Histology of the Lymphatic System

Lymphatic System

- Consists of lymphatic organs, tissue, cells, lymph, and lymph vessels
- It is a part of the immune system
- Organs include:

  Thymus

  Tissues in the form of MALT → mucosa associated Lymphatic tissue like RS

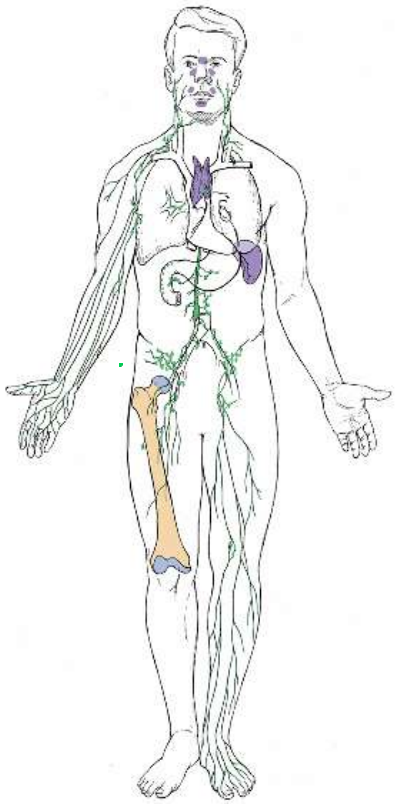
  Tonsils

  Peyer patches → in ileum

  Appendix →

  Lymph nodes

  Spleen

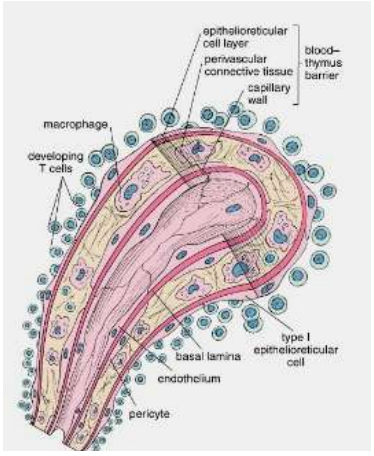


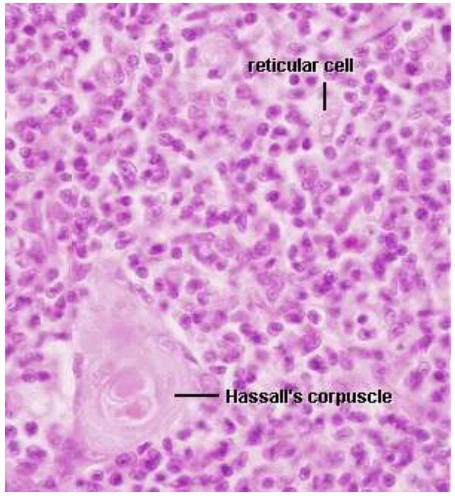
Thymus Gland

- Location
- Development and Growth
- Structure

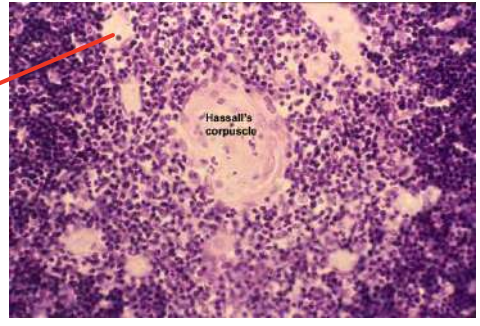
1. Capsule and lobules
2. Cortex (T-Cell precursor (lymphoblast), Reticuoepithelial cells, abundant Macrophages)
3. Medulla (mature T-Cells, Hassall corpuscles)
4. Thymic blood barrier

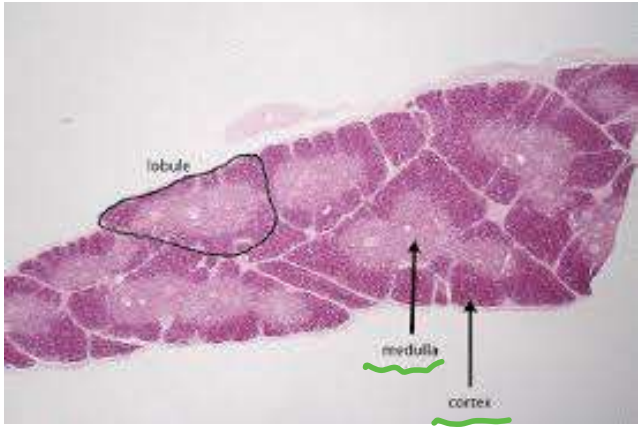
cause the dark color of the cortex





This wight color because of reticuoepithelial cells





- Location : in the mediastinum , retrosternally
- Development : from the third pharyngeal pouch
- growth :
  - grows rapidly during childhood and reaches maximus size during puberty
  - After puberty , the thymus gradully replaced by adipose tissue

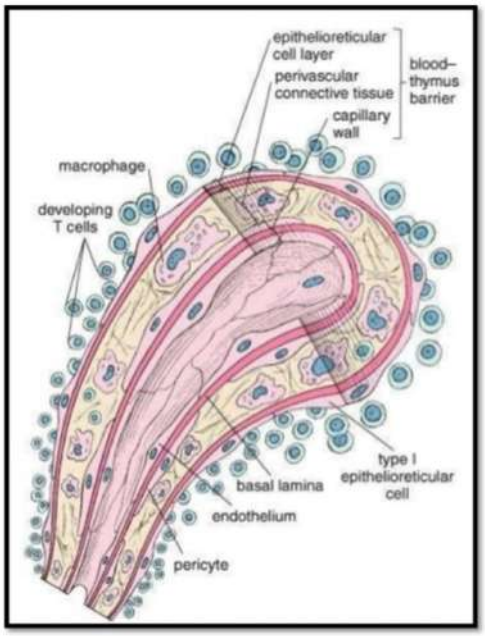
- structure :
  - bilobed , each lobe is coverd by a CT capsule
  - each capsule separated by trabecula
  - each parenchyma contain dark (cortex) and lighter (medulla) area
  - blood supply reach through the septa (trabeculae) between each lobules

- cortex is darker becaus of T-cell precursor and (nucleus of lymphoblast)

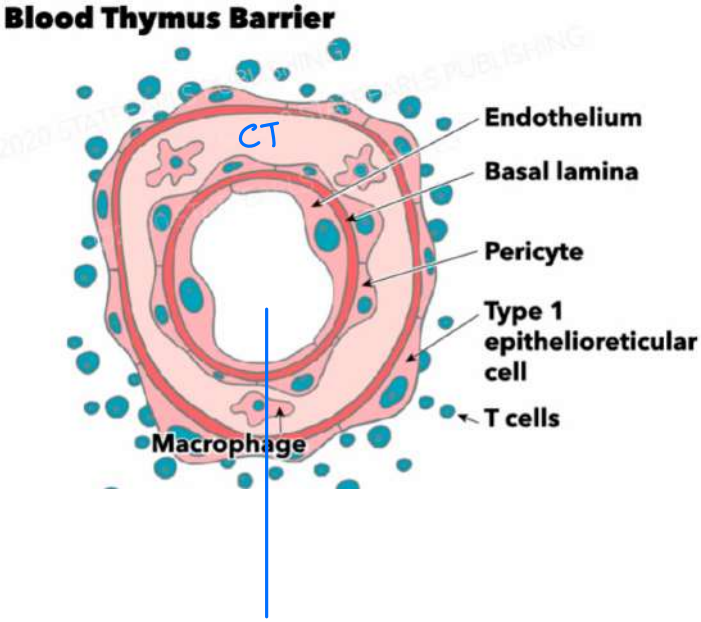
- when T-cells become mature (just 2% will reach maturity) they will inter medulla (98% will die) → the medulla color is lighter

