# Human Histology session 7

# 1st stage

# 2020-2021

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## Histology of Lymphatic system

# Introduction

* The lymphatic system is part of the immune system. It also maintains fluid balance and plays a role in absorbing fats and fat-soluble nutrients.

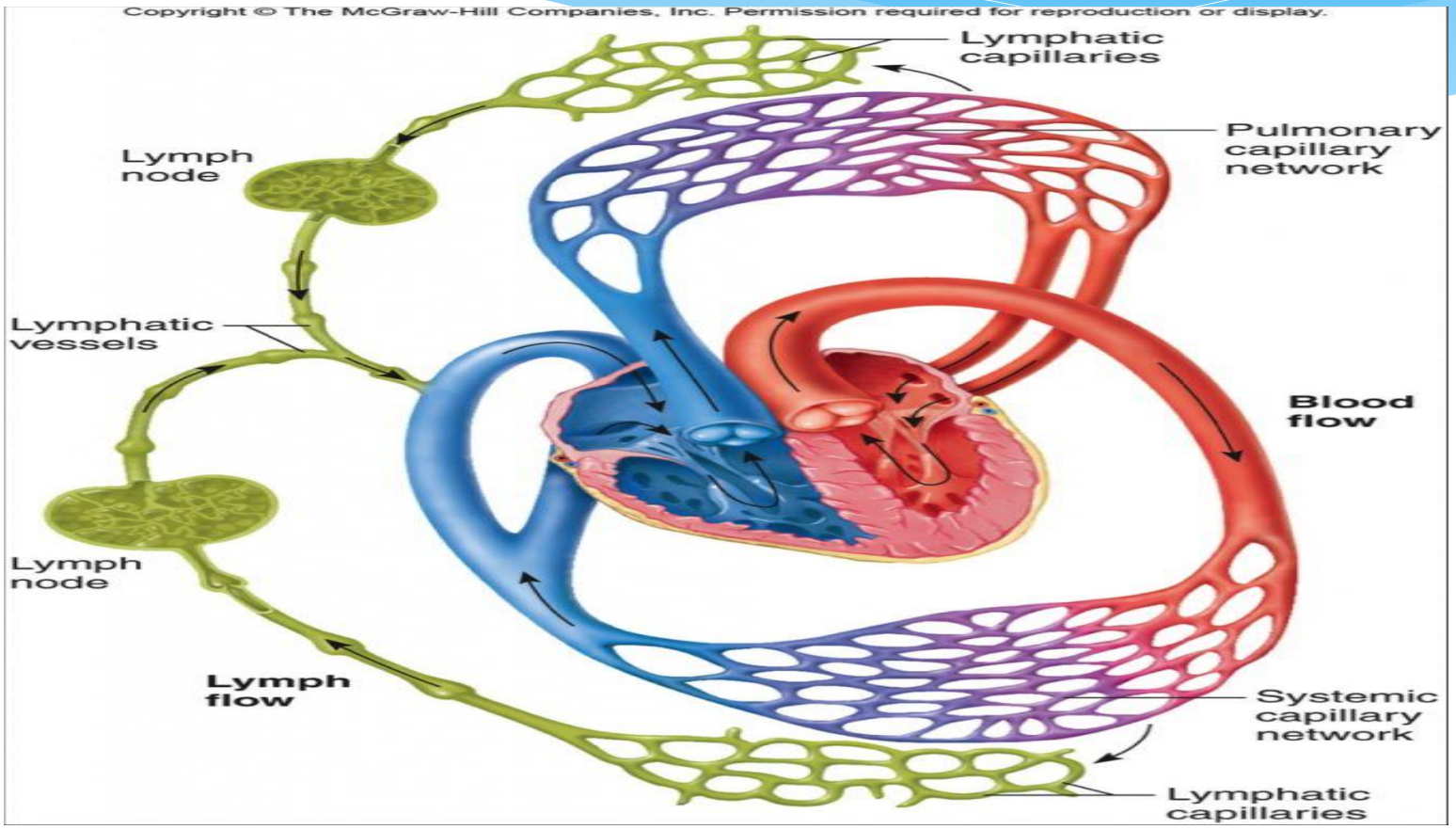
* The lymphatic or lymph system involves an extensive network of vessels that passes through almost all our tissues to allow for the movement of a fluid called lymph. Lymph circulates through the body in a similar way to blood.

* There are about 600 lymph nodes in the body. These nodes swell in response to infection, due to a build-up of lymph fluid, bacteria, or other organisms and immune system cells.

# facts about the lymphatic system

* The lymphatic system plays a key role in the immune system, fluid balance, and absorption of fats and fat-soluble nutrients.
* As lymph vessels drain fluid from body tissues, this enables foreign material to be delivered to the lymph nodes for assessment by immune system cells.
* The lymph nodes swell in response to infection, due to a build-up of lymph fluid, bacteria, or other organisms and immune system cells.

