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INSTITUTE-UNIVERSITY INSTITUTE OF ENGINEERING

ACADEMIC UNIT-II

Computer Science Engineering

Subject Name-Biology For Engineers

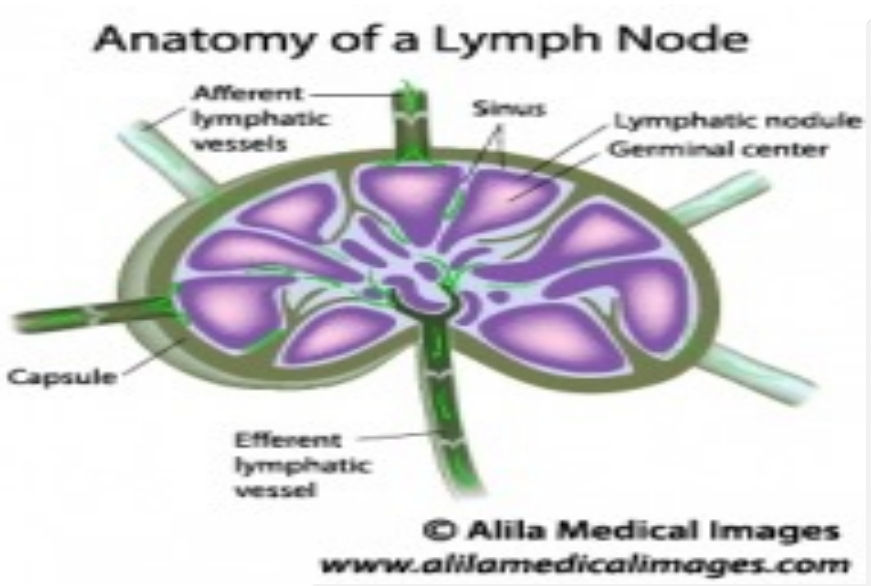
Subject Code- 20SZT148

LYMPHOID ORGANS

LYMPHOID ORGANS

Course Outcome

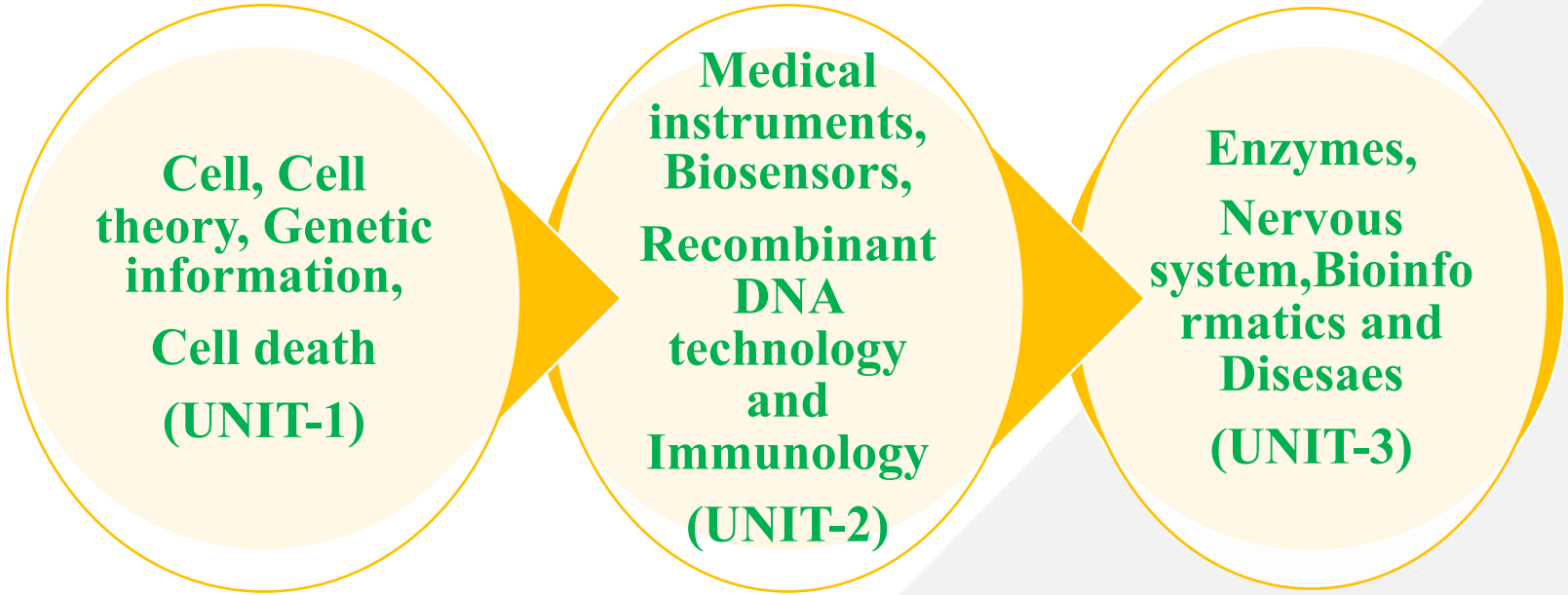
CO Number	Title	Level
CO1	It gives an idea about the about the basic cell biology.	**Understanding**
CO2	It deals with the idea of uses of biology in engineering.	**Understanding**
CO3	It provide knowledge about the uses of softwares in biology field.	**Remembering**



