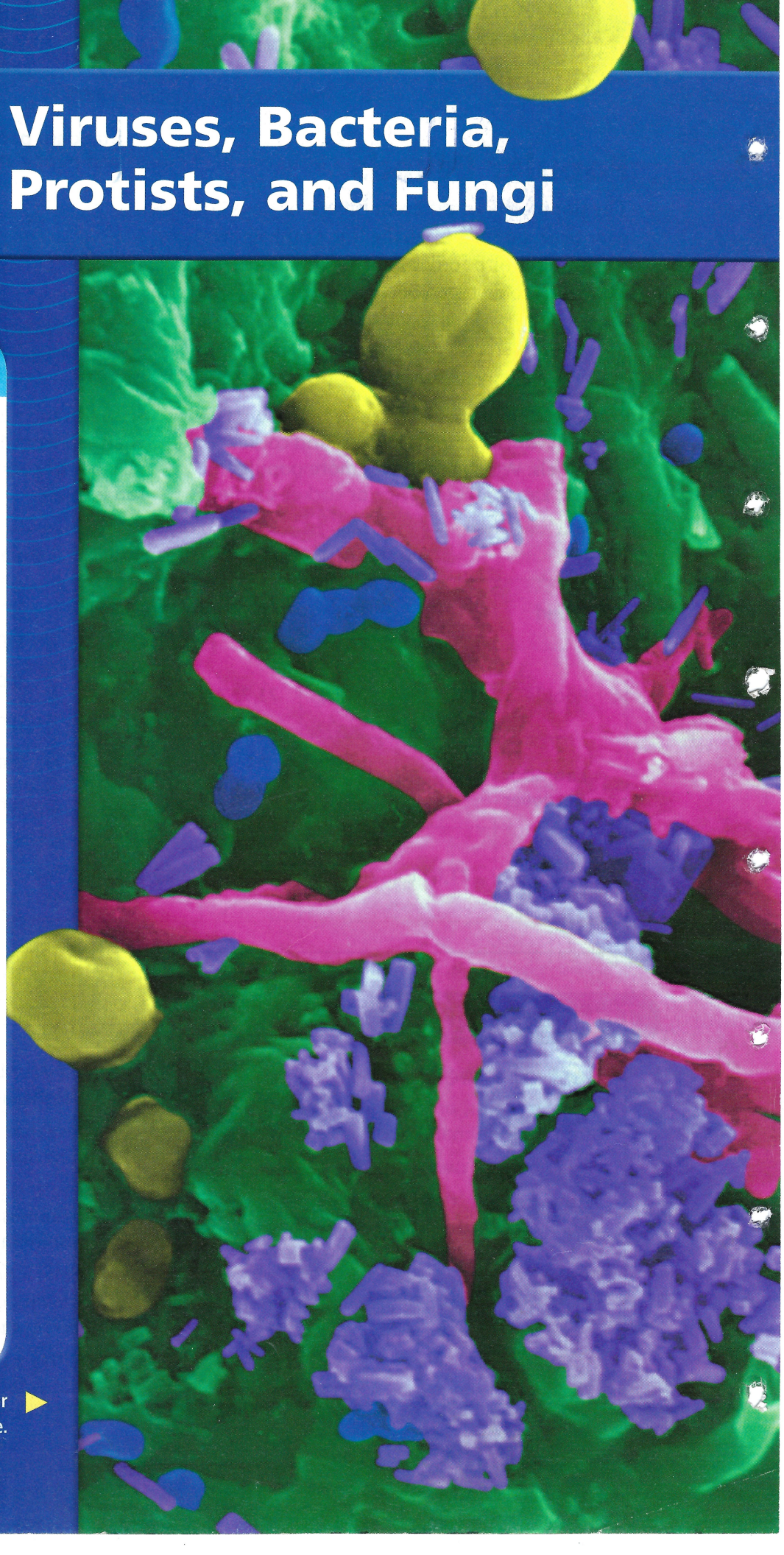
Chapter 7

Viruses, Bacteria, Protists, and Fungi

Chapter Preview

Interactive Textbook



Bacteria (blue and purple rods) and other microorganisms lurk in a kitchen sponge.

