



20.1 Viruses

Lesson Objectives

-  Explain how viruses reproduce.
-  Explain how viruses cause infection.

Lesson Summary

The Discovery of Viruses In 1935, the American biochemist Wendell Stanley isolated a virus for the first time.

- ▶ A **virus** is a particle made of nucleic acid, protein, and, in some cases, lipids.
- ▶ A typical virus is composed of a core of DNA or RNA surrounded by a protein coat called a **capsid**.
- ▶ Viruses that infect bacteria are called **bacteriophages**. They enter living cells and, once inside, use the machinery of the infected cell to produce more viruses.

Viral Infections Viruses have two methods of infection once inside a host cell.

- ▶ In a **lytic infection**, a virus enters a cell, makes copies of itself, and causes the cell to burst, releasing new virus particles that can attack other cells. In the case of bacteriophage *T4*, viral DNA directs the synthesis of new viruses using materials in the cell.
- ▶ In a **lysogenic infection**, a virus integrates part of its DNA called a **prophage** into the DNA of the host cell. The viral genetic information replicates along with the host cell's DNA. Eventually, the prophage will remove itself from the host cell DNA and make new virus particles.

In a **retrovirus**, the genetic information is copied backward—from RNA to DNA instead of from DNA to RNA. The virus that causes the disease AIDS is a retrovirus.

Viruses must infect a living cell in order to reproduce. Although viruses are parasites, they are not made of cells and are not considered living things.

The Discovery of Viruses

1. What is a bacteriophage?

2. What are viruses?

3. What is a capsid?

4. How does a typical virus get inside a cell?

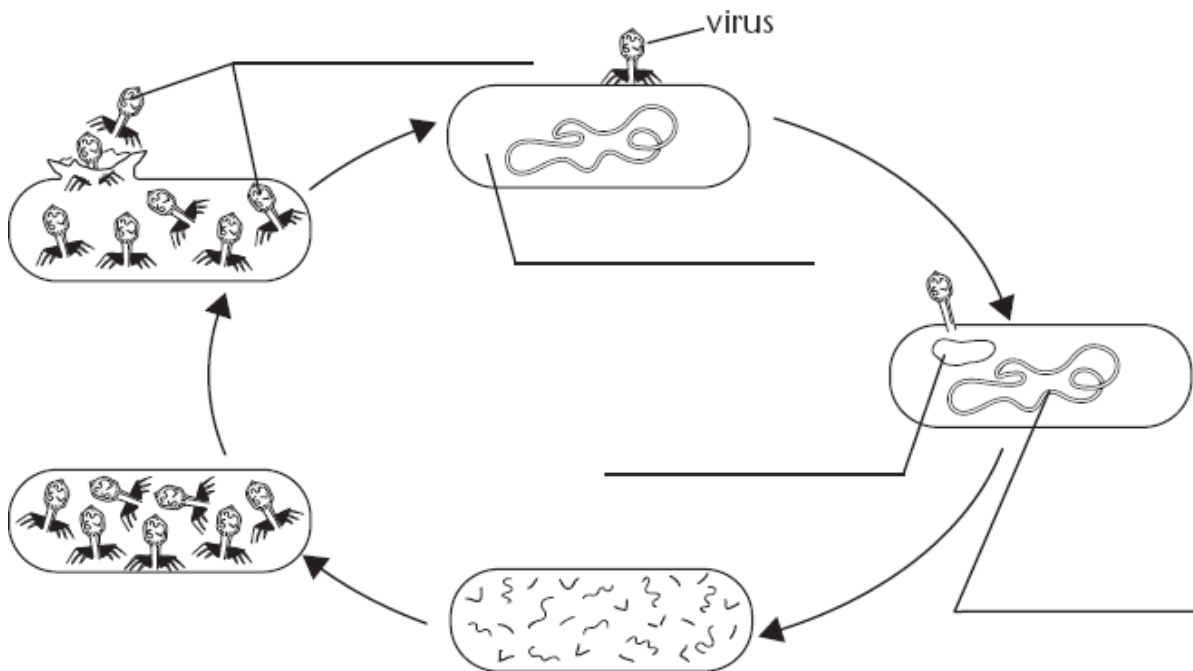
5. What occurs when viruses get inside cells?

Viral Infections

6. **VISUAL ANALOGY** In the visual analogy, why is the outlaw locking up the sheriff, instead of the other way around?



7. **THINK VISUALLY** The diagram below shows the lytic cycle of a viral infection. Label the bacterial DNA, host bacterium, viral DNA, and virus. Then, circle the step that shows lysis of the host cell.



8. In a lysogenic infection, how can one virus infect many cells?




9. How is the common cold like the HIV virus?

Apply the Big idea

10. What would happen to a virus that never came in contact with a living cell? Explain your answer.

20.2 Prokaryotes

Lesson Objectives

-  Explain how the two groups of prokaryotes differ.
-  Describe how prokaryotes vary in structure and function.
-  Explain the role of bacteria in the living world.

