system to fight off invading pathogens varies, depending on a number of preventive factors. Perhaps the most important is good nutrition. When you fail to take in adequate nutrients, you can jeopardize your immune system. This is one reason poorly planned weight-loss programs can make a person ill. Overexposure to **ultraviolet rays** also affects your immune response.