# Study Outline Chapter 17

**Introduction (p. 461)**

- An individual' s genetically predetermined resistance to certain diseases is called innate resistance.
- Individual resistance is affected by gender, age, nutritional status, and general health.

**Immunity (p. 461)**

- Immunity is the ability of the body to specifically counteract foreign organisms or substances called antigens.
- Immunity results from the production of specialized lymphocytes and antibodies.

**Types of Acquired Immunity (pp. 461- 462)**

- Acquired immunity is specific resistance to infection developed during the life of the individual.
- A person may develop or acquire immunity after birth.

Naturally Acquired Immunity (p. 462)

- Immunity resulting from infection is called naturally acquired active immunity; this type of immunity may be long-lasting.
- Antibodies transferred from a mother to a fetus (transplacental transfer) or to a newborn in colostrum results in naturally acquired passive immunity in the newborn; this type of immunity can last up to a few months.

Artificially Acquired Immunity (p. 462)

- Immunity resulting from vaccination is called artificially acquired active immunity and can be long-lasting.
- Vaccines can be prepared from attenuated, inactivated, or killed microorganisms and toxoids.
- Artificially acquired passive immunity refers to humoral antibodies acquired by injection; this type of immunity can last for a few weeks.
- Antibodies made by a human or other mammal may be injected into a susceptible individual.
- Serum containing antibodies is often called antiserum.
- When serum is separated by gel electrophoresis, antibodies are found in the gamma fraction of the serum and are termed immune serum globulin, or gamma globulin.

**The Duality of the Immune System (p. 463)**

- Humoral immunity is in body fluids.
- Cell-mediated immunity is due to certain types of lymphocytes.

The Humoral (Antibody-Mediated) Immune System (p. 463)

- The humoral immune system involves antibodies produced by B cells in response to a specific antigen.

- Antibodies primarily defend against bacteria, viruses, and toxins in blood plasma and lymph.

The Cell-Mediated Immune System (p. 463)

- The cell-mediated immune system depends on T cells and does not involve antibody production.
- Cellular immunity is primarily a response to intracellular bacteria and viruses, multicellular parasites, transplanted tissue, and cancer cells.

**Antigens and Antibodies (pp. 463- 467)**

The Nature of Antigens (pp. 463- 464)

- An antigen (or immunogen) is a chemical substance that causes the body to produce specific antibodies or sensitized T cells.
- As a rule, antigens are foreign substances; they are not part of the body' s chemistry.
- Most antigens are components of invading microbes: proteins, nucleoproteins, lipoproteins, glycoproteins, or large polysaccharides with a molecular weight greater than 10,000.
- Antibodies are formed against specific regions on the surface of an antigen called antigenic determinants.
- Most antigens have many different determinants.
- A hapten is a low-molecular-weight substance that cannot cause the formation of antibodies unless combined with a carrier molecule.

The Nature of Antibodies (pp. 464- 467)

- An antibody, or immunoglobulin, is a protein produced by B cells in response to the presence of an antigen and capable of combining specifically with that antigen.
- An antibody has at least two identical antigen-binding (valence) sites.

*Antibody Structure* (pp. 464- 465)

- A single bivalent antibody unit is a monomer.
- Most antibody monomers consist of four polypeptide chains. Two are heavy chains, and two are light chains.
- Within each chain is a variable (V) region, where antigen binding occurs, and a constant (C) region, which serves as a basis for distinguishing the classes of antibodies.
- An antibody monomer is Y- or T-shaped; the variable regions form the tips, and the constant regions form the base and Fc (stem) region.
- The Fc region can attach to a host cell or complement.

*Immunoglobulin Classes* (pp. 465- 467)

- IgG antibodies are the most prevalent in serum; they provide naturally acquired passive immunity, neutralize bacterial toxins, participate in complement fixation, and enhance phagocytosis.
- IgM antibodies consist of five monomers held by a joining chain; they are involved in agglutination and complement fixation.
- Serum IgA antibodies are monomers; secretory IgA antibodies are dimers that protect mucosal surfaces from invasion by pathogens.

- IgD antibodies are antigen receptors on B cells.
- IgE antibodies bind to mast cells and basophils and are involved in allergic reactions.

**B Cells and Humoral Immunity (pp. 467- 472)**

- Humoral immunity involves antibodies that are produced by B cells.
- Bone marrow stem cells give rise to B cells.
- Mature B cells migrate to lymphoid organs.
- A mature B cell recognizes an antigen with antigen receptors.

