

## Lymphatic system

BY

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**First stage**

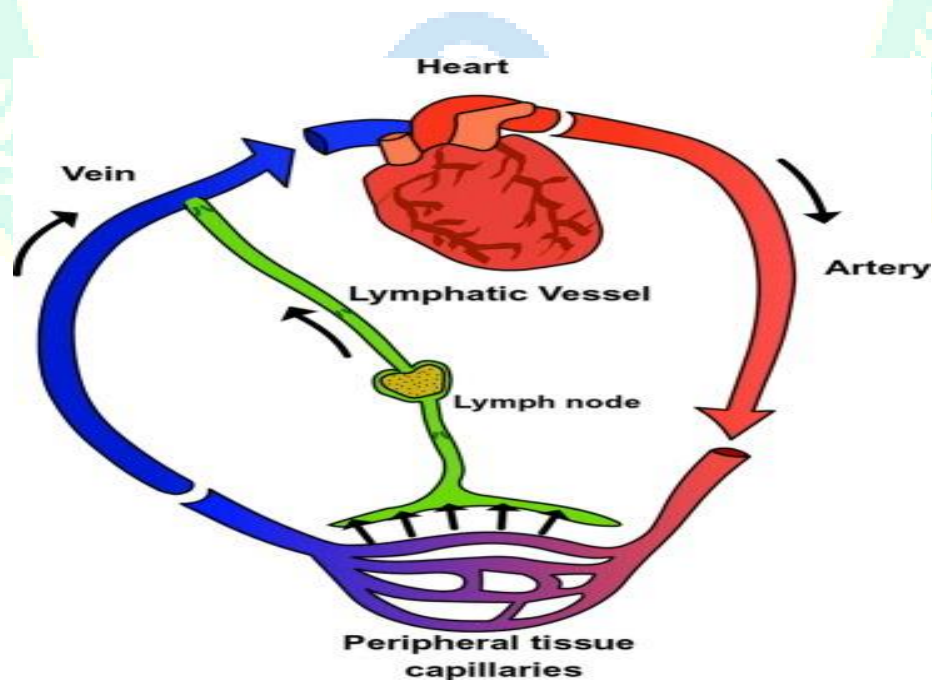
**2021-2022**

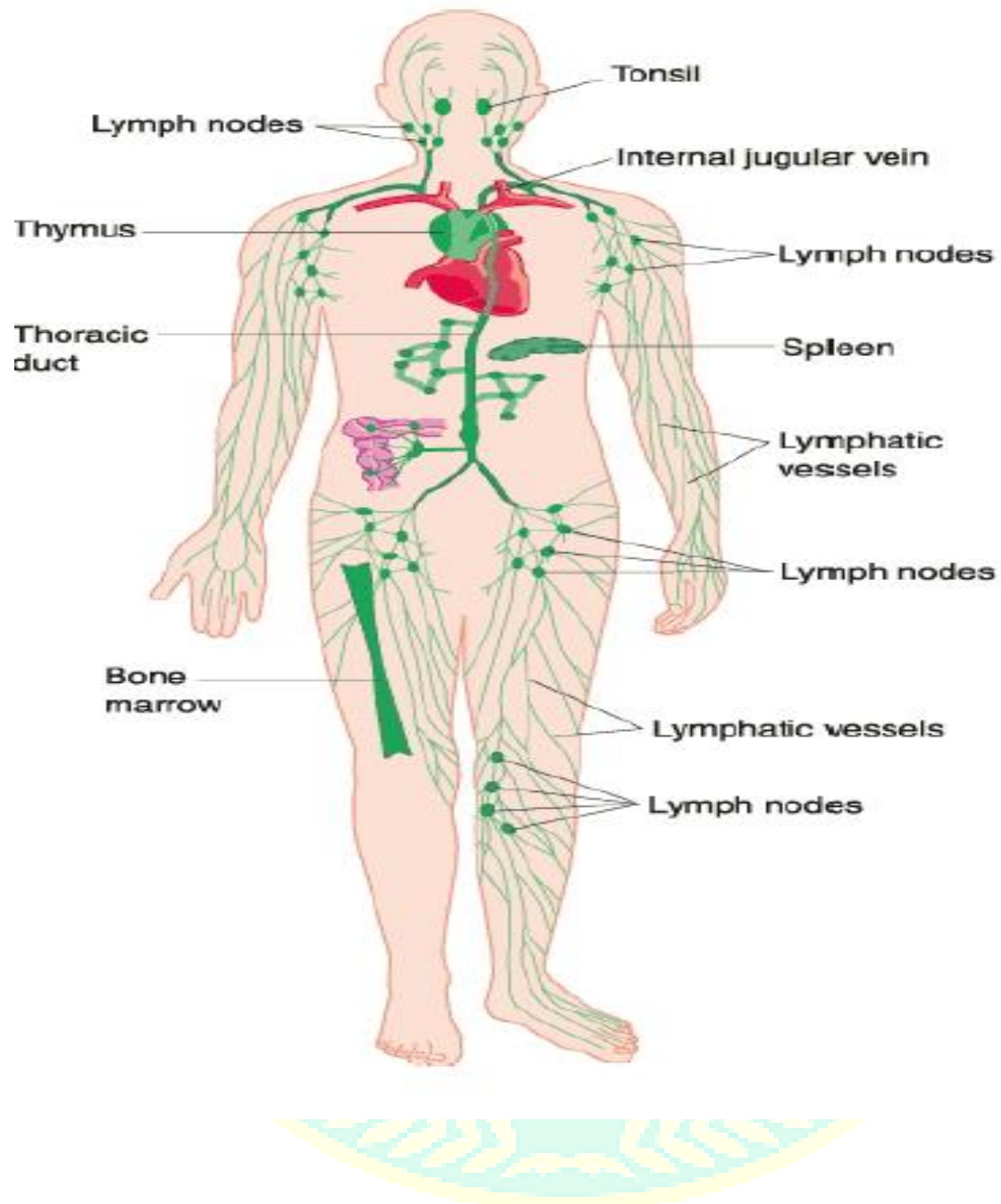
## Introduction

The lymphatic system is one of the systems in the human body, and it is affiliated with the **immune system in its work**.

This system consists of a giant network of vessels spread in the various tissues of the body, through which the fluid known as the **lymphatic fluid** passes, and in fact, this fluid circulates in the body similar to the circulation of blood in the body.

The origin of this fluid goes back to the blood plasma, after the heart and circulatory system pump approximately two liters of blood on a daily basis to the tissues of the body, and when it reaches the body tissues, it returns to the lymphatic vessels and is known as the **fluid Lymphatic**. As the **lymphatic vessels** work in cooperation with the **veins** to form this fluid, in addition to that, the lymphatic system follows the so-called **lymph nodes**, there are approximately 600 lymph nodes in the body, and these nodes