

Organs of Immune system

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Organs of Immune system

- Main organs contributing in generation of immune response or immunity are primarily divided into two categories:
 - Primary Lymphoid Organs:
 - Secondary Lymphoid Organs:

Primary Lymphoid Organs

- The primary lymphoid organs perform various functions like:
 - Production of cells of immune system,
 - Provides microenvironment for their
 - Maturaton,
 - Differentiation and
 - Acquisition of
immune competence.
- Example:
 - Bone marrow,
 - Thymus,
 - Bursa of Fabricius [in avian spp.],
 - Peyer's patches [in ruminants],
 - Appendix [in Rabbit]

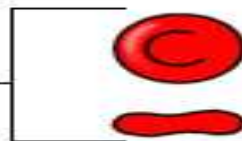
Bone Marrow

- Bone Marrow is a loosely-organized grouping of cells located in central soft tissue portion of long bones.
- Bone marrow is the seat of Hematopoiesis i. e., production of blood cells
- All the cells present in blood (WBCs and RBCs) are derived from hematopoietic stem cells present in Bone Marrow.
- In general, cells like RBCs, Eosinophils, Basophils, Neutrophils, Monocytes and B cells produced in bone marrow and mature cells are released in blood.
- In most mammals, Bone marrow is also the site for B-cells development and acquisition of B cell receptors.
- *In mammals, Peyer's patches in ruminants and Appendix in rabbit are other sites known where Pro- B cells undergo maturation.*

