جامعة المستقبل
AL MUSTAQBAL UNIVERSITY
كلية العلوم
قسم الفيزياء الطبية

Anatomy

The Lymphatic System

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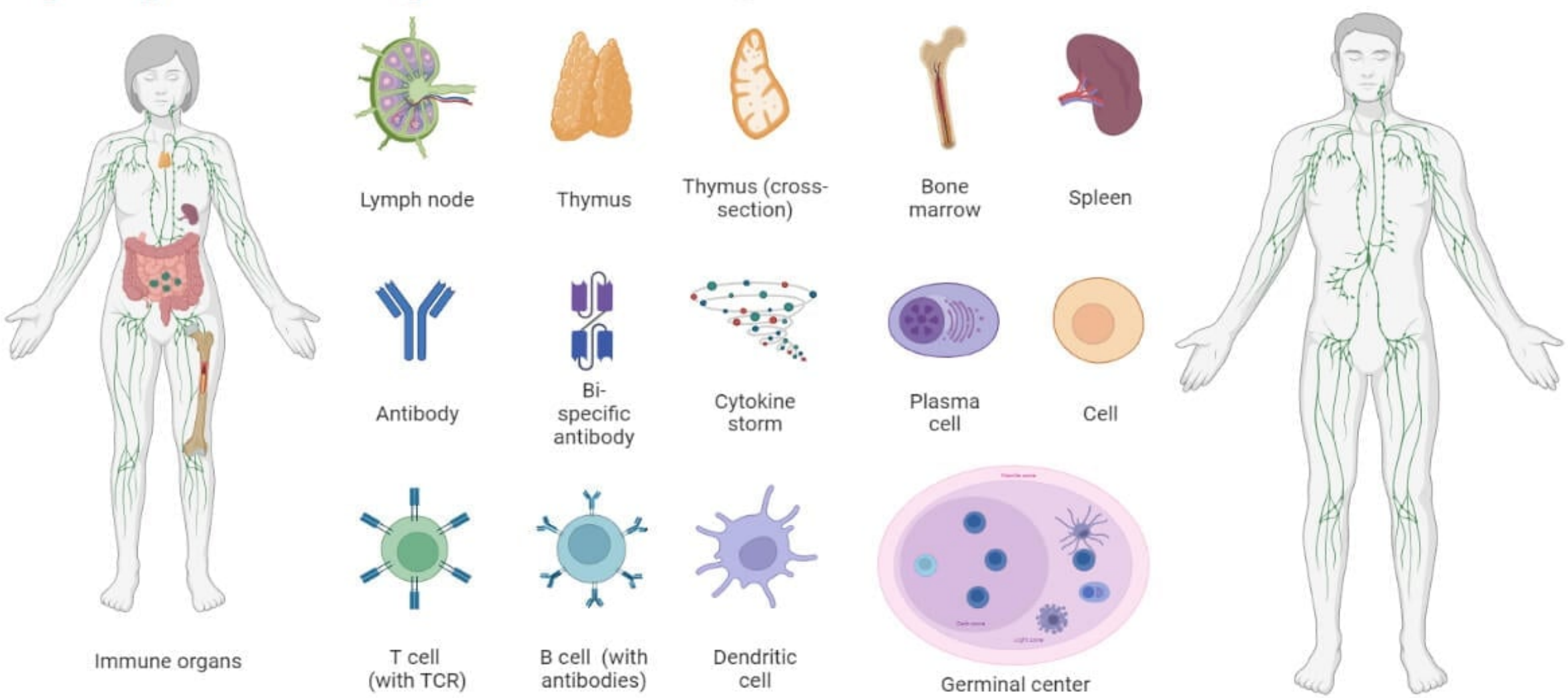
The lymphatic system is an organ system in vertebrates that helps collect (excess interstitial fluid) lymph from tissues and the transportation of the fluid back to the bloodstream for re-circulation.