Will be covered in this lecture

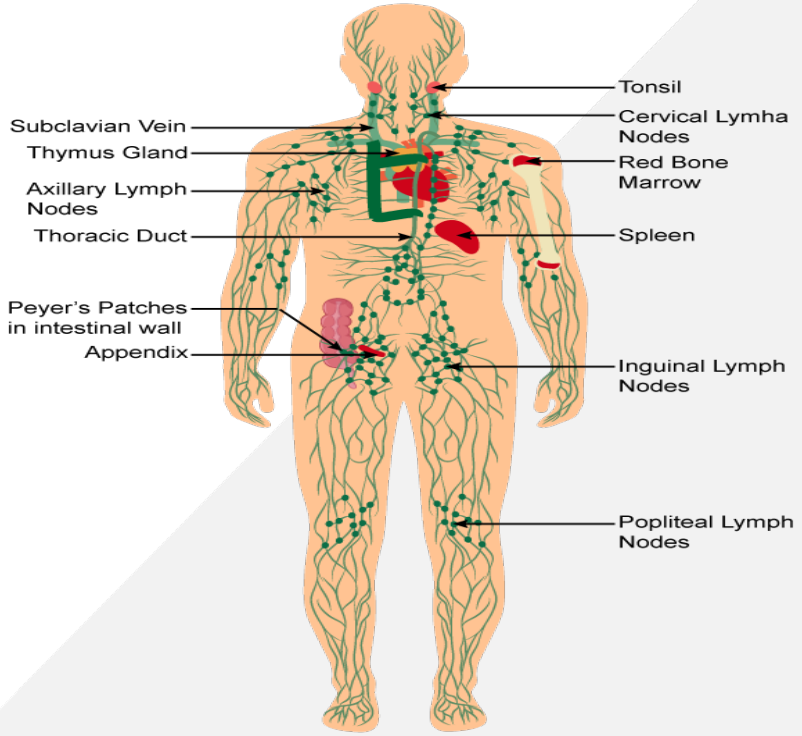
http://www.alilamedicalimages.org/2013/08/06/lymphatic-system-gallery/

BIOLOGY FOR ENGINEERS



LYMPHOID ORGANS

The immune system is made up of organs that control the production and maturation of certain defense cells, the lymphocytes. Bone marrow and the thymus, a gland situated above the heart and behind the breast bone, are so-called primary lymphoid organs. The bone marrow produces defense cells.