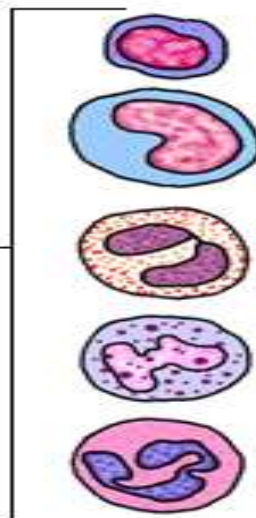


Marrow

Red Blood Cells



White Blood Cells



Lymphocyte

Monocyte

Eosinophil

Basophil

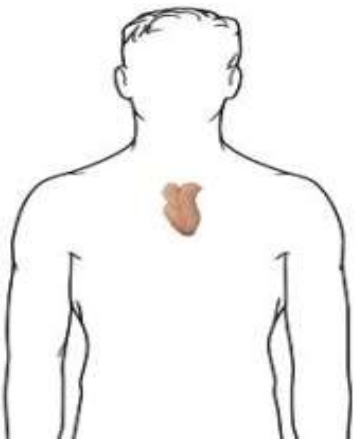
Neutrophil

Platelets

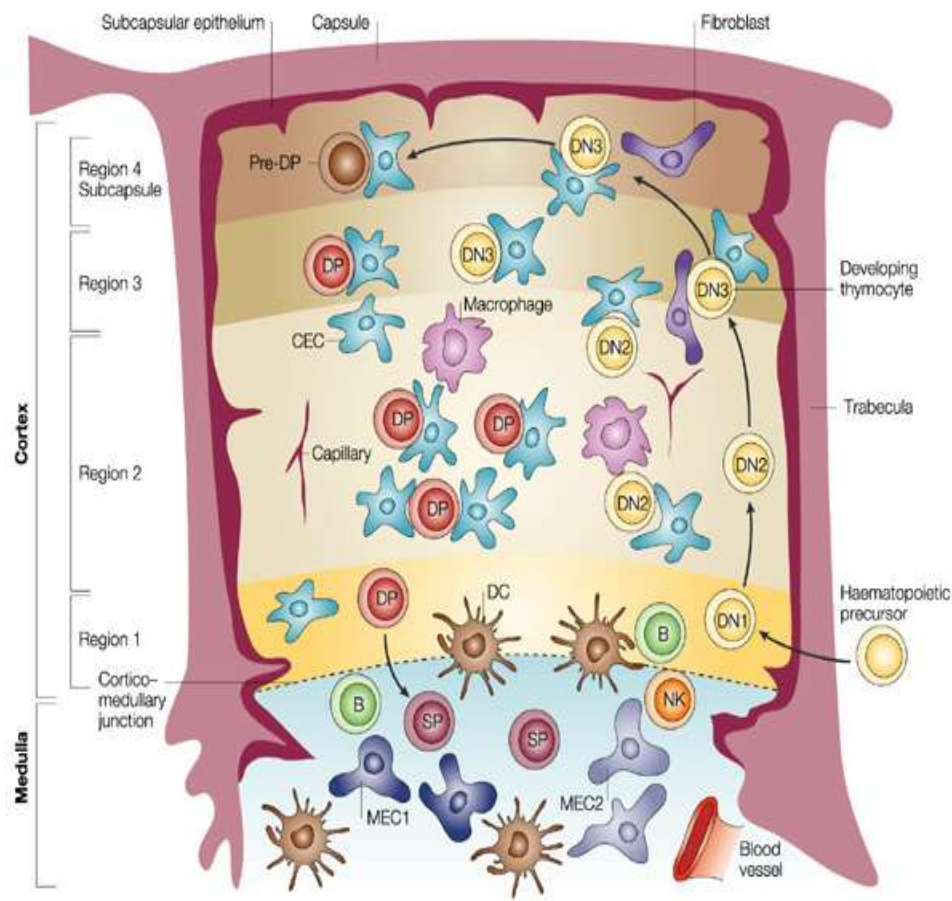
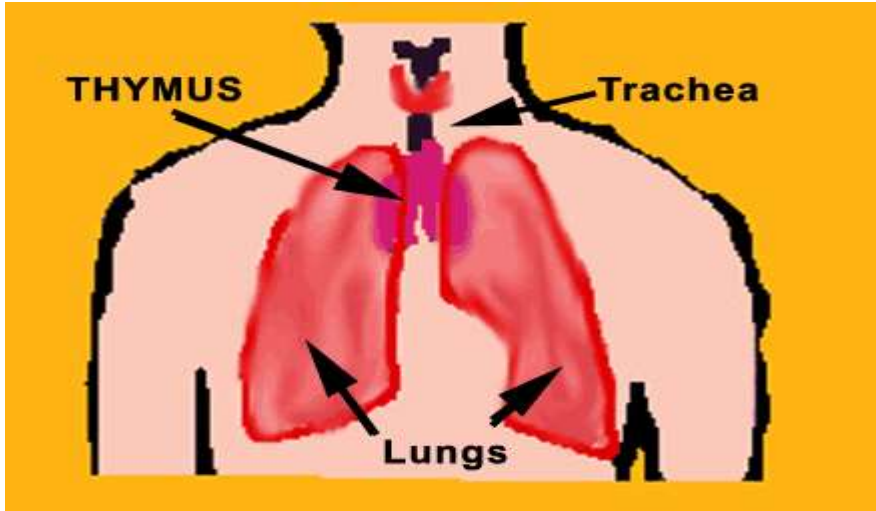


Thymus

- Thymus, a bilobed organ situated in the thoracic cavity, is the seat of T cell development.
- Thymic lobes show two distinct compartments: An outer dense “cortical” and inner loosely arranged “medullary” areas.
- Pro- T cells (thymocytes) migrating from Bone marrow to thymus for development enter thymus to cortex first.
- **Nurse cells** (thymic epithelial cells) present in cortex, provide nourishment to the developing thymocytes and can feed approximately 50 thymocytes at a time.
- In medulla, **Hassall’s corpuscles** are found.