work alongside other parts of the lymphatic system Such as the **spleen and thymus**, which collect white blood cells known as **lymphocytes**, which are work, in turn, helps to reproduce and produce antibodies to counteract bacteria, viruses, and abnormal cells such as cancer cells.

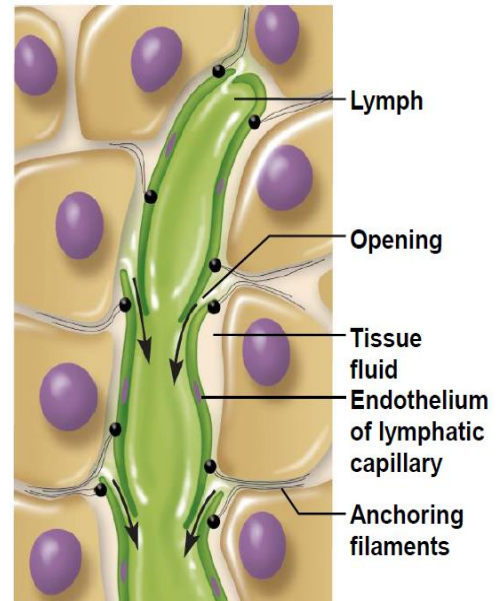




**The lymphatic system**

## Structure of Lymphatic system

- Lymph is a clear watery fluid that resembles blood plasma but: have fewer proteins its composition varies depending on the organs that it drains. It consists of fluid derived from plasma =lymph and white blood cells (esp. lymphocytes and macrophages (monocytes)).
- Network of tissues, organs, and vessels that help to maintain the body's fluid balance & protect it from pathogens.
- Lymphatic vessels, lymph nodes, spleen, thymus, tonsils, etc.
- Without it, neither the circulatory system nor the immune system would function.
- Can be thought of as an accessory to the circulatory system. It helps the circulatory system do its job; the two systems are directly connected together.
- The lymph travels in only one direction.



