Reproduction of Viruses

The structure of viruses allows them to succeed in their main mission—reproduction.

Lytic Cycle Once attached to a host cell, a virus injects its nucleic acid into the cell. The nucleic acid takes over the normal operation of the host cell and produces multiple copies of the virus's protein coat and nucleic acid. Once produced, the protein coats and the nucleic acids are assembled into new viruses. As the host cell fills with newly assembled viruses, it bursts, just like a balloon with too much air. The host cell then dies, and the released viruses begin searching for the next host cell. This type of viral reproduction is called a **lytic** (LIT ihk) **cycle**. The steps of a lytic cycle for a bacteriophage are illustrated in **Figure 7.4**.

Lysogenic Cycle Some viruses, such as herpes and HIV, enter the host cell but remain hidden for years. Even though the viral nucleic acid becomes part of the host cell's chromosome, it does not seem to affect the functions of the cell. At some point, however, the viral nucleic acid becomes active. It separates itself from the host cell's genetic material, takes over the functions of the cell to produce new viruses, and destroys the host cell as the new viruses are released. This type of viral reproduction is called a **lysogenic** (li suh JE nihk) **cycle**. The steps of a lysogenic cycle are also shown in **Figure 7.4**.

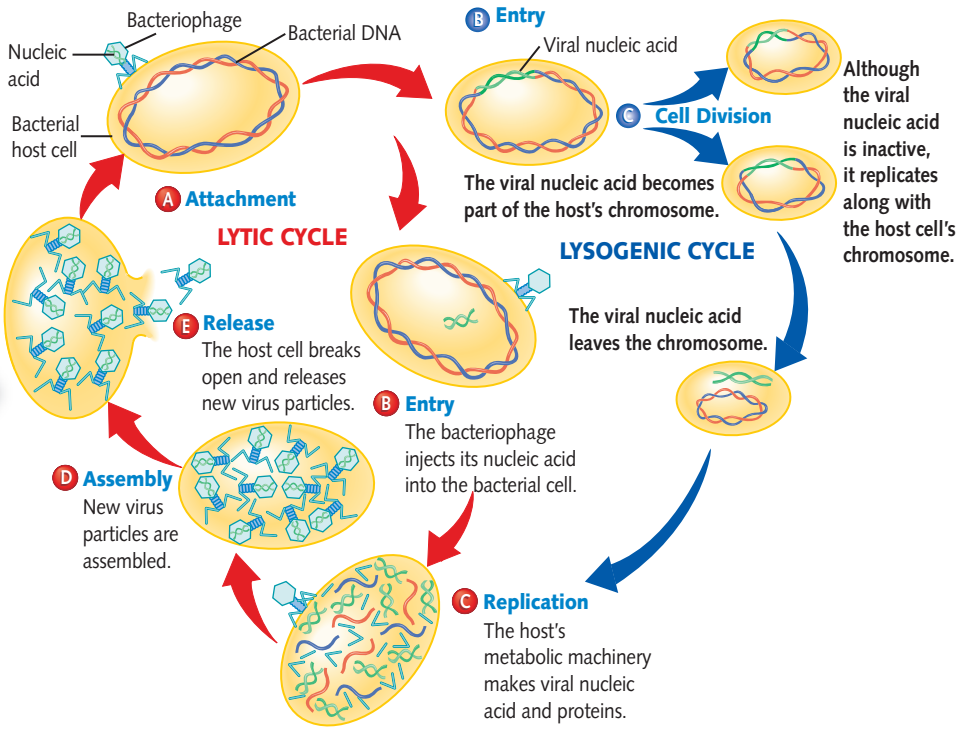


Figure 7.4 In a lytic cycle (red arrows), the virus uses the host cell's organelles to make new viruses. In a lysogenic cycle (blue arrows), the virus "hides" in the host cell's chromosome until it becomes active and uses the host cell's organelles to reproduce.

Did You Know?

The word *reproduce* is commonly used when discussing viruses, but in the strictest sense, viruses do not reproduce. Viruses use the machinery of the host cell to replicate themselves by creating an exact copy of the virus, just as a copy machine is used to replicate a document. Whatever you call it, however, the result is the same: viruses multiply!

Explain It!

Once a computer virus infects a machine, the virus can spread to other disks, programs, and even other computers. In your Science Notebook, explain why the term *virus* is a good description of these computer invaders.