- Hassall's corpuscels : unige structures found in the medulla , These structures are composed of concentric layers of epithelial cells and are involved in the maturation and selection of T-lymphocytes within thymus

longitudinal section



cross section



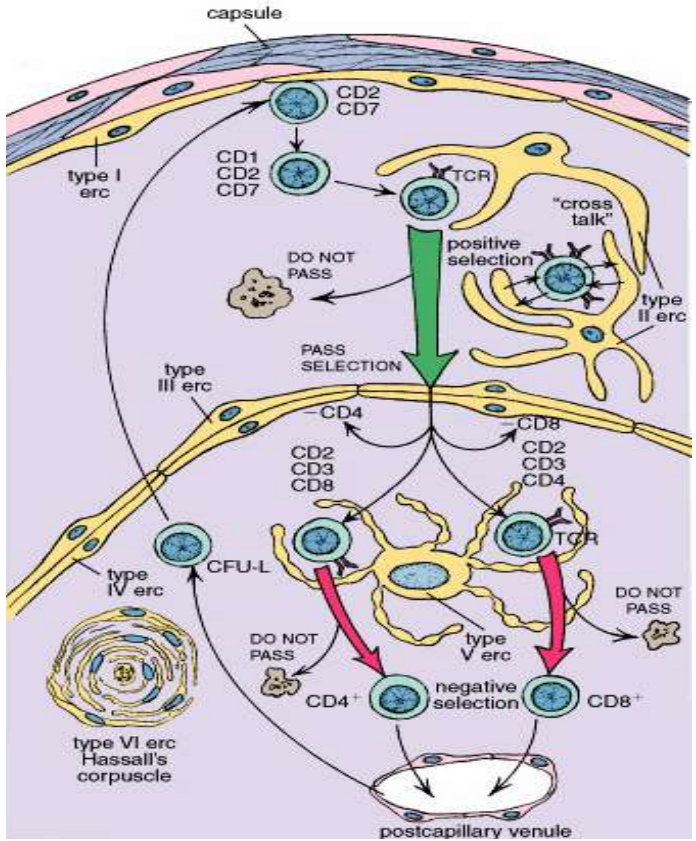
- immature T-cells come from this capillary and inter the thymuc parenchyma

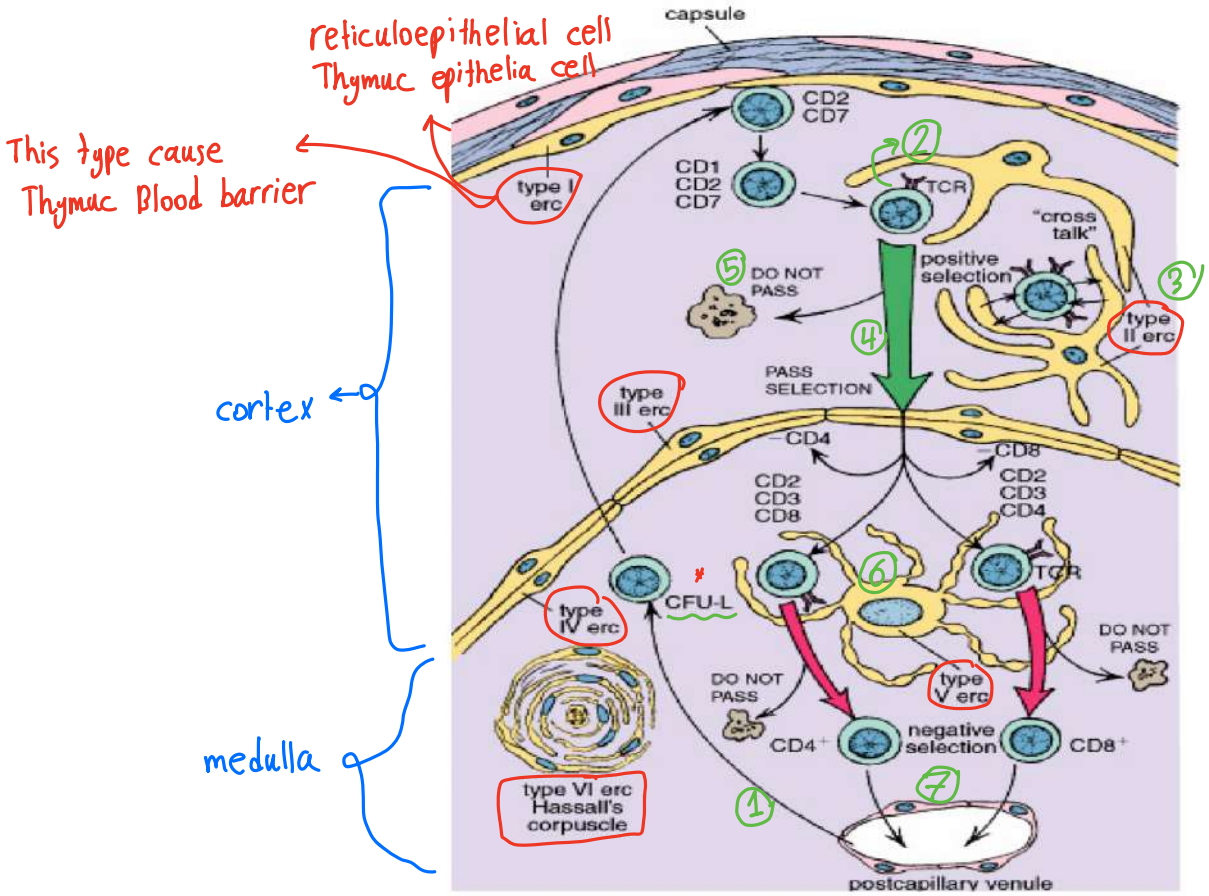
1) bass from the endothelial lining of the capillary
2) then throgh basement membrane of the capillary
3) then the cytoplasm of pericytes outside the capillary
4) then the CT of the thymas
5) then cytoplasm of reticuloepithelial cells
6) then the parenchyma of thymas

- It leaves the capillary throgh post-capillary venule

T-Cells Differentiation

- It is the site of terminal differentiation, maturation, and selection of T-lymphocytes
- No receptors on the cell surface of precursor cells
- In the cortex, they divide by mitosis and present to MHC molecules on thymic epithelial cells (TECs).
- Cells that interact with MHC molecules will survive (+ve selection) and pass to the medulla, others will die by apoptosis and will be eliminated by macrophages





① .entrance of the immature T-cell
CFU-L → coloni forming unit-Lymphocyte,
this is resources of T-cell from bone marrow
.These cells don't carry any type of receptors

② T-cells start requiring receptors (TCR = T cell receptor)

