Page 1: Introduction

Page 2: Goals
- To describe the general functions of the immune system.
- To describe the key characteristics of the common types of pathogens that attack our bodies.
- To name the three lines of defense and outline their properties.
- To distinguish between innate and adaptive immunity based on four key characteristics.
- To understand the definitions of antigen and antibody.
- To distinguish between humoral and cell-mediated (cellular) immunity and the location of the pathogens they target.

Page 3: Functions of the Immune System
- The immune system destroys pathogens and detects and kills abnormal cells such as cancerous cells.

Page 4: Know Your Enemy!
- Pathogens can be classified according to size and whether they are generally intracellular or extracellular.
- From largest to smallest they are multicellular organisms (such as parasitic worms), single-celled eukaryotes (such as the protozoan that causes malaria and many fungi), bacteria, and viruses.
- Viruses are mostly intracellular pathogens, and most bacteria and fungi are extracellular pathogens.

Page 5: Three Lines of Defense
- Surface barriers (innate external defenses) are the first line of defense.
- Innate internal defenses are the second line of defense.
- Adaptive defenses are the third line of defense.

Page 6: Innate Immunity
- Innate internal defenses have their own ways of identifying enemies by recognizing a limited number of markers unique to pathogens.
- When they recognize enemies, they attack immediately.
- When innate defense cells are overwhelmed, they secrete chemical messengers to mobilize adaptive defenses.

Page 7: Adaptive Immunity
- Adaptive defenses are specific.
- Adaptive defenses involve B and T lymphocytes.
- Adaptive defenses have memory.
- Adaptive defenses are systemic.
Page 8: Antigens
- The special shape that a particular lymphocyte recognizes is called an antigenic determinant and is formed by the three-dimensional structure of a large molecule called an antigen.
- Antigens are usually proteins, but they can also be large carbohydrates or nucleic acids.
- The surface of any given pathogen is studded with many different antigens, each usually having many different antigenic determinants.
- Antigens bind to receptors on B and T cells and to protein molecules called antibodies.

Page 9: Humoral and Cellular Immunity
- Humoral immunity involves B cells and the antibodies they ultimately produce.
- Humoral immunity is directed primarily against extracellular pathogens.
- Humoral immunity can be transferred in plasma.
- Cellular immunity involves T cells.
- Cellular immunity is directed primarily against intracellular pathogens and cancerous cells.
- Cellular immunity cannot be transferred in plasma.
- Humoral immunity depends on elements of cellular immunity.

Page 10: Summary
- The immune system defends against pathogens and destroys cancerous cells.
- Common pathogens include viruses, bacteria, fungi, protozoa, and worms.
- Viruses are intracellular pathogens, whereas most other pathogens are extracellular.
- The immune system’s three lines of defense are surface barriers, innate internal defenses, and adaptive defenses.
- Adaptive immunity differs from innate immunity in that it is specific, involves B and T lymphocytes, has memory, and is systemic.
- Antigens are molecules that can be recognized by the immune system.
- Humoral immunity involves B cells and targets extracellular pathogens; cellular immunity involves T cells and targets intracellular pathogens.

Study Questions
1. (Goal 1, Page 3) List two general functions of the immune system.
2. (Goal 2, Page 4) Explain two ways pathogens are classified.
3. (Goal 2, Page 4) Rank each pathogen according to its size (largest = 4 to smallest =1).
   ___ a. virus
   ___ b. protozoan
   ___ c. parasitic worm
   ___ d. bacteria
4. (Goal 2, Page 4) Name one pathogen that is primarily intracellular and two that are primarily extracellular.
5. (Goal 3, Page 5) List the three main lines of defense.
6. (Goal 3, Page 6) How do innate internal defenses identify enemies that have entered the body?
7. (Goal 3, Page 6) What happens when innate defense cells recognize invading enemies?
8. (Goal 3, Page 6) What do innate defense cells do when they are overwhelmed?
9. (Goal 4, Page 7) List four ways adaptive defenses differ from innate defenses.
10. (Goal 5, Page 8) How do B and T lymphocytes recognize foreign invaders?
11. (Goal 5, Page 8) Explain the difference between an antigen and an antigenic determinant site.
12. (Goal 5, Page 8) Name three molecules that can function as antigens.
13. (Goal 5, Page 8) List three places where antigen receptors are located.
14. (Goal 6, Page 9) Name the cell and cell product that are responsible for humoral immunity.
15. (Goal 6, Page 9) Against what type of pathogens are antibodies typically directed?
16. (Goal 6, Page 9) Which branch of adaptive immunity can be transferred via body fluids (for example, plasma)?
17. (Goal 6, Page 9) Which branch of adaptive immunity involves T cells?
18. (Goal 6, Page 9) What do T cells target and eliminate?

**Matching.** Match each term with its definition/description. Place the term in the blank in front of its definition/description. Each answer is used only one time.

<table>
<thead>
<tr>
<th>Adaptive defense</th>
<th>B lymphocyte (B cell)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Humoral immunity</td>
<td>Pathogen</td>
</tr>
<tr>
<td>Antigenic determinant site (Antigen)</td>
<td>Cell-mediated immunity</td>
</tr>
<tr>
<td>T lymphocyte (T cell)</td>
<td>Innate external defense</td>
</tr>
<tr>
<td>Virus</td>
<td>Bacteria</td>
</tr>
<tr>
<td>Innate internal defense</td>
<td></td>
</tr>
</tbody>
</table>

1. __________________________  The smallest of invaders, this microorganism enters body cells.
2. __________________________  A cell that produces and releases antibodies directed at an antigenic determinant site.
3. __________________________  A general term for an organism that causes a disease.
4. __________________________  These microbes occasionally hide in cells but most often are found outside of the cell.
5. __________________________  These cells attack virally infected cells and cancerous cells.
6. __________________________  The skin belongs to this line of defense.
7. __________________________  The region of a molecule that is recognized by acquired immunity cells.
8. __________________________  This response is specific, systemic, has memory, and involves B and T lymphocytes.
9. __________________________  This type of immunity is transferred via body fluids.
10. __________________________  This type of immunity involves cells (T lymphocytes).
11. __________________________  This line of defense involves cells that attack an invader immediately.

**Summary**
**Fill-in-the-blanks.** Fill in each blank with the correct term.

The __________ system defends against _________ and destroys cancerous cells. Common pathogens include viruses, __________, fungi, protozoa, and worms. __________ are intracellular pathogens, whereas most other pathogens are extracellular.

The immune system’s _______ lines of defense are:

- first line; innate external defense (for example, ________________).  
- second line; innate ________ defenses are cells that recognize enemies and attack immediately.  
- third line; ____________ defenses (for example B and T lymphocytes).

Adaptive immunity differs from innate immunity in that it is specific, involves B and T lymphocytes, has _______________, and is systemic. Humoral immunity involves B lymphocytes and targets _______________ pathogens; cellular immunity involves T lymphocytes and targets _______________ pathogens and cancerous cells.  

______________ are molecules that are recognized by the immune system.