Thymus gland

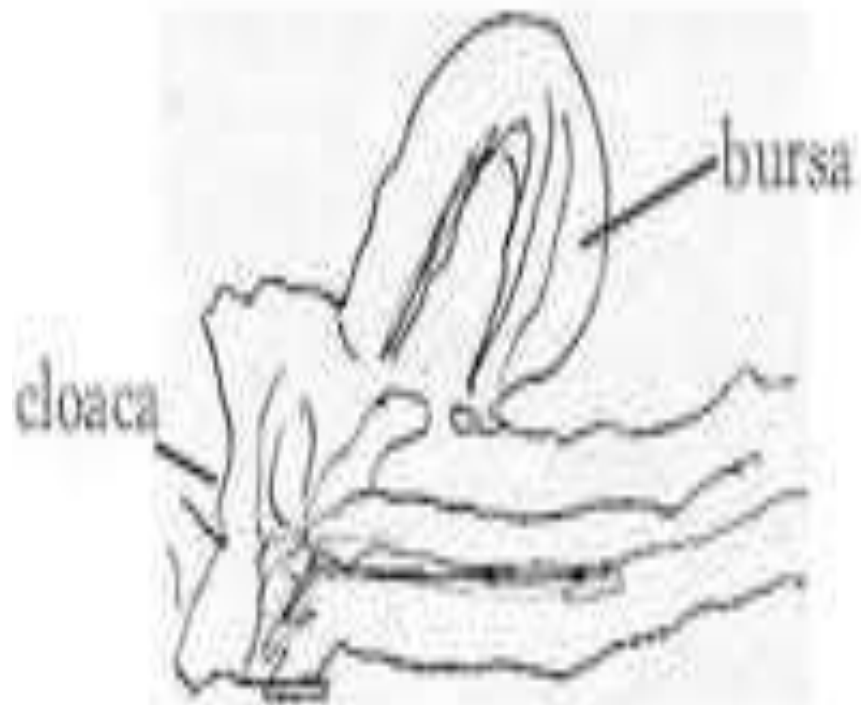
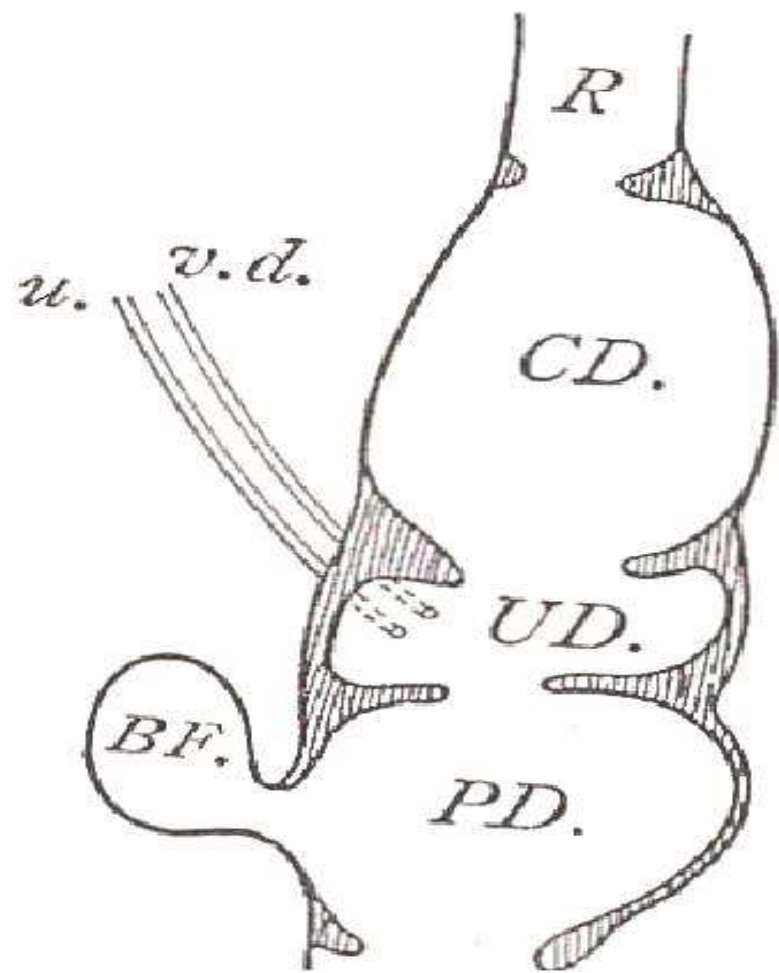


