35.3 Fighting Infectious Disease

GETTING STARTED

Objectives

35.3.1 Distinguish between active immunity and passive immunity.
35.3.2 Describe how public health measures and medications fight disease.
35.3.3 Describe why patterns of infectious disease have changed.

Student Resources

Study Workbooks A and B, 35.3 Worksheets
Spanish Study Workbook, 35.3 Worksheets
Lab Manual B, 35.3 Hands-On Activity Worksheet

For corresponding lesson in the Foundation Edition, see pages 846-848.

ACTIVATE PRIOR KNOWLEDGE

Find on the Internet or obtain from the health department a schedule of recommended vaccinations for children and teens. Show students the schedule, and ask them how they think vaccinations help develop immunity. Also, discuss how a community increases its protection against epidemics of serious infectious diseases as more people in the community are vaccinated against those diseases. After the discussion, post the schedule on a classroom bulletin board.

NATIONAL SCIENCE EDUCATION STANDARDS

UNIFYING CONCEPTS AND PROCESSES

II, IV

CONTENT
C.1.a, C.3.a, C.4.e, F.1, F.5, F.6, G.3

INQUIRY
A.1.b, A.2.a, A.2.b

KEY QUESTIONS

How do vaccines and externally produced antibodies fight disease?
How do public health measures and medications fight disease?
Why have patterns of infectious diseases changed?

VOCABULARY
vaccination
active immunity
passive immunity

TAKEING NOTES

Venn Diagram: Make a Venn diagram that compares and contrasts active and passive immunity.

FIGURE 35-14 Jenner Vaccinating James Phipps

THINK ABOUT IT

More than 200 years ago, English physician Edward Jenner noted that milkmaids who contracted a mild disease called cowpox didn’t develop smallpox. At the time, smallpox was a widespread disease that killed many people. Jenner wondered, could people be protected from smallpox by deliberately infecting them with cowpox?

ACQUIRED IMMUNITY

How do vaccines and externally produced antibodies fight disease?

Jenner performed a bold experiment. He put fluid from a cowpox patient’s sore into a small cut he made on the arm of a young boy named James Phipps. As expected, James developed mild cowpox. Two months later, Jenner injected James with fluid from a smallpox infection. Fortunately for James (and Jenner!), the boy didn’t develop smallpox. His cowpox infection had protected him from smallpox infection. Ever since that time, the injection of a weakened form of a pathogen, or of a similar but less dangerous pathogen, to produce immunity has been known as a vaccination. The term comes from the Latin word vacca, meaning “cow,” as a reminder of Jenner’s work.

ACTIVE IMMUNITY

Today, we understand how vaccination works. Vaccination stimulates the immune system with an antigen. The immune system produces memory B cells and memory T cells that quicken and strengthen the body’s response to repeated infection. This kind of immunity, called active immunity, may develop as a result of natural exposure to an antigen (fighting an infection) or from deliberate exposure to the antigen (through a vaccine).

PASSIVE IMMUNITY

Disease can be prevented in another way. Antibodies produced against a pathogen by other individuals or animals can be used to produce temporary immunity. If externally produced antibodies are introduced into a person’s blood, the result is passive immunity. Passive immunity lasts only a short time because the immune system eventually destroys the foreign antibodies. Passive immunity can also occur naturally or by deliberate exposure.

ENDURING UNDERSTANDING

The human body is a complex system. The coordinated functions of its many structures support life processes and maintain homeostasis.

GUIDING QUESTION

How do humans prevent and fight the spread of disease?

EVIDENCE OF UNDERSTANDING

After completing the lesson, this assessment should show student understanding of how humans prevent the spread of infectious disease. Ask each student to create an information sheet that could inform the public about why acquired immunity is important to the prevention of infectious disease. The sheet can have a combination of words and illustrations. Have volunteers present their information sheets to the class.
Public Health and Medications

How do public health measures and medications fight disease?

In 1900, more than 30 percent of deaths in the United States were caused by infectious disease. In 2005, less than 5 percent of deaths were caused by infectious disease. Two factors that contributed to this change are public health measures and the development of medications.

Public Health Measures

When humans live in large groups, behavior, cleanliness of food and water supplies, and sanitation all influence the spread of disease. The field of public health offers services and advice that help provide healthy conditions. Public health measures help prevent disease by monitoring and regulating food and water supplies, promoting vaccination, and promoting behaviors that avoid infection. Promoting childhood vaccinations and providing clean drinking water are two important public health activities that have greatly reduced the spread of many diseases that once killed many people.

Medications

Prevention of infectious disease is not always possible. Medications, such as antibiotics and antiviral drugs, are other weapons that can fight pathogens. Antibiotics can kill bacteria, and some antiviral medications can slow down viral activity.

The term antibiotic refers to a compound that kills bacteria without harming its host. In 1928, Alexander Fleming was the first scientist to discover an antibiotic. Fleming noticed that a mold, Penicillium notatum, seemed to produce something that inhibited bacterial growth. Research determined that this “something” was a compound Fleming named penicillin. Researchers learned to mass-produce penicillin just in time for it to save thousands of World War II soldiers. Since then, dozens of antibiotics have saved countless numbers of lives.

Antibiotics have no effect on viruses. However, antiviral drugs have been developed to fight certain viral infections. These drugs generally inhibit the ability of viruses to invade cells or to multiply once inside cells.

