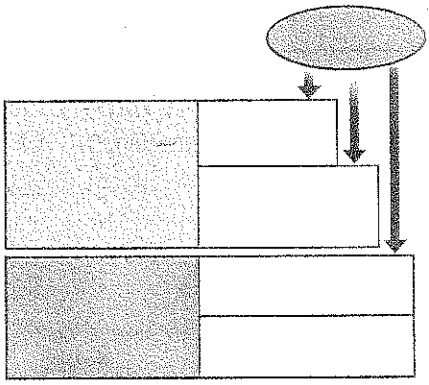
Name _____ **Period** _____

Chapter 43: The Immune System

Our students consider this chapter to be a particularly challenging and important one. Expect to work your way slowly through the first three concepts. Take particular care with Concepts 43.2 and 43.3. It is rewarding, however, in Concept 43.4 to put your new knowledge to work and truly understand the devastation caused by the destruction of helper T cells by HIV. The AP Biology Curriculum Framework emphasizes the immune system in Big Idea 2, EK 2.D.4, where you are expected to know much of the specific information in this chapter. In addition, the topic of cell communication underlies all the signals and responses described in this system. All in all, this chapter is core to your study of biology this year.

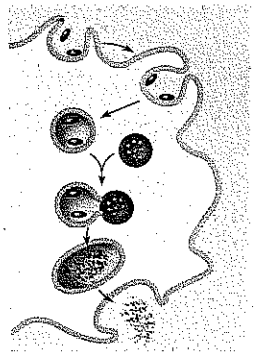
Overview

The immune responses of animals can be divided into *innate immunity* and *adaptive immunity*. As an overview, complete this figure indicating the divisions of both innate and adaptive immunity.



Concept 43.1 In innate immunity, recognition and response rely on traits common to groups of pathogens

1. We first encountered *phagocytosis* in Chapter 6, but it plays an important role in the immune systems of both invertebrates and vertebrates. Review the process by briefly explaining the six steps to ingestion and destruction of a microbe by a phagocytic cell.



2. Give three examples of *barrier defenses* that show their broad and varied means of repelling pathogens.

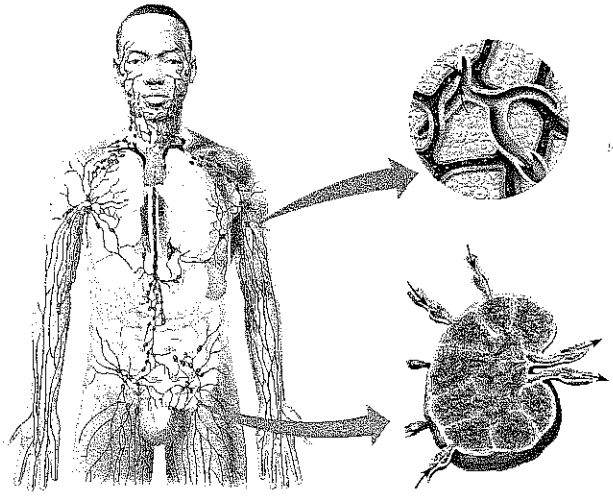
3. How are *toll-like receptors* used in cellular innate defenses? Use TLR3 and TLR4 as examples to explain the essential feature of how these receptors work.

4. In the following chart, explain the role of the following four types of phagocytic cells.

Phagocytic Cell Type	Role in Innate Defense
Neutrophils	
Macrophages	
Dendritic cells	
Eosinophils	

5. *Natural killer cells* are not phagocytic. How do they assist in innate defenses, and what types of cells do they detect?

6. In the following figure, trace the flow of lymph in four stages. For each stage (especially note stage 3), explain the lymphatic system's role in innate defense.