# facts about the lymphatic system



# Lymphatic system functions

* It maintains the balance of fluid between the blood and tissues, known as fluid homeostasis.
* It forms part of the body's immune system and helps defend against bacteria and other intruders.
* It facilitates absorption of fats and fat-soluble nutrients in the digestive system.?

# Lymphatic system anatomy

* The lymphatic system consists of lymph vessels, ducts, nodes, and other tissues like(bone marrow ,thymus, spleen and tonsils).
* Around 2 liters of fluid leak from the cardiovascular system into body tissues every day. The lymphatic system is a network of vessels that collect these fluids, or lymph. Lymph is a clear fluid that is derived from blood plasma.
* The lymph vessels form a network of branches that reach most of the body's tissues. They work in a similar way to the blood vessels. The lymph vessels work with the veins to return fluid from the tissues.
* Unlike blood, the lymphatic fluid is not pumped but squeezed through the vessels when we use our muscles. The properties of the lymph vessel walls and the valves help control the movement of lymph. However, like veins, lymphatic vessels have valves inside them to stop fluid from flowing back in the wrong direction.

# Lymphatic system anatomy

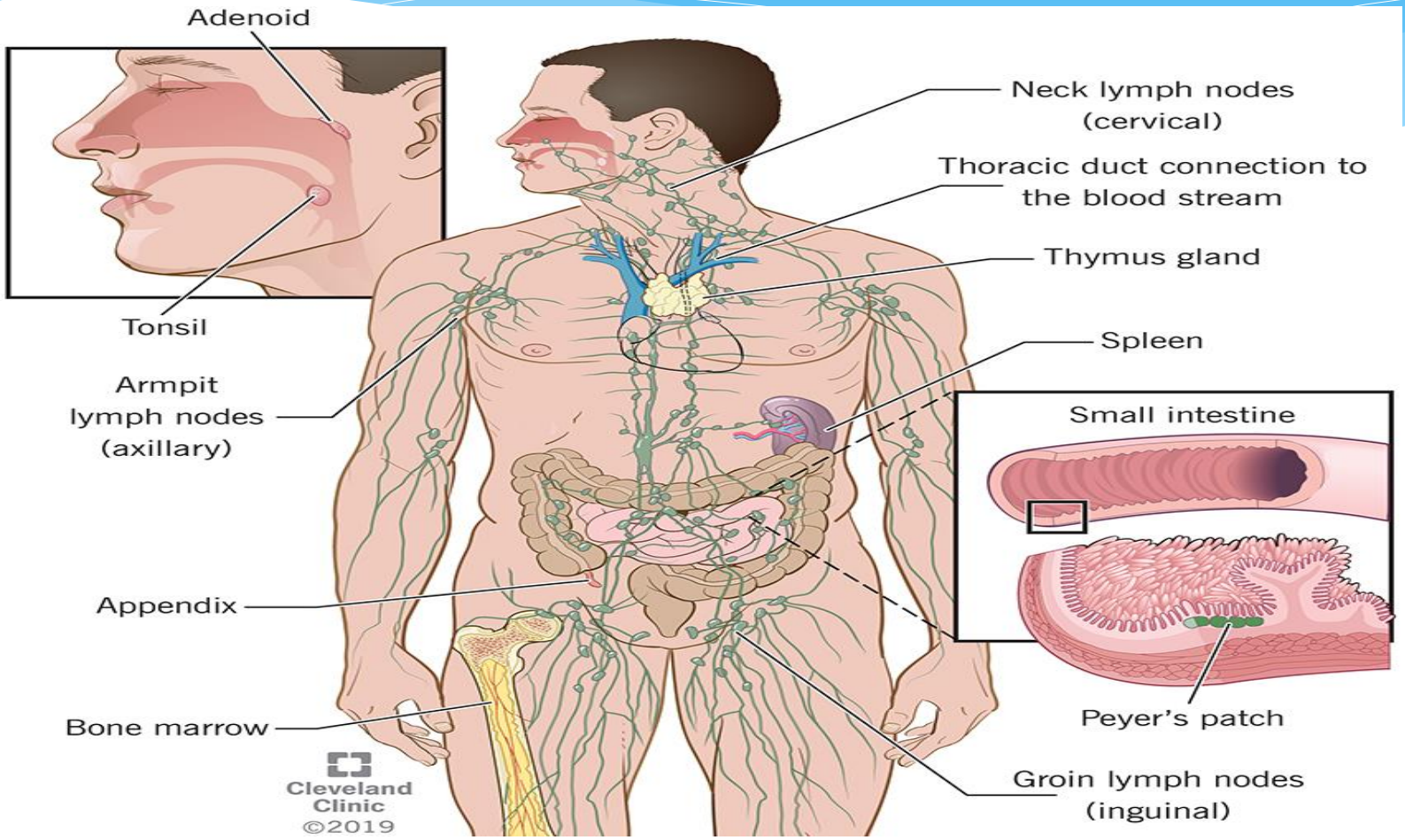
* Lymph is drained progressively towards larger vessels until it reaches the two main channels, the lymphatic ducts in our trunk. From there, the filtered lymph fluid returns to the blood in the veins.