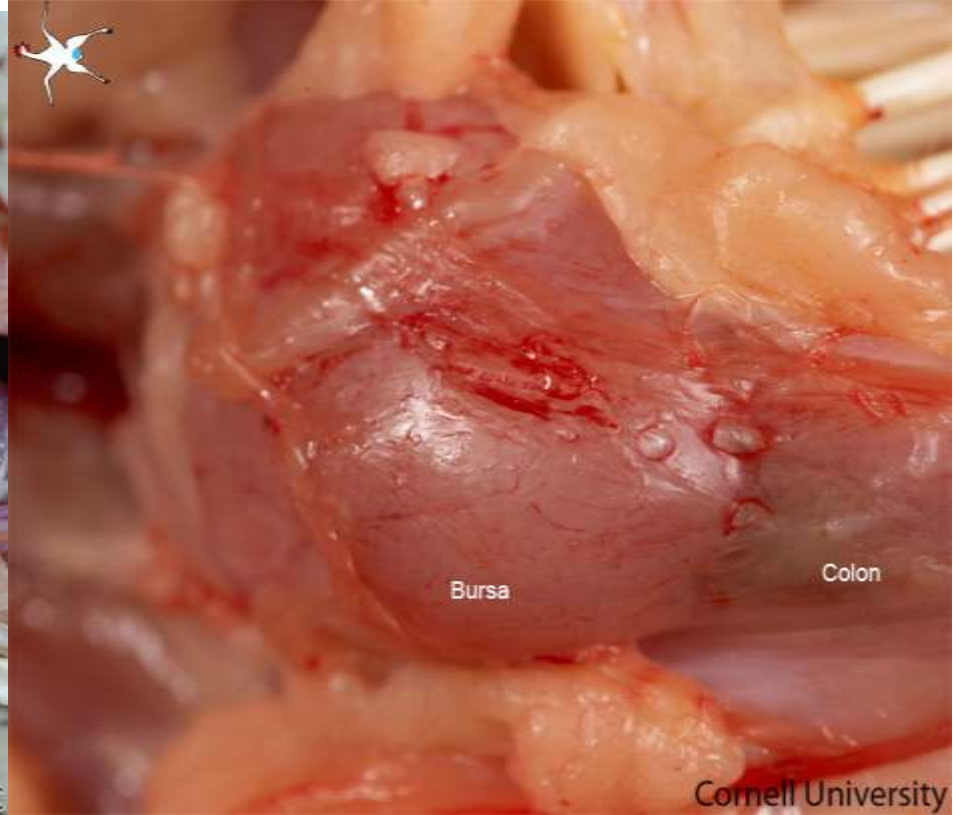
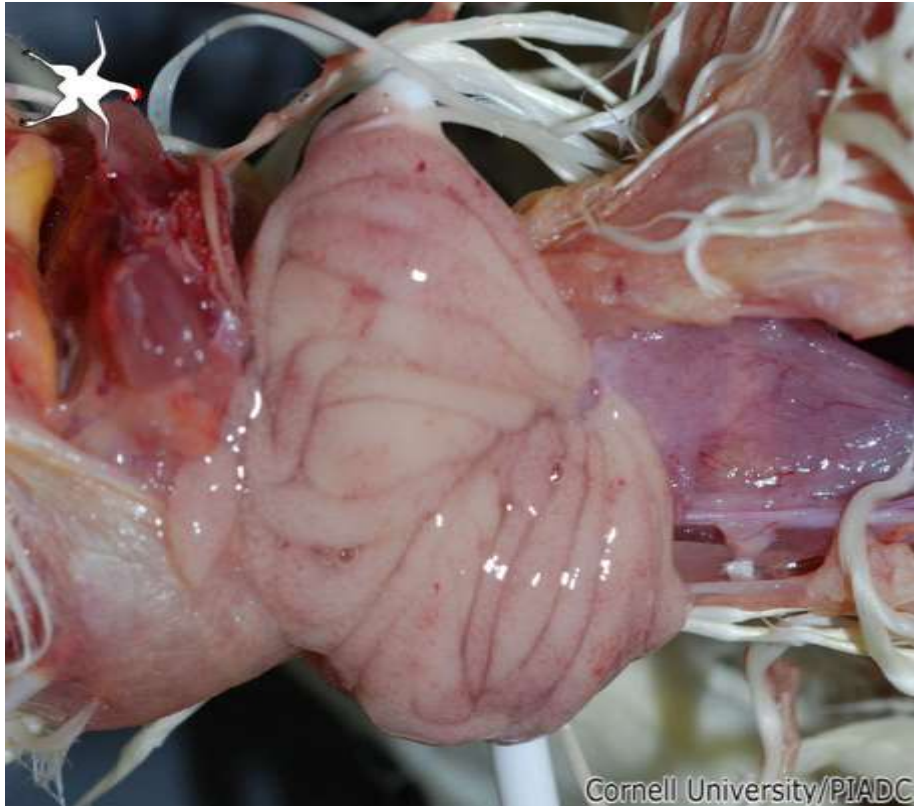
Thymus

- Immature T cells acquire T cell receptors (TCRs) in the cortex by a mechanism similar to generation of diversity by antibody molecules.
- After acquisition of TCRs, immature thymocytes undergo “**Positive and Negative selection**” in sequential manner.
- The soluble factors produced by thymic stromal cells are:
 - Alpha-thymocin
 - Beta –thymocin
 - Thymopoietin
 - Thymulin

