Chapter 39 Organizer

Refer to pages 4T-5T of the Teacher Guide for an explanation of the National Science Education Standards correlations.

Section	Objectives	Activities/Features
Section 39.1 **The Nature of Disease** National Science Education Standards UCP.1, UCP.2, UCP.5; A.1, A.2; C.1, C.4, C.6; F.1, F.5; G.1-3 (1 session)	1. **Outline** the steps of Koch's postulates. 2. **Describe** how infections are transmitted. 3. **Explain** what causes the symptoms of a disease.	**Problem-Solving Lab 39-1,** p. 1059 **MiniLab 39-1:** Testing How Diseases are Spread, p. 1060 **Internet BioLab:** Getting On-line for Information on Diseases, p. 1074
Section 39.2 **Defense Against Infectious Diseases** National Science Education Standards UCP.1-3, UCP.5; A.1, A.2; C.1, C.4, C.5, C.6; E.1, E.2; F.1, F.5, F.6; G.1-3 (3 sessions)	4. **Compare** nonspecific and specific immune responses. 5. **Compare** innate and acquired immune responses. 6. **Distinguish** between antibody and cellular immunity.	**Inside Story:** Lines of Defense, p. 1066 **MiniLab 39-2:** Distinguishing Types of White Blood Cells, p. 1067 **Problem-Solving Lab 39-2,** p. 1072 **BioTechnology:** New Vaccines, p. 1076

Need Materials? Contact Carolina Biological Supply Company at 1-800-334-5551 or at **http://www.carolina.com**

MATERIALS LIST

BioLab

p. 1074 Internet access, paper, pencil

MiniLabs

p. 1060 fresh apples (4), rotting apple, zipper-lock plastic bags (4), cotton ball, ethanol

p. 1067 microscope, prepared slide of blood cells, paper, pencil

Alternative Lab

p. 1064 *E. coli* culture, antibiotic disks (3 types), sterile untreated disks, petri dish with sterile nutrient agar, cotton swabs, forceps, ethanol, transparent tape, marking pen, incubator

Quick Demos

p. 1056 petri dish with sterile nutrient agar, incubator

p. 1064 microprojector, prepared slides of red and white blood cells

Key to Teaching Strategies

- L1 Level 1 activities should be appropriate for students with learning difficulties.
- L2 Level 2 activities should be within the ability range of all students.
- L3 Level 3 activities are designed for above-average students.
- ELL ELL activities should be within the ability range of English Language Learners.
- COOP LEARN Cooperative Learning activities are designed for small group work.
- P These strategies represent student products that can be placed into a best-work portfolio.
- These strategies are useful in a block scheduling format.

Immunity from Disease

Teacher Classroom Resources

Section	Reproducible Masters	Transparencies
Section 39.1 **The Nature of Disease**	Reinforcement and Study Guide, p. 171 L2 BioLab and MiniLab Worksheets, p. 173 L2 Laboratory Manual, pp. 285-292 L2 Content Mastery, pp. 189-190, 192 L1	Section Focus Transparency 96 L1 ELL Basic Concepts Transparency 76 L2 ELL
Section 39.2 **Defense Against Infectious Diseases**	Reinforcement and Study Guide, pp. 172-174 L2 Concept Mapping, p. 39 L3 ELL Critical Thinking/Problem Solving, p. 39 L3 BioLab and MiniLab Worksheets, pp. 174-176 L2 Content Mastery, pp. 189, 191-192 L1	Section Focus Transparency 97 L1 ELL Basic Concepts Transparency 77 L2 ELL Basic Concepts Transparency 78a, 78b L2 ELL Basic Concepts Transparency 79 L2 ELL Reteaching Skills Transparency 57 L1 ELL Reteaching Skills Transparency 58 L1 ELL

Assessment Resources

Chapter Assessment, pp. 229-234
MindJogger Videoquizzes
Performance Assessment in the Biology Classroom
Alternate Assessment in the Science Classroom
Computer Test Bank
BDOL Interactive CD-ROM, Chapter 39 quiz

Additional Resources

Spanish Resources ELL
English/Spanish Audiocassettes ELL
Cooperative Learning in the Science Classroom COOP LEARN
Lesson Plans/Block Scheduling

NATIONAL GEOGRAPHIC Teacher's Corner

Products Available From Glencoe

To order the following products, call Glencoe at 1-800-334-7344:

CD-ROM
NGS PictureShow: Human Body 3

Curriculum Kit
GeoKit: Human Body 1

Transparency Set
NGS PicturePack: Human Body 3

Videodisc
STV: Human Body

Products Available From National Geographic Society

To order the following products, call National Geographic Society at 1-800-368-2728:

Videos
Incredible Human Machine
Our Immune System

Index to National Geographic Magazine

The following articles may be used for research relating to this chapter:
"Our Immune System: The Wars Within," by Peter Jaret, June 1986.

GLENCOE TECHNOLOGY

The following multimedia resources are available from Glencoe.

Biology: The Dynamics of Life

CD-ROM ELL
Video: *Lymphocytes*
Animation: *Antibody Immunity*
Animation: *Cellular Immunity*

Videodisc Program
Lymphocytes
Antibody Immunity
Cellular Immunity

The Secret of Life Series
Tinkering With Our Genes: Genetic Medicine
Nothing to Sneeze At: Viruses

Chapter 39

Getting Started Demo

Have students calculate the average number of colds that students with tonsils and without tonsils have had in the last six months. Compare the average to see if there is any noticeable difference between the two groups. Discuss the role of the tonsils and the immune system. L2

Theme Development

The mechanisms by which parts of various body systems work together to fight disease are discussed, emphasizing the theme of **systems and interactions. Homeostasis** is emphasized as the immune system's response to disease is discussed.

0:00 Out of Time?

If time does not permit teaching the entire chapter, use the BioDigest at the end of the unit as an overview.

Chapter

39 Immunity from Disease

What You'll Learn

- You will describe how infections are transmitted and what causes the symptoms of diseases
- You will explain the various types of innate and acquired immune responses
- You will compare antibody and cellular immunity

Why It's Important

Your body constantly faces attack from disease-causing organisms. A knowledge of your immune system will help you understand how your body defends itself.

Getting Started

Gathering Data

Poll your biology class and find out who has had their tonsils removed and who has had a cold in the last six months. *Is there a relationship between the occurrence of colds and the presence of tonsils?*

interNET CONNECTION To find out more about the immune system, visit the Glencoe Science Web Site. **www.glencoe.com/sec/science**

Magnification: 17 350×

The immune system, like a castle, protects the body against invasion. Like the knight protecting his castle, the neutrophil shown here is on constant surveillance against foreign invaders.

Multiple Learning Styles

Look for the following logos for strategies that emphasize different learning modalities.

Kinesthetic Project, p. 1061

Visual-Spatial Biology Journal, pp. 1056, 1068; Reteach, p. 1062; Quick Demo, p. 1064; Portfolio, pp. 1067, 1072; Meeting Individual Needs, pp. 1068, 1069, 1071

Interpersonal Tech Prep, p. 1058; Check for Understanding, p. 1062; Portfolio, p. 1070

Intrapersonal Portfolio, p. 1060

Linguistic Meeting Individual Needs, pp. 1057, 1069; Enrichment, p. 1058; Tech Prep, pp. 1059, 1060; Biology Journal, pp. 1059, 1070, 1071, 1072

Section

39.1 The Nature of Disease

SECTION PREVIEW

Objectives

Outline the steps of Koch's postulates.

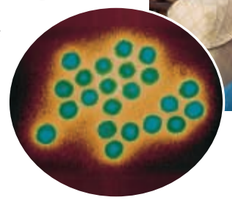
Describe how infections are transmitted.

Explain what causes the symptoms of a disease.

Vocabulary

pathogen
infectious disease
Koch's postulates
endemic disease
epidemic
antibiotic

Everyone occasionally gets a cold. Cold viruses enter your body by way of your nose and are swept to the back of your throat by hairlike cilia. Some are washed down your esophagus and destroyed by your digestive system. Others become lodged in your nasal passages. These viruses enter cells that line your nasal cavity. Once inside, the viruses unleash their genes, taking over the DNA of your cells. Soon you have a sore throat, stuffy nose, headache, and mild fever. How did the infection cause these symptoms?



Cold viruses (inset) make a person feel sick.

What Is an Infectious Disease?

The cold virus causes a disease—a change that disrupts the homeostasis in the body. Disease-producing agents such as bacteria, protozoans, fungi, viruses, and other parasites are called **pathogens.** The main sources of pathogens are soil, contaminated water, and infected animals, including other people.

Not all microorganisms are pathogenic. In fact, the presence of some microorganisms in your body is beneficial. Before birth, your body is free of pathogens. At birth, microorganisms establish themselves on your skin and in your upper respiratory system, lower urinary and reproductive tracts, and lower intestinal tract. ***Figure 39.1*** shows some common bacteria that live on your skin. They have a symbiotic relationship with

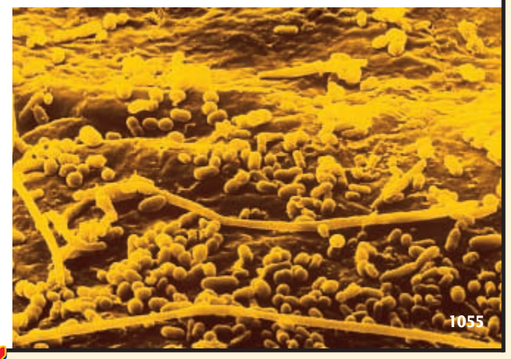


Figure 39.1
These bacteria establish a more-or-less permanent residence in or on your skin, but do not cause disease under normal conditions.

Assessment Planner

Portfolio Assessment
- **Portfolio, TWE,** pp. 1059, 1060, 1067, 1072
- **Problem-Solving Lab, TWE,** p. 1059

Performance Assessment
- **Assessment, TWE,** pp. 1069, 1071
- **Alternative Lab, TWE,** pp. 1064-1065
- **BioLab, SE,** pp. 1074-1075
- **BioLab, TWE,** pp. 1074-1075
- **MiniLab, SE,** pp. 1060, 1067
- **MiniLab, TWE,** pp. 1060, 1067

Knowledge Assessment
- **Assessment, TWE,** p. 1065
- **Problem-Solving Lab, TWE,** p. 1072
- **Section Assessment, SE,** pp. 1062, 1073
- **Chapter Assessment, SE,** pp. 1077-1079

Skill Assessment
- **Assessment, TWE,** pp. 1062, 1073
- **Problem-Solving Lab, SE,** pp. 1059, 1072

Section 39.1

Prepare

Key Concepts

The steps of Koch's postulates are presented. The spread of disease is covered with emphasis on how infections are transmitted.

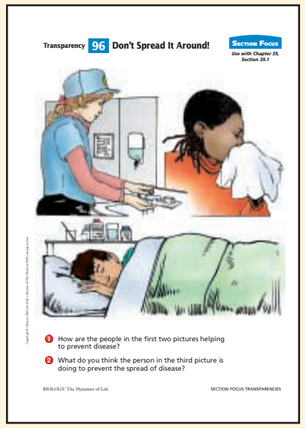
Planning

- Obtain printed materials from the local health department, doctors' offices, hospitals, or pharmacies for the Display.
- Prepare nutrient agar plates for the Quick Demo and the Project.
- Purchase apples and plastic bags for MiniLab 39-1.

1 Focus

Bellringer

Before presenting the lesson, display **Section Focus Transparency 96** on the overhead projector and have students answer the accompanying questions. L1 ELL



2 Teach

Discussion

Explain the term plague and ask why some people survived plagues while many others perished. *Students may suggest that people in better health may have been more resistant to infection or possessed some unusual trait that prevented them from succumbing to infection. Accept all logical responses.* Initiate a general discussion about the body's defenses to disease.

Quick Demo

Touch the surface of a plate of nutrient agar with the palm of your hand or your fingertips, or have a student do so. Cover and incubate for 24-48 hours. Show students the colonies of bacteria that grow on the agar.

INTERNET BioLab

The BioLab at the end of the chapter can be used at this point in the lesson.

GLENCOE TECHNOLOGY

VIDEODISC
VIDEOTAPE
The Secret of Life
Tinkering With Our Genes: Genetic Medicine

Resource Manager

Section Focus Transparency 96 and Master L1 ELL
Reinforcement and Study Guide, pp. 171-172 L2

Table 39.1 Human infectious disease

Disease	Cause	Affected organ system	Transmission
Smallpox	Virus	Skin	Droplet
Chicken pox	Virus	Skin	Droplet
Cold sores	Virus	Skin	Direct contact
Rabies	Virus	Nervous system	Animal bite
Poliomyelitis	Virus	Nervous system	Contaminated water
Infectious mononucleosis	Virus	Salivary glands	Direct contact
Colds	Viruses	Respiratory system	Direct contact
Influenza	Viruses	Respiratory system	Droplet
HIV/AIDS	Virus	Immune system	Exchange of body fluids
Hepatitis B	Virus	Liver	Direct contact
Measles	Virus	Skin	Droplet
Mumps	Virus	Salivary glands	Droplet
Tetanus	Bacteria	Nervous system	Deep wound
Food poisoning	Bacteria	Digestive system	Contaminated food
Tuberculosis	Bacteria	Respiratory system	Droplet
Whooping cough	Bacteria	Respiratory system	Droplet
Spinal meningitis	Bacteria	Nervous system	Droplet
Impetigo	Bacteria	Skin	Direct contact

your body. However, if you become weakened or injured, these same organisms can become potential pathogens.

Any disease caused by the presence of pathogens in the body is called an **infectious disease** (ihn FEK shus). ***Table 39.1*** lists some of the infectious diseases that occur in humans.

WORD Origin
pathogen
From the Greek words *pathos*, meaning "to suffer," and *geneia*, meaning "producing." Pathogens cause diseases.

Determining What Causes a Disease

One of the first problems scientists face when studying a disease is finding out what causes the disease. Not all diseases are caused by pathogens. Disorders such as hemophilia (hee muh FIHL ee uh), which is caused by a recessive allele on the X chromosome, and sickle cell anemia are inherited. Others, such as osteoarthritis (ahs tee oh ar THRITE us), may be caused by wear and tear on the body as it ages.

Pathogens cause infectious diseases and some cancers. In fact, about half of all human diseases are infectious. In order to determine which pathogen causes a specific disease, scientists follow a standard set of procedures.

First pathogen identified

The first proof that pathogens actually cause disease came from the work of Robert Koch in 1876. Koch, a German physician, was looking for the cause of anthrax, a deadly disease that affects mainly cattle and sheep but can also occur in humans. Koch discovered a rod-shaped bacterium in the blood of cattle that had died of anthrax. He cultured the bacteria on nutrients and then injected samples of the culture into healthy animals. When these animals became sick and died, Koch isolated the bacteria in their blood and compared them with the bacteria he had originally isolated from anthrax victims. He found that the two sets of blood cultures contained the same bacteria.

A procedure to establish the cause of a disease

Koch established experimental steps, shown in ***Figure 39.2***, for directly relating a specific pathogen to a specific disease. These steps, first published in 1884, are known today as **Koch's postulates:**

1. The pathogen must be found in the host in every case of the disease.
2. The pathogen must be isolated from the host and grown in a pure culture—that is, a culture containing no other organisms.
3. When the pathogen from the pure culture is placed in a healthy host, it must cause the disease.
4. The pathogen must be isolated from the new host and be shown to be the original pathogen.

Exceptions to Koch's postulates

Although Koch's postulates are useful in determining the cause of most diseases, some exceptions exist. Some organisms, such as the pathogenic bacterium that causes the sexually transmitted disease syphilis (SIHF uh lus), have never been grown on an artificial medium. Viral pathogens also cannot be cultured this way because they multiply only within cells. As a result, living tissue must be used as a culture medium for viruses.

The Spread of Infectious Diseases

For a disease to continue and spread, there must be a continual source of the disease organisms. This source can be either a living organism or an inanimate object on which the pathogen can survive.

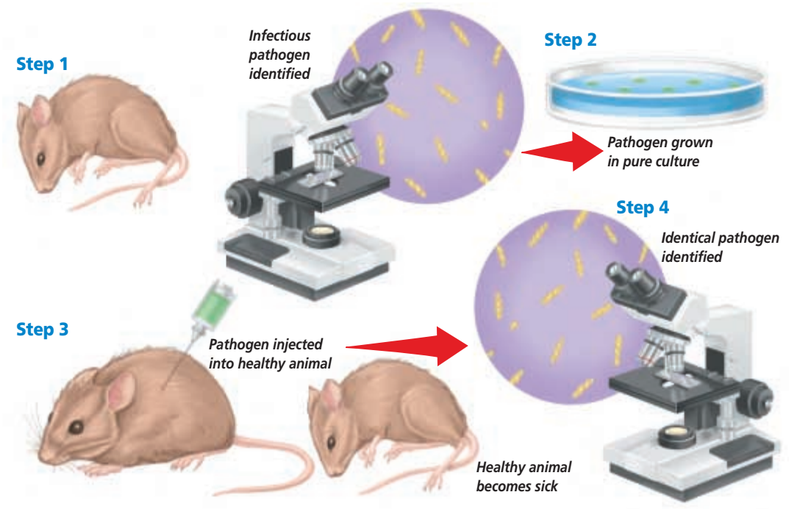


Figure 39.2
Koch's postulates are steps used to identify an infectious pathogen.

