

## Cheat Sheet

## Chapter 43 Questions

1. What is a pathogen?
2. What is the immune system?
3. What is innate immunity?
4. What is adaptive immunity?
5. What is lysozyme?
6. How does innate immunity work in insects?
7. What are hemocytes?
8. What is the Toll receptor?
9. Describe the antiviral defense in insects.
10. What is mucus?
11. How are lungs protected from infection?
12. What is the pH of human skin?
13. What is a Toll-like receptor (TLR)?
14. Name the function of TLR9, TLR3, TLR4, and TLR5?
15. What are the two main types of phagocytic cells?
16. What are dendritic cells?
17. What are eosinophils?
18. What are natural killer cells?
19. What is the lymphatic system (name the lymphoid organs)?
20. What are interferons?
21. What is the complement system?
22. What is an inflammatory response?
23. What are cytokines?
24. What are mast cells?
25. What is pus?
26. What causes fever?
27. What is septic shock?
28. What are Crohn's disease and ulcerative colitis?
29. What is *Streptococcus pneumoniae*?
30. What is *Mycobacterium tuberculosis*?
31. What are lymphocytes?
32. What is an antigen?
33. What is an antigen receptor?
34. What is an epitope?
35. Describe the structure of a B cell antigen receptor.
36. What is an antibody?
37. Describe the receptor of a T cell.
38. What is a major histocompatibility complex (MHC) molecule?
39. Describe antigen recognition by T cells.
40. Describe how Ig light chains are encoded.

41. How do different B cells produce different Igs?
42. Why does the immune system display self tolerance?
43. How do B and T cells contribute to adaptive immunity?
44. What are effector B cells called?
45. What are effector T cells?
46. What is clonal selection?
47. What is a primary immune response?
48. What is secondary immune response?
49. What is the humoral immune response?
50. What is the cell-mediated immune response?
51. What is a helper T cell?
52. What distinguishes antigen-presenting cells from other body cells?
53. How does helper T cell and antigen-presenting cell interact?
54. How are helper T cells affected by antigen presentation by dendritic cells, macrophages, and B cells?
55. Describe B cell activation.
56. How do antibodies work?
57. Describe how the complement system works.
58. How do antibodies interact with natural killer cells?
59. How many classes of Igs can B cells express?
60. What are cytotoxic T cells?
61. What is immunization?
62. Describe the first vaccination.
63. What is active immunity?
64. What is passive immunity?
65. What is antivenin?
66. What are monoclonal antibodies?
67. How do home pregnancy test kits work?
68. How come cells from another person are rejected?
69. What does the ABO blood group represent?
70. What are allergies?
71. What is hay fever?
72. What is anaphylactic shock?
73. What is an autoimmune disease?
74. What is systemic lupus erythematosus (lupus)?
75. What is type 1 diabetes?
76. What is multiple sclerosis?
77. What is rheumatoid arthritis?
78. Which gender is most likely to suffer autoimmune diseases?
79. What are regulatory T cells (Tregs)?
80. What is an immunodeficiency?
81. What is an inborn immunodeficiency?
82. What is severe combined immunodeficiency (SCID)?

- 83. What is acquired immunodeficiency?
- 84. What is Hodgkin's disease?
- 85. What is antigenic variation?
- 86. What is latency?
- 87. What are herpes simplex viruses?
- 88. What is HIV?
- 89. What is acquired immunodeficiency syndrome (AIDS)?
- 90. What is *Pneumocystis jirovecii*?
- 91. What are the two types of HPV vaccines and what cancer do they prevent?

## Chapter 43 Answers

1. Bacterium, fungus, virus, or other disease-causing agent
2. The body's defenses
3. Includes barrier defenses, molecular recognition relies on a small set of receptor proteins that bind to molecules or structures that are absent from animal bodies, common to pathogens
4. Molecular recognition relies on a vast arsenal of receptors, aka acquired immune response, activated after innate immune response, only in vertebrates
5. Enzyme that breaks down bacterial cell walls, further protects insect digestive system
6. Immune cell produce recognition proteins that binds to molecule common to class of pathogens, serve as identity tags, trigger innate response once bound
7. Major immune cells of insects, some ingest and break down microorganisms in phagocytosis. One class produces defense molecule that traps large pathogens. Others release antimicrobial peptide that circulate throughout body and disrupt plasma membranes of fungi or bacteria
8. If fungus infects insect, recognition proteins activate receptor, which activates production and secretion of antimicrobial peptides that kill fungal cells (similar receptor in phagocytic mammalian cells)
9. Host enzyme Dicer-2 recognizes dsRNA, cuts into 21 nucleotide-long fragments. Argonaute enzyme binds to RNA fragment, uses one of strands as guide to viral mRNA, blocks synthesis of viral proteins
10. Viscous fluid that traps pathogens and other particles
11. Cilia sweep mucus and any entrapped material upward in airway
12. 3 to 5
13. Mammalian recognition protein similar to Toll protein, produces signals to initiate responses upon recognizing pathogen, each binds to characteristic molecule fragments
14. TLR9 - DNA with unmethylated CG sequences (CpG DNA)  
TLR3 - Inner surface of endocytosed vesicles, binds dsRNA  
TLR4 - located on immune cell plasma membranes, recognizes lipopolysaccharide  
TLR5 - recognizes flagellin
15. Neutrophils (circulate in blood, attracted by signals from infected tissues), macrophages (larger phagocytic cells, some migrate, others reside permanently in organs such as spleen)
16. Populate tissues that contact environment such as skin, stimulate adaptive immunity against pathogens they engulf
17. Found in tissues underlying an epithelium, defend against multicellular invaders, discharge destructive enzymes
18. Cells that circulate through body, detect abnormal array of surface proteins characteristic of virus infected and cancerous cells, release chemicals that lead to cell death
19. Network that distributes lymph throughout body, some macrophages reside in lymph nodes, dendritic cells reside outside but migrate in after interacting with pathogens.

