

The Lymphatic System

Disclosure

- The material and the illustrations are adopted from the textbook **“Human Anatomy and Physiology / Ninth edition/ Eliane N. Marieb 2013”**

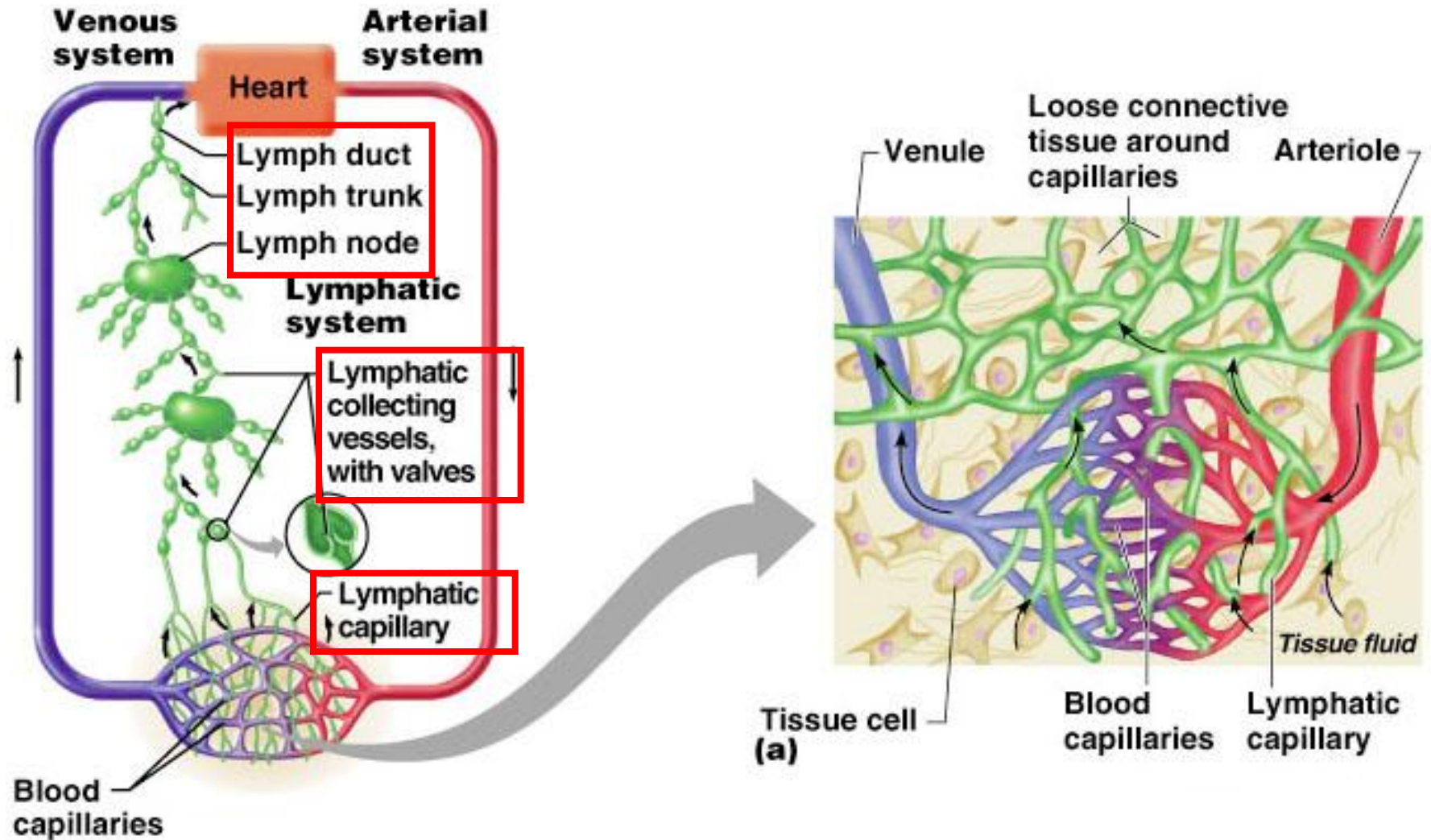
Lymphatic System: Overview

- Consists of two semi-independent parts
 - A meandering network of lymphatic vessels
 - Lymphoid tissues and organs scattered throughout the body
- Returns interstitial fluid and leaked plasma proteins back to the blood
- Lymph – interstitial fluid once it has entered lymphatic vessels

