

CHAPTER 35 – HUMAN IMMUNE SYSTEM

STANDARDS: SC.912.L.14.52 & SC.912.L.14.6

SECTION 1 - Infectious Disease

SWBAT:

1. Identify the causes of infectious disease.
2. Explain how infectious diseases are spread.

Lesson Summary

Causes of Infectious Disease

Changes to body physiology that disrupt normal body functions and are caused by microorganisms are called **infectious diseases**. This explanation, established by Louis Pasteur and Robert Koch, is called the **germ theory of disease**.

- Infectious diseases are caused by viruses, bacteria, fungi, protists, and parasitic worms. Disease-causing microorganisms are also called pathogens.
- Many microorganisms are symbionts that are either harmless or beneficial. Pathogens cause disease by destroying cells, disrupting body functions, or releasing toxins that kill cells or interfere with their normal functions.

How Diseases Spread

Infectious diseases can be spread in several ways.

- Some infectious diseases are spread from person to person through coughing, sneezing, physical contact, or exchange of body fluids. Most infectious diseases are spread through indirect contact, such as pathogens that are carried through the air. These pathogens can be inhaled, or they can be picked up from surfaces.
- Some pathogens are spread by specific kinds of direct contact, such as sexual contact or drug use that involves shared syringes.
- Other infectious diseases are spread through contaminated water or food.
- Some infectious diseases spread from animals to humans. Such a disease is called a **zoonosis**. Often, the spread of zoonoses involves **vectors**, which are disease carriers that usually do not get sick from the pathogen.

SECTION 2 - Defenses Against Infection

SWBAT:

1. Describe the body's nonspecific defenses against invading pathogens.
2. Describe the function of the immune system's specific defenses.
3. List the body's specific defenses against pathogens.

Lesson Summary

Nonspecific Defenses

The body has many nonspecific defenses, which defend against a wide range of pathogens.

- The first line of defense is skin. Skin keeps pathogens out of the body by forming a barrier that few pathogens can get through. Mucus, saliva, and tears contain an enzyme that can kill bacteria. Mucus can also trap pathogens.
- When pathogens do enter the body, the second line of defense goes to work. These nonspecific defenses include:
 - the **inflammatory response**, in which chemicals called **histamines** cause blood vessels near a wound to expand and phagocytes to move into the tissue to fight infection.
 - the production of proteins called **interferons**, which help block the replication of viruses.
 - the release of chemicals that produce a **fever**, an increase in normal body temperature, which may slow the growth of pathogens and speed up immune response.

Specific Defenses: The Immune System

The function of the immune system is to fight infection by inactivating foreign substances or cells that have entered the body. The specific immune response works in several ways, including:

- recognizing "self," including cells and proteins that belong to the body.
- recognizing "nonself", or **antigens**, molecules found on foreign substances. Antigens stimulate the immune system to produce cells called lymphocytes that recognize, attack, destroy, and "remember" specific pathogens.
- producing specific lymphocytes that recognize specific antigens. They work by attacking infected cells or producing **antibodies**, proteins which tag antigens for destruction by immune cells.

The Immune System in Action

The immune response works in two ways.

- In **humoral immunity**, white blood cells, called B lymphocytes (B cells), make antibodies that attack pathogens in the blood.

- In **cell-mediated immunity** white blood cells, called T lymphocytes (T cells), find and destroy abnormal or infected cells. After a pathogen is destroyed, memory B cells and memory T cells stay in the body. These cells help create a faster immune response if the same pathogen enters the body again.

SECTION 3 - Fighting Infectious Disease

SWBAT:

1. Distinguish between active immunity and passive immunity.
2. Describe how public health measures and medications fight disease.
3. Describe why patterns of infectious disease have changed.

Lesson Summary

Acquired Immunity

You can acquire immunity without having a disease.

- **Vaccination** is the injection of a weakened or mild form of a pathogen to cause immunity.
- **Active immunity** results from vaccines or natural exposure to an antigen.
- **Passive immunity** forms when antibodies are introduced into the body. It lasts only until the immune system destroys the foreign antibodies.

Public Health and Medications

In 2005, less than 5 percent of human deaths were caused by infectious diseases. This statistic is the result of two major factors.

- The field of public health provides services that help monitor food and water supplies and promote vaccinations and healthy behavior.
- The development and use of many new medications, particularly antibiotics and antiviral drugs, has saved many lives by helping to cure infectious diseases.

