Lymphatic System

Lymphatic system is part of defensive protective mechanism in our body called immune system.

The immune system comprises structures and cells that are distributed throughout the body.

Their principle function is to protect the body from invasion by microorganisms.

The lymphatic system is not a first line of defense. Protective defense mechanisms include:

i. ***Skin, mucous membrane of natural opening in our body, saliva in mouth cavity with its antimicrobial properties, acid environment in both the stomach and vagina, tears of the eye, and a layer of surface mucus that is continuously removed by ciliary action and replaced by goblet cells protects the respiratory tract. When such defences fail and an infection takes hold, the two other main types of defence mechanism are activated.***
ii. ***Group of cells known as macrophages,neutrophils and lymphocytes***
iii. ***The lymphatic system consists of a network of vessels and collections of tissue called lymphoid tissue. It collects excess fluid (lymph) from the body's tissues, returns this fluid to the blood, and stores and transports cells of the immune system, such as lymphocytes.***

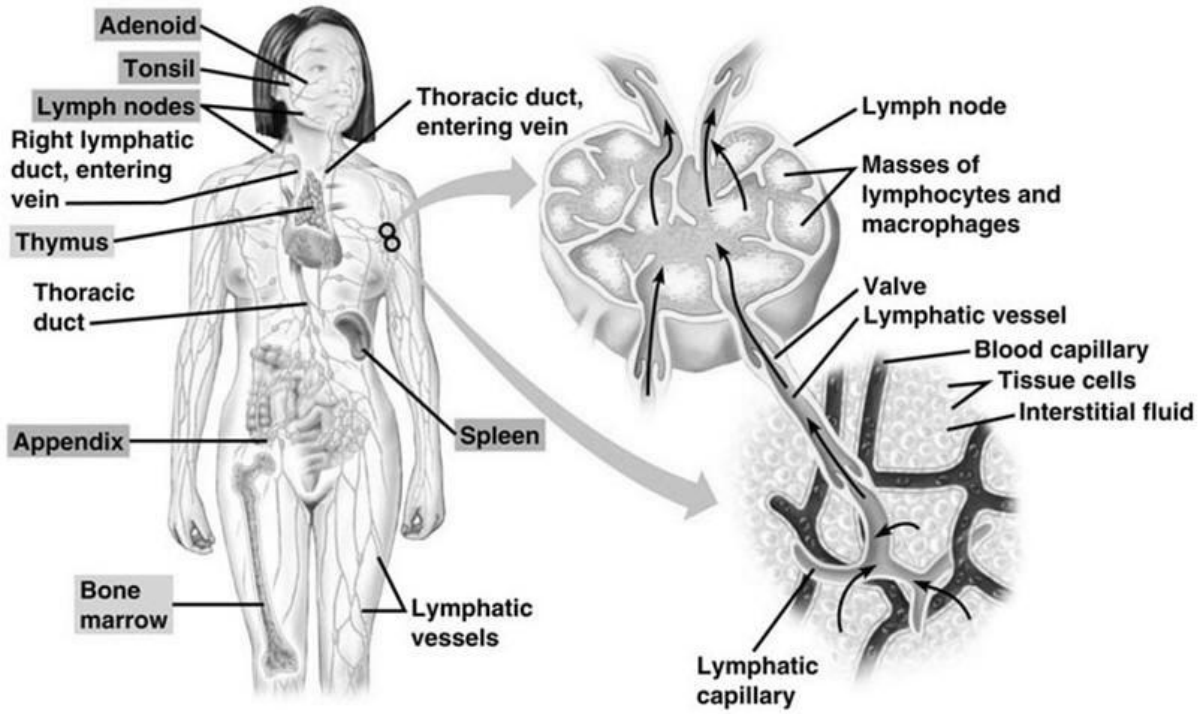
The lymphatic system is consisting of a network of tubes. These tubes are called lymphatic vessels. The fluid moving inside the system is a clear fluid known as lymph.