③ Thymuc epithelial cells type ② have Major histocompatibility molecule (MHC), so T-cells that possess receptors will interact with those molecules

④ Those cells that possess receptors will pass to medulla to continue differentiation → This process called positive selection

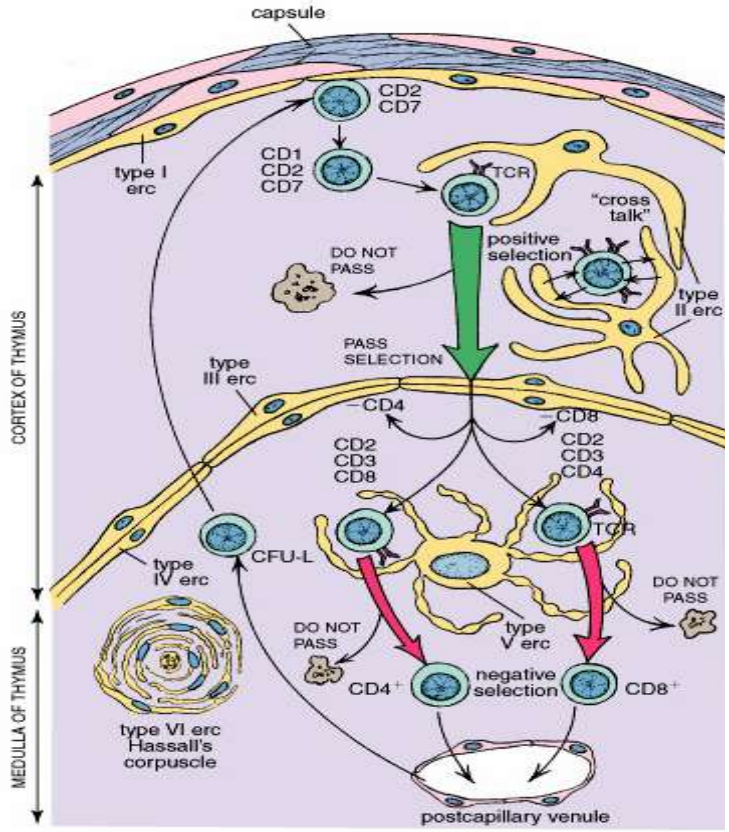
⑤ Those who don't possess receptors will not pass and will be eliminated

⑥ .The (TECs) type v have also (MHC) but with self antigens → negative selection
• if CD4, CD8 cells recognise the self antigens that mean that those cells recognise the self-antigen as non-self, and that is wrong, so they will get eliminated ☹

⑦ mature cells will leaves to circulation

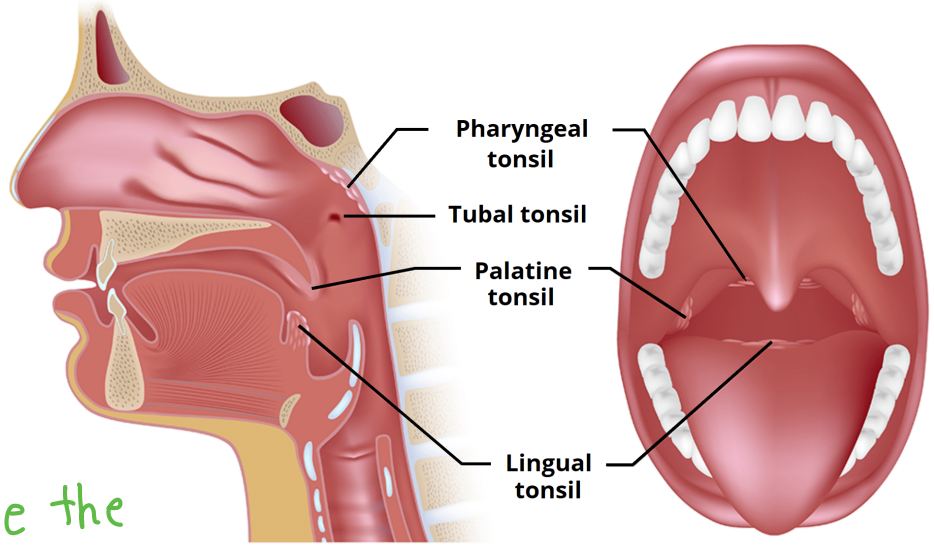
T-Cells Differentiation Cont.,

- In the medulla, cells are attached to self-antigens bound to class I and II MHC on the surface of TECs, dendritic cells, and macrophages, if accepted they will die (-ve selection) and other cells will continue the maturation
- Positive and negative selections
- Mature T-cells with receptors leave the thymus via capillaries or efferent lymphatic



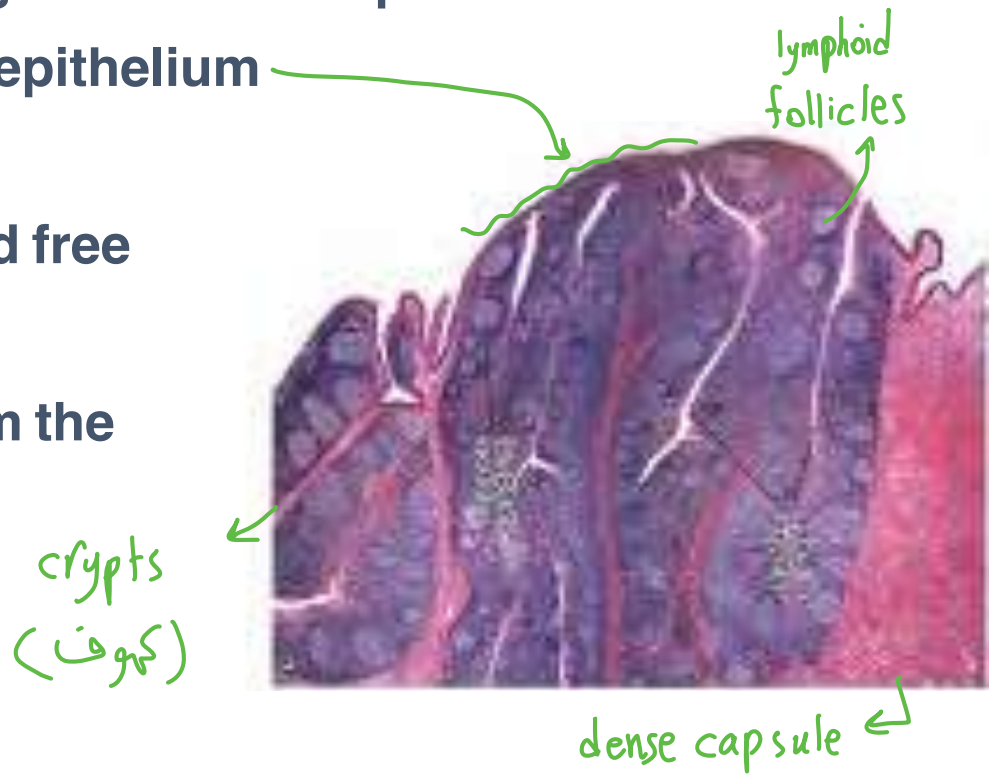
Tonsils

- They belong to MALT but considered organs because they are partially encapsulated
- Tonsils are covered by epithelium → stratified or pseudo stratified
- They include:
    1. Palatine tonsils
    2. Pharyngeal tonsils
    3. Lingual tonsils
    4. Tubal tonsils
- Waldeyer's ring
    - The cycle of those tonsils, they are the first line



