2.1.1 *The Structure of Viruses*

OBJECTIVES

- Defend the arguments for and against considering viruses as life-forms.
- Describe the basic characteristics of viruses.

VOCABULARY

- **electron microscope** a microscope that uses a beam of electrons to produce magnified images
- **virus** a tiny particle that contains nucleic acid encased in protein

TRY THIS

Virus Model

Construct a simple virus model. Twist two pipe cleaners to represent DNA or use single pipe cleaners to represent RNA strands of nucleic acid. Use plastic connecting bricks or other building materials to surround the virus and construction paper to surround the genetic material. Compare your virus to electron micrographs of actual viruses. In relation to the approximate size ratio of a virus to a cell, how large a cell would your virus infect?

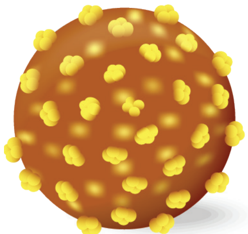
Have you ever had a virus? The answer must be yes because even if you have never had influenza or the chicken pox, you cannot have escaped the common cold. When people say they have a virus, they mean that they have an illness caused by a virus. Some of these illnesses are minor; others are serious. Today viruses can cause deadly diseases such as AIDS and hepatitis. Even though viruses are extremely small, they play a destructive role in the world.

What comes to mind when you hear the word *virus*? You probably think of feeling sick or of being vaccinated for measles or mumps, two illnesses caused by viruses. But what exactly are viruses? What are these things that can cause so much misery?

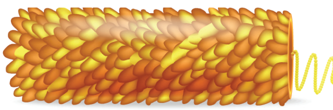
A **virus** is a tiny particle that contains nucleic acid—either DNA or RNA—encased in protein. Nucleic acids are organic compounds that contain genetic information and the information necessary for an organism to make the protein it needs. Some viruses are also surrounded by a membrane. Given all the trouble they cause, you might be surprised to learn how small viruses are. They are much smaller than the tiniest cell—only 17–300 nanometers. (A nanometer is one-billionth of a meter.) Tens of thousands of the largest viruses could line up in a centimeter.

Because viruses are about 300 times smaller than a cell, for centuries people knew them only by the diseases that they caused. But when the electron microscope was invented in 1931, microbiologists were able to look at viruses. An **electron microscope** uses a beam of electrons instead of light to detect objects, which allows objects as small as 0.5 nanometers in diameter to be seen. The electron microscope allowed scientists to see that just as each disease caused by a virus is different, so the size

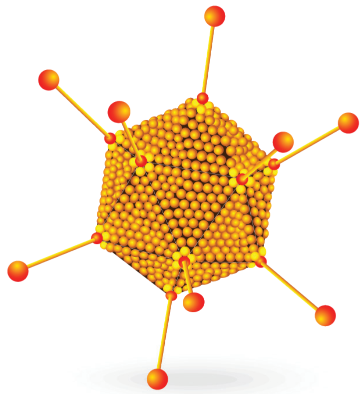
Virus Shapes



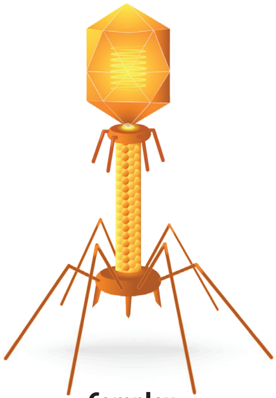
Spherical
(Influenza)



Helical
(Tobacco mosaic virus)



Polyhedral
(Adenovirus)



Complex
(Bacteriophage)

and shape of each virus is unique. In fact, a virus can be sphere-shaped, rod-shaped, spiral-shaped, or thread-shaped. Some viruses even look like tiny spaceships.

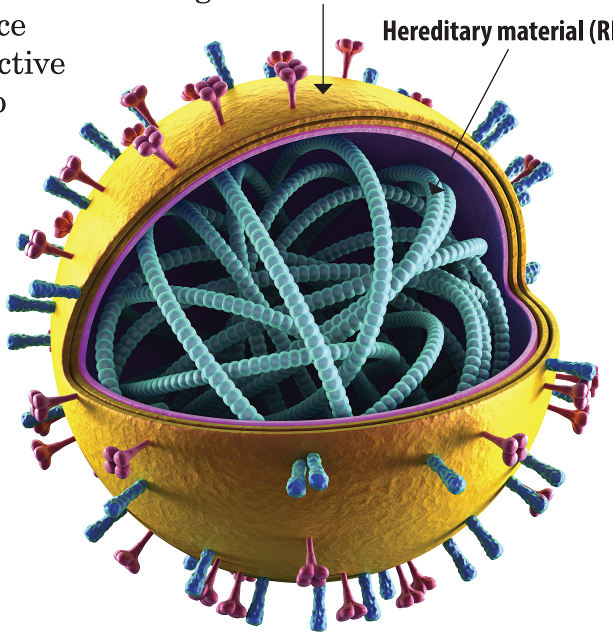
Despite everything that scientists know about viruses, they do not know the answer to one basic question: Are viruses living things? Viruses can reproduce and mutate, but only by infecting a living cell. They contain proteins that are found only in living things. Viruses also have genetic material—the RNA or DNA that a cell needs to reproduce itself. In these ways viruses are like living things.

TRY THIS

Virus Proportion

Imagine that your science room is a living cell. Using the approximate size ratio of a virus to a cell, make a square virus that infects this cell.

However, viruses are not made of cells, which are the building blocks of life. Viruses cannot mutate or reproduce outside of host cells. They can survive in an inactive form for years outside of host cells. They have to take control of cells to reproduce, which means they do not develop like other organisms do. A virus's genetic material resembles its host cell's genetic material more than it resembles the genetic material of other viruses. In these ways, viruses are not like living things.



The protein spikes that extend from the influenza virus mutate easily. That's why each flu season involves a different strain of influenza. People must build a new immunity with each mutation.

LESSON REVIEW

1. How did the invention of the electron microscope help scientists learn more about viruses?
2. How are viruses like living things?
3. How are viruses not like living things?
4. Describe the basic characteristics of viruses.