

بِسْمِ اللَّهِ الرَّحْمَنِ الرَّحِيمِ

# **IMMUNOLOGY**

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**Clinical Immunology**

# REFERENCES:

- Medical Microbiology by Jawetz
- Immunology by Roitt
- Immunology by kuby

# Objectives:

- Introduction
- Function of immune system
- Types of immunity and Characteristics
- Anatomy of immune system

**Immunity:** is a specific resistance to infection caused by different pathogens.

**Immune system:** collection of cells ,tissues, receptors, organs and molecules that mediate response and function properly .

**Immune response:** Coordinated reaction of cells and molecules to infectious disease.

# Immunology

**Is the science that study  
immune system and its  
response to pathogens**

# Function of the immune system:

1. Prevent infection
2. Eradicate established infection
3. self/non-self discrimination

# TYPES OF IMMUNITY

- Innate immunity
- Adaptive immunity



# **Innate immunity: Exterior defense mechanism**

## **Characteristics of innate immunity:**

- 1. Pre exist**
- 2. Not specific**
- 3. No memory**
- 4. Response minutes or hours**
- 5. No diversity**
- 6. Not discriminate between self cell and non self cell**

# ***1-Anatomic Barriers***

## **1-Skin**

**epidermis, dermis**

low pH due to lactic and fatty acids secreted from sebaceous glands associated with hair follicles

**2-Mucous membranes:** ciliated epithelial cells; saliva, tears and mucous secretions - GIT, urogenital, respiratory tracts

## ***2- Physiologic Barriers***

**1-Temperature** - normal body temperature inhibits growth of most microorganisms and

**Elevated body temperature** **fever** can have a direct effect on pathogenic microorganisms.

**2- pH** - low pH of stomach, skin, & vagina inhibits microbial growth

**3- Presence of Oxygen**

## 3-chemical barriers:

1. **Lysozyme**: hydrolytic enzyme found in mucous secretions able to cleave the petidoglycan layer of the bacterial cell wall
2. **Defensins**: Low molecular weight protein produced in base of crypts of small intestine and respiratory tract.
3. **Lactoferrin**: it is mucosal secretion present in the milk and mucosal secretion

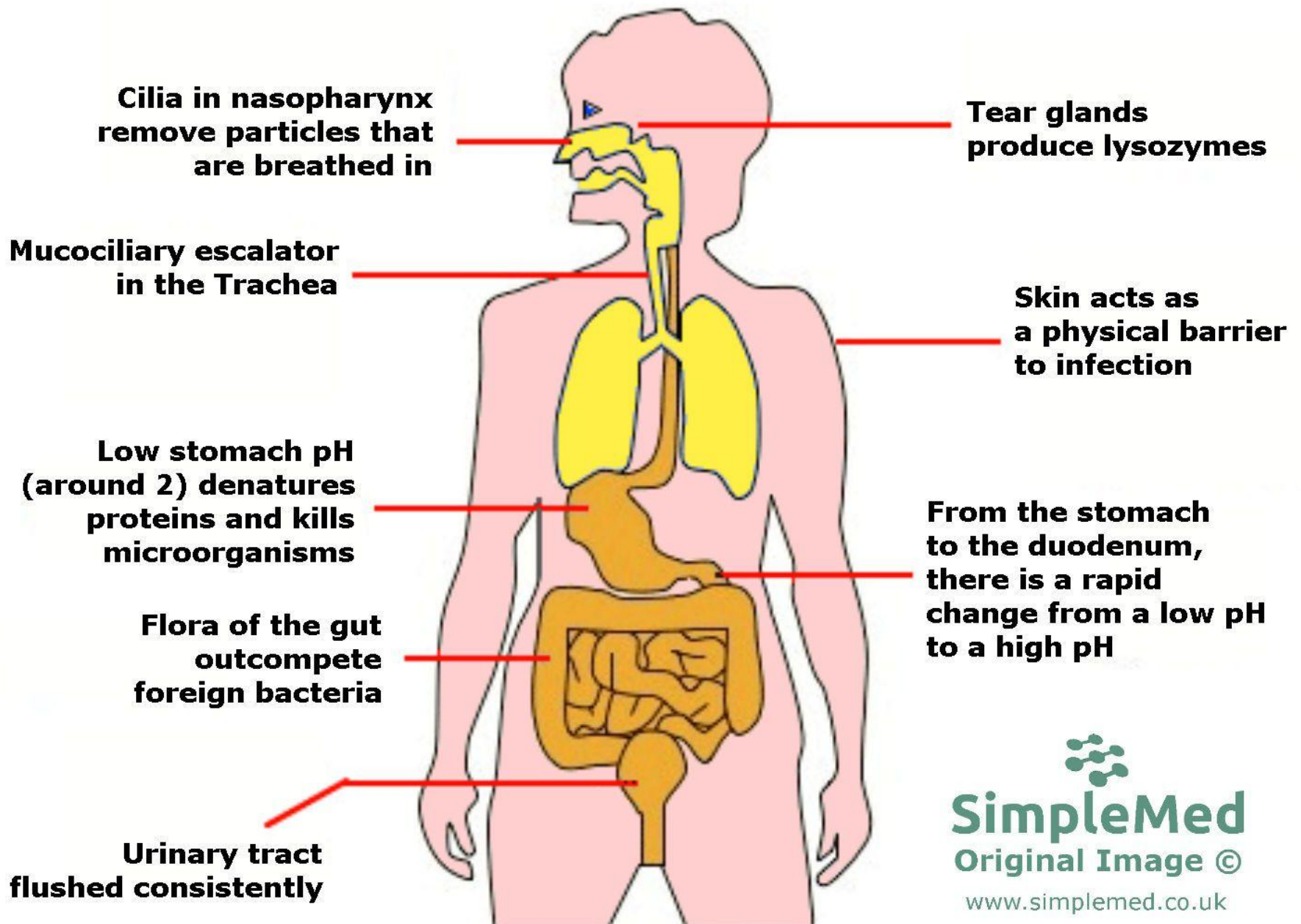
## 4-Cellular barrier

1. Neutrophil
2. Macrophages
- 3-Natural killer cells
- 4-Dendritic cells.

- The mechanism that cells can kill pathogen is phagocytosis
- Phagocytosis is triggered by specific receptors
  - 1- pattern recognition receptors like Toll like receptors
  - 2-Opsonin receptors like Ig Fc receptors and complement receptors

# Toll-like receptors

- Phagocytic cells have a variety of Toll-like receptors which recognize broad molecules on pathogens so called **PAMPs (pathogen associated molecular patterns)**. Binding of infectious agents to Toll-like receptors results in phagocytosis and the release of inflammatory mediators by the cell.





