Lymphatic System

1. **Main Functions:**
   a) Lymphatic System works quietly and makes possible the continued operation of Circulatory System. It brings back about 3-4L/day of fluids, blood cells, plasma proteins to venous system.
   b) It is also vital for the 100% working of body defense.
   c) It helps in absorption of fats from intestine to blood.

2. Circulatory system is a 2-way system – heart to body tissues and from body tissues to heart. On the other hand, lymphatic system operates only from tissues to heart. It is 1-way system. Lymphatic system originates in peripheral tissues as lymph capillaries and lymphatic ducts that end at venous connections (open into subclavian veins.)

Lymphatic system consists of

3. Lymphatic capillaries, lymphatic vessels, lymphatic trunks and lymphatic ducts
4. Lymphoid tissues – tonsils, vermiform appendix and Peyer’s patches in intestine
5. Lymphoid organs – Spleen, thymus, intestinal lymphoid nodules and lymph nodes
6. Lymph – blood plasma with lower % of proteins and white blood cells
7. Lymphatic capillaries $\rightarrow$ lymphatic collecting vessels $\rightarrow$ lymphatic trunks $\rightarrow$ lymphatic duct $\rightarrow$ opens into subclavian vein.
8. Lymphatic vessels usually have more valves and branch more frequently than veins. Like veins all 3 tunics are present in lymphatic vessels but are thinner.
9. Flap-like mini-valves are present in lymphatic capillaries and help to collect interstitial fluid.
10. Lacteals are special lymphatic capillaries present in finger like Villi of intestinal wall. These lacteals collect milky white lymph, called Chyle, rich in fat products.
11. Lymphatic Ducts include 2 large ducts in thoracic region. 1. Right Thoracic duct – collects lymph from right arm, right side of head, neck and thorax. 2. Thoracic Duct – collects lymph from rest of the body. It arises inferiorly as an extended sac – Cisterna Chyli, in front of 1st and 2nd lumbar vertebrae. Right thoracic duct is not present in all humans. When absent, the lymphatic trunks directly open into veins of the neck.
12. Lymphoid Cells – all lymph cells arise in bone marrow but get mature in different ways. B-cells mature in bone marrow and T-cells mature in thymus gland.
13. B-Cells produce immunoglobulin proteins called Antibodies. Helper T-cells stimulate B-cells to transform into Plasma Cells that produce antibodies on a massive scale.


15. Lymphoid Macrophages are large phagocytes in tissues and kill antigens by phagocytosis. Macrophages may be fixed or free inside tissues. Monocytes escape from blood capillaries and transform into macrophages inside tissues.

16. **Lymphoid Tissue** is mainly a kind of loose Reticular Connective Tissue. It provides site for storage and proliferation of lymphocytes. These include tonsils, vermiform appendix and Peyer’s Patches in intestine.

17. **Tonsils** are several swellings of mucosa. These include Pharyngeal, Palatine, and Lingual Tonsils. **Pharyngeal tonsils** lie close to opening of auditory tubes and prevent infection spreading to middle ear. **Palatine tonsils** lie on palate and **lingual tonsils** lie on posterior part of tongue.

18. **Lymph Nodes** are the principal lymphoid organs. Lymph nodes are Kidney shaped and present periodically associated with lymphatic collecting vessels and trunks. **Outer Cortex** forms lymphocytes and inner Medulla has cords and reticular fibers. Macrophages are associated with reticular fibers and destroy cancer cells, microorganisms and debris. Each lymph node receives many **afferent lymphatic vessels** and passes lymph into lesser number of **efferent lymphatic vessels**.

19. **Thymus** is associated to superior side of heart and major blood vessels. It is a bilobed organ. It is best developed at the time of birth. It degenerates in middle age. It secretes thymosin hormones for differentiation of T-cells.

20. **Spleen** is fixed to lateral side of stomach. It also lies next to pancreas and left kidney. It is covered with connective tissue capsule. Trabeculae are incomplete partitions attached to capsule. White pulp stores white blood cell and macrophages around branches of splenic artery. Red pulp filters blood and white pulp produces lymphocytes. Red pulp is present in most of the spleen around branches of splenic vein. Macrophages eliminate worn out RBC in spleen.

**Recap – The Lymphatic System**

1. Lymphatic system begins as a peripheral network of lymphatic vessels in -------- --------and ends at connections to -------- --------.
2. Lymph resembles plasma but has a much lower % of -------- --------.
3. Lymphatic organs are separated by connective tissue capsules from surrounding tissues and has connections to lymphatic vessels. Main lymphatic organs include -------- -------- and -------- --------.
4. Thoracic duct arises from a sac -------- -------- and collects lymph from body except upper right side.
5. -------- -------- duct collects lymph from right upper limb, right side of head, neck and chest.
6. -------- -------- lymphatic vessels are present in intestinal villi and collect dietary fats from intestinal cells.
7. Lymphatic vessels have walls made of --------, --------, and -------- layers.
8. Unlike blood capillaries lymphatic collecting vessels = lymphatic capillaries have one end ------

9. -------- ------ are clusters associated with lymphatic vessels including cervical in neck, thoracic in chest, Axillary in armpits, intestinal and abdominal in abdomen and popliteal in lower limbs.

10. Lymph nodes produce lymphocytes and filter lymph for ------- particles and ------- cells.

11. Spleen lies to the ----of stomach and filters blood.

12. In spleen-------- pulp produces lymphocytes and ---- pulp filters blood for ageing RBC’s

13. Three types of tonsils include -------, -----------, and ------- tonsils.

14. Lymphocytes from bone marrow travel to ------ and undergo maturation.

15. Thymus is best developed in ------ and shrinks in -----------.

16. Functions of lymphatic system include returning -----L of blood filtrate to veins, filter lymph for -- -----and -----------cells, and deliver ------- ----------- from intestine to blood.

17. Lymphoid tissues include ------- and -----------.

18. Lymphatic -------- → lymphatic collecting vessels → lymphatic trunks → lymphatic ---------- → opens into ----------- veins.