BIOLOGY JOURNAL

Diseases and Their Causes

Visual-Spatial Have students make a table that lists all the infectious diseases discussed in this section. As students read, have them fill in their tables with the cause of each disease, its vector (if applicable), and the body systems it infects. Have students use their tables as study tools. L1

MEETING INDIVIDUAL NEEDS

Gifted

Linguistic Have gifted students state their views on using humans to test unproved drugs and other therapies for life-threatening diseases, such as AIDS. Have them consider whether or not they would agree to participate in such tests if they were suffering from a fatal disease. L3

Display

Prepare a bulletin board with printed information about specific diseases. Brochures on diseases may be available from pharmaceutical companies, doctors' offices, or hospitals. Refer to the display as you discuss pathogens and diseases.

Visual Learning

Figure 39.2 Have students describe each of the four steps of Koch's postulates shown in the diagram.

Brainstorming

Have students discuss the importance of each step of Koch's postulates and how skipping any of them would affect the results of a search for the pathogen that causes a particular disease.

Resource Manager

Laboratory Manual, pp. 285-292 L2
Basic Concepts Transparency 76 and Master L2 ELL

Discussion

Elicit from students why Koch's postulates are not useful for identifying viral pathogens. *Viruses multiply only within living cells.*

Enrichment

Linguistic Have students research and report on the recent increase in tuberculosis (TB) infections in the United States. Since 1986, TB infections have increased 20%, creating an urban epidemic. Tuberculosis is caused by an airborne bacteria. Infection can be latent or active. Once active, it infects the lungs and other vital organs and can cause death if not cured. Among all the world's infectious diseases, TB remains the number-one cause of death. The majority of new cases in the United States occur among foreign-born groups, especially Asian-born refugees. The disease has also become common in the homeless populations of many urban centers. L2

NATIONAL GEOGRAPHIC

VIDEODISC
STV: Human Body
Vol. 3
AIDS Virus (tinted blue) 1

Reservoirs of pathogens

The main source of human disease pathogens is the human body itself. In fact, the body can be a reservoir of disease-causing organisms. People may transmit pathogens directly or indirectly to other people. Sometimes, people can harbor pathogens without exhibiting any signs of the illness and unknowingly transmit the pathogens to others. These people are called carriers and are a significant reservoir of infectious diseases.

Other people may unknowingly pass on a disease during its first stage, before they begin to experience symptoms. This symptom-free period, while the pathogens are multiplying within the body, is called an incubation period. Humans can unknowingly pass on the pathogens that cause colds, streptococcal throat infections, and sexually transmitted diseases (STDs) such as gonorrhea and AIDS during the incubation periods of these diseases.

Animals are other living reservoirs of microorganisms that cause disease in humans. For example, some types of influenza, commonly known as the flu, and rabies are often transmitted to humans from animals. The major nonliving reservoirs of infectious diseases are soil and water. Soil harbors pathogens such as fungi and the bacterium that causes botulism, a type of food poisoning. Water contaminated by feces of humans and other animals is a reservoir for several pathogens, especially those responsible for intestinal diseases.

Transmission of disease

How are pathogens transmitted from a reservoir to a human host? Pathogens can be transmitted from reservoirs in four main ways: by direct contact, by an object, through the air, or by an intermediate organism called a vector. ***Figure 39.3*** illustrates each of these.

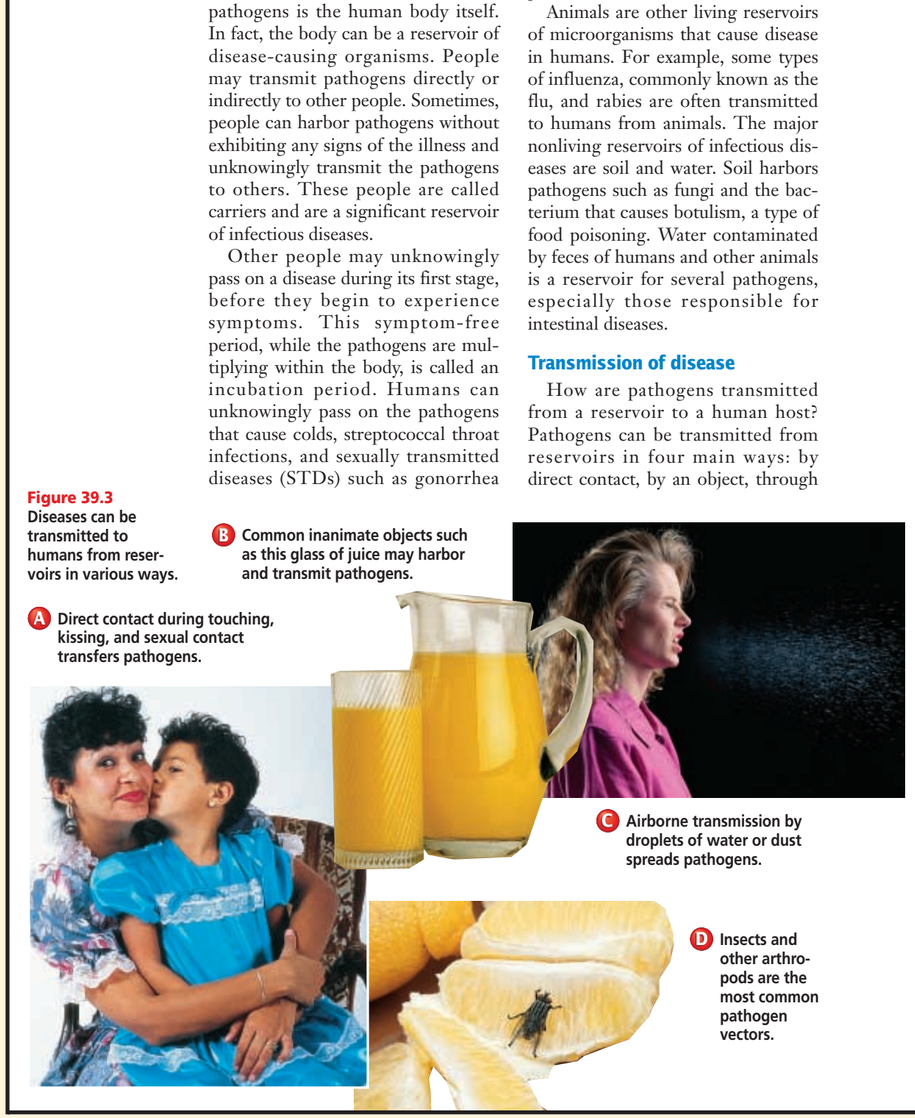


Figure 39.3
Diseases can be transmitted to humans from reservoirs in various ways.

A Direct contact during touching, kissing, and sexual contact transfers pathogens.

B Common inanimate objects such as this glass of juice may harbor and transmit pathogens.

C Airborne transmission by droplets of water or dust spreads pathogens.

D Insects and other arthropods are the most common pathogen vectors.

The common cold, influenza, and STDs are spread by direct contact. STDs, such as genital herpes and the virus that causes AIDS, are usually transmitted by the exchange of body fluids, especially during sexual intercourse.

Food poisoning is a common example of a disease transmitted by an object. This disease is often transmitted when food is contaminated by a food handler. To help prevent the spread of these types of diseases, restaurants have equipment that cleans and disinfects dishes and utensils. Today, laws require food handlers to wash their hands thoroughly before preparing food, and frequent inspections of restaurants help prevent unsanitary conditions.

Diseases transmitted by vectors are most commonly spread by insects and arthropods. You have read about malaria, which is transmitted by mosquitoes, and about Lyme disease, which is transmitted by ticks. The bubonic plague—a disease that swept through Europe in the 1600s, killing up to one-third of the population—was transmitted from infected rats to humans by fleas. Flies also are significant vectors of disease. They transmit pathogens when they land on infected materials, such as animal wastes, and then land on fresh food that is eaten by humans. To learn more about how diseases are spread, refer to the *Problem-Solving Lab* here and the *MiniLab* on the next page.

What Causes the Symptoms of a Disease?

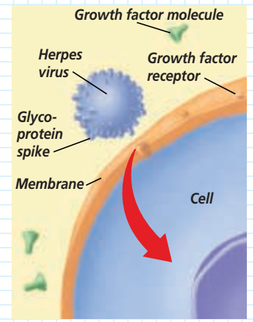
When a pathogen invades your body, it encounters your immune system. If the pathogen overcomes the defenses of your immune system, it can metabolize and multiply, causing damage to the tissues it has invaded, and even killing host cells.

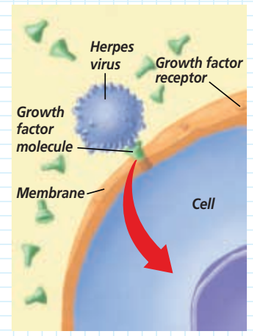
Damage to the host by viruses and bacteria

You already know that viruses cause damage by taking over a host cell's genetic and metabolic machinery. Many viruses also cause the eventual death of the cells they invade.

Problem-Solving Lab 39-1 — Designing an Experiment

How does the herpes simplex virus spread?
Herpes simplex virus, which causes cold sores, infects a person for life, occasionally reproducing and then spreading to other cells in the body of its host. Scientists have been interested for a long time in how the herpes virus actually enters a cell.





Analysis
Scientists have found that the herpes virus infects a cell in one of two possible ways. It may latch onto a cell receptor with its own glycoprotein spike, or it may use this spike to grab a growth factor molecule that latches onto the receptor, as shown in the diagram.

Thinking Critically
Design an experiment to determine which method the herpes virus uses to get into a cell.

TechPrep — Disease Prevention

Interpersonal Students who have part-time jobs or are looking for a career that includes disease prevention can find out what measures are used to prevent the spread of disease. Examples of work places in which disease prevention is practiced include plant nurseries, veterinarian's offices, and the food industry. L2

Biology Journal — Disease Transmission

Linguistic Ask students to list the ways in which diseases are transmitted and give an example of a disease transmitted in each way. Students may need help giving the examples. L2

TechPrep — Role Playing

Linguistic Have students prepare a skit demonstrating the ways diseases might spread in a restaurant from the viewpoint of a health inspector, a restaurant owner, a restaurant cook, or a disease organism. Methods of prevention should also be included. L2 ELL

Problem-Solving Lab 39-1

Purpose
Students will design an experiment to determine how a virus enters a cell.

Process Skills
observe and infer, formulate models

Teaching Strategies
- Ask students to include a control setup in their procedures.

Thinking Critically
Student answers will vary. One experiment might be to remove the growth factor from the cell to see if the virus can still get in. Another possibility would be to remove the receptor sites from the cell or to remove the glycoprotein spikes from the virus to see if the virus can still get in.

Assessment

Portfolio Ask students to write a summary of the lab. Have them include the summaries of their experimental designs in their Portfolios. Use the Performance Task Assessment List for Lab Report in **PASC**, p. 47. L2 P

NATIONAL GEOGRAPHIC

VIDEODISC
STV: Human Body
Vol. 3
Cell Bursting, Releasing Cold Virus

MiniLab 39-1

Purpose
Students will examine how microbes spread infection in apples.

Process Skills
use controls, collect and organize data, interpret data, experiment, analyze

Teaching Strategies
- Point out that the brown area under the apple skin may be caused by bacteria.

Safety Precautions
Have students wash their hands after handling the rotting apples. All apples should be destroyed following the Minilab.

Expected Results
Apples 2 and 3 will develop brown spots and decay. Apple 1 will show little or no change. Apple 4 will show little or no change, because the alcohol may have inhibited the decay.

Analysis
1. Apple 1 is a control for comparison.
2. Apple 2 decayed the most, Apple 3 had brown spots, and Apple 4 may have shown little or no change.
3. Cleaning a wound with alcohol may destroy some pathogens and help prevent infection.

Assessment

Performance Ask students to write a summary of the lab, including their results. Have them place their summaries and their answers to the Analysis questions in their journals. Use the Performance Task Assessment List for Lab Report in **PASC,** p. 47. L2

Resource Manager

BioLab and MiniLab Worksheets, p. 173 L2

MiniLab 39-1 Experimenting

Testing How Diseases are Spread Microorganisms cannot travel over long distances by themselves. Unless they are somehow transferred from one animal or plant to another, infections will not spread. One method of transmission is by direct contact with an infected animal or plant.

Rotten apples

Procedure

1. Label four plastic bags 1 to 4.
2. Put a fresh apple in bag 1 and seal the bag.
3. Rub a rotting apple over the entire surface of the remaining three apples. The rotting apple is your source of pathogens. **CAUTION:** ***Make sure to wash your hands after handling the rotting apple.***
4. Put one of the apples in bag 2.
5. Drop one apple to the floor from a height of about 2 m. Put this apple in bag 3.
6. Use a cotton ball to spread alcohol over the last apple. Let the apple air-dry and then place it in bag 4.
7. Store all of the bags in a dark place for one week.
8. Compare the apples and record your observations. **CAUTION:** ***Give all apples to your teacher for proper disposal.***

Analysis
1. What was the purpose of the fresh apple in bag 1?
2. Explain what happened to the rest of the apples.
3. Why is it important to clean a wound with disinfectant?

Most of the damage done to host cells by bacteria is inflicted by toxins. Toxins are poisonous substances that are sometimes produced by microorganisms. These poisons are transported by the blood and can cause serious and sometimes fatal effects. Some toxins produce fever and cardiovascular disturbances. Toxins can also inhibit protein synthesis in the host cell, destroy blood cells and blood vessels, or cause spasms by disrupting the nervous system.

For example, the toxin produced by tetanus bacteria affects nerve cells and produces uncontrollable muscle contractions. If the condition is left untreated, paralysis and death occur. Tetanus bacteria are normally present in soil, as ***Figure 39.4*** illustrates. If dirt transfers the bacteria into a deep wound on your body, the bacteria begin to produce the toxin in the wounded area. A small amount of this toxin, about the same amount as the ink used to make a period on this page, could kill 30 people. That is why you should be vaccinated for tetanus.

Patterns of Diseases

In today's highly mobile world, diseases can spread rapidly. Contaminated water, for example, can affect many thousands of people quickly. Therefore, identifying a pathogen, its method of transmission, and the geographic distribution of the disease it causes are major concerns of government health departments. The Centers for Disease Control and Prevention, the central source of disease information in the United States, publishes a weekly report about the incidence of specific diseases.

Some diseases, such as typhoid fever, occur only occasionally in the United States. These periodic outbreaks often occur because someone traveling in a foreign country has brought the disease back home. On the other hand, many diseases are constantly present in the population. Such a disease is called an endemic disease. The common cold is an **endemic disease.**

Sometimes, an **epidemic** breaks out. An epidemic occurs when many people in a given area are afflicted with the same disease at about the same time. Influenza is a disease that often achieves epidemic status, sometimes spreading to many parts of the world. During the 1950s, a polio epidemic spread across the United States. Victims of this disease were paralyzed or died when the polio virus attacked the nerve cells of the brain and spinal cord. Many survived only after being placed in an iron lung—a machine that allowed the patient to continue to breathe, as shown in ***Figure 39.5.***

Figure 39.5 During the 1950s polio epidemic, many patients were placed in iron-lung machines like those shown here.

Treating Diseases

A person who becomes sick often can be treated with medicinal drugs, such as antibiotics. An **antibiotic** is a substance produced by a microorganism that, in small amounts, will kill or inhibit the growth and reproduction of other microorganisms, especially bacteria. Antibiotics are produced naturally by various species of bacteria and fungi. Although antibiotics can be used to cure some bacterial infections, antibiotics do not affect viruses.

WORD Origin

epidemic
From the Greek words *epi*, meaning "upon," and *demos*, meaning "people." An epidemic is a disease found among many people in an area.

Figure 39.4 Conditions of a battlefield are ideal for tetanus bacteria. Before the days of modern medicine, wounded soldiers faced the additional, deadly danger of becoming infected with these bacteria.

Discussion

Elicit from students why addicts who share needles when taking drugs often spread diseases to each other. *The needles are not sterile. Pathogens present on the needles themselves or present in fluids (including blood) contained in the needles are easily passed from one person to the next.* Explain to students that this process is an example of transmission by an object.

Enrichment

Discuss with students how the development of a vaccine for tetanus has reduced the occurrence of this disease in developed nations. Explain the need for periodic boosters to maintain effectiveness of the vaccine.

