

# **The Lymphatic System**

Descriptive Histology 272

10 Nov. 2019

# The Lymphatic System

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- ▶ **Consists of two semi-independent parts**
  - ▶ Lymphatic vessels
  - ▶ Lymphoid tissues and organs
- ▶ **Lymphatic system functions**
  - ▶ provides a route for excess interstitial fluid ("lymph") to return to the blood.
  - ▶ Play essential roles in body defense and resistance to disease

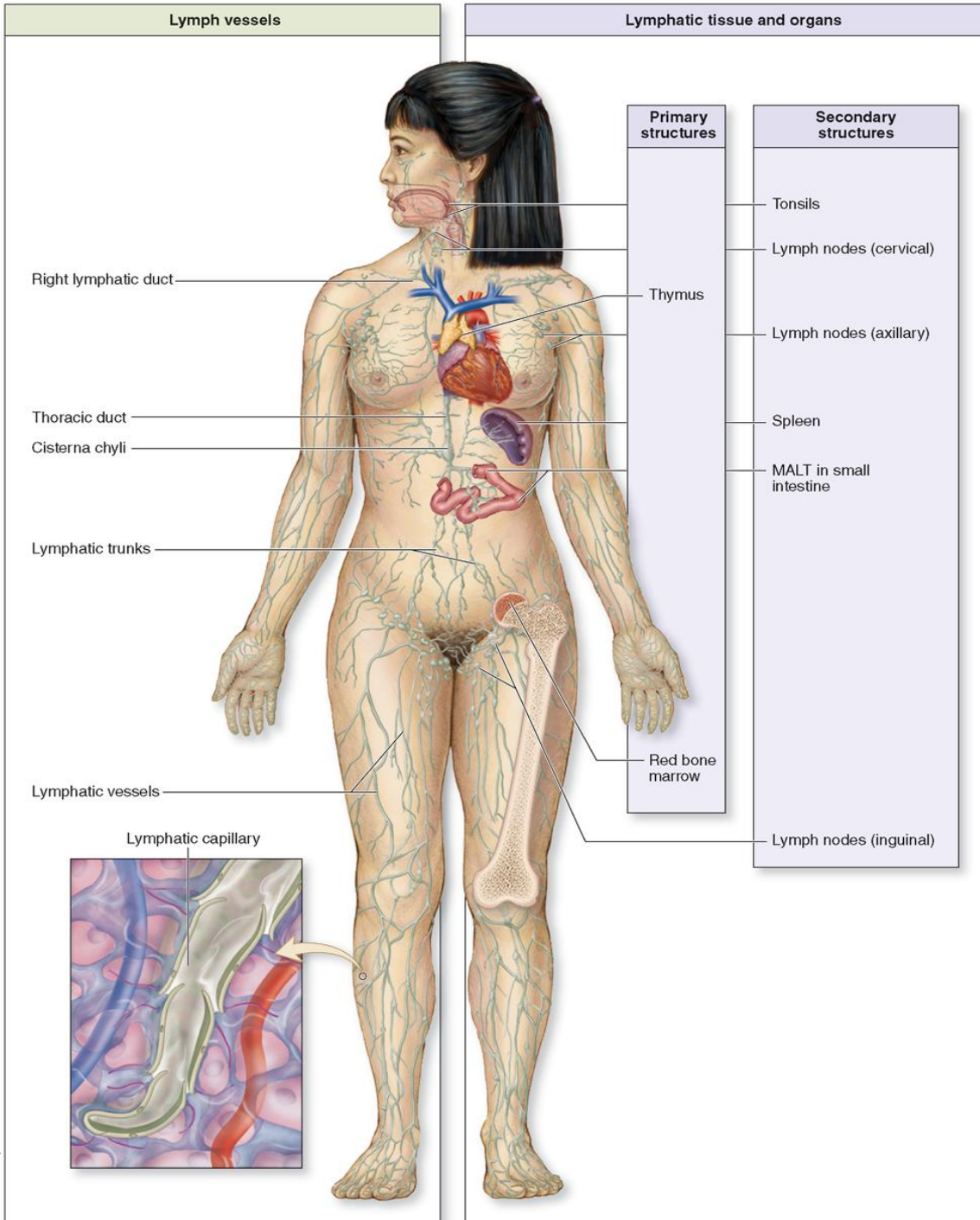


# Lymphatic system

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- ▶ **Primary lymphoid organs** (the thymus and bone marrow), where lymphocytes are formed initially
- ▶ **Secondary lymphoid organs** (the lymph nodes, the spleen, and diffuse lymphoid tissue found in the mucosa of the digestive system, including the tonsils, Peyer patches, and appendix).





# Lymphatic System Function

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Lymphatic System which consists of vessels and organs plays **two vital roles** in our lives:

- 1) The vessels: maintain interstitial fluid levels by carrying excess fluids and any plasma proteins, back into the blood circulation.
- 2) The organs: house for critical immune cells such as lymphocytes which carryout our **body defense against infection and disease as well as offer adaptive immunity** .