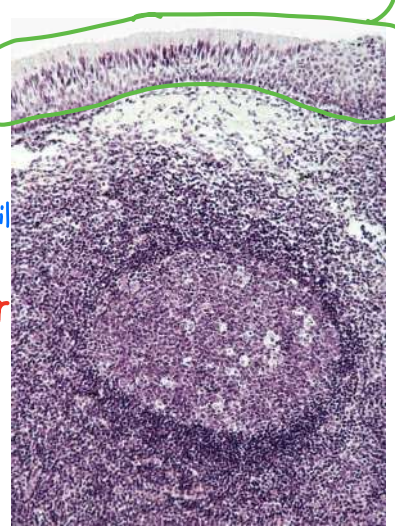
Palatine Tonsils

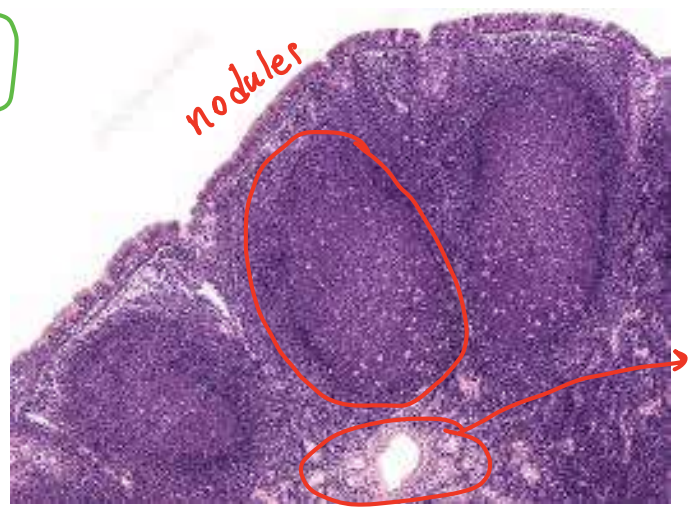
- A pair of them located in the oropharynx lodged between the palatoglossus and palatopharyngeus and the superior constrictor
- Covered by stratified squamous epithelium
- 10-20 crypts in each one
- A Sheet of lymphatic nodules and free lymphocytes below the mucosa
- A dense capsule separates it from the subjacent tissues



Pharyngeal Tonsil

- One in the nasopharynx covered by pseudostratified columnar epithelium
- Form a thin sheet of lymphoid nodules and diffuse lymphocytes
- No crypts → as we see, the epithelial membrane still continous (not separated)
- Very thin capsule
- Adenoid → inflammed pharyngeal tonsil

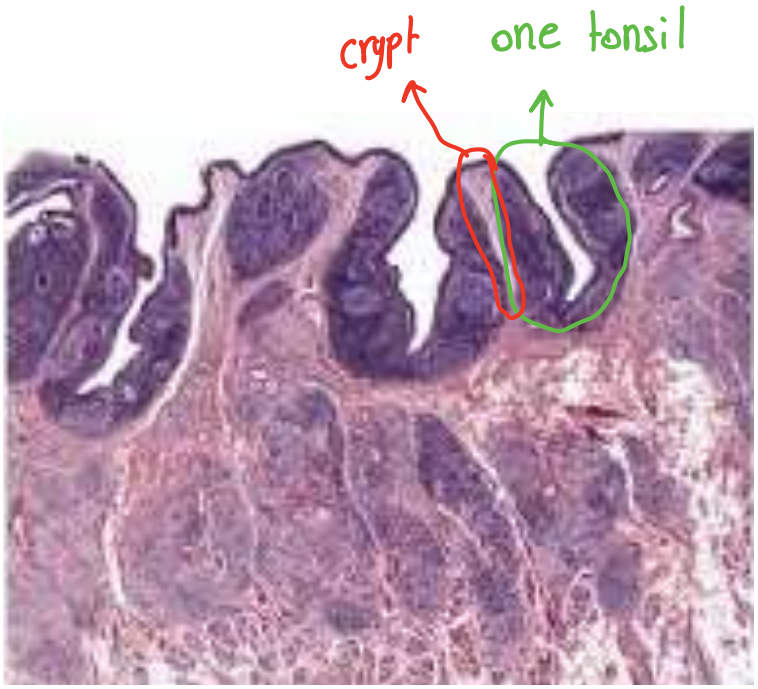




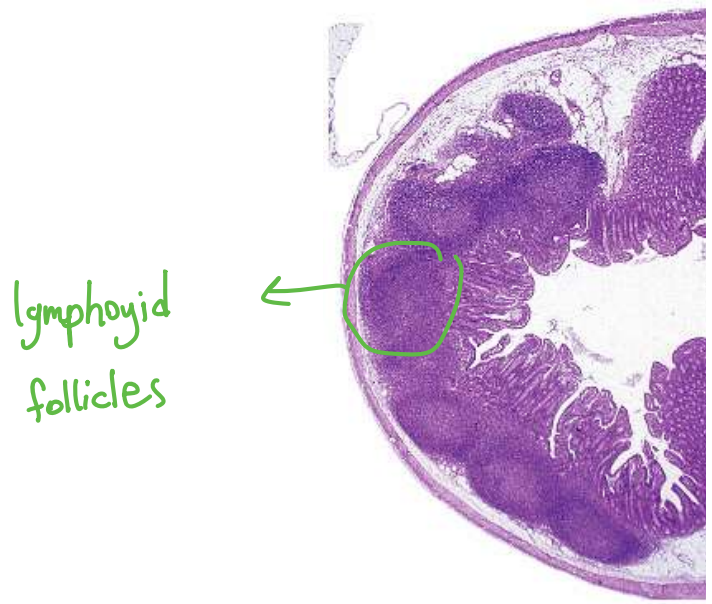
- in adult → atrophy and disappear
- in infants → some times maybe get hypertrophy lead to issues like congestion
- if infection still and cause hypertrophy (like staphyloccoccus infection) it is recommended to remove it

Lingual Tonsils

- They are multiple small ones at the base on the tongue
- Covered by stratified epithelium
- One crypt for each tonsil
- separated by dense connective tissue