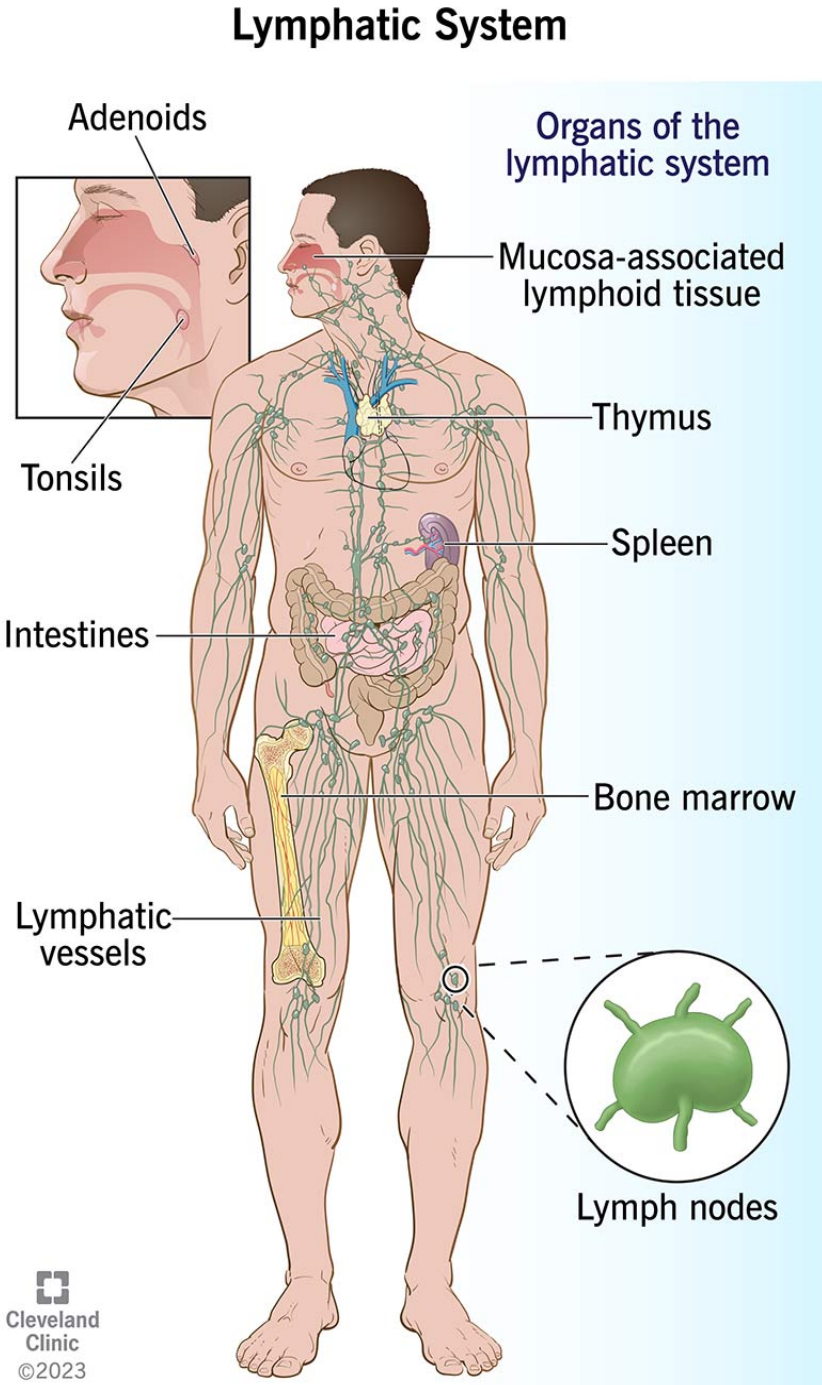


Lymphatic System is composed of lymphoid organs, lymph nodes, lymphatic vessels, and lymph.

The lymphatic system is a part of the circulatory system as well as a part of the immune system.

It collects the excess body fluid and returns it to the venous circulation so; it is a part of the circulatory system.

Similarly, it circulates lymphocytes and plays a key role in lymphocytes-mediated (adaptive) immunity; therefore, it is a part of the immune system.



Organs of the Lymphatic System

Anatomically, the lymphatic system is made up of two structures; the lymphoid tissues/organs, and the lymphatic vessels.

