

## Lymphatic system

The lymphatic system is a network of tissues, organs, and vessels that help to maintain the body's fluid balance, this system, which is closely associated with the cardiovascular system, has three main functions that contribute to homeostasis:

- 1. Fluid balance.** The lymphatic system takes up excess tissue fluid and returns it to the bloodstream.
- 2. Fat absorption.** The lymphatic system absorbs fats from the digestive tract and transports them to the bloodstream. Special lymphatic capillaries called **lacteals** are located in the intestinal villi.
- 3. Defense.** The lymphatic system helps defend the body against disease.

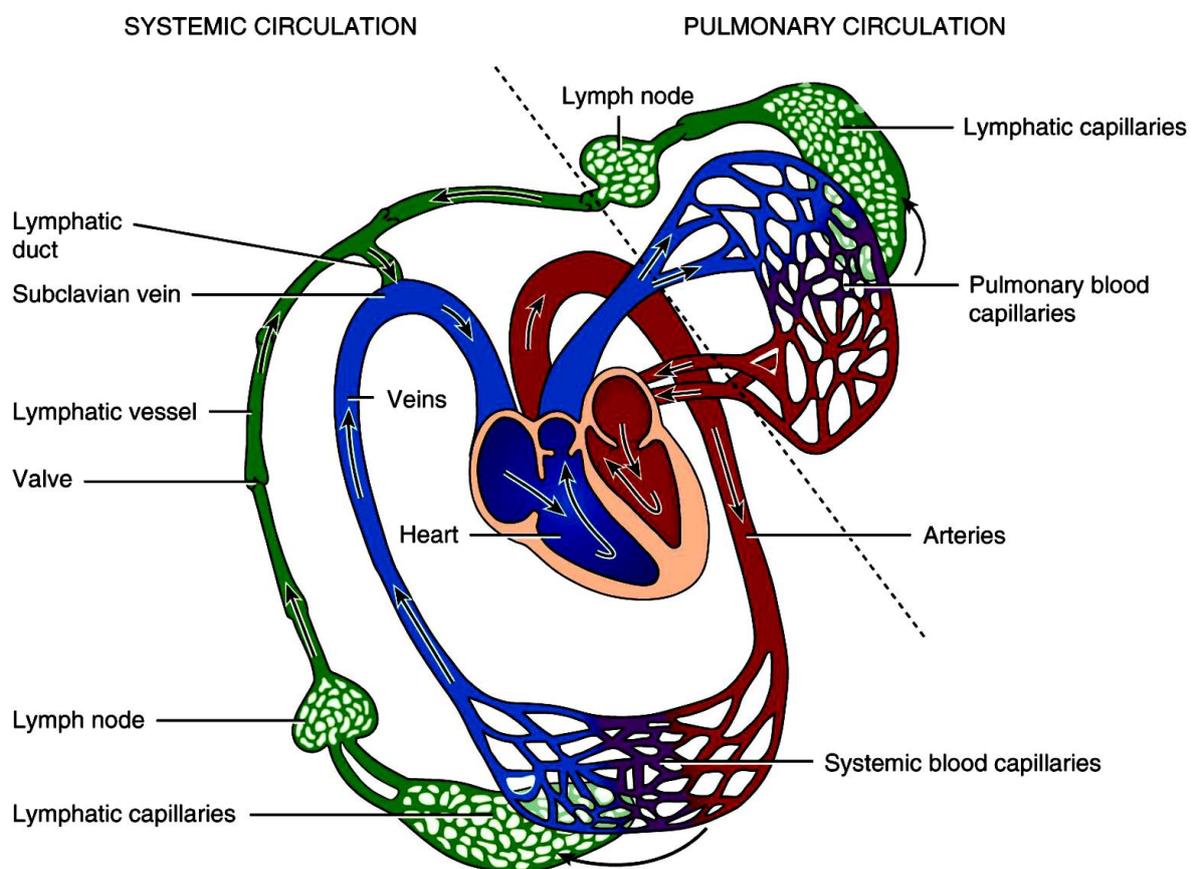


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### Components of the Lymphatic System