* The vessels branch through junctions called lymph nodes. These are often referred to as glands, but they are not true glands as they do not form part of the endocrine system.

* In the lymph nodes, immune cells assess for foreign material, such as bacteria, viruses, or fungus.

* Lymph nodes are not the only lymphatic tissues in the body. The tonsils, spleen, and thymus gland are also lymphatic tissues.

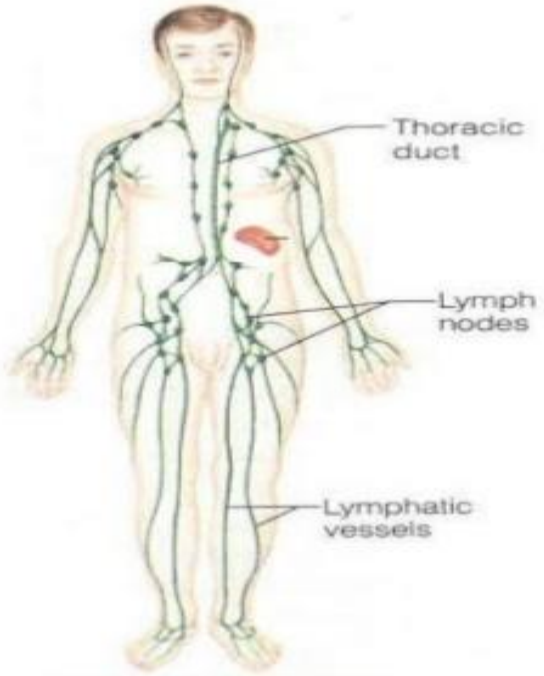
# Lymphatic system anatomy



# Components of lymphatic system

## Components of the Lymphatic System

- Lymph
- Lymphatic Vessels
  - Lymphatic Capillaries
  - Lymphatic Vessels
  - Lymphatic Trunks
  - Lymphatic Ducts
- Lymphatic Organs
  - Thymus
  - Lymph Nodes
  - Spleen
  - Tonsils
- Lymphatic cells



Lymphatic system

# MALT

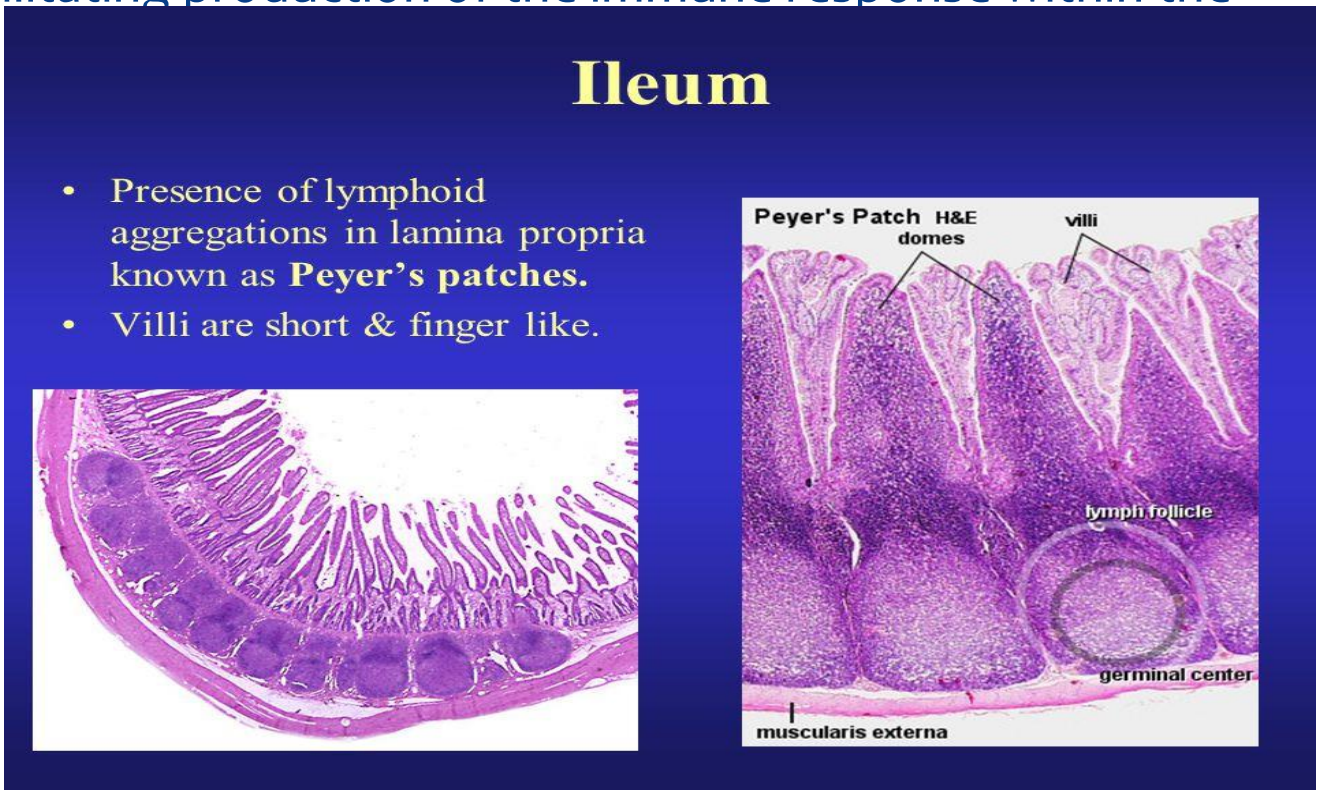
* The mucosa-associated lymphoid tissue (MALT), is a diffuse system of small concentrations of lymphoid tissue found in various submucosal membrane sites of the body, such as the gastrointestinal tract, nasopharynx, thyroid, breast, lung, salivary glands, eye, and skin. MALT is populated by lymphocytes such as T cells and B cells, as well as plasma cells and macrophages.
* Malt include:
* Gut-associated lymphoid tissue(GALT)
* Bronchial/tracheal-associated lymphoid tissue(BALT)