Viruses

Reading Preview

Key Concepts

- How are viruses like organisms?
- What is the structure of a virus?
- How do viruses multiply?
- How can you treat a viral disease?

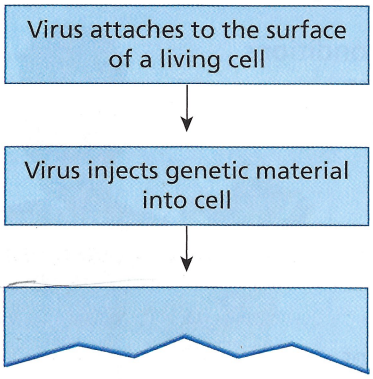
Key Terms

- virus
- host
- parasite
- bacteriophage
- vaccine

Target Reading Skill

Sequencing As you read, make two flowcharts that show how active and hidden viruses multiply.

How Active Viruses Multiply



Lab zone Discover Activity

Which Lock Does the Key Fit?

1. Your teacher will give you a key.
2. Study the key closely. Think about what shape the keyhole on its lock must have. On a piece of paper, draw the shape of the keyhole.
3. The lock for your key is contained in the group of locks your teacher will provide. Try to match your key to its lock without inserting the key into the keyhole.

Think It Over

Inferring How might a unique "lock" on its surface help a cell protect itself from invading organisms?

It is a dark and quiet night. An enemy spy slips silently across the border. Invisible to the guards, the spy creeps cautiously along the edge of the road, heading toward the command center. Undetected, the spy sneaks by the center's security system and reaches the door. Breaking into the control room, the spy takes command of the central computer. The enemy is in control.

What Is a Virus?

Although this spy story may read like a movie script, it describes events similar to those that can occur in your body. The spy acts very much like a virus invading an organism.

Characteristics of Viruses A **virus** is a tiny, nonliving particle that invades and then multiplies inside a living cell. Viruses are not cells. They do not have the characteristics of organisms. **The only way in which viruses are like organisms is that they can multiply.** Although viruses can multiply, they multiply differently than organisms. Viruses can only multiply when they are inside a living cell.

No organisms are safe from viruses. The organism that a virus multiplies inside is called a host. A **host** is a living thing that provides a source of energy for a virus or an organism. Viruses act like **parasites** (PA ruh syts), organisms that live on or in a host and cause it harm. Almost all viruses destroy their host cells.

The Structure of Viruses Viruses are smaller than cells and vary in size and shape. Some viruses are round. Others are shaped like rods, bricks, threads, or bullets. There are even viruses that have complex, robot-like shapes, such as the bacteriophage in Figure 1. A **bacteriophage** (bak TEER ee oh fayj) is a virus that infects bacteria. In fact, its name means "bacteria eater."

Although viruses may look different from one another, they all have a similar structure. **All viruses have two basic parts: a protein coat that protects the virus and an inner core made of genetic material.** A virus's genetic material contains the instructions for making new viruses. Some viruses are also surrounded by an additional outer membrane, or envelope.

The proteins on the surface of a virus play an important role during the invasion of a host cell. Each virus contains unique surface proteins. The shape of the surface proteins allows the virus to attach to certain cells in the host. Like keys, a virus's proteins fit only into certain "locks," or proteins, on the surface of a host's cells. Figure 2 shows how the lock-and-key action works.

