Chapter 40 The Immune System and Disease

Summary

40–1 Infectious Disease

A disease is any change, other than an injury, that disrupts the normal functions of the body. Diseases are produced by agents such as bacteria, materials in the environment such as cigarette smoke, or inherited conditions. Disease-causing agents are called pathogens. Diseases caused by pathogens are called infectious diseases.

In the 1800s, scientists concluded that infectious diseases are caused by microorganisms, or germs. This idea is now known as the germ theory of disease. A scientist named Robert Koch developed rules to identify the microorganism that causes a specific disease. These rules, known as Koch’s postulates, are still used.

Pathogens cause disease by destroying cells, releasing toxins, or disrupting body functions. Types of pathogens include viruses, bacteria, protists, worms, and fungi. Infectious diseases can be transmitted in several ways. Many are spread from one person to another through coughing, sneezing, or physical contact. Some are spread through contaminated water or food. Others are spread by infected animals. Vectors are animals that carry pathogens from person to person.

Antibiotics are drugs that kill bacteria without harming the cells of the host. Antiviral drugs fight certain viral diseases. The best treatment for most infections includes rest, a balanced diet, and fluids.

40–2 The Immune System

The immune system is the body’s main defense against pathogens. It produces cells that recognize, attack, destroy, and “remember” each type of pathogen that enters the body. This process is called immunity. The immune system has both nonspecific and specific defenses.

The skin is the most important nonspecific defense. It forms a barrier that few pathogens can get through. Mucus, saliva, and tears trap pathogens and contain an enzyme that kills bacteria. If pathogens manage to enter the body, other nonspecific defenses go to work. The inflammatory response occurs when tissue is damaged by injury or infection. Blood vessels near the site expand, and white blood cells enter the tissues to fight infection. The immune system also releases chemicals that cause a fever. The higher body temperature slows the growth of many pathogens. In addition, cells infected with a virus may produce proteins called interferons, which interfere with the growth of the virus.

If a pathogen is able to get past the nonspecific defenses, the immune system reacts with specific defenses against that particular pathogen. This is called the immune response. A substance that triggers the immune response is known as an antigen. Pathogens may serve as antigens.

There are two types of immune response: humoral immunity and cell-mediated immunity. In humoral immunity, white blood cells, called B cells, produce antibodies that travel through the bloodstream and attack pathogens in the blood. Antibodies are proteins that recognize and bind to specific antigens. In cell-mediated immunity, white blood cells, called T cells, track down and destroy abnormal or infected cells. T cells also attack the cells of transplanted organs. This is called rejection. It can be prevented with drugs. After a pathogen is destroyed, certain B cells or T cells, called memory cells, remain in the body. Memory cells can quickly respond to the same pathogen if it enters the body again. This greatly reduces the chance that the disease develops again.
Besides having a disease, immunity can be acquired in other ways. Vaccination is the injection of a weakened or mild form of a pathogen to produce immunity. This type of immunity is called active immunity. Active immunity appears after exposure to an antigen. Another type of immunity is called passive immunity. It is produced when antibodies enter the body. Antibodies may be injected to fight an infection. Antibodies also pass from mother to fetus. Passive immunity lasts only as long as the antibodies remain in the body.

40–3 Immune System Disorders

There are three types of immune system disorders: allergies, autoimmune diseases, and immunodeficiency diseases. Allergies are overreactions of the immune system to antigens such as pollen. Antigens that cause allergic reactions are called allergens. In response to allergens, the body produces chemicals called histamines, which cause symptoms such as sneezing and watery eyes. Some allergic reactions lead to asthma. Asthma is a chronic respiratory disease in which the air passages become narrower than normal. This may cause coughing and difficulty breathing.

Autoimmune diseases occur when the immune system attacks the body’s own cells. For example, in Type I diabetes, the immune system attacks cells of the pancreas that make insulin. Other examples of autoimmune diseases are rheumatoid arthritis, myasthenia gravis, and multiple sclerosis (MS).

Immunodeficiency diseases occur when the normal immune response breaks down. The most common immunodeficiency disease is AIDS. It is caused by the human immunodeficiency virus (HIV). HIV can be transmitted through the exchange of body fluids such as blood. The only no-risk behavior with respect to HIV and AIDS is abstinence. At present, there is no cure or vaccine for AIDS.

40–4 The Environment and Your Health

Anything that increases the chance of disease or injury is a risk factor. Risk factors in the environment include poor air quality and solar radiation. Air quality refers to the number and type of dangerous gases and particles in the air. Water, like air, can carry dangerous substances. For example, human or animal wastes can pollute water with bacteria. Bioterrorism is a new health threat. Bioterrorism is the intentional use of biological agents, such as viruses, to disable or kill people.