Figure It Out

1. What are the steps in a lytic cycle?
2. Compare and contrast a lytic cycle and a lysogenic cycle.

Viruses in the World

If you have ever had a cold or the flu or a childhood illness such as measles or chicken pox, you know that viruses can make you sick. But did you know that viruses can also protect you from diseases and save your life? As a young child, you received vaccinations (vak suh NAY shunz) made of dead or weakened viruses to protect you against viruses that try to invade your body.

Scientists are also using the ability of viruses to invade cells as a "delivery service" for genetic information that a person needs to treat or cure a disease. In gene therapy, viruses deliver normal genes that replace missing or faulty genes. Although gene therapy is a relatively new medical treatment, doctors are hopeful that it will be used widely in the future.

Viruses also affect plants and other animals. Your pets are vaccinated against diseases such as rabies and distemper to prevent infection by these deadly viruses. Other viruses that infect plants and animals can have an important economic impact. In the 1990s, cattle in Europe were infected with the virus that causes hoof-and-mouth disease. Thousands of animals had to be destroyed to prevent the spread of the disease. This caused a loss of millions of dollars.

Viruses can also be used to control pests that destroy crops used as food. The advantage of treating crops in this way is that it destroys harmful insects without polluting the environment.

Figure 7.5 These young people are receiving vaccinations for polio. Vaccines protect and save millions of lives. What vaccines have you received?

Figure 7.6 The stripes on this tulip were produced by the tulip mosaic virus.

CONNECTION: History

European explorers were able to conquer the Americas with small armies because they unknowingly brought with them a powerful weapon—an invisible army of viruses. Native Americans had never been exposed to these viruses, and the deaths caused by mumps, measles, diphtheria, and smallpox allowed the Europeans to defeat even the mighty Aztec empire.

Extend It!

Most schools require students to receive specific vaccinations at specific times before they can enroll or remain in school. Ask your school nurse or other administrator for a list of the vaccinations required by your school. Review the requirements and prepare a chart that shows the vaccination schedule for students in your grade. Why do you think it is important to have this requirement?

After You Read

1. Review the words and phrases you used in your "biopoem." Correct any of your predictions now that you know more about viruses. Select a title for your poem that you think best describes viruses. Are all viruses harmful? Explain your answer in a well-developed paragraph.
2. Describe the structure of viruses.
3. Compare the two ways in which viruses reproduce.
4. Is a virus a host or a parasite? Explain your answer.

7.2 Bacteria

Learning Goals

- Describe bacteria.
- Explain how bacteria reproduce.
- Identify how bacteria are important in the world.

New Vocabulary

bacterium
bacillus
coccus
spirillum
flagellum
binary fission
conjugation

Before You Read

In your Science Notebook, create a K-W-L-S-H chart. Think about the title of this lesson and read the Learning Goals. In the column labeled *K*, write what you already know about bacteria. In the column labeled *W*, write what you want to learn about bacteria.

Bacteria are everywhere. They can live in the saltiest waters on Earth, in hot springs and volcanic vents, in the freezing ice of the arctic, and even on your body. You cannot see or feel them, but bacteria live in your hair, lungs, mouth, stomach, and intestines. They practically cover your skin. They especially like your warm, moist armpits and your sweaty feet.

What Are Bacteria?

Microscopic prokaryotic cells are called **bacteria** (bak TIHR ee uh, singular: bacterium). As discussed in Chapter 3, prokaryotes do not have a membrane-bound nucleus or membrane-bound organelles, and their DNA is not organized into chromosomes.

Living or Nonliving? Even though a bacterium is microscopic and composed of only one cell, it is considered a living thing. Unlike the viruses you studied in Lesson 7.1, bacteria can sense and respond to stimuli, adapt to their environment, reproduce, and use energy to grow and develop. This is similar to the behavior of more complex organisms.

Classifying Bacteria Because bacteria are among the most numerous organisms on Earth, an amazing variety of them exists. Biologists group bacteria into two kingdoms, Archaebacteria and Eubacteria. *Archaebacteria* means "ancient bacteria." Scientists believe that these bacteria resemble Earth's first forms of life. Archaebacteria are often found in very harsh environments. Eubacteria is a much larger group of bacteria, and members of this kingdom are found everywhere that members of Archaebacteria are not. These are the bacteria that are found on and in your body, as well as in the soil, the air, and the water.