Bursa of Fabricius

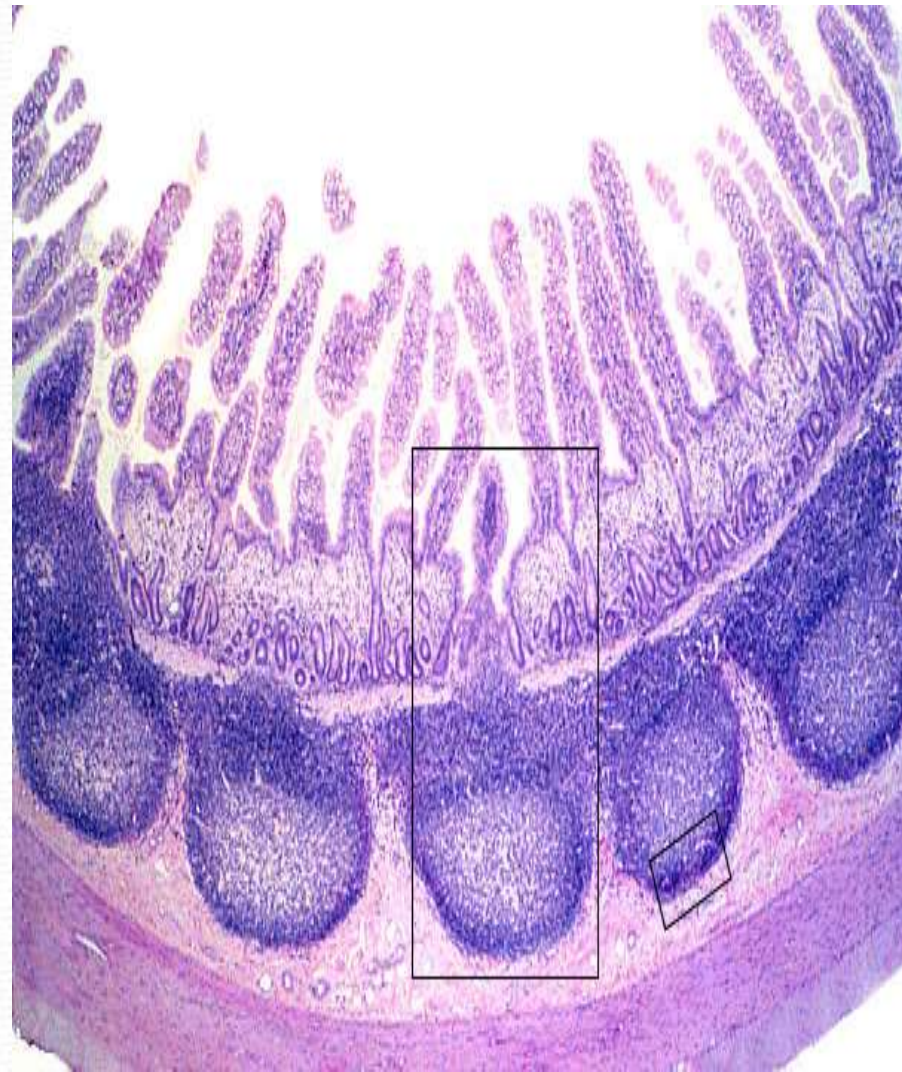
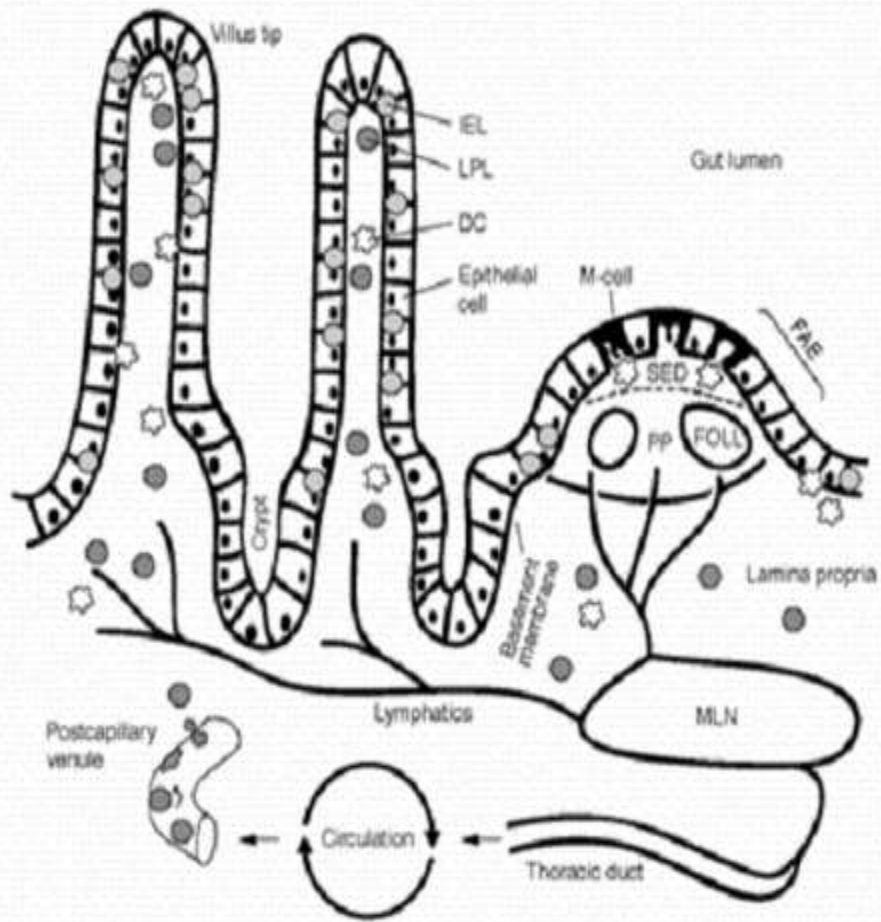
- Bursa of fabricius, a dorsal outpocketing of cloaca, is primary lymphoid organ in birds where B cells undergo maturation.
- Bursa increase in size upto 3 weeks of age and then undergoes involution or regression.
- Removal of bursa affects “humoral” immune response (production of antibody).
- “B cells” derived their name because they mature in bursa (to differentiate them from “T cells” maturing in thymus)





