**Introduction**

- **Components**
  - Lymph is the fluid
  - Vessels: lymphatics
  - Structures & organs
- **Functions**
  - Return tissue fluid to the bloodstream
  - Transport fats from the digestive tract to the bloodstream
  - Surveillance & defense

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**Lymphatics**

- Originate as **lymph capillaries**
- Capillaries unite to form larger vessels
  - Resemble veins in structure
  - Connect to lymph nodes

**Main Channels of Lymphatics**

- **Left and right lymphatic ducts** empty into large veins just before they join the superior vena cava

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**Major Lymphatic Vessels of the Trunk**

**Lymph Tissue**

- **Diffuse lymphatic tissue**
  - No capsule present
  - Found in connective tissue of almost all organs
- **Lymphatic nodules**
  - No capsule present
  - Oval-shaped masses
  - Found singly or in clusters
- **Lymphatic organs**
  - Capsule present
  - Lymph nodes, spleen, thymus gland
Tonsils
- Multiple groups of large lymphatic nodules
- Location – mucous membrane of the oral and pharyngeal cavities
- **Palatine tonsils**
  - Posterior-lateral walls of the oropharynx
- **Pharyngeal tonsil**
  - Posterior wall of nasopharynx
- **Lingual tonsils**
  - Base of tongue

Lymph Nodes
- Oval structures located along lymphatics
- Enclosed by a fibrous capsule
- Divided into compartments
  - **Sinuses**
  - Produce lymphocytes
- Lymph enters nodes through afferent lymphatics, flows through sinuses, exits through efferent lymphatic

Spleen
- Largest lymphatic organ
- Located between the stomach & diaphragm
- Structure – similar to node
  - Capsule present
  - No afferent lymphatic vessels
- Contains
  - Lymphatic tissue
  - Red blood cells
  - Lymphocytes (plasma cells)
  - Other leukocytes
- Functions
  - Filters & stores blood

Thymus Gland
- Location – behind the sternum
- Function
  - **Differentiation** and maturation of T cells

Function of the Lymphatic System
- Defense against harmful organisms and chemicals
  - **Nonspecific resistance**
    - Inherited
    - Wide variety of body reactions against a wide range of pathogens
  - **Specific resistance**
    - Resistance to a specific disease-causing microorganisms

Nonspecific Resistance
- **Skin**
  - 1st line of defense
    - Mechanical and chemical factors that fight disease
- **Tears**
- **Saliva**
- **Flow of urine**
- **Gastric juice**
Nonspecific Resistance (cont’d)

- **Interferon (IFN)**
  - Produced by body cells infected with viruses
  - Then released by the infected cells
  - Inhibits viral replication in neighboring cells
  - Decreases disease-producing power of many viruses
- **Phagocytosis**
- **Inflammation**
- **Fever**

Specific Resistance = Immunity

- Involves the production of a specific cell or molecule (antibody) to destroy a specific disease-causing organism or its toxin (antigen).
- **Innate Immunity**
  - Inborn immunity
- **Acquired Immunity**
  - Immunity acquired during organisms’ lifetime

**Characteristics of the Immune Response**

- **Specificity**
  - Involves the production of a specific cell or antibody to destroy a particular antigen
- **Memory**
  - Acquired ability to detect and eliminate foreign substances
  - Self vs. non-self recognition
    - **MHC**
      - Involves lymphocytes (B cells and T cells)

What is an antibody?

- Large protein
- Minimum of two binding sites which combine with antigens
- Also known as "immunoglobulins"

What is an antigen?

- **Antigen** = "antibody generating" molecule
  - any chemical substance that, when introduced into the body, causes the body to produce specific antibodies that can react with the antigen
- Properties of antigens:
  - **Foreign** proteins or polysaccharides
- Examples:
  - Cell membranes, flagella, viruses, toxins, pollen, transplanted tissues & organs, markers on red blood cells
What does an antigen do?

- Antigen stimulates the formation of specific antibodies
- Antibodies bind to the antigen
  - Forms an antigen-antibody complex
- The formation of the antigen-antibody complex ultimately leads to inactivation and removal of the antigen

Lymphocytes Initiate the Immune Response

- Types of lymphocytes
  - T cells
    - 80% of circulating lymphocytes
  - B cells
    - 10 – 15% of circulating lymphocytes
  - NK cells
    - 5 – 10% of circulating lymphocytes

Lymphocytes and the Immune Response

- Direct attack by T cells
  - Virus & bacterial infected host cells, fungi, parasites, transplanted tissues, tumors, etc.
- Attack by circulating antibodies
  - Released by plasma cells derived from activated B cells

T Cells and Immunity

- 1000s of different types of T cells
- When an antigen enters the body, only the particular T cell programmed to react with the antigen becomes activated
  - Macrophages phagocytize the antigen
  - Macrophages present it to the T cell
- T cells increase in size, divide, differentiate
  - Cytotoxic T cells
  - Helper T cells
  - Memory T cells

B Cells and Immunity

- 1000s of different kinds of B cells
  - Each type responds to a specific antigen
- When an antigen enters the blood
  - B cells are activated
    - Become plasma cells
    - Circulate in blood and lymph to reach site of invasion
  - B cells become memory B cells
    - Respond more rapidly and forcefully should a 2nd invasion occur
Disorders of the Immune System

- Allergy
- Autoimmune diseases
- Severe Combined Immunodeficiency (SCID)
- Acquired Immune Deficiency Syndrome (AIDS)
  - Human immunodeficiency virus (HIV)