

## Lymphatic system

The lymphatic system is composed of lymphatic vessels that transport interstitial fluid (as lymph) back to the blood circulation, and the lymphoid organs that house lymphocytes and other cells of the body's immune defense system. The major lymphoid organs include:

1. The *thymus*
2. The *bone marrow*
3. The *lymph nodes*, found at the junctions of major lymphatic vessels, are the sites where both T and B lymphocytes may interact with antigen and APCs from the circulating lymph, leading to lymphocyte activation and cell division.
4. The *spleen*, situated in the left upper quadrant of the abdomen, is the location where T and B lymphocytes may interact with blood-borne antigen and undergo stimulation and cell division.
5. *Mucosa-associated lymphoid tissue (MALT)* includes the *tonsils* and *adenoids* in the oropharynx, *Peyer's patches* and *lymphoid aggregates* of the small and large intestines.

TABLE 14-3

Approximate percentages of B and T cells in lymphoid organs.

Lymphoid Organ	T Lymphocytes (%)	B Lymphocytes (%)
Thymus	100	0
Bone marrow	10	90
Spleen	45	55
Lymph nodes	60	40
Blood	70	30

## Thymus

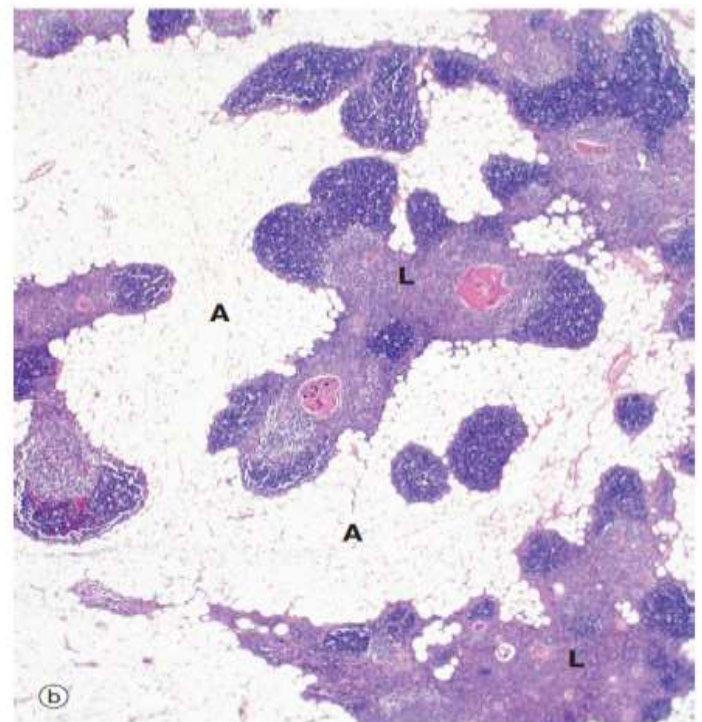
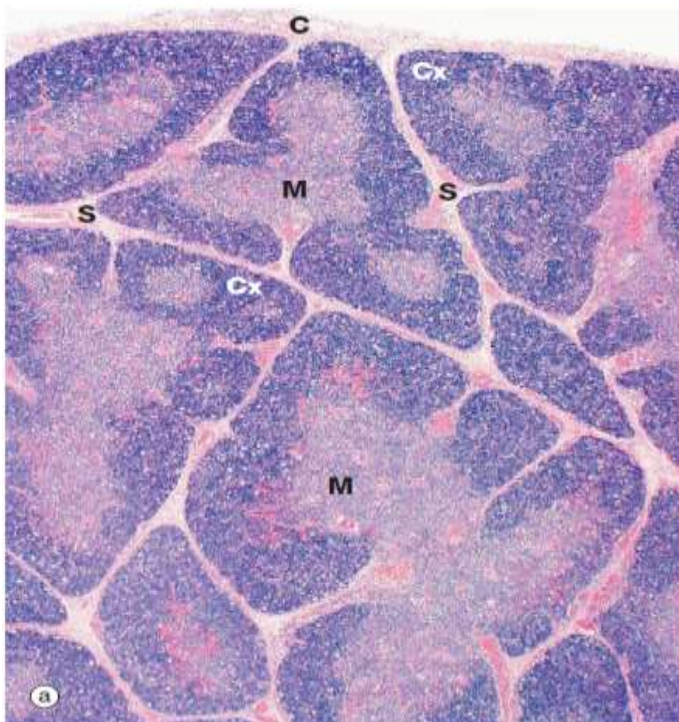
It is a flattened lymphoid organ located in the upper anterior mediastinum and lower part of the neck. The thymus is most active during childhood, reaching a weight of about 30 to 40g at puberty, after which it undergoes slow involution so that in the middle-aged or older adult it may be difficult to differentiate from adipose tissue.

### The functions of the thymus

1. Development of immunocompetent T lymphocytes from bone marrow
2. Proliferation of clones of mature T cells to supply the circulating lymphocyte pool and peripheral tissues.
3. More than 98% of maturing cells die by apoptosis within the thymus, and many of these are self-reactive.
4. The thymus secretes various polypeptides with hormonal characteristics, including *thymulin*, *thymopoietin* and *thymosins*. These hormones regulate T cell maturation, proliferation and function within the thymus and peripheral lymphoid tissues.

### Histological structure of thymus

The infant thymus (a) is a lobulated organ invested by a loose collagenous *capsule C* from which interlobular *septa S* containing blood vessels radiate into the substance of the organ. The thymus tissue is divided into two distinct zones, outer cortex *Cx* and an inner medulla *M*; distinction between the two is most marked in early childhood, as in this specimen. In the adult (mid-30s in this case), the thymus (b) is already well into the process of involution, which involves two distinct processes, fatty infiltration and lymphocyte depletion (lymphoid tissue *L*, adipose tissue *A*).



