6. Why is it that a specific virus can only infect a specific kind of body cell?
7. What is a bacteriophage?
8. Why was Martinus Beijerinck's theory important?
9. How does a vaccine help the human body's immune system fight a viral infection?
10. How did Edward Jenner develop his smallpox vaccine?
11. Why is HIV such a dangerous and potentially fatal virus?

Follow-up Discussion

Research indicates that students will retain their previous misconceptions about a topic, in preference to new information, until they actively recognize and correct their own errors. Therefore, it is important to have your students re-examine the facts/beliefs they put on their "Everything We Think We Know About…" list. It might also be helpful to review the list by marking each entry with a "+" or "-" to show which facts were correct and which were incorrect.

Thought-provoking discussions provide a good way to assess the overall depth of student understanding. The following are some suggested discussion topics.

- Compare and contrast viruses with other organisms.
- Discuss the importance of microscopes. How have they changed society?

Follow-up Activities

- Have students create an illustration to show the relative sizes of viruses, bacteria, plant cells and human cells. See Cells Alive (www.cellsalive.net/howbig.htm) for help with this project.
- Encourage students to imagine that they are viruses infecting the human body. They can write a blow-by-blow account of how they infect cells and replicate themselves. This account could be in the form of a comic book, younger child's picture book, television show, poem or play.
- Students can select a viral disease to research such as smallpox, hepatitis, polio, rabies, influenza or HIV. Students can then create a class chart that compares these diseases, based upon the effects of the disease, how it is transmitted, if it is contagious and if a vaccine is available.
- Students can research the work of epidemiologists and virologists in the past, present and future. Share excerpts of Mark P. Friedlander's book entitled *Outbreak: Disease Detectives at Work* (Lerner Publications, 2000). Students can also write to the Centers for Disease Control and Prevention, or invite a virus expert from a local hospital to share more information about viruses with the class.

TEACHER'S GUIDE

Suggested Internet Resources

Periodically, Internet Resources are updated on our web site at www.LibraryVideo.com

- **www.microbe.org/microbes/virus1.asp**
  The American Society for Microbiology hosts "Stalking the Mysterious Microbe," a site for elementary students interested in learning more about microorganisms including viruses.
- **library.thinkquest.org/23054/gather/index.shtml**
  "Hidden Killers: Deadly Viruses" is an informative site created by students to address the basics about viruses. Detailed information is provided about the human immune system, specific virus profiles and the research of epidemiologists.

Suggested Print Resources

- Brynie, Faith Hickman. *101 Questions About Your Immune System You Felt Defenseless to Answer…Until Now.* Twenty-First Century Books, Brookfield, CT; 2000.
- Needham, Cynthia. *Intimate Strangers: Unseen Life on Earth.* ASM Press, Washington, DC; 2000.
- Thomas, Peggy. *Bacteria and Viruses.* Lucent Books, Chicago, IL; 2004.

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TITLES

- **BACTERIA**
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TEACHER'S GUIDE

Simple Organisms IN ACTION™

Viruses

Grades 5–8

Students in grade 5–8 classrooms possess a wide range of background knowledge. Student response to this video program is sure to be varied, so the teachers at these grades need all the help they can get! This guide has been designed to help the 5–8 science teacher by providing a brief synopsis of the program, previewing and follow-up questions, activities, vocabulary and additional resources.

Before Viewing: Extensive research tells how important it is for the teacher to discover what the students know — or think they know — about a topic, before actually starting a new unit. Therefore, after prompting discussion with the pre-viewing questions, lead your class to create an "Everything We Think We Know About…" list. You may also wish to preview key vocabulary words, and have students raise additional questions they hope will be answered.

After Viewing: Have your students share video excerpts that fascinated or surprised them, then challenge your students to prove or disprove the accuracy of the facts they put on their "Everything We Think We Know About…" list. Discuss what else they learned and use the follow-up questions and activities to inspire further discussion. Encourage students to research the topic further with the Internet and reading resources provided.

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Program Summary

Humans are giants in a world filled with small wonders. All around us — in the air we breathe, in the water we drink and in our very own bodies — are living things called simple organisms. Viruses, which come in many different shapes and forms, are the smallest of these microbes and are visible only under an electron microscope. Unlike other simple organisms such as bacteria, fungi and protists, viruses are not considered by all scientists to be true living things. As a result, viruses are not classified in any scientific kingdom. Viruses are not even made up of cells. A protein coat surrounds the only contents of a virus — its nucleic acid, or the genetic information necessary to duplicate itself.

Viruses need host cells in order to reproduce and can attack living things, including animals, plants and even bacteria. In humans, viruses are responsible for many illnesses, such as the common cold, warts, chicken pox and influenza. The success of any virus is due to its ability to replicate itself and to spread rapidly through a population. Once a viral epidemic is diagnosed, it is the job of scientists called epidemiologists to trace a virus back to its source, to discover its cause and, finally, to discover a cure.

