

KEY CONCEPT

1.3

Viruses are not alive but affect all living things.

BEFORE, you learned

- Most organisms are made of a single cell
- Living things share common characteristics
- Viruses are not living things

NOW, you will learn

- About the structure of viruses
- How viruses use a cell's machinery to reproduce
- How viruses affect host cells

VOCABULARY

host cell p. 26

EXPLORE Viruses

How were viruses discovered?

PROCEDURE

- 1 Fill a small container with mixed sesame seeds and salt.
- 2 Holding the sieve over the paper plate, pour the mixture into the sieve.
- 3 Gently shake the sieve until nothing more falls through.
- 4 Using a hand lens, examine the material that fell through the sieve and the material that stayed in the sieve.

MATERIALS

- small container
- sesame seeds
- table salt
- small kitchen sieve
- paper plate
- hand lens

WHAT DO YOU THINK?

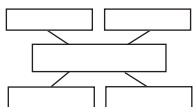
- What is the most important difference between the particles that got through the sieve and the particles that remained behind?
- How could you change your sieve to make it not let through both kinds of particles?



Viruses share some characteristics with living things.

MAIN IDEA WEB

Remember to make a web of the important terms and details about the main idea: *Viruses share some characteristics with living things.*



In the late 1800s, scientists such as Louis Pasteur showed that some small organisms can spoil food and cause disease. Once the cause was found, scientists looked for ways to prevent spoilage and disease. One method of prevention they found was removing these harmful organisms from liquids.

Bacteria may be removed from liquids by pouring the liquid through a filter, like a coffee filter or a sieve. To remove bacteria, a filter must have holes smaller than one millionth of a meter in diameter.

INVESTIGATE Viruses

How do infections spread?

PROCEDURE

- 1 Get a cup of sample liquid from your teacher. Pour half the liquid from your cup into the cup of a classmate, then pour the same amount back into the original cup. Your cup should then contain a mixture of the liquids from both cups.
- 2 Repeat step 1 with at least two other classmates.
- 3 Drop one drop of solution A into your paper cup. If it changes color, you are “infected.” If you were “infected,” add drops of solution B until your liquid turns clear again. Count how many drops it takes to “cure” you.

WHAT DO YOU THINK?

- If you were “infected,” can you figure out who “infected” you?
- If you were not “infected,” is it possible for anyone who poured liquid into your cup to be “infected”?

CHALLENGE Only one person in your class started out with an “infection.” Try to figure out who it was.

SKILL FOCUS
Analyzing

MATERIALS

- paper cup
- sample liquid
- solution A
- solution B

TIME
30 minutes



When a filter had removed all of the harmful organisms from a liquid, the liquid no longer caused any illnesses. This method worked when there was only bacteria in the liquid. Sometimes filtering did not prevent disease. Something much smaller than bacteria was in the liquid. Scientists called these disease-causing particles viruses, from the Latin word for “slimy liquid” or “poison.”



Learn more about viruses.

CHECK YOUR READING

How does the size of viruses compare with the size of bacteria?

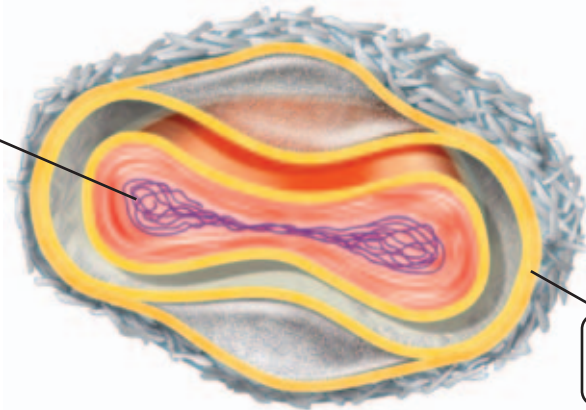
Scientists have learned much about viruses, and can even make images of them with specialized microscopes. Viruses consist of genetic material contained inside a protective protein coat called a capsid. The protein coat may be a simple tube, such as the coat of an ebola virus, or have many layers, such as the smallpox virus shown on page 26.

Viruses may come in many shapes and sizes, but all viruses consist of a capsid and genetic material. The ability of viruses to make copies of their genetic material is one way that viruses are similar to living things. Also the protein coat is similar to a cell’s outer membrane. But viruses do not grow, and viruses do not respond to changes in their environment. Therefore, viruses are not living organisms.