Functions of the Lymphatic System

1. Draining excess interstitial fluid & plasma proteins from tissue spaces
2. Transporting dietary lipids & vitamins from GI tract to the blood
3. Facilitating immune responses
 - recognize microbes or abnormal cells & responding by killing them directly or secreting antibodies that cause their destruction

Lymphatic System: Overview



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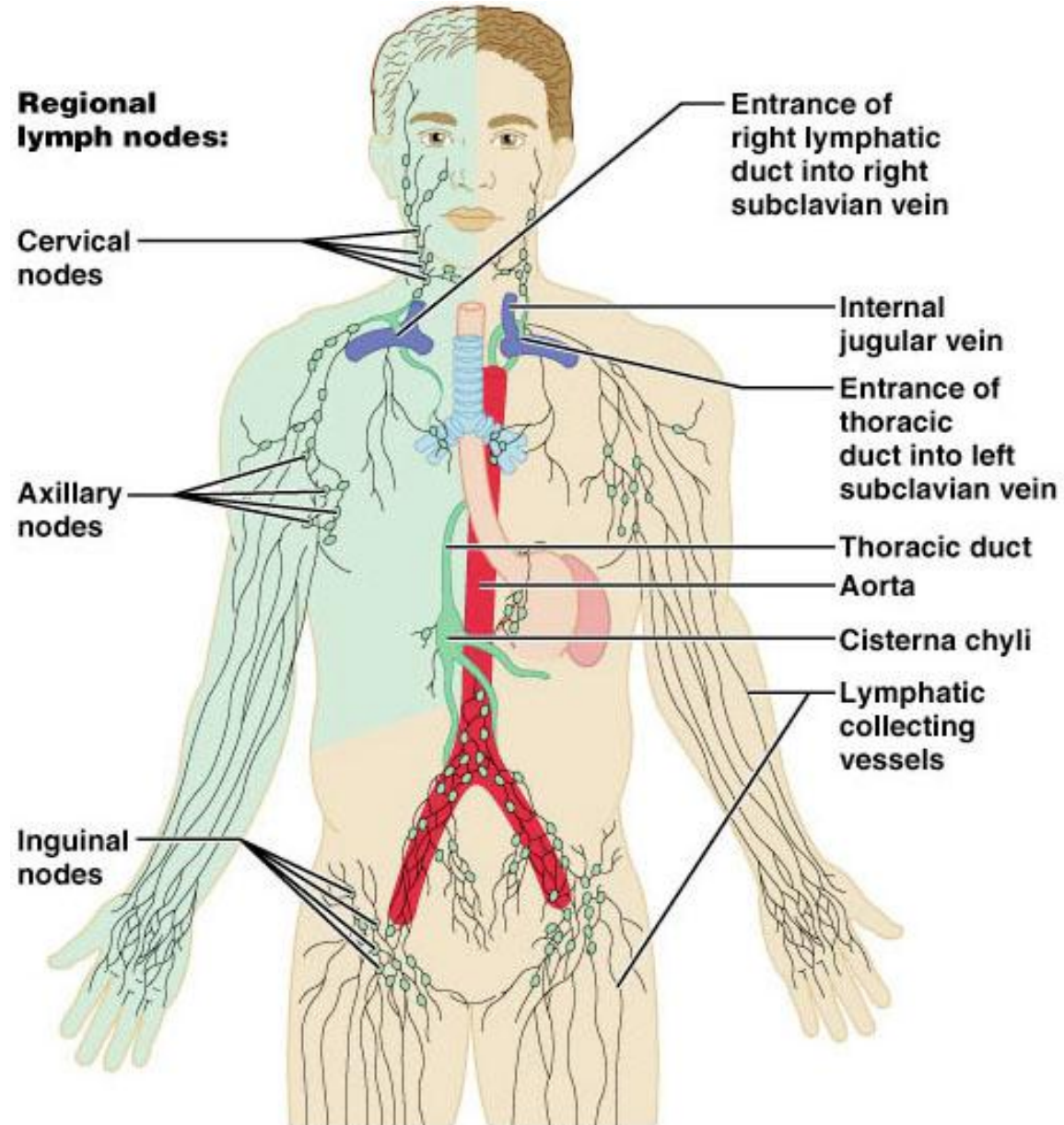