Lesson Summary

Classifying Prokaryotes The smallest and most common microorganisms are **prokaryotes**, which are unicellular organisms that lack a nucleus. Prokaryotes are classified either in domain Bacteria or domain Archaea.

- ▶ They can be surrounded by a cell wall, which contains peptidoglycan. Inside the cell wall is a cell membrane surrounding the cytoplasm.
- ▶ Archaea look similar to bacteria, but are genetically closer to eukaryotes. Archaea lack peptidoglycan and have different membrane lipids than bacteria.

Structure and Function Prokaryotes are identified by characteristics such as shape, the chemical nature of their cell walls, the way they move, and the way they obtain energy.

- ▶ **Bacilli** are rod-shaped. **Cocci** are spherical. **Spirilla** are spiral or corkscrew-shaped.
- ▶ Most prokaryotes are heterotrophs. Others are autotrophs. Autotrophs may be photoautotroph, or chemoautotrophs.
- ▶ Prokaryotes that require a constant supply of oxygen to live are called obligate aerobes. Those that cannot survive in oxygen are called obligate anaerobes. Organisms that can survive without oxygen when necessary are called facultative anaerobes.

Prokaryotes reproduce asexually by **binary fission**, which results in two identical “daughter” cells. Many prokaryotes can form **endospores** when conditions are unfavorable in order to protect their DNA. They can also exchange genetic information by **conjugation**.

The Importance of Prokaryotes Prokaryotes are vital to maintaining the ecological balance of the living world.

- ▶ Some are decomposers that break down dead matter.
- ▶ Others are producers that carry out photosynthesis.
- ▶ Some soil bacteria convert natural nitrogen gas into a form plants can use through a process called nitrogen fixation.
- ▶ Humans use bacteria in industry, food production, and other ways.

Classifying Prokaryotes

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

1. Unicellular organisms that lack a nucleus are called _____.
2. The two different domains of prokaryotes are _____ and _____.
3. A cell wall made of _____ protects some bacteria from damage.

4. Archaea are more closely related to _____ than _____.
5. Some bacteria have a second _____ outside the cell wall.
6. **THINK VISUALLY** Use the box to draw and label a diagram of a typical bacterium.

Structure and Function

Write the letter of the correct answer on the line at the left.

- _____ 7. What are rod-shaped bacteria called?
 - A. cocci
 - B. bacilli
 - C. spirilla
 - D. endospores
 - _____ 8. What are spherical bacteria called?
 - A. cocci
 - B. bacilli
 - C. spirilla
 - D. endospores
 - _____ 9. Whiplike structures on a bacterium that produce movement are called
 - A. pilli.
 - B. capsids.
 - C. flagella.
 - D. endospores.
10. Complete the table about the different ways prokaryotes obtain energy.

Energy Capture by Prokaryotes	
Group	Description
	Organism that carries out photosynthesis in a manner similar to that of plants
Chemoautotroph	
	Organism that takes in organic molecules and then breaks them down
Photoheterotroph	

11. What occurs in the process of binary fission?

12. What occurs during conjugation?

The Importance of Prokaryotes

13. How do decomposers help the ecosystem recycle nutrients when a tree dies?

14. What would happen to plants and animals if decomposers did not recycle nutrients?

15. Why do all organisms need nitrogen?

16. Why is the process of nitrogen fixation important?

17. What kind of relationship do many plants have with nitrogen-fixing bacteria?




18. Describe three different ways that humans use bacteria.

Apply the Big idea

19. Suppose you were studying an infectious unicellular organism with a cell wall under a microscope. How could you confirm that the organism was a prokaryote? How could scientists determine whether it should be classified in domain Bacteria or domain Archaea?

20.3 Diseases Caused by Bacteria and Viruses

Lesson Objectives

-  Explain how bacteria cause disease.
-  Explain how viruses cause disease.
-  Define emerging disease and explain why emerging diseases are a threat to human health.

Lesson Summary

Bacterial Diseases Microorganisms that cause diseases are known as **pathogens**. Bacterial pathogens can produce many diseases that affect humans and other animals. They do so in one of two general ways:

- ▶ They destroy living cells and tissues directly or by causing an immune response that destroys tissue.
- ▶ They damage the cells and tissues of the infected organism directly by breaking down the cells for host.
- ▶ They release toxins (poisons) that travel throughout the body, interfering with the normal activity of the host.

Many bacterial pathogens can be controlled by washing, using disinfectants, preparing and storing food safely, or sterilizing exposed items. Bacterial diseases can be prevented and treated through the following methods:

- ▶ A **vaccine** is a preparation of weakened or killed pathogens or inactivated toxins. A vaccine can prompt the body to produce immunity to the disease. Immunity is the body's natural way of killing pathogens.
- ▶ When a bacterial infection does occur, **antibiotics** can be used to fight the disease. Antibiotics are compounds that block the growth and reproduction of bacteria.