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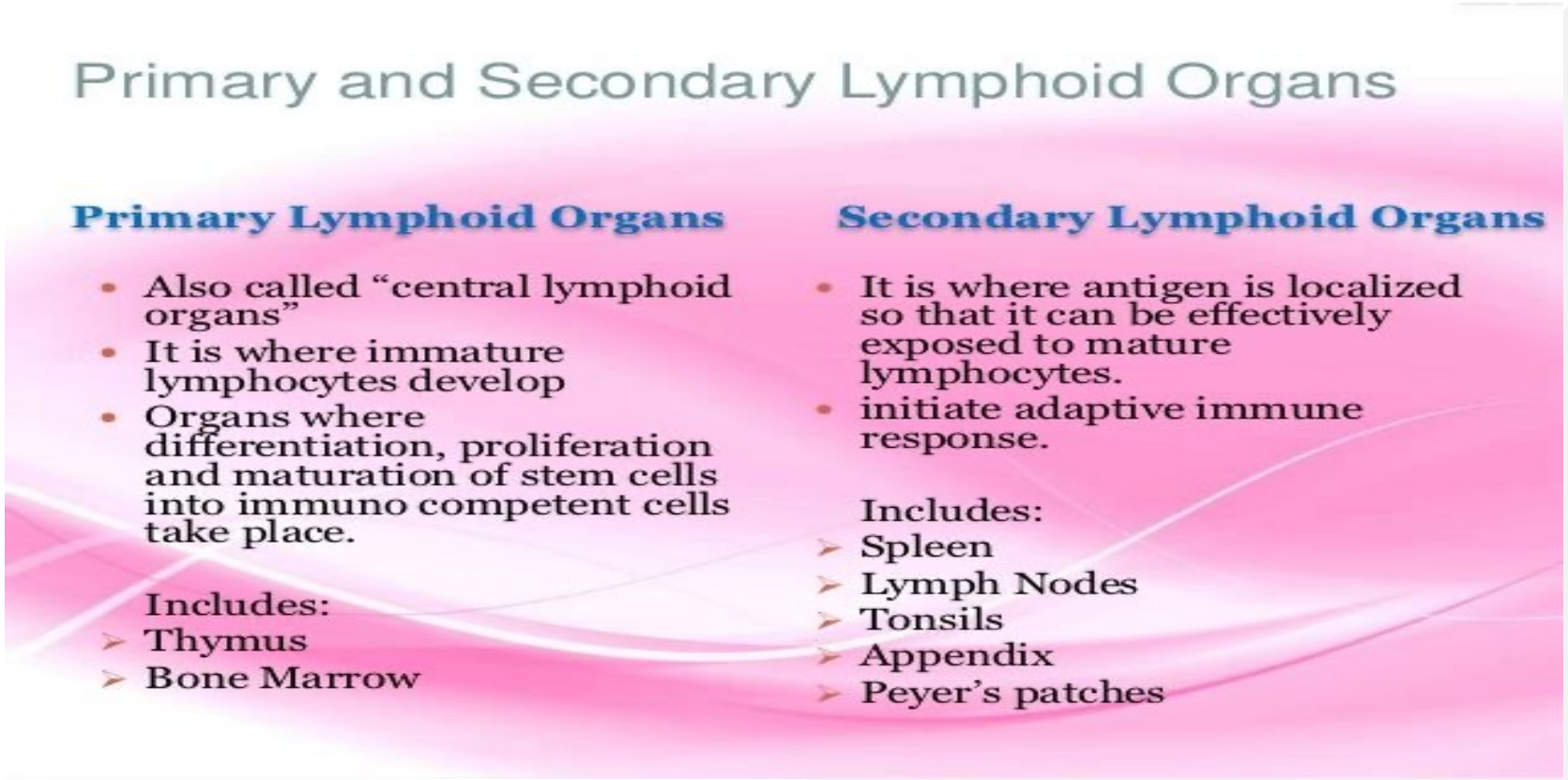
LYMPHOID ORGANS



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PRIMARY LYMPHOID ORGANS

- Immature lymphocytes generated in hematopoiesis, the process of formation and development of blood cells, mature and become committed to a particular antigenic specificity within the primary lymphoid organs, namely, thymus, bursa of Fabricius (in birds) and bone marrow (in mammals). A lymphocyte becomes immuno-competent, i.e., capable of mounting an immune response only after it matures within a primary lymphoid organ.

1. Thymus:

- Thymus is a greyish, flat, bilobed lymphoid organ situated above the heart and extending into the neck on the front and sites of trachea. It develops from the epithelium of third and fourth pharyngeal pouches and, on maturity, acts as the site of development and maturation of lymphocytes named thymus-derived lymphocytes or T-lymphocytes or T-cells.

PRIMARY LYMPHOID ORGANS

- The thymus reaches peak activity in childhood and attains its largest size at puberty.
- Thereafter, the thymus begins to atrophy without any apparent effect on T-lymphocyte function and is extremely small in old age.