Adenoids (nose), tonsils (throat/face), thymus (chest), spleen(left side), Peyer's patches(small intestine), appendix (cecum)

20. Proteins that provide innate defense by interfering with viral infections. Virus-infected cells secrete them, inducing nearby uninfected cells to inhibit viral replication. Some wbc's secrete interferon that enhances phagocytic ability of macrophages
21. 30 proteins in blood plasma, circulate in inactive state, activated by substances on surface of pathogens, activation causes invading cells to lyse
22. Set of events triggered by signaling molecules from injury or infection.
23. Signaling molecules discharged by activated macrophages/neutrophils, recruit neutrophils, promotes blood flow
24. Immune cells in connective tissue, release signaling molecule histamine at damaged sites, triggers nearby blood vessels to dilate and become more permeable
25. Fluid rich in white blood cells, dead pathogens, and debris from damaged tissues
26. Activated macrophages release substances that cause thermostat to reset to higher temperature
27. Life-threatening condition caused by overwhelming system inflammatory response caused by certain bacterial infections (high fever, low blood pressure, poor blood flow in capillaries, occurs in very old and very young). Fatal in 1/3 cases
28. Debilitating disorders in which inflammatory response disrupts intestinal function
29. Cause of pneumonia and meningitis, outer capsule interferes with molecular recognition and phagocytosis, bacteria
30. Bacteria, causes tuberculosis, grows and reproduces within host cells
31. B cells and T cells, originate from bone marrow, some migrate to thymus (organ in thoracic cavity above heart, called T cells). Those that remain in marrow called B cells. Natural killer cells are also, remain in blood
32. Any substance that triggers response from B or T cell
33. Protein that allows cell to bind to antigen, each cell makes 100,000 of only 1 type
34. Small accessible portion of antigen that binds antigen receptor
35. Y shaped protein, two identical heavy chains (polypeptides) and 2 light chains, linked by disulfide bridges. Each chain has constant (C) region, in heavy chains has transmembrane region. Each has variable (V) region, amino acid sequence varies extensively. Two binding sites
36. Immunoglobulin (Ig), soluble form of B cell receptor, lack membrane anchor
37.  $\alpha$  chain and  $\beta$  chain linked by disulfide bridge. Base of receptor is transmembrane region, variable regions at outer tip, single binding site. Bind only to fragments of antigens that are displayed on surface of host cells
38. Host protein that displays antigen fragment on cell surface to T cells
39. Pathogen taken in by immune cell, cleaved by enzymes into antigen fragments (smaller peptides). Fragment binds to MHC molecule, which transports it to cell surface (antigen presentation). T cell antigen receptor binds to antigen fragment and MHC, triggering adaptive immunity
40. single C segment, 40 different V segments, 5 different J segments