1. Lymphoid Tissues/Organs

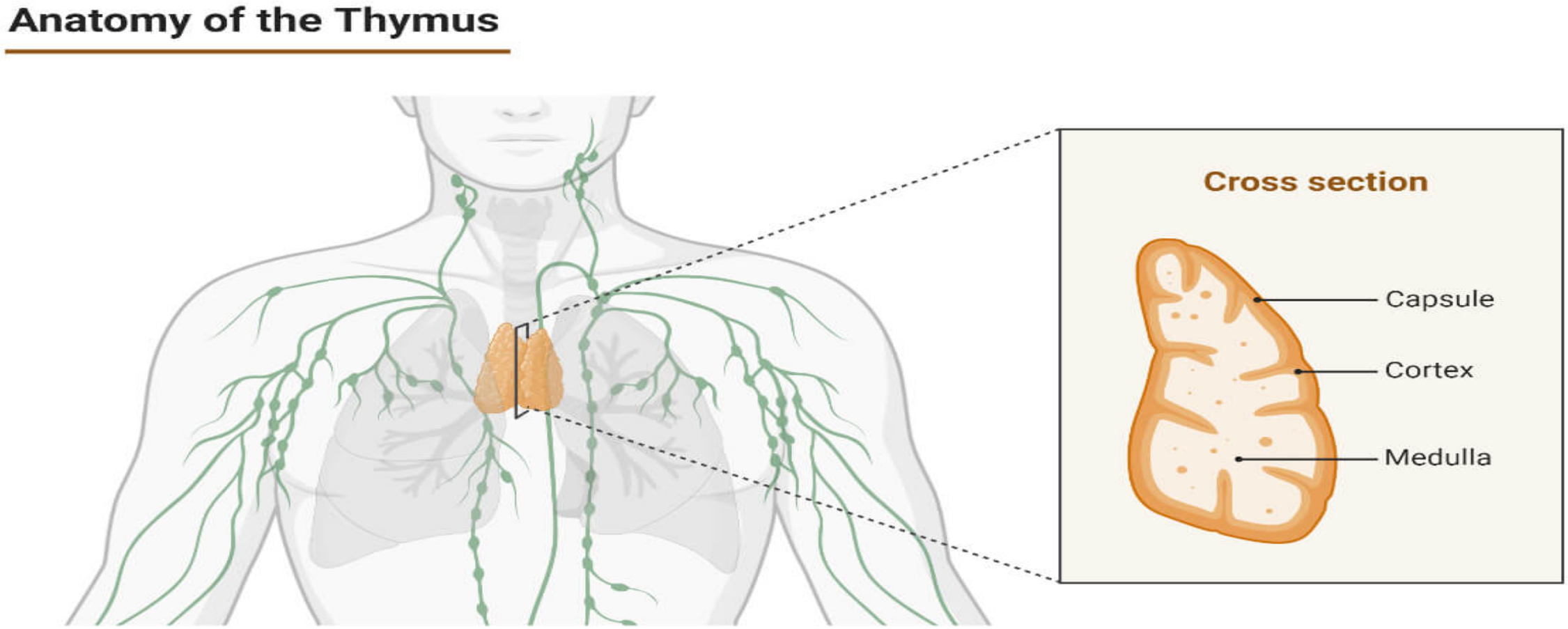
It comprises organs and specialized tissues that produce and maintains lymphocytes and/or collect lymph and connect it to the bloodstream. The lymphoid organ system can be categorized into primary and secondary lymphoid organs.

a. Primary Lymphoid Organs

It includes lymphoid organs where the lymphocytes are produced, maintained, and matured. It includes:

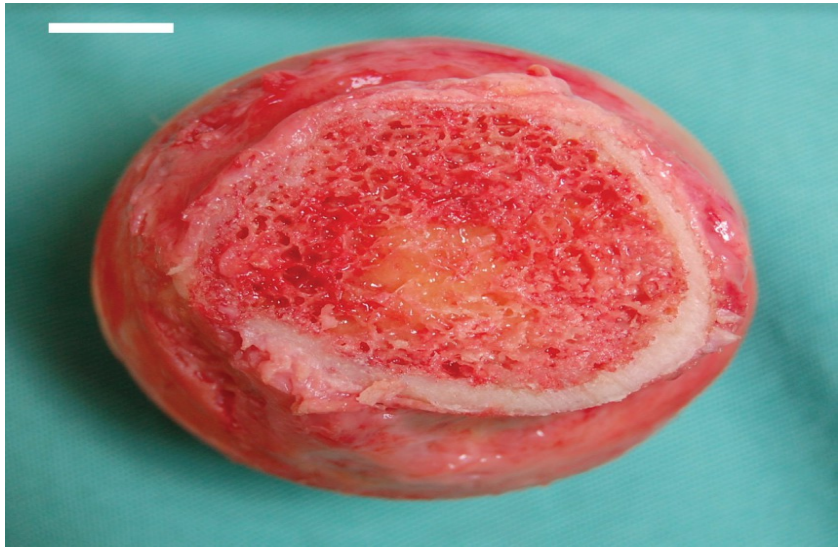
Thymus

The thymus is a primary lymphoid organ where T-lymphocytes are matured. It is located in the throat in front of the heart, just behind the sternum in the anterior portion of the mediastinum.



Bone Marrow

Bone marrow is a special semi-solid tissue mass composed primarily of hematopoietic stem cells, adipose tissue, and stromal cells that is present inside the bone in the cancellous section. The red bone marrow is a primary organ of a lymphoid system whose main function is to produce B lymphocytes.