New and Re-Emerging Diseases

Since 1980, many new diseases have appeared and several diseases once thought to have been eradicated have recurred. There are two main reasons for these changes.

- Interactions with exotic animals have increased.
- The misuse of medications has caused diseases that were once under control, such as tuberculosis and malaria, to evolve resistance to many antibiotics.

SECTION 4 - Immune System Disorders

SWBAT:

1. Explain what happens when the immune system overreacts to harmless pathogens.
2. Describe how HIV is transmitted and how it affects the immune system.

Lesson Summary

When the Immune System “Misfires”

Sometimes, the immune system overreacts to otherwise harmless antigens. Three types of disorders are caused in this way.

- The most common immune-system disorders are **allergies**, which occur when antigens enter the body and bind to mast cells. The mast cells release histamines, which increase the flow of blood and fluids to the area. This causes allergy symptoms.
- Allergic reactions in the respiratory system can cause **asthma**, a dangerous chronic disease in which the air passages narrow and breathing becomes difficult.
- When the immune system makes a mistake and attacks the body's own cells, an autoimmune disease results. Autoimmune diseases include Type I diabetes, rheumatoid arthritis, and lupus.

HIV and AIDS

In the 1970s, clusters of cases of opportunistic diseases—diseases that attack people with weakened immune systems—led to the discovery of a new disease called acquired immunodeficiency syndrome (AIDS).

- Research revealed that AIDS is an infectious disease caused by human immunodeficiency virus (HIV). HIV attaches to receptors on helper T cells. Once inside the cells, HIV copies itself and the new viruses infect more helper T cells.
- HIV infection gradually leads to the death of more and more T cells. When a person's T cell count drops to about one-sixth the normal level, the person has AIDS.
- HIV can only be transmitted through contact with infected blood, semen, vaginal secretions, or breast milk.

35.1 CONTENT REVIEW QUESTIONS

Causes of Infectious Disease

1. What are infectious diseases, and what causes them?
2. How did the germ theory of disease get its name?
3. What is another name that scientists use for a disease-causing agent?

For Questions 4–12, match each type of disease with the type of disease-causing agent that causes it. Some types of disease-causing agents may be used more than once.

Disease

- _____ 4. African sleeping sickness
- _____ 5. athlete's foot
- _____ 6. botulism
- _____ 7. chicken pox
- _____ 8. hookworm
- _____ 9. influenza
- _____ 10. malaria
- _____ 11. trichinosis
- _____ 12. tuberculosis

Type of Disease-Causing Agent

- A. virus
- B. bacterium
- C. protist
- D. parasitic worm
- E. fungus

13. Are microorganisms always harmful to the human body? Explain your answer, and give an example.
14. List two ways that bacteria can produce illness.
15. List three ways that parasitic worms cause disease.

How Diseases Spread

For Questions 18–26, complete each statement by writing the correct word or words.

16. Natural selection favors pathogens with _____ that help them spread from host to host.
17. Symptoms of disease that can spread pathogens include _____ and _____.
18. The best ways to prevent infections of the nose, throat, and respiratory tract are frequent and thorough _____ and avoiding _____ your mouth and nose.
19. _____ that cause skin infections can be transmitted by any body contact or contact with contaminated towels/equipment.
20. _____ is spread from one host to another in body fluids exchanged during sexual activity.
21. Blood on shared syringes can spread certain forms of _____, as well as _____.
22. A symptom of diseases spread by contaminated water or food is _____.
23. Lyme disease, mad cow disease, and SARS are all examples of _____.
24. The _____ that carries the West Nile virus between birds and humans is a mosquito.
25. Explain how coughing and sneezing can not only spread infection, but also help protect against invading organisms.

35.2 CONTENT REVIEW QUESTIONS

Nonspecific Defenses

For Questions 1–8, write the letter of the definition that best matches each term.

Term	Definition
_____ 1. skin	A. An increase in body temperature, which slows or stops pathogens
_____ 2. lysozyme	B. A secretion of the nose and throat that traps pathogens
_____ 3. inflammatory response	C. An enzyme found in tears and saliva that breaks down bacterial cell walls
_____ 4. histamines	D. Chemicals that increase blood flow to tissues
_____ 5. interferons	E. Combination of physical & chemical barriers that defend vs pathogens
_____ 6. fever	F. Redness, pain, and swelling at the site of an injury
_____ 7. mucus	G. Proteins that fight viral growth
_____ 8. nonspecific defenses	H. The body's most important nonspecific defense

Specific Defenses: The Immune System

For Questions 9–14, complete each statement by writing the correct word or words.