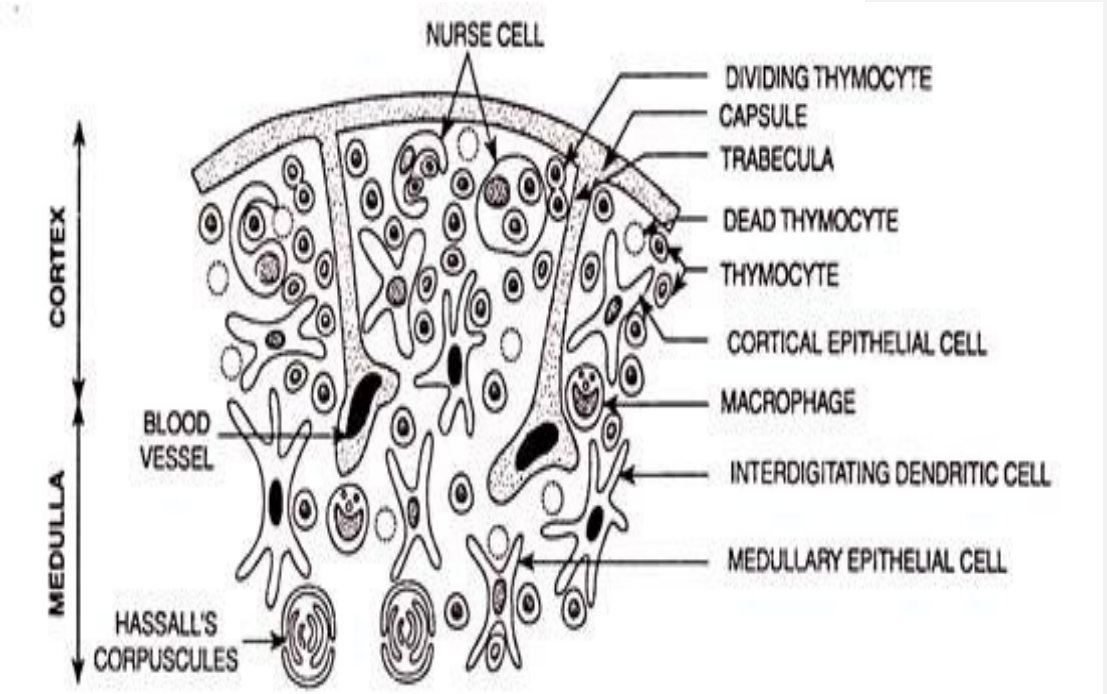

FIG. 42.2. Cross section (diagrammatic) of a portion of the thymus showing several lobules separated by trabeculae (connective tissue strands); each lobule differentiated into outer cortex and inner medulla. Cortex is densely populated by thymocytes, while medulla is sparsely populated.

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PRIMARY LYMPHOID ORGANS

- Each lobe of thymus is surrounded by a capsule and is divided into a series of lobules, which are separated from each other by strands of connective tissue called trabeculae. Each lobule is organized into two compartments-outer and inner. The outer component is called cortex, whereas the inner component is called medulla.
- The cortex is densely packed with thymocytes, whereas the medulla is sparsely populated with thymocytes.
- The function of the thymus is to generate T-lymphocytes and to confer immunological competence on to them during their stay in the organ.
- T-lymphocytes so educated in the thymus become capable of mounting cell-mediated immune response against appropriate antigen.

PRIMARY LYMPHOID ORGANS

2.Bone marrow

- Bone marrow is the site of origin and development of B-lymphocytes or B-cells (bone marrow derived lymphocytes) in mammals particularly in humans and mice after birth. Before birth, the yolk sac, foetal lever, and total bone marrow are the major sites of B-lymphocyte maturation.
- Development of B-lymphocytes (B-cells) begins with the differentiation of lymphoid stem cells into the earliest distinctive progenitor B cells (pro-B cell), which proliferate within the bone marrow filling the extravascular spaces between large sinusoids in the shaft of a bone.
- Proliferation and differentiation of pro-B cells into precursor B cells (pre-B cells) requires the microenvironment provided by the bone marrow stromal cells.

SECONDARY LYMPHOID ORGANS

- As stated earlier, the lymphocytes mature, proliferate, and differentiate in the primary or central lymphoid organs.
- These lymphocytes migrate therefrom via circulation to the secondary or peripheral lymphoid organs. Here they bind appropriate antigens and undergo further antigen-dependent differentiation.
- Once in the secondary lymphoid organs, the lymphocytes do not remain there but move from one lymphoid organ to another through the blood and lymphatic's. The passage of lymphocytes facilitates the induction of an immune response.
- Lymph nodes and the spleen are the most highly organized secondary or peripheral lymphoid organs, whereas mucosa-associated lymphoid tissue (MALT) is the less organized lymphoid tissue.

