



# The Immune System

赵慧    [zhaohui@jlu.edu.cn](mailto:zhaohui@jlu.edu.cn)

Department of Histology & Embryology

Jilin University

# Introduction

## ❖ Structural components

- I. Immune cell
- II. Immune tissue ( Lymphoid tissue )
- III. Immune organ ( Lymphoid organ )

## ❖ Functions:

- Immunologic defense
  - 病原微生物/异体细胞和大分子
- Immunologic surveillance
  - 肿瘤/病毒感染细胞
- Immunologic homeostasis
  - 衰老死亡细胞

# I. Immune cell

## The Immune System

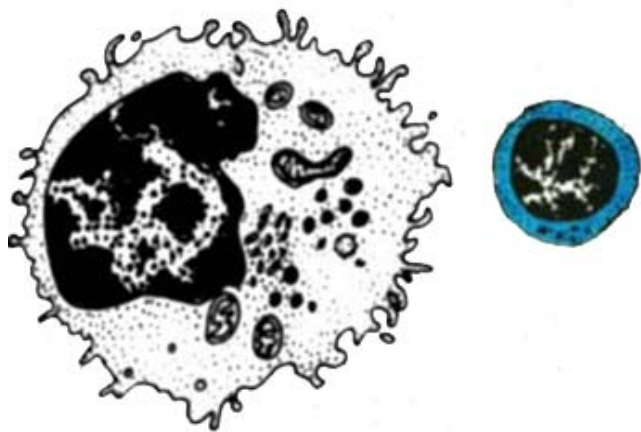
- ❖ 1. Lymphocyte
- ❖ 2. Mononuclear phagocyte system, MPS
- ❖ 3. Antigen presenting cell

# 1. Lymphocyte

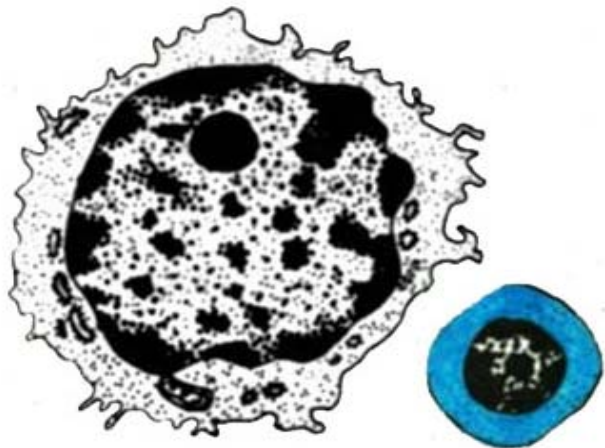
- ❖ Thymus dependent lymphocyte (T cell)
  - Helper cell (Th cell)
  - Cytotoxic cell (Tc cell)
  - Suppressor cell (Ts cell)
  - Cellular immunity
- ❖ Bone marrow dependent lymphocyte (B cell)
  - Humoral immunity
- ❖ Natural killer cell (NK cell)
- ❖ 来源/数量/形态/功能

# Lymphocyte

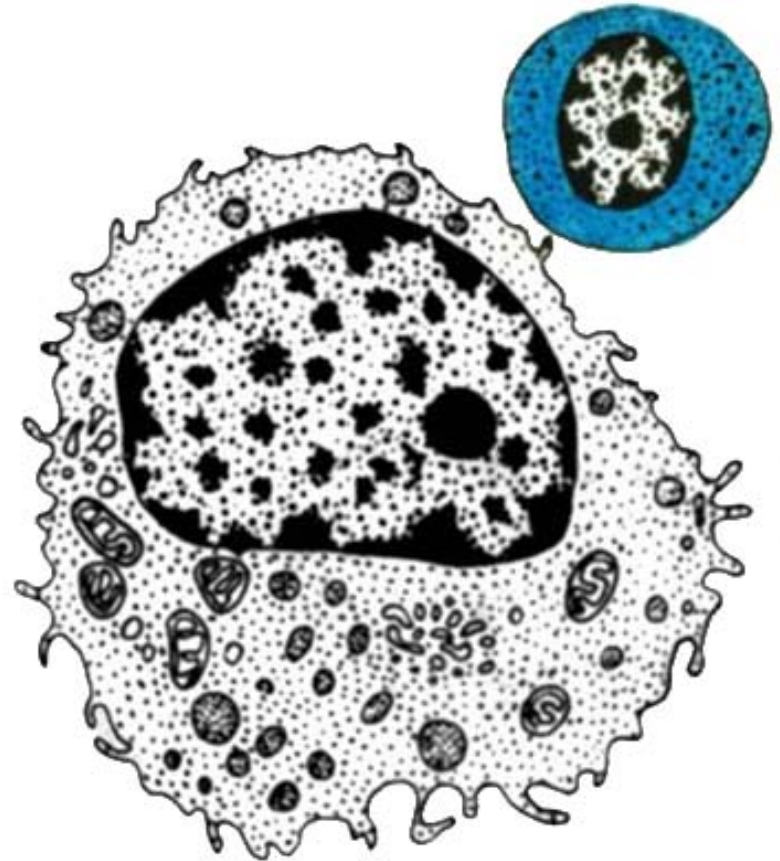
The Immune System



T Cell



B Cell



NK Cell

# 2. Mononuclear phagocytic system, MPS

- ❖ **Definition: monocytes and macrophages**
- ❖ **Constitutor**
  - **Liver: Kupffer cell**
  - **Lung: Dust cell**
  - **Nerve tissue: Microglia**
  - **Osseous tissue: Osteoclast**
- ❖ **Function: phagocytose**