### There are two types of lymphoid organs:

1. **Central (primary) lymphoid organs:** as the thymus and bone marrow, where lymphoid cells precursors undergo antigen-independent proliferation, to develop as T-lymphocyte (in the thymus), or B-lymphocyte (in the bone marrow).
2. **Peripheral (secondary) lymphoid organs:** the spleen, lymph node, tonsil, Peyer's patches, and lymphatic nodules in the wall of digestive, urinary, respiratory, and reproductive systems, where lymphocytes migrate to them after leaving central lymphoid organs.

## LYMPHATIC SYSTEM VERSUS IMMUNE SYSTEM

Lymphatic system is the network of vessels through which the lymph drains back to the blood

A component of the immune system

Comprises lymph, lymph nodes, lymph vessels and organs such as thymus, spleen, tonsils, etc.

Connected to the circulation system

Immune system is the organs and the reactions of the body, which provides resistance to infections and toxins

Defend the body against pathogens

A functional system

Connected to endocrine and nervous system

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## Spleen:

The spleen contains the largest single accumulation of lymphoid tissue in the body and is the only lymphoid organ involved **infiltration of blood**, making it an **important organ in defense against blood-borne antigens**. It is also the main site of **old erythrocyte destruction**. As is true of other secondary lymphoid organs, the **spleen is a production site of antibodies and activated lymphocytes**, which here are delivered directly into the blood.

Located high in the left upper quadrant of the abdomen, the spleen's volume varies with its **content of blood** and tends to decrease very slowly after **puberty**. The organ is surrounded by a capsule of **dense connective tissue** ~~from which emerge trabeculae to penetrate the parenchyma or splenic pulp.~~



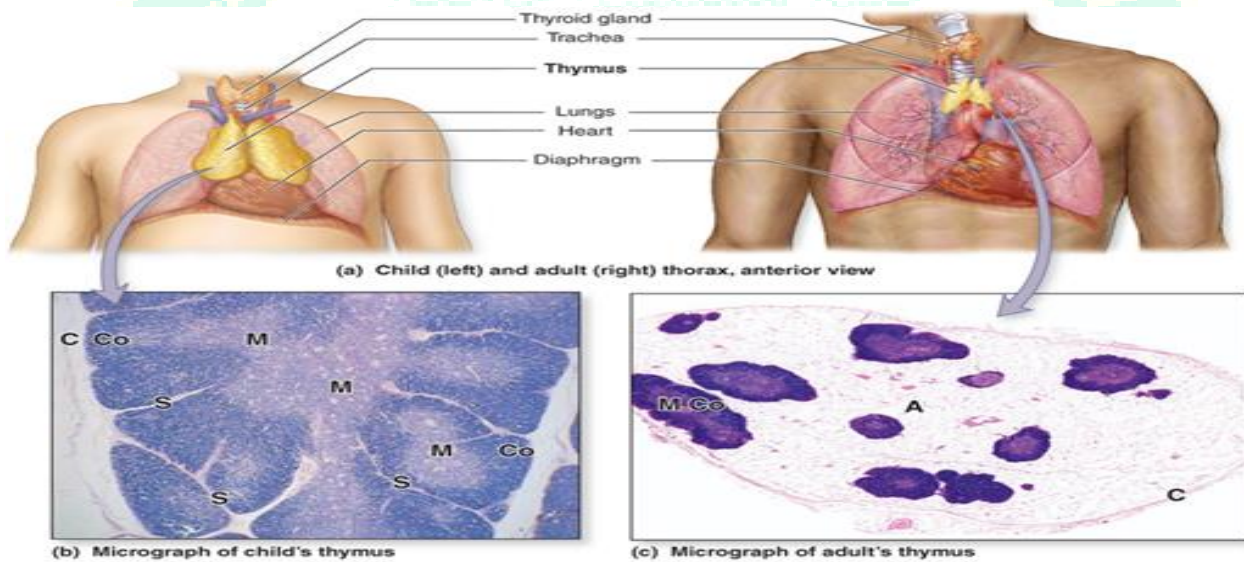
Source: Anthony L. Mescher: Junqueira's Basic Histology, 14th Edition.  
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The capsule (C) of the spleen connects to trabeculae (T) extending into the pulp-like interior of the organ. The red pulp (R) occupies most of the parenchyma, with white pulp (W) restricted to smaller areas, mainly around the central arterioles. Names of these splenic areas refer to their color in the fresh state: red pulp is filled with blood cells of all types, located both in cords and sinuses; the white pulp is lymphoid tissue. Large blood vessels and lymphatics enter and leave the spleen at a hilum. (X20; Picro-Sirius-hematoxylin)