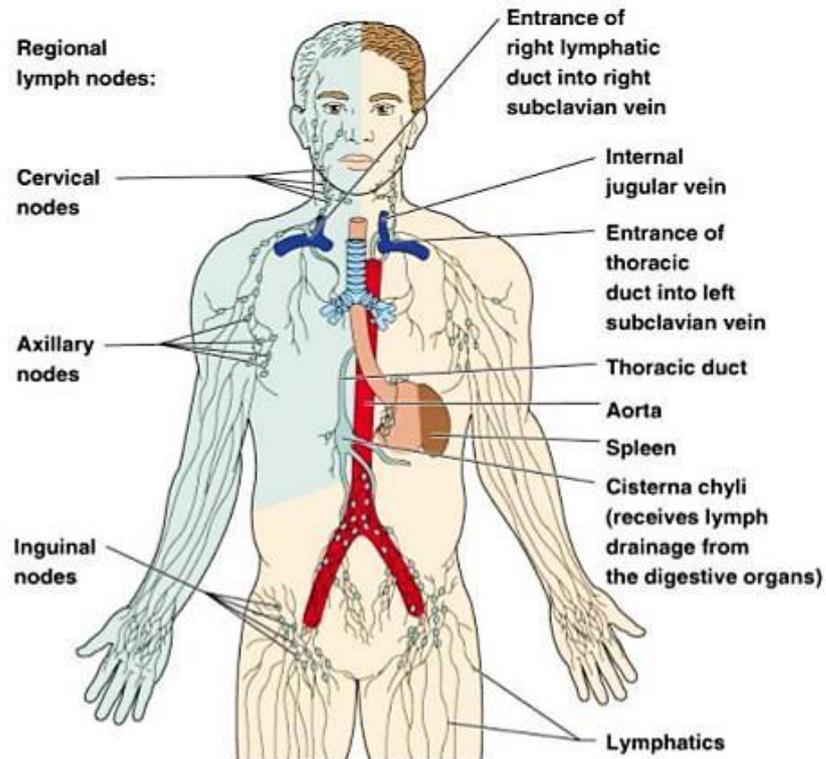
- Lymph
- Lymphatic Vessels: Lymphatic Capillaries, Lymphatic Vessels, Lymphatic Trunks and Lymphatic Ducts.
- Lymphatic Organs: Thymus, Lymph Nodes and Spleen.

**Lymph** is usually a clear, colorless fluid, similar to blood plasma but low in protein. It originates as tissue fluid that has been taken up by the lymphatic vessels.

### **Lymphatic Vessels**

Lymphatic vessels form a one-way system (contain valve) that begins with lymphatic capillaries. Most regions of the body are richly supplied with lymphatic capillaries, tiny, closed-ended vessels whose walls consist of simple squamous epithelium. Lymphatic capillaries take up excess tissue fluid (lymph). The lymphatic capillaries join to form lymphatic vessels that merge before entering one of two ducts:

1. The **right lymphatic duct** is formed by the convergence of the **right jugular, subclavian, and bronchomediastinal trunks** in the **right side of thoracic cavity**. It receives lymphatic drainage from the **right upper limb and right side of the thorax and head**, and empties into the **right subclavian vein**.
2. The **thoracic duct**, on the left, is larger and longer. It begins just below the diaphragm, anterior to the vertebral column. Here, the two lumbar trunks and the intestinal trunk join and form a prominent sac called the **cisterna chyli**, named for the large amount of chyle that it collects after a meal. The thoracic duct then passes through the diaphragm with the aorta and ascends the mediastinum, adjacent to the vertebral column. As it passes through the thorax, it receives additional lymph from the **left bronchomediastinal, left subclavian, and left jugular trunks**, then empties into the **left subclavian vein**. Collectively, this duct therefore drains all of the body below the diaphragm, and the **left upper limb and left side of the head, neck, and thorax**. The construction of the larger lymphatic vessels is similar to that of cardiovascular veins, including the presence of **valves**. Lymphatic vessels is **absent** from the **central nervous system, cartilage, cornea, bone, and bone marrow**.