Brainstorming

Ask students to speculate why antibiotics are sometimes given during a viral infection if they are ineffective against viruses. *to prevent secondary bacterial infections*

Portfolio

New Medicines

Intrapersonal Have students conduct research to find examples of medicines developed during wartime that have become important in treating civilians. Ask them to identify the reason the medicine was developed and explain what disease(s) it has been used to treat. L3 P

TECHPREP

Health Careers

Linguistic Encourage students who are interested in health-related careers to set up an interview with members of the local Health Department to learn about their roles in safeguarding community health. L2

PROJECT

Locating Agents of Disease

Kinesthetic Ask students to survey their school for areas that have large numbers of bacteria present. Have them swab various surfaces with a moistened cotton swab and then streak the swab across the surface of an agar plate. Have them incubate the agar plates and observe and record the results. Caution students to treat the cultures as if they were pathogenic. Keep petri dishes closed when making observations. The agar plates should be autoclaved. L2 ELL

Assessment

Knowledge Have students explain how the graph in **Figure 39.6** is an example of natural selection.

3 Assess

Check for Understanding

Interpersonal Have students work in groups to draw an infection cycle that involves a vector. Ask them to describe ways of disrupting and preventing the cycle. L2 COOP LEARN

Reteach

Visual-Spatial Have students illustrate Koch's postulates for a specific disease. L2

Extension

Ask students to research the history of the development of antibiotics. L3

Assessment

Skill Provide students with a diagram of a disease infection cycle. Ask them to provide feasible ways of disrupting the cycle. L2

4 Close

Discussion

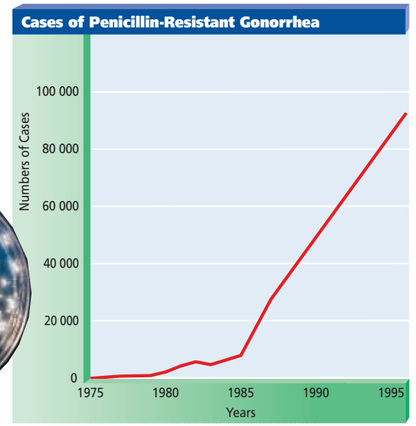
Discuss the kinds of precautions school cafeterias must take to avoid disease transmission.

Resource Manager

Content Mastery, pp. 189-190 L1

Figure 39.6
This graph shows the occurrence of penicillin-resistant gonorrhea. Notice the increase in the number of reported cases of gonorrhea in the United States.

Penicillin



A problem that sometimes occurs with the continued use of antibiotics is that the bacteria become resistant to the drugs. That means the drugs become ineffective. Penicillin, an antibiotic produced by a fungus, was used for the first time in the 1940s and is still one of the most effective antibiotics known. However, penicillin has now been in use for more than 50 years, and more and more types of bacteria have evolved that are resistant to it. Bacteria that are resistant to penicillin produce an enzyme that breaks down this antibiotic. In certain infections, such as the STD gonorrhea, this resistance is a problem because, until now, penicillin has been the most successful drug in treating the infection. The increase in penicillin-resistant gonorrhea is graphed in ***Figure 39.6.***

The use of antibiotics is only one way to fight infections. Your body also has its own built-in defense system—the immune system—that is continually working to keep you healthy.

WORD Origin

antibiotic
From the Greek words *anti*, meaning "against," and *bios*, meaning "life." An antibiotic is given to control a bacterial infection.

Section Assessment

Understanding Main Ideas

1. What are the major reservoirs of pathogens?
2. In what way can a family member who is in the incubation period for strep throat be a threat to your good health?
3. When does a disease become an epidemic?
4. In what ways are diseases transmitted?

Thinking Critically

5. Many patients enter the hospital with one medical problem but contract an infection while in the hospital. What are possible ways in which a disease might be transmitted to a hospital patient?

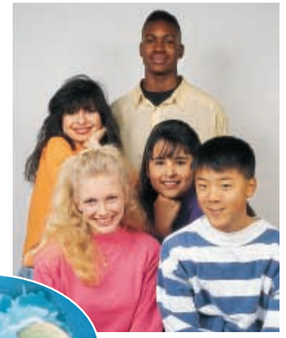
SKILL REVIEW

6. **Designing an Experiment** Design an experiment that could be conducted to determine whether a recently identified bacterium causes a type of pneumonia. For more help, refer to *Practicing Scientific Methods* in the **Skill Handbook.**

Section

39.2 Defense Against Infectious Diseases

You can't see it, but a war is going on around these teenagers. In fact, the same sort of war is occurring around you. Hordes of unseen enemies are present everywhere—in the air, on the ground, and even on your clothes. Defenders ready to protect you from the onset of attack are inside your body. How does your body save you from the microscopic foes that cause infectious diseases? How do the body's defenses protect you from these unseen enemies?



Magnification: 3700×

Lymphocytes (inset) help protect you from diseases.

SECTION PREVIEW

Objectives

Compare nonspecific and specific immune responses.

Compare innate and acquired immune responses.

Distinguish between antibody and cellular immunity.

Vocabulary

innate immunity
phagocyte
macrophage
pus
interferons
acquired immunity
tissue fluid
lymph
lymph node
lymphocyte
T cell
B cell
vaccine

Innate Immunity

Your body produces a variety of white blood cells that defend it against invasion by pathogens that are constantly bombarding you. No matter what pathogens are present, your body is always ready. The body's earliest lines of defense against any and all pathogens make up your nonspecific, **innate immunity.**

Skin and body secretions

When a potential pathogen contacts your body, often the first barrier it must penetrate is your skin. Like the walls of a castle, intact skin is a formidable physical barrier to the entrance of microorganisms.

In addition to the skin, pathogens also encounter your body's secretions of mucus, sweat, tears, and saliva. The main function of mucus is to prevent various areas of the body from drying out. Because mucus is slightly viscous (thick), it also traps many microorganisms and other foreign substances that enter the respiratory and digestive tracts. Mucus is continually swallowed and passed to the stomach, where acidic gastric juice (made of hydrochloric acid and other fluids) destroys most bacteria and their toxins. Sweat, tears, and saliva all contain the enzyme lysozyme, which is capable of breaking down the cell walls of some bacteria.

Section Assessment

1. infected animals, soil, and contaminated water
2. They can spread the disease to you.
3. when many people in a given area are infected with the same disease in a relatively short period of time
4. direct contact, by an object, through the air, or by a vector
5. by direct contact with employees or patients, through contaminated objects, or by airborne transmission
6. Take the suspected organisms from an infected animal, grow them in a pure culture, then inject them into another animal. If that animal develops the same disease, the organisms probably caused it. To be sure, isolate the organisms and compare with the original organisms.

Internet Address Book

interNET CONNECTION Note Internet addresses that you find useful in the space below for quick reference.

Resource Manager

Section Focus Transparency 97 and Master L1 ELL
Basic Concepts Transparency 77 and Master L2 ELL
Reinforcement and Study Guide, pp. 173-174 L2

Prepare

Key Concepts

The anatomy and physiology of the lymphatic system are discussed in this section. Various types of nonspecific defense mechanisms are described along with the specific defenses of antibody and cellular immunity. The last part of the section discusses AIDS and its effect on the immune system.

Planning

- Collect articles about AIDS for the Display and Biology and Society.
- Prepare nutrient agar plates for the Alternative Lab.

1 Focus

Bellringer

Before presenting the lesson, display **Section Focus Transparency 97** on the overhead projector and have students answer the accompanying questions. L1 ELL

2 Teach

Display

Assemble a bulletin board display of newspaper and magazine articles about AIDS. Refer to the articles when discussing AIDS and other viral infections.

Tying to Previous Knowledge

Ask students why, when a patient complains of a sore throat, the physician feels under the patient's chin and behind his or her ears and looks down the patient's throat. *The doctor is looking for swollen lymph glands and for redness and blotchy white spots in the throat that would indicate a bacterial infection.*

Quick Demo

Visual-Spatial Using a microprojector, demonstrate the differences between white blood cells (nucleated) and red blood cells. You can also use 35-mm slides or have students examine prepared slides.

NATIONAL GEOGRAPHIC

VIDEODISC
STV: Human Body Vol. 3
Immune System
Unit 1, Side 1, 1 min. 56 sec.
Phagocytes

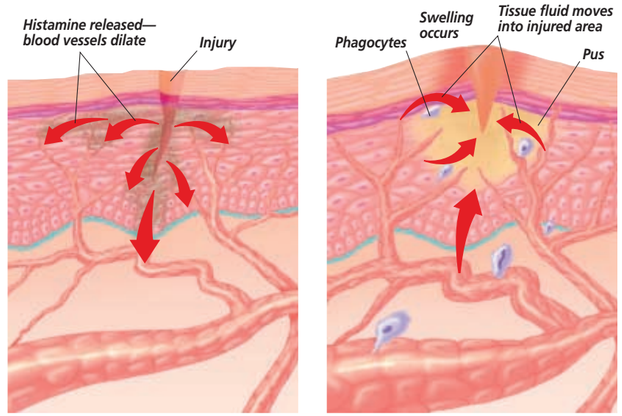


Figure 39.8
When tissues become inflamed, histamine release causes blood vessels to dilate. Tissue fluid leaks out of the vessels into the injured area, causing swelling.

Inflammation of body tissues

If a pathogen manages to get past the skin and body secretions, your body has several other nonspecific defense mechanisms that can destroy the invader and restore homeostasis. Think about what happens when you get a splinter. When bacteria or other pathogens damage body tissues, inflammation (ihn fluh MAY shun) may result. Inflammation is characterized by four symptoms—redness, swelling, pain, and heat. As ***Figure 39.8*** shows, inflammation begins when damaged tissue cells, and white blood cells called basophils, release histamine (HIHS tuh meen). Histamine causes blood vessels in the injured area to dilate, which makes them more permeable to tissue fluid. These dilated blood vessels cause the redness of an inflamed area. Fluid that leaks from the vessels into the injured tissue helps the body destroy toxic agents and restore homeostasis. This increase in tissue fluid causes swelling and pain, and may also cause a local temperature increase. Inflammation can occur as a reaction to other types of injury as well as infections. Physical force, chemical substances, extreme temperatures, and radiation may also inflame body tissues.

Phagocytosis of pathogens

Pathogens that enter your body may encounter cells that carry on phagocytosis. Recall that phagocytosis occurs when a cell engulfs a particle. **Phagocytes** (FAG uh sites) are white blood cells that destroy pathogens by surrounding and engulfing them. Phagocytes include macrophages, neutrophils, monocytes, and eosinophils. Macrophages are present in body tissues. The other types of phagocytes circulate in the blood.

Macrophages are white blood cells that provide the first line of defense against pathogens that have managed to enter the tissues. Macrophages, shown in ***Figure 39.9***, are found in the tissues of the body. They are sometimes called giant scavengers, or big eaters, because of the manner in which they engulf pathogens or damaged cells. Lysosomal enzymes inside the macrophage digest the particles it has engulfed.

If the infection is not stopped by the tissue macrophages, another type of phagocyte, called a neutrophil, is attracted to the site. Neutrophils constitute the second line of defense. They also destroy pathogens by engulfing and digesting them.

If the infection is not stopped by tissue macrophages and neutrophils, there is a third line of defense. A different type of phagocyte begins to arrive on the scene. Monocytes are small, immature macrophages that circulate in the bloodstream. These cells squeeze through blood vessel walls to move into the infected area. Once they reach the site of the infection, they mature, becoming as large as tissue macrophages. They then begin consuming pathogens and dead neutrophils by phagocytosis. Once the infection is over, some monocytes mature into tissue macrophages that remain in the area, prepared to fend off a new infection.

After a macrophage has destroyed large numbers of pathogens, dead neutrophils, and damaged tissue cells, it dies. After a few days, infected tissue harbors a collection of dead macrophages and body fluids called **pus.** Pus formation usually continues until the infection subsides. Eventually, the pus is cleared away by macrophages.

Which white blood cells are involved in each of the body's lines of defense against pathogens? Find out by reading the *Inside Story* on the following page and carry out the *MiniLab* that follows to observe the different types of white blood cells.

Protective Proteins

When an infection is caused by a virus, your body faces a problem. Phagocytes cannot destroy viruses. Recall that a virus multiplies within a host cell. A phagocyte that engulfs a virus will itself be destroyed if the virus multiplies within it. One way

WORD Origin
Phagocyte
From the Greek words *phagein*, meaning "to eat," and *kytos*, meaning "hollow." A phagocyte consumes foreign particles by engulfing them.

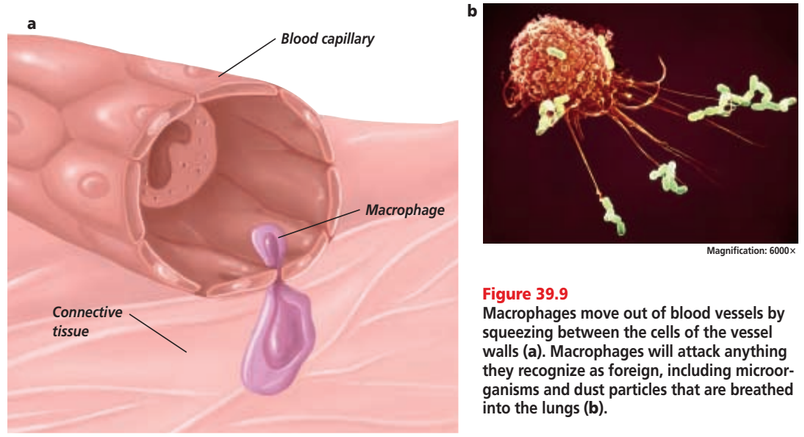


Figure 39.9
Macrophages move out of blood vessels by squeezing between the cells of the vessel walls (a). Macrophages will attack anything they recognize as foreign, including microorganisms and dust particles that are breathed into the lungs (b).

Reinforcement

Have students orally make an analogy between the reaction of the immune system and a battle scene. Ask them who or what might represent the skin, tissue macrophages, neutrophils, and monocytes.

Assessment

Knowledge Ask students to describe similarities between a macrophage and an amoeba. *Both engulf particles by phagocytosis.* L2

GLENCOE TECHNOLOGY

VIDEOTAPE
The Secret of Life
Nothing to Sneeze at: Viruses

CD-ROM
Biology: The Dynamics of Life
Video: *Lymphocytes*
Disc 5

VIDEODISC
Biology: The Dynamics of Life
Lymphocytes (Ch. 44)
Disc 2, Side 1, 26 sec.

Alternative Lab

Antibiotics and Bacteria

Purpose

Students will determine which antibiotics are most effective in inhibiting bacterial growth.

Materials

E. coli bacterial culture, 3 types of antibiotic disks, sterile untreated disks, cotton swabs, forceps, ethanol, transparent tape, plates of nutrient agar, marking pen, incubator

Procedure

Give students the following directions:

CAUTION: ***Wear lab aprons, safety goggles, and disposable latex gloves. Do not open petri dishes after they have been sealed. Wash hands after inoculating petri dishes and after making observations. Used petri dishes and toothpicks should be autoclaved before disposal.***

1. Use the marking pen to make a cross on the bottom of an agar plate, dividing it into four sections.
2. Using a cotton swab, gently transfer some of the bacterial culture onto the agar plate.
3. Spread the culture evenly over the surface of the agar plate using the cotton swab.
4. Dip the forceps into alcohol and allow them to air dry without touching any surface.
5. Use the forceps to transfer two antibiotic disks into each of three sections of the plate. Label the bottom with the type of antibiotic used in each section.
6. Use the forceps to transfer two untreated disks to the fourth section of the agar plate.
7. Tape the plates closed and incubate for 48 hours at 37°C.
8. Look for regions of inhibition near the disks.

Analysis

1. Why were untreated disks placed in one section? *This section was the control.*
2. Did any of the antibiotics inhibit the growth of the bacteria? *Answers will vary.*

Assessment

Performance Have students design and perform another lab procedure using disks treated with antibiotics. Use the Performance Task Assessment List for Designing an Experiment in **PASC,** p. 23. L2

INSIDE STORY

Purpose
Students visualize the various types of white blood cells and their role in the immune system.

Teaching Strategies
- Review this page with students before and after completing MiniLab 39-2
- Have students prepare a table of the white blood cells that compares their characteristics, functions, and where they are found.
- Have students discuss what would happen to the numbers of white blood cells during an infection. *The number of white blood cells per milliliter of blood increases during an infection.*

Visual Learning
- Using a microscope projector, point out the various types of white blood cells on a blood smear slide.

Critical Thinking
Mature tissue macrophages are not found in the blood. Immature macrophages, called monocytes, are found in the bloodstream.

Internet Address Book
interNET CONNECTION Note Internet addresses that you find useful in the space below for quick reference.