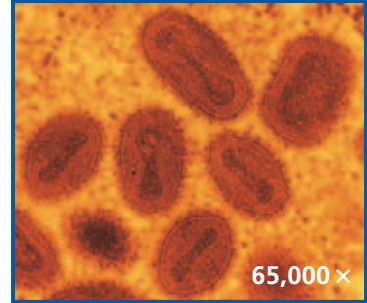
Virus

All viruses, including this smallpox virus, contain genetic material surrounded by a capsid.

The **genetic material** stores information the virus needs to make copies of itself.



Smallpox Virus



The **capsid** protects the genetic material and gives shape to the virus.

Viruses multiply inside living cells.



VISUALIZATION
CLASSZONE.COM

See how viruses infect and multiply within bacteria.

Remember that all living things reproduce. Viruses cannot reproduce by themselves, which is one of the ways they are different from living things. However, viruses can use materials within living cells to make copies of themselves. The cells that viruses infect in order to make copies are called **host cells**. Despite their tiny size, viruses have the ability to cause a lot of damage to cells of other organisms.

One of the best studied viruses infects bacteria. It's called a bacteriophage (bak-TEER-ee-uh-FAYJ), which comes from the Latin for "bacteria eater." Some of the steps that a bacteriophage goes through to multiply are shown in the illustration.

- 1 Attachment** The virus attaches to the surface of a bacterium.
- 2 Injection** The virus injects its DNA into the bacterium.
- 3 Production** Using the same machinery used by the host cell for copying its own DNA, the host cell makes copies of the viral DNA.
- 4 Assembly** The viral DNA forces the infected cell to assemble new viruses from the parts it has created.
- 5 Release** The cell bursts open, releasing 100 or more new viruses.

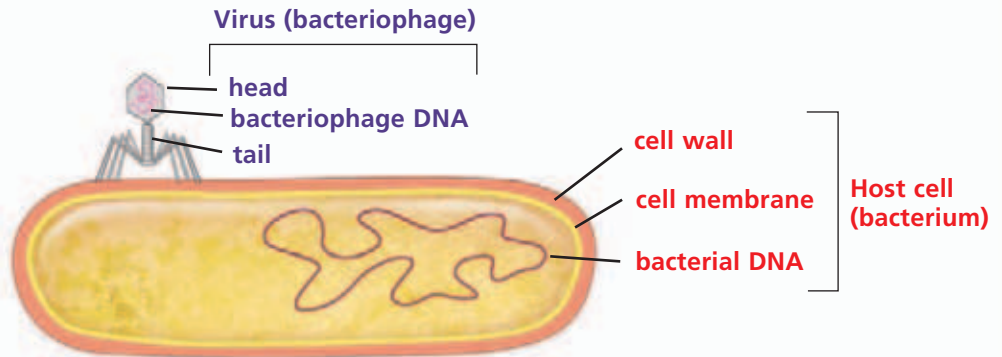
Viruses have proteins on their surfaces that look like the proteins that the host cell normally needs. The virus attaches itself to special sites on the host that are usually reserved for these proteins.

Not every virus makes copies in exactly the same way as the bacteriophage. Some viruses are inside host cells. Others use the host cell as a factory that produces new viruses one at a time. These viruses may not be as harmful to the infected organism because the host cell is not destroyed.

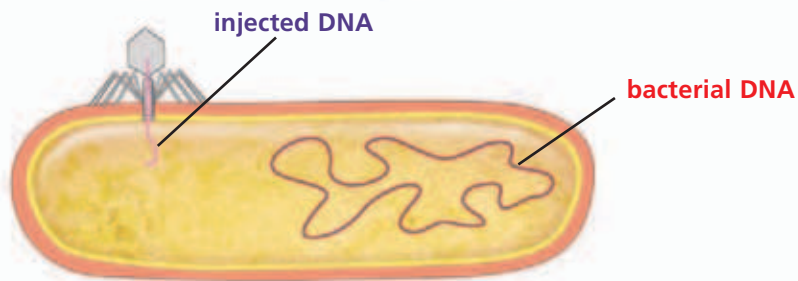
Making New Viruses

Viruses, such as this bacteriophage, use other cells to make new viruses.