PEYER'S PATCHES

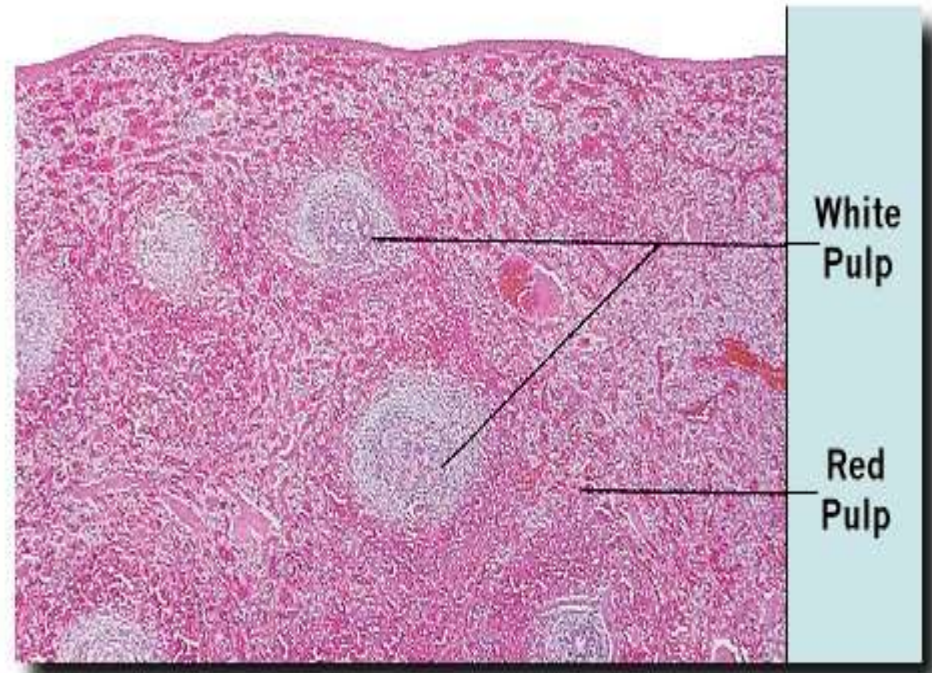
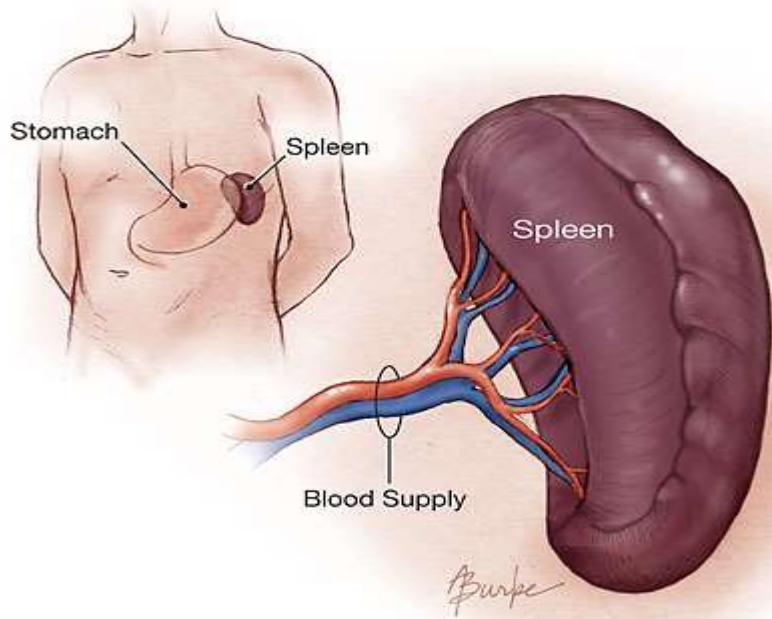
- Peyer's patches are areas of lymphoid tissue located in the wall of the intestine, and
- In some mammalian species such as sheep, cattle and rabbits Peyer's patches have a function similar to the bursa of fabricius of birds and bone marrow of other mammals i.e., B cell differentiation and maturation.
- Two types of Peyer's patches seem to occur: one with primary lymphoid function and one type with secondary lymphoid function.