Figure 20.2a

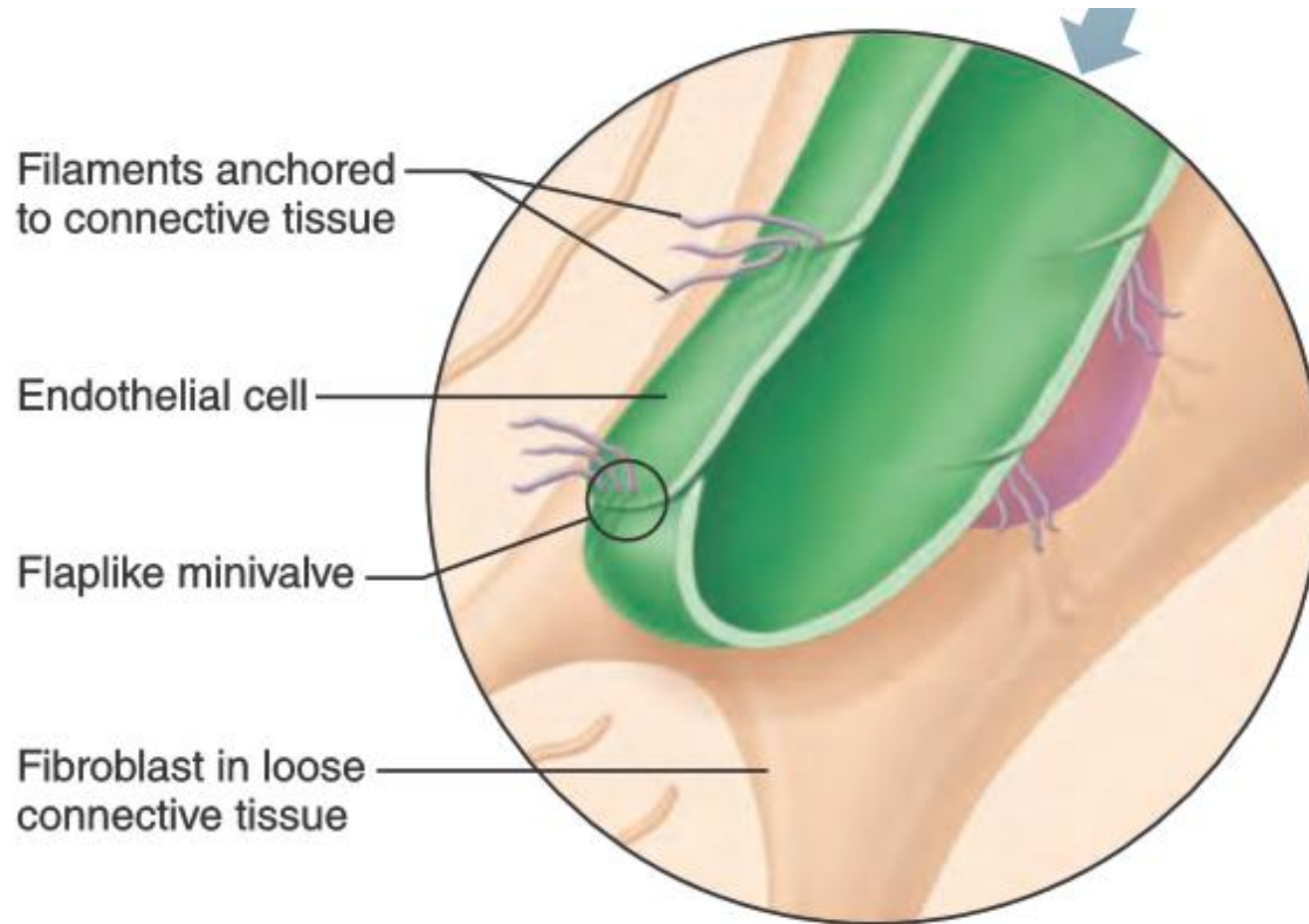
Lymphatic Vessels

- A **one-way** system in which lymph flows toward the heart
- Lymph vessels include:
 - Microscopic, permeable, blind-ended **capillaries**
 - Lymphatic **collecting vessels**
 - **Trunks** and **ducts**

Lymphatic Capillaries

- Similar to blood capillaries, with modifications
 - Remarkably permeable
 - Loosely joined endothelial minivalves
 - The minivalves function as one-way gates that:
 - Allow interstitial fluid to enter lymph capillaries
 - Do not allow lymph to escape from the capillaries
 - Withstand interstitial pressure and remain open