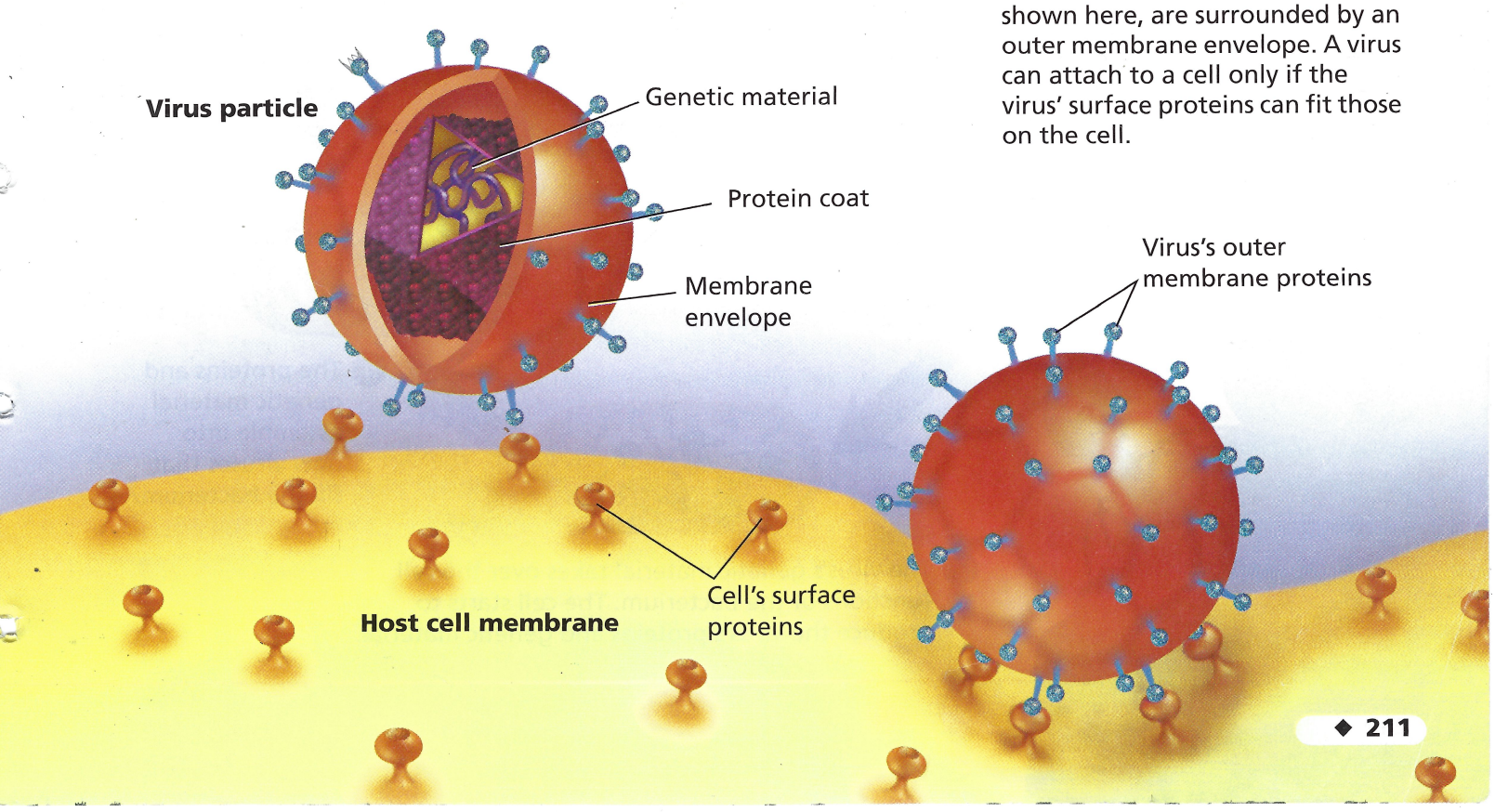
Because the lock-and-key action of a virus is specific, a certain virus can attach only to one or a few types of cells. For example, most cold viruses infect cells only in the nose and throat of humans. These cells are the ones with proteins on their surface that complement or "fit" those on the virus.

Reading Checkpoint **What information does a virus's genetic material contain?**

FIGURE 1
Bacteriophage
This robot-like virus infects bacteria.