SECONDARY LYMPHOID ORGANS

1. Lymph Nodes:

- Lymph nodes are small, encapsulated, bean-shaped structures clustered at junctions of the lymphatic vessels which are distributed throughout the body. Lymph nodes contain a reticular network packed with lymphocytes, macrophages and dendritic cells, and filter out pathogenic microorganisms and antigens from the lymph.
- A lymph node consists of three regions: the cortex, the paracortex, and the medulla. Cortex is the outermost region and contains several rounded aggregates of lymphocytes (mostly B-lymphocytes), macrophages, and follicular dendritic cells arranged in primary follicles. Each follicle has a pale-staining germinal centre surrounded by small dark-staining lymphocytes.
- The deeper region lying beneath the cortex is the paracortex.

SECONDARY LYMPHOID ORGANS

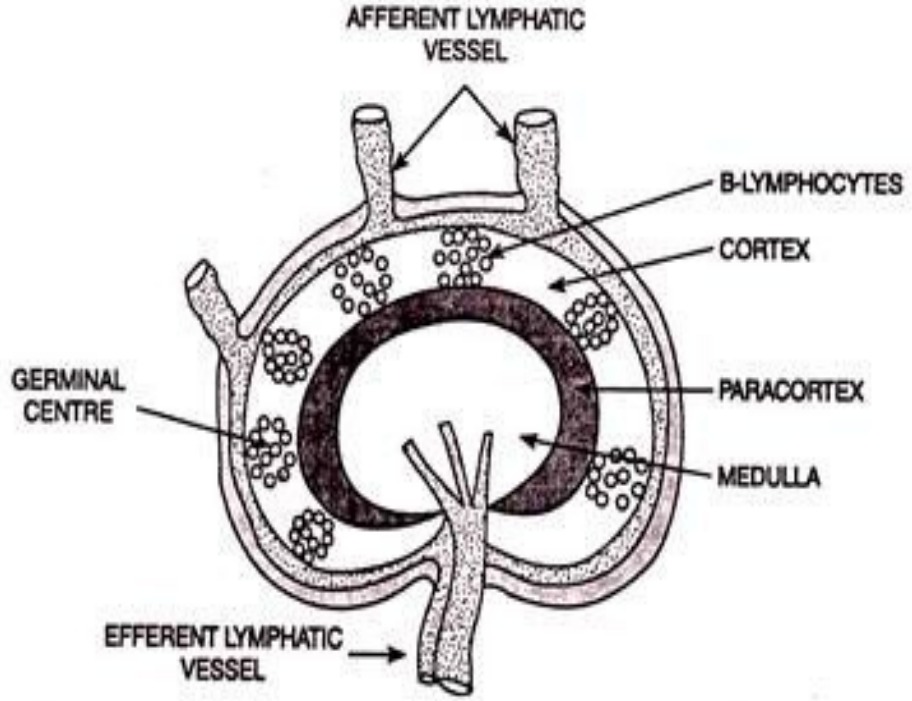

FIG. 42.3. Lymph node structure showing cortex, paracortex, medulla, afferent and efferent lymphatic vessels, and lymphocytes.

https://www.biologydiscussion.com/immunology/lymphoid-organs-of-immune-system-immunology/56010#google_vignette

SECONDARY LYMPHOID ORGANS

- Because of the presence of large number of T-lymphocytes in it. the Para-cortex is also referred to as a thymus-dependent area in contrast to the cortex which is a thymus-independent area. Medulla, the inner most region of lymph node, is more sparsely populated with lymphoid-lineage cells. Of the lymphoid-lineage cells present, many are plasma cells actively secreting antibody molecules.
- Each lymph node has a number of lymph vessels called afferent lymphatic vessels, The lymph now percolates slowly inward through the cortex, paracortex, and medulla, allowing phagocytic cells and dendritic cells to trap pathogens and antigens carried by the lymph.
- The lymph then is drained into a single large lymph vessels called efferent lymphatic vessel that carries the lymph to the thoracic duct, which empties into a large vein in the neck.

SECONDARY LYMPHOID ORGANS

2. Spleen:

- The spleen is an ovoid encapsulated, and the largest secondary or peripheral lymphoid organ. Spleen is specialized for trapping blood-borne antigens and is present high in the left abdominal cavity and being encapsulated, its capsule extends a number of projections, called trabeculae, into the interior resulting in the formation of compartments.