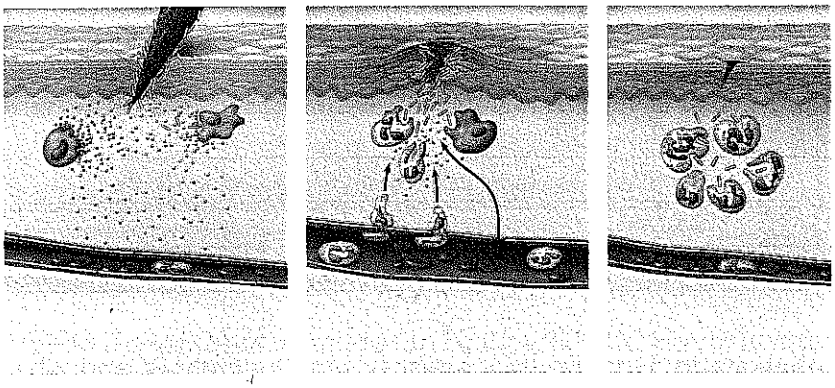
7. Explain the role of the following two antimicrobial compounds.

interferon

complement

8. List the three innate defenses vertebrates share with invertebrates and the two defenses unique to vertebrates.

9. Use the following figure to explain the three steps of an *inflammatory response.*



10. It might seem like pathogens have little hope of mounting an infection, but do not forget that pathogens are constantly evolving ways to circumvent our immune system. As examples, how do the pathogens that cause pneumonia and tuberculosis avoid our immune responses?

Concept 43.2 In adaptive immunity, receptors provide pathogen-specific recognition

11. From the first four paragraphs of this concept, summarize where *T cells* and *B cells* develop, and give an overview of their functions. (Note that they are a type of white blood cell known as a *lymphocyte.*)

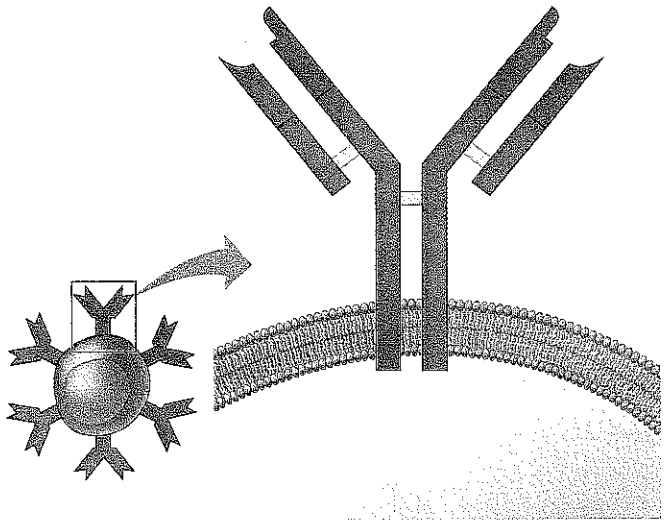
12. The following brief questions will serve as a primer for immune system recognition.

    a. What is an *antigen*?

    b. What is the relationship between an *antigen receptor*, an *antibody*, and an *immunoglobin*?

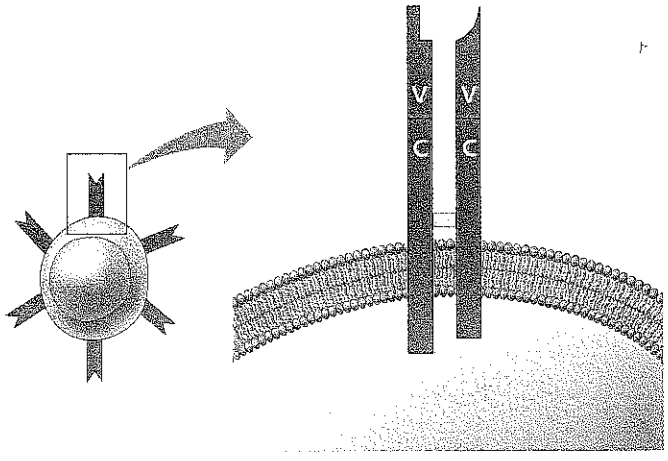
    c. How is an *epitope* related to an antigen? (Look at Figure 43.10 in your text.)

13. In the following figure of a B cell, label the *antigen-binding sites, light and heavy chains, variable and constant regions, transmembrane region*, and *disulfide bridges*.