Types of Bacteria

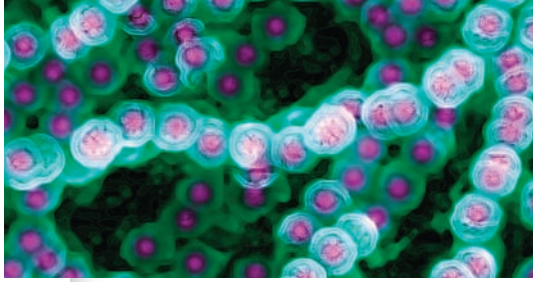
There may be thousands of different types of bacteria, but they all have one of the three basic shapes shown in **Figure 7.7**. These basic shapes provide biologists with one way to identify different bacteria.

Did You Know?

Bacteria get their energy in a variety of ways. Some bacteria are heterotrophs and get their food from other organisms. Some bacteria are autotrophs that capture matter and energy from their surroundings using energy from the Sun or chemicals in the environment.

Bacilli

Spirilla



Cocci

Figure 7.7 Bacteria can be identified by their shapes.

Bacteria that are shaped like sticks or rods are called **bacilli** (buh SIH li, singular: bacillus). Bacteria that are shaped like globes or spheres are called **cocci** (KAH ki, singular: coccus). Bacteria that are shaped like corkscrews or spirals are called **spirilla** (spi RIH luh, singular: spirillum).

Structure of Bacteria The cells of bacteria are prokaryotic cells. Because bacteria are cells, they have some of the same structures that were discussed in Chapter 3. As you read this section, locate each structure in **Figure 7.8**.

The outer wall of most bacteria is the cell wall. The cell wall is rigid and tough, and it protects the bacterial cell and determines its shape. Inside the cell wall is the cell membrane. The cell membrane controls what substances enter and leave the bacterial cell. Inside the cell membrane is the jelly-like cytoplasm that contains all the other structures found in a bacterial cell.

DNA, the bacterial cell's genetic material, is the rope-like tangle in the cytoplasm. Because bacteria are prokaryotes, their DNA is not enclosed in a nucleus. However, the DNA still controls the activities of the cells. The production of proteins is carried out by the ribosomes found throughout the cytoplasm.

Another structure found on some bacteria is the flagellum. **Flagella** (fluh JEH luh, singular: flagellum) are whiplike structures that extend outward from the cell membrane into the bacterial cell's environment and move the cell through that environment. Bacteria without flagella must depend on air or water currents or other living organisms to move from one place to another.

As You Read

In the column labeled *L* in your K-W-L-S-H chart, write three or four things you have learned about bacteria.

Are bacteria prokaryotes or eukaryotes? How do you know?

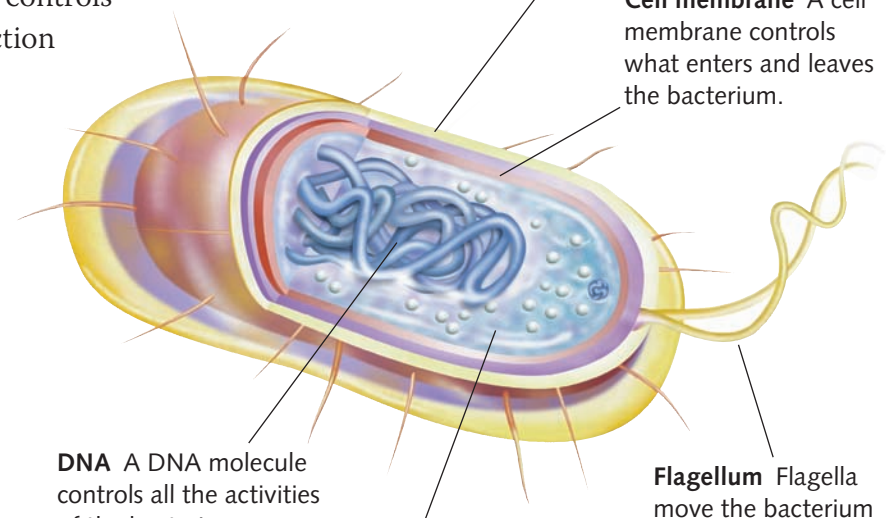


Figure 7.8 A typical gram-negative bacterial cell would have the structures shown in this diagram.