## Thymus

The primary or central lymphoid organ in which T cells are produced in the thymus. It's a bilobed structure in the mediastinum, **at birth** (fully formed) the thymus remains large and very active in T-cell production until **puberty** during which it normally undergoes involution, with decreasing lymphoid tissue mass and cellularity and reduced T cell output, and may be involved with the decline of immune function in the elderly.

A child's thymus, showing **connective tissue of the capsule and septa between thymic lobules**, each having an outer cortex and incompletely separated medulla of lymphoid tissue.



Source: Anthony L. Mescher: Junqueira's Basic Histology, 14th Edition.  
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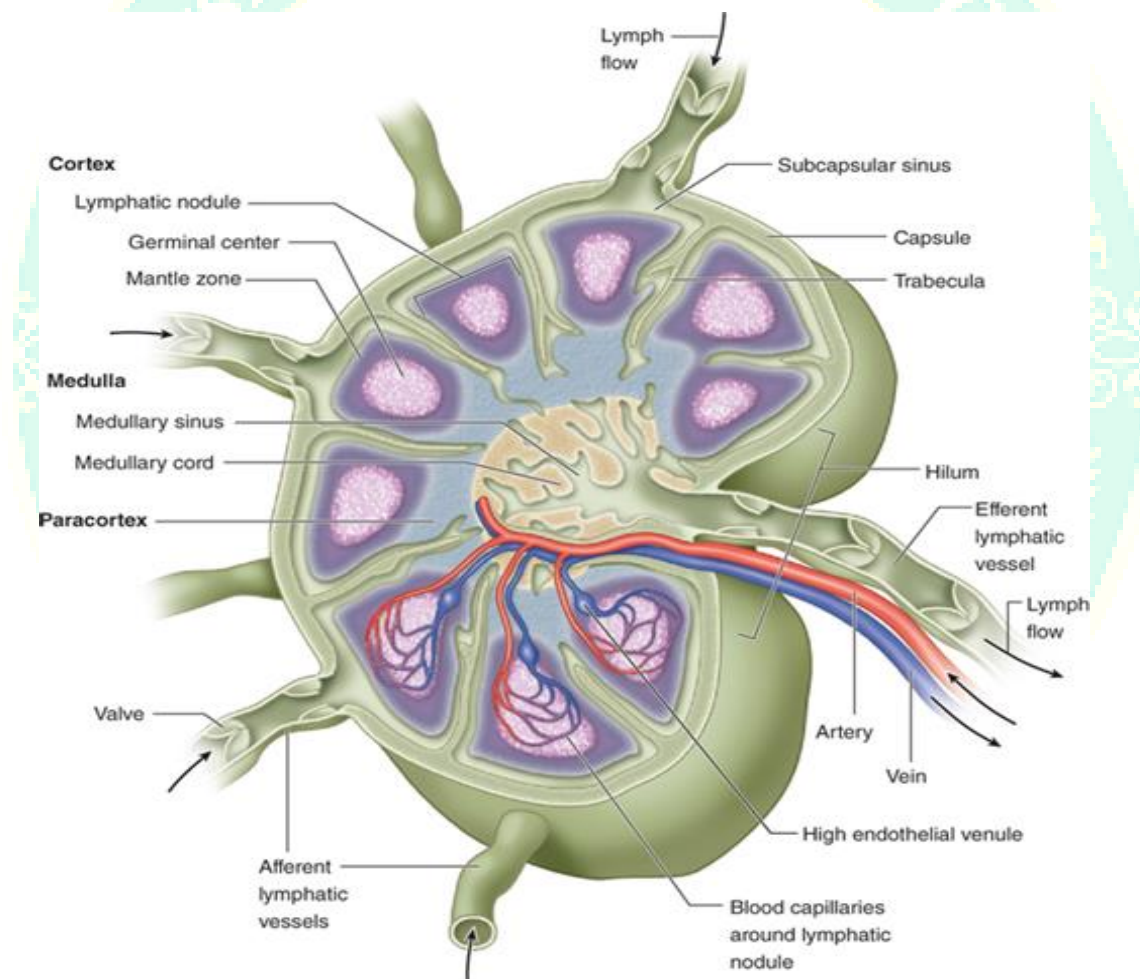
The thymus is a bilobed organ in the mediastinum that is most active and prominent before puberty and undergoes involution with less activity in the adult.

