

KEY IDEAS**As you read this section, keep these questions in mind:**

- Why is a virus not considered a living organism?
- What two structures are characteristic of viruses?
- What are two ways that a virus can reproduce?
- What are viroids and prions?

READING TOOLBOX

Summarize As you read this section, underline the main ideas. When you finish reading, write a summary of the section using the underlined ideas.

Critical Thinking

1. Apply Concepts Do viruses have mitochondria? Explain your answer.

Background

Recall that *metabolism* is the sum of all chemical processes that occur in an organism.

READING CHECK

2. Identify Where do viruses make copies of their genetic information?

Is a Virus Alive?

All living things are made of cells, are able to grow and reproduce, and have DNA that dictates their traits. Viruses are not considered living because they do not share all the characteristics of living things. Viruses have the following properties:

- Viruses are not made of cells. They have genetic material, but they do not have any cytoplasm or organelles.
- Viruses cannot reproduce on their own. They reproduce by infecting host cells and using the cell's ribosomes, enzymes, and other molecules to make more viruses.
- Viruses do not grow. They become full size within the host cells where they are reproduced.
- Viruses do not carry out metabolic activities, and do not maintain internal balance or homeostasis.

What Is the Structure of a Virus?

All viruses have nucleic acid and a protein coat called a **capsid**. In addition, viruses may have tail fibers or a covering called an envelope.

NUCLEIC ACIDS

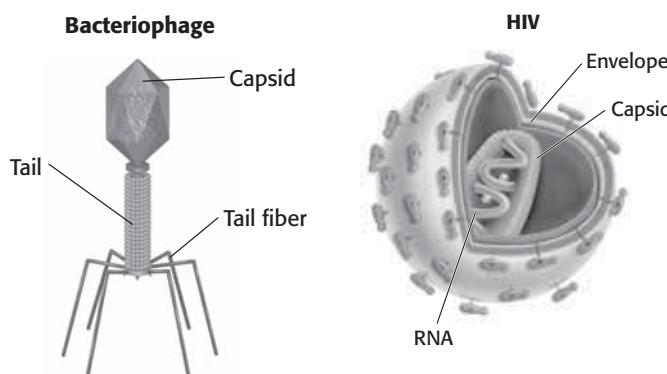
Viral nucleic acid can be either DNA or RNA. Both DNA and RNA viruses insert their genetic material into a host cell. They use the host cell's enzymes and nucleotides to make more copies of their genetic material. 

The genetic material of viruses codes for the structural parts of a virus. Viruses also use the host cell to make new viral proteins. In RNA viruses called *retroviruses*, viral DNA is first transcribed into DNA before it can be used to make viral proteins.

SECTION 2 Viruses *continued***CAPSID AND TAIL FIBERS**

The protein coat, or capsid, of a virus surrounds its genetic material. Viruses can enter a host cell only if the proteins in their capsid match the proteins on the surface of the host cell. Capsids have a variety of shapes.

In some viruses, such as bacteriophages, the capsid is attached to a helical tail with tail fibers. **Bacteriophages**, shown below left, are viruses that infect bacteria. Their tail and tail fibers help inject the viral DNA into a bacterium.

**READING CHECK**

- 3. Define** What is a bacteriophage?
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LOOKING CLOSER

- 4. Identify** What is the genetic material in HIV?
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ENVELOPE

Many viruses have a membrane, called an **envelope**, which surrounds the capsid. The envelope is covered with molecules that help the virus attach to its host cell. HIV, shown above right, is a retrovirus that has an envelope. The envelope of HIV covers an oval-shaped capsid.

How Do Viruses Reproduce?

A viral infection begins when the genetic material of a virus enters a host cell. Once inside a host cell, a virus can reproduce by a lysogenic cycle and/or a lytic cycle.

**READING CHECK**

- 5. Identify** What viral structure does an envelope cover?
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LYSOGENIC CYCLE

In the **lysogenic** cycle, a virus inserts its DNA into the host cell's chromosome. The infecting virus is then called a provirus or *prophage*. When the host cell replicates its own DNA, it also replicates the viral DNA. When the host cell divides, each new cell receives a copy of the viral DNA along with a copy of its own DNA. In the lysogenic cycle, viral DNA is replicated but no new viruses are made. In addition, the host cell is not destroyed.