<http://www.youtube.com/watch?v=Kh-XdNnTZUo>

<http://www.youtube.com/watch?v=EEP0PYEWcwU>



# Lymphatic Characteristics

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- ▶ **Lymph** – excess tissue fluid carried by lymphatic vessels ( general definition)
- ▶ **Properties of lymphatic vessels**
  - ▶ One way system toward the heart
  - ▶ No pump
  - ▶ Lymph moves toward the heart
    - ▶ Milking action of skeletal muscle
    - ▶ Rhythmic contraction of smooth muscle in vessel walls



# Composition of Lymph

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- ▶ Lymph is usually a clear, colorless fluid, similar to blood plasma but low in protein
- ▶ Its composition varies from place to place; after a meal, for example, lymph drained from the small intestine, takes on a milky appearance, due to lipid content.
- ▶ Lymph may contain macrophages, viruses, bacteria, cellular debris and even traveling cancer cells.



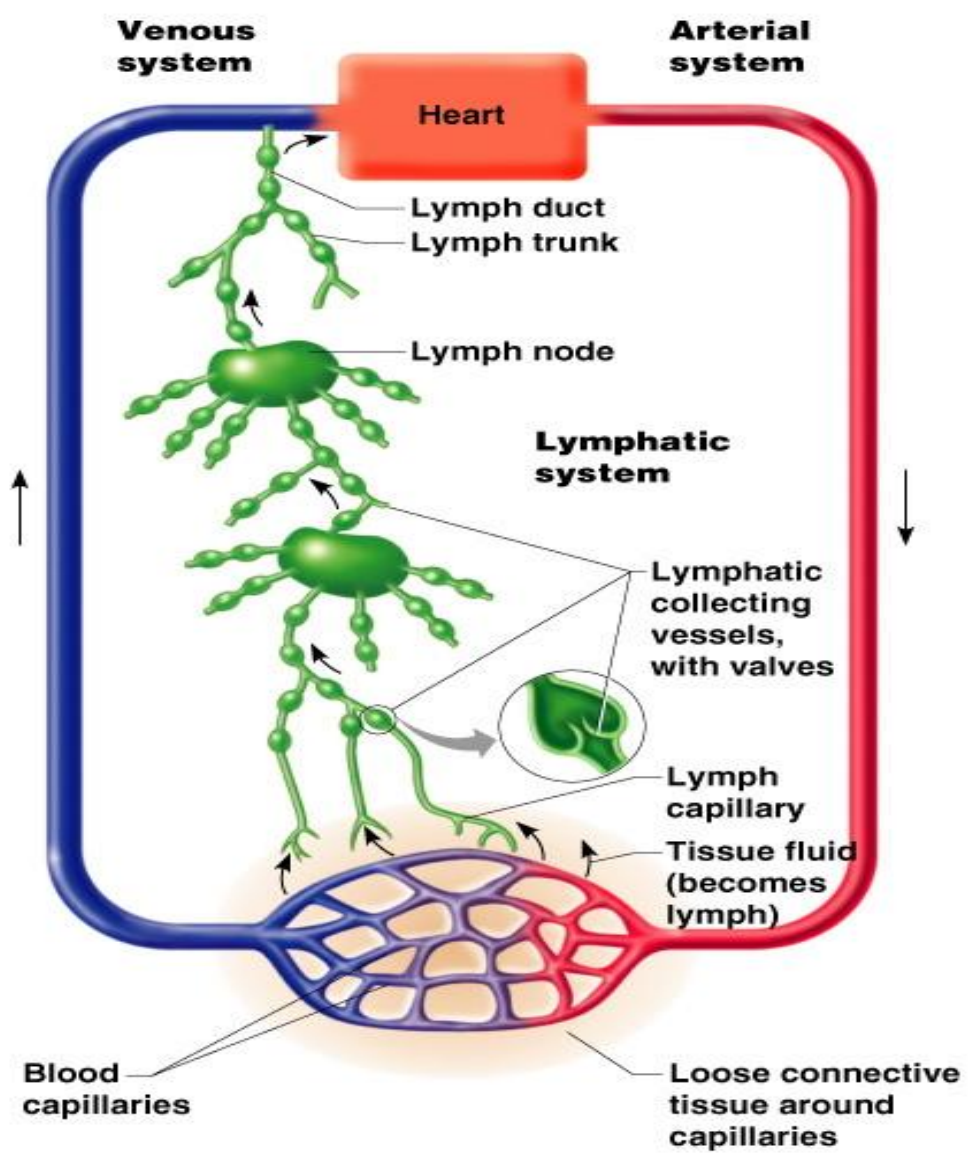


# Edema

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- ▶ **Edema is the excess accumulation of fluids in tissue spaces.**
- ▶ Anything that causes increased capillary pressure, such as decreased plasma protein, increased capillary permeability **or lymphatic blockage**, can result in swelling and congestion of the extravascular compartment.





# Lymphatic Vessels

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## Lymph Capillaries

- ▶ Walls overlap to form flap-like mini-valves
- ▶ Fluid leaks into lymph capillaries
- ▶ Capillaries are anchored to connective tissue by filaments
- ▶ Higher pressure on the inside closes minivalves



# Lymphatic Vessels

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- ▶ The vessels are called **lymphatics**.
- ▶ They are thin-walled and are comparable to veins.
- ▶ Small lymphatics are similar to capillaries only more porous; Larger vessels are called collecting vessels:  
both have valves.