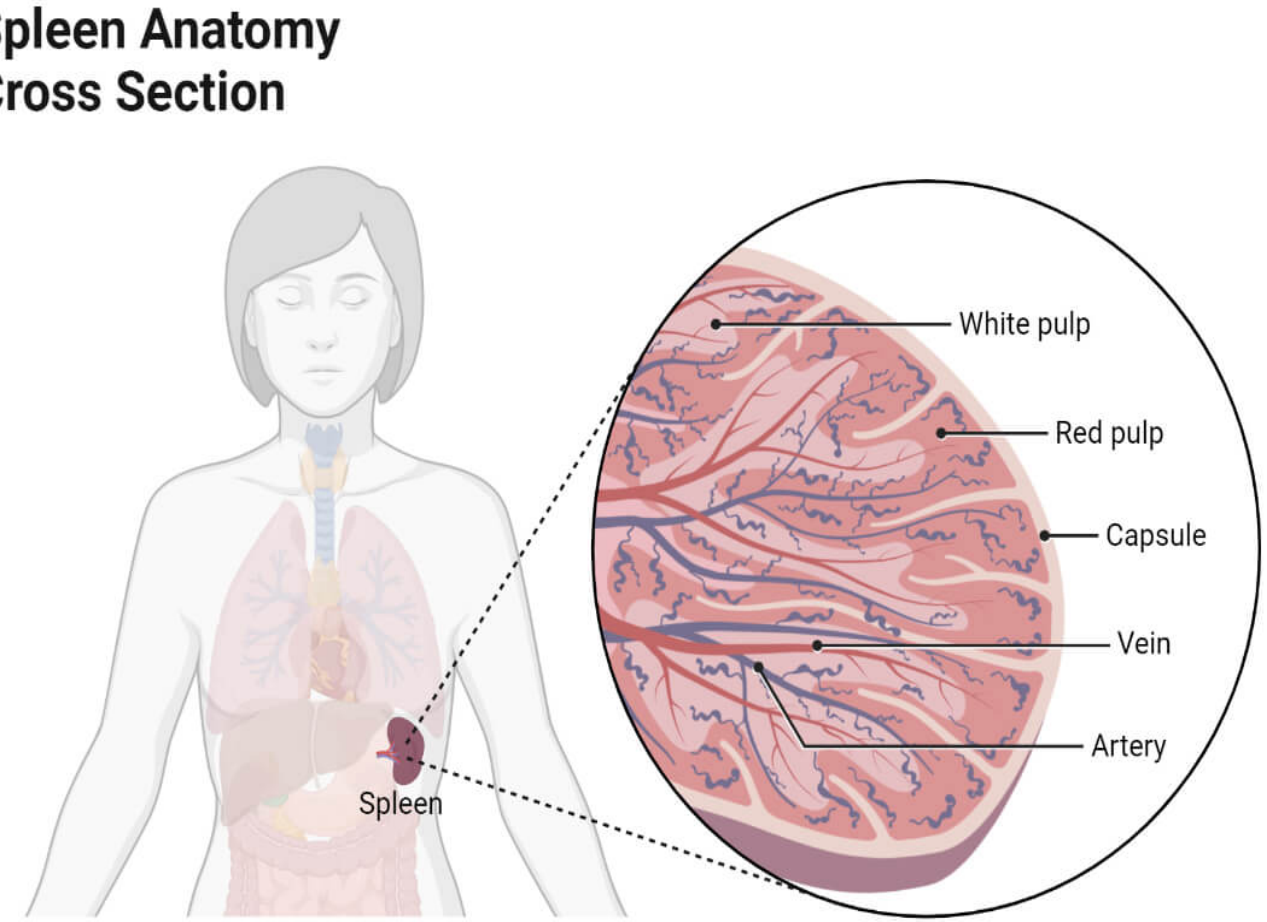


Fetal Liver

In the fetus stage, the liver cells produce lymphocytes; hence, the fetus's liver is a primary organ of the fetal lymphatic system. However, the liver of infants and adults does not produce any lymphocytes.

b. Secondary Lymphoid Organs

It includes lymphoid organs where the lymphocytes undergo further maturation and contact the bloodstream with the lymph. It includes:



Spleen

The spleen is the blood filter found at the back of the stomach in the abdominal cavity below the diaphragm. It is a large organ and weighs about 200 grams. Anatomically, it contains two distinct types of tissues; the red pulp and the white pulp.