FIGURE 2
Virus Structure and Infection

All viruses consist of genetic material surrounded by a protein coat. Some viruses, like the ones shown here, are surrounded by an outer membrane envelope. A virus can attach to a cell only if the virus' surface proteins can fit those on the cell.



How Viruses Multiply

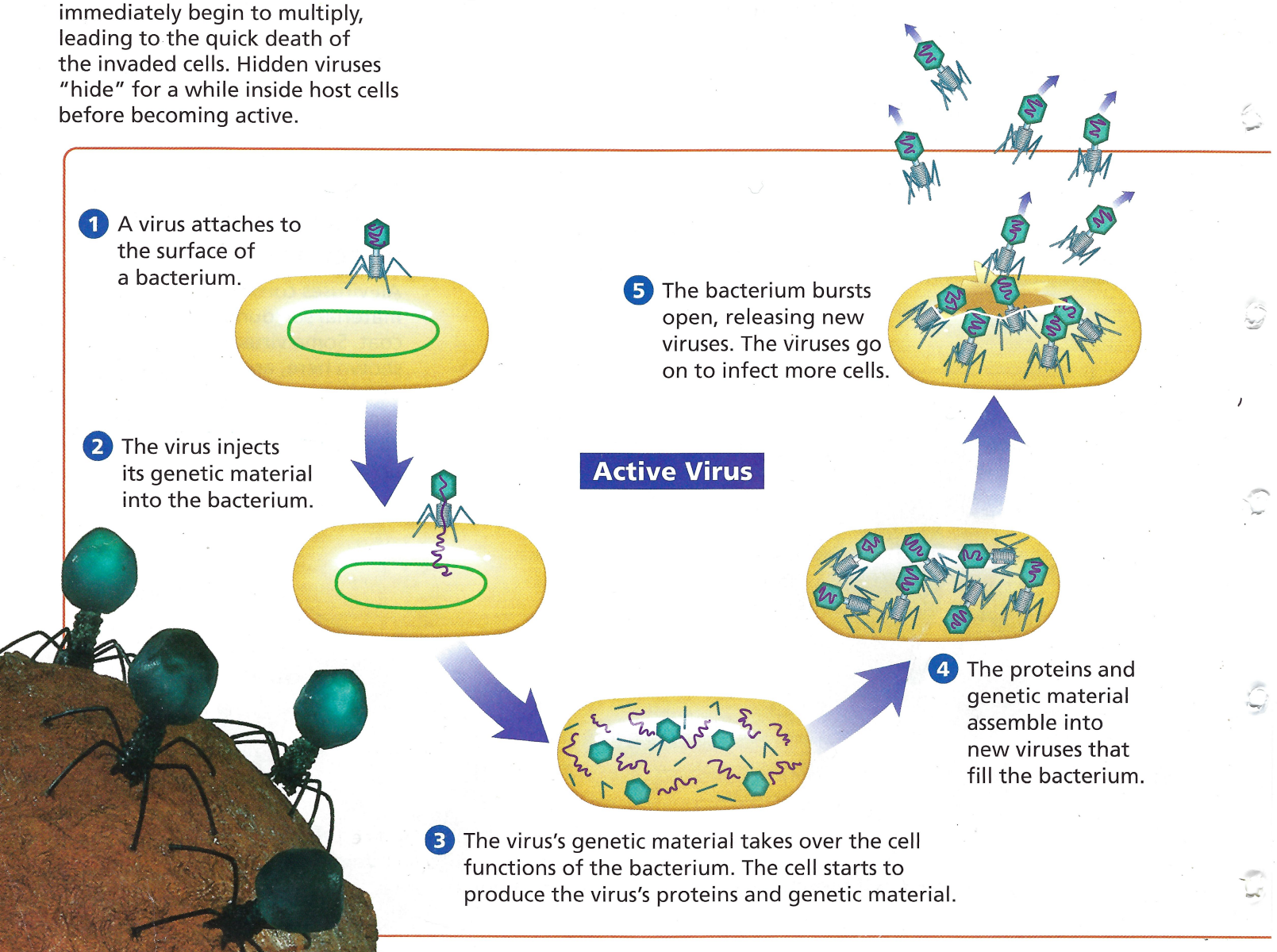
After a virus attaches to a host cell, it enters the cell. **Once inside a cell, a virus's genetic material takes over many of the cell's functions. It instructs the cell to produce the virus's proteins and genetic material. These proteins and genetic material then assemble into new viruses.** Some viruses take over cell functions immediately. Other viruses wait for a while.

