lymphatic system

Which of the following structures carry lymph into the node's subcapsular sinus, through the cortical sinus and into the superficial cortex and paracortex?

- efferent lymphatic vessels
- afferent lymphatic vessels
- both afferent and efferent lymphatic vessels
- neither afferent or efferent lymphatic vessels

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• afferent lymphatic vessels

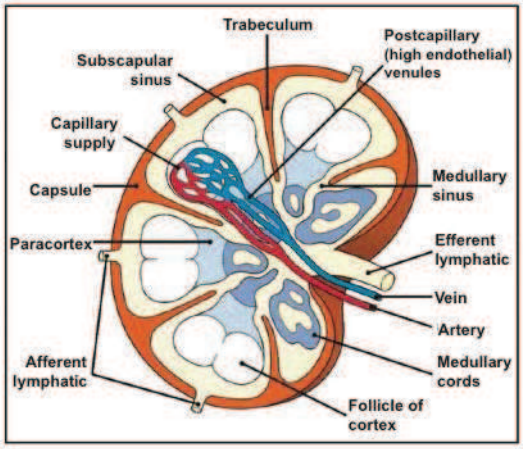
Lymph nodes are small oval bodies enclosed in fibrous capsules. Lymph nodes contain phagocytic cortical tissue (reticular tissue) adapted to filter lymph. Specialized bands of connective tissue, called **trabeculae,** divide the lymph node.

Afferent lymphatic vessels carry lymph into the node's subcapsular sinus, through the cortical sinus and into the superficial cortex and paracortex. **Conversely,** the lymph may travel directly from the cortical sinus into the medullary sinus. It is primarily in these cortices and the medullary sinus that the lymph is cleansed by macrophages, and antigens are presented and processed by lymphocytes, and plasma cells. The filtered lymph leaves the node through the **efferent** lymphatic vessels, which merge through the **concave hilum** and transport the lymph into **efferent collecting vessels,** which converge into larger vessels called **lymph trunks** (there are five major lymph trunks in the body). The thoracic duct receives lymph from three out of the four quadrants of the body; both lower quadrants and the upper left quadrant. The right lymphatic duct receives lymph only from the upper right quadrant.

Note: The **thoracic duct** receives lymph from three out of the four quadrants of the body; both lower quadrants and the upper left quadrant. The **right lymphatic duct** receives lymph only from the upper right quadrant.

Important:

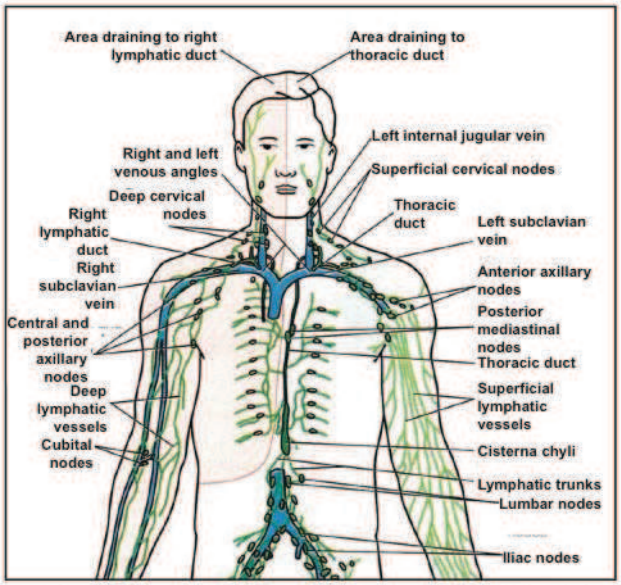
1. The afferent lymphatic vessels enter on the **convex surface** of the node.
2. There are **fewer efferent** vessels than afferent vessels associated with a node.
3. The spleen, thymus, palatine, and pharyngeal tonsils **do not** have numerous afferent vessels entering them **as do** lymph nodes.
4. The **paracortex** is dominated by T-cells.



Lymph node structure. The bean-shaped lymph node has a hilum into which blood vessels enter, and from which efferent lymphatics emerge. It has an investing capsule. Afferent lymphatic vessels penetrate the convex surface of the gland and drain into the subcapsular and medullary sinus system. The lymphoid parenchyma is subdivided into cortex, paracortex and medulla. The most prominent structures in the cortex are the lymphoid follicles.

1-I

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Lymphoid system. Pattern of lymphatic drainage. Except for right superior quadrant of the body (pink), lymph ultimately drains into the left venous angle via the thoracic duct. The right superior quadrant drains into the right venous angle, usually via a right lymphatic duct. Lymph typically passes through several sets of lymph nodes, in a generally predictable order, before it enters the venous system.