Lymphatic Capillaries

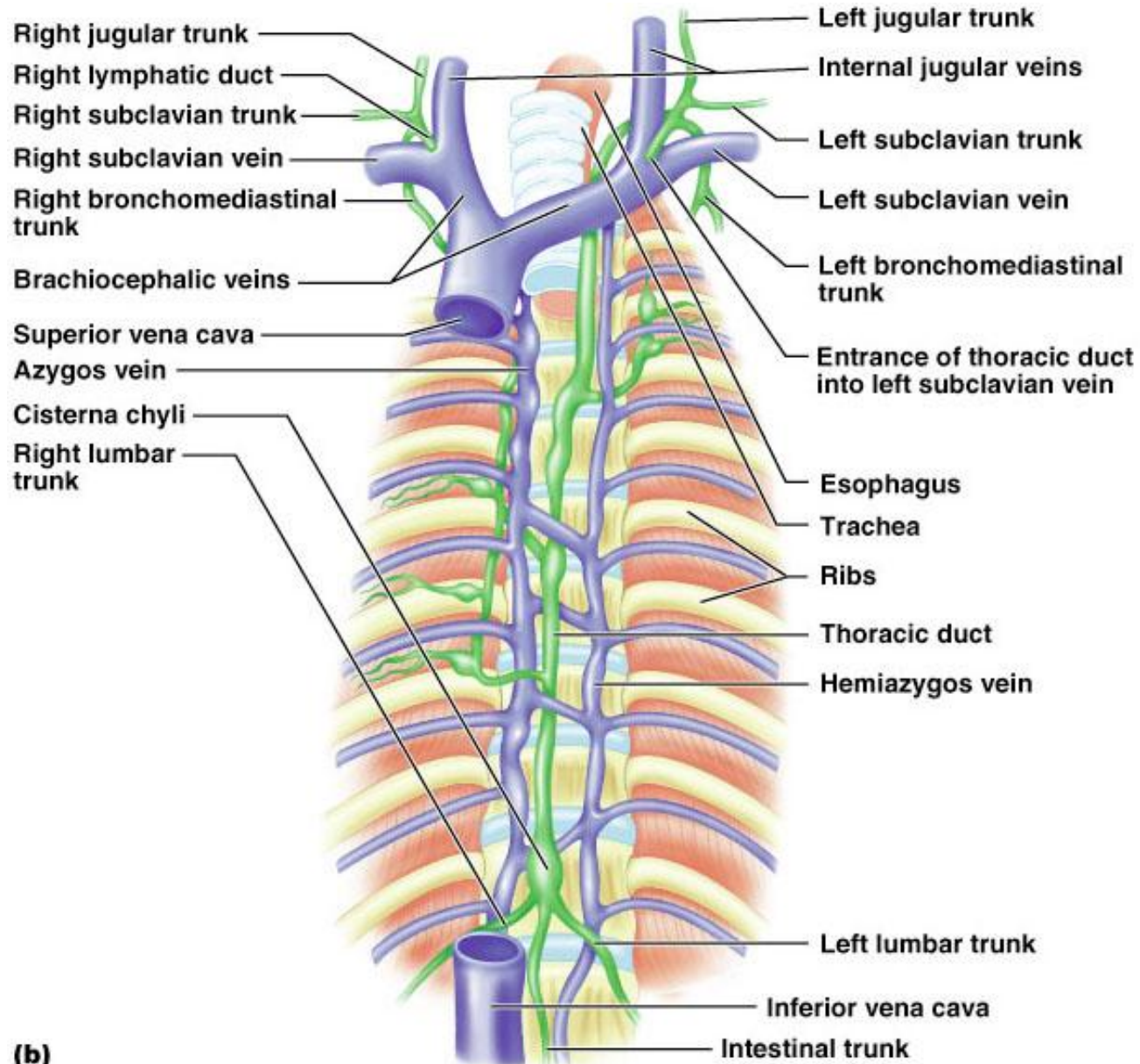


Lymphatic Capillaries

- During **inflammation**, lymph capillaries can **absorb**:
 - Cell debris
 - Pathogens
 - Cancer cells
- Cells in the lymph nodes:
 - Clean and “examine” this debris
- Lacteals – specialized lymph capillaries present in intestinal mucosa
 - Absorb digested fat and deliver chyle to the blood

(Chyle is a milky bodily fluid consisting of lymph and emulsified fats, or free fatty acids (FFAs). It is formed in the small intestine during digestion of fatty foods, and taken up by lacteals.)