Apoptosis (p. 467)

- Lymphocytes that are not needed undergo apoptosis, or programmed cell death, and are destroyed by phagocytes.

Activation of Antibody-Producing Cells by Clonal Selection (pp. 468- 469)

- According to the clonal selection theory, a B cell becomes activated when an antigen reacts with antigen receptors on its surface.
- Recombination events in the gene coding for the variable region result in the ability to produce huge numbers of different antibody molecules.
- The activated B cell produces a clone of plasma cells and memory cells.
- Plasma cells secrete antibodies. Memory cells recognize pathogens from previous encounters.
- T cells and B cells that react with self antigens are destroyed during fetal development; this is called clonal deletion.

Antigen- Antibody Binding and Its Results (pp. 469- 471)

- An antigen binds to the antigen-binding site (variable region) of an antibody to form an antigen- antibody complex.
- IgG antibodies inactivate viruses and neutralize bacterial toxins.
- Agglutination of cellular antigens occurs when an IgG or IgM antibody combines with two cells.
- Antigen- antibody complexes involving IgG and IgM antibodies can fix complement, resulting in the lysis of a bacterial (antigenic) cell.

Immunological Memory (p. 471)

- The amount of antibody in serum is called the antibody titer.
- The response of the body to the first contact with an antigen is called the primary response. It is characterized by the appearance of IgM followed by IgG.
- Subsequent contact with the same antigen results in a very high antibody titer and is called the secondary, anamnestic, or memory response. The antibodies are primarily IgG.

Monoclonal Antibodies and Their Uses (pp. 471- 472)

- Hybridomas are produced in the laboratory by fusing a cancerous cell with an antibody-secreting plasma cell.
- A hybridoma cell culture produces large quantities of the plasma cell' s antibody, called monoclonal antibodies.
- Monoclonal antibodies are used in serologic identification tests, to prevent tissue rejections, and to make immunotoxins to treat cancer.

- Immunotoxins can be made by combining a monoclonal antibody and a toxin; the toxin will then kill a specific antigen.

**T Cells and Cell-Mediated Immunity (pp. 472- 477)**

- Cell-mediated immunity involves specialized lymphocytes, primarily T cells, that respond to intracellular antigens.

Chemical Messengers of Immune Cells: Cytokines (p. 472- 473)

- Cells of the immune system communicate with each other by means of chemicals called cytokines.
- Interleukins (IL) are cytokines that serve as communicators between leukocytes.
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- Chemokines cause leukocytes to move to the site of infection.
- Cytokines may be useful in treating tumors.

Cellular Components of Immunity (p. 474- 477)

- T cells are responsible for cell-mediated immunity.
- After differentiation in the thymus gland, T cells migrate to lymphoid tissue.
- T cells differentiate into effector T cells when they are stimulated by an antigen.
- Some effector T cells become memory cells.

*Types of T Cells* (pp. 474- 476)

- T cells are classified according to their functions and cell-surface receptors called CDs.
- The antigen must be processed by an antigen-presenting cell (APC) and positioned on the surface of the APC.
- The major histocompatibility complex (MHC) consists of cell-surface proteins that are unique to each individual and provide self molecules.
- A T cell recognizes antigens in association with MHC on an APC, causing the APC to release IL-1.
- After binding to an APC, helper T (TH) or CD4 cells secrete IL-2 to activate other TH cells specific for that antigen.
- Cytotoxic T (TC) or CD8 cells release perforin to lyse cells carrying the target antigen and MHC.
- Delayed hypersensitivity T (TD) cells are associated with certain types of allergic reactions and transplant rejection.
- Suppressor T (TS) cells appear to regulate the immune response.

*Nonspecific Cellular Components* (pp. 476- 477)

- Macrophages that are stimulated by ingesting an antigen or by cytokines become activated to have enhanced phagocytic ability.
- Natural killer (NK) cells lyse virus-infected and tumor cells. They are not T cells and are not antigenically specific.

**The Interrelationship of Cell-Mediated and Humoral Immunity (pp. 477- 480)**

- TH cells activate B cells to produce antibodies against T-dependent antigens.
- Antigens that directly activate B cells are called T-independent antigens.
- In antibody-dependent cell-mediated cytoxicity (ADCC), NK cells, macrophages, and other leukocytes lyse antibody-coated cells.

- ADCC is useful against helminthic parasites.