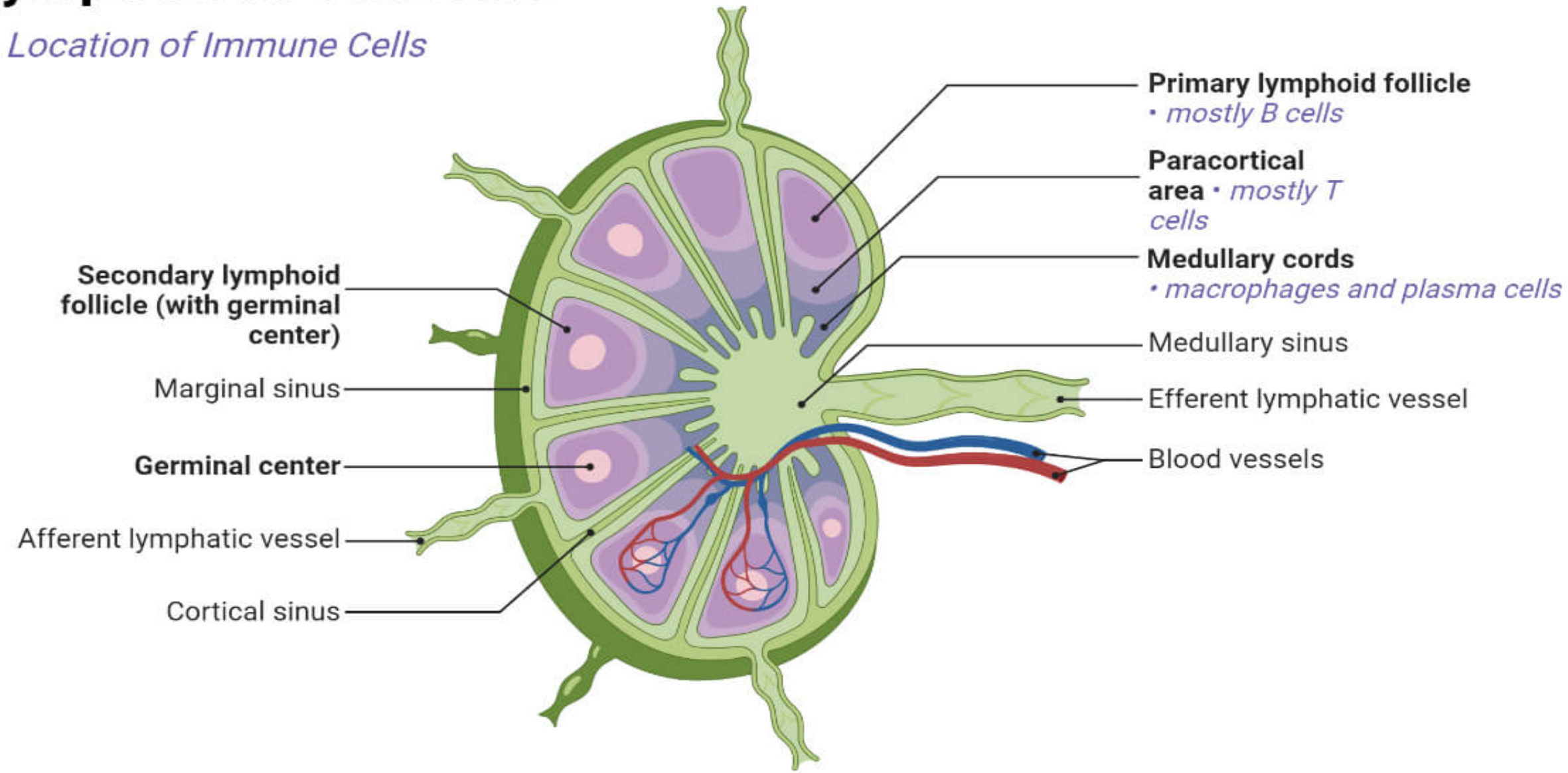
Lymph Nodes

Lymph nodes are encapsulated small kidney-shaped mass of lymphatic tissues distributed throughout the body along the network of lymphatic vessels which filters the lymph and stores lymphocytes. They are numerous (more than 600 in an adult human).
They are prevalent in the armpits (Called the **axillary lymph nodes**), groins (called the **inguinal lymph nodes**), neck (called the **cervical lymph nodes**)