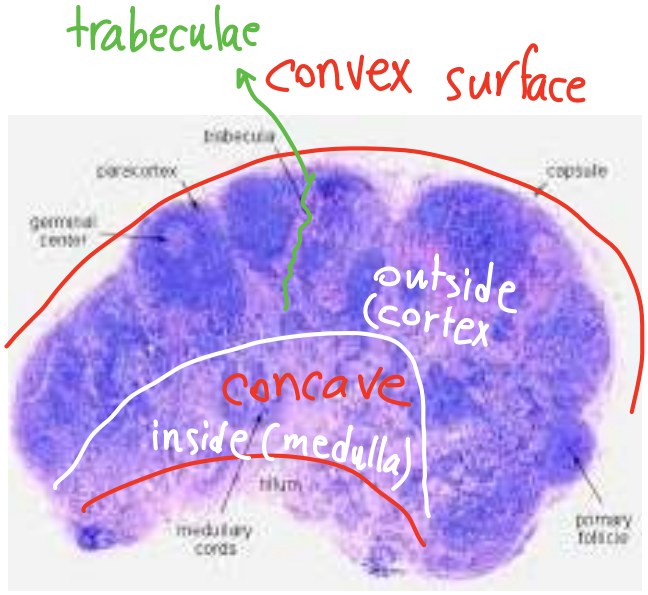
Appendix

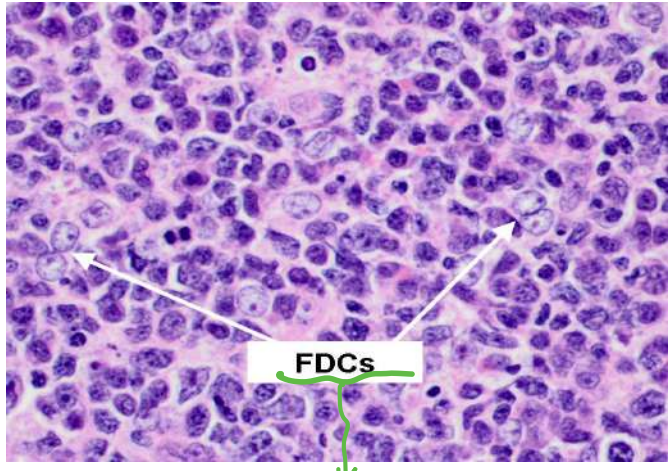


Lymph Node

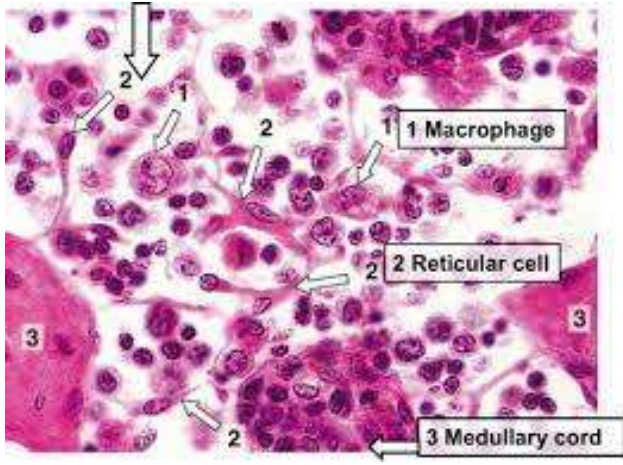
- Shape
- Structure
- Cortex
- Medulla
- Cells

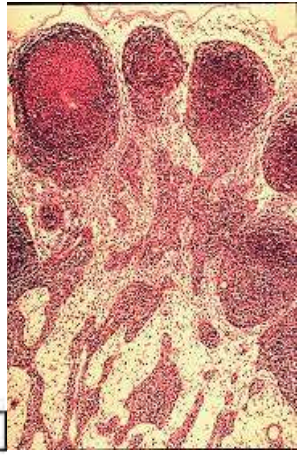
- there is dense connective tissue capsule that send trabeculae, those trabeculae divide it to outside and inside parts, outside has collection of lymphoid follicles, inside has tow parts: lymphocytes (dark), sinuses (light area)

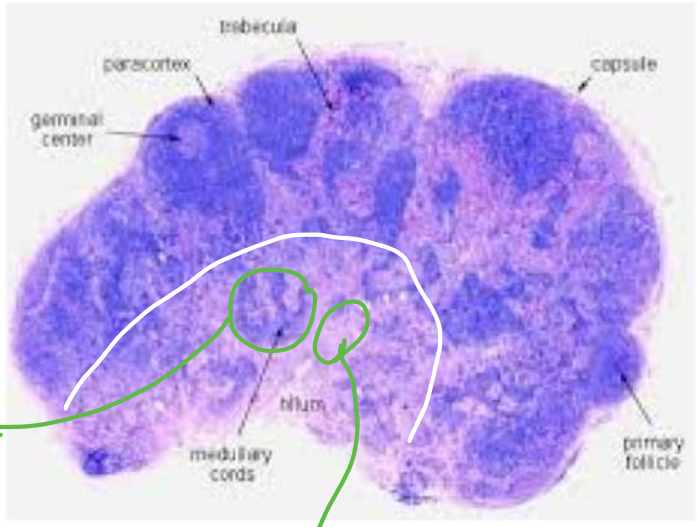




follicular dentritic cells



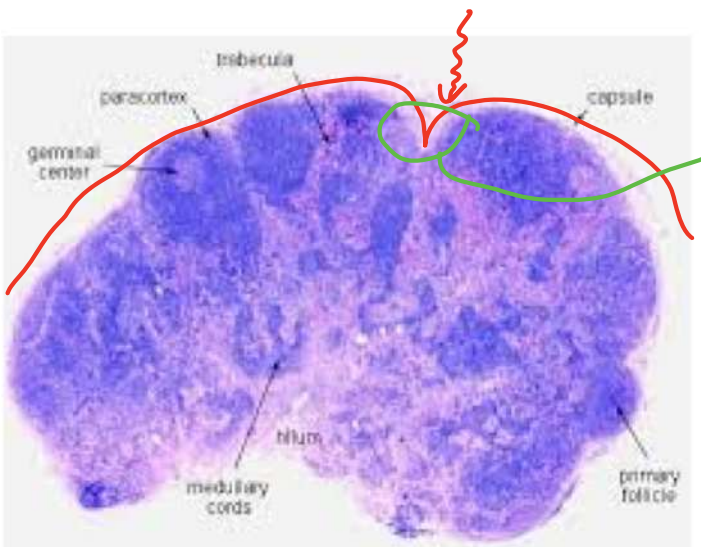




lymphocytes

sinuses

The convex surface of the lymph node receive affarent lymphatic vessel and that make other sinus under the capsule (sub-capsular sinus) and continue as trabecular sinuses, and they aggregate together to give medullary sinuses