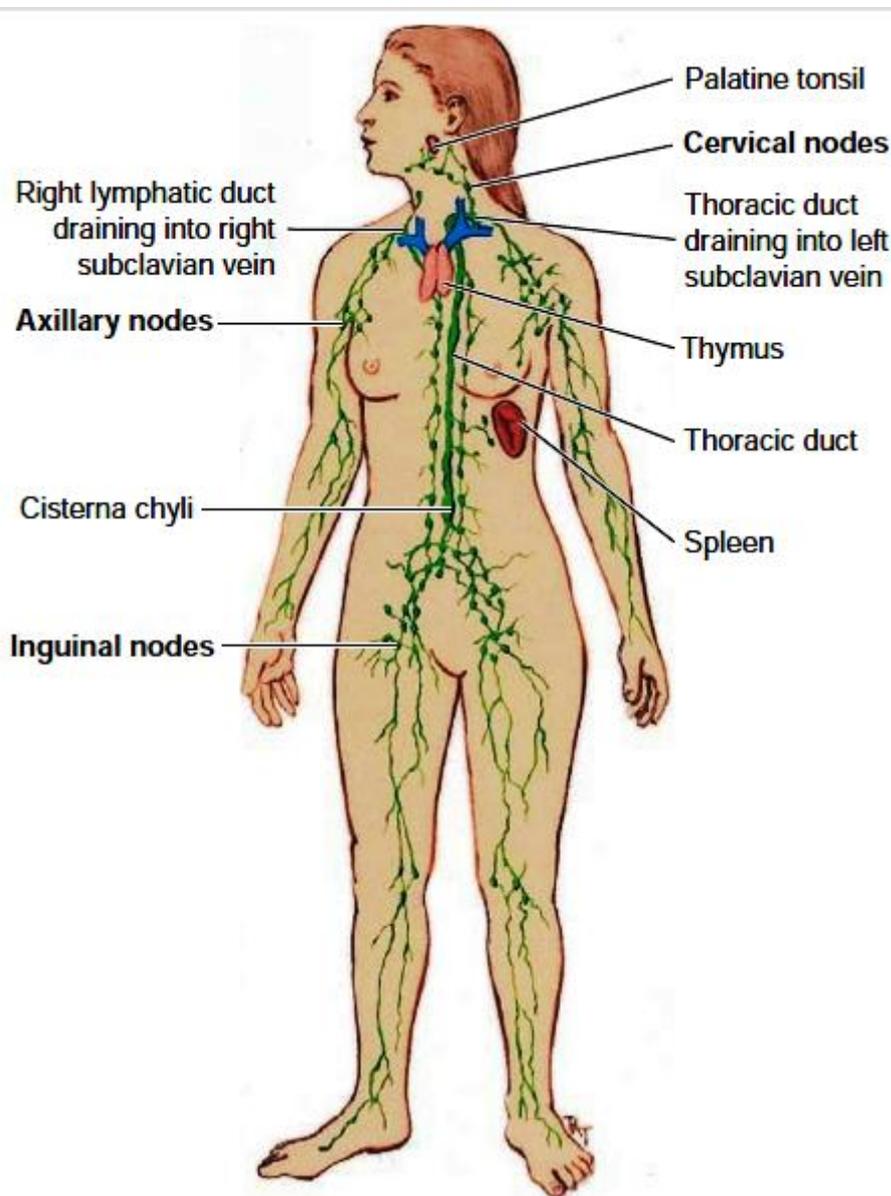
## Lymph Nodes

Lymph nodes are small, bean-shaped structures that are usually less than (2.5 cm) in length. They are widely distributed throughout the body along the lymphatic pathways, where they filter the lymph before it is returned to the blood. Lymph nodes are not present in the central nervous system. There are **three superficial regions** on each side of the body where lymph nodes tend to cluster. These areas are the **inguinal nodes** in the **groin**, the **axillary nodes** in the **armpit**, and the **cervical nodes** in the **neck**. The typical lymph node is surrounded by a connective tissue **capsule** and divided into compartments called **lymph nodules**.

## Lymphatic Nodules

Lymphatic nodules are egg-shaped masses of lymphatic tissue; unlike lymph nodes, they are not surrounded by a capsule. Because they are scattered throughout the **lamina propria (connective tissue)** of mucous membranes lining the **gastrointestinal, urinary, reproductive tracts** and **the respiratory airways**, lymphatic nodules in these areas are also referred to as **mucosa associated lymphatic tissue (MALT)**. Although many lymphatic nodules are small and solitary, some occur in multiple large aggregations in specific parts of

the body. Among these are the **tonsils** in the **pharyngeal region** and the **aggregated lymphatic follicles (Peyer's patches)** in the **ileum** of the **small intestine**. Aggregations of lymphatic nodules also occur in the **appendix**.



### Tonsils

**Tonsils** are clusters of lymphatic tissue just under the mucous membranes that line the **nose, mouth, and throat (pharynx)**. There are **three** groups of tonsils. 1- **pharyngeal tonsils** are located near the opening of the nasal cavity into the pharynx. When these tonsils become enlarged, they may interfere with breathing and are called **adenoids**.

2- **palatine tonsils** are two These are located near the opening of the oral cavity into the pharynx.