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INSIDE STORY

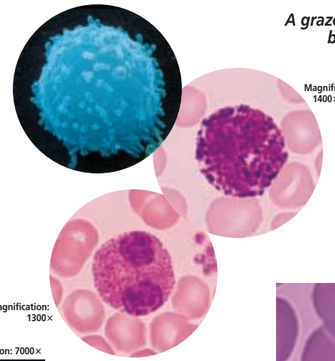
Lines of Defense

White blood cells play a major role in protecting your body against disease. Many of these cells leave the bloodstream to fight disease organisms in the tissues.

Critical Thinking ***Why would you not expect to see tissue macrophages in a sample of blood cells?***

A graze breaks the protective barrier of the skin

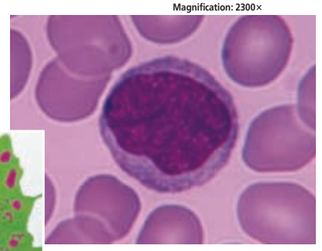
1 Innate immune response: first line of defense Macrophages are large, phagocytic white blood cells found in the tissues. They are the first to arrive at the site of an infection. Basophils, found in the blood, are not phagocytic. They are filled with granules that release histamine at an infection site. Eosinophils are also granular and also play a role in inflammation.



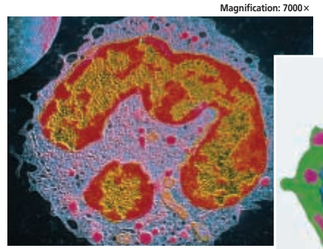
Magnification: 1400×

Magnification: 1300×

Tissue macrophage (top), basophil (middle), and eosinophil (bottom)

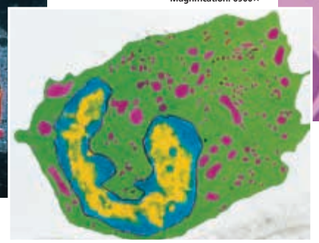


Magnification: 2300×



Magnification: 7000×

2 Second line of defense A neutrophil (above) is a phagocytic white blood cell with a nucleus that has several lobes.



Magnification: 6900×

3 Third line of defense After moving from the blood into an infected area, monocytes (above) mature into macrophages. Monocytes are two to three times larger than other blood cells and have large nuclei. They replenish the supply of tissue macrophages following an infection.

4 Acquired immune response Lymphocytes (above) are cells with nuclei that nearly fill the cell. They include B cells and T cells and are involved in developing immunity to specific pathogens. Lymphocytes are found in the blood, spleen, thymus, lymph nodes, tonsils, and appendix.

your body can counteract viral infections is with interferons. **Interferons** are proteins that protect cells from viruses. They are host-cell specific; that is, human interferons will protect human cells from viruses but will do little to protect cells of other species from the same virus.

Interferon is produced by a body cell that has been infected by the virus. The interferon diffuses into uninfected neighboring cells, which then produce antiviral proteins that can prevent the virus from multiplying.

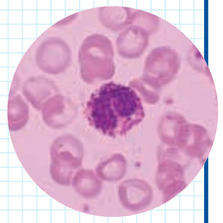
Acquired Immunity

The cells of your innate immune system continually survey your body for foreign invaders. When a pathogen is detected, these cells begin defending your body right away. Meanwhile, as the infection continues, another type of immune response that counteracts the invading pathogen is also mobilized. Certain white blood cells gradually develop the ability to recognize a specific foreign substance. This acquired immune response enables these white blood cells to inactivate or destroy the pathogen. Defending against a specific pathogen by gradually building up a resistance to it is called **acquired immunity.**

Normally, the immune system recognizes components of the body as self, and foreign substances, called antigens, as nonself. Antigens are usually proteins present on the surfaces of whole organisms, such as bacteria, or on parts of organisms, such as the pollen grains of plants. An acquired immune response occurs when the immune system recognizes an antigen and responds to it by producing antibodies against it. Antigens are foreign substances that stimulate an immune response, and antibodies are proteins in the blood that correspond specifically to each antigen. The development of acquired immunity is the job of the lymphatic system. The process of acquiring immunity to a specific disease can take days or weeks.

MiniLab 39-2 Observing and Inferring

Distinguishing Types of White Blood Cells The human immune system includes five types of white blood cells found in the bloodstream: basophils, neutrophils, monocytes, eosinophils, and lymphocytes.



A blood smear

Procedure

1. Copy the data table below.
2. Mount a prepared slide of blood cells on the microscope and focus on low power. Turn to high power and look for white blood cells. **CAUTION:** ***Use care when working with microscope slides.***
3. Find a neutrophil, monocyte, eosinophil, and lymphocyte. You may see a basophil, although they are rare. Refer to the *Inside Story* for photos of these cells.
4. Count a total of 50 white blood cells, and record how many of each type you see.
5. Calculate the percentage by multiplying the number of each cell type by two. Record the percentages. Diagram each cell type.

Data Table

Type of white blood cell	Number counted	Percent	Diagram
Neutrophil			
Monocyte			
Basophil			
Lymphocyte			
Eosinophil			

Analysis

1. Which type of white blood cell was most common? Second most common?
2. How do red and white blood cells differ?

MiniLab 39-2

Purpose
Students will determine the percentages of different kinds of white blood cells.

Process Skills
classify, observe and infer, compare and contrast, collect and organize data

Safety Precautions
Caution students to use care when working with prepared slides and microscopes. Special care should be taken when viewing slides under high power so the objective does not break the slide.

Teaching Strategies
- It would be helpful for student identification to set up a prepared microscope slide showing both an eosinophil and a basophil.

Expected Results
The common percentages of white blood cells are: neutrophils, 60-70%; lymphocytes, 20-25%; monocytes, 3-8%; eosinophils, 2-4%; and basophils, 0.5-1%.

Analysis
1. neutrophils, lymphocytes
2. White blood cells have a nucleus; red blood cells don't.

Assessment
Performance Have students include summaries of the lab, their data tables, and their answers to the Analysis questions in their Biology Journals. Use the Performance Task Assessment List for Lab Report in **PASC,** p. 47. L2

Cultural Diversity

Susumu Tonagawa and Immunity
Introduce students to the important contributions Japanese immunologist Susumu Tonagawa has made toward our understanding of the immune system. Tonagawa's major contribution ended the debate on whether individuals inherit separate genes for each of the millions of antibody molecules, or whether individuals inherit a small number of genes that diversify in specialized somatic cells. Tonagawa was able to show that somatic cells use a multi-step process to rearrange fragments from different genes, in different ways, to produce many different antibodies. For this work, Tonagawa received a Nobel prize in 1987.

Portfolio

Scientific Illustration
Visual-Spatial Have students sketch the different types of blood cells they observe when viewing a blood smear in MiniLab 39-2. Ask them to add these illustrations to their portfolios. L1 ELL P

Resource Manager

BioLab and MiniLab Worksheets, p. 174 L2
Basic Concepts Transparency 78a and Master L2 ELL
Concept Mapping, p. 39 L3

Discussion

Ask students to compare and contrast the functions of the circulatory system and the lymphatic system. Have students as a class discuss the two systems.

Enrichment

Have students research the life of David, the "bubble boy" of Houston, Texas, who lived in a sterile plastic bubble for all but 15 days of his life. He suffered from severe combined immune deficiency (SCID), a rare genetic disorder related to a dysfunction of the lymphocyte-producing cells of the bone marrow. At birth, David was placed in a sterile plastic bubble. As he grew, he was placed in increasingly larger bubbles. At the age of 12, he left his bubble and underwent a bone marrow transplant using tissue from his sister. David died four months later, in February, 1984, of blood cancer, which was unrelated to his transplant. Encourage students to find out about current treatments for SCID. L3

NATIONAL GEOGRAPHIC

VIDEODISC
STV: Human Body Vol. 3
Immune System
Unit 1, Side 1, 4 min. 13 sec.
Lymphocytes and Antibodies

GLENCOE TECHNOLOGY

CD-ROM
Biology: The Dynamics of Life
Animation: *Antibody Immunity*
Disc 5

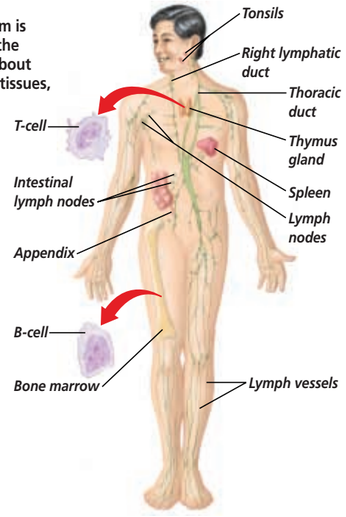


Figure 39.10
The lymphatic system is spread throughout the body. As you read about the various vessels, tissues, and organs of the lymphatic system, locate them on this diagram.

The lymphatic system

Your lymphatic (lihm FAT ihk) system not only helps the body defend itself against disease, but also maintains homeostasis by keeping body fluids at a constant level. ***Figure 39.10*** shows the major glands and vessels that make up the lymphatic system.

Your body's cells are constantly bathed with fluid. This **tissue fluid** forms when water and dissolved substances diffuse from the blood into the spaces between the cells that make up the surrounding tissues. This tissue fluid collects in open-ended lymph capillaries. Once the tissue fluid enters the lymph vessels, it is called **lymph.** ***Figure 39.10*** shows the major glands and vessels that make up the lymphatic system.

Lymph capillaries meet to form larger vessels called lymph veins. The flow of lymph is only toward the heart, so there are no lymph arteries. The lymph veins converge to form two major lymph ducts. These ducts return the lymph to the bloodstream in the shoulder area, after it has been filtered through various lymph glands.

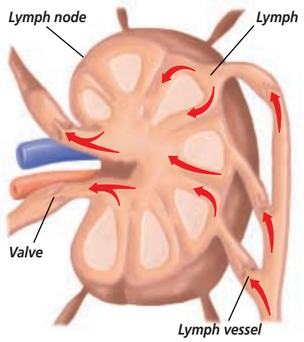


Figure 39.11
As lymph filters through a lymph node, the lymphocytes in the node trap and kill pathogens.

Glands of the lymphatic system

At locations along the lymphatic pathways, the lymph vessels pass through lymph nodes. A **lymph node** is a small mass of tissue that contains lymphocytes and filters pathogens from the lymph, as shown in ***Figure 39.11.*** Lymph nodes are made of an interlaced network of connective tissue fibers that holds lymphocytes. A **lymphocyte** (LIHM fuh site) is a type of white blood cell that defends the body against foreign substances.

Have you ever had a sore throat caused by infected tonsils? The tonsils are large clusters of lymph tissue located at the back of the mouth cavity and at the back of the throat. They form a protective ring around the openings of the nasal and oral cavities. Your tonsils provide protection against bacteria and other pathogens that enter your nose and mouth.

The spleen is an organ in which certain types of lymphocytes are stored. The spleen also filters out and destroys bacteria and worn-out red blood cells and acts as a blood reservoir. Unlike lymph nodes, the spleen does not filter lymph.

Another important component of the lymphatic system is the thymus gland, which is located above the heart. The thymus gland stores immature lymphocytes until they mature and are released into the body's defense system.

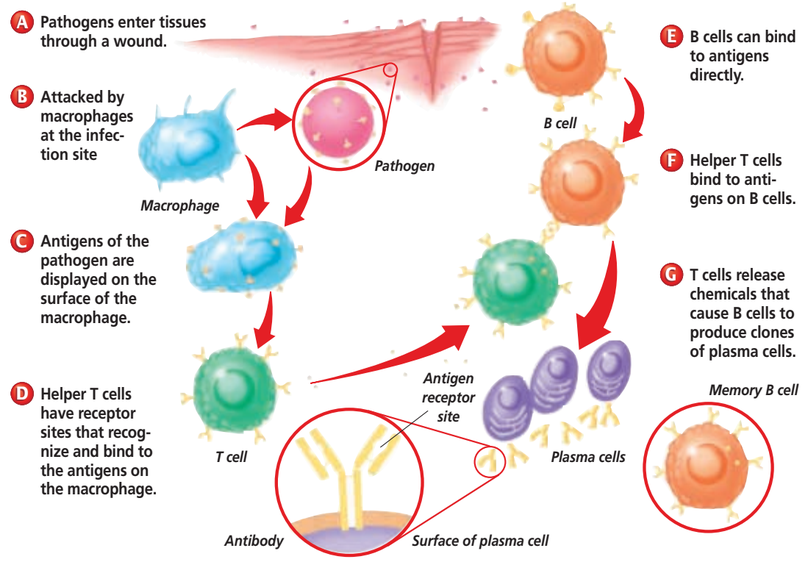


Figure 39.12
Antibody immunity utilizes B cells and antibodies in defending your body against invading pathogens.

CD-ROM
View an animation of antibody immunity in the Presentation Builder of the Interactive CD-ROM.

Antibody Immunity

Acquired immunity involves the production of two kinds of immune responses: antibody immunity and cellular immunity. Antibody immunity is a type of chemical warfare within your body that involves several types of cells. Follow the steps of antibody immunity illustrated in ***Figure 39.12.***

When a pathogen invades your body, it is first attacked by the cells of your innate immune system, as shown in ***Figure 39.12A***, ***B***, and ***C***. If the infection is not controlled, then your body builds up acquired immunity to the antigen by producing antibodies to it. A type of lymphocyte called a T cell becomes involved. A **T cell** is a lymphocyte that is produced in bone marrow and processed in the thymus gland. Two kinds of T cells play different roles in immunity.

Visual Learning

Figure 39.12 Ask students to write a summary of what is happening in this figure.

Reinforcement

Compare the antigen-antibody reaction to the lock-and-key fit of enzymes and substrates.

Assessment

Performance Assessment in the Biology Classroom, p. 45, *Vaccine Models and the Common Cold.* Have students carry out this activity to find out why a single vaccine will not combat the common cold. L2

Concept Development

Explain to students that normally the body's immune response helps maintain homeostasis. However, sometimes the body loses its ability to discriminate between self and nonself, which leads to autoimmunity. Autoimmunity is a response by antibodies or sensitized T cells against a person's own tissue antigens. It is involved in multiple sclerosis, Graves' disease of the thyroid, rheumatic fever (in which antibodies are formed against the heart), and juvenile diabetes (in which antibodies are formed against the pancreas).

GLENCOE TECHNOLOGY

VIDEODISC
Biology: The Dynamics of Life
Antibody Immunity (Ch. 45)
Disc 2, Side 1, 52 sec.

BIOLOGY JOURNAL

Outlining the Lymphatic System

Visual-Spatial Ask students to draw an outline of a human figure. Have them add and label all of the components of the lymphatic system. L2

MEETING INDIVIDUAL NEEDS

Learning Disabled/English Language Learners

Visual-Spatial Ask students who are having difficulty understanding the difference between lymph fluid and blood label an illustration of the flow of tissue fluid back into the bloodstream. L1 ELL

MEETING INDIVIDUAL NEEDS

Visually Impaired

Visual-Spatial Photocopy and enlarge Figures 39.12 and 39.13. Use a felt-tip pen to outline the edges of the cells and the arrows in the illustrations for use by visually impaired students. L1 ELL

Physically Challenged

Linguistic Ask students who are physically challenged by allergies or asthma to speak to the class about how the disorder affects their lives.

Enrichment

Have students research the successful eradication of smallpox. Smallpox was the first disease for which a vaccine was made and the first to be eradicated throughout the world through the use of vaccines. The last known case of smallpox occurred in Somalia, Africa, in 1977. Smallpox was spread by droplets and caused lesions in layers of the skin that left disfiguring scars. This disease devastated Native American populations when European settlers brought it to America. L3

Reinforcement

Visual-Spatial Have students make a flowchart to show the sequence of events in cellular immunity as shown in Figure 39.13. L2

GLENCOE TECHNOLOGY

CD-ROM
Biology: The Dynamics of Life
Animation: *Cellular Immunity*
Disc 5

VIDEODISC
Biology: The Dynamics of Life
Cellular Immunity (Ch. 46)
Disc 2, Side 1, 51 sec.

Resource Manager

Basic Concepts Transparency 78b and Master L2 ELL
Critical Thinking/Problem Solving, p. 39 L3
Reteaching Skills Transparency 58 and Master L1 ELL

One kind of T cell, called a helper T cell, interacts with B cells, shown in ***Figure 39.12D, E,*** and ***F.*** A **B cell** is a lymphocyte that, when activated by a T cell, becomes a plasma cell and produces antibodies. B cells are produced in the bone marrow. Plasma cells, shown in ***Figure 39.12G*** and ***H,*** release antibodies into the bloodstream and tissue spaces. Some activated B cells do not become plasma cells but remain in the bloodstream as memory B cells. Memory B cells are ready and armed to respond rapidly if the same pathogen invades the body at a later time. The response to a second invasion is immediate and rapid, usually without any symptoms.