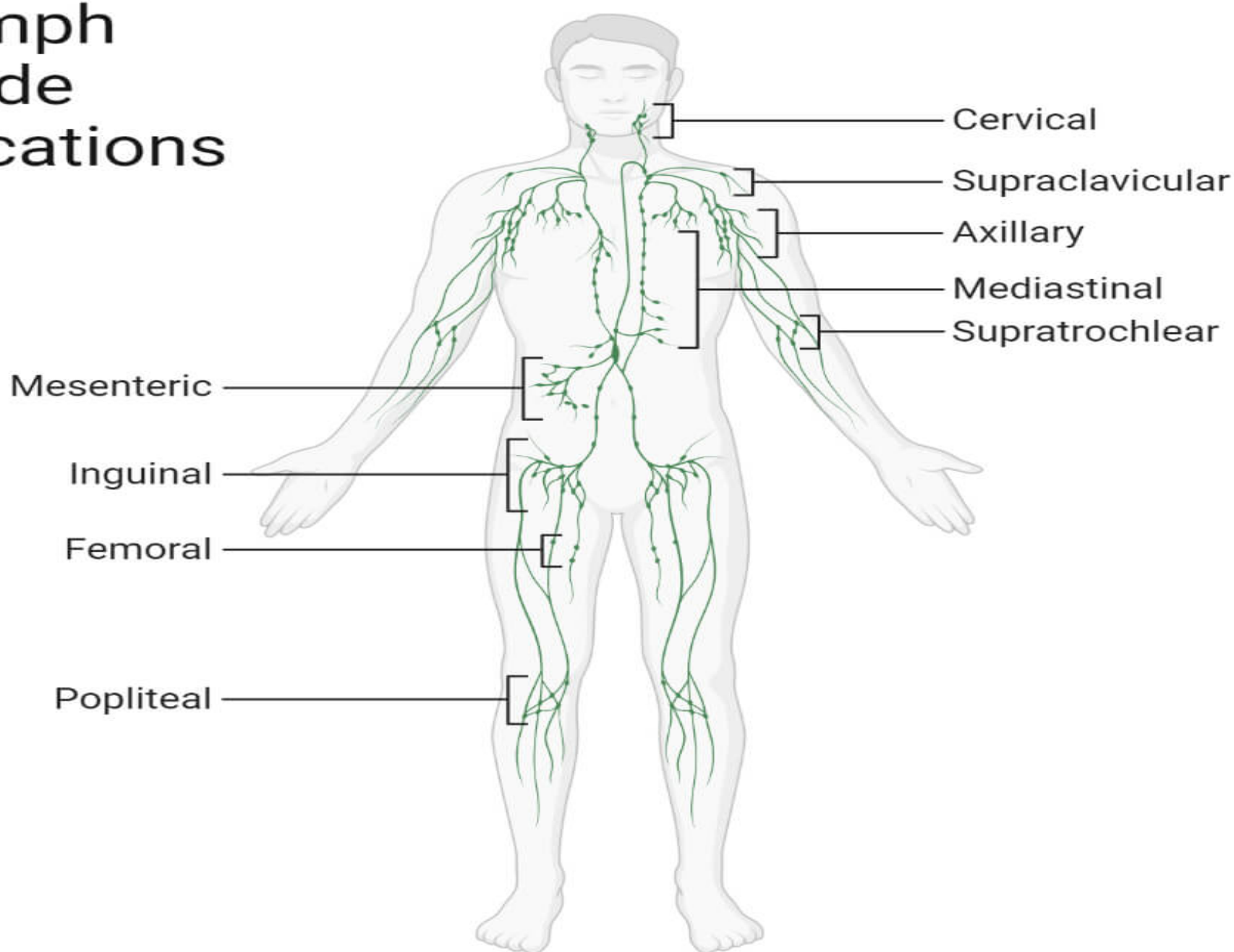
Anatomically, the lymph node is divided into two regions; the inner **medulla** and the outer **cortex** externally covered by a fibrous capsule. Each lymph node is connected with multiple **afferent** lymphatic vessels in its convex side from where lymph enters the node. On the concave side, there is an **efferent** lymphatic vessel from where filtered lymph leaves the node

Lymph Node Structure

& Location of Immune Cells



Lymph Node Locations



Mucosa-associated Lymphatic Tissues

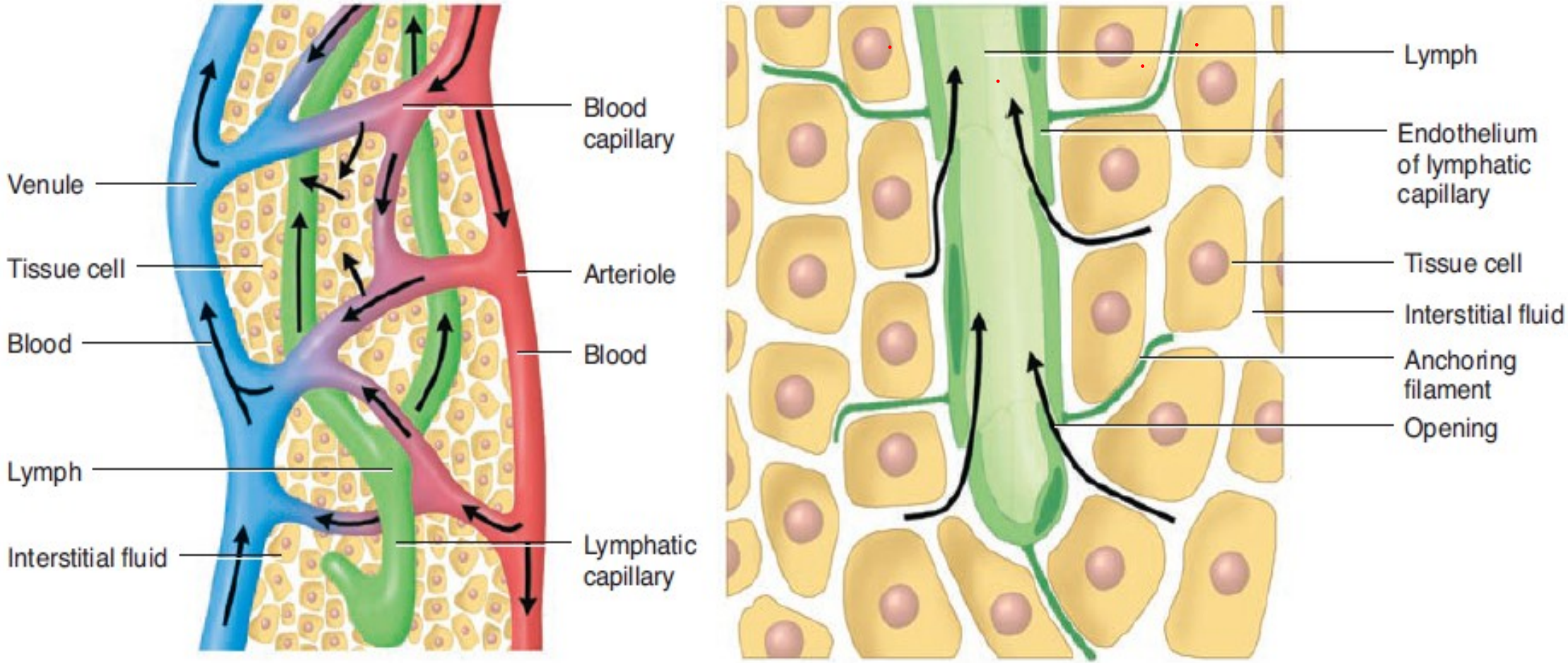
These include diverse types of lymphoid tissue masses present in the mucosal surface of several organs, like gastrointestinal, respiratory, and genitourinary systems. The major types of mucosa-associated lymphatic tissues are found in tonsils and Payer's patches.