14. What forms the specific *antigen-binding site*? (Be sure to recognize that each B cell produces only one type of antigen receptor. For any one cell, all antigen receptors or antibodies produced are identical.)

15. In the following figure of a T cell, label the *antigen-binding site,* α *and* β *chain, variable and constant regions, transmembrane region*, and *disulfide bridge*.

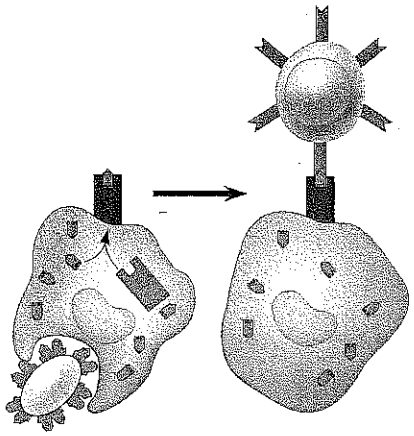


16. T cells also display only one type of receptor on the cell's surface. Compare and contrast a T cell with a B cell.

17. *B cell receptors* recognize and bind to antigens whether they are free antigens (like a secreted toxin) or on the surface of a pathogen. Explain the role of the *major histocompatibility complex (MHC)* to *T cell receptor* binding.

18. Explain how a host cell uses the MHC for *antigen presentation*.

19. Using Figure 43.12 in your text as a guide, completely label the following figure and describe how a T cell recognizes an antigen.



20. Refer to the section on B Cell and T Cell Development on page 954 in your text. List four major characteristics of the *adaptive immune system*. This will give an important overview of adaptive immunity and will guide you through the details to follow.

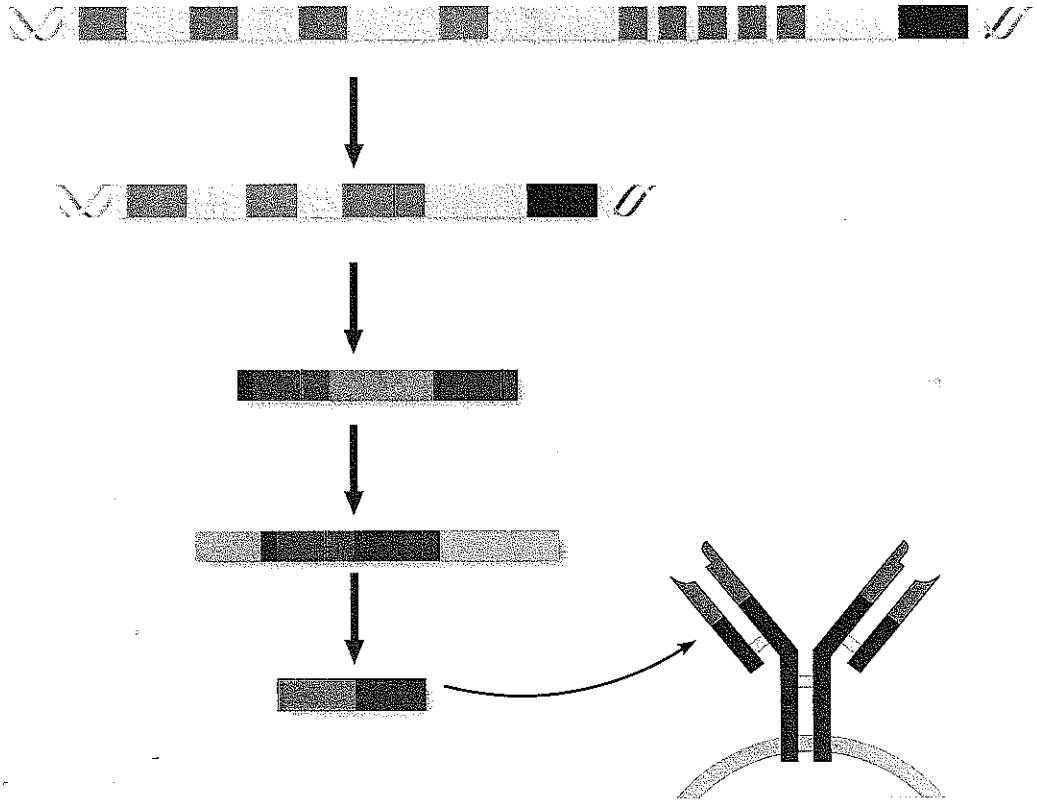
    a.

    b.

    c.

    d.

