Immunology

Frameworksheet

Standards: 10a-e

10. Organisms have a variety of mechanisms to combat disease. As a basis for understanding the human immune response:

a. *Students know* the role of the skin in providing nonspecific defenses against infection.

The skin serves as a physical barrier to prevent the passage of many disease-causing microorganisms. Cuts and abrasions compromise the skin's ability to act as a barrier. Teachers can use charts and overhead projections to show the dangers and physiologic responses of a break in the skin.

Questions for Standard 10.a.

1. **What is the difference between nonspecific defense and specific defense against infection? (Hint: Look at 10b)**
2. **How does the skin protect against disease?**
3. **How can the skin's defense be compromised?**

10. b. *Students know* the role of antibodies in the body's response to infection.

Cells produce antibodies to oppose antigens, substances that are foreign to the body. An example of an antigen is a surface protein of a flu virus, a protein with a shape and structure unlike those of any human proteins. The immune system recognizes that the flu virus structure is different and generates proteins called *antibodies* that bind to the flu virus. Antibodies can inactivate pathogens directly or signal immune cells that pathogens are present.

Questions for Standard 10.b.

4. **Why is the difference between an antibody and an antigen?**
5. **Give an example of an antigen.**
6. **How are antibodies created?**
7. **What are two ways that antibodies protect the body from pathogens?**

10. c. *Students know* how vaccination protects an individual from infectious diseases.

Several weeks are required before the immune system develops immunity to a new antigen. To overcome this problem, vaccinations safely give the body a look in advance at the foreign structures. Vaccines usually contain either weakened or killed pathogens that are responsible for a specific infectious disease, or they may contain a purified protein or subunit from the pathogen. Although the vaccine does not cause an infectious disease, the antigens in the mixture prompt the body to generate antibodies to oppose the pathogen. When the individual is exposed to the pathogenic agent, perhaps years later, the body still remembers having seen the antigens in the vaccine dose and can respond quickly. Students have been exposed to the practical aspects of immunization through their knowledge of the vaccinations they must receive before they can enter school. They have all experienced getting shots and may have seen their personal vaccination record in which dates and kinds of inoculations are recorded. The review of a typical vaccination record, focusing on the reason for the shots and ways in which they work, may serve as an effective entry to the subject. Students should review the history of vaccine use. Early literature provides descriptions of vaccine use from pragmatic exposure, but the term *vaccine* is derived from the cowpox exudate that Edward Jenner used during the 1700s to inoculate villagers against the more pathogenic smallpox. Louis Pasteur, noted for his discovery of the rabies treatment, also developed several vaccines. Poliovirus, the cause of infantile paralysis (poliomyelitis), was finally conquered in the 1950s through vaccines that Jonas Salk and Albert B. Sabin refined.

Questions for Standard 10.c.

8. **How long does it take the immune system to develop immunity to a new antigen? How do vaccines overcome this problem?**
9. **What do vaccines usually contain?**
10. **Do vaccines cause disease?**
11. **How do vaccines work? How can a vaccine prevent disease even when an individual is exposed to a pathogen years after the vaccine is given?**

12. **Discuss the effect that the following scientists had in the history of vaccinations:**
    a. **Edward Jenner –**
    b. **Louis Pasteur –**
    c. **Jonas Salk and Albert B. Sabin –**

10. d. *Students know* there are important differences between bacteria and viruses with respect to their requirements for growth and replication, the body's primary defenses against bacterial and viral infections, and effective treatments of these infections.

A *virus,* which is the simplest form of a genetic entity, is incapable of metabolic life and reproduction outside the cells of other living organisms. A virus contains genetic material but has no ribosomes. Although some viruses are benign, many harm their host organism by destroying or altering its cell structures. Generally, the body perceives viruses as antigens and produces antibodies to counteract the virus. *Bacteria* are organisms with a full cellular structure. They, too, can be benign or harmful. Harmful bacteria and their toxins are perceived as antigens by the body, which in turn produces antibodies. In some cases infectious diseases may be treated effectively with *antiseptics,* which are chemicals that oxidize or in other ways inactivate the infecting organism. Antiseptics are also useful in decontaminating surfaces with which the body may come in contact (e.g., countertops). *Antibiotics* are effective in treating bacterial infections, sometimes working by destroying or interfering with the growth of bacterial cell walls or the functioning of cell wall physiology or by inhibiting bacterial synthesis of DNA, RNA, or proteins. Antibiotics are ineffective in treating viral infections.

Students might research infections caused by protists (malaria, amoebic dysentery), bacteria (blood poisoning, botulism, food poisoning, tuberculosis), and viruses (rabies, colds, influenza, AIDS). They might also investigate the pathogens currently being discussed in the media and study each infectious organism's requirements for growth and reproduction. Teachers should review the dangers of common bacteria becoming resistant to antibiotics through long-standing over-application, as shown by the increasing incidence of drug-resistant tuberculosis and other bacteria. Using a commercially available kit, teachers can demonstrate how antibiotics may act generally or specifically against bacteria. Agar plates may be inoculated with different bacteria, and different antibiotic discs may be placed on these plates to create a clear zone in which growth around the antibiotic discs is inhibited.

Questions for Standard 10.d.

13. **What do viruses need to survive and reproduce?**
14. **Does a virus have DNA? Does a virus have ribosomes?**
15. **How do viruses harm cells?**
16. **How does the body fight against viruses?**
17. **How does the body fight against bacteria?**
18. **What are antiseptics? Why are they important?**
19. **What are antibiotics?**
20. **Describe how antibiotics work.**
21. **Should you take an antibiotic if you have the flu virus? Why or why not? (Explain in detail)**
22. **List as many infections as you can that are caused by:**
    a. **Protists –**
    b. **Bacteria –**
    c. **Viruses –**
23. **What is drug-resistance? How can bacteria become drug-resistant?**

10. e. *Students know* why an individual with a compromised immune system (for example, a person with AIDS) may be unable to fight off and survive infections by microorganisms that are usually benign.

When an immune system is compromised (e.g., through infection by the human immunodeficiency virus [HIV]), it becomes either unable to recognize a dangerous antigen or incapable of mounting an appropriate defense. This situation happens when the virus infects and destroys key cells in the immune system.

Questions for Standard 10.e.

24. **What is a compromised immune system? How can an immune system become compromised?**
25. **How does HIV compromise the human immune system?**