Cellular Immunity

Like antibody immunity, cellular immunity also involves T cells with antigens on their surfaces. The T cells involved in cellular immunity are cytotoxic, or killer, T cells. T cells stored in the lymph nodes, spleen, and tonsils transform into cytotoxic T cells that are specific for a single antigen. However, unlike B cells, they do not form antibodies. Cytotoxic T cells differentiate and produce identical clones. They travel to the infection site and release enzymes directly into the pathogens, causing them to lyse and die. The steps in cellular immunity are illustrated in ***Figure 39.13.***

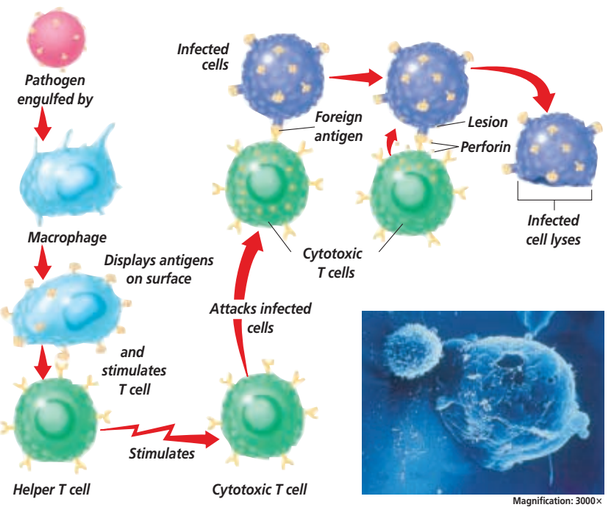


Figure 39.13 Cellular immunity involves T cells that transform into cytotoxic T cells. These T cells release perforin, which pokes holes in cells invaded by pathogens.

CD-ROM
View an animation of cellular immunity in the Presentation Builder of the Interactive CD-ROM.

Passive and Active Immunity

Perhaps you had chicken pox as a child. Many children have had chicken pox by the time they enter school. Most people don't have chicken pox a second time because they have become immune to the chicken pox virus. Acquired immunity to a disease may be either passive or active. Passive acquired immunity develops as a result of acquiring antibodies generated in another host. For example, at birth, a human infant acquires passive immunity to disease from its mother. Active acquired immunity develops when your body is directly exposed to antigens and produces antibodies in response to those antigens.

Table 39.2 Recommended childhood immunizations

Immunization	Agent	Protection against
Acellular DPT or Tetrammune	Bacteria	Diphtheria, pertussis (whooping cough), tetanus (lockjaw)
MMR	Virus	Measles, mumps, rubella
OPV	Virus	Poliomyelitis (polio)
HBV	Virus	Hepatitis B
HIB or Tetrammune	Bacteria	*Haemophilis infuenzae B* (spinal meningitis)

Passive immunity

Passive immunity may develop in two ways. Natural passive immunity develops when antibodies are transferred from a mother to her unborn baby through the placenta or to a newborn infant through the mother's milk. Artificial passive immunity involves injecting into the body antibodies that come from an animal or a human who is already immune to the disease. For example, a person who is bitten by a snake might be injected with antibodies from a horse that is immune to the snake venom.

Active immunity

Active immunity is obtained naturally when a person is exposed to antigens. The body produces antibodies that correspond specifically to these antigens. Once the person recovers from the infection, he or she will be immune if exposed to the pathogen again.

Active immunity can be induced artificially by vaccines. A **vaccine** is a substance consisting of weakened, dead, or incomplete portions of pathogens or antigens that, when injected into the body, cause an immune response. Vaccines produce immunity because they prompt the body to react as if it were naturally infected. ***Table 39.2*** lists some common vaccines.

In 1798, Edward Jenner, an English country doctor, demonstrated the first safe vaccination procedure. Jenner knew that dairy workers who acquired cowpox from infected cows were resistant to catching smallpox during epidemics. Cowpox is a disease similar to, but milder than, smallpox. To test whether immunity to cowpox also caused immunity to smallpox, Jenner infected a young boy with cowpox. The boy developed a mild cowpox infection. Six weeks later, Jenner scratched the skin of the boy with viruses from a smallpox victim, as depicted in ***Figure 39.14.***

Figure 39.14 This portrait shows Jenner vaccinating a young boy with smallpox. A worldwide attack on the disease through vaccinations brought an end to it. Because of the efforts of the World Health Organization, smallpox has been eliminated.

Biology Journal

Immune System Roles

Linguistic Have students write a story about the various immune system "characters" involved in the immune response to a viral disease, such as chicken pox or AIDS. L2 COOP LEARN

Portfolio

Demonstrating Immune Response

Interpersonal Divide students into groups to write and perform a short play that demonstrates aspects of the immune system and its responses. They should each include a copy of the play in their portfolios. L2 P COOP LEARN

Meeting Individual Needs

English Language Learners

Visual-Spatial Have students prepare a chart of the functions of T and B cells. Use the charts to check their understanding of these concepts. L1 ELL

Biology Journal

The Nature of Scientific Discovery

Linguistic Ask students to prepare a report on Louis Pasteur's work with rabies or Jonas Salk's and Albert Sabin's work with polio vaccines. L2

Assessment

Performance Have students use the text to develop a flowchart that traces the steps Jenner took to find a vaccine for smallpox. Then ask students to develop a second flowchart that describes the events that must have taken place in the immune system of the boy Jenner vaccinated. L2

Concept Development

Review the life cycle of a retrovirus. After discussing the AIDS epidemic, have students find out their school policy on educating students about AIDS and its prevention.

NATIONAL GEOGRAPHIC

VIDEODISC
STV: Human Body Vol. 3
Immune System
Unit 1, Side 1, 5 min. 22 sec.
Viruses and Vaccination

Resource Manager

Content Mastery, pp. 191-192 L1
Basic Concepts Transparency 79 and Master L2 ELL
Reteaching Skills Transparency 57 and Master L1 ELL

Problem-Solving Lab 39-2

Purpose

Students will determine that a person's immune system responds to a disease faster and more vigorously if he or she has been vaccinated against that disease.

Process Skills

analyze information, apply concepts, define operationally, compare and contrast, draw a conclusion, make and use graphs, recognize cause and effect, think critically

Teaching Strategies

- Remind students of the difference between a toxin and toxoid.
- Review the difference between antigen and antibody.

Thinking Critically

1. They illustrate acquired immunity. Innate immunity consists of skin barriers or body secretions. Acquired immunity is the process by which the body adapts to a specific antigen by forming antibodies against it.
2. A toxin is a poison released by a pathogen that may cause disease symptoms. A toxoid is a treated form of the toxin that does not harm the body but stimulates the immune system to form antibodies against the toxin.
3. Line A-B involves macrophages, T cells, and B cells. Line B-C probably involves memory B cells and plasma cells.

Assessment

Knowledge Provide students with a variety of antigen shapes and have students model the antibodies that would be formed by the immune system against each antigen shape. Use the Performance Task Assessment List for Model in **PASC,** p. 51. L1 ELL

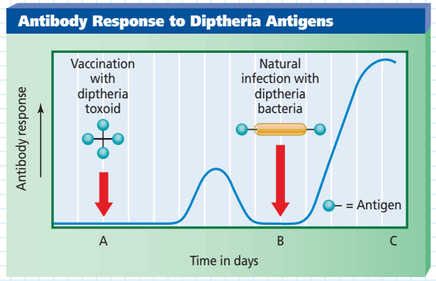
Problem-Solving Lab 39-2

Analyzing Information

Get a Shot or Get the Disease? You have had personal experience with injections for immunization. You know that these shots prevent you from catching a particular disease. But how do they actually work? Why are you protected against a specific disease when you receive a vaccination for that disease?

Analysis

Diphtheria toxoid is a modified form of the toxin produced by the bacterium *Cornyebacterium diphtheriae.* The toxin causes the symptoms associated with the disease diphtheria. When injected into your body, the toxoid prompts the immune system to respond as if it were being attacked by the diphtheria toxin. The graph below shows the human body's response to receiving an immunization shot of the diphtheria toxoid and then to being infected later on by the diphtheria bacterium.



Thinking Critically

1. Are the events in the graph illustrating innate or acquired immunity? Explain your answer.
2. What is the difference between a toxin and a toxoid?
3. Which cells associated with the immune system are most likely involved with line A-B? With line B-C?

The viruses for cowpox and smallpox are so similar that the immune system cannot tell them apart. The boy, therefore, did not get sick because he had artificially acquired active immunity to the disease. To learn more about how vaccines work, try the *Problem-Solving Lab* here.

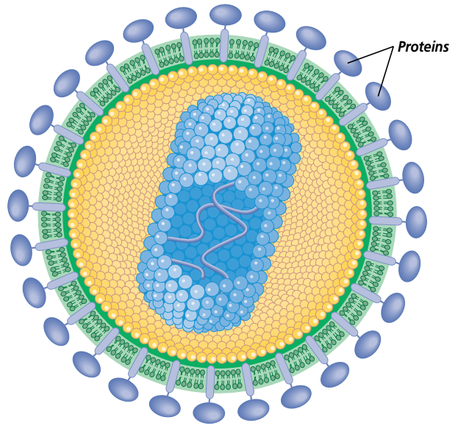
AIDS and the Immune System

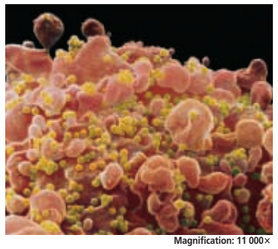
In 1981, an unusual cluster of cases of a rare pneumonia caused by a protozoan appeared in the San Francisco area. Medical investigators soon related the appearance of this disease with the incidence of a rare form of skin cancer called Kaposi's sarcoma. Both diseases seemed associated with a general lack of function of the body's immune system. By 1983, the pathogen causing this immune system disease had been identified as a retrovirus, now known as Human Immunodeficiency (ihm yew noh dih FIHSH un see) Virus, or HIV. HIV kills helper T cells and leads to the disorder known as Acquired Immune Deficiency Syndrome, or AIDS.

HIV is transmitted when blood or body fluids from an infected person are passed to another person through direct contact, or through contact with objects that have been contaminated by infected blood or body fluids. Methods of transmission include intimate sexual contact, contaminated intravenous needles, and blood-to-blood contact, such as through transfusions of contaminated blood. Since 1985, careful screening measures have been instituted by blood banks in the United States to help keep HIV-infected blood from being given to people who need transfusions. A pregnant woman infected with the virus can transmit it to her fetus. The virus can also be transmitted through breast milk.

Abstinence from intimate sexual contact provides protection from HIV and other sexually transmitted diseases. Among illegal drug users, HIV transmission can be prevented by not sharing needles.

The HIV virus in ***Figure 39.15*** is basically two copies of RNA wrapped in proteins, then further wrapped in a lipid coat. The knoblike outer proteins of the virus attach to a receptor on a helper T cell. The virus can then penetrate the cell, where it may remain inactive for months. HIV contains the enzyme reverse transcriptase, which allows the virus to use its RNA to synthesize viral DNA in the host cell.





Magnification: 11 000×

Figure 39.15
HIV is a retrovirus with an outer envelope covered with knoblike attachment proteins. Researchers are studying these proteins to find ways to stop the spread of the virus in humans. The photo shows a T-lymphocyte with yellow-green HIV particles on its surface.

The first symptoms of AIDS may not appear for eight to ten years after initial HIV infection. During this time, the virus reproduces and infects an increasing number of T cells. Infected persons may eventually develop AIDS. During the early stages of the disease, symptoms may include swollen lymph nodes, a loss of appetite and weight, fever, rashes, night sweats, and fatigue.

It is not known what percentage of persons infected with HIV will develop AIDS, but present indications are that the majority will. Almost all who develop AIDS die, usually because of infectious diseases or certain forms of cancer that take advantage of the body's weakened immune system.

Section Assessment

Understanding Main Ideas

1. What role do phagocytes play in defending the body against disease?
2. What role does a lymph node play in defending your body against microorganisms?
3. What is the difference between naturally acquired passive immunity and naturally acquired active immunity?
4. How does histamine release lead to inflammation of a wound?

Thinking Critically

5. Why is it adaptive for memory cells to remain in the immune system after an invasion by pathogens?

Skill Review

6. **Sequencing** Sequence the events that occur in the formation of antibody immunity. For more help, refer to *Organizing Information* in the **Skill Handbook.**

3 Assess

Check for Understanding

Visual-Spatial Ask students to create a flowchart of B and T cell immune reactions. L1

Reteach

Have students prepare a table of the components of the lymphatic system and their functions. L1

Extension

Ask students to find out the current status of an AIDS vaccine. Have them look in the latest issues of medical and scientific journals. L3

Assessment

Skill Have students explain how the AIDS virus overcomes both nonspecific and specific immunity. L2

4 Close

Discussion

Ask students to summarize the role of B and T cells in immune reactions. L2

Portfolio

Types of Immunity

Visual-Spatial Have students make concept maps that identify the different types of immunity and describe how they develop. Have students begin their concept maps with the terms Passive Immunity and Active Immunity. L3 P

Biology Journal

Spreading the Word

Linguistic Ask students to prepare a hypothetical newspaper article announcing development of a new vaccine that could prevent people from getting AIDS. Students should include a summary of what is known about AIDS in their articles. L2

Section Assessment

1. Phagocytes are white blood cells that ingest and destroy pathogens by surrounding and engulfing them.
2. A lymph node is a small mass of tissue that filters lymph and traps and destroys microorganisms.
3. Naturally acquired passive immunity involves a mother passing antibodies to her baby through the placenta or breast milk. Naturally acquired active immunity involves having the disease and forming your own antibodies.
4. Histamine causes blood vessels in the injured area to dilate, making them more permeable to tissue fluid, which leaks out, causing swelling.
5. Memory cells remain in case the body encounters the same antigen again. The second response will be rapid, before the antigen is able to cause disease.
6. Helper T cells interact with macrophages that have "self" and pathogen antigens on their surfaces. The helper T cells activate B cells which produce antibodies and cloned memory B cells.

INTERNET BioLab

Time Allotment
One class period

Process Skills
acquire information, classify, collect data, communicate, compare and contrast, make and use tables, think critically, write about biology

Preparation

Alternative Materials
- Textbooks and materials from the school or public library may be substituted for Internet information if computers are not available to all students.

Resource Manager

BioLab and MiniLab Worksheets, pp. 175-176 L2

INTERNET BioLab

Getting On-line for Information on Diseases

There are two main categories of disease, infectious and noninfectious. Infectious diseases are caused by pathogens. These diseases, like the common cold or AIDS, are said to be communicable because they can be passed from one person to another. Noninfectious diseases are not caused by a pathogen. These diseases, like cancer or arthritis, are said to be noncommunicable because they are not passed from one person to another.

Preparation

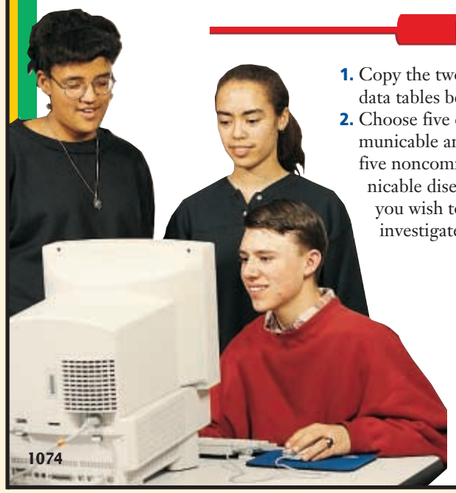
Problem
How can you use the Internet to obtain current research information on different diseases?

Objectives
In this BioLab, you will:
- **Choose** five communicable and five noncommunicable diseases for study.
- **Use the Internet** to gather information.
- **Collect data** on the ten diseases and record in a table.

Materials
access to the Internet

Skill Handbook
Use the **Skill Handbook** if you need additional help with this lab.

Procedure



1. Copy the two data tables below.
2. Choose five communicable and five noncommunicable diseases you wish to investigate.
3. List the diseases in your data tables. Try to make your disease choices as specific as possible. For example, cancer as a topic is too broad. Instead, limit your choice to a specific type of cancer, such as breast cancer, prostate cancer, or Hodgkin's disease.
4. Go to the Glencoe Science Web Site **to find links** that will provide you with information for this BioLab.
5. Be sure to complete the last two rows asking for current research findings and your sources of information.