9. The _____ response is the body's response to specific invaders.
10. A substance that triggers the immune response is known as a (n) _____.
11. The main working cells of the immune system are two types of _____. Their specific types are determined by a person's _____.
12. _____ defend the body against pathogens that have infected body cells.

The Immune System in Action

For Questions 16–22, write True or False on the line provided.

- _____ 13. Humoral immunity is a response to pathogens in blood and lymph.
- _____ 14. The first response of humoral immunity to infection is much faster than the second response.
- _____ 15. Cell-mediated immunity involves antibodies.
- _____ 16. Cell-mediated immunity only works on viral diseases.
17. Complete the table to compare how humoral and cell-mediated immunity work after a virus invades the body for the first and second times.

Humoral Immunity vs. Cell-Mediated Immunity	
Action of Humoral Immunity	Action of Cell-Mediated Immunity
Primary response:	Primary response:
	Macrophages consume viruses and display their antigens on the cell surface. Helper T cells are activated.
Activated B cells grow and divide rapidly.	
	Helper T cells activate B cells and cytotoxic T cells and produce memory cells.
Plasma cells release antibodies that capture antigens and mark them for destruction.	
Secondary response:	Secondary response:

35.3 CONTENT REVIEW QUESTIONS

Acquired Immunity

1. What was the origin of the term *vaccination*? Explain why this name was given.
2. How does a vaccine work?
3. What type of immunity do vaccinations produce?
4. What type of immunity does a mother pass on to her infant while breastfeeding?
5. Why is passive immunity only temporary?

Public Health and Medications

For Questions 7–11, complete each statement by writing the correct word or words.

6. Promoting childhood _____ and providing clean drinking water are two _____ activities that have greatly reduced the spread of many infectious diseases.
7. Compounds that kill bacteria without harming the host cells are called _____.
8. The first antibiotic to be discovered was _____.
9. _____ drugs inhibit the ability of viruses to invade cells or multiply within cells.
10. How did Alexander Fleming discover the first antibiotic?

New and Re-Emerging Diseases

For Questions 12–16, write the letter of the correct answer on the line at the left.

- _____ 12. Which of the following is NOT considered to be a major cause of new or re-emerging diseases?
A. misuse of medications
B. merging of human and animal habitats
C. vaccination
D. trade in exotic animals
- _____ 13. Which is an example of an infectious disease that was eliminated by public health measures?
A. avian influenza
B. hantavirus
C. smallpox
D. West Nile virus
- _____ 14. How are monkeypox and SARS thought to have started in humans?
A. by animal trade for pets and food
B. antibiotic resistance
C. the clearing of new areas of land in the tropics
D. by the merging of human and animal habitats
- _____ 15. Malaria and tuberculosis are two examples of diseases that have
A. been totally eliminated from the human population.
B. evolved resistance to many antibiotics.
C. increased because of a lack of understanding of how vaccines work.
D. recently been discovered in the United States.
- _____ 16. Failing to follow vaccination recommendations are thought to be responsible for the comeback of
A. Ebola.
B. influenza.
C. Lyme disease.
D. measles.

35.4 CONTENT REVIEW QUESTIONS

When the Immune System “Misfires”

For Questions 1–5, complete each statement by writing the correct word or words.

1. An overreaction of the immune system to antigens of pollen and other harmless substances is called a(n) _____.
2. Sneezing, a runny nose, and watery eyes are symptoms of the _____ response in the respiratory system.
3. Drugs called _____ counteract the effects of _____ produced by mast cells.
4. A dangerous condition that affects the respiratory system and can be caused by allergies is called _____.
5. Examples of _____ triggers for allergic reactions include tobacco smoke, pollution, molds, and pet dander.
6. What is an autoimmune disease?

7. Describe the advantage and disadvantage of treating an autoimmune illness such as lupus.

8. Complete the table about autoimmune diseases.

Autoimmune Diseases	
Autoimmune Disease	Organ or Tissue That Is Attacked
Type I diabetes	
	Connective tissues around the joints
Lupus	

HIV and AIDS

9. What does AIDS stand for?

10. What is the term that describes diseases that attack people with a weakened immune system?

11. List four body fluids that can transmit AIDS.

12. What behaviors prevent people from being infected with HIV?

13. Why is curing HIV infection so challenging? Explain your answer.