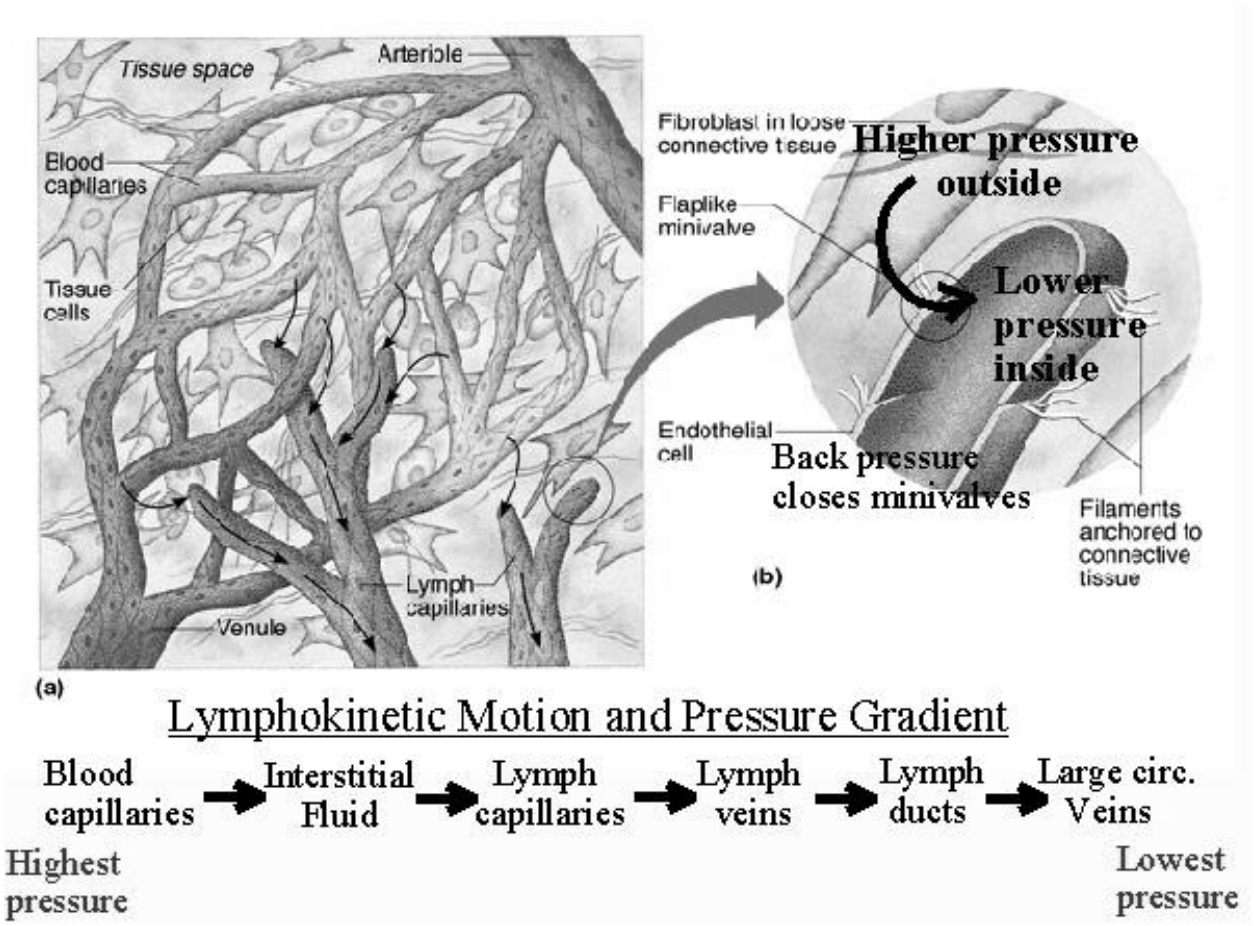
The lymphatic system has three interrelated functions:

(1) Removal of excess fluids from body tissues

(2) Absorption of fatty acids in the small intestine.

(3) Production of immune cells such as lymphocytes and. antibodies producing plasma cells.





Antigens

A foreign molecule that is recognized by cells of the immune system .

Cells of immune system:

1. Lymphocytes: Classified as T and B lymphocytes and natural killer cells.

T-lymphocytes: Responsible for cellular immunity. They originate from bone marrow a migrate to the thymus where they complete their differentiation,

Constitute 70% of circulating lymphocytes

Originate in the bone marrow and migrate to the thymus for proliferation and maturation. From the thymus they will be carried to other lymphoid tissues.