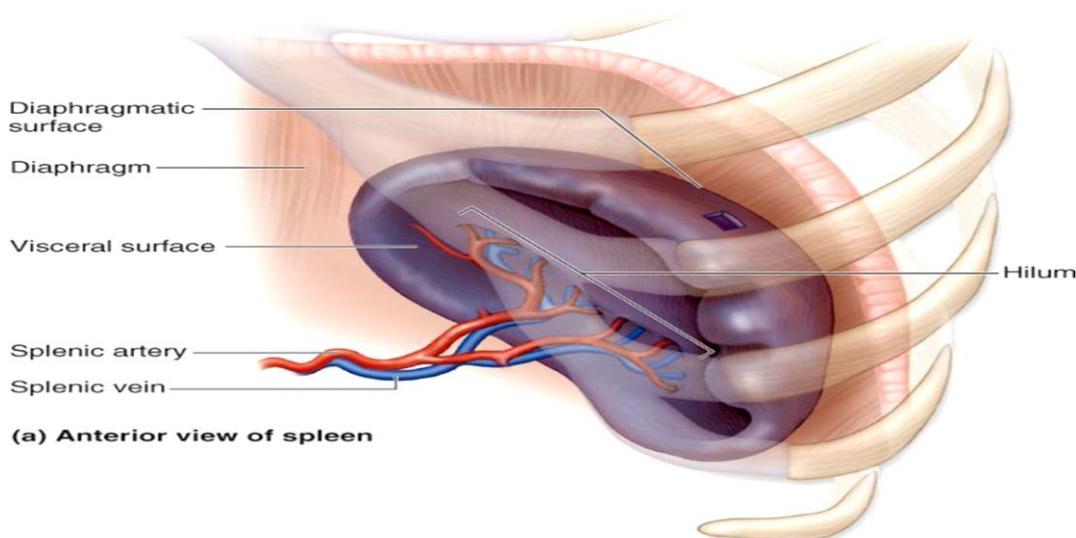
3- **Lingual tonsils** are located on the posterior surface of the tongue, which also places them near the opening of the oral cavity into the pharynx. Lymphocytes and macrophages in the tonsils provide protection against harmful substances and pathogens that may enter the body through the nose or mouth.



### Spleen

The **spleen** is located in the upper **left abdominal cavity**, just beneath the diaphragm, and posterior to the stomach. It is similar to a lymph node in shape and structure but it is much larger. The spleen is the **largest** lymphatic organ in the body and is approximately 12 cm in length, 7 cm wide and 2.5 cm thick. It weighs about 200 g and is purplish in colour. Surrounded by a connective tissue capsule, which extends inward to divide the organ into lobules, the spleen consists of two types of tissue called **white pulp** and **red pulp**. It is in contact with the stomach, the left kidney and the diaphragm. The blood supply to the spleen enter it at hilum derives from the splenic artery and the splenic vein.

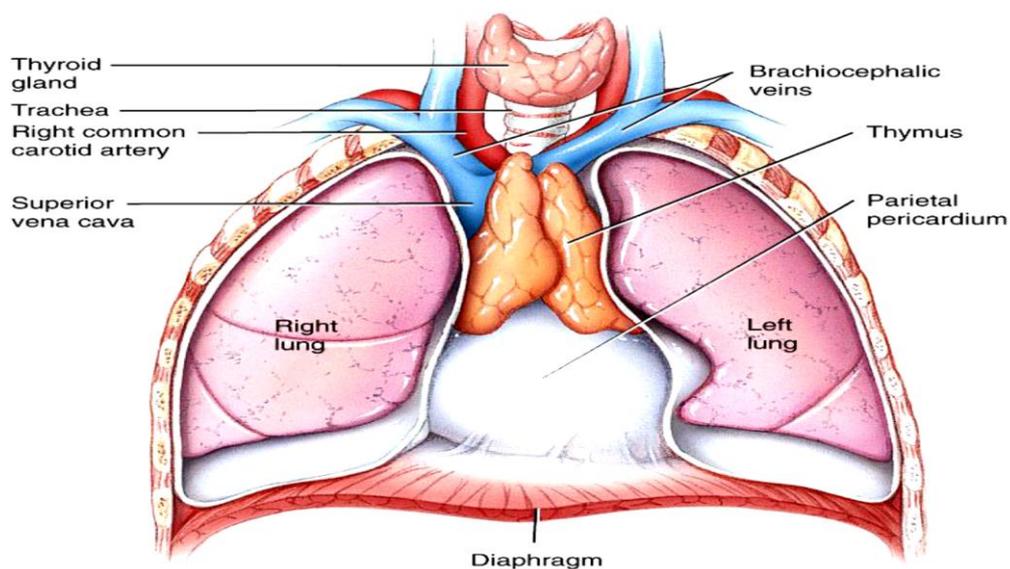
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(a) Anterior view of spleen