Active Viruses After entering a cell, an active virus immediately goes into action. The virus's genetic material takes over cell functions, and the cell quickly begins to produce the virus's proteins and genetic material. Then these parts assemble into new viruses. Like a photocopy machine left in the "on" position, the invaded cell makes copy after copy of new viruses. When it is full of new viruses, the host cell bursts open, releasing hundreds of new viruses as it dies.

FIGURE 3

Active and Hidden Viruses

Active viruses enter cells and immediately begin to multiply, leading to the quick death of the invaded cells. Hidden viruses "hide" for a while inside host cells before becoming active.



Hidden Viruses Other viruses do not immediately become active. Instead, they "hide" for a while. After a hidden virus enters a host cell, its genetic material becomes part of the cell's genetic material. The virus does not appear to affect the cell's functions and may stay in this inactive state for years. Each time the host cell divides, the virus's genetic material is copied along with the host's genetic material. Then, under certain conditions, the virus's genetic material suddenly becomes active. It takes over the cell's functions in much the same way that active viruses do. Soon, the cell is full of new viruses and bursts open.

The virus that causes cold sores is an example of a hidden virus. It can remain inactive for months or years inside nerve cells in the face. While hidden, the virus causes no symptoms. When it becomes active, the virus causes a swollen, painful sore to form near the mouth. Strong sunlight and stress are two factors that scientists believe may activate a cold sore virus. After an active period, the virus once again "hides" in the nerve cells until it becomes active again.

Reading Checkpoint **Where in a host cell does a hidden virus "hide" while it is inactive?**