1 A-I

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lymphatic system

Which of the following vessels are characterized by the presence of valves?

- arterioles only
- capillaries only
- sinusoids only
- veins only
- lymphatics only
- lymphatics and capillaries
- lymphatics and veins

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• lymphatics and veins

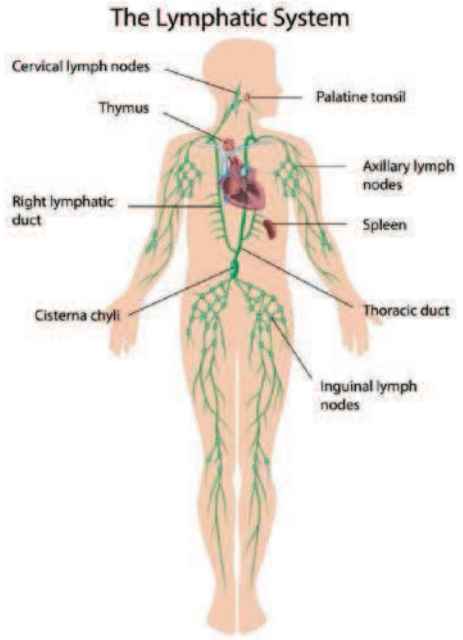
Primary lymphatic organs are responsible for the generation and selection of lymphocytes. These are the thymus and bone marrow. Secondary lymphatic organs include the tonsils, spleen, lymph nodes, appendix, which are responsible for the filtering component. There are also areas of diffuse lymphoid tissue throughout the body including MALT, GALT, and BALT (mucosa-, gut-, and bronchus-associated lymphoid tissue, respectively). GALT includes the tonsils and Peyer's patches. The **common component** to all lymphatic tissues is the **presence of lymphocytes**.

Functions of the lymphatic system:

- **Returns tissue fluid to the bloodstream:** when this fluid enters lymph capillaries, it is called lymph. Lymph is returned to the venous system via two large lymph ducts, the **thoracic duct** and the **right lymphatic duct**
- **Transports absorbed fats:** within the villi in the small intestine, lymph capillaries, called lacteals, transport the products of fat absorption away from the GI tract and eventually into the circulatory system through the thoracic duct
- **Provides immunological defenses against disease-causing agents:** lymph filters through lymph nodes, which filter out microorganisms (such as bacteria) and foreign substances. Lymph nodes have also been shown to trap cancerous cells in the body.



1. **Lymph** contains a liquid portion that resembles blood plasma, as well as white blood cells (mostly lymphocytes) and a few red blood cells.
2. **Lymph** is absorbed from the tissue spaces by the lymphatic capillaries (which is a system of closed tubes) and eventually returned to the venous circulation by the lymphatic vessels, after lymph flows through the filtering system (lymph nodes).
3. In the **upper limb**, a hallmark of lymphatic vessels is that they **follow the veins**.
4. The lymphatic system **does not** have a central pump to move lymph throughout the body. "Instead, the lymphatic system depends on the contractions of skeletal muscles, the presence of valves in lymphatic vessels (similar to those in veins), breathing, and simple gravity to move fluid throughout the body."



2-I

lymphatic system

T cells are produced in the _____and mature in the _____.

- liver, thymus
- bone marrow, liver
- bone marrow, thymus
- lymph nodes, thymus

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• bone marrow, thymus

The thymus is a **bilobed lymphoid organ** positioned in the superior mediastinum in adults, with the inferior part contained in the anterior mediastinum of children; it **does not** contain lymph nodules or vessels.The main function of the thymus is to potentiate immunocompetent T cells from their immunoincompetent precursors. Additionally, self-recognizing T cells are destroyed in the thymus. The thymus is relatively large in newborns, continues to grow until puberty, at which point it undergoes involution, being replaced by adipose tissue. **Note:** In the **adult thymus**, the blood supply **is isolated** from the parenchyma (which is the functioning portion of the gland as distinguished from the connective tissue or stroma). This is sometimes referred to as the **blood thymus barrier.** In the **child thymus**, the blood supply **is not isolated** from the parenchyma.