Lymphatic Trunks



(b)

Figure 20.2b

Lymphoid Cells

- Lymphocytes are the main cells involved in the immune response
- The two main varieties are T cells and B cells

- T cells and B cells protect the body against antigens
- **Antigen** – anything the body perceives as foreign
 - Bacteria and their toxins; viruses
 - Mismatched RBCs or cancer cells

Lymphocytes

- T cells
 - Manage the immune response
 - Attack and destroy foreign cells
- B cells
 - Produce plasma cells, which secrete antibodies
 - Antibodies immobilize antigens

Other Lymphoid Cells

- Macrophages – phagocytize foreign substances and help activate T cells
- Dendritic cells – *spiny-looking cells* with functions similar to macrophages
- Reticular cells – fibroblastlike cells that produce a stroma, or network, that supports other cell types in lymphoid organs

Lymphoid Tissue

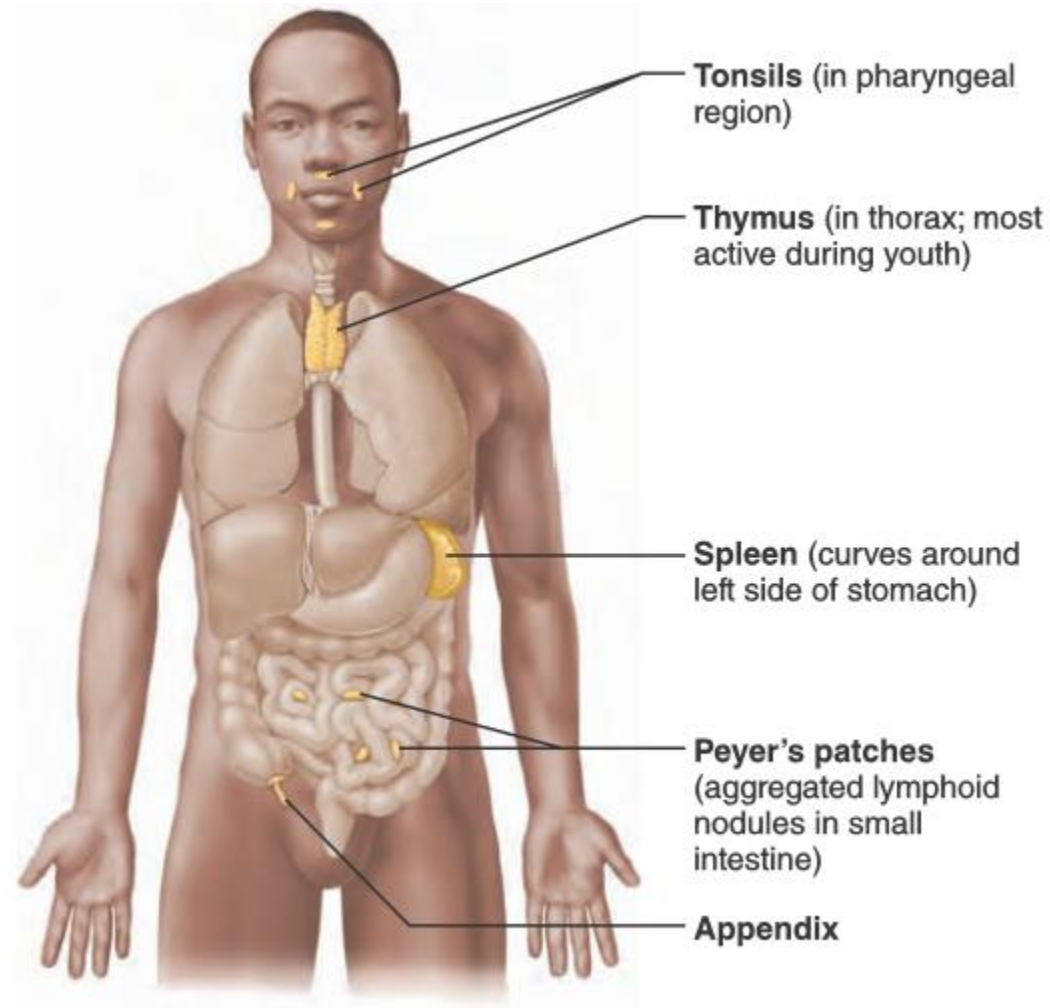
- Diffuse lymphatic tissue: **scattered** reticular tissue elements in every body organ
- Lymphatic follicles (nodules):
 - **Solid**, spherical bodies consisting of tightly packed reticular elements and cells
 - Have a **germinal center** composed of dendritic and **B cells**