41. Enzyme complex called recombinase links one light chain V gene to one J gene segment, forming single exon that is part V, part J, acts randomly, rearrangements are permanent and passed to daughter cells
42. Antigen receptors tested for self-reactivity, those that are are destroyed by apoptosis
43. Once bound to epitope, undergo multiple cell divisions, resulting in clone. Some cells of clone become effector cells (short lived, take effect immediately) and others become memory cells (long-lived, give rise to effector cells if same antigen is encountered)
44. plasma cells, secrete antibodies
45. Helper T cells and cytotoxic T cells
46. Different antigen selects which lymphocyte will divide
47. Effector cells formed by clones of lymphocytes after initial exposure
48. Response to same antigen if encountered later, faster, greater magnitude, longer
49. Occurs in blood and lymph (body humors), antibodies help neutralize or eliminate toxins and pathogens in body fluids
50. Specialized T cells destroy infected host cells
51. Activates humoral and cell-mediated responses, binds to antigens on surface of antigen-presenting cell (dendritic cell, macrophage, or B cell)
52. Antigen-presenting cells have both class I and class II MHC, normal only have class I
53. Antigen receptors on T cell bind antigen fragment and to class II MHC molecule (displays fragment). Accessory protein CD4 on T cell binds class II MHC molecule, keep cells joined. Cytokines exchanged (when secreted from dendritic act with antigen to stimulate T cell)
54. Dendritic or macrophage activates T cell. B cells present antigens to already activated T cells to become activated
55. Presents antigen to which it binds to helper T cell. Stimulated by antigen and cytokines, then proliferates, leads to robust humoral immune response
56. Interfere with pathogen activity, mark pathogens for inactivation or destruction.  
Neutralization is where antibodies bind to proteins on virus, preventing infection of host cell  
Opsonization - Antibodies bound to antigens present readily recognized structures for macrophages/neutrophils  
Can link pathogens into aggregates
57. Complement protein binds to antigen-antibody complex, triggering generation of membrane attack complex that forms pore in membrane of cell, causing lysis
58. Bind to viral products on surface of infected body cells, can recruit killer cell that causes infected cell to undergo apoptosis
59. 5 classes (IgA, IgD, IgE, IgG, IgM), each with distinct heavy chain C region, antigen receptor (IgD) is exclusively membrane bound
60. Use toxic proteins in cell mediated immune response to kill infected cells, require signals from helper T cells and antigen presenting cells. Infected cells display foreign protein with MHC class I molecules. these have CD8 accessory protein that binds MHC.  
Release perforin molecules to form pores in membrane, release granzymes (enzymes that break down proteins and initiate apoptosis)

61. Use of antigens artificially introduced into the body to generate an adaptive immune response and memory cell formation.
62. People with cowpox (mild disease usually in cows) did not get smallpox, so cowpox virus could be used to induce adaptive immunity against smallpox
63. Defenses that arise when a pathogen infection or immunization prompts an immune response
64. Protection when IgG antibodies in blood of female transferred to fetus because antibodies produced by another individual. IgA antibodies in breast milk provide immunity to infant digestive tract, persists only as long as antibodies are transferred
65. Serum from sheep or horses that have been immunized against snake venom, can save humans bitten by snakes
66. Antibodies prepared from single clone of B cells produced in culture
67. Use monoclonal antibodies to detect human chorionic gonadotropin (hCG)
68. Each person expresses one of more than 100 MHC alleles
69. The carbohydrates on the surface of red blood cells
70. Exaggerated responses to certain antigens called allergens, most commonly involve IgE antibodies.
71. Plasma cells secrete IgE antibodies specific for antigens on surface of pollen grains. Some attach by base to mast cells, so when pollen grains enter, IgE molecules are cross-linked and mast cell releases histamine and other inflammatory chemicals. Can be cured by antihistamine by blocking histamine receptors
72. Life-threatening allergic response. Inflammatory chemicals trigger constriction of bronchioles and sudden dilation of peripheral blood vessels (drop in blood pressure). Cured by injection of epinephrine that counteracts response
73. Immune system active against particular molecules of body.
74. Immune system generates antibodies against histones and DNA released by breakdown of body cells, causing skin rashes, fever, arthritis, and kidney dysfunction.
75. Insulin-producing beta cells of pancreas killed by immune cells
76. Myelin sheaths killed by immune cells
77. Damaging and painful inflammation of cartilage and bone in joints
78. females (9 times for lupus, 2-3 for arthritis)
79. Specialized T cells helping to modulate immune system activity to prevent autoimmune
80. Disorder in which immune system response to antigen is missing
81. Results from genetic or developmental defect in immune system
82. Functional lymphocytes are absent, increasing susceptibility to infections
83. Immunodeficiency acquired later in life
84. Damages lymphatic system, type of cancer
85. Changing epitope expression to prevent triggering secondary immune response (such as trypanosomiasis, or sleeping sickness)
86. Inactive state that viruses enter after infecting cells, avoids immune response. Persists until conditions favor survival of virus



87. Establish themselves in human sensory neurons, type 1 causes oral herpes, type 2 causes genital herpes. Neurons express few MHC I molecules. Stress can lead to replication that causes cold sores or genital sores
88. Pathogen that causes AIDS, infects helper T cells by binding to CD4. Has high mutation rate. Latent while DNA is integrated in genome
89. HIV replication causes cell death and loss of helper T cells, impairment in immune responses leaves body susceptible to infections
90. Common fungus that does not cause disease in healthy people, can result in pneumonia in people with AIDS
91. Gardasil or Cervarix, Cervical cancer