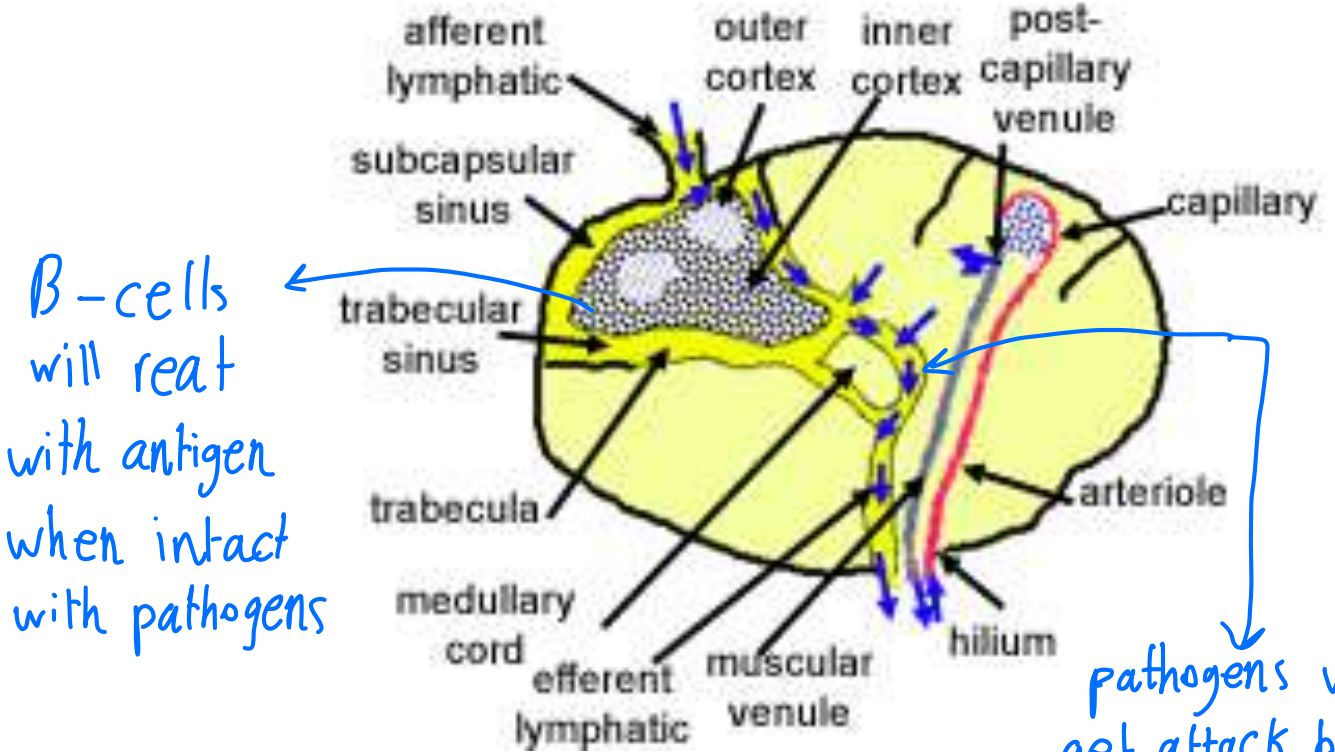


sub-capsular sinus

the paramedullary zone or juxtamedullary zone → the region where cortex transition to medulla, it is also called T-dependent zone because of its important in the maturation and activation of T-cells

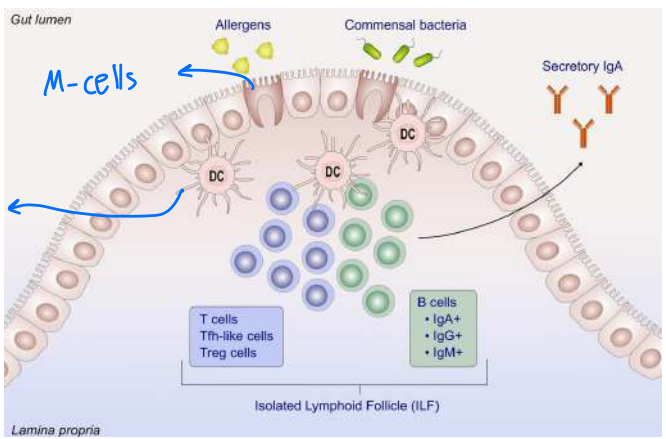
Lymph Node Cont.,

- Lymph circulation



Peyer Patches

- A collection of lymphoid follicles in the lamina propria of the ileum
- It made of a collection of B lymphocyte
- It has a role in immunity by attacking antigens or other particles
- M-cells between the columnar enterocytes has a role in this process

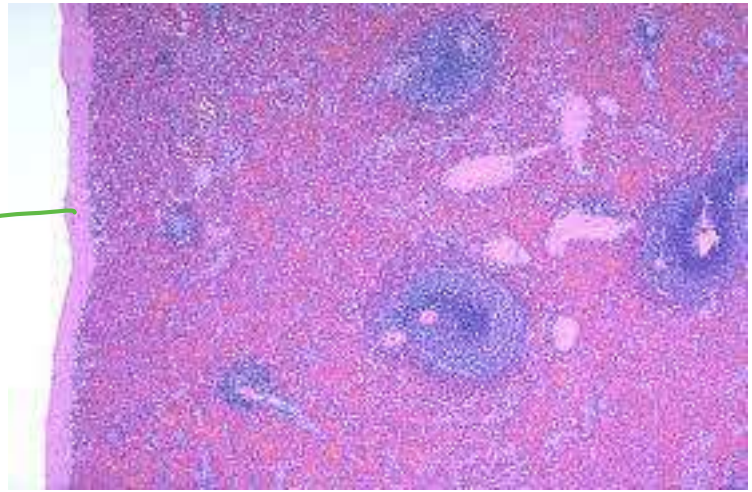


dendritic cells take some pathogen from M-cells and expose it to lymphocytes, this process will transform lymphocytes into plasma cells and make it release IgA that go to lumen and attack pathogens

The Spleen

- Largest lymphoid organ
- Contains of large number macrophages
- It is a blood filter
- Structure: capsule, trabeculae, splenic pulp

- no affarent



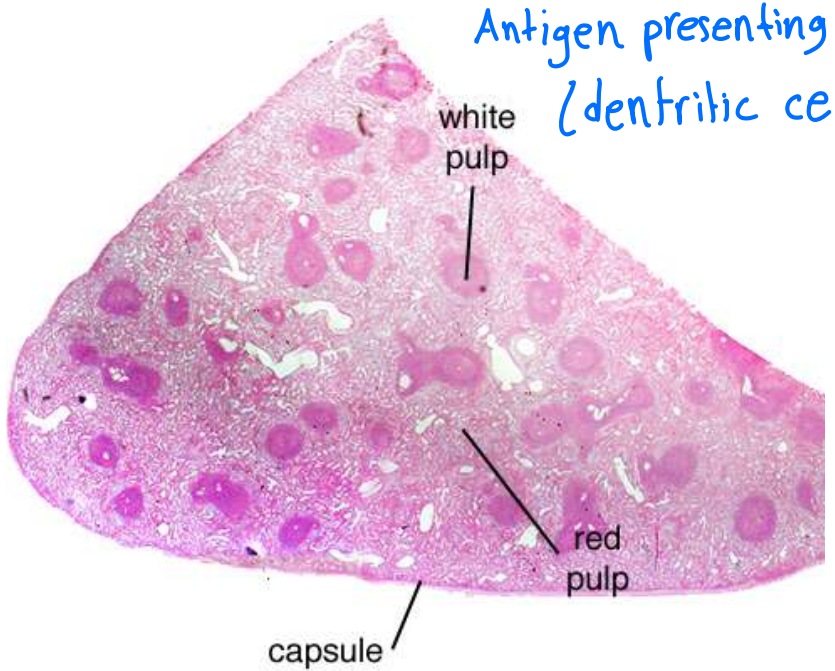
dense CT capsule

in median side of spleen the hillium exist

Splenic pulp

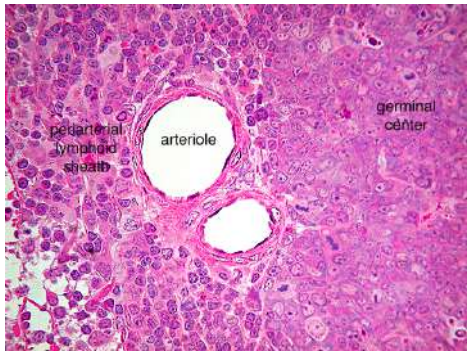
- Spleen composed of a network of reticular tissue with reticular cells, lymphocytes, other blood cells, macrophages and APCs
- White pulp
- Red pulp