# Peyer's patches

* Peyer’s patches are groupings of lymphoid follicles in the mucus membrane that lines your small intestine. Lymphoid follicles are small organs in your lymphatic system that are similar to lymph nodes.
* Peyer’s patches are located in your small intestine, usually in the ileum area. The ileum is the last portion of your small intestine. In addition to further digesting the food you eat, the ileum also absorbs water and nutrients from food.

# Peyer's patches functions

* Because the lumen of the gastrointestinal tract is exposed to the external environment, much of it is populated with potentially pathogenic microorganisms. Peyer's patches thus establish their importance in the immune surveillance of the intestinal lumen and in facilitating production of the immune response within the mucosa.



# Peyer's patches structure and histology

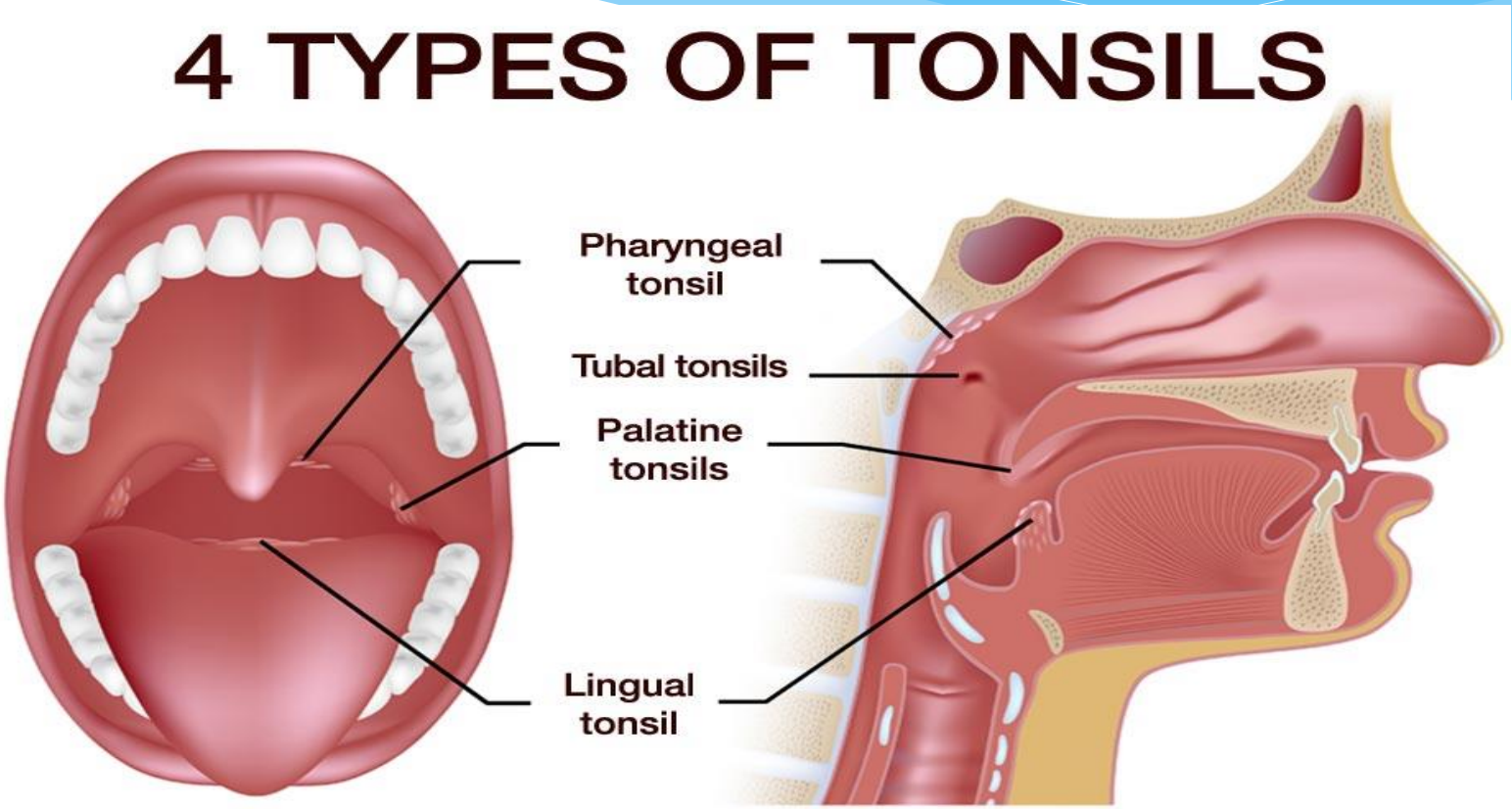
* Peyer's patches are observable as elongated thickenings of the intestinal epithelium measuring a few centimeters in length. About 100 are found in humans. Microscopically, Peyer's patches appear as oval or round lymphoid follicles (similar to lymph nodes) located in the mucosa layer of the ileum and extend into the submucosa layer.
* Peyer's patches are covered by a special follicle-associated epithelium that contains specialized cells called microfold cells (M cells) which sample antigen directly from the lumen and deliver it to antigen-presenting cells.