Viruses are totally inactive until they find a cell for which they have a key. Cells have openings called receptors, through which nutrients can enter. The shape of the receptors is different for each different type of cell. A virus that fits into a cell's receptor enters as if it were a key unlocking a door. Once viruses enter a host cell, the cell is directed by the virus to do nothing but replicate more of the same virus, using the genetic blueprint contained in that virus' nucleic acid. The host cell keeps creating viruses until it bursts open and spreads many new viruses throughout the body. When the invader is detected by the body's immune system, a number of things can happen. If the body has been exposed to the virus in the past, proteins called antibodies can be sent in to defeat the infection. If, on the other hand, the virus is new to the body, a greater battle ensues. Special white blood cells called T-cells come in to both identify and eliminate the virus as well as prepare the body's defenses against a future infection. Infected cells can also give off protein protectors called interferons that travel to nearby uninfected cells, blocking their receptors, thus closing the door to a spread of the disease.

Vaccines are very effective ways of warding off viral infections. In the 18th century, an English physician named Edward Jenner theorized that if he injected cowpox serum into humans, their immune systems would build a defense against smallpox, a virus that killed millions of people. This was the first successful vaccine. Against viruses, prevention is everything! Although scientists are constantly working on new antiviral drugs, for the most part, once you have been infected, the only thing you can do is to allow the virus to run its course. Considering their size and simplicity, it is amazing that viruses remain one of the most powerful forces on Earth!

Vocabulary

The following words are included for teacher reference or for use with students. They are listed in the order in which they appear in the video.

simple organisms — The smallest and simplest of all living things, some of which can be seen only by microscope. Bacteria, protists, fungi and viruses are examples of simple organisms.

virus (singular: virion) — (Latin: "poison") Extremely simple microorganisms that typically contain a protein coat surrounding a core of genetic material, that are capable of growth and multiplication only in living cells, and that cause various diseases in plants, animals and bacteria. Because of their simplicity, some scientists do not consider them to be living organisms; instead they are viewed as extremely complex molecules.

microorganism — A small living thing that cannot be seen without a microscope.

protein coat — The outer layer of a virus that surrounds the genetic information inside.

influenza — A contagious disease caused by a virus. A strain of influenza virus killed nearly 30 million people worldwide in 1918.

epidemic — An outbreak of disease that affects a great number of people.

epidemiologists — Scientists who investigate and deduce causes of diseases.

parasites — Organisms that survive by invading and injuring other organisms.

host cell — The cell of an organism that is invaded by a virus, and provides materials that viruses need to copy themselves.

receptors — The openings in cell walls through which cells get their nutrients. Viruses can also enter host cells through their receptors.

bacteriophage — A virus that attacks and destroys bacteria cells.

nucleic acid — The genetic blueprint for the virus, contained within the protein coat.

Martinus Beijerinck — A Dutch microbiologist who, in 1897, deduced that a virus was harming crops. His discovery changed the way people looked at disease and its causes.

electron microscope — A special type of microscope, invented in 1933 by a German engineer named Ernst Ruska, that permitted scientists to see the smallest of microbes, such as viruses, for the first time.

rhinovirus — The scientific name for the common cold, which is actually caused by many different viruses.

Ebola virus — A deadly virus that killed 90% of the people infected in Zaire, Africa, in 1995, and still poses a threat to populations.

Hepatitis B — A virus causing liver damage and possibly death.

immune system — A body system that defends the body against disease. The immune system includes skin, saliva, antibodies, white blood cells, T-cells and interferons.

(Continued)

antibodies — Proteins that are produced by the immune system to attack invaders.

T-cells — Special white blood cells that can take command of the entire immune system.

interferons — Protein protectors produced by an infected cell that rush to uninfected neighboring cells to plug up their receptors, preventing a virus from infecting the cells.

HIV (Human Immunodeficiency Virus) — A viral attack of the body's immune system that infiltrates the T-cells of the immune system and turns them into HIV factories.

AIDS (Acquired Immune Deficiency Syndrome) — A disease of the body's immune system that opens the body to other diseases and is caused by an infection from the HIV virus.

Edward Jenner — (1749-1823) An 18th-century English physician who theorized that the human body can develop immunity to a disease. He created a treatment against smallpox by using a cowpox serum and named this treatment a vaccine ("vacca" means "cow" in Latin).

immunity — Resistance to a disease. The purpose of vaccines is to provide immunity against disease.

vaccine — A weakened or modified virus that is introduced into an organism and is used to increase immunity to a particular disease.

Pre-viewing Discussion

Before students generate their list of "Everything We Think We Know About…" for this topic, stimulate and focus their thinking by raising these questions so that their list will better reflect the key ideas in this show:

- Brainstorm a list of diseases that you know. What causes these diseases?
- What are viruses?
- Do you think viruses are alive? Why or why not?

After the class has completed their "Everything We Think We Know About…" list, ask them what other questions they have that they hope will be answered during this program. Have students listen closely to learn if everything on their class list is accurate and to hear if any of their own questions are answered.

Focus Questions

1. What size are viruses?
2. Is a virus a living thing? Why or why not?
3. What are the parts of a virus? How is the structure of a virus different from every other type of organism?
4. What is the job of an epidemiologist?
5. If we think of a human cell as a house, how does the virus get in through the front door?

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