21. One of the early problems in immunology was trying to understand how an organism with a limited number of genes (for humans, about 20,000) could produce a million different B cell protein receptors and 10 million different T cell protein receptors! The answer resulted in a Nobel Prize and a startling exception to the notion that all cells have exactly the same DNA. Use the following figure to label and explain the four steps in producing genetically unique B cell receptors.



22. Explain how the body develops *self-tolerance* in the immune system.

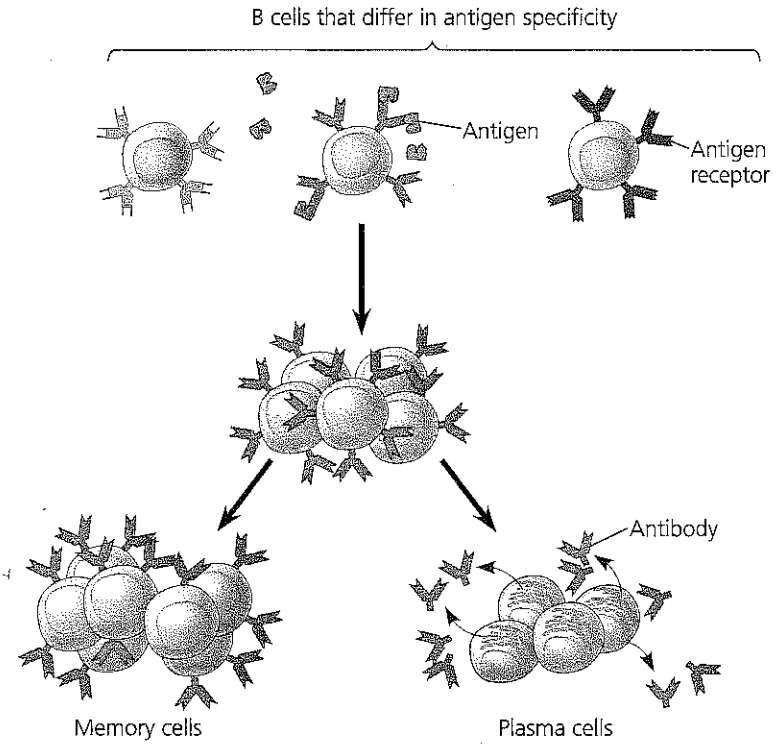
23. Define the following terms.

effector cells

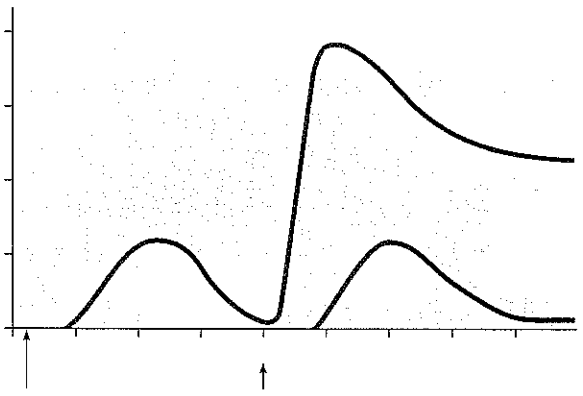
memory cells

clonal selection

24. Using the blue text in the margin of Figure 43.14, explain the three key events to clonal selection.



25. Graphs similar to the following one have been seen on several AP Biology exams. It depicts the primary and secondary immune response. The first arrow shows exposure to antigen A. The second arrow shows exposure to antigen A again, and also antigen B. Label this graph and then use it to explain the difference between a *primary* and *secondary immune response*.



