**Chapter 43 Notes**

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* Innate immunity
  + Immunity that is present before any exposure to pathogens
  + Effective from birth
* Acquired immunity
  + Develops only after exposure to inducing agents such as microbes
  + Lymphocytes
    - White blood cells that produce two types of immune responses
      * Cell-mediated and humoral
  + Antibodies
    - Defensive proteins that bind to microbes and mark them for elimination
* Innate immunity
  + External defenses
    - Skin
    - Mucous membranes
    - Secretions
      * Lysozyme
        + An enzyme that digests the cell wall of many bacteria
  + Internal cellular and chemical defenses
    - Phagocytosis
      * The ingestion of invading microorganisms
      * Phagocytic cells
        + Phagocytes

Attach to their prey via surface receptors

* + - Neutrophils
      * White cells that make up 60-70% of white cells
      * Engulfs and destroys microbes
    - Macrophages
      * Develop from monocytes
        + Constitute 5% of circulating white blood cells
    - Eosinophils
      * Low phagocytic activity but are critical to defense against multicellular parasitic invaders
    - Dendritic cells
      * Can ingest microbes similar to macrophages
    - Antimicrobial proteins
      * Complement system
        + Made up of 30 serum proteins
        + Inactive when infection is absent
      * Two types of interferon provide innate defense against viral infections
        + Alpha and beta
        + Secreted by virus infected body cells
        + Induce unaffected neighboring cells
    - Inflammatory response
      * Triggered by a damage to the tissue
      * Histamine
        + One of the most active chemicals
        + Stored in the mast cells of connective tissues
      * Swelling enhances blood flow
      * Chemokines
        + Small proteins that direct the migration of phagocytes and signal them to increase production of microbe-killing compounds
    - Natural killer cells
      * Patrol the body and attack virus-infected body cells and cancer cells
      * Triggers the release of chemicals that triggers apoptosis
        + Programmed cell death
  + Invertebrate immune mechanisms
    - Insect equivalent to blood
      * Hemolymph
        + Contains hemocytes
    - Research indicates that invertebrates lack cells analogous to lymphocytes, white blood cells responsible for acquired specific immunity
    - Invertebrates exhibit no immunological memory
      * Ability to respond to the same virus quicker the second time around
* Cytokines
  + Proteins that help activate lymphocytes and other cells of the immune system
* Antigens
  + Any foreign molecule that that is specifically recognized by lymphocytes and elicits a response from them is called an antigen
* Epitope
  + Antigenic determinant
    - A single antigen usually has several different epitopes
* Antigen recognition by lymphocytes
  + 2 types
    - B lymphocytes (B cells)
    - T lymphocytes (T cells)
    - Concentration in spleen, lymph nodes, and other lymphoid tissues
  + Recognize antigens by means of antigen-specific receptors
    - A single B or T cell contains about 100,000 of these receptors
* B cell receptors for antigens
  + B cell receptor
    - Y-shaped molecule consisting of four polypeptide chains
      * 2 identical heavy chains and two identical light chains
      * Linked by disulfide bridges
    - Immunoglobulins
      * Secreted antibodies that are structurally similar to B cell receptors
  + T cell receptors for antigens and the role of the MHC
    - T cell receptor
      * Consists of two different polypeptide chains
        + Alpha and beta
      * Recognize and bind with antigens
      * Major histocompatibility complex (MHC)
        + Transported towards plasma membrane and binds with fragment of protein antigen within the cell and brings it to the cells surface

Antigen presentation

* + - * MHCI
        + Found on almost all nucleated cells of the body
        + When displaying bound peptide antigens, they are recognized by a subgroup of T cells called cytotoxic T cells
      * MHCII
        + Are made by just a few cell types

Mainly dendritic cells

* + - * + Antigen-presenting cells

Have a key role in displaying such internalized antigens to another subgroup of T cells called helper T cells