# Tonsils

The tonsils are masses of lymphoid tissue and form an important part of our immune system located at the gateway of respiratory and digestive tract. They act as the first line of defense against ingested or inhaled pathogens.

The tonsils are part of MALT (mucosa associated lymphoid tissue).

# Tonsil types



# Tonsils histology

* Microscopically, the tonsil is a mass of lymphoid follicles supported on a connective tissue framework. In addition, the center of each of these nodules is densely packed with lymphocytes, and is referred to as the germinal center. The tonsillar crypts (except the pharyngeal tonsil) will penetrate from the surface, almost down to the very center of the tonsil follicle. The luminal surfaces of the tonsils are coated in non-keratinizing stratified squamous epithelium, which is the same tissue of the surrounding oropharynx.

# Lymph node

* The presence of foreign organisms within the blood stream can trigger a massive cascade of events that will disrupt many homeostatic microenvironments within the body. Therefore, the immune system carries out detailed surveillance of the blood in order to detect these pathogens. One method of screening takes place at the level of the lymph nodes. These are secondary lymphoid organs that are widely distributed throughout the body.

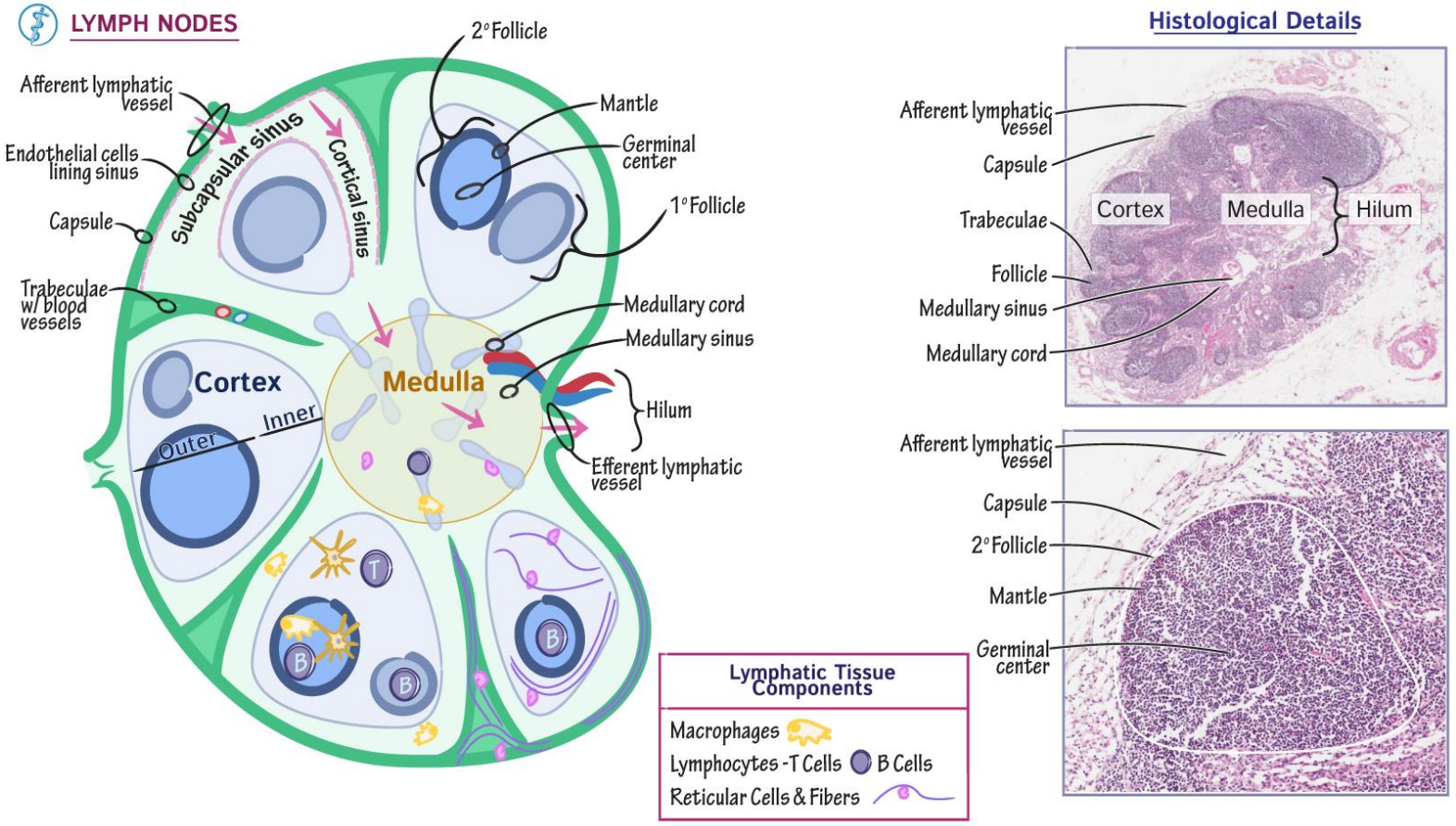
# Lymph node anatomy

* At approximately 0.1 by 2.5 cm, the lymph node is a relatively small glandular structure that resembles a kidney-bean. It has a convexed surface that is penetrated by afferent lymph vessels. On the opposing side, there is a concavity that is penetrated by the supplying artery, vein and nerve and also allows exit of efferent lymphatic vessels. This concavity is known as the hilum of the lymph node.

# Lymph node histology

* Lymph nodes are encapsulated by dense connective tissue comprised of elastin and collagen fibers along with interspersed fibroblasts. The convexed surface of the lymph node is pierced by numerous afferent lymph vessels. They extend to the deeper areas of the lymph node by way of the trabecular extensions of the cortex. As the trabeculae penetrate the lymph node, they continue as reticulin fibrils (type III collagen) that offer additional structural support to the gland.