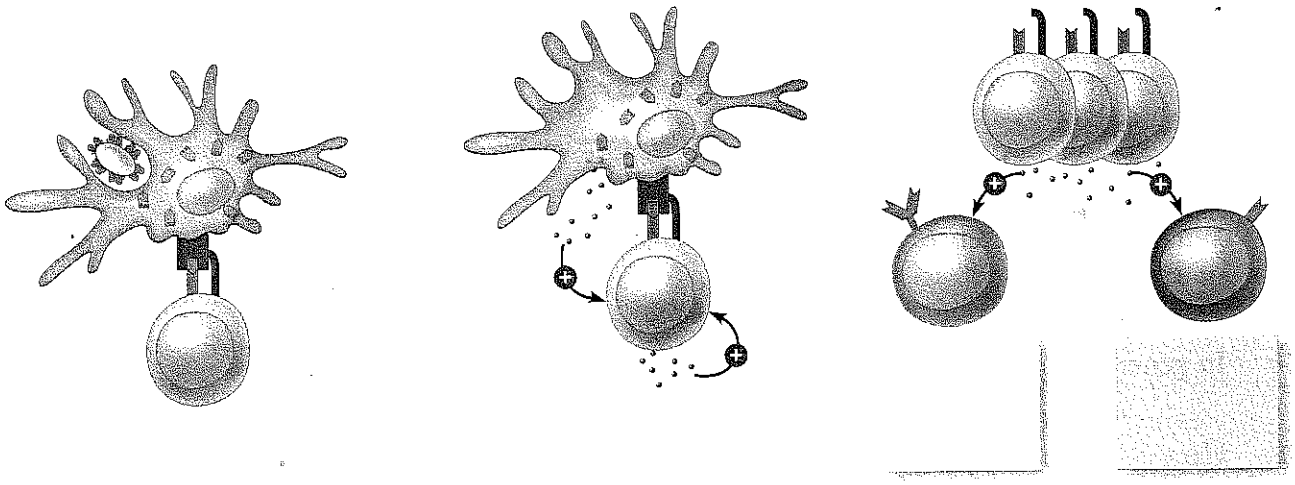
Concept 43.3 Adaptive immunity defends against infection of body fluids and body cells

26. Explain the function of the two divisions of acquired immunity.

humoral immune response

cell-mediated immune response

27. *Helper T cells* play a critical role in activation of both T cells and B cells. In full detail, label and explain the three steps involved using Figure 43.16.



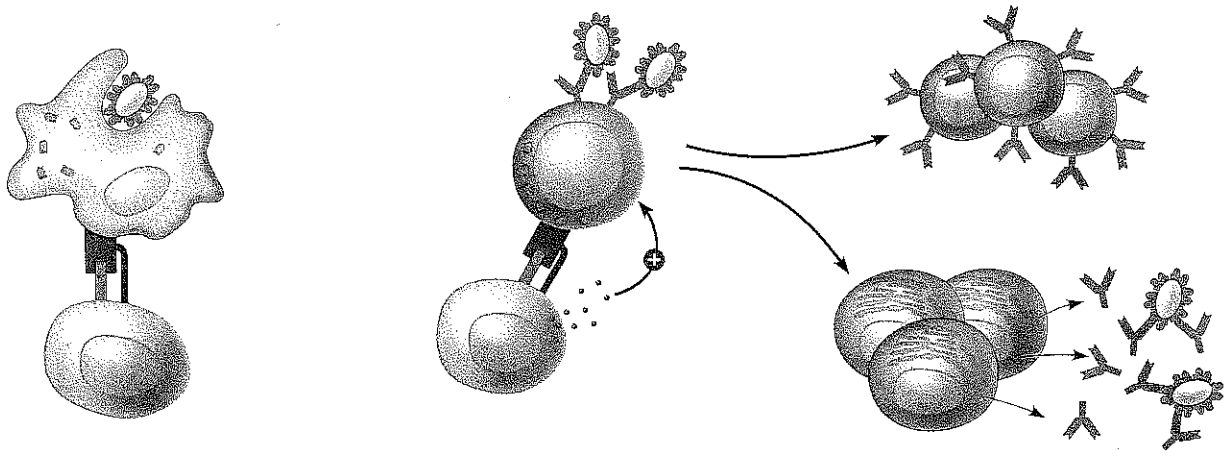
28. _____ are the effector cells in cell-mediated immunity.