There are four types of T- lymphocytes:

i. **T-Helper: Stimulate the differentiation of B-lymphocytes into plasma cells.(*T- cells are killed by the virus causing AIDS ,which cripples the immunity of infected patients.***
ii. **T-Cytotoxic: Act against foreign cells or virus infected cells.**
iii. **T-Suppressor: Decrease the activity of both T and B lymphocytes.**
iv. **T-Memory: Respond more rapidly upon subsequent exposure by same antigens.**

2. B- Lymphocytes: Responsible for humoral immunity which depends on the presence of antibodies.

Derived from bone marrow and complete their differentiation inside the bone marrow. They migrate from there to other non-thymic lymphoid structures, where they nest, proliferate when activated and differentiate into antibody secreting plasma cells.

Constitute 5-10 % of the circulating blood lymphocytes. Some B cells do not become plasma cells; instead, they generate B memory cells which react rapidly to a second exposure to the same antigen.

Plasma cell:

Defence cell of connective tissue. Plasma cell is activated B lymphocyte. Plasma cells secrets antibodies (immunoglobulins).

Antibodies are circulating glycoproteins that interact with antigens, as a matter of defenses against these antigens. The interaction between the antigens and antibodies also facilitates phagocytosis of the antigens.

There are five classes of antibodies:

- **IgM:10% of blood immunoglobulins; attached to surface of B lymphocytes, for their activation to produce more plasma cells.**
- **IgA: Found mainly in tears,saliva,digestive system ,nasal,bronchial and prostatic secretion**
- **IgG:75% serum immunoglobulins.It is the only immunoglobulin that crosses the placenta to protect the newborn against infection.**
- **IgE: Has affinity for cell membrane of mast cell and basophils. It has a receptor there .**
- **when antigens attached to IgE ,an antigen-antibody complex formed which triggers the production of:**

  a. **Heparin :Act as anticoagulants.**
  b. **Histamine:act as vasodilator.**
  c. **Eosinophil-chemotactic factor which bring eosinophil to the site of injury.**

- **IgD: 0.2% of blood immunoglobulins ;found on cell membrane of B lymphocytes (for activation)**

d. Natural killer cells: They are a type of activated cytotoxic lymphocytes. Attack virus infected cells and cancer cells .

Thymus

It is primary lymphatic organ, attain its peak development during youth,

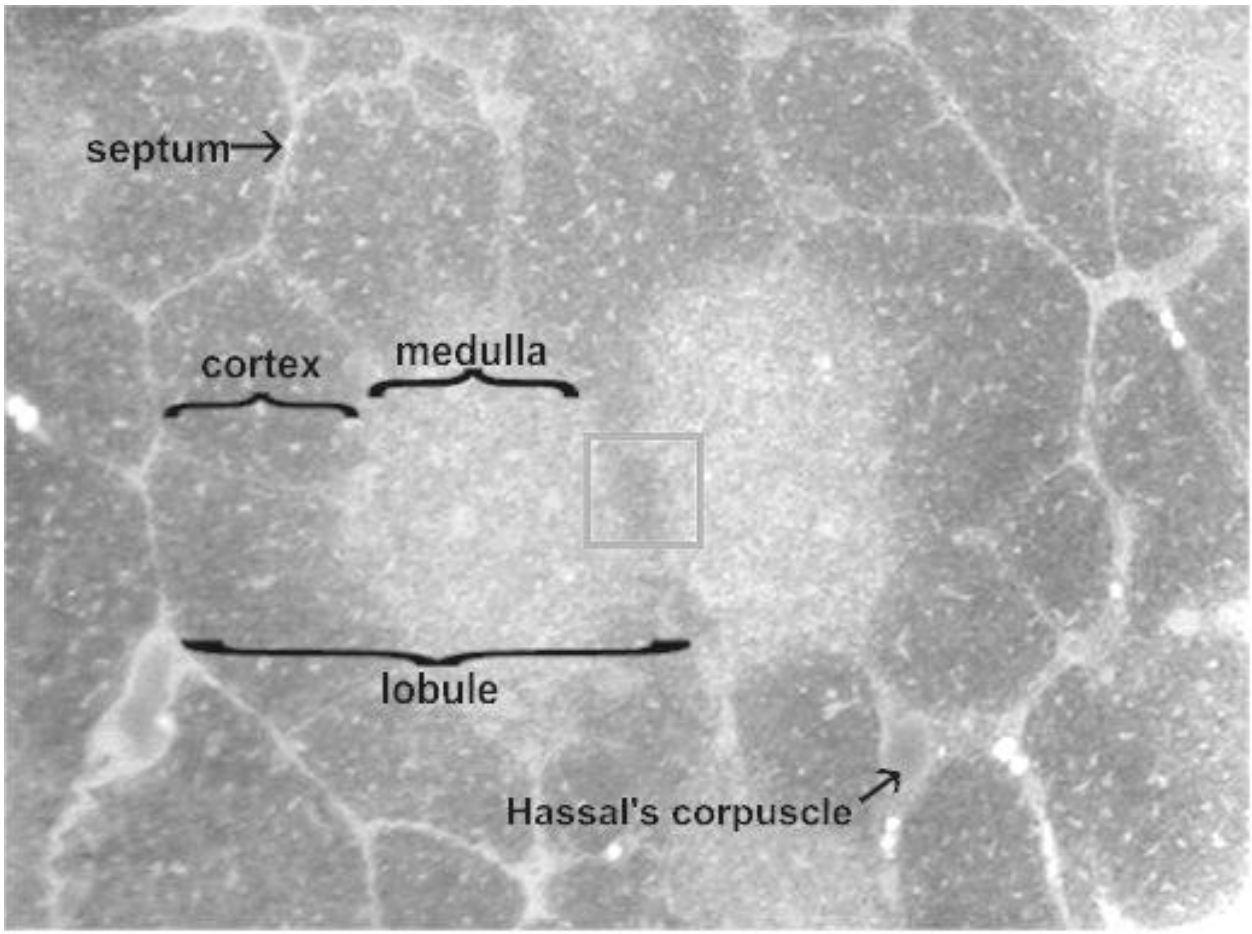
It has connective tissue capsule that send trabecullae to divide the organ into lobules.