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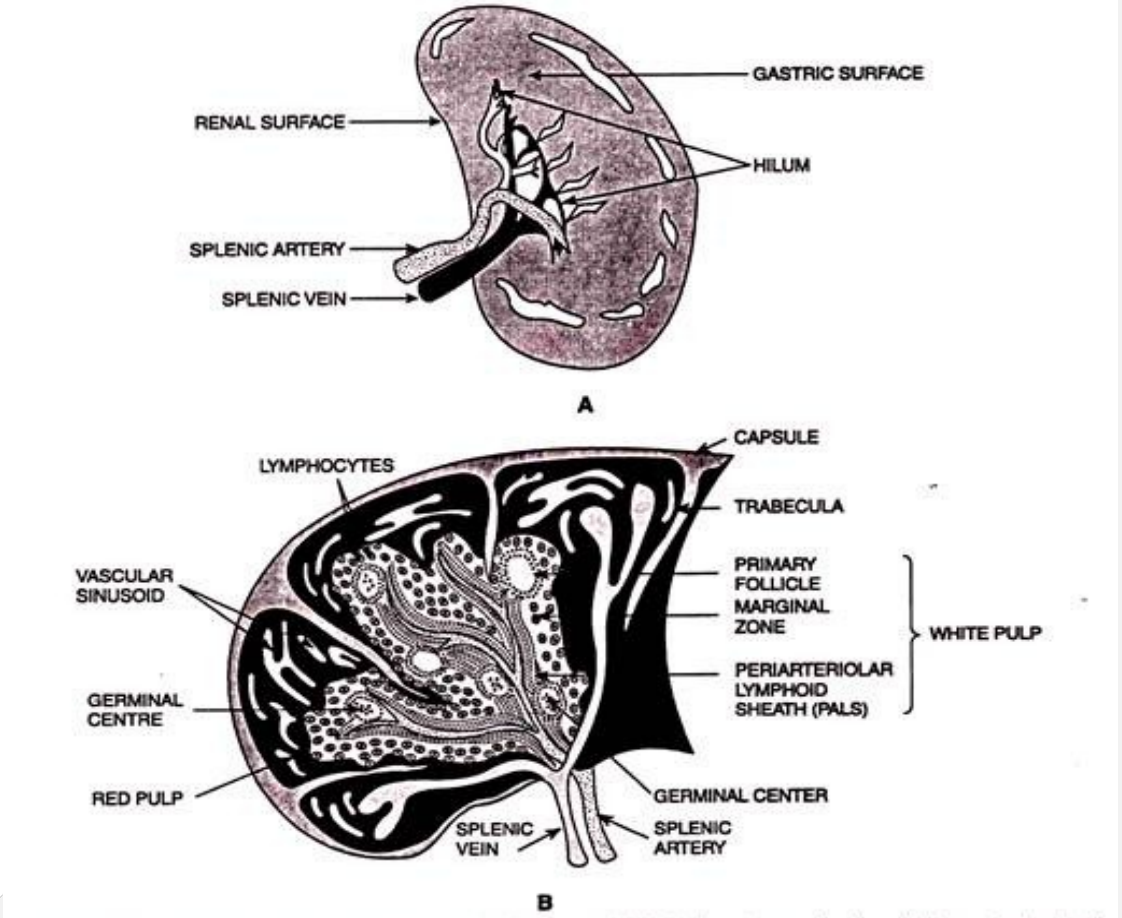

FIG. 42.4. Structure of spleen. (A) Morphological view of spleen, which is the largest secondary lymphoid organ being about 5 inches long in adults, and (B) diagrammatic cross section showing different internal components of the spleen.

SECONDARY LYMPHOID ORGANS

- These compartments are filled by two types of tissues, the red pulp and white pulp, which are separated by a diffuse marginal zone . The red pulp consists of a network populated by large number of erythrocytes (red blood cells) and macrophages and few lymphocytes.The white pulp consist of the branches of the splenic artery that make a periarteriolar lymphoid sheath (PALS) populated heavily by T-lymphocytes.
- When the blood-borne antigens enter the spleen the B- and T-lymphocytes present in PALS are initially activated.The activated B-lymphocytes, together with some T_H cells then migrate to primary follicles in the marginal zone. When the primary follicles are challenged by antigen, they differentiate into characteristic secondary follicles.The latter contain germinal centres where rapidly dividing B-lymphocytes and plasma cells are surrounded by dense clusters of concentrically arranged lymphocytes.