# Lymphatic Vessels

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- 2 large Ducts: Right **Lymphatic duct** and **Thoracic duct**  
**(both empty into the Rt and Lt *subclavian veins*)**
- Lymph flows only **to the heart (one way)**.
- This is a **low-pressure, pump-less system**.
- Lymph moves via skeletal muscles and pressure changes in thorax during breathing only.

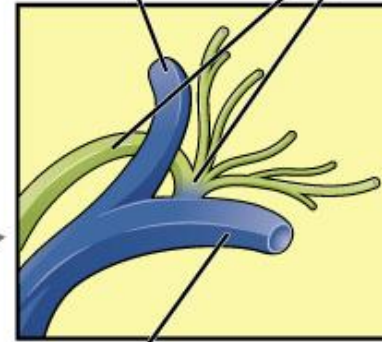
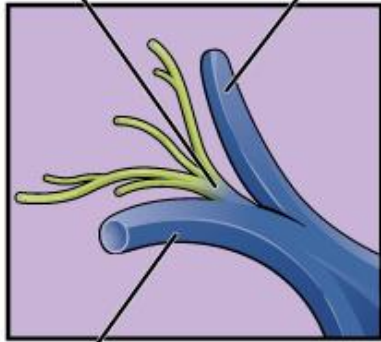


Right lymphatic duct

Right internal jugular vein

Left internal jugular vein

Thoracic duct drains into subclavian vein



Right subclavian vein

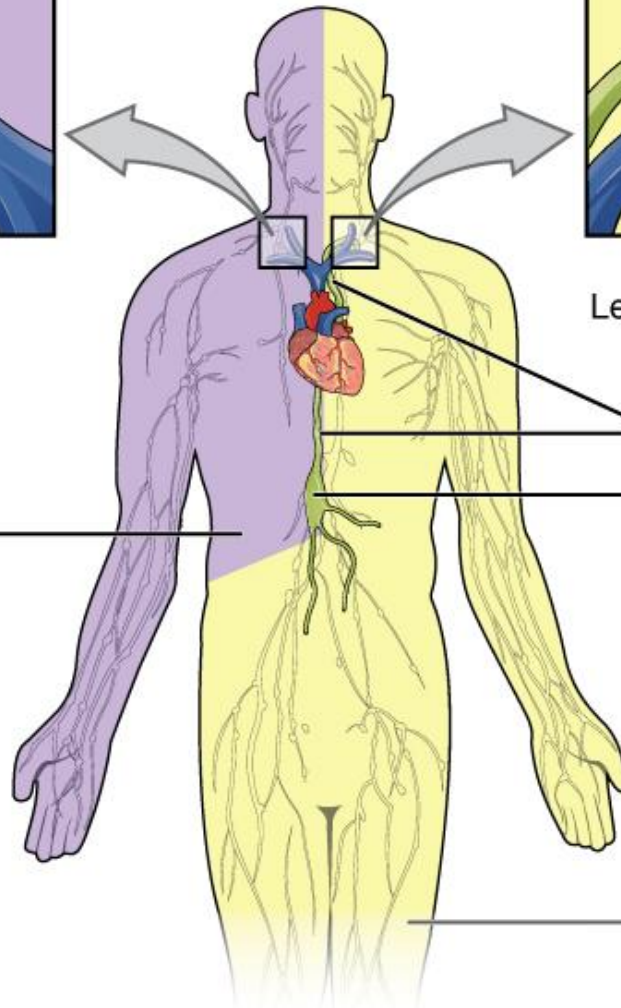
Left subclavian vein

Drained by right lymphatic duct

Thoracic duct

Cisterna chyli of thoracic duct

Drained by thoracic duct



# Lymph Carries ...

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- ▶ Harmful materials that enter lymph vessels
  - ▶ Bacteria
  - ▶ Viruses
  - ▶ Cancer cells
  - ▶ Cell debris