2. Lymphatic Vessels

Lymphatic vessels also called lymph vessels or lymphatics, are the closed thin-walled tubes that form a network of ducts interconnecting the lymphoid organs through which lymph circulates. Structurally they can be classified as smaller lymph capillaries , and larger collecting lymph vessels formed by converging of several lymph capillaries which circulate the lymph. Lymph vessels are one-way vessels that collect and transport lymph from body tissues to the heart. There are several lymphatic mini-valves that check the backflow of lymph and maintain the unidirectional flow of lymph.

Lymphatic capillaries.

Lymphatic capillaries are found throughout the body except in avascular tissues, the central nervous system, portions o
the spleen, and bone marrow.



(a) Relationship of lymphatic capillaries to tissue cells and blood capillaries

(b) Details of lymphatic capillary

The lymph eventually flows into **two large lymph ducts**. One of them is called **thethoracic duct**, and this receives lymph from:

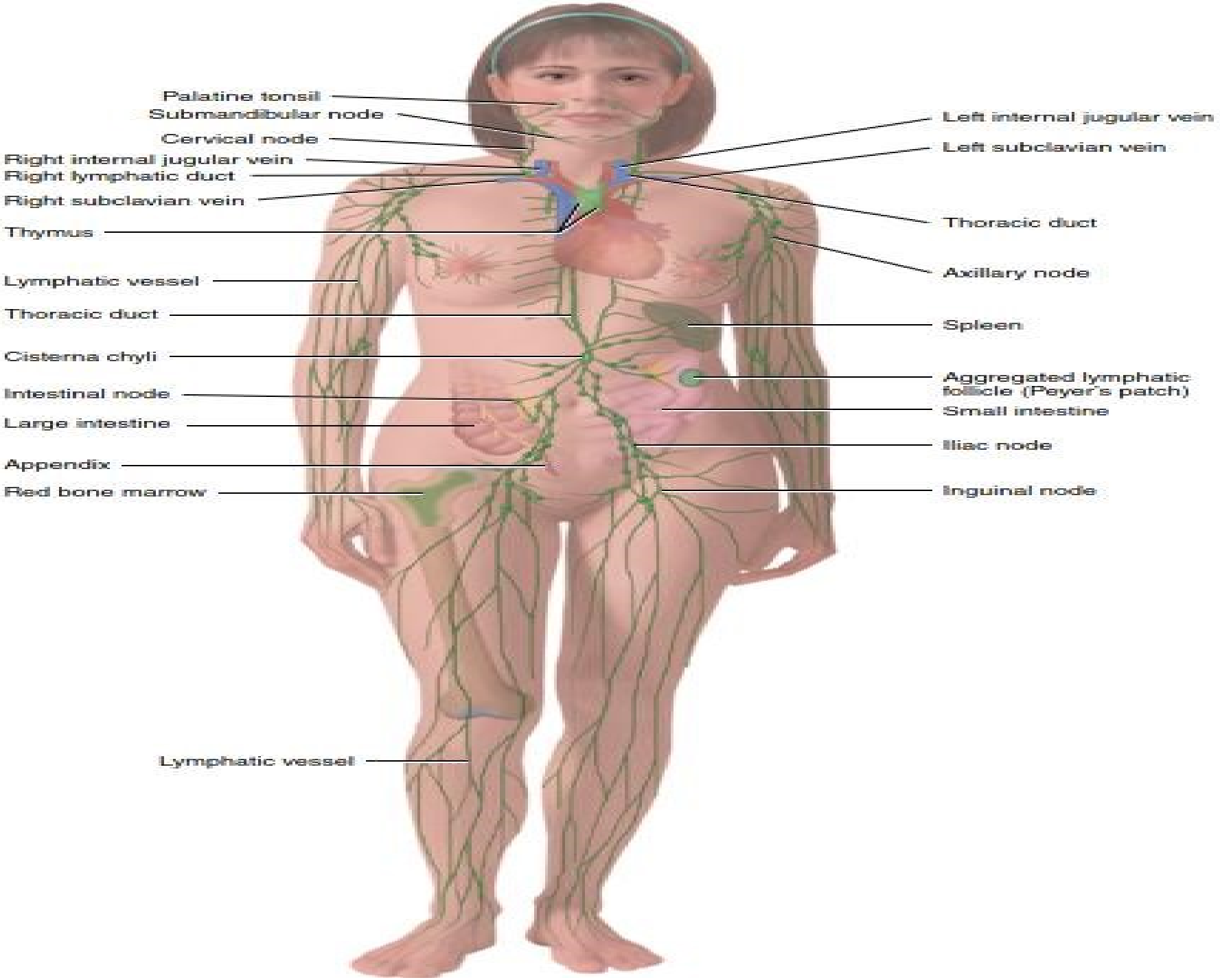
- the lower limbs
- the digestive tract
- the left arm
- the left side of the thorax, head and neck