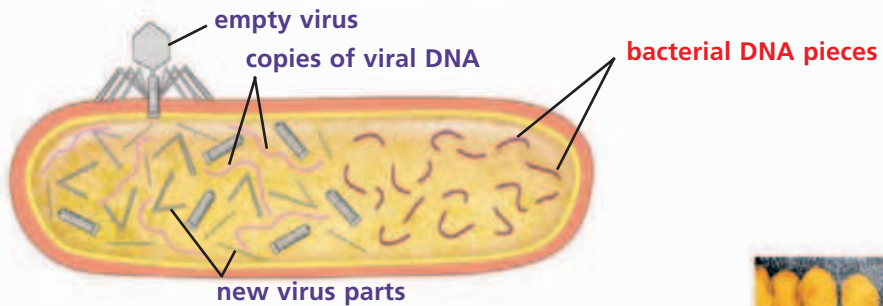
- 1 Attachment**
The bacteriophage virus attaches to a bacterium.



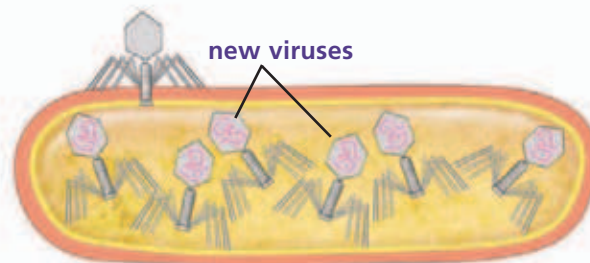
- 2 Injection**
The virus breaks through the cell wall and cell membrane and injects its DNA into the host cell.



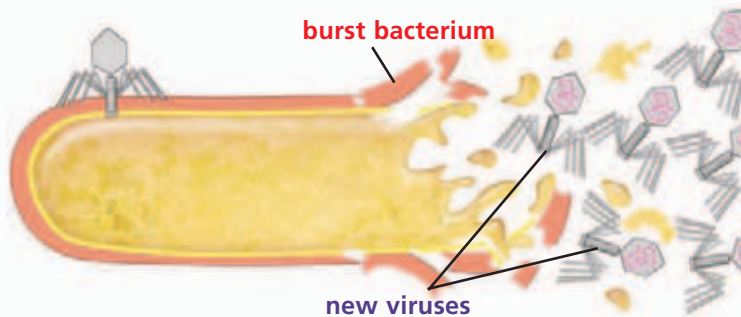
- 3 Production**
The viral DNA breaks down the host cell's DNA and uses the host cell's machinery to produce the parts of new viruses.



- 4 Assembly**
The viral DNA uses the host cell's machinery to assemble new viruses.



- 5 Release**
The host cell breaks apart and new viruses that are able to infect other host cells are released.





Rows of hospital beds are filled with Massachusetts influenza patients in 1918.

Viruses may harm host cells.

A host cell does not often benefit from providing living space for a virus. The virus uses the cell's material, energy, and processes. In many cases, after a virus has made many copies of itself, the new viruses burst out of the host cell and destroy it.

Harmful viruses cause huge problems. Viruses that cause diseases such as polio, smallpox, diphtheria, or AIDS have had a major impact on human history. About 25 million people died of influenza in an outbreak that occurred just after World War I.

In the photograph, nurses work to ease the symptoms of infected patients. The most infectious patients were enclosed in tents. Others were made as comfortable as possible on beds outside. Since viruses such as influenza can spread quickly, the camp was isolated from the rest of the community.

Plant viruses can stunt plant growth and kill plants. When plant viruses invade crop plants, they can cause much economic damage, decreasing food production. Plants, animals, bacteria, and all other living things are capable of being infected by viruses.

Today, scientists are discovering ways to use viruses in a positive way. Scientists use viruses to insert certain pieces of genetic material into living cells. For example, the portion of genetic material that allows some marine organisms to produce a chemical that glows can be inserted into tissue samples to help with their identification.

1.3 Review

KEY CONCEPTS

1. What are the two parts that every virus has?
2. Why are viruses not considered to be living things?
3. Explain how copies of viruses are produced.

CRITICAL THINKING

4. **Compare and Contrast** What features do viruses and cells have in common? How are they different?
5. **Explain** Summarize the steps by which a bacteriophage makes new viruses.

CHALLENGE

6. **Synthesize** What characteristics of viruses can make them so dangerous to humans and other living organisms?