Data Table 1

Communicable diseases	1	2	3	4	5
Disease name					
Organism responsible					
Classification of organism					
Mode of transmission					
Symptoms					
Treatment					
Current research					
Source of information					

Data Table 2

Noncommunicable diseases	1	2	3	4	5
Disease name					
Symptoms					
Organs affected					
Age group affected					
Treatment					
Current research					
Source of information					

Children with chicken pox

Elderly woman with osteoporosis

Analyze and Conclude

1. **Defining** What is a pathogen? Provide several examples.
2. **Comparing** Describe the difference between a communicable and a noncommunicable disease. Provide several examples of each.
3. **Thinking Critically** What are vectors? Are they associated with communicable or noncommunicable diseases? Explain your answer.
4. **Applying Concepts** Explain why the table for noncommunicable diseases does not have a column for organism responsible or method of transmission.
5. **Using the Internet** What is one advantage of getting information on disease research by way of the Internet rather than from textbooks or an encyclopedia?

Sharing Your Data

internNET CONNECTION Find this BioLab on the Glencoe Science Web Site at **www.glencoe.com/sec/science.** Post your findings in the data table provided for this activity. Add additional data from other students to your data table. Analyze the data to help you answer the problem posed for this BioLab.

Procedure

Teaching Strategies
- You may wish to have students complete all or part of this activity at home if they have access to computers, or in the school library or computer center.
- Point out to students that their data tables will have to be expanded in size to accommodate all the information they obtain.
- Have students share their findings with classmates at the conclusion of the activity.

Data and Observations
Student data and observations will vary, depending on the diseases selected and the information resources used.

Internet Address Book

internNET CONNECTION Note Internet addresses that you find useful in the space below for quick reference.

INTERNET BioLab

Analyze and Conclude

1. A pathogen is a disease-producing agent. Pathogens include bacteria, viruses, parasites, and fungi.
2. Communicable diseases, (such as flu, TB, AIDS) can be passed from one person to another while noncommunicable diseases (such as cancer, arthritis) cannot.
3. Vectors are carriers of a pathogen. Since noncommunicable diseases are not caused by pathogens, there are no vectors involved in their transmission.
4. Noncommunicable diseases are not caused by an organism or pathogen.
5. Internet information can be updated more frequently than information printed in textbooks and encyclopedias.

Assessment

Skill Have students combine their lists of communicable diseases so that a total of at least 20 diseases are included. Have students use the list to compare characteristics of viral versus bacterial diseases. Use the Performance Task Assessment List for Analyzing the Data in **PASC,** p. 27. L2

Sharing Your Data

internNET CONNECTION To navigate to the Internet BioLabs, choose the *Biology: The Dynamics of Life* icon at the Glencoe Science Web Site. Click on the student site icon, then the BioLabs icon. Ask students to research current efforts to develop an AIDS vaccine or a cure for cancer or other disease.

BIO Technology

Purpose

Students learn that genetic engineering technology can be used to develop new vaccines.

Background

Traditional vaccines against rabies, measles, mumps, and many other diseases are made from live, attenuated (weakened) viruses. The virus is grown in laboratory cultures of nonhuman cells and allowed to mutate over several generations. Then a strain is selected that does not produce the disease but does induce an immune response. This strain is used to make the vaccine. There is a danger that the virus could mutate back into the form that produces disease. The advantage of using recombinant DNA to make attenuated vaccines is that mutations in the viral genome can be engineered to ensure that reverse mutation back to a pathogenic form is virtually impossible.

Teaching Strategies

- Have students research their own vaccination histories and make a chart that lists each vaccine they have received since birth and approximately when they received it. L1

Investigating the Technology

A person could be vaccinated against a number of diseases with a single innoculation.

BIO Technology

New Vaccines

Greater understanding of how the immune system works and rapid advances in gene technology have paved the way for the development of new types of vaccines that offer hope in the fight against some of the world's most deadly and widespread diseases.

Traditionally, most vaccines have been made from weakened or killed forms of a disease-causing virus or bacterium, or from some of its cellular components or toxins. Although these types of vaccines have helped to prevent disease, they sometimes cause severe side effects. Furthermore, it hasn't been possible to create vaccines for diseases such as malaria and AIDS using traditional methods. With the help of genetic engineering technology, researchers can now manipulate microbial genes to create entirely new kinds of vaccines.

Recombinant vaccines One revolutionary approach to developing vaccines uses recombinant DNA technology, a process in which genes from one organism are inserted into another organism. The hepatitis B virus vaccine was the first genetically engineered vaccine to be produced in this way. Researchers isolated the gene in the hepatitis virus that codes for the production of the antigen protein that stimulates an immune response. Then they inserted that gene into yeast cells. Like tiny microbial machines, the genetically altered yeast cells produce great quantities of pure hepatitis B antigen, which is then used to make a vaccine.

Applications for the Future

An antigen-coding gene from a disease-causing virus such as HIV can be inserted into a non-disease-causing virus such as cowpox virus. When a vaccine made from a carrier virus is injected into a host, the virus replicates and in the process produces the antigen protein, which causes an immune response. This type of vaccine, called a live vector vaccine, shows promise against AIDS.

DNA Vaccines DNA vaccines differ from other vaccines in that only the cloned segment of DNA that codes for a disease-causing antigen is injected into a host—the DNA itself is the vaccine. The DNA can be injected through a hypodermic needle into muscle tissue, or tiny DNA-coated metal beads can be fired into muscle cells using a "gene gun." Once in the cells, the foreign DNA is expressed as antigen protein that induces an immune response. Researchers currently are working on DNA vaccines for cancer and tuberculosis.

Investigating the Technology

Thinking Critically It is possible to insert antigen-coding genes for several different diseases into one virus carrier that can be used to make a vaccine. What would be an advantage of such a vaccine?

internet CONNECTION To find out more about vaccines, visit the Glencoe Science Web Site.
www.glencoe.com/sec/science

Reasearchers who work with viruses must wear protective clothing.

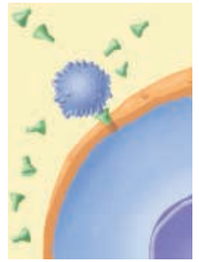
Going Further

Encourage students to use the library or the Internet to find out about new vaccines that have been or are being developed using genetic engineering technologies. L2

Chapter 39 Assessment

Summary

Section 39.1 The Nature of Disease



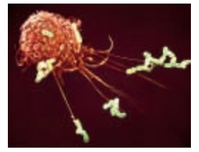
Main Ideas

- Infectious diseases are caused by the presence of pathogens in the body.
- The cause of an infection can be established by following Koch's postulates.
- Animals, including humans, and nonliving objects can serve as reservoirs of pathogens. Pathogens can be transmitted by direct contact, by a contaminated object, through the air, or by a vector.
- Symptoms of a disease are caused by direct damage to cells or by toxins produced by the pathogen.
- Some diseases occur periodically, whereas others are endemic. Occasionally, a disease reaches epidemic proportions.
- Some infectious diseases can be treated with antibiotics, but pathogens may become resistant to these drugs.

Vocabulary

antibiotic (p. 1061)
endemic disease (p. 1061)
epidemic (p. 1061)
infectious disease (p. 1056)
Koch's postulates (p. 1057)
pathogen (p. 1055)

Section 39.2 Defense Against Infectious Diseases



Main Ideas

- The lymphatic system consists of the lymphatic vessels and the lymphatic organs: lymph nodes, tonsils, spleen, and thymus.
- Innate immunity provides general protection against various pathogens.
- Acquired immunity provides a way of fighting specific pathogens by recognizing invaders as nonself. It includes the production of antibodies and cellular immunity.
- AIDS is caused by HIV, which damages the immune system and allows other infections to invade the body.

Vocabulary

acquired immunity (p. 1067)
B cell (p. 1070)
innate immunity (p. 1063)
interferons (p. 1067)
lymph (p. 1068)
lymph node (p. 1068)
lymphocyte (p. 1068)
macrophage (p. 1064)
phagocyte (p. 1064)
pus (p. 1065)
T cell (p. 1069)
tissue fluid (p. 1068)
vaccine (p. 1071)

Understanding Main Ideas

1. Koch's postulates are a series of steps a scientist takes to relate a specific _____ to a specific disease.
   a. host **c.** epidemic
   b. medium **d.** pathogen
2. Bacteria, viruses, and other disease-producing agents are called _____.
   a. parasites **c.** antibodies
   b. pathogens **d.** lymph
3. Bacteria damage host cells by producing _____.
   a. toxins **c.** hormones
   b. antibodies **d.** tRNA

GLENCOE TECHNOLOGY

VIDEOTAPE
MindJogger Videoquizzes
Chapter 39: *Immunity from Disease*
Have students work in groups as they play the videoquiz game to review key chapter concepts.

Resource Manager

Chapter Assessment, pp. 229-234
MindJogger Videoquizzes
Computer Test Bank
BDOL Interactive CD-ROM, Chapter 39 quiz

Main Ideas

Summary statements can be used by students to review the major concepts of the chapter.

Using the Vocabulary

To reinforce chapter vocabulary, use the Content Mastery Booklet and the activities in the Interactive Tutor for Biology: The Dynamics of Life on the Glencoe Science Web Site.
www.glencoe.sec/science

THE PRINCETON REVIEW

All Chapter Assessment questions and answers have been validated for accuracy and suitability by The Princeton Review.

Understanding Main Ideas

1. d
2. b
3. a

4. c
5. b
6. b
7. a
8. d
9. a
10. b
11. infectious
12. endemic
13. antibiotic
14. tissue, lymph
15. basophil
16. lysozyme, cell walls
17. inflammation
18. acquired immunity
19. macrophage
20. T helper cell

Applying Main Ideas

21. The disease tetanus is due to a toxin produced by the bacteria. Killing the bacteria does not affect the toxin that has already been produced.
22. A burn patient loses protective layers of skin, exposing the body to the possibility of massive infection.

Chapter 39 Assessment

4. Which of these diseases is caused by a pathogen?
   a. osteoarthritis **c.** smallpox
   b. hemophilia **d.** cystic fibrosis
5. Which of these diseases is spread only through sexual intercourse?
   a. food poisoning **c.** tetanus
   b. genital herpes **d.** mumps
6. Of these, which is NOT a component of the innate immune system?
   a. phagocytosis **c.** skin
   b. antibodies **d.** mucus
7. What is produced by a body cell that has been infected with a virus?
   a. interferon **c.** lysozyme
   b. toxins **d.** histamine
8. What scientist demonstrated the first safe vaccination procedure?
   a. Koch **c.** Mendel
   b. Pasteur **d.** Jenner
9. Of the following, which is NOT a reservoir for pathogens?

a.

c.

b.

d.

10. How is malaria transmitted?

a.

c.

b.

d.

11. Any disease caused by microorganisms in the body is known as a(n) _____ disease.
12. Diseases that are constantly present in the population are _____ diseases.
13. A(n) _____ is a substance produced by a microorganism that inhibits the growth of other microorganisms.
14. When _____ fluid collects in open-ended vessels, it is called _____.
15. A(n) _____ is a type of white blood cell that secretes histamine.
16. _____, an enzyme produced in sweat, tears, and saliva, can break down the _____ of some bacteria.
17. _____ is a body response to an injury characterized by redness, swelling, pain, and heat.
18. Building up a resistance to a specific pathogen is called _____ _____.
19. A tissue _____ combats invading pathogens by engulfing them.
20. A _____ is a type of lymphocyte destroyed by HIV.

Test-Taking Tip

Read the Instructions
No matter how many times you've taken a particular test or practiced for an exam, it's always a good idea to skim through the instructions provided at the beginning of each section. It only takes a moment.

Applying Main Ideas

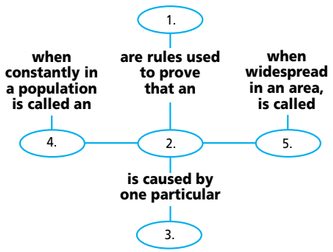
21. If the bacteria that cause tetanus are easily killed by penicillin, why doesn't penicillin cure the disease tetanus?
22. Why must severe burn victims be kept in pathogen-free isolation?

Chapter 39 Assessment

23. While building a tree house, you get a tiny splinter in your finger. Two days later, the area is swollen and pus leaks out. Why is there pus around the splinter?
24. A month after buying a new pet parakeet, Susan experienced pains in her legs, followed by chills, fever, diarrhea, and a headache. She recovered after two weeks of antibiotics. When she next visited the pet store, many of the parakeets were ill. How could researchers find out if Susan had the same disease as the birds?

Thinking Critically

25. **Observing and Inferring** A new mother had chicken pox as a child. Why doesn't her newborn infant get the disease, even after being exposed to the virus that causes it?
26. **Observing and Inferring** How does AIDS upset homeostasis in the body?
27. **Concept Mapping** Complete the concept map by using the following vocabulary terms: infectious disease, pathogen, endemic, Koch's postulates, epidemic.

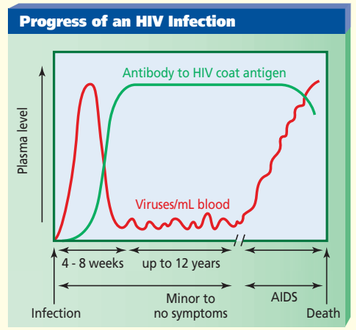


CD-ROM

For additional review, use the assessment options for this chapter found on the ***Biology: The Dynamics of Life Interactive CD-ROM*** and on the Glencoe Science Web Site.
www.glencoe.com/sec/science

Assessing Knowledge & Skills

The graph below shows the progress of a typical HIV infection with signs of the various stages of the AIDS disease.



Interpreting Data Use the graph to answer these questions.

1. Which variable is the dependent variable?
   a. time **c.** level in blood
   b. symptoms **d.** antibody
2. When does the antibody level begin to rise?
   a. at about 4 weeks
   b. at about 8 weeks
   c. during the AIDS symptom stage
   d. at death
3. The HIV virus attacks _____.
   a. red blood cells **c.** T cells
   b. B cells **d.** epithelial cells
4. What type of molecule are antibodies?
   a. carbohydrates **c.** proteins
   b. fats **d.** nucleic acids
5. **Observing and Inferring** Explain why AIDS is considered a syndrome rather than a single disease.

Chapter 39 Assessment

23. Macrophages that came to the injured area engulfed microbes and damaged tissue, then died. Dead macrophages and body fluids collectively are called pus.
24. Researchers would have to isolate the organism from the parakeets and run Koch's postulates on them. The organism can also be exposed to human cell cultures to determine susceptibility.

Thinking Critically

25. The mother's antibodies to chicken pox crossed the placenta and are in the baby's blood, protecting the baby against chicken pox.
26. AIDS destroys the immune system, which constantly monitors the body for invasion by pathogens. If the immune system is not functioning, the body is extremely susceptible to disease.
27. 1. Koch's postulates; 2. Infectious disease; 3. Pathogen; 4. Endemic; 5. Epidemic

Assessing Knowledge & Skills

1. c
2. a
3. c
4. c
5. The HIV infection's destruction of the immune system is not directly life threatening; the secondary infections are.

National Science Education Standards
UCP.1, UCP.2, UCP.3, UCP.5, C.1, C.5, C.6, F.1

Prepare

Purpose

This BioDigest can be used as an overview of the structures and functions of the human body systems. You may wish to use this unit summary to teach human biology in place of the chapters in the Human Biology unit.

Key Concepts

Students learn about the level of organization in body systems. They are then introduced to the structures and functions of 11 major body systems. Various vital statistics provide students with interesting facts about their body systems.

1 Focus

Bellringer

Using a large picture of a human body or a plastic model of a torso, ask students to name as many body systems as they can. Have students list organs under each body system. L1 ELL

GLENCOE TECHNOLOGY

CD-ROM
Biology: The Dynamics of Life
BioQuest: *Body Systems*
Disc 1-5

For a **preview** of the human body unit, study this BioDigest before you read the chapters. After you have studied the human biology chapters, you can use the BioDigest to **review** the unit.

The Human Body

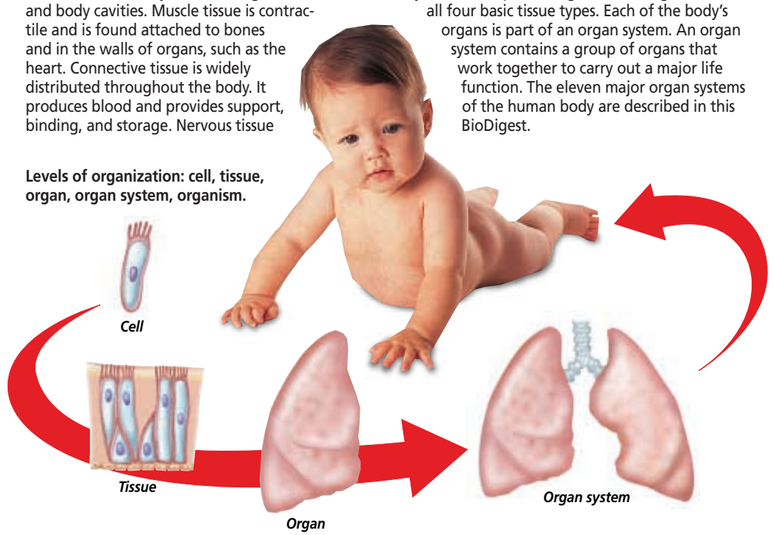
How do the human body systems function together? When an Olympic ice-skater performs on the ice, the cells, tissues, organs, and organ systems of the skater's body function together to help the athlete perform at his or her best and perhaps win a gold medal. All body systems must work together to make an award-winning performance possible.