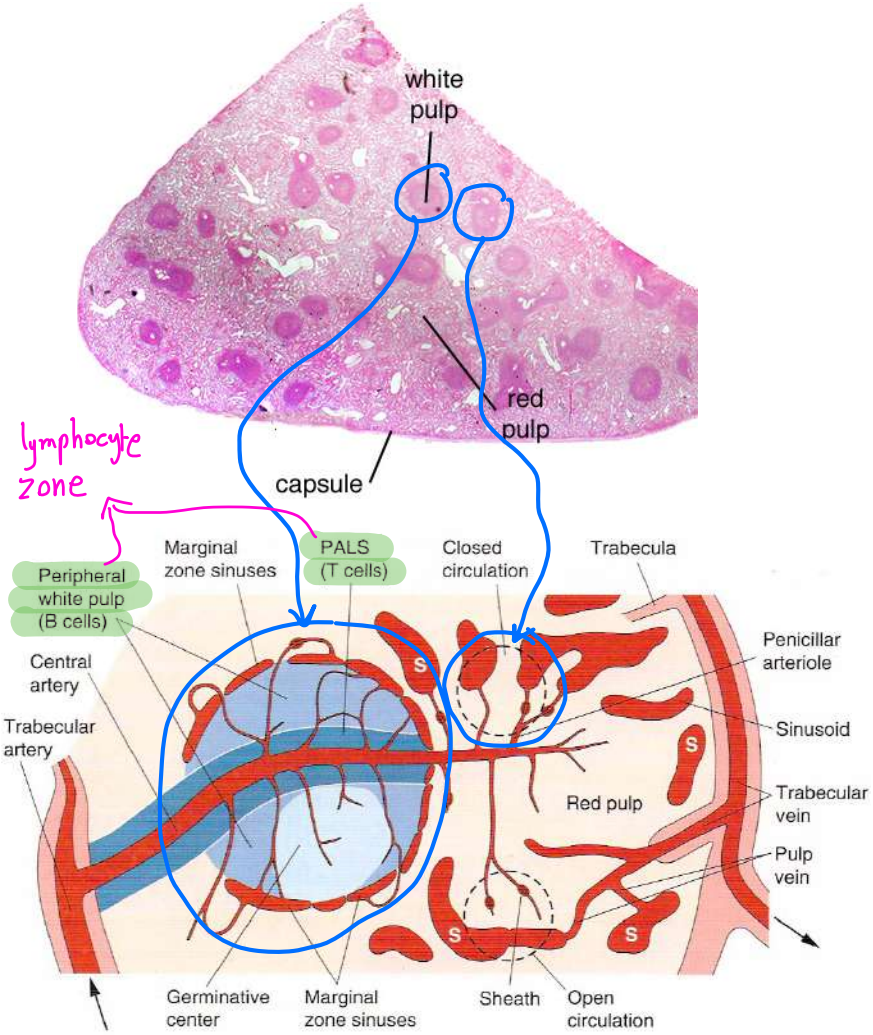
Antigen presenting cells (dentritic cells)



White Pulp

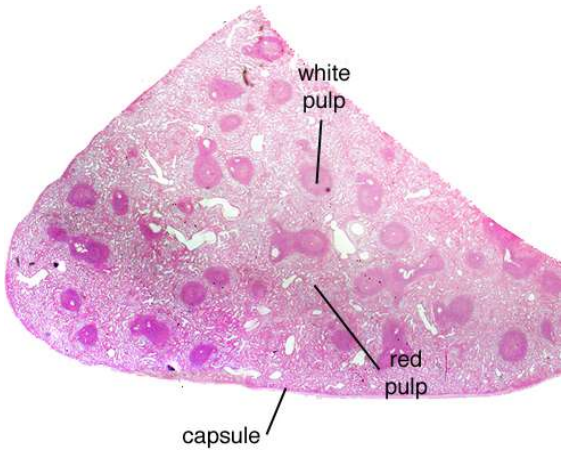
- Blood supply
- Periarterial lymphatic sheath (PALS)
- Lymphoid nodule
- Marginal zine
- Penicillar arteries