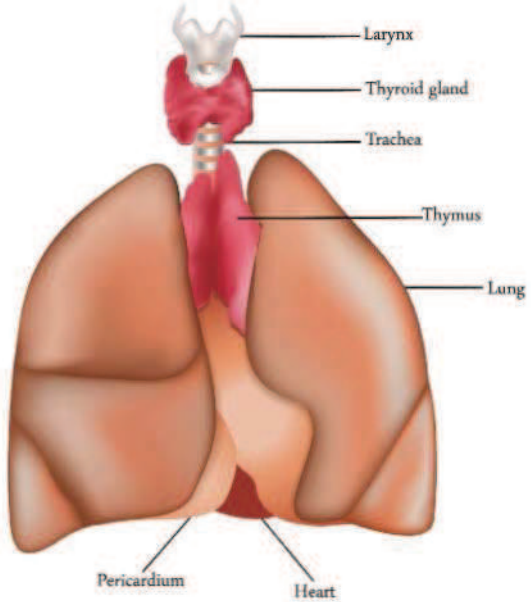


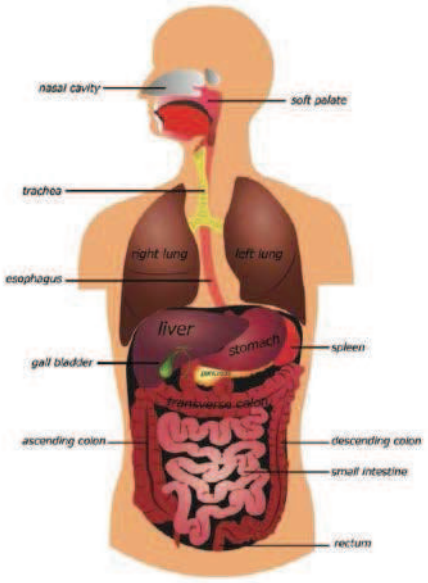
• Hassall's corpuscles: are structures found in the medulla of the human thymus, formed from eosinophilic type VI epithelial reticular cells arranged concentrically. The function of Hassall's corpuscles is currently unclear.

• Digeorge syndrome: is a congenital disease that is characterized by absent or underdeveloped thymus and parathyroid glands. It's typically caused by a deletion on the chromosome numbered 22. Patients suffering from Digeorge have profound immunodeficiency due to a lack of T cells. No other immune cell populations are affected.

The spleen is formed by reticular and lymphatic tissue and is the largest lymph organ. The spleen lies between the fundus of the stomach and the diaphragm. The spleen is purplish in color and varies in size in different individuals. The spleen is slightly oval in shape with the hilum on the lower medial border. The spleen is entirely covered by peritoneum, **except** at the hilum. It is enclosed in a fibroelastic capsule that dips into the organ, forming **trabeculae**, but trabeculae DO NOT divide the spleen into lobes/lobules. The spleen also has no distinct cortex or medulla. The cellular material, consisting of lymphocytes and macrophages, is called **splenic pulp**, and it lies between the trabeculae. Supplied by the splenic artery, a branch of the celiac artery.

The spleen is the **largest single mass** of lymphoid tissue in the body. The spleen can be considered as two organs in one; it filters the blood and removes abnormal cells (such as old and defective red blood cells), and it makes disease-fighting components of the immune system (including antibodies and lymphocytes). The body of the spleen appears red and pulpy, surrounded by a tough capsule. The **red pulp** consists of blood vessels (splenic sinusoids) interwoven with connective tissue (splenic cords). The red pulp filters the blood and removes old and defective blood cells. It, along with the liver, are site of **erythropoiesis** (blood formation) in the fetus and infant. The **white pulp** is inside the red pulp, and consists of little lumps of lymphoid tissue. Antibodies are made inside the white pulp.





3 A-I

lymphatic system

Posterior 1/3 of the tongue drains into:

- facial nodes
- occipital nodes
- submandibular nodes
- deep cervical nodes
- submental nodes
- jugulodigastric nodes

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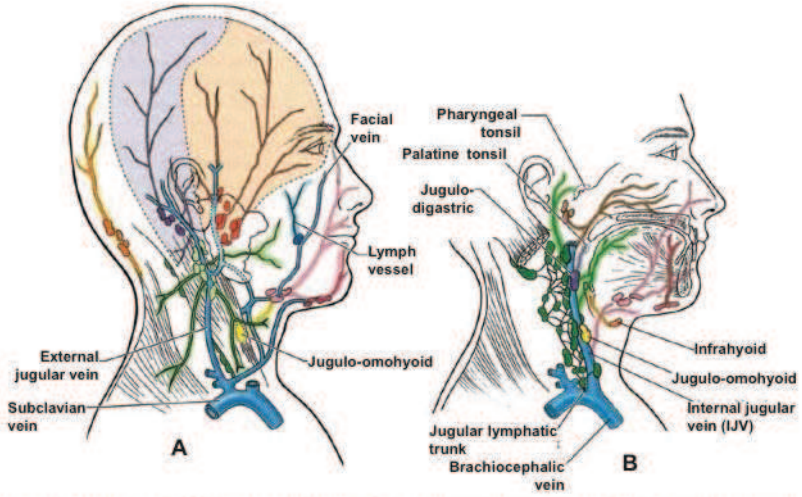
• deep cervical nodes

The deep cervical lymph nodes are located along the length of the internal jugular vein on each side of the neck, deep to the sternocleidomastoid muscle. The deep cervical nodes extend from the base of the skull to the root of the neck, adjacent to the pharynx, esophagus, and trachea. The deep cervical nodes are further classified as to their relationship to the sternocleidomastoid muscle as being superior or inferior.