SPLEEN

- Spleen is the **largest lymphoid organ**
- It is also known as “**Grave yard of RBCs**” - it removes aged or old RBCs.
- Spleen has two compartments namely “**Red Pulp and White Pulp**”. Marginal zone is present in between.
- **Red pulp** is the site where old RBCs are destroyed -richly populated with macrophages and dying RBCs
- **White pulp** is mainly role in generation of immune response.



SPLEEN

- White pulp is around “Splenic arterioles”.
- T lymphocytes are populated around splenic arterioles forming “**Periarteriolar Lymphoid Sheath (PALS)**”.
- So, PALS is considered as “**T-cell dependent area**”.
- **Marginal zone** surrounds PALS which is predominantly populated with B cells. Thus, marginal zone is considered as “**B-cell dependent area**”.
- **Spleen doesn't** have “afferent lymph vessel”.
- The antigens present in blood are filtered when they pass through “Spleen”. (**Blood borne Antigens** are captured by APCs present in Spleen).

Lymph nodes

- Lymph nodes are **bean shaped encapsulated nodules** present along the lymphatics.
- The **antigens coming along with the draining lymph is trapped in the lymph nodes.**
(Thus, they actually filter the tissue fluid passing through the lymph nodes).
- Being lymphoid organ, lymph node is composed mainly of B cells, T cells and APCs.
- The structure is largely organized into three concentric rings i.e., ***Cortex, Paracortex and Medulla.***

The lymph node

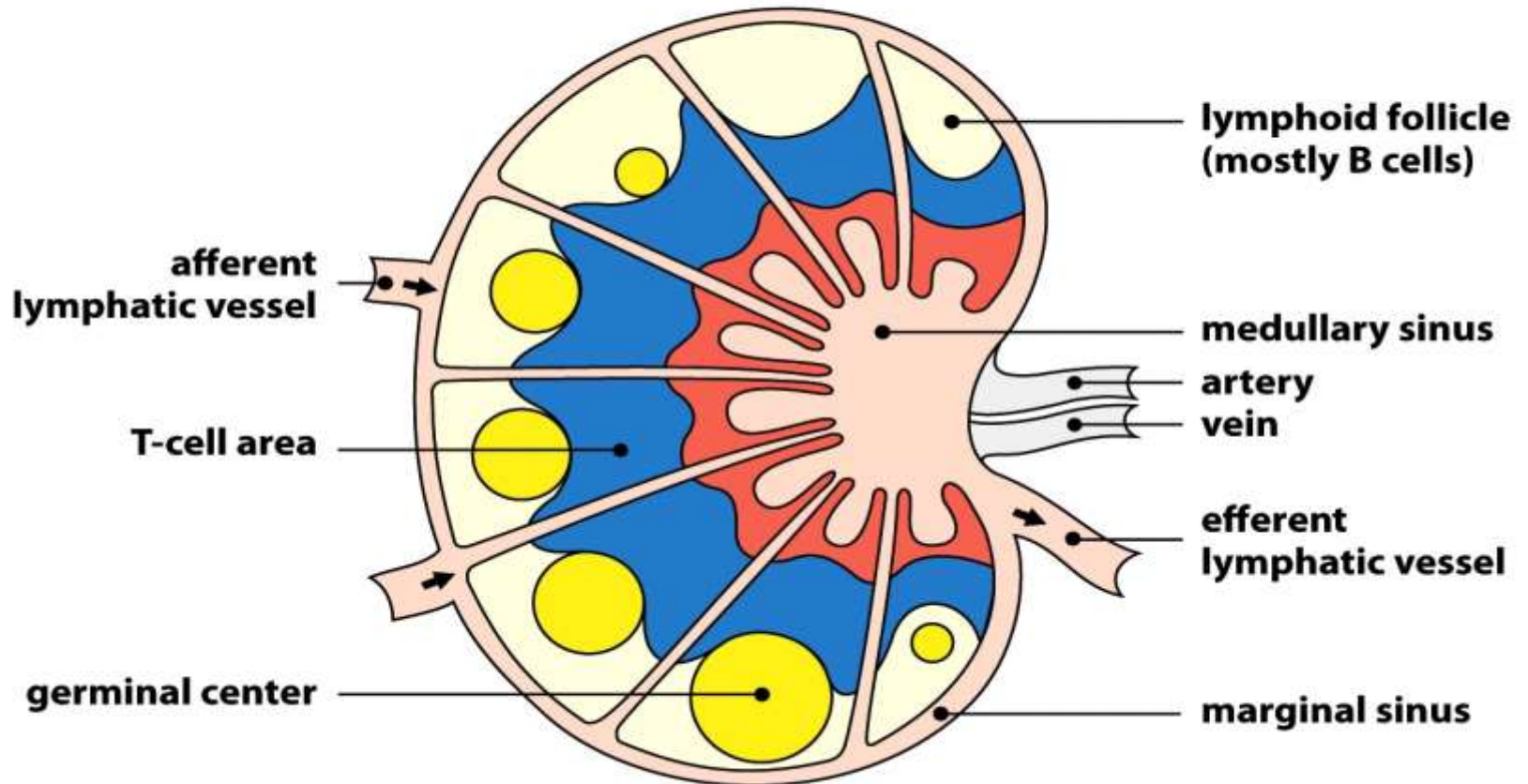
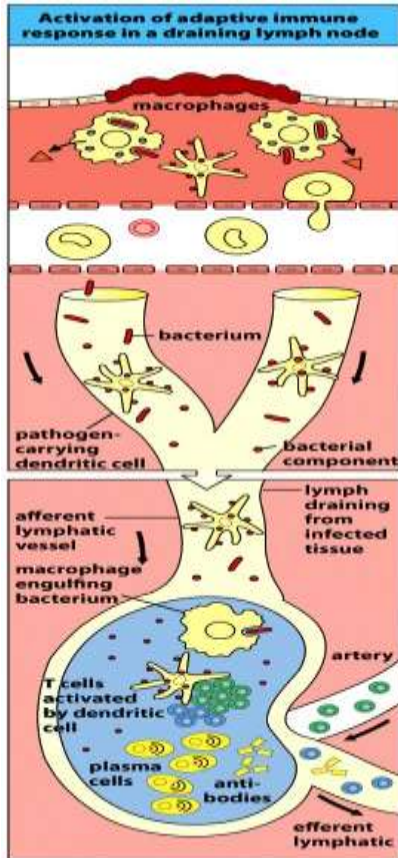