Viral Diseases Viruses produce disease by directly destroying living cells or by affecting cellular processes in ways that disrupt homeostasis. In many viral infections, viruses attack and destroy certain body cells, causing the symptoms of the disease. Viral diseases in humans include the common cold, influenza, AIDS, chicken pox, and measles. Viruses produce other serious diseases in other animals and in plants. Protection against viruses, either by hygiene or vaccination, is the best way to avoid viral illness. A handful of antiviral drugs have been developed that help reduce the symptoms of specific viruses.

Emerging Diseases An unknown disease that appears in a population for the first time or a well-known disease that suddenly becomes harder to control is called an **emerging disease**. The increase of worldwide travel and food shipments is one reason new diseases are spreading. Another is virus and bacteria evolution. Scientists are struggling to keep up with changes. They recently discovered **prions**, which are disease-causing forms of proteins. Prions cause disease in animals, including humans.

Bacterial Diseases

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

1. One way bacteria can cause disease is by breaking down and damaging _____ of the infected organism.
2. Bacteria can also cause disease by releasing _____ that harm the body.
3. A(n) _____ is a disease-causing agent.
4. One way to control bacterial growth is by subjecting the bacteria to high temperatures during a process known as _____.
5. A(n) _____ is a preparation of weakened or killed pathogens or inactivated toxins that can prompt the body to produce immunity to a disease.
6. What organs do the bacteria that cause tuberculosis typically damage?

7. What are antibiotics?

8. How are the causes of tuberculosis and diphtheria similar? How are they different?

9. Describe the similarities and differences of antibiotics and disinfectants.

10. Why should meat be cooked until it is well-done?

Match the bacterial control method with an example of the method

Bacterial Control Method

- _____ 11. physical removal
- _____ 12. disinfectant
- _____ 13. safe food storage
- _____ 14. safe food processing
- _____ 15. sterilization by heat

Example

- A. Putting milk in a refrigerator
- B. Using bleach to clean a countertop
- C. Using boiling water to clean dishes
- D. Washing hands
- E. Boiling soup

Viral Diseases

16. What are some human diseases caused by viruses?

17. How do antiviral medications work? Why don't they also kill host cells?

Write the letter of the correct answer on the line at the left.

_____ 18. A person has a low helper-T cell count. What viral disease does he or she most likely have?

A. HPV

C. hepatitis B

B. AIDS

D. chicken pox

_____ 19. A person has blister-like lesions on the skin. What viral disease does he or she most likely have?

A. HPV

C. hepatitis B

B. AIDS

D. chicken pox

Emerging Diseases

For Questions 20-24, write True if the statement is true. If the statement is false, change the underlined word or words to make the statement true.

_____ 20. Pathogens are able to evolve over time.

_____ 21. A(n) noninfectious disease is an unknown disease that appears in a population for the first time.

_____ 22. The widespread use of vaccines has led to the emergence of resistant strains of bacteria.

_____ 23. Slight genetic changes would be needed for the bird flu virus to become infectious to humans.

_____ 24. Scrapie is most likely caused by pathogens known as viroids.

Apply the Big idea

25. RNA viruses have shown an ability to evade antiviral drugs. How do you suppose this is possible, when viruses are not alive? How may the reproductive methods of viruses help the process?

Chapter Vocabulary Review

1. The picture shows three different bacteria shapes. Label each shape.



Match the term with its definition

Term

- _____ 2. lysogenic infection
- _____ 3. prion
- _____ 4. bacteriophage
- _____ 5. antibiotic
- _____ 6. virus
- _____ 7. prokaryote
- _____ 8. prophage
- _____ 9. pathogen
- _____ 10. lytic infection
- _____ 11. endospore
- _____ 12. binary fission
- _____ 13. vaccine

Definition

- A. Compound that can block the growth and reproduction of bacteria
- B. Misfolded protein that causes disease in animals
- C. Bacteriophage DNA that is embedded in the host's DNA
- D. Protective structure formed by a prokaryote when growth conditions are unfavorable
- E. A particle made of nucleic acid, protein, and in some cases, lipids that can replicate only by infecting living cells
- F. Process in which viral DNA becomes part of a host cell's DNA
- G. Disease-causing microorganism
- H. Preparation of weakened or killed pathogens or inactivated toxins used to produce immunity
- I. Process in which a host cell bursts after being invaded by a virus
- J. Organism consisting of one cell that lacks a nucleus
- K. Virus that infects bacteria
- L. Process in which a bacterium replicates its DNA and divides in half

Complete each statement by writing the correct word or words.

14. A protein coat surrounding a virus is a(n) _____.
15. Viruses that have RNA as their genetic material are called _____.
16. Some bacteria exchange genetic material through the process of _____.
17. SARS, MRSA, Ebola, and bird flu are all examples of _____.