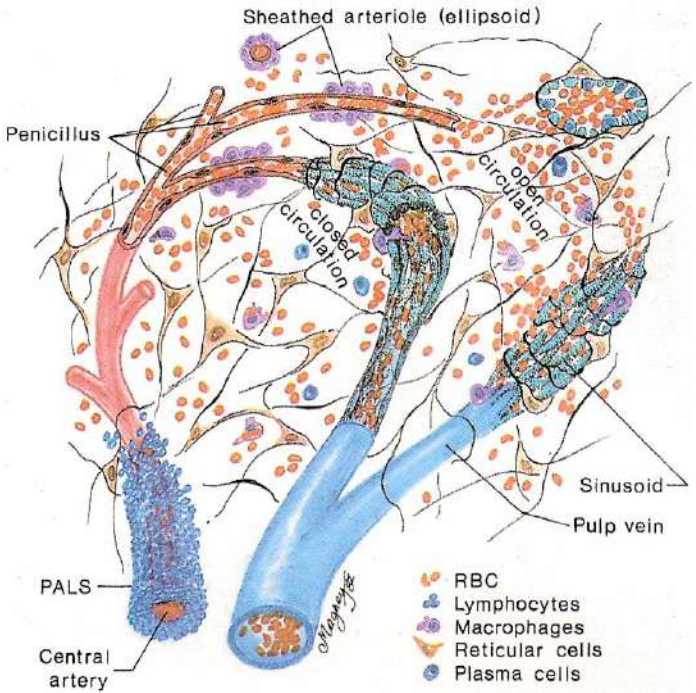


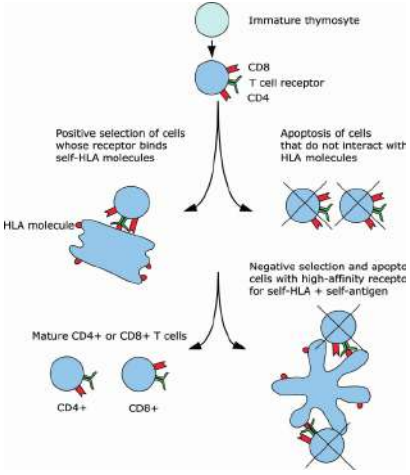


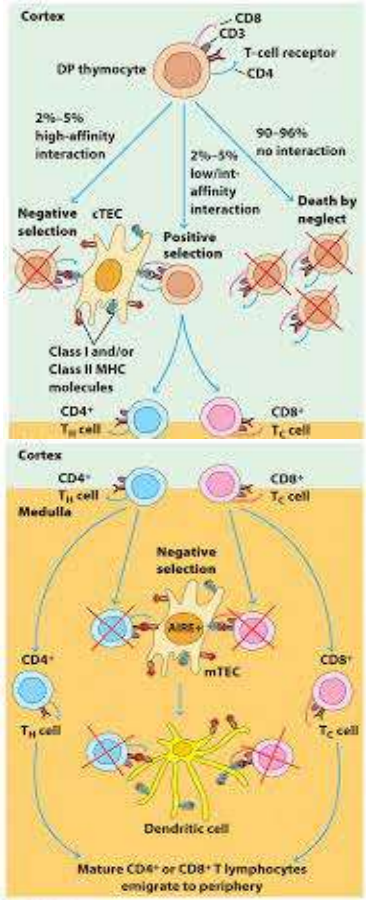
Red Pulp

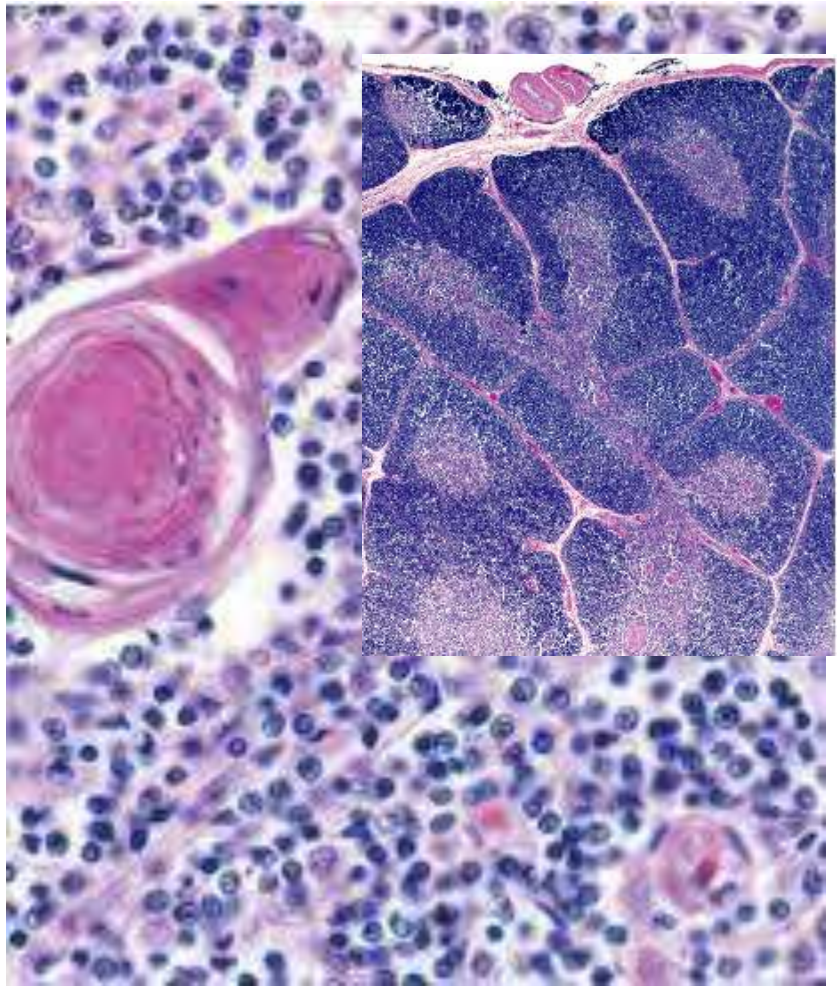
- Splenic cords are supported by reticular fibers and contain T-cells, B-cells, macrophages, plasma cells, and many blood cells.
- Splenic sinusoids (Sava cells)
- Closed circulation
- Open circulation

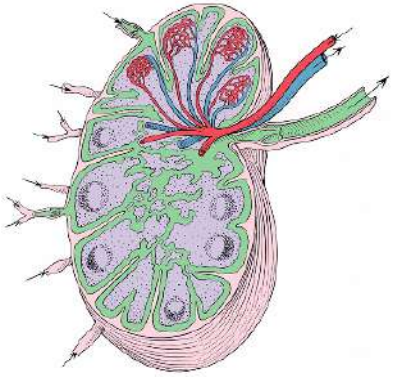


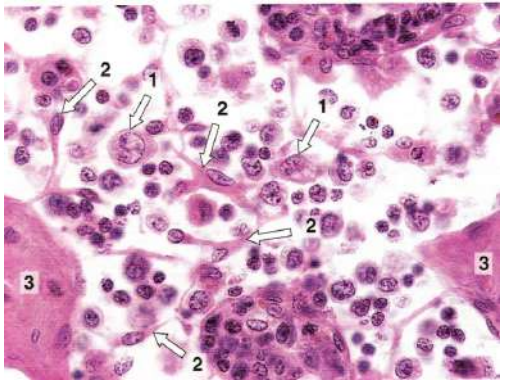



Immature thymosyte
CD8
T cell receptor
CD4
Positive selection of cells whose receptor binds self-HLA molecules
Apoptosis of cells that do not interact with HLA molecules
HLA molecule
Negative selection and apopto cells with high-affinity recepto for self-HLA + self-antigen
Mature CD4+ or CD8+ T cells
CD4+
CD8+


Cortex
CD8
CD3
T-cell receptor
CD4
DP thymocyte
2%–5% high-affinity interaction
2%–5% low/int-affinity interaction
90–96% no interaction
Death by neglect
Negative selection
cTEC
Positive selection
Class I and/or Class II MHC molecules
CD4+ TH cell
CD8+ TC cell
Cortex
CD4+ TH cell
CD8+ TC cell
Medulla
Negative selection
AIRE+
mTEC
CD4+
CD8+
TH cell
TC cell
Dendritic cell
Mature CD4+ or CD8+ T lymphocytes emigrate to periphery



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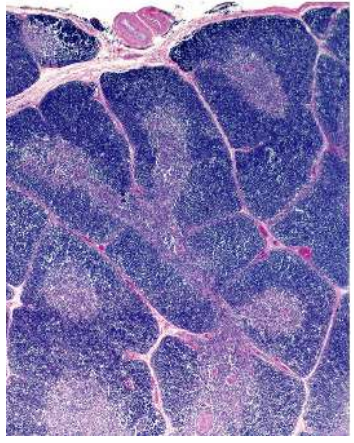

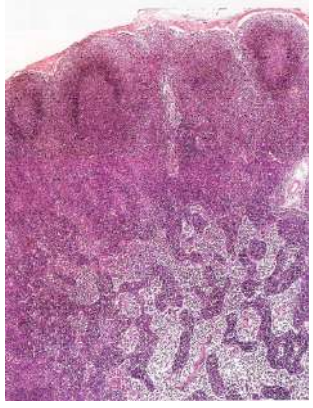

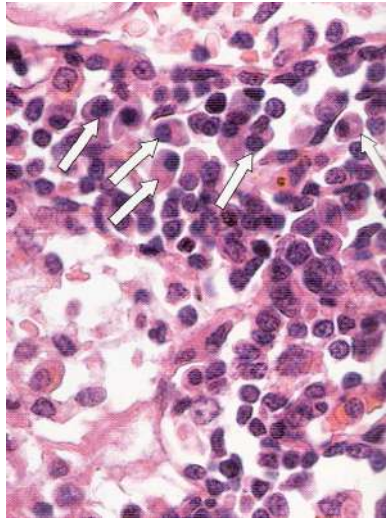

*) note from doctor :

Lymphoid organs with Both Afferent and Efferent lymphatic vessels:
ans: lymph node

Lymphoid organs with just Efferent
ans: spleen, thymus