**PLymph Nodes:** bean-shaped, encapsulated lymphatic organs. They range in size from about 1 mm to about 1 to 2 cm in their longest interposed along the larger regional vessels of the lymph vascular system. The human body has about 450 lymph nodes, grouped mainly in areas where the lymphatics converge to form larger trunks as in the neck, axillae, groins, lung and mesentery of the bowel.

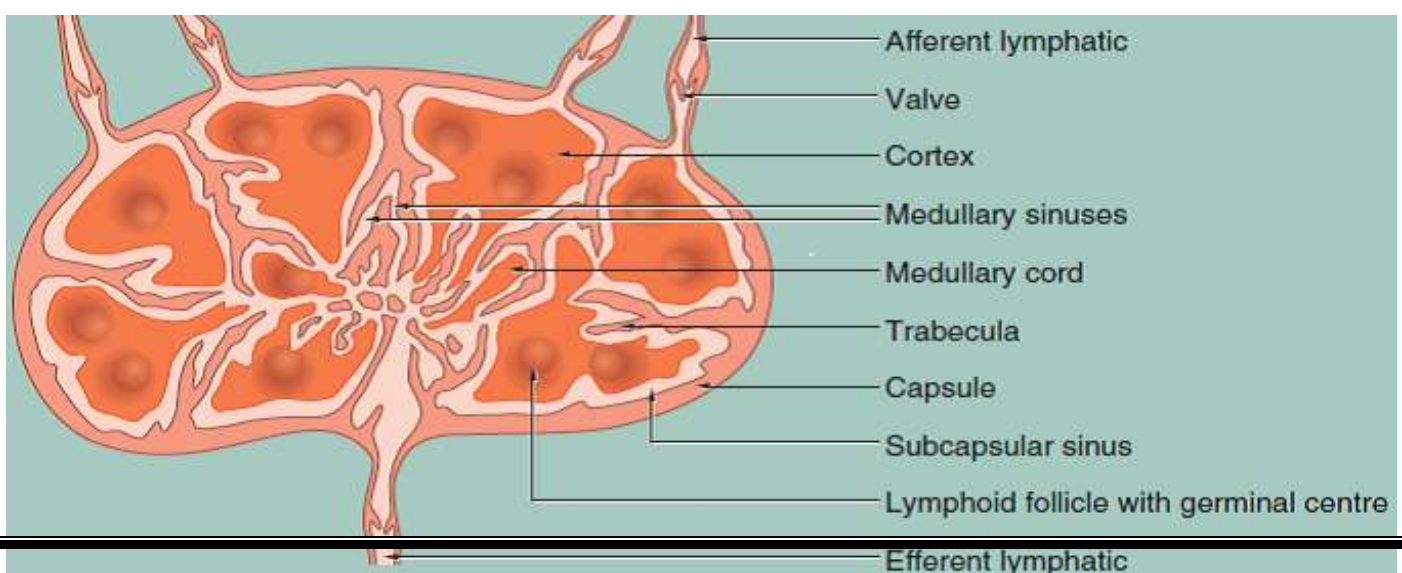
### Structure of a lymph node

A lymph node has a convex surface where **afferent lymphatics** enter and a concave depression, the **hilum**, where an **efferent lymphatic** leaves and where an artery, vein, and nerve penetrate the organ, form three major regions: an outer **cortex**, a central **medulla**, and a smaller area between these two called the **paracortex**. The **cortex** includes the following components:

- A **subcapsular sinus**, immediately inside the capsule, receives lymph from the afferent lymphatics ,
- **Cortical sinuses** (or **trabecular sinuses**) branch internally among the lymphoid nodules along trabeculae.
- **Lymphoid nodules (lymphoid follicles)**, with or without germinal centers, fill most cortical areas

The **medulla** of a lymph node has two major components:

- **Medullary cords** are branched cordlike masses of lymphoid tissue extending from the paracortex. They contain T and B lymphocytes and many plasma cells.
- **Medullary sinuses** are dilated spaces lined by discontinuous endothelium that separate the medullary cords.



**Spleen** is a large lymphoid organ situated in the left upper part of the abdomen. In humans, the spleen has four main functions:

1. Production of immunological responses against blood borne antigens
2. Removal of particulate matter and aged or defective blood cells, particularly erythrocytes, from the circulation
3. Recycling iron to the bone marrow
4. Haematopoiesis in the normal fetus and in adults with certain diseases

### Structure spleen

The organ is surrounded by a **capsule(C)** of dense connective tissue from which emerge **trabeculae (T)** to penetrate the parenchyma or **splenic pulp**, This splenic pulp has two components: the **white pulp (W)** (20% of the spleen) and the **red pulp (R)**. The small masses of white pulp consist of **lymphoid nodules** and the **periarteriolar lymphoid sheaths (PALS)**, while the red pulp consists of blood-filled **sinusoids** and **splenic cords**.

FIGURE 14-21 Spleen.



**Mucosa-associated lymphoid tissues (MALT):** Secondary lymphoid structures, where most lymphocytes are activated by antigen presentation, is distributed at many mucosal surfaces throughout the body but is concentrated in the **tonsils**, **Peyer patches**, and the **appendix**, because of mucosa or inner lining of the digestive, respiratory, and genitourinary tracts is a common site of invasion by pathogens because their lumens open to the external environment.