Each lobule has an outer darkly stained cortex and an inner lighter medulla .

The cortex is composed of thymocytes (T lymphocytes). T lymphocytes get its maturation inside the thymus.

.

The medulla contains Hassall's corpuscles.

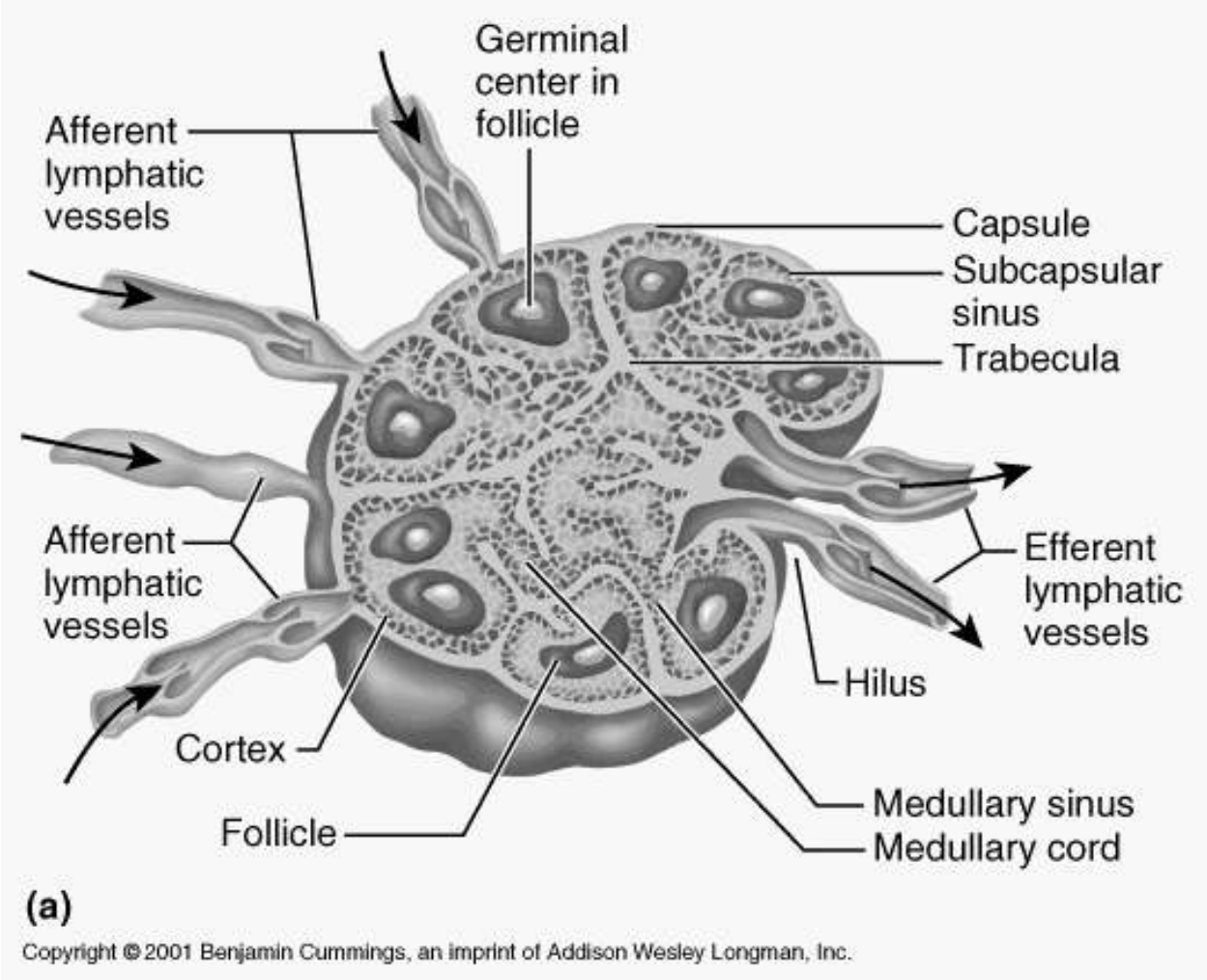


Lymphoepithelial bilobed organ located in the superior mediastinum.

Lymph node