Lymphoid Tissue

- Lymph nodes
 - They are the principal lymphoid organs of the body
 - Nodes are imbedded in connective tissue and clustered along lymphatic vessels
 - Aggregations of these nodes occur near the body surface in inguinal, axillary, and cervical regions of the body
 - Their two basic functions are:
 - Filtration – macrophages destroy microorganisms and debris
 - Immune system activation – monitor for antigens and mount an attack against them

Other Lymphoid Organs

- The **spleen, thymus gland, tonsils and Peyer's patches**
- All are composed of reticular connective tissue and all help protect the body
- Only lymph nodes filter lymph



Spleen

- Largest lymphoid organ, located on the left side of the abdominal cavity beneath the diaphragm
- It extends to curl around the anterior aspect of the stomach
- Functions
 - Site of lymphocyte proliferation
 - Immune surveillance and response
 - Cleanses the blood by removing old RBC

Additional Spleen Functions

- Stores breakdown products of RBCs for later reuse
 - Spleen macrophages salvage and store iron for later use by bone marrow
- Site of fetal erythrocyte production (normally ceases after birth)
- Stores blood platelets

Thymus

- A bilobed organ that secretes hormones (thymosin and thymopoietin) that cause T lymphocytes to become immunocompetent
- The size of the thymus varies with age
 - In infants, it is found in the inferior neck and extends into the mediastinum where it partially overlies the heart
 - It increases in size and is most active during childhood
 - It stops growing during adolescence and then gradually atrophies

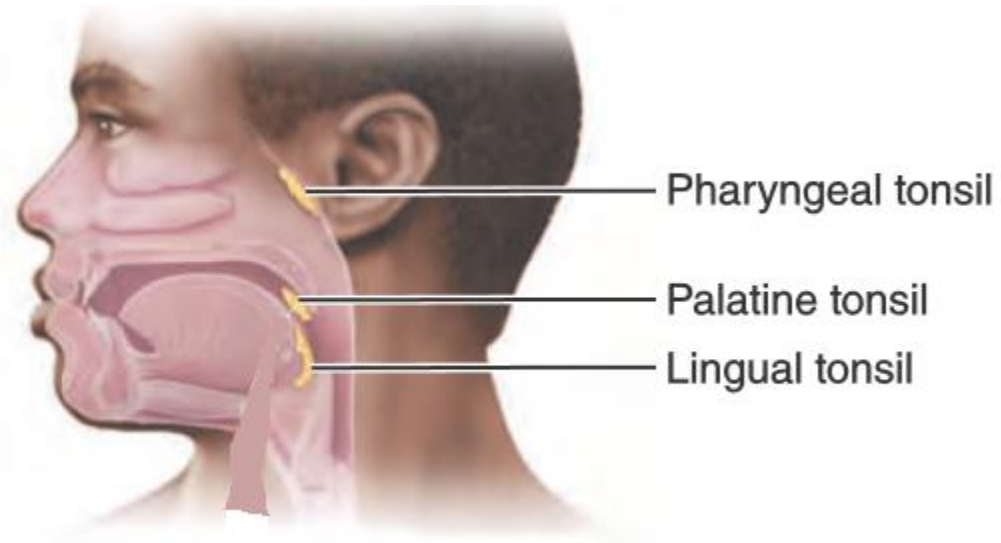
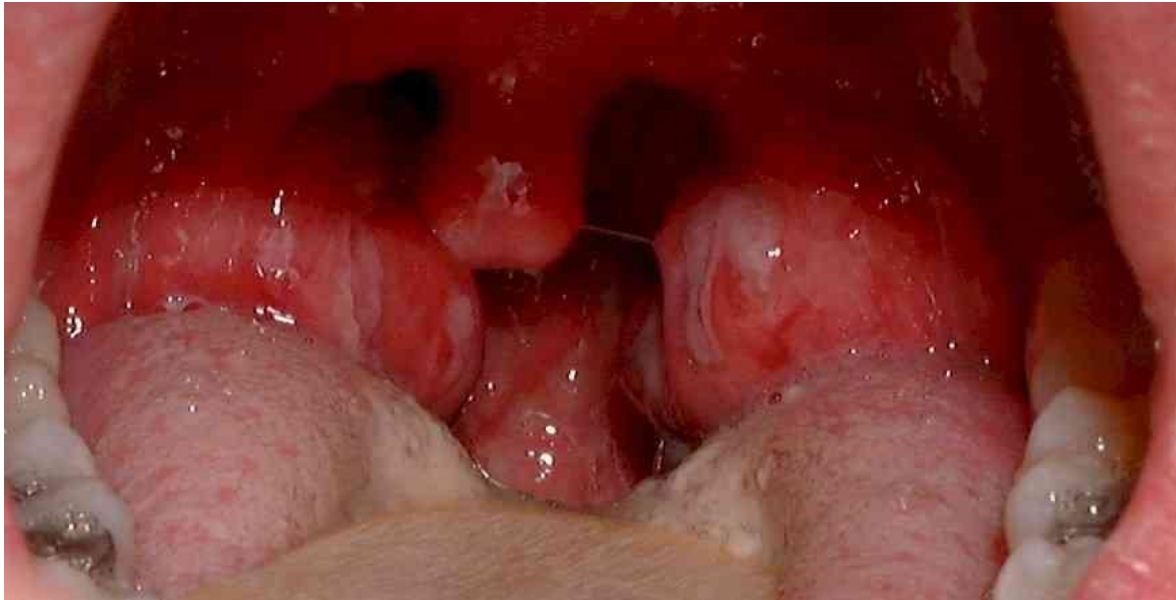
- The thymus differs from other lymphoid organs in important ways
 - It functions strictly in T lymphocyte maturation
 - It does not directly fight antigens