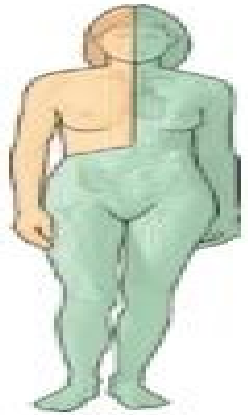
.

The other large lymph vessel, **the right lymphatic duct**, receives lymph from:

- the right arm
- the right side of the head, neck and thorax.

The two lymph ducts then empty into the great veins in the neck, thus restoring fluid and proteins to the venous circulation.





Areas drained by right lymphatic and thoracic ducts

Area drained by right lymphatic duct

Area drained by thoracic duct

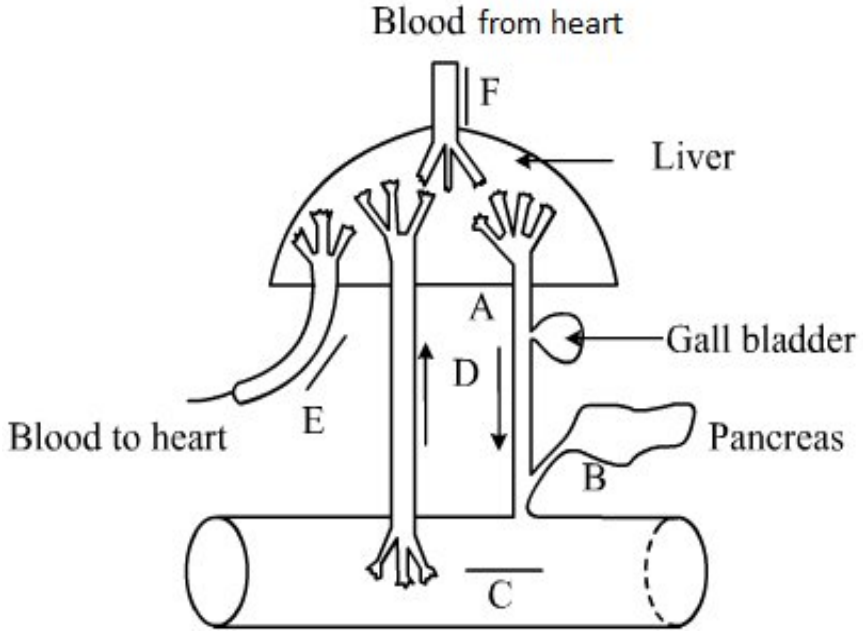
Lymph

Lymph is a clear, yellow-colored extra interstitial fluid. It is similar to highly filtered plasma in composition with fewer plasma proteins and abundant leukocytes (lymphocytes and macrophages).

Lymphoid Circulation

Lymph circulates through the lymphatic vessels. Lymph circulation is a unidirectional process i.e. unlike blood circulation lymph only circulates from body tissues to the heart. Similarly, there is no pumping organ like a heart for powering lymph circulation. The pressure generated by the smooth muscle contraction of lymphatics and the movement of organs and tissues forces the movement of lymph inside the lymph vessels. There are several valves to prevent the backflow of the lymph.

THANK YOU!


Blood from heart
F
Liver
A
Gall bladder
D
Blood to heart
E
Pancreas
B
C