Cancer is a life-threatening disease in which cells multiply uncontrollably and destroy healthy tissue. Cancer may cause a tumor. A tumor is a mass of cells growing out of control. Some tumors are not cancerous. All forms of cancer are ultimately caused by harmful mutations. Mutations may be inherited or caused by viruses, chemicals, or radiation. Chemicals that cause cancer are called carcinogens. Sources of potentially harmful radiation include sunlight and radon gas, which is found in rocks and can leak into buildings. Protecting the body from radiation and carcinogens can help prevent cancer. Other ways of maintaining health include eating a healthful diet, getting plenty of exercise and rest, abstaining from harmful activities, and having regular checkups.
Chapter 40 The Immune System and Disease

Section 40–1 Infectious Disease (pages 1031–1035)

This section describes the causes of disease and explains how infectious diseases are transmitted.

Introduction (page 1031)
1. Any change, other than an injury, that disrupts the normal functions of the body, is a(an) ________________.
2. What are three ways diseases can come about? ________________
   ________________
   ________________

3. Disease-causing agents are called ________________.

The Germ Theory of Disease (pages 1031–1032)
4. State the germ theory of disease. ________________

5. Circle the letter of each scientist whose work led to the germ theory of disease.

6. Is the following sentence true or false? Lyme disease is caused by bacteria. ________________

7. Circle the letter of the type of organism that spreads Lyme disease.
   a. mosquito  b. deer tick  c. deer fly  d. horse fly

Koch’s Postulates (page 1032)
8. What are scientists trying to identify when they use Koch’s postulates? ________________

9. Number the steps in the flowchart below so they show how to apply Koch’s postulates.
   Pathogen identified → Pathogen injected into healthy lab mouse → Pathogen grown in pure culture → Healthy mouse becomes sick → Pathogen identified
Agents of Disease (pages 1033–1034)
10. Is the following sentence true or false? Most of the bacteria and yeast that are found in the body are harmful and cause disease. ________________

11. List two ways that bacteria can produce illness.
   a. ____________________________________________
   b. ____________________________________________

Match each type of pathogen with a disease caused by that type.

<table>
<thead>
<tr>
<th>Type of Pathogen</th>
<th>Disease</th>
</tr>
</thead>
<tbody>
<tr>
<td>12. Virus</td>
<td>a. Athlete’s foot</td>
</tr>
<tr>
<td>13. Bacterium</td>
<td>b. Anthrax</td>
</tr>
<tr>
<td>14. Protist</td>
<td>c. Tapeworm</td>
</tr>
<tr>
<td>15. Worm</td>
<td>d. Influenza</td>
</tr>
<tr>
<td>16. Fungus</td>
<td>e. Malaria</td>
</tr>
</tbody>
</table>

How Diseases Are Spread (page 1034)
17. List three ways that infectious diseases are spread.
   a. ____________________________________________
   b. ____________________________________________
   c. ____________________________________________

18. Animals that carry pathogens from person to person are called ________________.

19. Is the following sentence true or false? Thorough hand washing does not help prevent the spread of many pathogens. ________________

Fighting Infectious Diseases (page 1035)
20. Compounds that kill bacteria without harming the cells of humans or animals are called ________________.

21. Circle the letter of each sentence that is true about antibiotics.
   a. They work by interfering with the cellular processes of microorganisms.
   b. Many of them are produced by living organisms.
   c. They were first discovered in the 1940s.
   d. They are effective against viruses.

22. How do antiviral drugs fight viral diseases? ________________________________
Section 40–2 The Immune System (pages 1036–1042)

This section describes the body’s defenses against disease-causing organisms and explains what immunity is.

Introduction (page 1036)
1. The body’s main defense against pathogens is the _____________________________.

Match the type of defense with its role in the body.