Go Online active art

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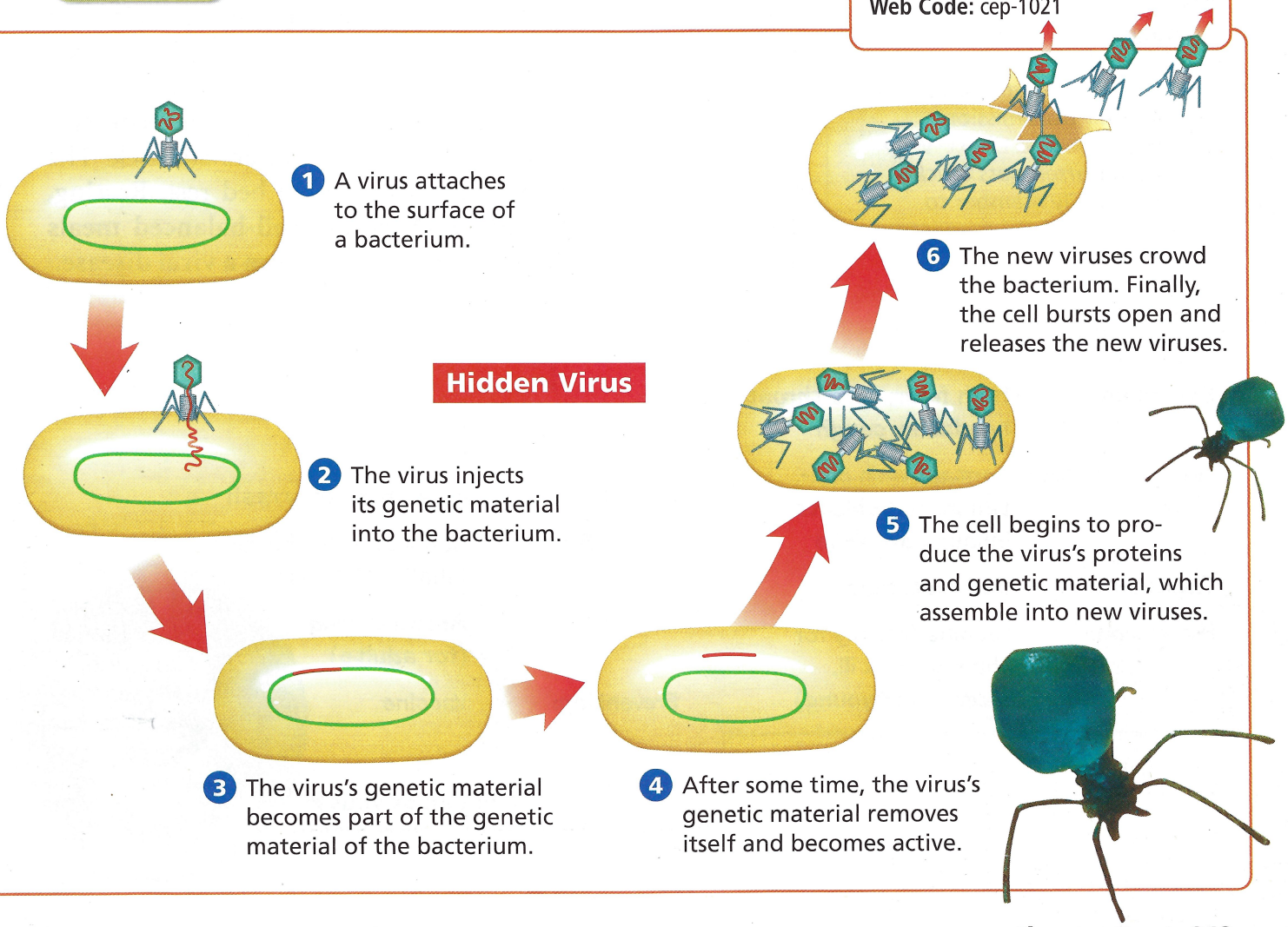


Viruses and Disease

If you've ever had a cold sore or been sick with the flu, you know that viruses can cause disease. Some diseases, such as colds, are mild—people are sick for a short time but soon recover. Other diseases, such as acquired immunodeficiency syndrome, or AIDS, have much more serious consequences on the body.

Viruses also cause diseases in organisms other than humans. For example, apple trees infected by the apple mosaic virus may produce less fruit. House pets, such as dogs and cats, can get deadly viral diseases, such as rabies and distemper.

The Spread of Viral Diseases Viral diseases can be spread in various ways. For example, some viral diseases can be spread through contact with a contaminated object, while others are spread through the bite of an infected animal. Some viruses, such as cold and flu viruses, can travel in tiny drops of moisture that an infected person sneezes or coughs into the air. Other viruses can spread only through contact with body fluids, such as blood.

Treating Viral Diseases There are currently no cures for viral diseases. However, many over-the-counter medications can help relieve symptoms of a viral infection. While they can make you feel better, these medications can also delay your recovery if you resume your normal routine while you are still sick. The best treatment for viral infections is often bed rest. **Resting, drinking plenty of fluids, and eating well-balanced meals may be all you can do while you recover from a viral disease.**

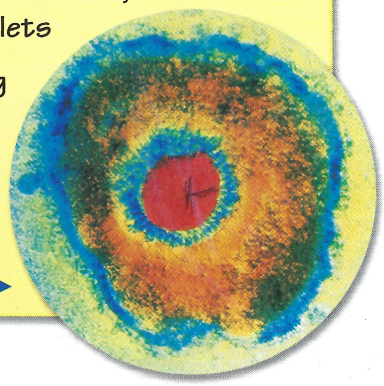
FIGURE 4
Viral Diseases
Although there is currently no cure for viral diseases, there are ways to treat the symptoms and prevent their transmission.
Relating Cause and Effect *Why does the flu often pass quickly from one family member to another?*