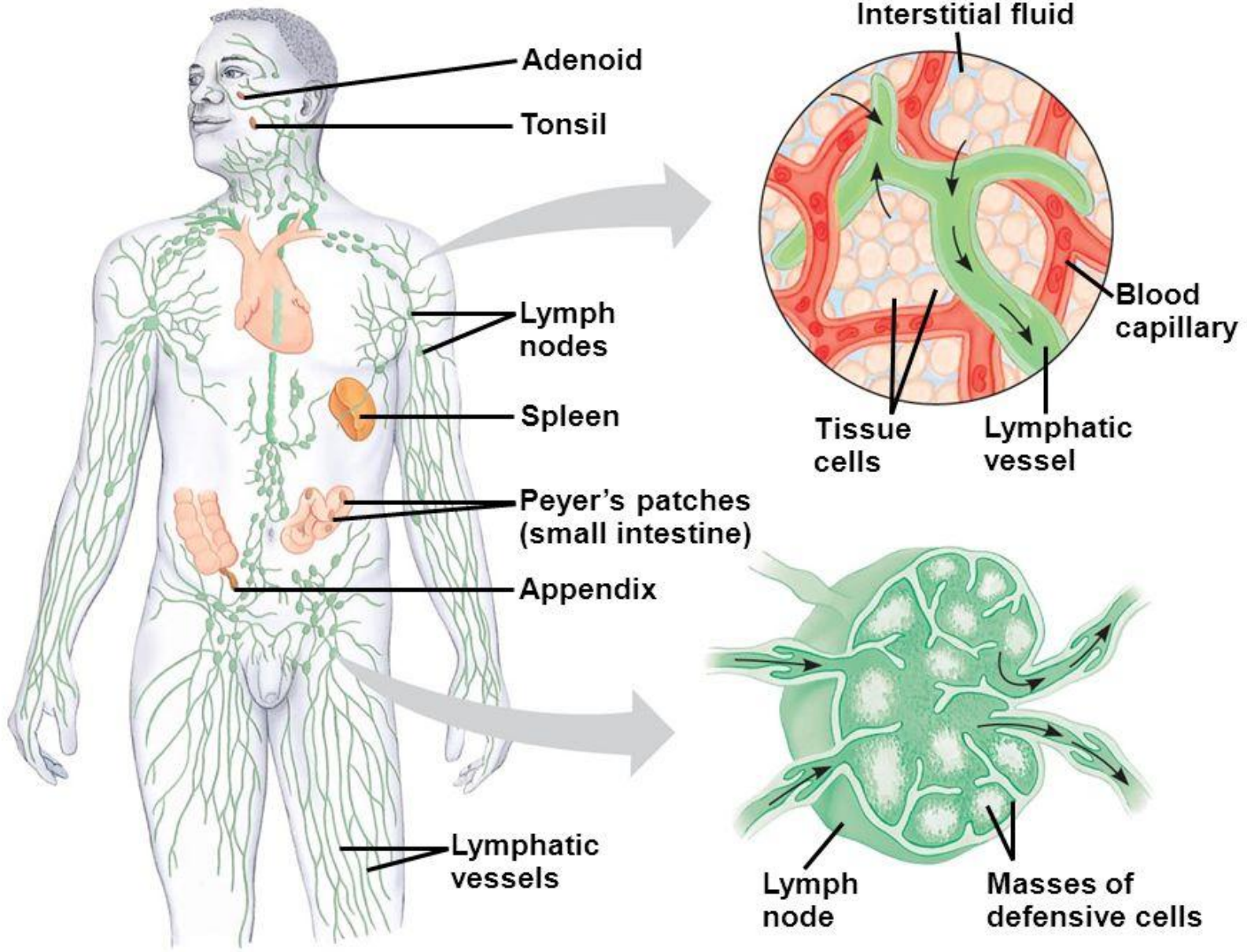
# Lymphatic Organs

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- ▶ **Lymph Node-** Important lymphocytes of the immune response are matured here.
- ▶ **Spleen:** destroys RBCs and Reservoir of Blood; **It is the largest** Lymph organ and it filter blood of bacteria and antigen-filled cells.
- ▶ **Thymus Gland:** produces hormone, ***thymosin***, functions in **programing** lymphocytes T and B cells; T cells matured here (become immunocompetent)
- ▶ **Tonsils:** Traps bacteria and other microbes in throat.
- ▶ **Peyer's Patch:** capture and destroy bacteria in intestine, thereby preventing them from penetrating the intestinal wall.







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# Lymph Nodes

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- ▶ Lymph Nodes take the germ-filled lymph and filter it before it is returned to the blood
- ▶ Defense cells within lymph nodes
  - ▶ Macrophages – engulf and destroy foreign substances
  - ▶ Lymphocytes – provide immune response to antigens