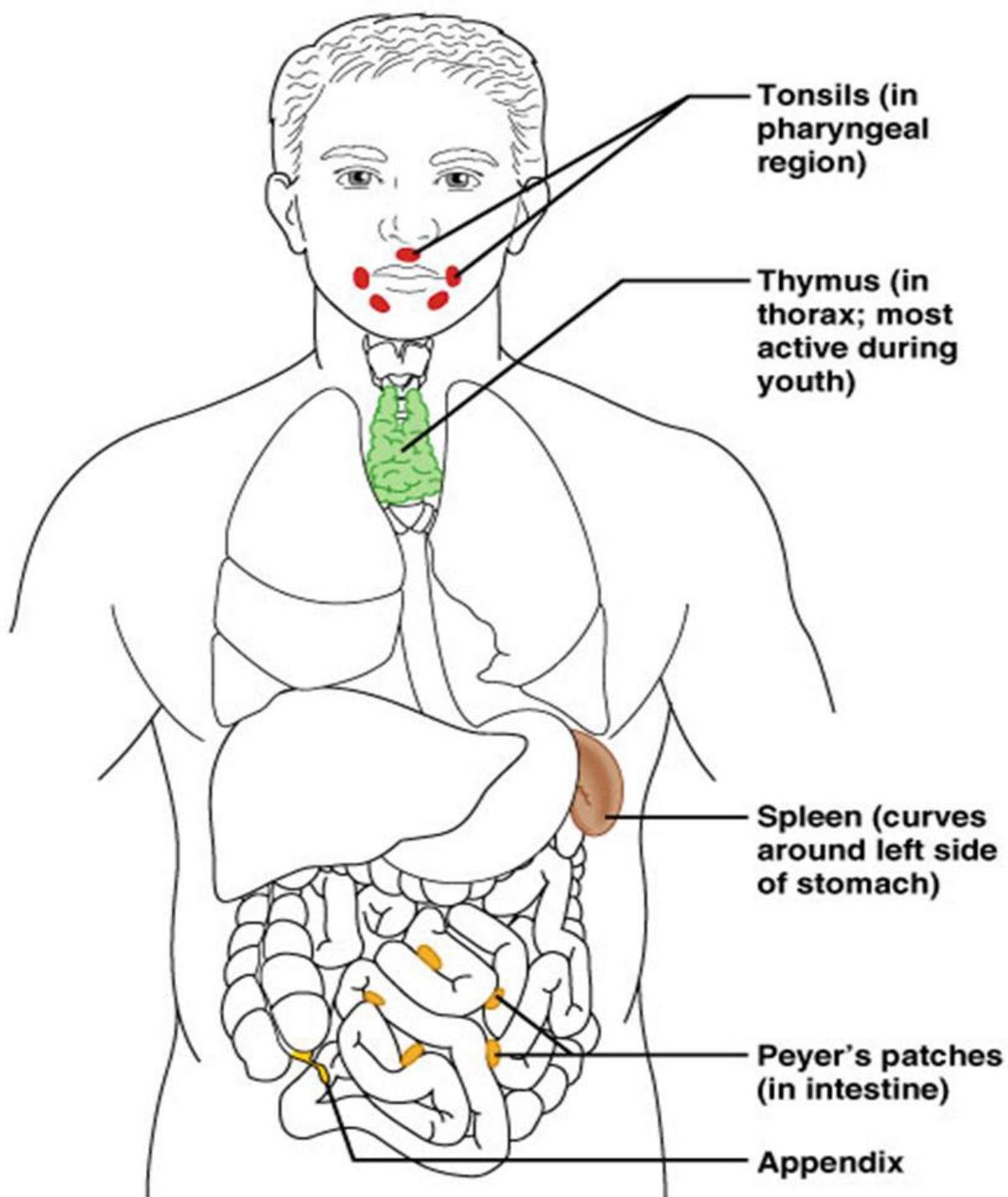
## Thymus

The **thymus** is a soft organ with two lobes that is a ductless, pinkish - grey mass of lymphoid tissue located anterior to the ascending aorta and posterior to the sternum. It is relatively large in infants and children, but after puberty it begins to decrease in size so that in older adults it is quite small. The primary function of the thymus is the processing and maturation of special lymphocytes called **T lymphocytes** or **T cells**. While in the thymus, the lymphocytes do not respond to pathogens and foreign agents. The thymus also produces a hormone, **thymosin** that stimulates the maturation of lymphocytes in other lymphatic organs.



(a) Thymus of adolescent

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