(b) A child's thymus, showing connective tissue of the capsule (C) and septa (S) between thymic lobules, each having an outer cortex (Co) and incompletely separated medulla (M) of lymphoid tissue. (H&E; X40)

(c) After-involution the thymus shows only small regions of lymphoid tissue, here still with cortex (Co) and medulla (M), and these are embedded in adipose tissue (A). Age-related thymic involution reduces production of naïve T cells and may be involved with the decline of immune function in the elderly. (H&E; X24)

## Lymph nodes

Small lumps of tissue that contain white blood cells, which **fight infection**. They are part of the body's immune system and **filter lymph fluid**, which is composed of fluid and waste products from body tissues. Lymph nodes are located throughout the body, including the neck, armpits, groin, around gut, and between lungs. A **connective tissue capsule** surrounds the lymph node. A **loose reticular tissue** extends throughout the node.



Source: Anthony L. Mescher: Junqueira's Basic Histology, 14th Edition.  
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## Tonsils

The tonsils constitute lymphoid tissue that lies beneath, and in contact with, the epithelium of the initial portion of the digestive tract. Depending on their location, Three main sets of tonsils (palatine, pharyngeal, or lingual).

### 1. Palatine

**Location** → Lateral walls of the oropharynx

**Capsule** → Separating the lymphoid tissue from subjacent structures is a band of dense connective tissue. This capsule usually acts as a barrier against spreading tonsillar infections.

**Lining** → Stratified squamous epithelium.

### 2. pharyngeal

**Location** → Superior posterior portion of the pharynx

**Capsule** → Thinner than the capsule of the palatine tonsils

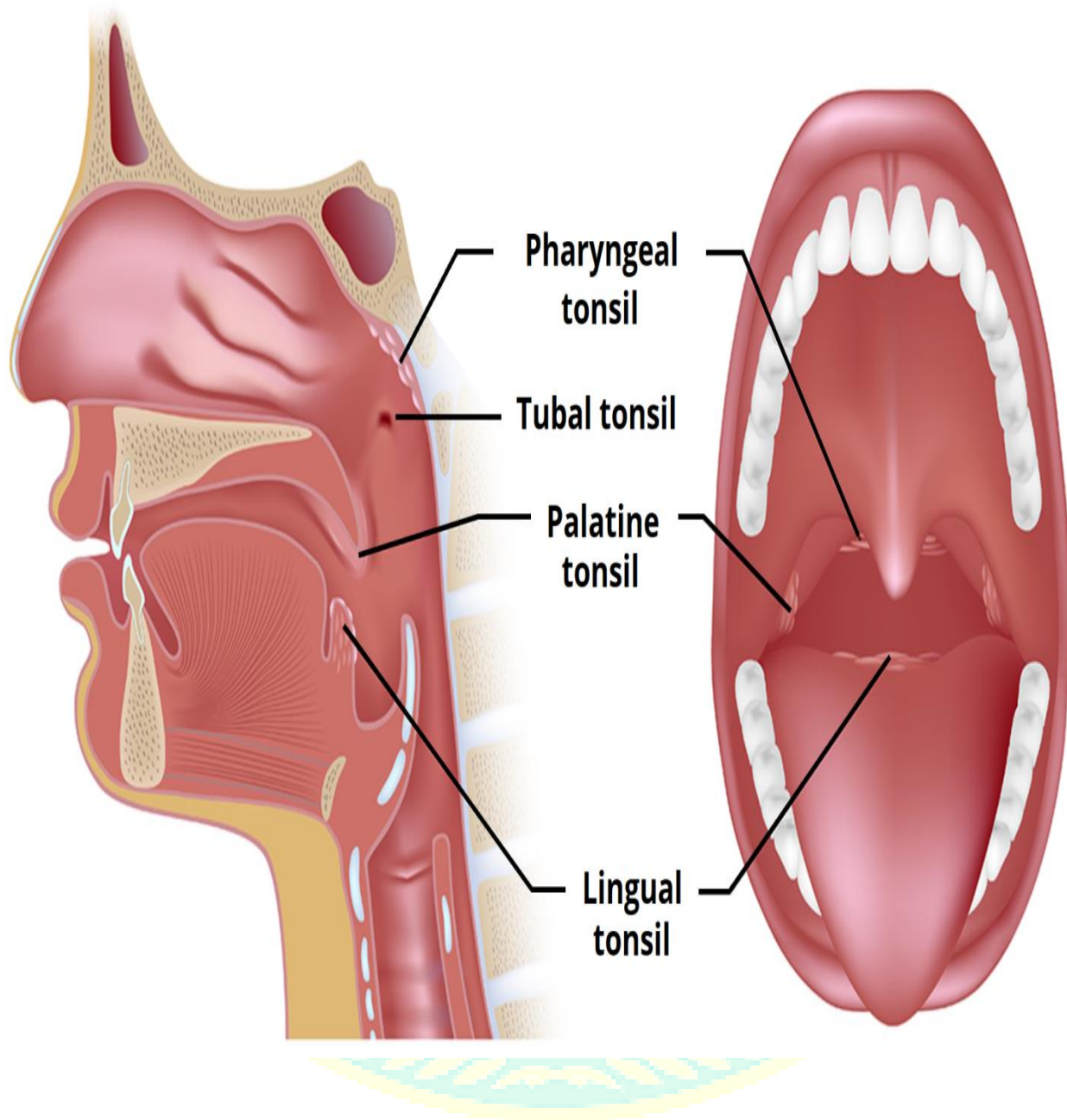
**Lining** → Ciliated pseudo stratified columnar epithelium