# Adaptive immunity include:

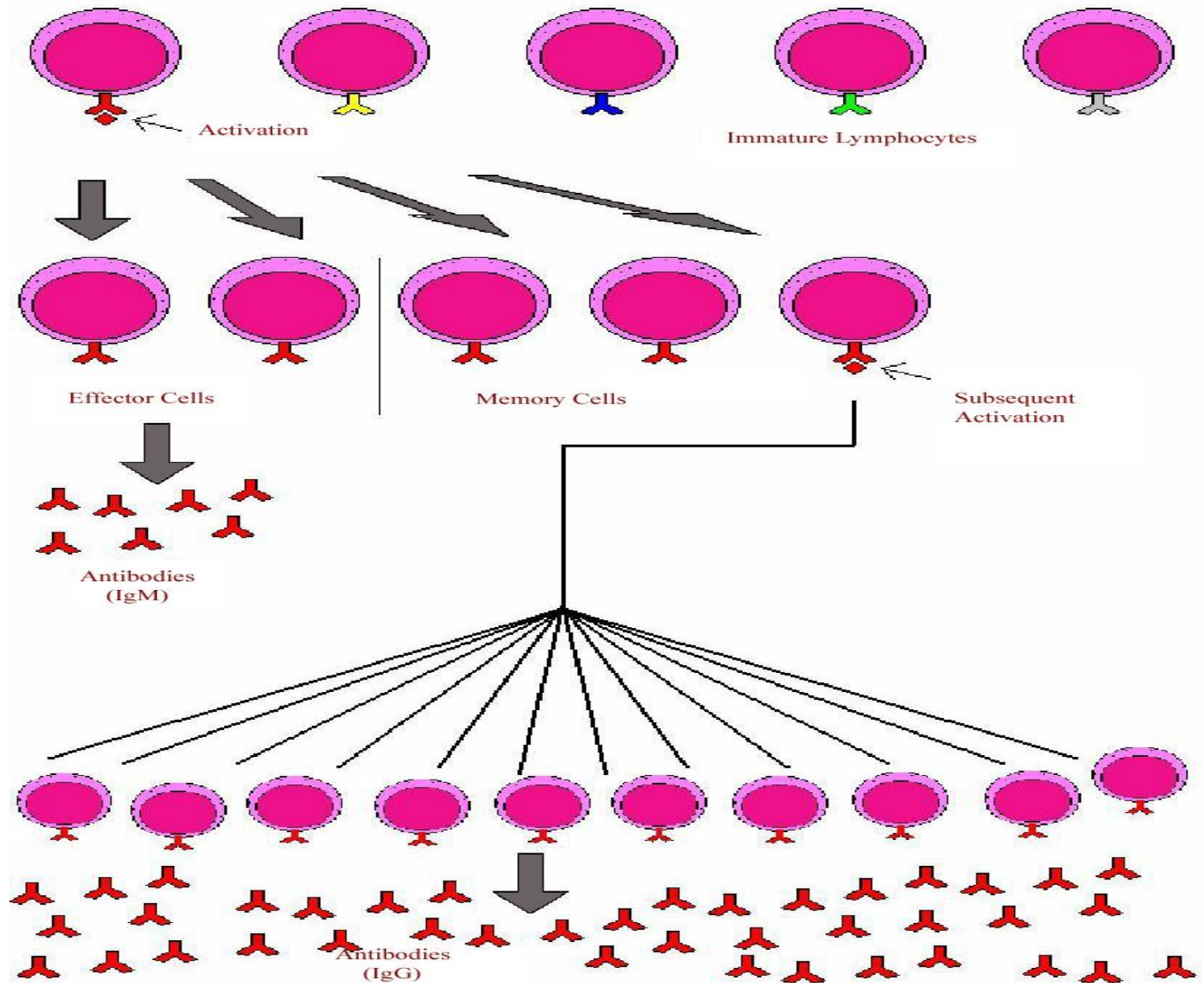
## 1- Lymphocytes

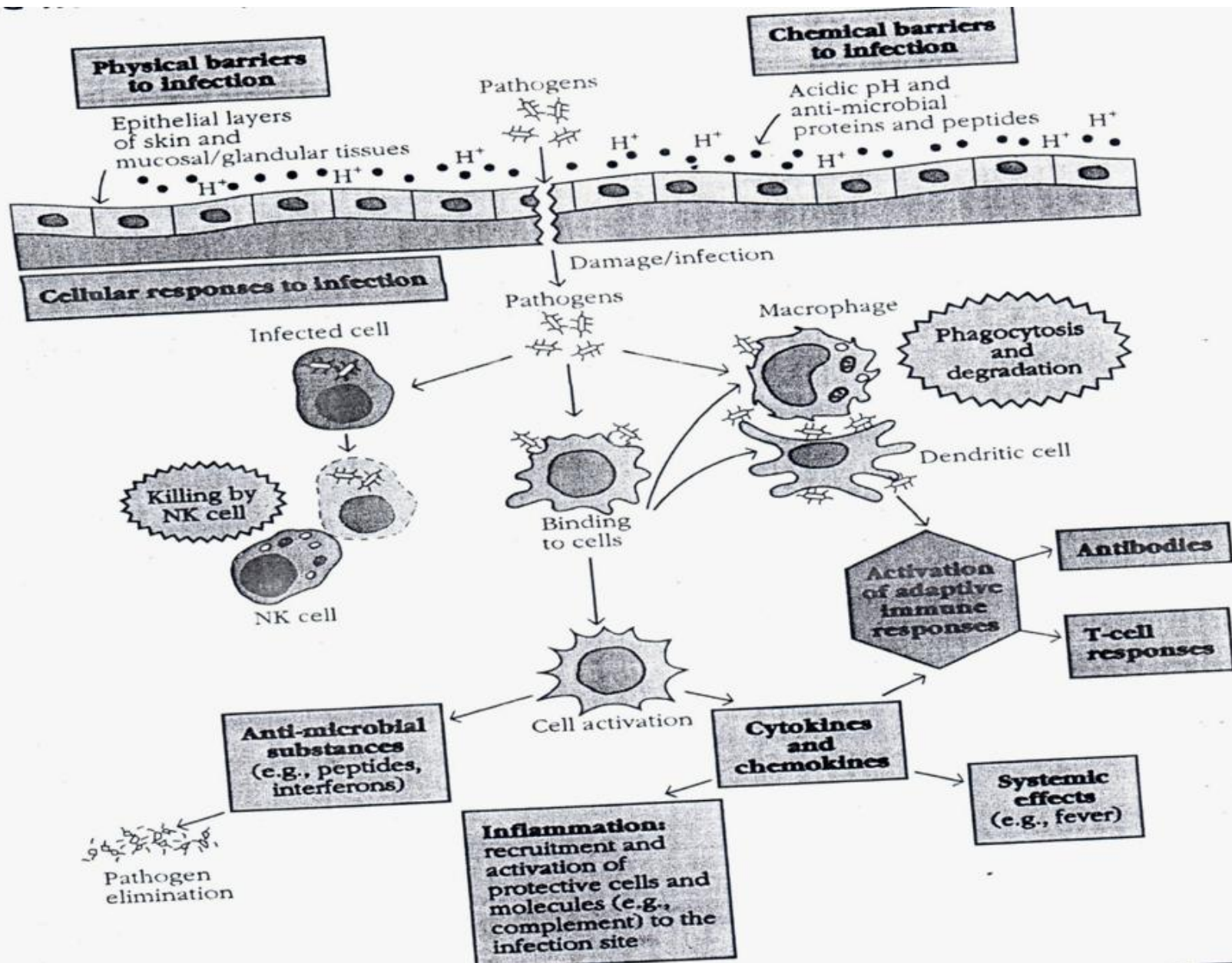
T lymphocytes-----cell mediated immunity