In Your Notebook

How does your school promote public health?

Teach

Lead a Discussion

Discuss the story of John Snow and the Broad Street pump introduced in Figure 35–15. Then, talk about public health measures in the students’ own community that prevent similar outbreaks of serious diseases. Review with students what they learned in Lesson 35.1 about the ways infectious diseases spread.

Ask

How do inspectors and other government employees in the community help to prevent the spread of disease? (Sample answer: Inspectors of restaurants help prevent diseases spread in food. The water department makes sure diseases are not spread in drinking water.)

Differentiated Instruction

Less Proficient Readers

Give students five minutes to write a response to this common saying: An ounce of prevention is worth a pound of cure. Ask them to explain what the saying means and whether they agree or not with its meaning.

Mystery Clue

Have students investigate why a “germ-free” society can be both good and bad for human immunity using Data Analysis: Society and Immunity.

Address Misconceptions

Vaccine Effectiveness

Some students may have the common misconception that vaccines are not effective because the majority of people who get diseases have been vaccinated. Point out that vaccines are not 100 percent effective, and a small percentage of those vaccinated against a disease will become infected. Routine childhood vaccines, for example, are 85 to 95 percent effective. That gives a vaccinated person a much greater chance of avoiding a disease than one who is not vaccinated.

Answers

In Your Notebook

Answers will vary. Students might mention the school’s nurse, daily cleaning of the school, a school dietician, and any special efforts made by school staff to promote healthy behaviors.
Teach continued

Lead a Discussion
Talk about the threat of emerging diseases causing epidemics in the United States and elsewhere. Point out that for most of these emerging diseases, either there is no vaccine, or the vaccines are not available for wide distribution to a large population.

Differ enated Instruction

Advanced Students Ask pairs of students with a firm understanding of the principles of evolution to prepare a presentation to the class about how the misuse of medications results in pathogens that are resistant to antibiotics and other medications.

Assess and Remediate

Evaluate Understanding
Read aloud the lesson’s Key Concepts and the sentences defining new vocabulary terms. In each case, leave out the most significant term in the sentence. Call on students to fill in the blanks. Then, have them complete the 35.3 Assessment.

Remediation Suggestion

Struggling Students If students have trouble answering Question 2b, review the consequences of misusing medications.

Assessment Answers

1a. Vaccination stimulates the immune system with an antigen. The immune system produces memory B cells and memory T cells that quicken and strengthen the body’s response to repeated infection. Externally produced antibodies, which are antibodies produced against a pathogen by other individuals or animals, can be used to produce temporary immunity.

1b. Active immunity may develop as a result of natural exposure to an antigen or from deliberate exposure to the antigen. Passive immunity occurs when externally produced antibodies are introduced into a person’s blood.

2a. To prevent disease by monitoring food and water supplies, to promote vaccination, and to recommend ways to avoid infection.

2b. Antibiotics can kill bacteria, but they have no effect on viruses.

3a. One factor is changing interactions with animals. As people clear new land and environments change, people come in contact with new pathogens. Exotic animal trade has given pathogens new opportunities to jump from animals to humans. Another factor is the misuse of medicines. Some pathogens are developing resistance to a variety of antibiotics and other medications.

3b. Sample answer: Global travel has increased the spread of emerging diseases because infected people who show no symptoms can travel around the world very quickly, spreading the disease more widely than possible in earlier times.

4. Debate arguments will vary depending on research results. Students should find information in library sources or on the Internet that describes the fear of death and sickness caused by vaccines as well as assurances that vaccines are safe.
Changing interactions with animals is one factor in the spread of emerging diseases. An example is monkeypox, a rare viral disease mainly confined to Africa that causes symptoms in humans similar to smallpox. The disease is called monkeypox because it was first discovered in monkeys, though the virus can also infect other animals, including mice and rabbits. In the United States, this disease was first reported in 2003. Investigations revealed that monkeypox had spread to people from their pet prairie dogs. How did the prairie dogs get an African virus? The source was a shipment of wild African rodents to Texas. The rodents were kept by a seller in close proximity to prairie dogs, which were eventually sold to people as pets.

Biology and History 1023

**Biology In-Depth**

**THE CASE OF MONKEYPOX**

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**Teach**

**Lead a Discussion**

Have students relate the diseases included in the time line with what they learned in the subsection New and Re-Emerging Diseases, in Lesson 35.3.

**Ask** What is an example on the time line of a disease that emerged as a result of the misuse of medications? (tuberculosis cases in the United States)

**Ask** How might an American tourist in Asia contribute to the global spread of avian influenza? (The tourist could come in contact with the virus and bring it back to America when he or she returns home.)

**DIFFERENTIATED INSTRUCTION**

| Advanced Students | Ask students to report on one of the emerging diseases on the time line. Tell them that to find up-to-date information on a disease, they should search reliable sources on the Internet, such as the World Health Organization (WHO) and the Centers for Disease Control and Prevention (CDC). Ask students to give a brief presentation to the class about the disease they researched. |

**Answers**

**WRITING** Student essays will vary. Students might suggest the Surgeon General may have been confident of his statement in 1967 because of the success of vaccinations and antibiotics in preventing and treating many diseases, such as polio and tuberculosis. In the discussion of the comeback of infectious disease, students should describe changing interactions with animals and the misuse of medications.