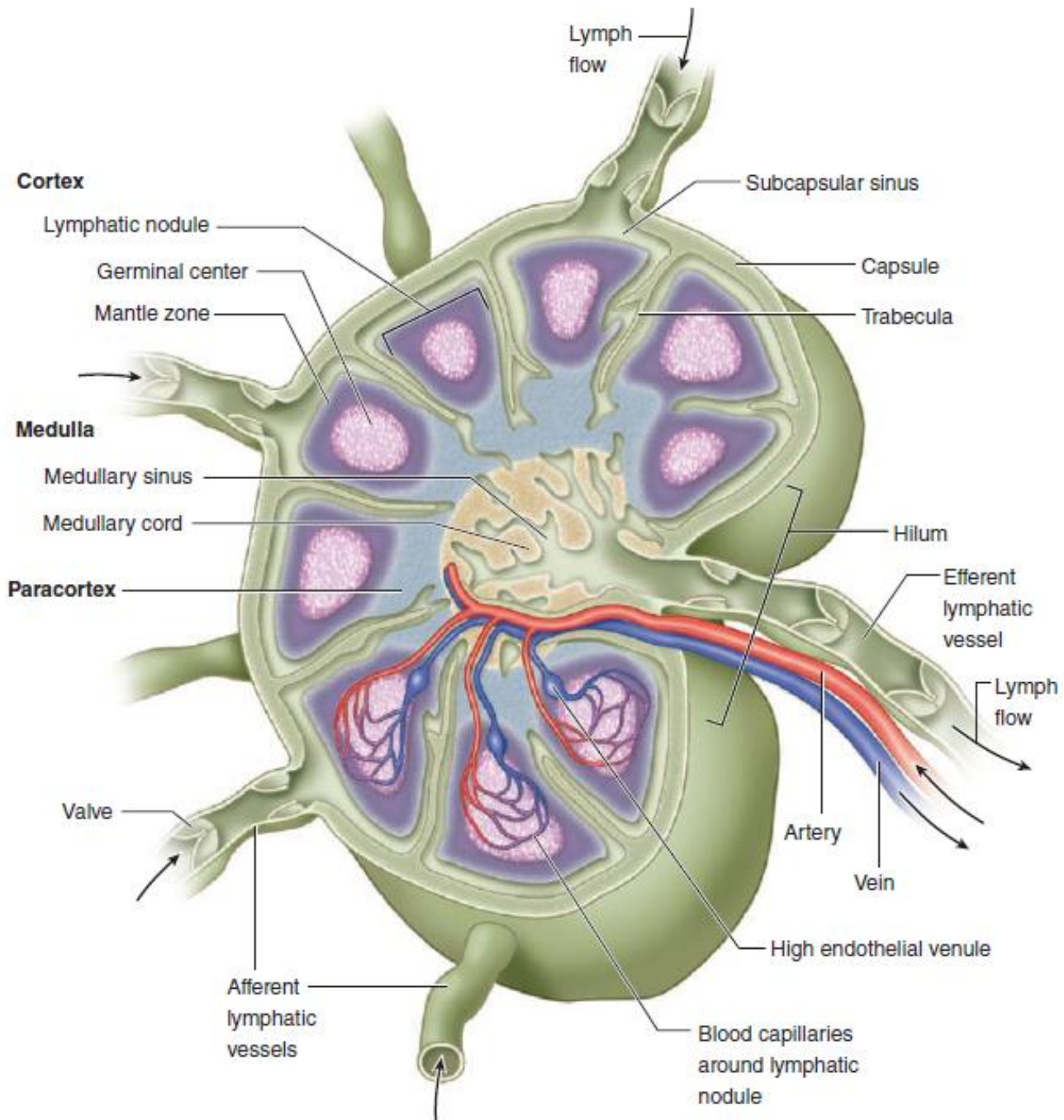


# Lymph Node Structure

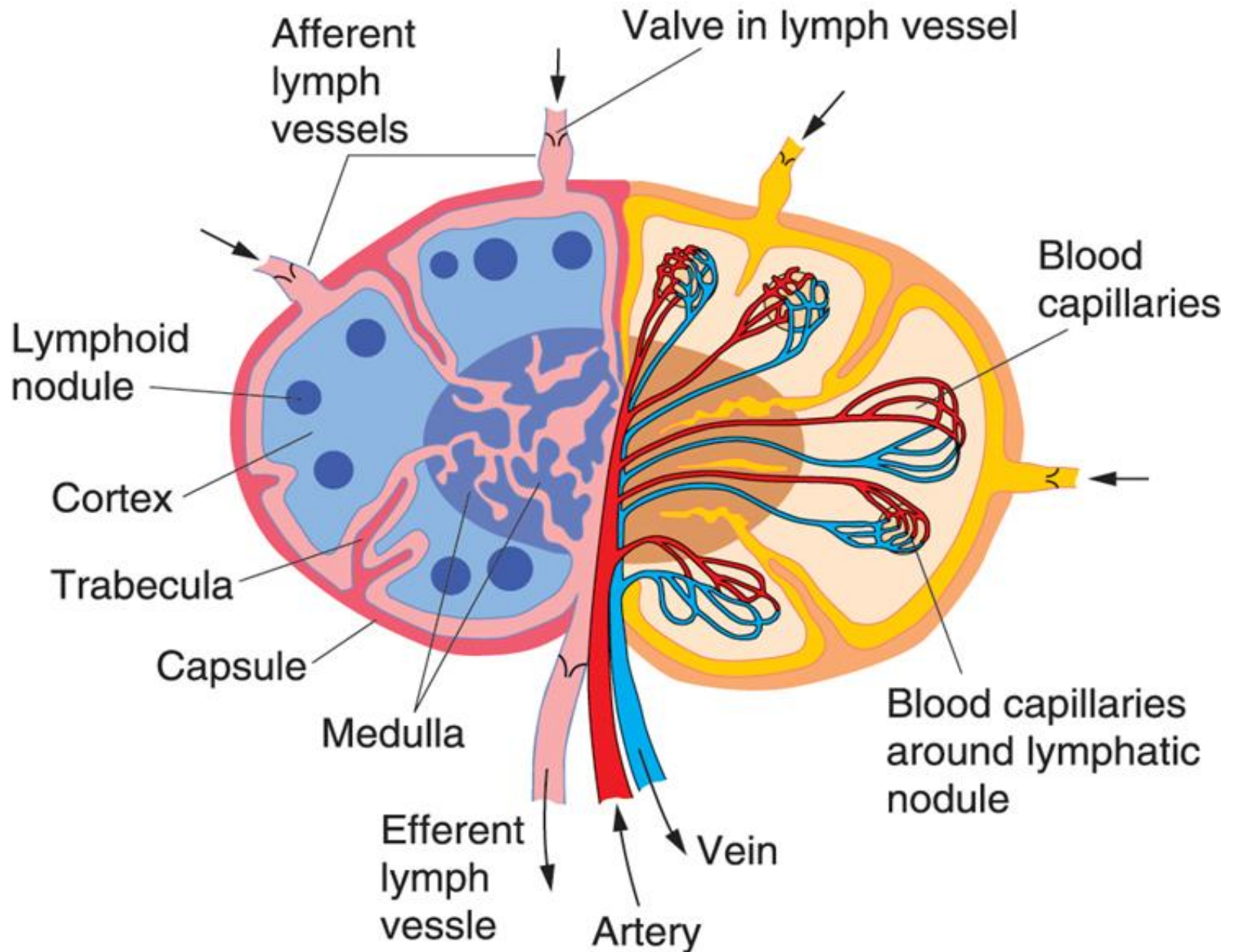
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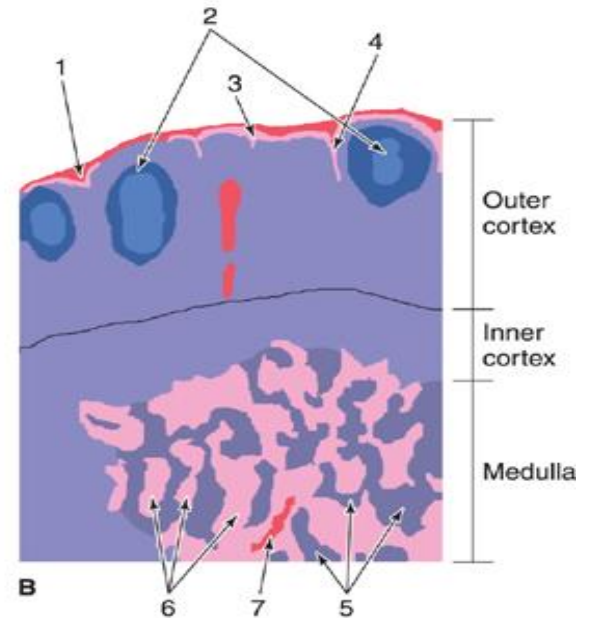
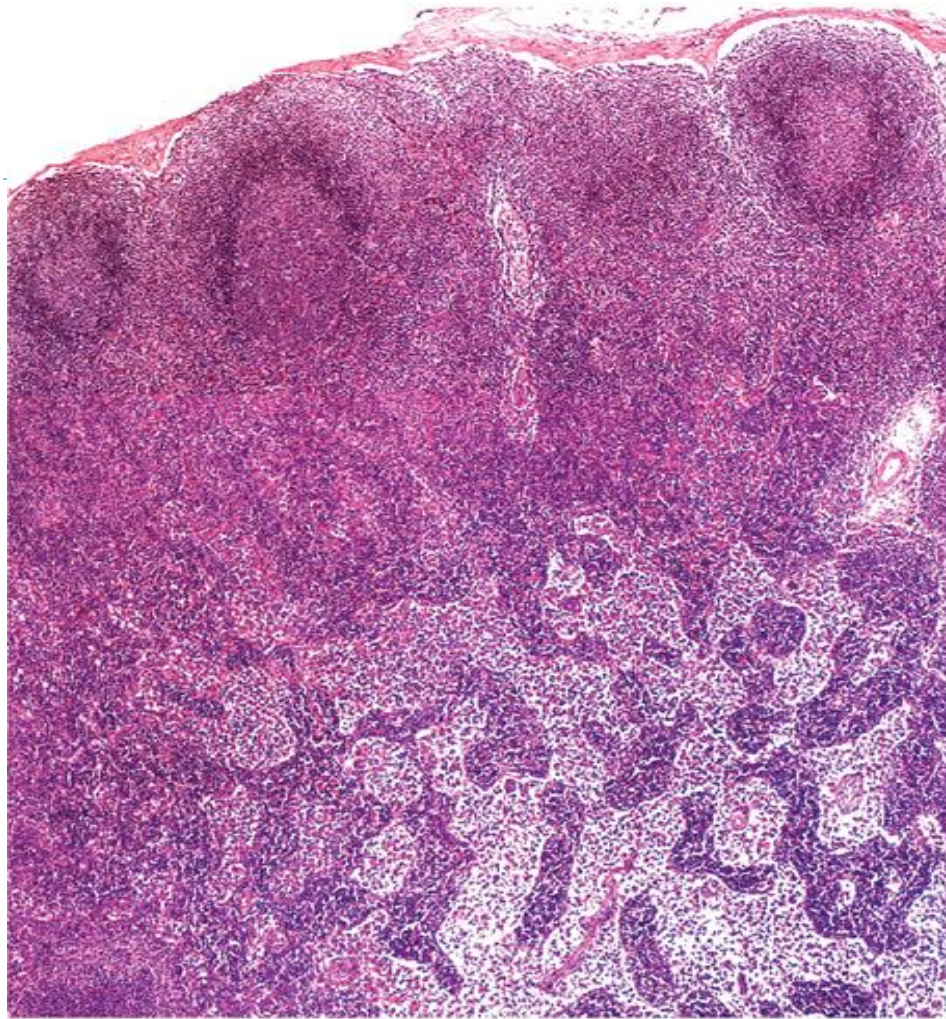
- ▶ Most are kidney-shaped, less than 1 inch long
- ▶ **Cortex**
  - ▶ Outer part
  - ▶ Contains lymphoid nodules (follicles) collections of lymphocytes
- ▶ **Medulla**
  - ▶ Inner part
  - ▶ Contains phagocytic macrophages











**A**  
**A:** Section of a lymph node showing the cortex and the medulla and their primary components. **B:** (1) Capsule; (2) lymphoid nodule with germinal center; (3) subcapsular sinus; (4) intermediate sinus; (5) medullary cords; (6) medullary sinus; (7) trabecula. H&E stain. Low magnification. (Courtesy of PA Abrahamsohn.)