Levels of Organization

All organisms are made of cells. In complex organisms, such as humans, most cells are organized into functional units called tissues. The four basic tissues of the human body are epithelium, muscle, connective, and nervous tissues. Epithelium covers the body and lines organs, vessels, and body cavities. Muscle tissue is contractile and is found attached to bones and in the walls of organs, such as the heart. Connective tissue is widely distributed throughout the body. It produces blood and provides support, binding, and storage. Nervous tissue transmits impulses that coordinate, regulate, and integrate body systems.

Tissues to Systems

Groups of tissues that perform specialized functions are called organs. Your stomach and eyes are examples of organs. Most organs contain all four basic tissue types. Each of the body's organs is part of an organ system. An organ system contains a group of organs that work together to carry out a major life function. The eleven major organ systems of the human body are described in this BioDigest.



Levels of organization: cell, tissue, organ, organ system, organism.

Skin

The skin and its associated structures, including hair, nails, sweat glands, and oil glands, are important in maintaining homeostasis in the body. The skin protects tissues and organs, helps regulate body temperature, produces vitamin D, and contains sensory receptors.

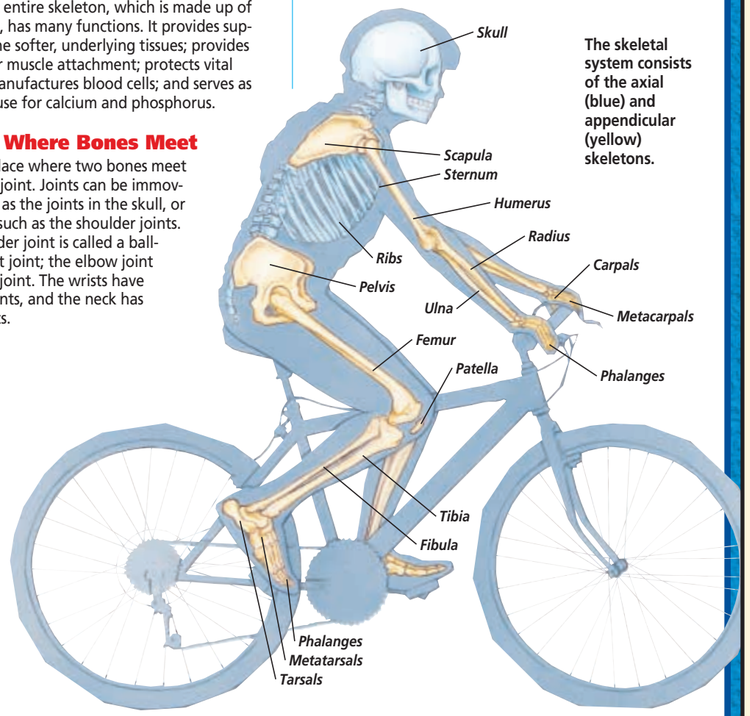
Skin structure varies somewhat from place to place on the body.

Skeletal System

The skeletal system consists of the axial skeleton and appendicular skeleton. The axial skeleton supports the head and includes the skull and the bones of the back and chest. The appendicular skeleton contains the bones associated with the limbs. The entire skeleton, which is made up of 206 bones, has many functions. It provides support for the softer, underlying tissues; provides a place for muscle attachment; protects vital organs; manufactures blood cells; and serves as a storehouse for calcium and phosphorus.

Joints: Where Bones Meet

The place where two bones meet is called a joint. Joints can be immovable, such as the joints in the skull, or movable, such as the shoulder joints. The shoulder joint is called a ball-and-socket joint; the elbow joint is a hinge joint. The wrists have gliding joints, and the neck has pivot joints.



The skeletal system consists of the axial (blue) and appendicular (yellow) skeletons.

Multiple Learning Styles

Look for the following logos for strategies that emphasize different learning modalities.

Kinesthetic Meeting Individual Needs, p. 1084; Quick Demo, p. 1085

Visual-Spatial Project, p. 1082; Meeting Individual Needs, p. 1082; Reteach, p. 1088

Interpersonal Reinforcement, p. 1086; Tech Prep, p. 1086

Linguistic Biology Journal, pp. 1084, 1088; Project, p. 1085; Meeting Individual Needs, p. 1087; Portfolio, p. 1088

Logical-Mathematical Project, p. 1083

Assessment Planner

Portfolio Assessment
Portfolio, TWE, p. 1088

Performance Assessment
Assessment, TWE, p. 1088

Knowledge Assessment
Assessment, TWE, p. 1087
BioDigest Assessment, SE, p. 1089

Skill Assessment
Assessment, TWE, p. 1082

2 Teach

Visual Learning

Draw students' attention to the levels of organization diagram showing how cells are organized into tissues, organs, and organ systems. All systems together make up an organism.

Concept Development

Have students examine areas of their skin. The palms of the hands and soles of the feet contain no hairs. The fingertips contain large numbers of sensory nerve endings and ridges to help grip objects. Have students also note the different patterns and types of skin coloration.

Quick Demo

Visual-Spatial A model human skeleton can be used to talk about the skeletal system and how skeletal muscles function. A human torso can be used to demonstrate the other body systems. These can often be borrowed from a nearby college.

GLENCOE TECHNOLOGY

CD-ROM
Biology: The Dynamics of Life
Exploration: *Bones in the Body's Support,* Disc 5

Display

Students could prepare a bulletin board or posters using pictures cut out of magazines to illustrate the body systems. L1 ELL

Assessment

Skill Have students make a table comparing the three types of muscles. They should make columns for visual characteristics and where the muscles are found. L2

Display

Prepare a bulletin board of magazine and newspaper articles of various disorders, sports injuries, and other problems relating to each body system.

NATIONAL GEOGRAPHIC

VIDEODISC
STV: Human Body Vol. 2
Muscular and Skeletal Systems
Unit 1, Side 1, 17 min. 57 sec.
Muscular and Skeletal Systems
(In its entirety)

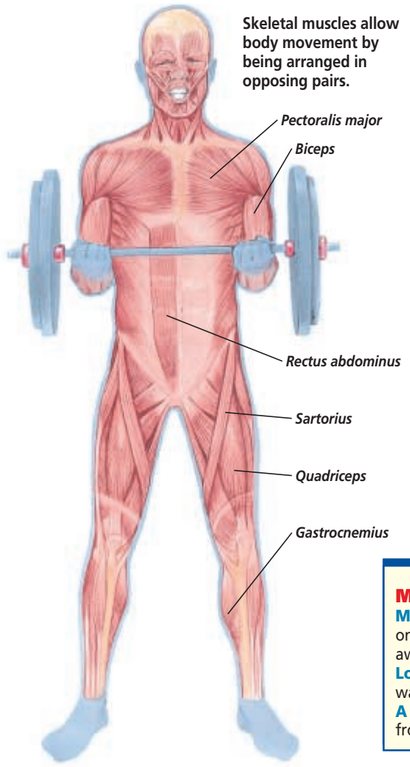
BIODIGEST

Muscular System

The muscular system includes three types of muscles: smooth, cardiac, and skeletal.

Smooth Muscle

Smooth muscles are found in the walls of hollow internal organs, such as inside the stomach or blood vessels. These muscles are not under conscious control and are called involuntary muscles. Smooth muscle cells are spindle shaped and contain a single nucleus.



Skeletal muscles allow body movement by being arranged in opposing pairs.

During physical activity, almost every muscle can be involved, either voluntarily or by reflex actions.

Skeletal Muscle

Skeletal muscles are usually attached to bones. They can be controlled by conscious effort so they are called voluntary muscles. Skeletal muscle tissue is made up of long, threadlike cells, called fibers, which have alternating dark and light striations. Each fiber has many nuclei.

Heart Muscle

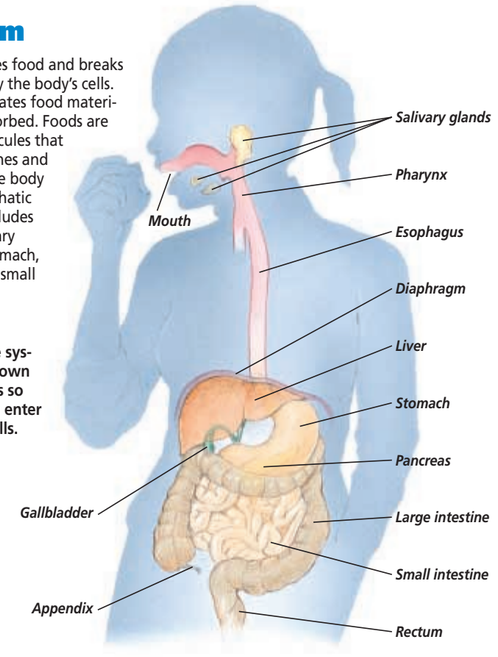
Cardiac muscle tissue is found only in the heart. These cells contain a single nucleus and striations made up of organized protein filaments that are involved in contraction of the muscle. Like smooth muscle, cardiac muscle is involuntary muscle. Cardiac muscle has the unique ability to contract without first being stimulated by nervous tissue.

Vital Statistics

Muscles
Most powerful skeletal muscle: The muscle you sit on is the gluteus maximus; it moves the thighbone away from the body and straightens the hip joint.
Longest muscle: The sartorius muscle runs from the waist to the knee and flexes the hip and knee.
A broad smile: A smile uses 17 facial muscles; a frown uses more than 40.

Digestive System

The digestive system receives food and breaks it down so it can be absorbed by the body's cells. The digestive system also eliminates food materials that are not digested or absorbed. Foods are broken down into simpler molecules that can move through cell membranes and be transported to all parts of the body by the bloodstream or the lymphatic vessels. The digestive system includes the mouth, tongue, teeth, salivary glands, pharynx, esophagus, stomach, liver, gallbladder, pancreas, and small and large intestines.



The digestive system breaks down food particles so that they can enter the body's cells.

Focus on Health

Blood Glucose Levels

A healthy breakfast can be an important supply of carbohydrates.

Levels of glucose in the blood are maintained all day long by hormones secreted by the pancreas. After a meal, the sugars from the food are transported into the blood, raising the blood glucose level. The sugars are either used immediately for activity or stored in the liver for later use. The pancreas secretes insulin, which helps the body's cells take up the sugar or convert it to glycogen in the liver for storage.

Between meals, when blood glucose levels go down, the pancreas secretes glucagon. Glucagon causes the glycogen in the liver to be broken down into glucose, which is then released into the bloodstream and made available to the body's cells. The control of blood sugar levels in the body is an example of a feedback mechanism that is vital for maintaining homeostasis.

BIODIGEST

Quick Demo

X rays of the skeletal system and barium X rays of the digestive system can be viewed by hanging them on classroom windows or projecting them with an overhead projector. Use the X rays to discuss the parts and functions of each of these systems.

Enrichment

TECH PREP

Have a doctor from a sports medicine clinic speak to the class concerning fitness and the effects of sports injuries on the muscular system and other body systems.

Chalkboard Activity

Make a list of the items students have eaten in the last two days that would increase blood glucose levels. Discuss what happens in terms of insulin after the body takes in sugar.

NATIONAL GEOGRAPHIC

VIDEODISC
STV: Human Body Vol. 1
Digestive System
Unit 2, Side 2, 15 min. 55 sec.
Digestive System
(In its entirety)

GLENCOE TECHNOLOGY

CD-ROM
Biology: The Dynamics of Life
Exploration: *Nutrition*
Disc 5

PROJECT

Photo Essay of Body Systems

Visual-Spatial Have students become familiar with the different body systems by asking groups of two or three students to use pictures from magazines to prepare a photo essay representing one body system. They should present their essays to the class with an oral explanation. L2 ELL COOP LEARN

Meeting Individual Needs

Hearing Impaired/Learning Disabled

Visual-Spatial Have hearing impaired students make flash cards with a body system named on one side of the card and its functions on the other side. Students can use the cards as a study aid. L1 ELL

PROJECT

Daily Calorie Intake

Logical-Mathematical Have students keep track of what they eat and of all of their activities (including resting, sleeping, watching TV, etc.) for 48 hours. Students can use a calorie guide to estimate their daily calorie intake and an activity guide to calculate their calorie usage. L1

Chalkboard Example

Draw a neuron on the chalkboard and label the parts. Using arrows, indicate the direction an impulse travels along a neuron. As you discuss transmission across the synapse, bring in the action of various drugs on the synapse. You can find more information in the chapter on the nervous system.

Quick Demo

Kinesthetic To demonstrate a protective reflex, have a student hold up a piece of Plexiglas in front of his or her face. Have another student throw a soft ball, such as Nerf ball, at the Plexiglas. The student behind the glass will blink automatically, even if trying not to blink.

NATIONAL GEOGRAPHIC

VIDEODISC
STV: Human Body
Vol. 2
Nervous System
Unit 2, Side 2, 16 min. 19 sec.
Nervous System
(In its entirety)

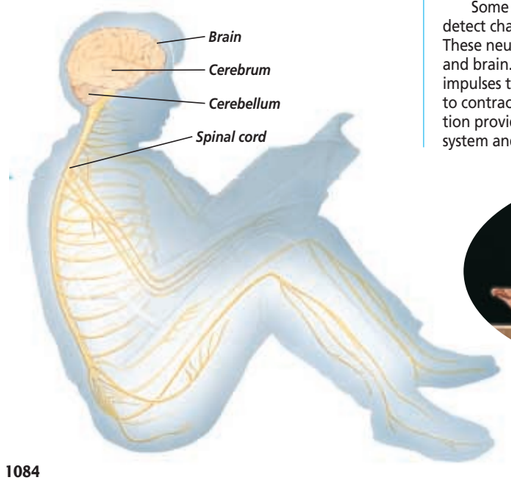
Endocrine System

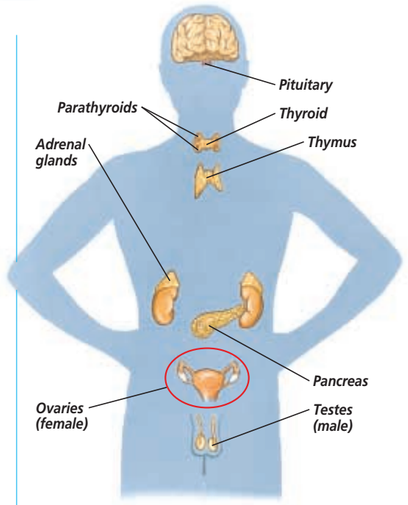
The endocrine system controls all of the metabolic activities of body structures. This system includes all of the glands in the body that secrete chemical messengers called hormones. Hormones travel in the bloodstream to target tissues, where they alter the metabolism of the target tissue. Some of the major endocrine glands include the pituitary, thyroid, parathyroids, adrenals, pancreas, ovaries, and testes.

Nervous System

The organs of the nervous system include the brain, spinal cord, nerves, and sensory receptors. These organs contain nerve cells, called neurons, that conduct impulses. Nerve impulses allow the neurons to communicate with each other and with the cells of muscles and glands. Each impulse consists of an electrical charge that travels the length of a neuron's cell membrane.

Between two neurons there is a small gap called a synapse. When one neuron is stimulated, it releases chemicals called neurotransmitters into the synapse, which stimulates a change in electrical charge in the next neuron. Nerve impulses travel through the body this way, from neuron to neuron.





The major glands of the endocrine system secrete hormones that regulate body functions.

Sensory Receptors

Some nerve cells act as sensory receptors that detect changes inside and outside of the body. These neurons carry impulses to the spinal cord and brain. The brain and spinal cord then send impulses to muscles or glands, stimulating them to contract or secrete hormones. This interconnection provides coordination between the nervous system and the endocrine system.

Interpreting and acting on information sent to the central nervous system (brain and spinal cord) is the major job of the nervous system.