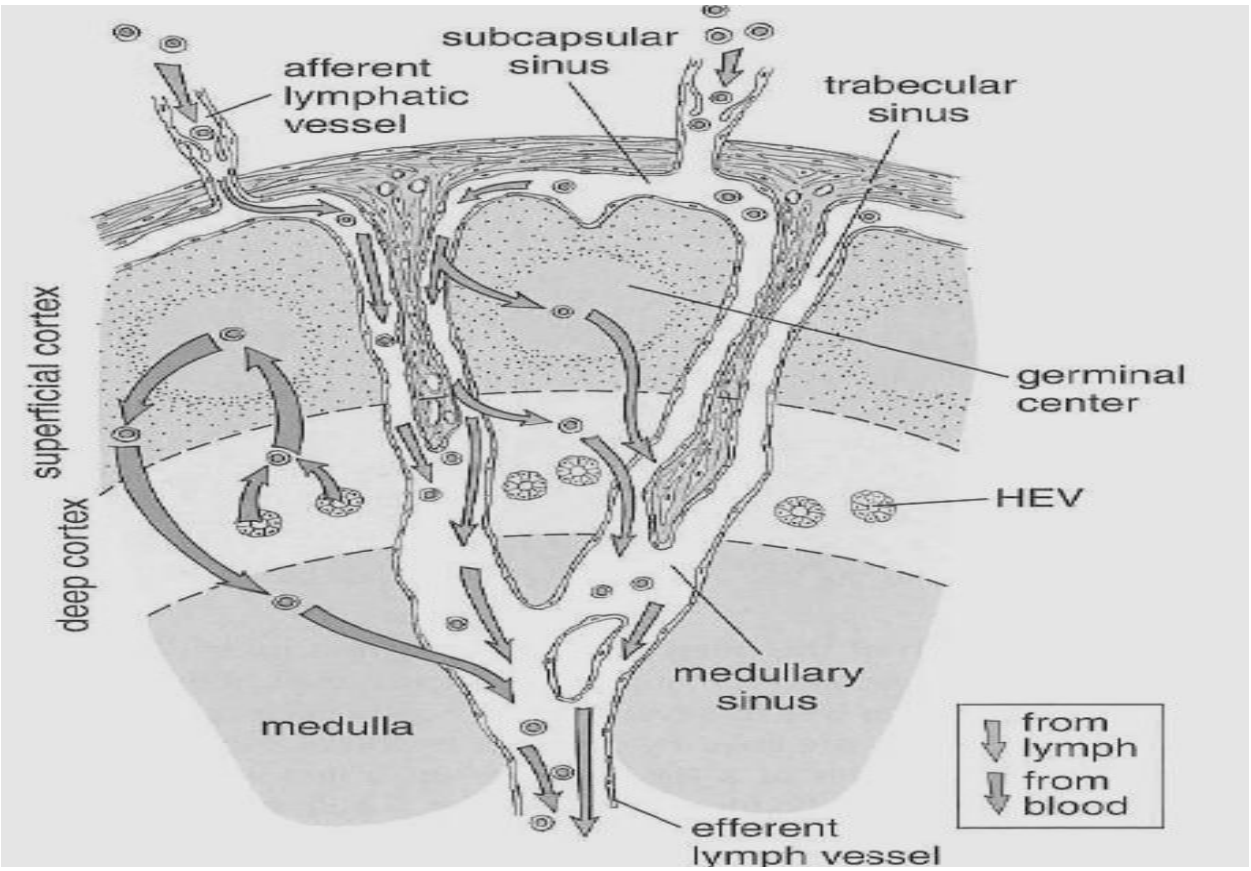
Small encapsulated organ located in the pathway of lymph vessels. They are absent in the CNS. Its main function is *filtering the lymph*. It is covered by a capsule and having a bean shape ,thus it has a convex side and a concave depression called the hilum through which blood vessels enter and leave the organ.