# Thymus Gland

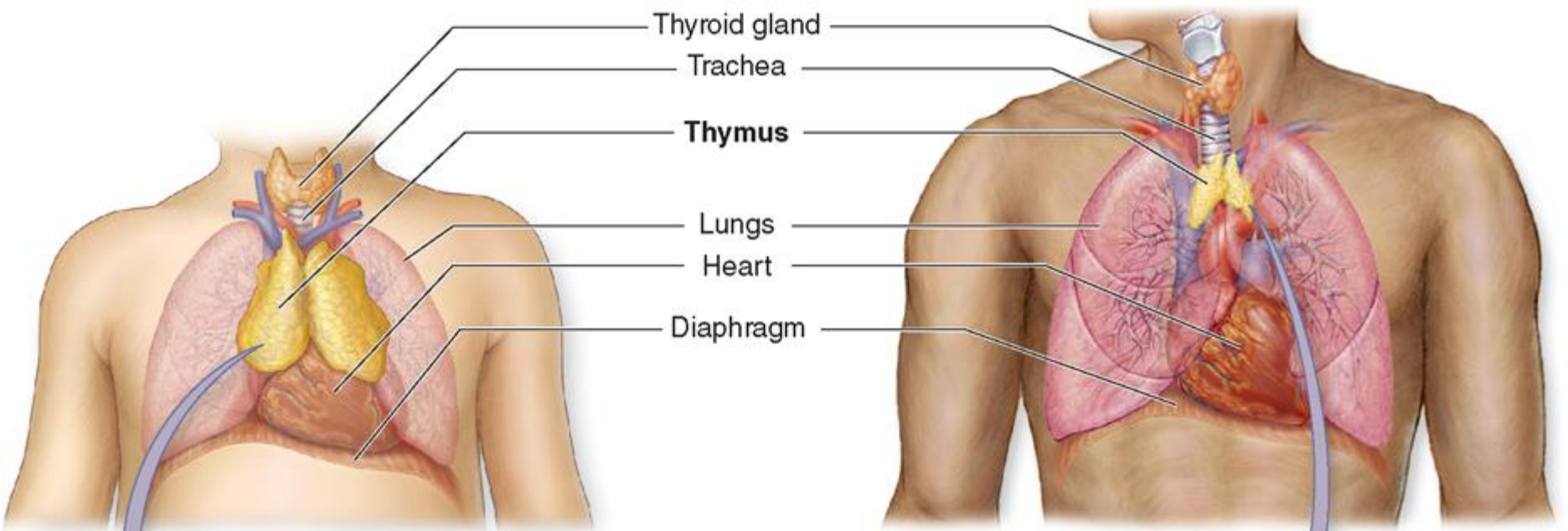
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Histologically, each lobe of the thymus is subdivided by collagenous septa into lobules. Each lobule consists of

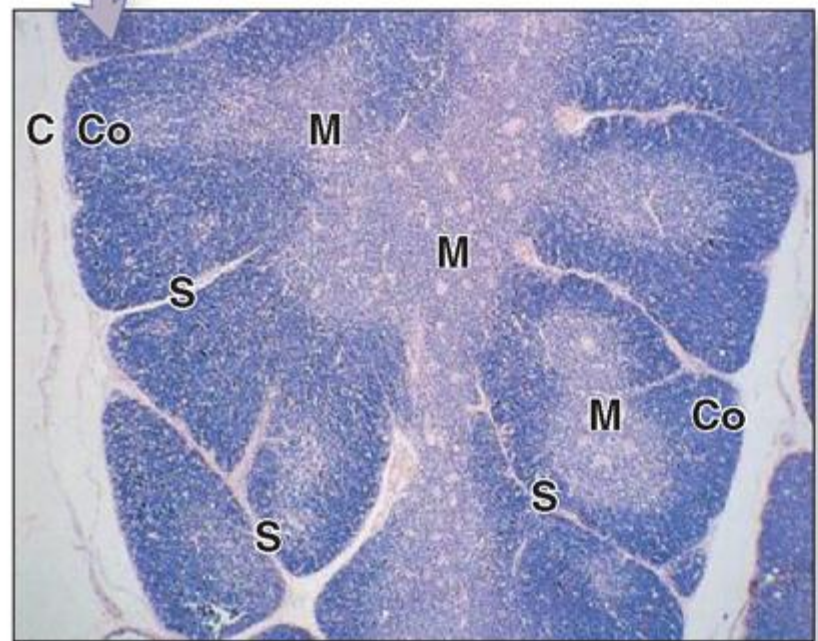
- ▶ **Peripheral cortex** composed of lymphocytes
  - ▶ **Medulla lacking lymphocytes** but containing glandular tissue.
  - ▶ Thymic hormones produced by the medulla to regulate the differentiation of T lymphocytes, for example, thymosin and thymopoietin.
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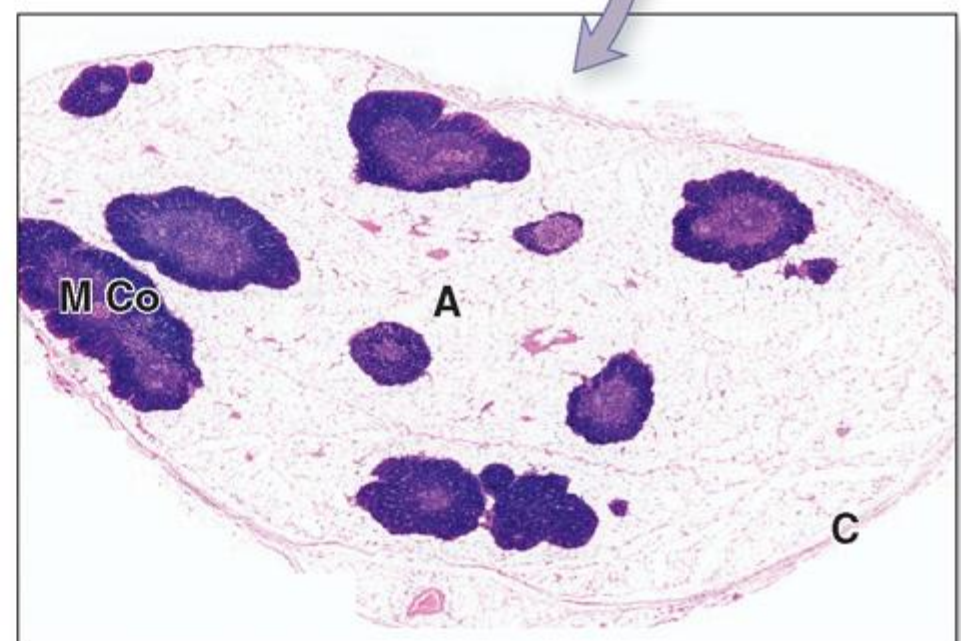