Meeting Individual Needs

Visually Impaired

Kinesthetic Pair a visually impaired student with a peer to go over the organs of the respiratory and nervous systems using a model of a human torso. Ask the students to consider the functions of each organ. L1 ELL

Biology Journal

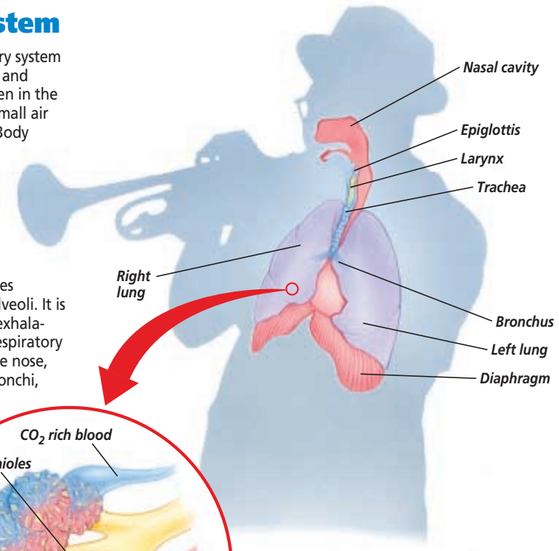
The Brain

Linguistic Have students write a skit in their journal with a major player being the brain and how it interacts with and controls the body systems. L2 COOP LEARN

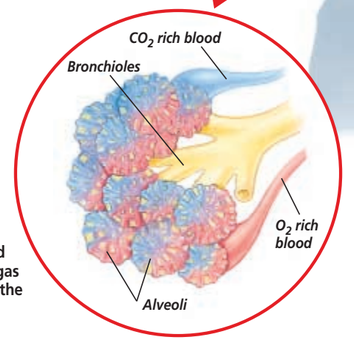
Respiratory System

The organs of the respiratory system exchange gases between blood and the air. During inhalation, oxygen in the air passes into the blood from small air sacs called alveoli in the lungs. Body cells use oxygen to break down glucose to make ATP needed for metabolism.

Carbon dioxide (CO_2) is produced by the breakdown of glucose and is transported to the lungs by the blood. In the lungs, carbon dioxide diffuses out of the blood and into the alveoli. It is forced out of the lungs during exhalation. The major organs of the respiratory system are the nasal cavity in the nose, the pharynx, larynx, trachea, bronchi, and lungs.



The respiratory system filters the air as it passes into the nose, down the air passes, and into the lungs.



The lungs contain many small sacs called alveoli, where gas exchange with the blood occurs.

Vital Statistics

Respiration
Breathing: At rest, humans inhale and exhale about 12 to 20 times per minute, moving about 15 L of air per minute, and inhaling 21.6 cubic meters of air each day.
Lungs: Lungs weigh about 2.2 kg each. The right lung has three lobes and the left lung has two lobes. There are 300 million alveoli in the lungs. Flattened out, they would cover 360 square meters.
Sneezes: A sneeze ejects particles at 165.76 km/hr.

A swimmer comes up for air between strokes.

Project

Tobacco and Cancer

Linguistic Many representatives of the tobacco industry claim there is no proof that use of tobacco causes cancer. After researching the issue, have students write an essay in their journals on how they would respond to the assertion that tobacco usage does not cause cancer. L2

Visual Learning

Review the process of diffusion using the diffusion of oxygen out of the alveoli into the blood and carbon dioxide out of the blood into the alveoli.

Quick Demo

Kinesthetic Have students work in pairs. Have one student count the breathing rate of the other student, and vice versa. Compare individual (anonymous) breathing rates to the average breathing rate of the class. Discuss factors that could affect breathing rates, such as size, activity level when the breath rate is measured, congestion from a cold or allergies. L2 ELL

Enrichment

Have students choose a disease (infectious or noninfectious) of the respiratory system to research in the library or on the Internet.

NATIONAL GEOGRAPHIC

VIDEODISC
STV: Human Body
Vol. 1
Circulatory and Respiratory Systems
Unit 1, Side 1, 16 min. 29 sec.
Circulatory and Respiratory Systems (In its entirety)

Reinforcement

Interpersonal Play a body systems password game. Divide students into teams of two. One person on each team gives one-word clues to his or her partner, whose job is to guess the password with as few clues as possible. Each team plays against one other team. Each team works on a separate term and alternates giving clues to their partners. The first team to guess their word gets a point, then both teams go onto another password. Tally scores at the end of the game. L2 COOP LEARN

Enrichment

Have students research the various treatments for kidney disease, including portable kidney dialysis and kidney transplants.

GLENCOE TECHNOLOGY

CD-ROM
Biology: The Dynamics of Life
BioQuest: *Triathalon*
Disc 5

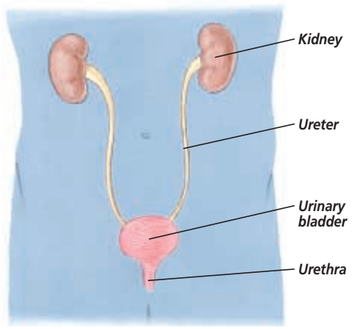
NATIONAL GEOGRAPHIC

VIDEODISC
STV: Human Body Vol. 3
Reproductive Systems
Unit 2, Side 2, 19 min. 57 sec.
Reproductive Systems
(In its entirety)

BIODIGEST

Urinary System

Metabolic waste products are created during the breakdown of amino acids. The urinary system removes these metabolic wastes from the blood, maintains the balance of water and salts in the blood, stores wastes in the form of urine, and transports urine out of the body.

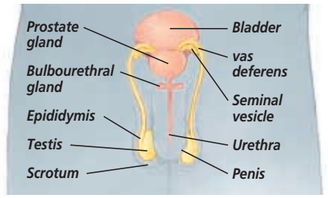


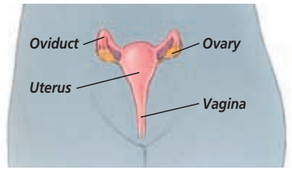
The urinary system filters the blood, collects urine, and excretes urine from the body.

Reproductive System

The reproductive system is involved in the production of gametes. The male reproductive system produces and maintains sperm cells and transfers them into the female reproductive tract. The female reproductive system produces and maintains egg cells, receives and transports sperm cells, and supports the development of the fetus.

The male reproductive system.





The female reproductive system.

Focus on Health

Your Blood Pressure

Blood pressure measurements give an indication of the health of the heart and blood vessels.

Systolic Pressure When the cuff of the blood pressure machine squeezes the arm, it blocks the blood flow in an artery. As the pressure in the cuff is released, a gauge attached to the cuff measures the pressure in the artery as blood flows back into the artery. This is the systolic pressure, which is a measure of the pressure when the right and left ventricles contract.

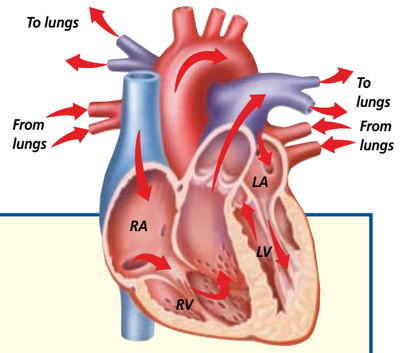
Diastolic Pressure
When the first rush of blood through the arteries slows, the gauge measures a pressure called the diastolic pressure. This is the lowest pressure in the vessels, just before the two ventricles contract again. Blood pressure readings give both the systolic and the diastolic pressure of the arteries. Blood pressure is used to evaluate artery condition.

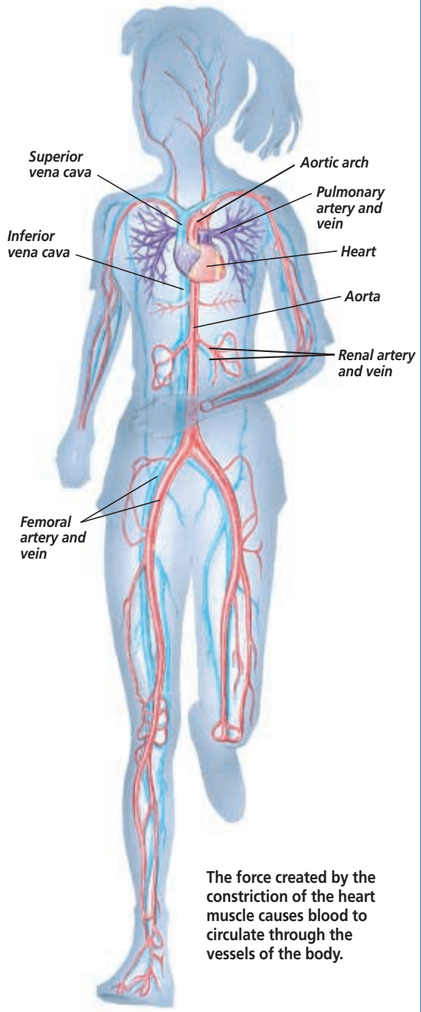
Vital Statistics

Reproduction
Testes: The testes contain 244 m of tubules in which sperm cells are continually produced by meiosis.
Ovaries: At birth, a female already has about 2 million eggs. About 300 000 survive to puberty, but only 450 or so mature and are expelled from the ovary during her lifetime.

Circulatory System

The circulatory system includes the heart, blood vessels (arteries, veins, and capillaries), and blood. The muscular heart pumps blood through the blood vessels. The blood carries oxygen from the lungs and nutrients from the digestive tract to all the body cells. Blood also carries hormones to their target tissues, carbon dioxide back to the lungs, and other waste products to the excretory system.





The force created by the constriction of the heart muscle causes blood to circulate through the vessels of the body.

Quick Demo

TECH PREP Ask the school nurse to demonstrate measuring blood pressure on a few students in the class.

Enrichment

Have students use the Internet to research the factors involved in the development of arteriosclerosis and its treatment.

Assessment

Knowledge Assign each student one component of a body system. Have students write a description of their assigned component and how it interacts with its body system and the entire organism. L2

Extension

Have students interested in a career in sports medicine visit with a trainer from their high school or local college team to find out what type of education is needed to become an athletic trainer. L2

Resource Manager

Reinforcement and Study Guide, pp. 175-176 L2
Content Mastery, pp. 193-196 L1

TechPrep

Health Professionals

Interpersonal Have students prepare for an interview with a health professional such as a nurse, doctor, emergency room personnel, ambulance driver, EMT, physician's assistant, or phlebotomist. They should prepare questions about what the person does and what education is needed for the job. The information can be shared with the whole class. L2

Meeting Individual Needs

Gifted

Linguistic Have gifted students research premature infant care costs. They can write a position paper on whether Americans should spend more or less on dramatic lifesaving measures and why. L3

3 Assess

Check for Understanding

Provide groups of students with diagrams of the different human body systems. Have them use colored pencils to shade various organs of particular systems. For example, the components of the circulatory system could be colored red (oxygenated blood) and blue (nonoxygenated blood).

Reteach

Students can be broken into groups that are assigned to summarize the components of each of the body's systems and present the summaries to the class.

Extension

Ask the school nurse to speak to the class on prevention of disease transmission and vaccination.

Assessment

Performance If necessary, explain to students that AIDS is caused by human immunodeficiency virus (HIV). Ask the students to explain why, since an infection with HIV is itself not fatal, a person who develops AIDS could die. *AIDS suppresses the immune system. A person with AIDS usually dies of an infectious disease or cancer.* L2

4 Close

Reteach

Visual-Spatial Have students make a table based on this BioDigest with three columns: System, Major Parts, and Function. L1

BioDigest

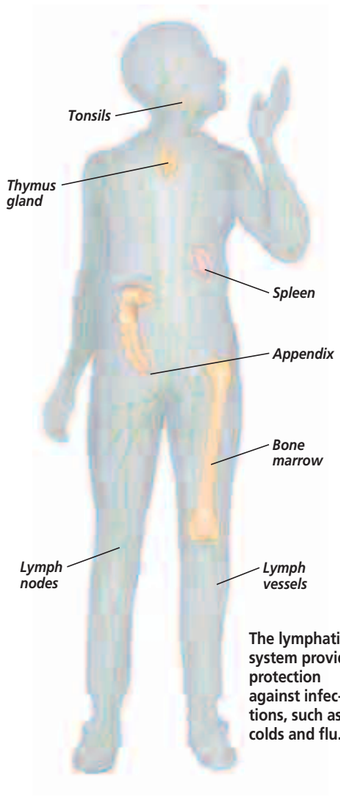
Lymphatic System

Fluids leak out of capillaries and bathe body tissues. The lymphatic system, also known as the immune system, transports this tissue fluid back into the bloodstream. As tissue fluids pass through lymphatic vessels and lymph nodes, disease-causing pathogens and other foreign substances are filtered out and destroyed.

Innate immunity involves the action of several types of white blood cells that protect the body against any type of pathogen. Macrophages and neutrophils engulf foreign substances that enter the body. If the infection persists, the lymphatic system becomes involved. The body develops an acquired immune response that defends against the specific pathogen.

Acquired immunity involves helper T cells that pass on chemical information about the pathogen to B cells. B cells produce antibodies that disarm or destroy the invaders. Some B cells remain in the body as memory B cells that recognize the antigens if they ever invade the body again. This process provides the body with acquired natural immunity against disease.

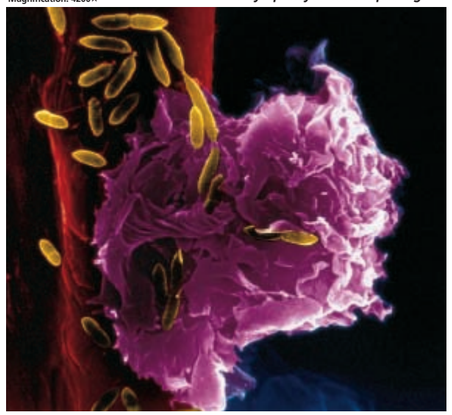
The lymphatic system includes lymph nodes, tonsils, the thymus gland, and spleen. T cells mature in the thymus. The spleen stores both T cells and B cells.

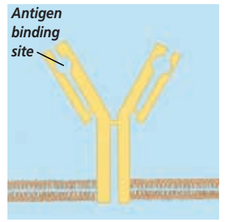


The lymphatic system provides protection against infections, such as colds and flu.

Magnification: 4200×

A lymphocyte attacks pathogens





An antibody has an antigen binding site that varies from one antibody to the next.

Portfolio

Health Myths

Linguistic Have students look up health myths from the 1700-1800s. Books on the history of medicine, surgery, or disease are good sources of this information. Have the class discuss modern treatments and how our understanding of the human body has changed over time. L2 P

Biology Journal

Summarizing Body Systems

Linguistic Ask students to write a paragraph summarizing the function of each of the body systems. L2

BioDigest Assessment

Understanding Main Ideas

1. Which of the following is NOT one of the levels of organization of cells in the human body?
   a. tissue **c.** organ system
   b. organ **d.** receptor
2. Which of the following systems manufactures blood cells?
   a. skin **c.** circulatory system
   b. skeletal system **d.** respiratory system
3. Which type of muscle lines hollow internal organs?
   a. smooth **c.** cardiac
   b. skeletal **d.** voluntary
4. Which of the following organs is NOT a part of the digestive system?
   a. tongue **c.** spleen
   b. saliva glands **d.** pancreas
5. Oxygen is needed by your body cells to _____.
   a. produce carbon dioxide in the cells
   b. break down glucose to make ATP
   c. exchange gas in the alveoli of the lungs
   d. provide muscles with energy to contract
6. What type of event occurs at the synapse between two neurons?
   a. Calcium passes from one cell to another cell.
   b. A neurotransmitter passes from one neuron to the next neuron.
   c. A wave of electrical charges passes from one cell to the next cell.
   d. Sensory receptors detect changes inside the body.
7. Which system secretes hormones to control the metabolic activities of the body structures?
   a. endocrine system
   b. nervous system
   c. circulatory system
   d. excretory system
8. Which type of immune cell creates antibodies against foreign invaders?
   a. red blood cells **c.** spleen cells
   b. T cells **d.** B cells

9. Urine contains the metabolic waste products from the digestion of _____.
   a. glucose **c.** amino acids
   b. fats **d.** water
10. The highest blood pressure, systolic pressure, is the force created by _____.
    a. the lungs **c.** the two ventricles
    b. the two atria **d.** the arteries

Thinking Critically

1. Describe how both the nervous system and endocrine system are involved in controlling all other body systems.
2. AIDS is a viral disease that attacks and kills T cells. Why does a person with AIDS usually die from the inability to fight off infection?
3. Which systems are involved in excretion of waste materials?
4. How does the respiratory system work with the circulatory system?
5. How might an injury to the skeletal system affect the circulatory system?

BioDigest

BioDigest Assessment

Understanding Main Ideas

1. d
2. b
3. a
4. c
5. b
6. b
7. a
8. d
9. c
10. c

Thinking Critically

1. The nervous system receives information from the inside and outside of the body, interprets it, and acts on the information by stimulating muscles or glands. The endocrine system secretes hormones that regulate metabolic activities of body structures.
2. The disease destroys T cells, thereby removing the very immune system cells capable of killing agents that cause infections.
3. digestive, respiratory, and urinary
4. The respiratory system delivers oxygen, which is transported by the circulatory system to the body cells. The circulatory system delivers carbon dioxide from the body cells to the lungs for elimination from the body.
5. Breaking a bone will disrupt capillaries, causing bleeding. Blood clots must be formed until the capillaries can be healed. Breaking a bone could also disrupt blood cell production from that area until healing restores the bone.