29. What must occur for a *cytotoxic T cell* to become activated?

30. Using Figure 43.17 as a guide. Give an overview of the three steps in the killing action of a cytotoxic T cell.

31. How is B cell antigen presentation unique? (Hint: Figure 43.18, step 2)

32. Completely label the following diagram. Then carefully explain the three primary steps that occur in *B cell activation.*



33. What is the difference between *plasma cells* and *memory cells* produced from the activation of B cells?

34. In general, how do antibodies dispose of antigens?

35. How do antibodies and natural killer cells work together to fight viral infections while the virus is inside the body cell?

36. Using examples, explain the difference between *active* and *passive immunity*.

37. Describe how *immunizations* develop active immunity.

38. Explain how *monoclonal antibodies* are used in home pregnancy kits.

39. Why is the antibody response to a microbial infection *polyclonal*?

40. Why is immune rejection an example of a healthy immune system?

41. Briefly describe the following features of immune rejection.

    a. Explain how antibodies against blood types are present.

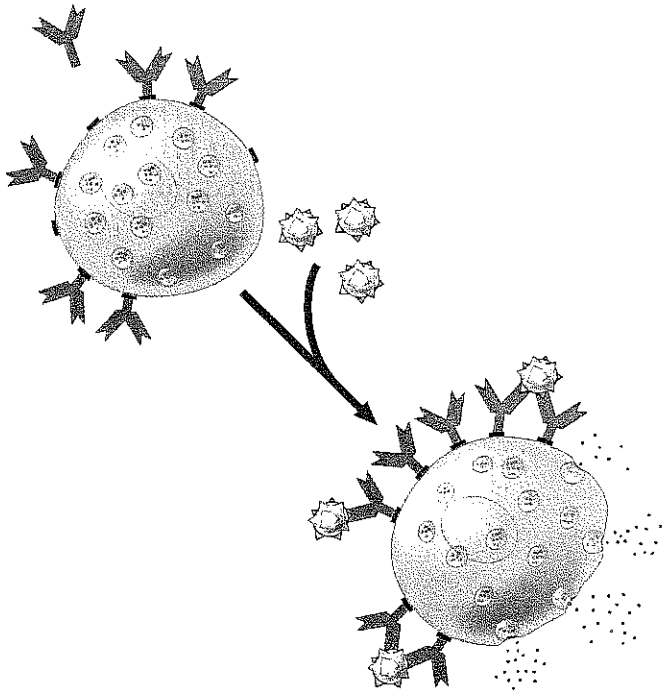
    b. What is the role of MHC in tissue and organ transplants?

    c. Why are bone marrow transplants medically unique?

Concept 43.4 Disruptions in immune system function can elicit or exacerbate disease

42. What are allergies?

43. Label Figure 43.22 and then use it to explain a typical allergic response.



44. Explain what happens if a person experiences *anaphylactic shock*. Does anyone in your school carry an EpiPen loaded with epinephrine to protect against anaphylactic shock?

45. *Autoimmune diseases* occur when the immune system turns against particular molecules of the body. Describe the cause and symptoms of the following autoimmune diseases.

lupus

rheumatoid arthritis

type 1 diabetes mellitus

multiple sclerosis

46. Explain how *inborn immunodeficiency* is different from *acquired immunodeficiency.*

47. Just as our immune system has evolved to thwart pathogens, pathogens have evolved to thwart our immune system. Describe the following pathogen strategies.

antigenic variation

latency

attack on the immune system: HIV

48. Explain how the high mutation rate in surface antigen genes in HIV has hampered development of a vaccine for AIDS. (You might take note that HIV—human immunodeficiency virus—is the virus that causes the disease AIDS—acquired immunodeficiency syndrome. These acronyms are often used incorrectly.)

Test Your Understanding Answers

Now you should be ready to test your knowledge. Place your answers here:

1. _____ 2. _____ 3. _____ 4. _____ 5. _____ 6. _____

7. _____