B lymphocytes-----humoral immunity  
production of antibodies

## 2- Characteristics of Adaptive immunity

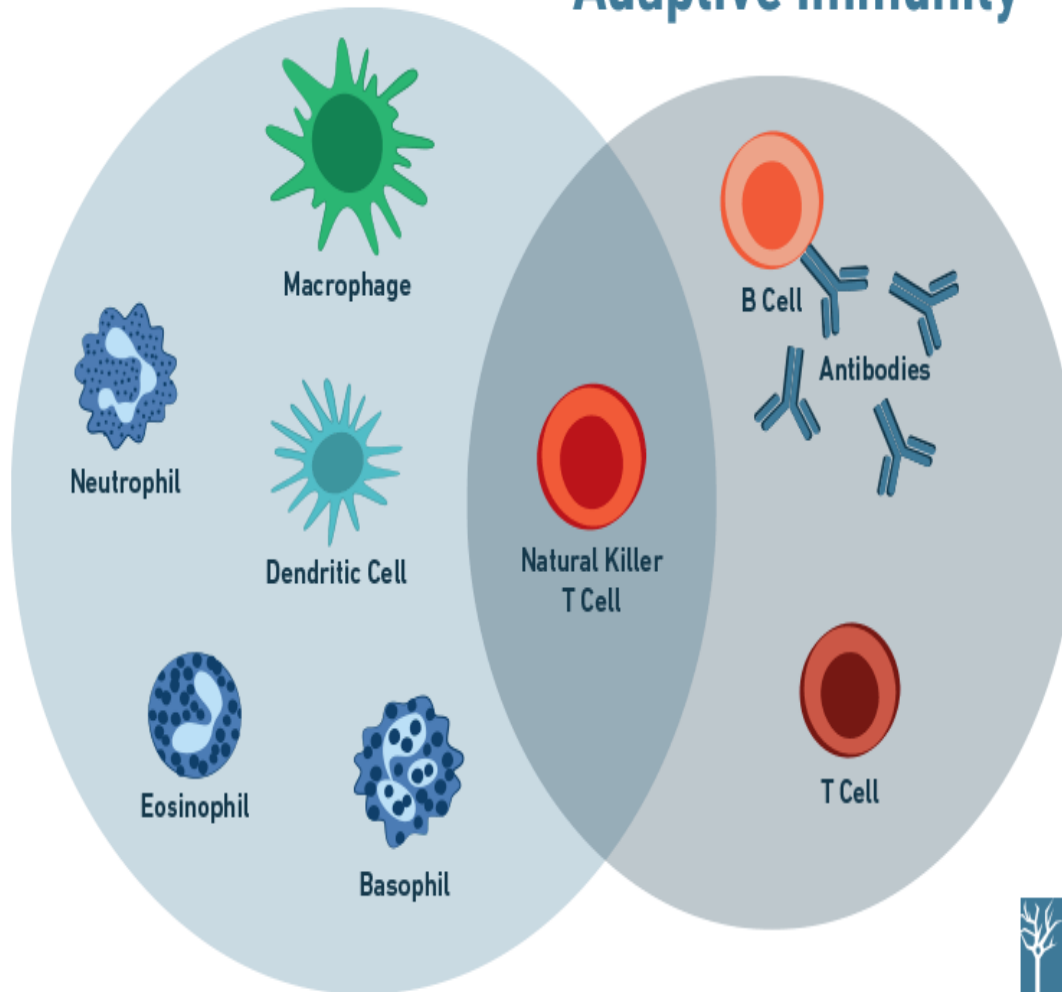
1. Specificity: Virus, bacteria, fungus and helminthes
2. Diversity: very large number of receptors
3. Memory
4. Self cell non self cell recognition
5. Clonal expansion:an immunological response in which lymphocytes stimulated by antigen proliferate and amplify the population of relevant cells
6. Delay response time (Days)