**a Child (left) and adult (right) thorax, anterior view**



**b Micrograph of child's thymus**



**c Micrograph of adult's thymus**

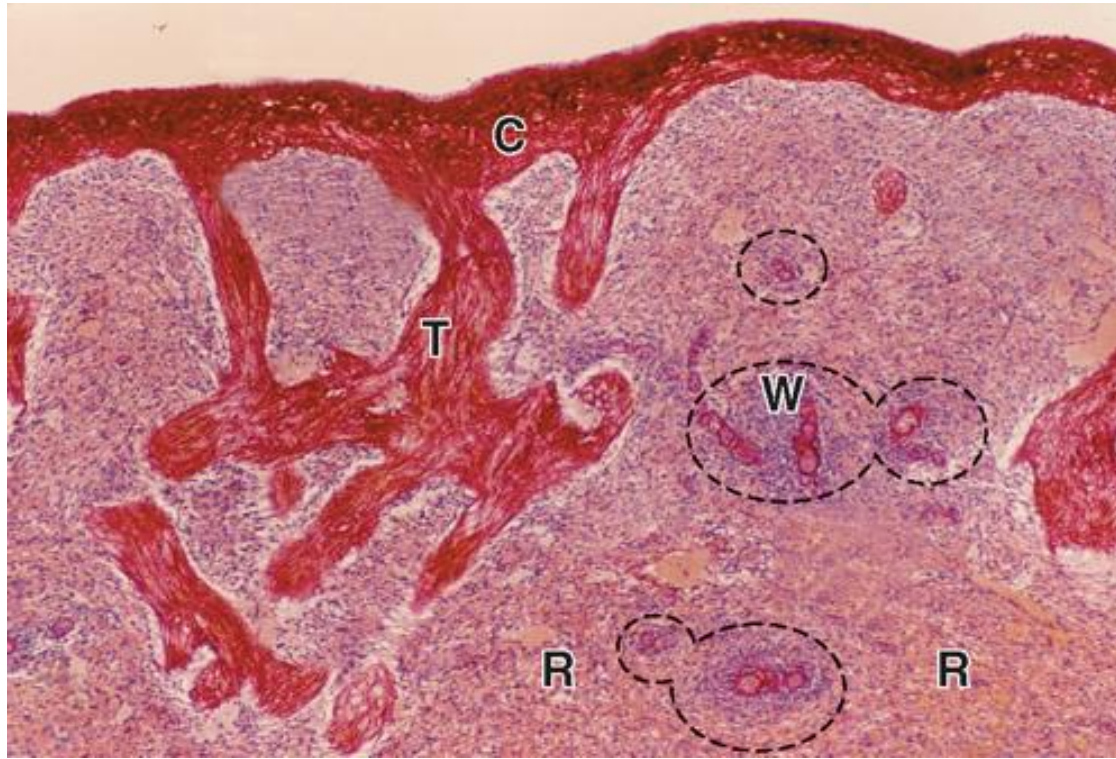


# Spleen

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- ▶ **Filters blood** of bacteria, viruses and other debris
  - ▶ Destroys worn out blood cells. It then returns (or recycles) some of the breakdown products of RBCs to the liver ..for example Fe, so that more RBCs can be made. The unusable portion of worn-out blood is excreted in bile.
- ▶ Another function: **Stores platelets** and acts as a blood reservoir.
- ▶ Lymphocytes are produced; RBCs also made in **fetus only**.





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; white pulp is lymphoid tissue. Large blood vessels and lymphatics enter and leave the spleen at a hilum.



<http://www.youtube.com/watch?v=yvhU2UyRv-Q>