Tonsils

- Simplest lymphoid organs; form a **ring of lymphatic tissue around the pharynx**
- Location of the tonsils
 - **Palatine tonsils** – either side of the posterior end of the oral cavity
 - **Lingual tonsils** – lie at the **base of the tongue**
 - **Pharyngeal tonsil** – **posterior wall** of the nasopharynx
 - **Tubal tonsils** – surround the openings of the **auditory tubes** into the pharynx

- Lymphoid tissue of tonsils contains follicles with germinal centers
- Tonsil masses are **not fully encapsulated**
- Epithelial tissue overlying tonsil masses invaginates, forming blind-ended crypts
- Crypts **trap and destroy bacteria** and particulate matter

Tonsilitis

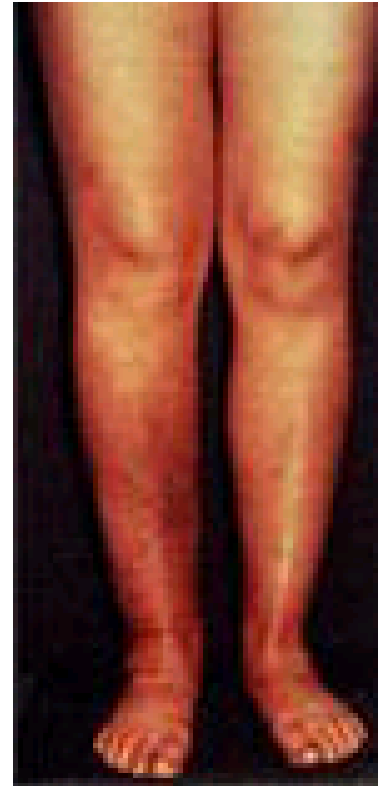


Peyer's patches

- Isolated clusters of lymphoid tissue, similar to tonsils
 - Found in the wall of the distal portion of the small intestine
 - Similar structures are found in the appendix
- Peyer's patches and the appendix:
 - Destroy bacteria, preventing them from breaching the intestinal wall
 - Generate “memory” lymphocytes for long-term immunity

- Mucosa-Associated Lymphatic Tissue (MALT) is composed of:
 - Peyer's patches, tonsils, and the appendix (digestive tract)
 - Lymphoid nodules in the walls of the bronchi (respiratory tract)
- MALT protects the digestive and respiratory systems from foreign matter

Lymphedema



Lymphedema



Lymphedema