# Innate Immunity

# Adaptive Immunity



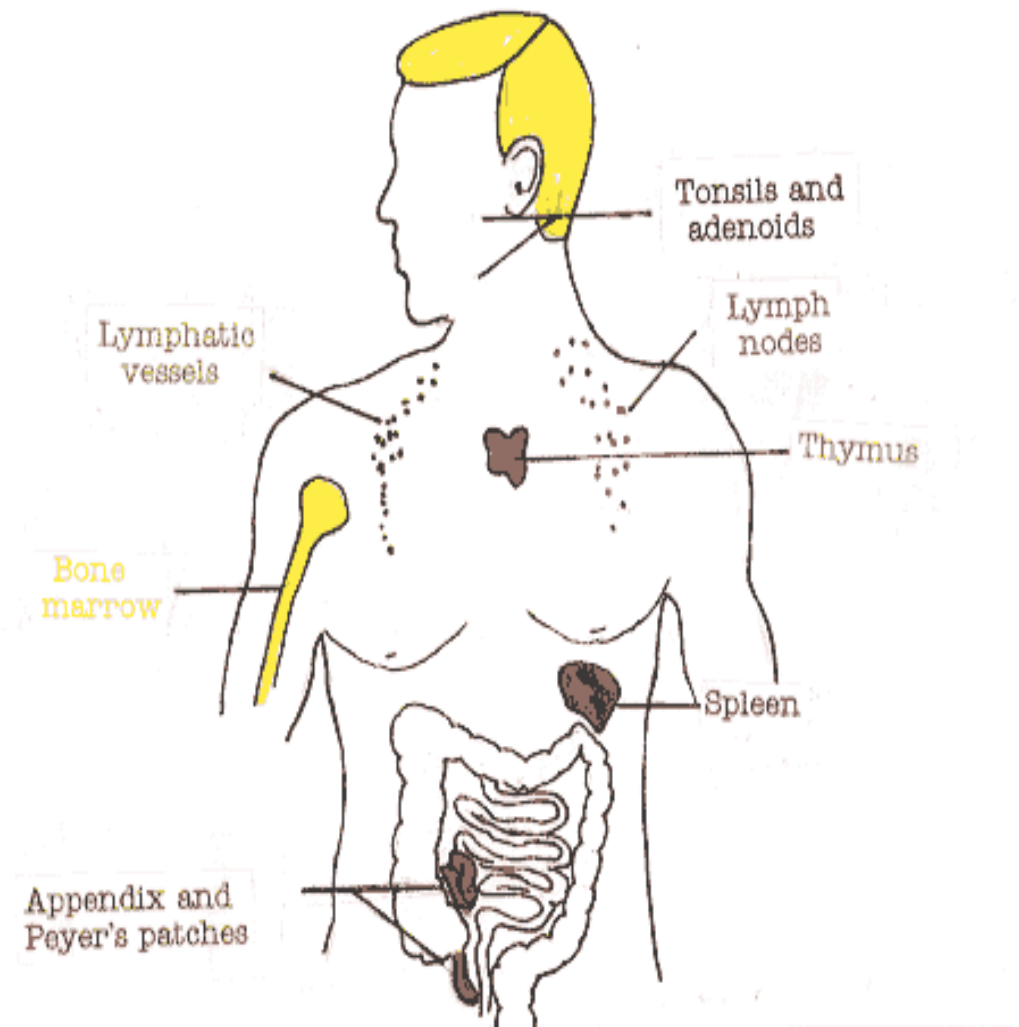
# ANATOMY OF THE IMMUNE SYSTEM

## 1. Primary:

- thymus,
- Bone Marrow,
- bursa of Fabricius

## 2- Secondary:

- Spleen
- Lymph Node,
- Tonsils,
- adenois,
- GALT,MALT



- Generation of mature lymphocytes first occurs in the embryo in
  - yolksac
  - fetal liver and spleen
  - fetal bone marrow

and continues through out life in birds (lymphoid organs called Bursa of fibricius (primary site of B-cell maturation)  
In humans –Bone Marrow and other lymphoid tissue serve as Bursa equivalent

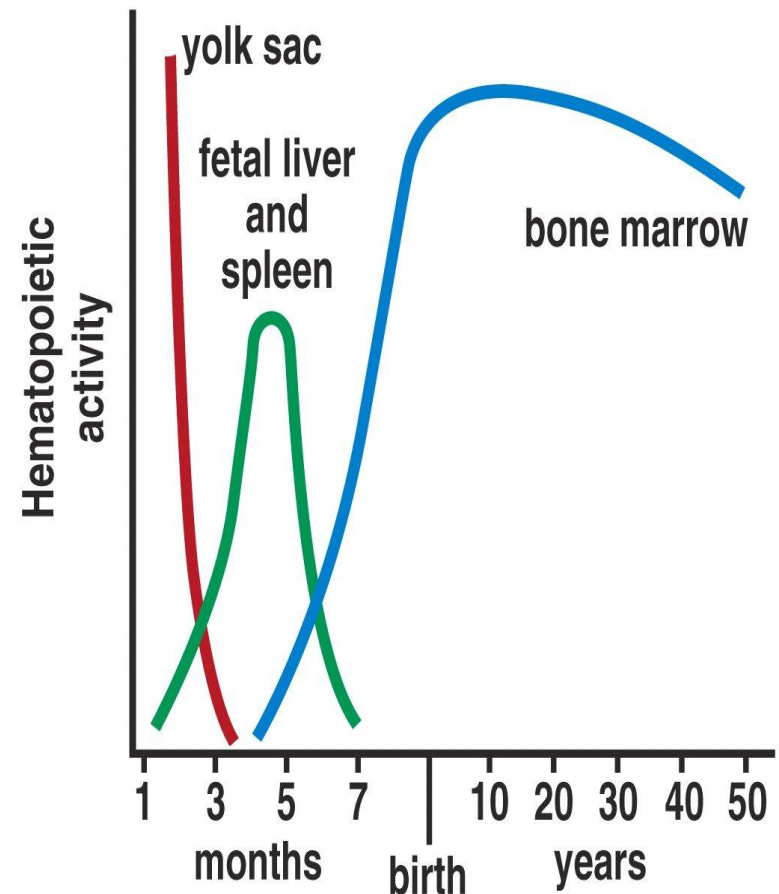
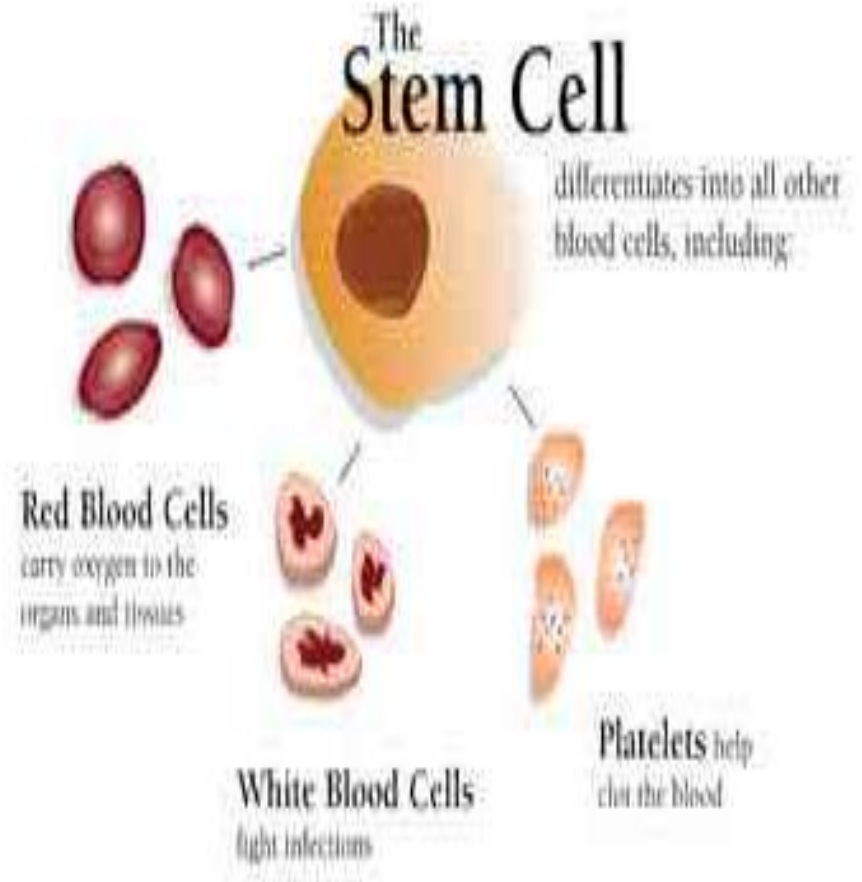