*

# Lymph node histology



# Cross sectional analysis of a lymph node

* Cross sectional analysis of a lymph node reveals that it is subdivided into three regions:
* Outer cortex
* The outermost layer is the cortex. It is made up of a subcapsular sinus, cortical sinus and lymphoid nodules. The subcapsular sinus is the first space that lymph fluid from the afferent channels enters within the node. The fluid then travels from here to the cortical sinuses; which are branches of the subcapsular sinus. The cortical sinuses are also known as trabecular sinuses because they travel along the trabecular network within the lymph node.
* lymphoid nodules are situated around the branched may or may not have a germinal center depending on if it is a primary or secondary follicle.
  The primary follicle is comprised of small dormant lymphocytes throughout, while the secondary follicle has a heterogeneous collection of large B lymphocytes that have already been activated by inciting antigens.

# Cross sectional analysis of a lymph node

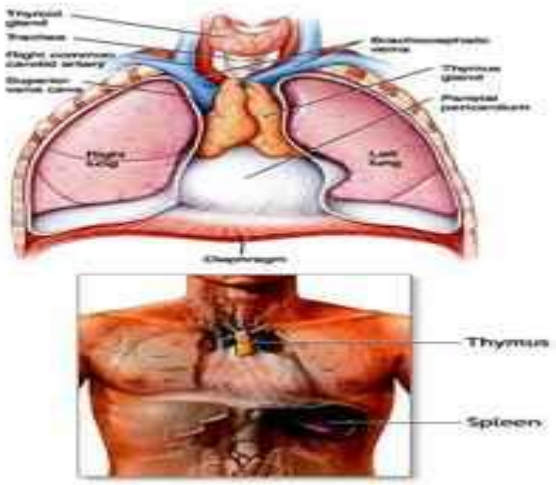
* Paracortex
* Deep to the cortical layer is the paracortex. Its margins blend with the superficial cortex and deep medulla. The principal distinguishing features are the absence of lymphoid nodules and the large number of T lymphocytes .
* Medulla
* The deepest layer of the lymph node is the medulla. It is subdivided functionally and histologically into two other regions; which are the medullary cords and sinuses. The cords are populated by plasma cells, as well as B – cells and T – cells.
* The medullary sinuses are the terminal continuations of the peripherally located cortical sinuses. They eventually culminate at the hilum of the lymph node to form efferent lymphatic vessels.

# Thymus

* An organ that is part of the lymphatic system, in which T lymphocytes grow and multiply. The thymus is in the chest behind the breastbone.