SECONDARY LYMPHOID ORGANS

3. Mucosal-Associated Lymphoid Tissue (MALT):

- The mucous membranes lining the alimentary, respiratory, and genitourinary systems have a very large combined surface area ,which is constantly exposed to numerous antigens and is the major site of entry for most pathogens.
- These vulnerable membrane surfaces possess a group of organized lymphoid tissues which defend it from pathogens and antigens. The group of organized lymphoid tissues is known collectively as mucosal-associated lymphoid tissue . There are several types of MALT; the most studied one is the gut-associated lymphoid tissue (GALT) which includes tonsils, Peyer's patch, appendix, and loosely organised clusters of lymphoid cells in the intestinal villi.
- MALT is functionally very significant in immune system of the body because of the presence of large number of antibody-producing plasma cells in it.

SECONDARY LYMPHOID ORGANS

(i) Tonsils:

- There are three groups of tonsil present at three different locations: palatine, lingual, and pharyngeal (adenoids). Palatine group of tonsil occur at the sides of the back of the mouth; lingual in the basal region of the tongue; and pharyngeal (adenoids) in the roof of the nasopharynx .
- All the aforesaid tonsil groups are nodule-like and consist of a meshwork of reticular cells and fibres interspersed with lymphocytes, macrophages, granulocytes, and mast cells.
- The B-lymphocytes are organised into follicles and germinal centres. The germinal centres are surrounded by regions showing T-lymphocyte activity. However, the tonsils protect against antigens that enter through the nausal and oral epithelial routes.