Figure 1-10 The Immune System, 2/e (© Garland Science 2005)



# Bone marrow

The bone marrow is where the lymphatic process begins. Stem cells in the soft tissue in the shafts of the long and pelvis produce white blood cells and red blood cells. The white blood are transported in a whitish medium called the lymph throughout the lymphatic distribution system.



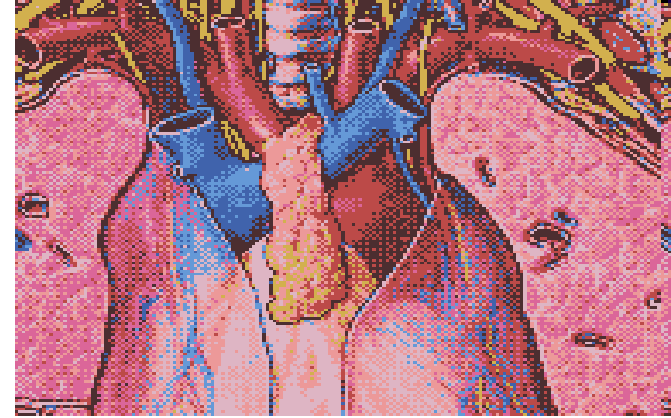


## In BM a selection process occurs and elimination of B-cells that react with self antigens

There are thousands of lymph vessels or channels throughout the body that transport and distribute lymph-containing white cells. This network of channels is parallel to and connects to **the blood vessels**. The lymphatic system also scavenges dead cells from the blood and distributes and re-absorbs the various cells of the immune system to and from the blood.



# Thymus



- Its flat , bilobed organ situated above the heart. Each lobe is surrounded by a capsule divide into lobule and separated from each other by a trabeculae.Each lobule is organized into cortex and medulla.
- Hormones (thymosin, thymulin )and (enzymes like adenosine deaminase)

# In the thymus:

## 1-differentiation occur

1- Progenitor T cells (hematopoiesis) leave bone marrow then enter thymus and undergo differentiation by acquiring differentiation markers during development called CD markers (CD = Cluster of Differentiation ) markers.

1-Immature double negative (CD3+ CD4- CD8-) then

2-immature double positive thymocytes (CD3+ CD4+ CD8+) then

3-mature single positive single negative thymocytes (CD3+ CD4+ CD8-)

(CD3+ CD4 – CD8+)

## 2-Thymic education and selection

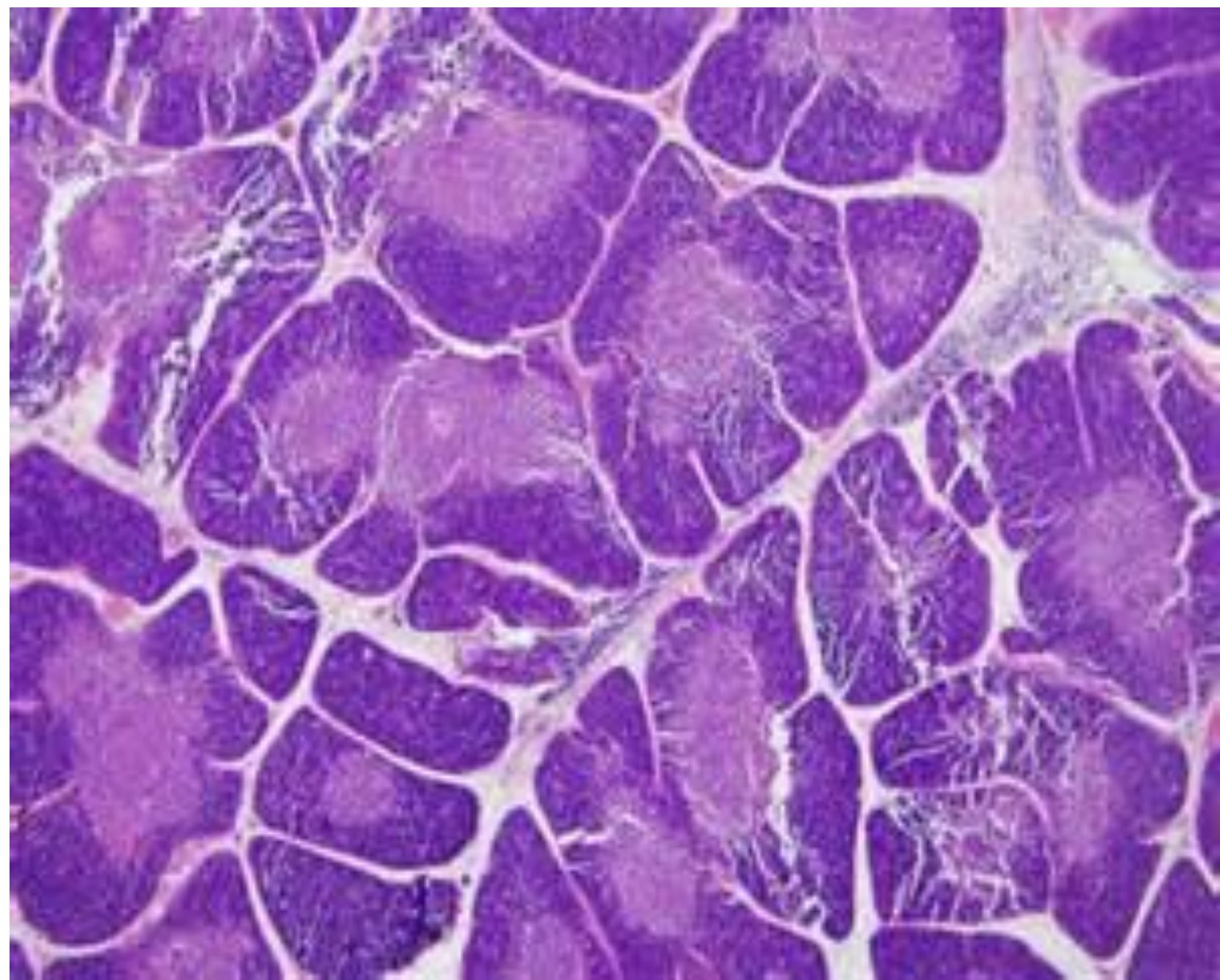
- The property of mature T cells is recognized only foreign Ag (non self)+self MHC molecule. This can be achieved by selection process
- Negative selection.
- Positive selection.
- The two processes called lymphocytes teachings or education.