The deep cervical lymph nodes are responsible for the drainage of most of the circular chain of nodes, and receive direct efferents from the salivary and thyroid glands, the posterior 1/3 of the tongue, the tonsils, the nose, the pharynx, and the larynx. All these vessels join together to form the **jugular lymph trunk**. This vessel drains into either the **thoracic duct** on the left, the **right lymphatic duct** on the right, or independently drains into either the internal jugular, subclavian, or brachiocephalic veins.

Some **regional groups** of lymph nodes:

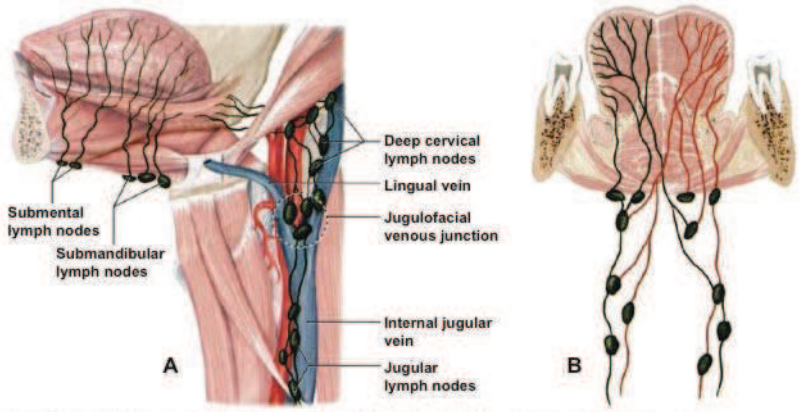
- **Parotid lymph nodes** - receive lymph from a strip of scalp above the parotid salivary gland, from the anterior wall of the external auditory meatus, and from the lateral parts of the eyelids and middle ear. The efferent lymph vessels drain into the **deep cervical nodes**.
- **Submandibular lymph nodes** - located between the submandibular gland and the mandible; receive lymph from the front of the scalp, the nose, and adjacent cheek; the upper lip and lower lip (except the center part); the paranasal sinuses; the **maxillary** and **mandibular teeth** (except the mandibular incisors); the **anterior two-thirds of the tongue** (except the tip); the floor of the mouth and vestibule; and the gingiva. The efferent lymph vessels drain into the **deep cervical nodes**.
- **Submental lymph nodes** - located behind the chin and on the mylohyoid muscle; receive lymph from the **tip of the tongue**, the floor of the mouth beneath the tip of the tongue, the **mandibular incisor teeth** and **associated gingiva**, the center part of the lower lip, and the skin over the chin. The efferent lymph vessels drain into the **submandibular** and **deep cervical nodes**.



Lymphatic drainage of face and scalp. A. Superficial drainage. A pericervical collar of superficial lymph nodes is formed at the junction of the head and neck by the submental, submandibular, parotid, mastoid, and occipital nodes. These nodes initially receive most of the lymph drainage from the face and scalp. **B.** Deep drainage. All lymphatic vessels from the head and neck ultimately drain into the deep cervical lymph nodes, either directly from the tissues or indirectly after passing through an outlying group of nodes.

4-I

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Lymphatic drainage of the tongue and oral floor. **A** Left lateral view. **B** Anterior view.

The lymphatic drainage of the tongue and oral floor is mediated by submental and submandibular groups of lymph nodes that ultimately drain into the lymph nodes along the internal jugular vein. (**A,** jugular lymph nodes). Because the lymph nodes receive drainage from both the ipsilateral and contralateral sides (**B**), tumor cells may become widely disseminated in this region (e.g., metastatic squamous cell carcinoma, especially on the lateral border of the tongue, frequently metastasizes to the opposite side).

4 A-I

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lymphatic system

When antigen recognition occurs by a lymphocyte, B cells are activated and migrate to which area of the lymph node?

- inner medullary region
- medullary cords
- medullary sinuses
- germinal centers

[refer to card 1-I for illustration]

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