* Lymphocyte development
  + Lymphocytes originate from pluripotent stem cells in bone marrow
  + Lymphocytes that migrate from bone marrow to thymus, a gland in the thoracic cavity above the heart, develop into T cells
* Generation of lymphocyte diversity
  + The immunoglobulin light-chain gene contains a series of 40 variable (V) gene segments separated by a long stretch of DNA from 5 joining (J) gene segments
  + Once V-J rearrangement has occurred, the gene can be transcribed
* Testing and removal of self-reactive lymphocytes
  + Because the rearrangements of antigen receptor genes are random, a developing lymphocyte may end up with antigen receptors that are specific for some of the body’s own molecules
  + Lymphocytes bearing receptors specific for molecules already present in the body are either destroyed by apoptosis or rendered nonfunctional
* Clonal selection of lymphocytes
  + Effector cells
    - Short lived cells that combat the same antigen
  + Memory cells
    - Long lived cells bearing receptors specific for the same inducing antigen
  + Clonal selection
    - Antigen-driven cloning of lymphocytes
  + The selective proliferation and differentiation of lymphocytes that occur the first time the body is exposed to a particular antigen represent the primary immune response
    - Does not peak until about 10 to 17 days after the initial exposure to the antigen
  + Plasma cells
    - Antibody secreting effector B cells generated by selected B cells
  + Secondary immune response
    - When an individual is exposed to the same antigen, the response is faster
    - Antibodies produced in this response have a greater affinity for the antigen than those in the primary immune response
    - Immunological memory
* Humoral and cell-mediated immunity defend against different types or threats
  + Humoral immune response
    - Involves the activation and clonal selection of B cells
  + Cell-mediated immune response
    - Involves the activation and clonal selection of cytotoxic T cells, which destroy target cells
  + Helper T cell
    - Responds to peptide antigens displayed on antigen presenting cells
* Helper T cells: A response to nearly all antigens
  + CD4
    - A surface protein present on most helper T cells
    - Binds MHCII
* Cytotoxic T cells: A response to infected cells and cancer cells
  + Effectors of cell-mediated immunity
  + Eliminate body cells infected by viruses or other intracellular pathogens
  + CD8
    - Surface protein present on most cytotoxic t cells
    - Greatly enhances the interaction between a target cell and a cytotoxic T cell
* B cells: a response to extracellular pathogens
  + Antigens that elicit a humoral immune response are typically proteins and polysaccharides present on the surface of bacteria or incompatible transplanted tissue or transfused blood cells
  + Antigens that induce antibody production only with assistance from helper T cells are known as T-dependent antigens
* Antibody classes
  + A secreted antibody has the same general Y-shaped structure as a B cell receptor
  + Monoclonal antibodies
    - Prepared from a single clone of B cells grown in culture
    - Identical and specific for a for the same epitope on an antigen
  + Antibody-Mediated disposal of antigens
    - The binding of antibodies to antigens is the basis of many disposal mechanisms
      * Viral neutralization
        + Antibodies bind to certain proteins on the surface of a virus
      * Opsonization
        + The bound antibodies enhance macrophage attachment
      * Agglutination
        + Clumping od bacteria
      * Precipitation
        + Antibodies cross link soluble antigen molecules dissolved in body fluids
    - Membrane attack complex (MAC)
      * Forms a pore in the membrane
* Active and passive immunization
  + Active immunity
    - Depends on the actions of a persons on lymphocytes
  + Immunization or vaccination
    - Active immunity can develop from vaccines
  + Passive immunity
    - Immunity that des not result from the action of the recipient’s own B and T cells
* Blood groups and transfusions
  + 4 blood types
    - A, B, AB, O
    - Must be certain type to be able to donate and receive in a blood transfusion
* Tissue and organ transplants
  + MHC molecules are responsible for stimulating the immune response that leads to the rejection of tissue and organs
  + Graft versus host reaction
    - Limited if the MHC molecules of the donor are well matched
* Allergies
  + Anaphylactic shock
    - Whole body life threatening reaction
  + Allergies are exaggerated responses to certain antigens called allergens
* Autoimmune diseases
  + When the immune system loses tolerance for self and turns against certain molecules of the body
* Immunodeficiency diseases
  + The inability of the immune system to protect the body from pathogens or cancer cells
  + Inborn immunodeficiencies
    - Result from defects in the development of various immune system cells
  + Acquired immunodeficiency diseases
    - Immune system dysfunction hat develops later in life
    - Acquired immunodeficiency syndrome
      * Caused by virus
  + Stress and the immune system
    - Healthy immune system depends on endocrine and nervous systems
  + AIDS (Acquired immunodeficiency syndrome)
    - AIDS arises from the loss of helper T cells after an organism has been infected with the human immunodeficiency virus (HIV)
    - Transfer of body fluids arises in the infection of HIV