# Negative selection

- Any lymph. Acquire receptors with high affinity for self Ags will be die by a programmed cell death (apoptosis). This occurs in the medulla by macrophages and dendritic cells. (95-99%)

# Positive selection

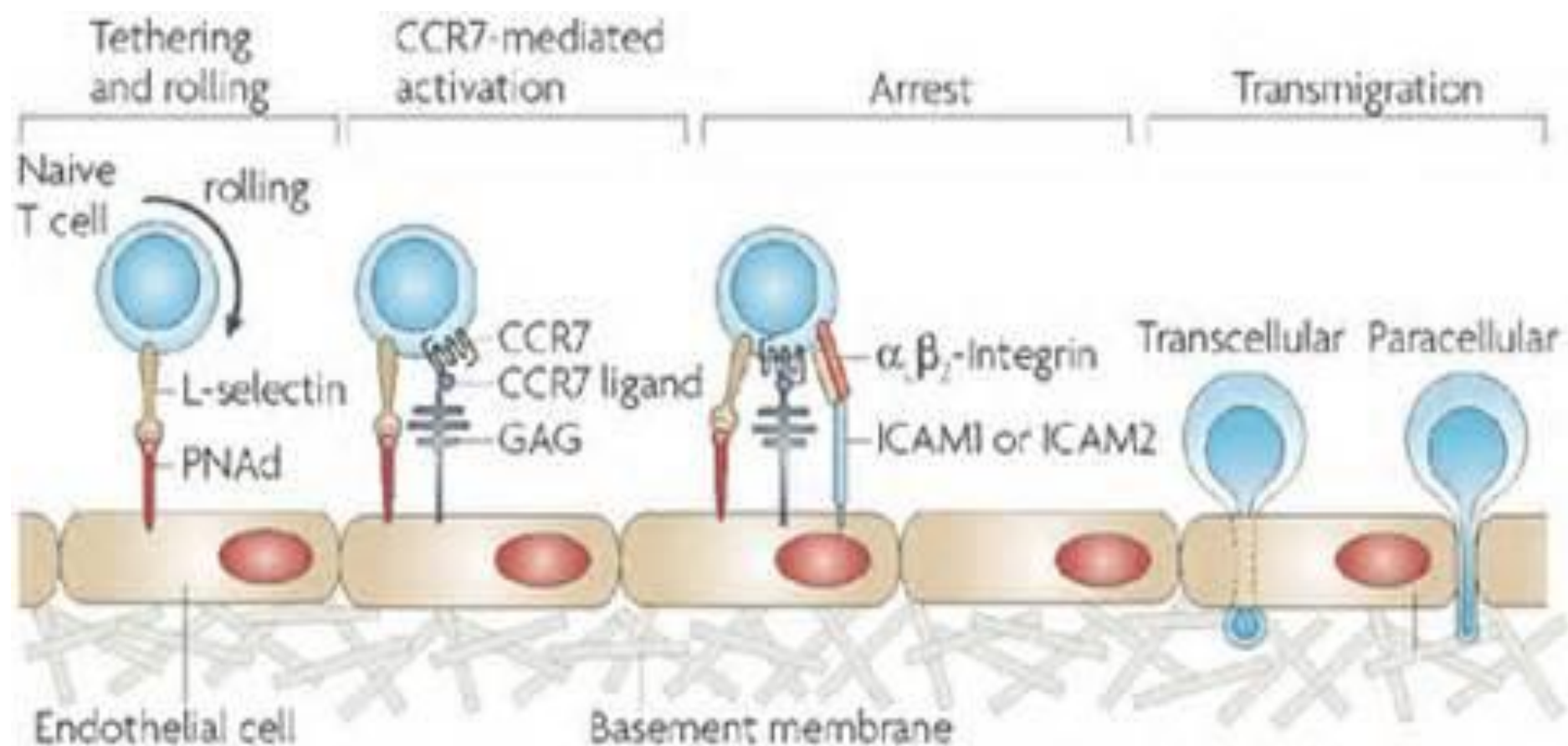
- Any lymph. Acquire receptors recognize foreign Ags+ self MHC molecule will allow to mature and expand and survive (1-5%). This occurs in the cortex of the thymus by epithelial cells.