**READING CHECK**

- 6. Explain** When does a prophage form?
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SECTION 2 Viruses *continued***LYTIC CYCLE**

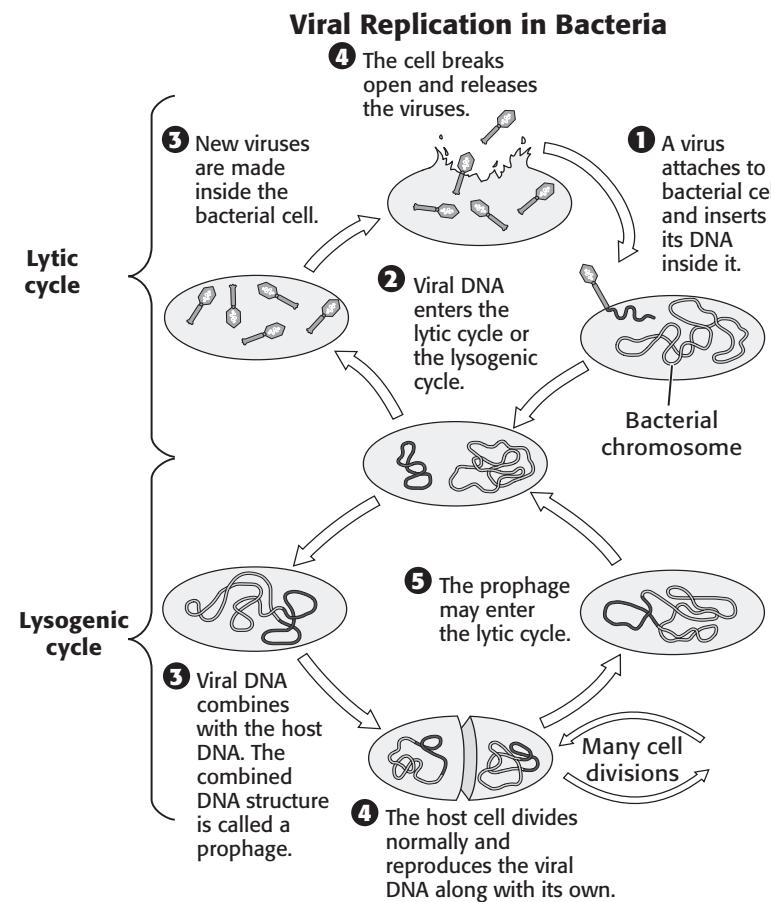
After a period of time, a prophage may leave the host cell's DNA and enter the lytic cycle. In the **lytic** cycle, viral DNA remains separate from the host cell's DNA. The virus uses the host cell to replicate its genetic material and make proteins to build new viruses. The host cell then breaks open and dies, releasing the newly made viruses. Some viruses reproduce only by the lytic cycle. 

 **READING CHECK**

- 7.** **Describe** What happens to the host cell at the end of the lytic cycle?

LOOKING CLOSER

- 8.** **Describe** Where is viral DNA located in the lysogenic cycle?

**What Are Viroids and Prions?**

Viroids and prions are nonliving particles that can cause disease. A *viroid* is a single strand of RNA that has no capsid. Inside a host cell, this RNA can make new viroids that interfere with the host cell's growth. 

A *prion* is a protein with an abnormal shape that attaches to normal proteins in the brain. The prion causes the normal proteins to stop functioning. As a result, brain tissue is destroyed. Prions cause mad cow disease in cattle and Creutzfeldt-Jakob disease in humans.

 **READING CHECK**

- 9.** **Compare** How is the structure of a viroid different from the structure of a virus?

Section 2 Review

SECTION VOCABULARY

bacteriophage a virus that infects bacteria

capsid a protein sheath that surrounds the nucleic acid core in a virus

envelope a membranelike layer that covers the capsids of some viruses

lysogenic describes viral replication in which a viral genome is replicated as a provirus without destroying the host cell

lytic describes viral replication that results in the destruction of a host cell and the release of many new virus particles

- 1. Summarize** Use the words “yes” and “no” to indicate whether each property listed below describes living things, viruses, or both.

| Property | Living Things | Viruses |
|--|---------------|---------|
| Made of cells | | |
| Have genetic material | | |
| Can grow | | |
| Can reproduce on their own | | |
| Can only replicate DNA inside host cells | | |

- 2. Identify** What two structures do all viruses have?

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- 3. Identify** What structures help a bacteriophage inject its DNA into a bacterium?

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- 4. Compare** Describe three ways in which the lysogenic cycle and lytic cycle are different.

- 5. Describe** When a host cell divides in the lysogenic cycle, what genetic material does each new cell receive?

- 6. Describe** What is a prion and how does it cause disease?