SECONDARY LYMPHOID ORGANS

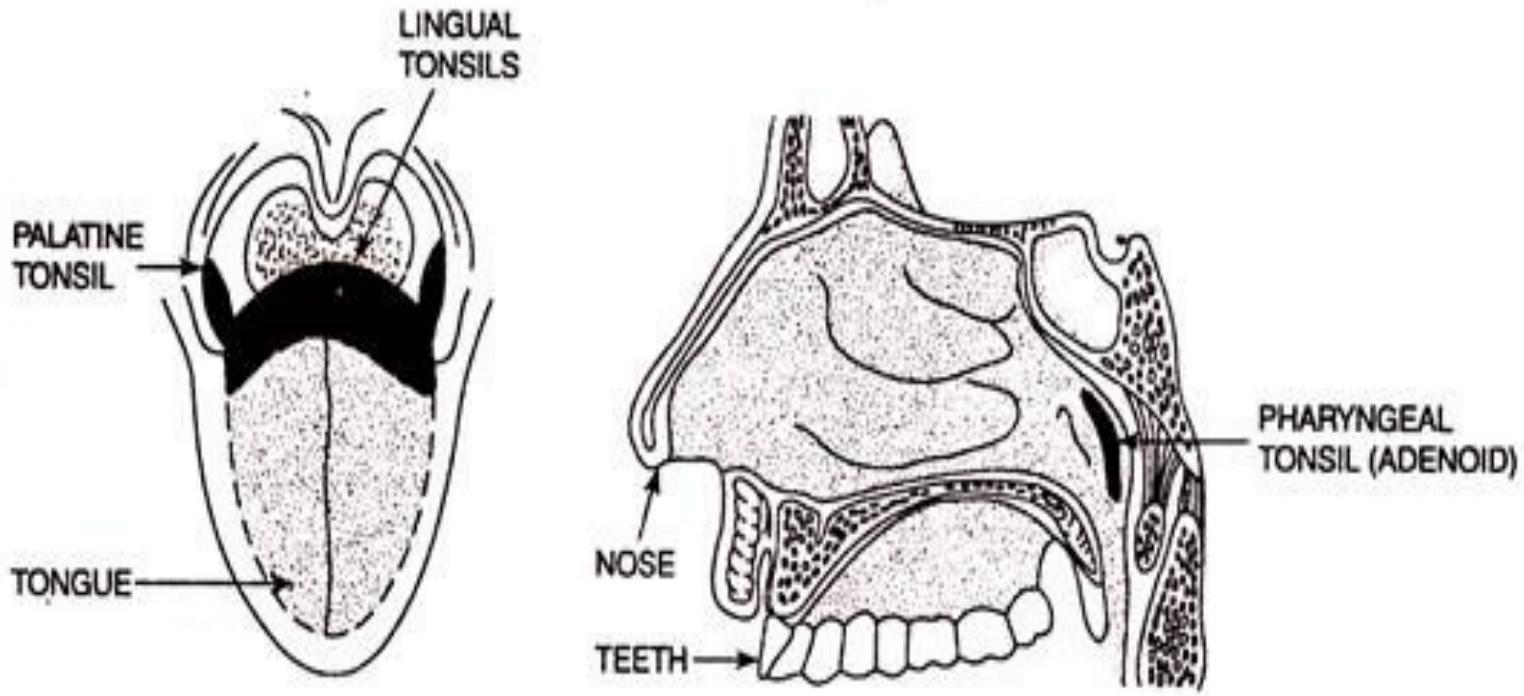

FIG. 42.5. Three types of tonsils : palatine, lingual, and pharyngeal (adenoid).

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SECONDARY LYMPHOID ORGANS

(ii) Peyer's Patch:

- Peyer's patches occur in the sub-mucosal layer present beneath the lamina propria lying under the epithelial layer of intestinal villi.
- Each Peyer's patch is a nodule of 30-40 lymphoid follicles. Like lymphoid follicles in other sites, those that compose Peyer's patches can develop into secondary follicles with germinal centres

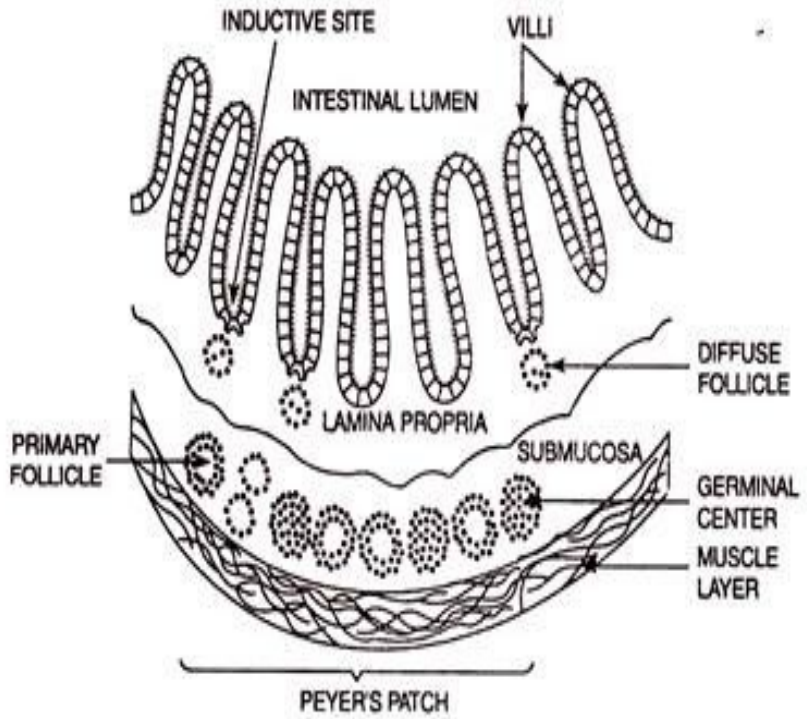

FIG. 42.6. Cross sectional view of the mucous membrane lining the intestinal lumen, and showing Peyer's patch and Lamina propria. Peyer's patch is constituted by nodule of lymphoid follicles in submucosa, whereas lamina propria contains loose clusters of lymphoid cells and diffuse follicles.

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SECONDARY LYMPHOID ORGANS

(iii) Lamina Propria:

- Lamina propria occurs under the epithelial layer of intestinal villi .
- It is populated with large number of plasma cells, macrophages, activated T helper cells (activated T_H cells) in loose clusters.
- More than 15,000 lymphoid follicles have beer, reported within the lamina propria of a healthy child.

CONCLUSION

- Primary lymphatic organs are where lymphocytes are formed and mature. They provide an environment for stem cells to divide and mature into B- and T- cells: There are two primary lymphatic organs: the red bone marrow and the thymus gland.
- The immune system is made up of organs that control the production and maturation of certain defense cells, the lymphocytes.
- Bone marrow
- Thymus
- Lymph nodes
- Spleen
- Tonsils

ASSESSMENT PATTERN

Assessment Pattern	Total Marks
1st Hourly Test	36
2nd Hourly Test	36
Surprise Test	12
Assignment (3)	10
Quiz	4
End Semester Examination	60

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THANK YOU

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