# Lymphocytes homing

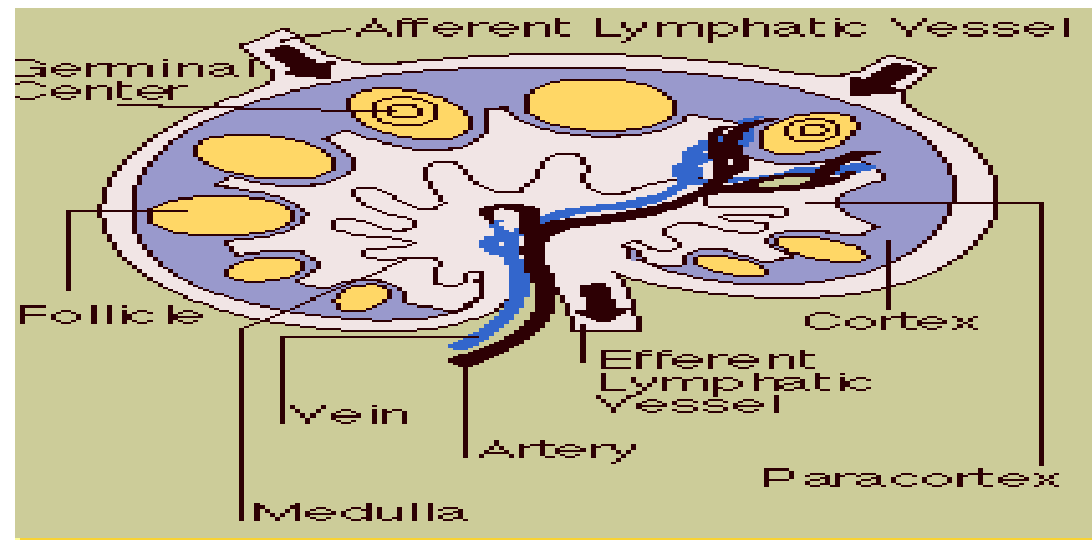
- Lymphocytes leave thymus to sec. lymphoid organs (LN) and to sites of inflammations through high endothelial venules (HEV) by binding to specific receptors on lym. and cell adhesion molecules on HEV after that lym. homing to different tissues (GALT, MALT, skin dermal endothelial venules ) by a cascade of interactions between adhesions molecules on lym. And other cells.



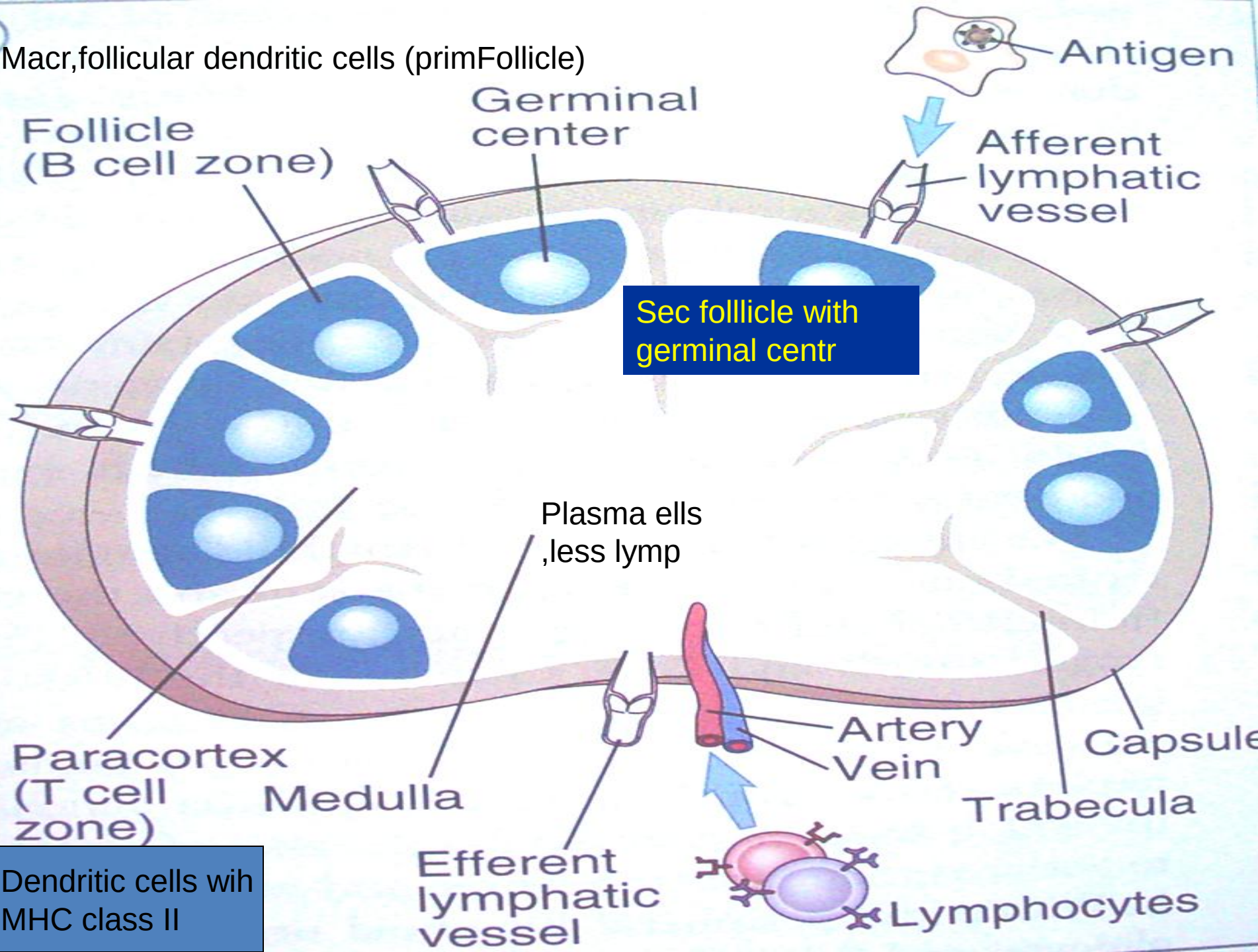


# Lymph nodes

- Bean shaped , encapsulated ,containing a reticular network packed with lymph., macrophages and dendretic cells .
- Cortex. populated with B cell
- Paracortex. populated with T cell
- Medulla .