The connective tissue capsule surrounding the lymph node, send trabecullae into its interior. Each node contains an outer cortex and an inner medulla.



Cortex:

Outer cortex: The cells of the outer cortex are including dendritic cell and B lymphocytes. At outer surface of the outer cortex is the subscapular sinus which communicates with medullary sinuses. It is formed of lymphatic nodules (follicles).There are two types of L. nodules: primary and secondary. The primary nodules have no germinal center while the secondary nodules are characterized by presence of germinal centers.



Circulation of lymph inside the Lymph node:

Lymph is entering the lymph node through the afferent lymphatic vessels which cross the capsule and pour lymph into the subcapsular sinuses which passes into the medullary sinuses. The complex architecture of both the subcapsular sinuses and medullary sinuses slow the flow of lymph through the node, facilitating the uptake and digestion of foreign materials by macrophages and dendritic cells. Lymph is collected by efferent lymphatic vessels at the hilum.

As lymph flow through the sinuses, 99% of the antigens are removed by the phagocytic activity of the macrophages.

Spleen

The spleen is the largest accumulation of lymphoid tissue in the body and the only one interposed in the blood circulation.

Functions

1. Filtration of blood: because of its abundance of phagocytic cells, the spleen is an important defense against antigens that reach the blood circulation.

ii. It is also the site of destruction of aged erythrocytes.

2. The spleen is a production site of activated lymphocytes, which are delivered to the blood.

General Structure:

The spleen is surrounded by a capsule of dense connective tissue from which emerge trabeculae, which divide the parenchyma, into incomplete compartments. Only efferent Lymphatic vessels present in spleen

The splenic pulp has two components: The white pulp and the red pulp .

White Pulp

The splenic artery divides into smaller arteries which enter the parenchyma, the arteries are immediately enveloped by a sheath of T lymphocyte . These vessels are known as central arteries.

Red Pulp

The red pulp is composed of splenic cords and sinusoids . The splenic cords contain T and B lymphocytes, macrophages, plasma cells, and many blood cells (erythrocytes, and platelets). In the red pulp there will be removal of the aged red blood cells which have reached 120 days of age. The macrophage is responsible for that job.

Tonsils

The tonsils constitute a lymphoid tissue that are covered by epithelium. Tonsils in the mouth and pharynx are called **palatine, pharyngeal,** or **lingual tonsil in the posterior one third of the tongue. These tonsils form a ring in the pharynx called tonsilar ring of Waldeyer's.**

Palatine Tonsils

The two palatine tonsils are located in the lateral walls of the oral part of the pharynx .

Each tonsil has 10–20 epithelial invaginations that penetrate the tonsil deeply, forming **crypts,** whose lumens contain desquamated epithelial cells, live and dead lymphocytes, and bacteria.