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Lymph nodes

- The outer most area called “**Cortex**” is rich in B cell populations which are arranged as “Primary Follicles”. So, cortex is “**B- cell dependent**” area.
- The “middle” area called “**Paracortex**” is rich in T cell population and thus is “**T-dependant area**”.
- This region also contains some of the APCs i.e., **Macrophages and Interdigitating Dendritic cells**.
- The less dense innermost area is called “**Medulla**” which contains macrophages, Interdigitating Dendritic cells and **antibody secreting Plasma cells**.

Connection between Innate and Adaptive Immune responses



Dendritic cell

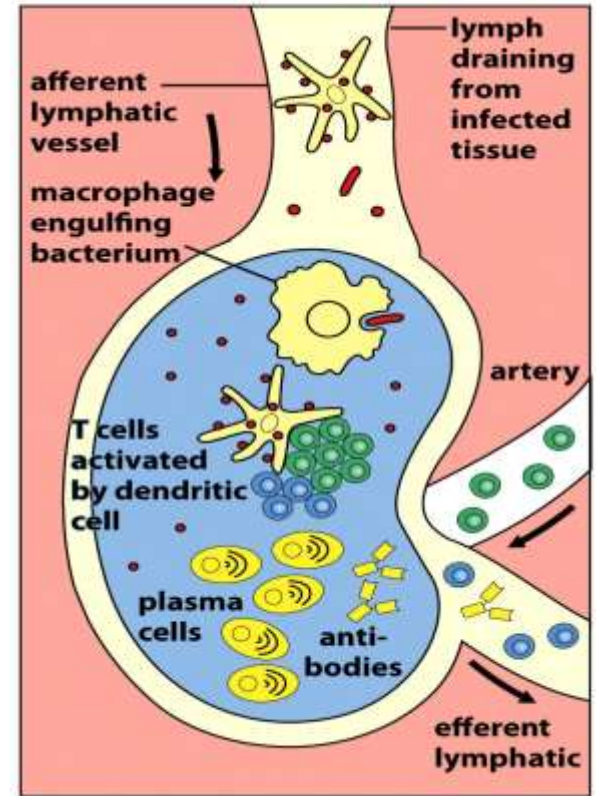
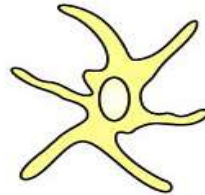


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Figure 1.22 The Immune System, 3ed. (© Garland Science 2009)

Mucosa Associated Lymphoid Tissue (MALT)

- The term MALT is used for lymphoid tissues that are strategically placed along with the mucous lining of **digestive, respiratory and uro-genital tract**.
- MALTs consist of well organized, non encapsulated permanent lymphoid tissues like:
 - Tonsils,
 - Peyer's patches,
 - appendix etc.

Follicles of Lymphoid cells: It is diffused congregation of B cells, T cells and macrophages.

THE END

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