Macr,follicular dendritic cells (primFollicle)



Sec follicle with germinal centr

Plasma cells, less lymph

Paracortex (T cell zone)

Dendritic cells with MHC class II

Efferent lymphatic vessel

Artery Vein

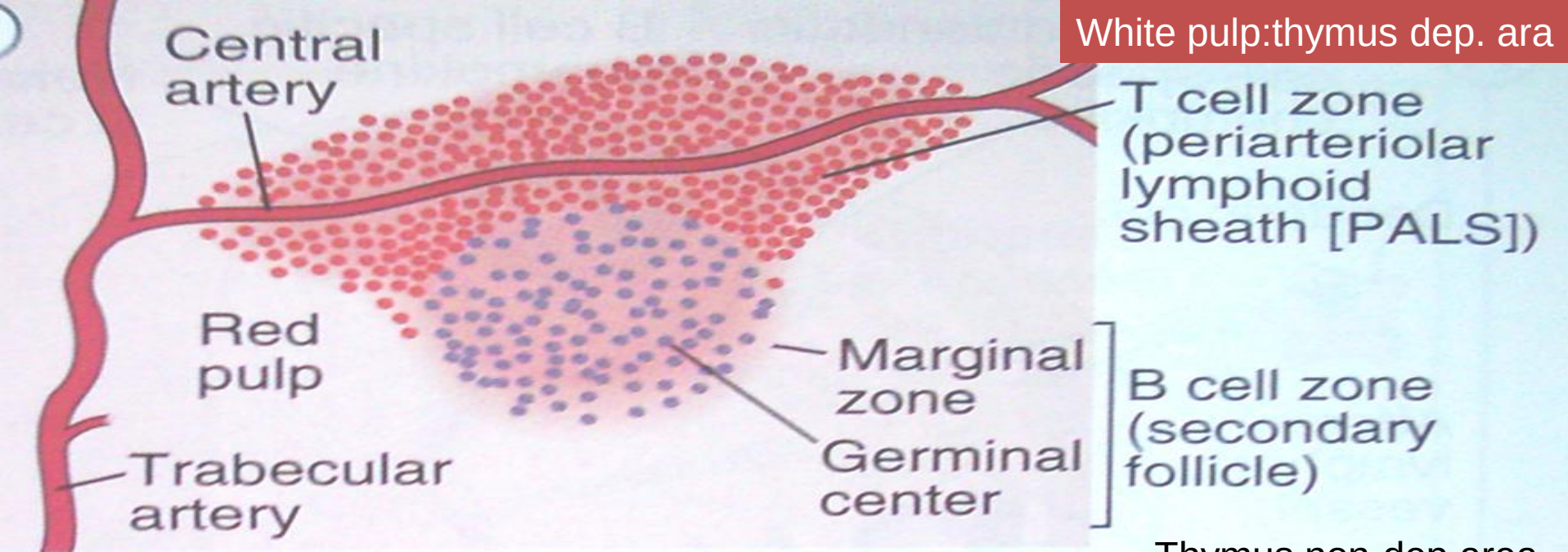
Capsule Trabecula

Lymphocytes

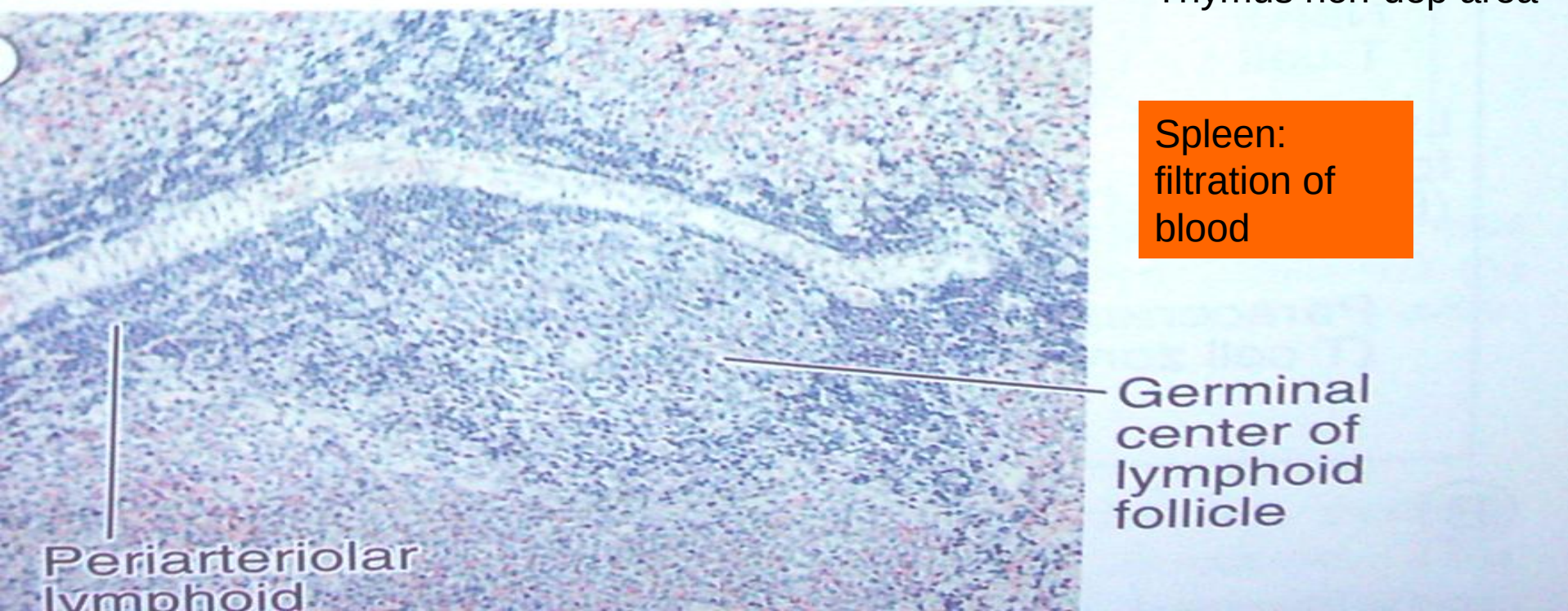
# Spleen

- Function: filtration of blood
- Consisted from:
  - white pulp (thymus dependant area)
    - T cell zone (PALS)
    - B cell zone
  - red pulp





Thymus non-dep area



THANK YOU