<table>
<thead>
<tr>
<th>Defense</th>
<th>Role</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>2. Nonspecific</td>
</tr>
<tr>
<td></td>
<td>a. Destroying harmful pathogens that enter the body</td>
</tr>
<tr>
<td>3. Specific</td>
<td>b. Preventing pathogens from entering the body</td>
</tr>
</tbody>
</table>

Nonspecific Defenses (pages 1036–1038)
4. What is the job of the body’s first line of defense? ____________________________

5. List the four components of the body’s first line of defense.
   a. ____________________  c. ____________________
   b. ____________________  d. ____________________

6. Is the following sentence true or false? The body’s most important nonspecific defense is the skin. ____________________

7. How does mucus help protect the body from disease? ____________________________

8. Body secretions contain an enzyme, called ____________________, that kills bacteria.

9. When does the body’s second line of defense come into play? ____________________________

10. Is the following sentence true or false? The inflammatory response is a nonspecific reaction to tissue damage caused by injury or infection. ____________________

11. White blood cells called ____________________ engulf and destroy bacteria.

12. Why does an increase in the number of white blood cells indicate that the body is dealing with a serious infection? ____________________________

13. An elevated body temperature is called a(an) ____________________. 
14. Circle the letter of each sentence that is true about elevated body temperature.
   a. It kills many pathogens.
   b. It speeds up the action of white blood cells.
   c. It decreases heart rate.
   d. It slows down chemical reactions.

15. Is the following sentence true or false? Interferon is a protein that helps fight bacterial infections. ______________

Specific Defenses (pages 1038–1041)

16. What is the immune response? ________________________________

17. A substance that triggers the immune response is known as a(an) ______________.

18. What are some examples of antigens? ________________________________

19. List the two different immune responses.
   a. ________________________________  b. ________________________________

20. Circle the letter of each sentence that is true about humoral immunity.
   a. It is a response to pathogens in body fluids.
   b. It depends on lymphocytes.
   c. It involves antibodies.
   d. It involves plasma cells.

21. A protein that helps destroy pathogens is called a(an) ______________.

22. Is the following sentence true or false? Antibodies can fight viruses but not bacteria. ______________

23. Label the antigen-binding sites in the drawing below.
24. Is the following sentence true or false? Plasma cells are specialized B cells. ________________

25. What happens once the body has been exposed to a pathogen? ________________

26. Circle the letter of each sentence that is true about cell-mediated immunity.
   a. It is a defense against the body’s own cells.
   b. It involves killer T cells.
   c. It involves antibodies.
   d. It causes pathogen cells to rupture and die.

27. Is the following sentence true or false? Cell-mediated immunity is particularly important for diseases caused by prokaryotic pathogens. ________________

**Acquired Immunity** (pages 1041–1042)

28. The first smallpox vaccine was produced by _________________.

29. What is vaccination? ________________

30. How do vaccines work? ________________

31. Complete the Venn diagram by labeling the two types of immunity.

<table>
<thead>
<tr>
<th>Is due to antigens</th>
<th>Can result from vaccination</th>
<th>Is due to antibiotics</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lasts for life</td>
<td></td>
<td>Lasts for a short time</td>
</tr>
</tbody>
</table>
Section 40–3 Immune System Disorders (pages 1043–1047)

This section describes diseases that affect the immune system.

Allergies (page 1043)
1. An overreaction of the immune system caused by antigens is called a(an) ________.

2. Circle the letter of each choice that is a result of allergens binding to mast cells.
   a. The mast cells release chemicals known as histamines.
   b. There is increased flow of blood and fluids to the surrounding area.
   c. Sneezing, runny nose, watery eyes, and other symptoms occur.
   d. Antihistamines are released by the mast cells.

Asthma (page 1044)
3. A chronic respiratory disease in which air passages become narrower than normal is called ________.

Autoimmune Diseases (page 1044)
4. What produces an autoimmune disease? __________________________

5. Complete the table about autoimmune diseases.

<table>
<thead>
<tr>
<th>Autoimmune Disease</th>
<th>Organ or Tissue That Is Attacked</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rheumatoid arthritis</td>
<td>Connective tissues around joints</td>
</tr>
<tr>
<td>Type I diabetes</td>
<td>Insulin-producing cells of the pancreas</td>
</tr>
<tr>
<td>Myasthenia gravis</td>
<td>Neuromuscular junctions</td>
</tr>
<tr>
<td>Multiple sclerosis</td>
<td>Myelin sheath that surrounds neurons</td>
</tr>
</tbody>
</table>

AIDS, an Immunodeficiency Disease (pages 1045–1047)
6. Is the following sentence true or false? AIDS is a type of disease in which the immune system is weakened by infection. ________________

7. What does AIDS stand for? _____________________________
8. List some of the diseases that may be symptoms of AIDS.
   a. 
   b. 

9. Circle the letter of the choice that refers to the cells that are attacked by HIV.
   a. Helper T cells  
   b. Killer T cells  
   c. Red blood cells  
   d. Helper B cells

10. Is the following sentence true or false? The body does not produce antibodies against HIV.

11. Circle the letter of each choice that is true about the spread of HIV.
   a. It is usually spread by casual contact.
   b. It is spread only by sexual contact.
   c. It can be spread by sharing needles.
   d. It is spread only by contact with infected blood or other body fluids.