### 3. Lingual

**Location** → At the base of the tongue

**Capsule** → No

**Lining** → Ciliated pseudo stratified columnar epithelium



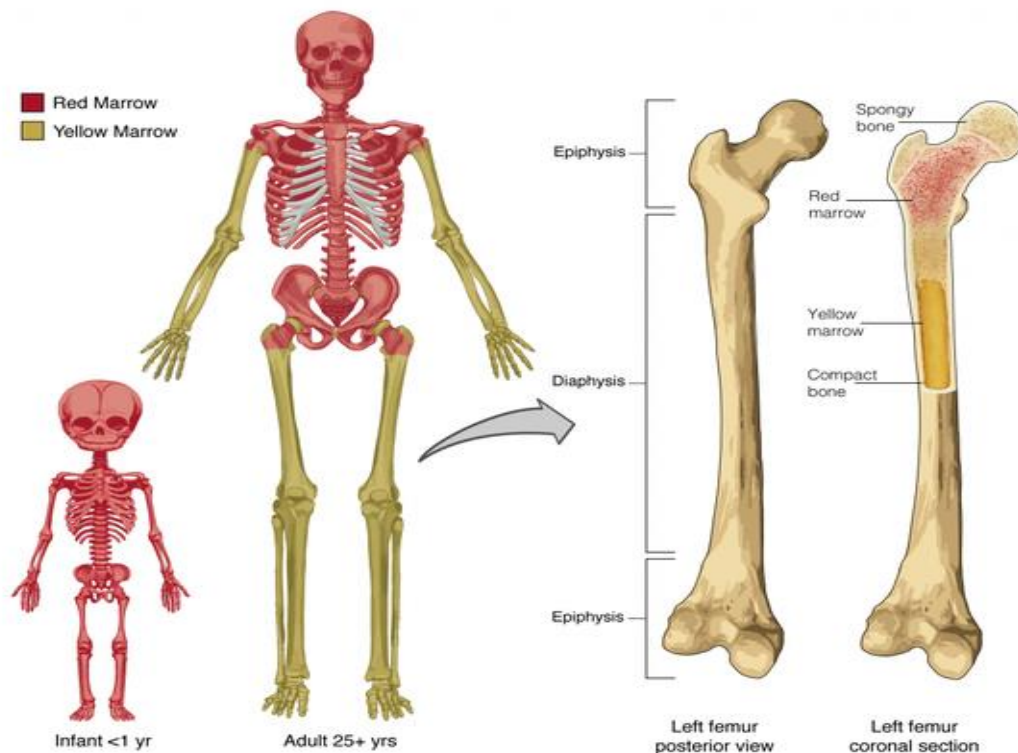
## Bone marrow

Bone marrow is a specialized connective tissue found in the medullary canals of long bones and in the small cavities of cancellous bone. There are two types of bone marrow based on their appearance at the gross examination:

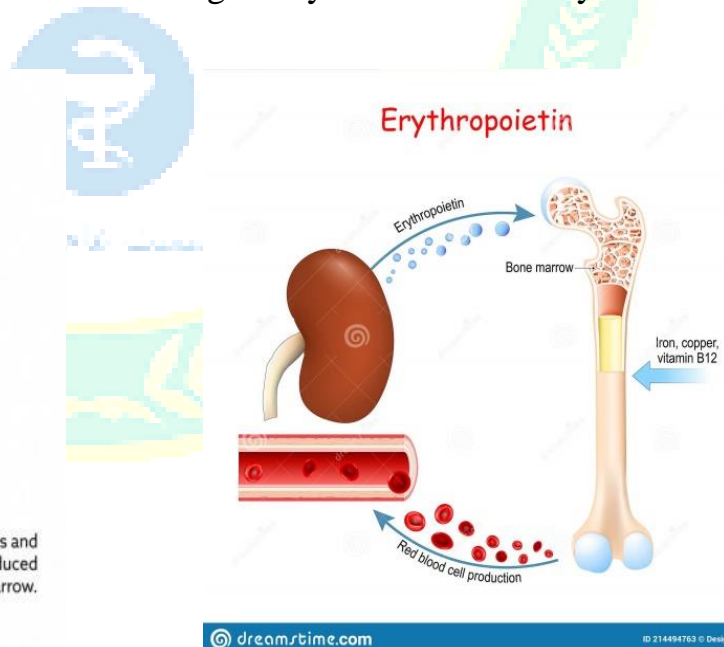
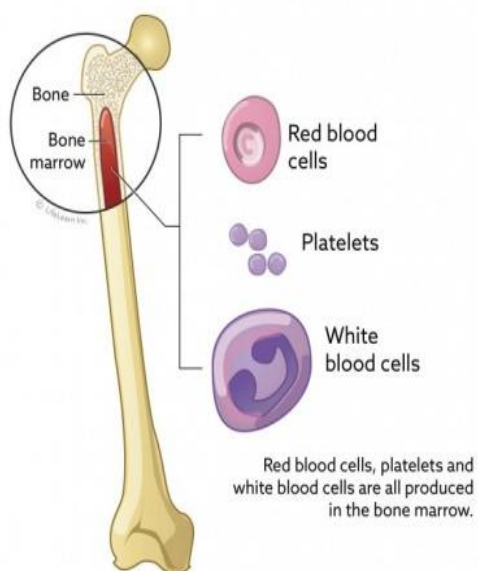
1. Red bone marrow, whose color is produced by an abundance of blood and hemopoietic cells.
2. Yellow bone marrow, which is filled mostly with adipocytes and few hemopoietic cells.

\*In the newborn all the marrow is red and active in blood cell production, but as the child grows, most of the marrow changes gradually to the yellow variety.

\*Under certain conditions, such as severe bleeding or hypoxia, yellow marrow reverts to red.



- ✓ Most red blood cells, platelets, and white blood cells form in the **red bone marrow**, while **yellow bone marrow** produces fat, cartilage, and bone.
- ✓ White blood cells survive from a few hours to a few days, platelets for about 10 days, and red blood cells for about 120 days. Bone marrow needs to replace these cells constantly, as each blood cell has a set life expectancy.
- ✓ Certain conditions may trigger additional production of blood cells. This may happen when the oxygen content of body tissues is low, if there is loss of blood or anemia, or if the number of red blood cells decreases. If these things happen, the kidneys produce and release **erythropoietin**, which is a hormone that stimulates bone marrow to produce more red blood cells.
- ✓ Bone marrow also produces and releases more white blood cells in response to infections and more platelets in response to bleeding. If a person experiences serious blood loss, yellow bone marrow can activate and transform into red bone marrow.
- ✓ Healthy bone marrow is important for a range of systems and activity.



## Functions of the Lymphatic System

- The lymphatic system has 3 main functions:
  - Drains excess interstitial fluid and returns it to the blood
  - Transports lipids and lipid-soluble vitamins (A, D, E, and K) absorbed by the GI tract to the blood
  - Carries out specific immune responses against certain foreign invaders (microbes, etc.)



*Thank you for your attention*