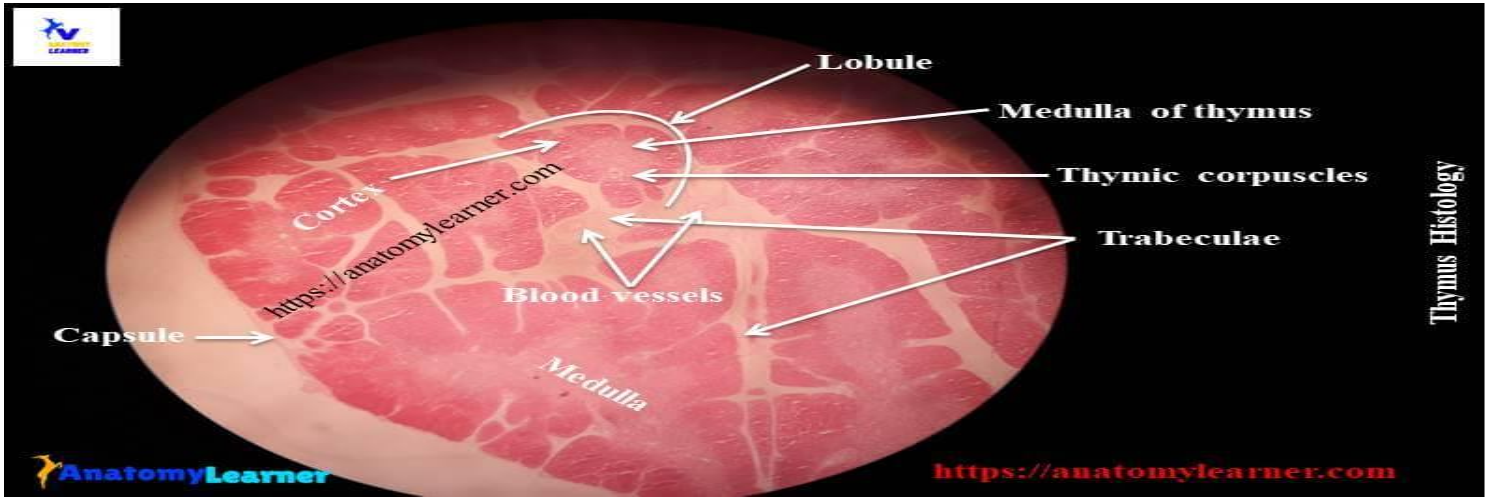
## Thymus Gland

- Anatomy
  - Upper mediastinum.
  - Large in infants (70 g), atrophied in adult (3 g).
  - 2 lobed organ.
- Hormones- thymosins.
- Target- T lymphocytes (white blood cells).
- Hormone Functions
  - Promote production and maturation of T lymphocytes.



# Thymus gland histology

* The thymus is an encapsulated primary lymphoid organ. Histologically, it is divided into subcapsular cortical, cortical and medullary regions within each lobule, created by the intervening connective tissue septae extending from the capsule.



# Thymus gland histology

* There are three subtypes of epithelial cells in the cortex:
  * Squamous thymic epithelial cells are important in the formation of the thymus blood barrier that reduced exposing thymocytes to improper antigens.
  * Stellate thymic epithelial cells that form the cytoreticulum(antigen presenting cells (APC).
  * Other squamous thymic epithelial cells that form the corticomedullary barrier.This functional partition separates the outer cortex from the inner medulla.
* There are three subtypes of epithelial cells in the medulla:
  * The squamous thymic and stellate thymic cells of the medulla have similar functions to their counterparts in the cortex.
  * Hassall corpuscles

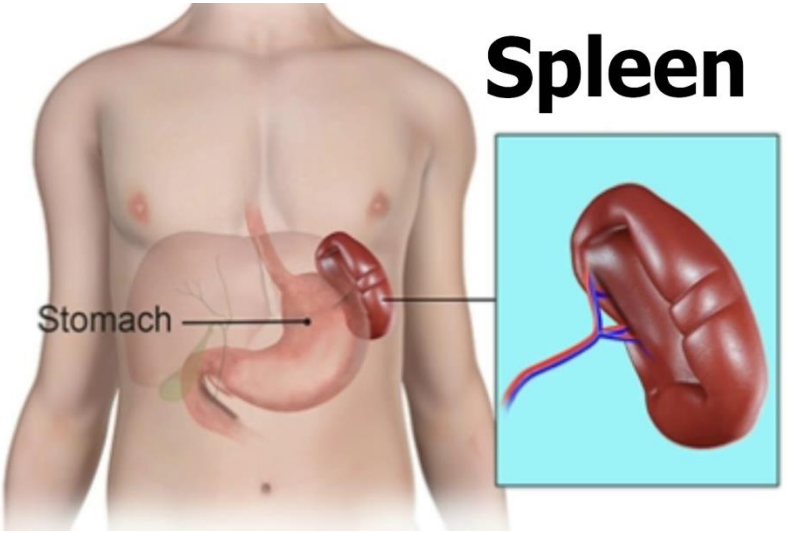
  They are responsible for the release of cytokines that regulate dendritic activity.

# Spleen

* The spleen is an organ in the upper far left part of the abdomen, to the left of the stomach. The spleen varies in size and shape between people, but it's commonly fist-shaped, purple, and about 4 inches long. Because the spleen is protected by the rib cage, you can't easily feel it unless it's abnormally enlarged.