12. Is the following sentence true or false? Any sexual contact carries some risk of contracting HIV.

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**Reading Skill Practice**

When you read about new or difficult concepts, making a concept map can help you better understand and remember the ideas. Make a concept map that shows how immune system disorders are classified, based on the material in Section 40–3. For more information about concept maps, see Appendix A of your text. Do your work on a separate sheet of paper.
Section 40–4 The Environment and Your Health
(pages 1049–1054)

This section describes some environmental factors that can affect your health. It also explains healthful behaviors you can practice.

Introduction (page 1049)
1. A ________________ is anything that increases the chance of disease or injury.
2. Is the following sentence true or false? Both heredity and environmental factors can affect your health. __________

Air Quality (pages 1049–1050)
3. Circle the letter of each factor that is part of air quality.
   a. number and concentrations of gases
   b. amount of sunlight
   c. nature and amount of tiny particles
4. Why can overexposure to carbon monoxide be fatal? ________________

5. ________________ is a highly reactive form of oxygen that is produced by vehicle exhaust and factory emissions.
6. Allergic reactions can be triggered by ________________

Water Quality (pages 1050–1051)
7. What has probably been the single most important factor in nearly doubling human life expectancy over the last century or so? ________________
8. Circle the letter of each of the following that can be a water pollutant.
   a. human and animal wastes
   b. carbon monoxide
   c. chemicals
   d. dust mites

Bioterrorism (page 1051)
9. The intentional use of biological agents to disable or kill individuals is called ________________.
10. Why could the release of smallpox virus cause serious problems? ________________
Cancer (pages 1052–1053)

11. Circle the letter of each sentence that is true about cancer.
   a. It is generally a life-threatening disease.
   b. It is characterized by cells multiplying uncontrollably and destroying healthy tissue.
   c. It is caused by foreign cells invading the body.
   d. Its is easy to treat and to understand.

12. When do cancers begin? ________________________________

13. A mass of growing tissue is known as a(an) ________________.

14. Is the following sentence true or false? All tumors are cancerous. ________________

Match the type of tumor with its description.

<table>
<thead>
<tr>
<th>Tumor Type</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>15. Benign</td>
<td>a. Does not spread to surrounding healthy tissue or to other parts of the body</td>
</tr>
<tr>
<td>16. Malignant</td>
<td>b. Can invade and destroy surrounding healthy tissue</td>
</tr>
</tbody>
</table>

17. List three ways that cancer cells cause illness as they spread.
   a. ________________________________________
   b. ________________________________________
   c. ________________________________________

18. Complete the concept map.

```
Gene Defects

Inherited

The result of mutations

Occur spontaneously

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19. Chemical compounds that are known to cause cancer are called ________________________________.

20. Why is it important to detect cancer early? ________________________________________________________________

Maintaining Health  (page 1054)

21. Give three reasons it is important to eat a healthful diet. ________________________________________________________________
   ________________________________________________________________
   ________________________________________________________________

22. For most people, adequate rest means getting about _________ hours of sleep each night.

23. ____________________________________________ can cause a variety of respiratory conditions as well as cancers of the lung, mouth, and throat.

24. Is the following sentence true or false? Discovering a disease early does not make it easier to treat. ________________
Name______________________________ Class________________________ Date ______________

WordWise

Answer the questions by writing the correct vocabulary terms from Chapter 40 in the blanks. Use the circled letter from each term to find the hidden word. Then, write a definition for the hidden word.

1. What is a general name for something that can reduce air or water quality?
   
   __ __ __ __ __ __ __ __

2. What is a compound that blocks the growth and reproduction of bacteria?
   
   __ __ __ __ __ __ __ __

3. What is a mass of rapidly growing tissue?
   
   __ __ __ __

4. What is a chemical that is released by activated mast cells?
   
   __ __ __ __ __ __ __ __

5. What is a specialized protein produced by the immune system that helps destroy disease-causing organisms?
   
   __ __ __ __ __ __ __ __

6. What is a tumor called if it can invade and destroy surrounding healthy tissue?
   
   __ __ __ __ __ __ __ __

7. What is a form of oxygen with three oxygen atoms?
   
   __ __ __ __ __

8. What is a substance that triggers an immune response?
   
   __ __ __ __ __ __ __

Hidden Word: ________________________________

Definition: ________________________________