INFLUENZA (Flu)

Symptoms:	High fever; sore throat; headache; cough
How It Spreads:	Contact with contaminated objects; inhaling droplets
Treatment:	Bed rest; fluids
Prevention:	Vaccine (mainly for the high-risk ill, elderly, and young)

CHICKENPOX

Symptoms:	Fever; red, itchy rash
How It Spreads:	Contact with the rash; inhaling droplets
Treatment:	Antiviral drug (for adults)
Prevention:	Vaccine



Chickenpox virus ▶

Preventing Viral Diseases Of course, you'd probably rather not get sick in the first place. An important tool that helps prevent the spread of many viral diseases is vaccines. A **vaccine** is a substance introduced into the body to stimulate the production of chemicals that destroy specific disease-causing viruses and organisms. A viral vaccine may be made from weakened or altered viruses. Because they have been weakened or altered, the viruses in the vaccine do not cause disease. Instead, they trigger the body's natural defenses. In effect, the vaccine puts the body "on alert." If that disease-causing virus ever invades the body, it is destroyed before it can cause disease. You may have been vaccinated against diseases such as polio, measles, and chickenpox.

Another important way to protect against viral diseases is to keep your body healthy. You need to eat nutritious food, as well as get enough sleep, fluids, and exercise. You can also protect yourself by washing your hands often and by not sharing eating or drinking utensils.

Unfortunately, despite your best efforts, you'll probably get viral infections, such as colds, from time to time. When you do get ill, get plenty of rest, and follow your doctor's recommendations. Also, it's very important to try not to infect others.

Reading Checkpoint **Why don't vaccines cause disease themselves?**

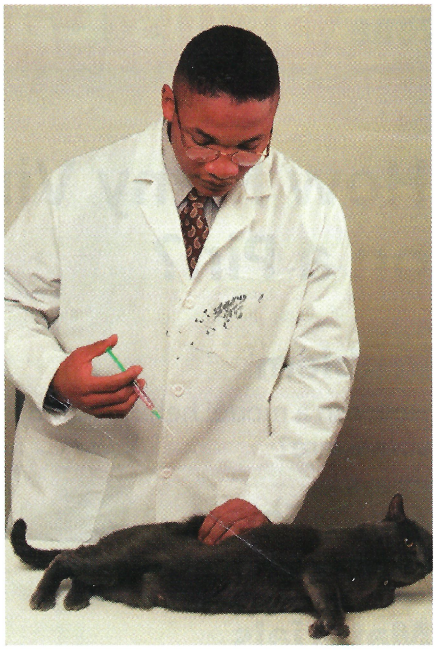


FIGURE 5
Vaccines
Veterinarians can give pets vaccine injections that protect the animals against many viral diseases.

Section 1 Assessment

Target Reading Skill **Sequencing** Refer to your flowcharts about how viruses multiply as you answer Question 3.

Reviewing Key Concepts

1. a. **Defining** What is a virus?
   b. **Comparing and Contrasting** How are viruses similar to organisms?
   c. **Inferring** Scientists hypothesize that viruses could not have existed on Earth before organisms appeared. Use what you know about viruses to support this hypothesis.
2. a. **Identifying** What basic structure do all viruses share?
   b. **Relating Cause and Effect** What role do the proteins in a virus's outer coat play in the invasion of a host cell?
3. a. **Reviewing** How does an active virus multiply?
   b. **Sequencing** List the additional steps that occur when a hidden virus multiplies.
   c. **Classifying** Do you think that the cold virus is an active virus or a hidden virus? Explain.
4. a. **Reviewing** What is often the best treatment for viral diseases?
   b. **Explaining** How are vaccines important in preventing viral diseases?

Writing in Science

Public Service Announcement Write a public service announcement for a radio show that teaches young children how to stay healthy during cold and flu season.