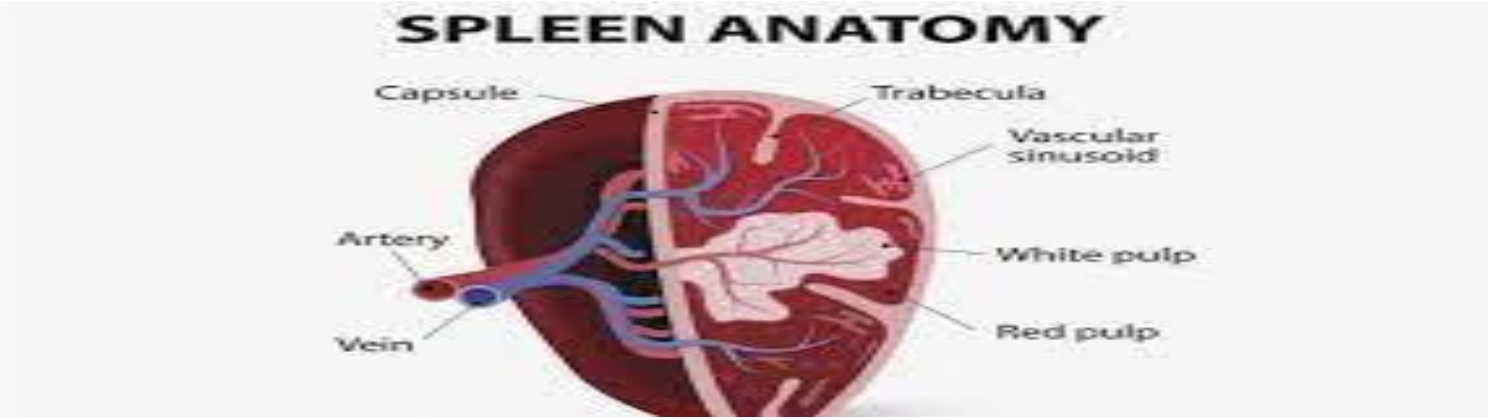
What is the function of the spleen?

- A) Filters blood and stores large amounts of red blood cells
- B) Exchange of oxygen and carbon dioxide in the cells
- C) Transportation of excess tissue fluid to the general circulation
- D) Production of T-lymphocytes, red blood cells and enzymes



# Spleen anatomy

* The capsule of the spleen consists of dense irregular fibroelastic tissue. The connective tissue of the capsule contains contractile cells called myofibroblasts. By producing weak contraction of the capsule, these cells help to discharge the blood stored within the spleen into the circulation. The capsule also allows the spleen to significantly increase in size when necessary and discharge a large amount of blood to contribute to the tissues oxygenation, like during physical exercise. The capsule splits into several septae called trabecula which penetrate into the parenchyma of the spleen and partly divide its tissue.



# Spleen histology

* Like every other organ, the spleen consists of stroma and parenchyma. The stroma of the spleen is composed mainly of a network of reticular connective tissue. This mesh provides support for blood cells and cells of the immune system (lymphocytes, macrophages, and dendritic cells). The parenchyma of the spleen is divided into two functionally and morphologically distinct compartments (red pulp and white pulp)

# Red pulp

* The red pulp occupies the majority of the stromal tissue of the spleen. It consists of the cords of Billroth and splenic sinusoids. The cords of Billroth (splenic cords) are the cellular aggregations supported by the reticular connective tissue. They appear as stripes and consist of  of macrophages, plasmocytes and blood cells.
* Splenic sinusoids are found between the cords of Billroth. They are filled with blood and give the red pulp its distinguishable red appearance. Blood slowly flows through the sinusoids where it is exposed to macrophages from the cords of Billroth, patiently waiting for foreign antigens that can appear in the blood. The red pulp functions as a blood filter for various toxins, destroying them before they enter systemic circulation and get the chance to spread throughout the body and damage other organs.

# White pulp

* The white pulp of the spleen is made of three different compartments: Periarterial lymphoid sheath (PALS), lymphoid follicles and the marginal zone.
* The PALS consists of a central artery (a branch of the splenic artery) surrounded by a sheath of lymphoid tissue. Here, the lymphoid tissue organized into two layers: The inner layer and outer layer. The inner layer is mainly composed of T lymphocytes which is why it is also called the T-zone. The outer layer has a more diverse cellular morphology, containing T and B lymphocytes.
* The branches of central arterioles are surrounded by the sharply defined areas of B lymphocytes, comprising the lymphoid follicles of the spleen. There are two types of lymphoid follicles depending on the features of the B lymphocytes that comprise them: Primary follicles and secondary nodules.

# White pulp

* A follicle that consists mainly of small, immature lymphocytes is called a primary follicle. However, most nodules found in the spleen are secondary nodules that arise from primary follicles as the lymphocytes mature and increase in size.
* The marginal zone is found on the very edge of the lymphoid follicles, containing different immune cells that are well equipped for starting an appropriate immune response.

# End

* Thanks a lot for attention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* 2020-2021