# 3. Antigen presenting cell, APC

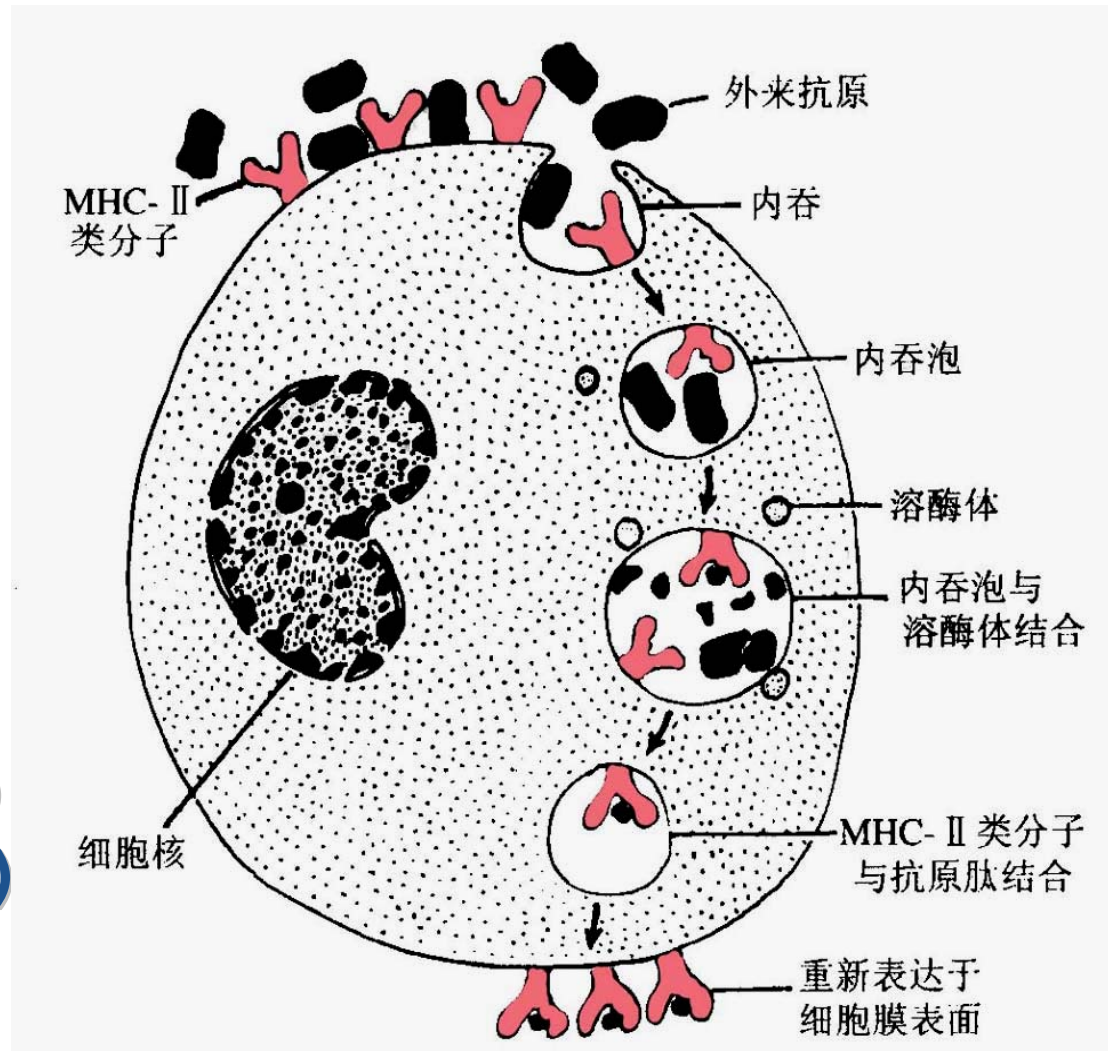
The Immune System

## ❖ Definition

- Antigen, T cell

## ❖ Constitutor

- macrophage
- 树突状细胞 (dendritic cell, DC)
- 郎格汉斯细胞 (langerhans cell)
- 交错突细胞 (interdigitating cell)
- 面纱细胞 (veiled cell)



# II. Lymphatic tissue

## ❖ Diffuse lymphatic tissue

- Postcapillary venule
- 分布/形态

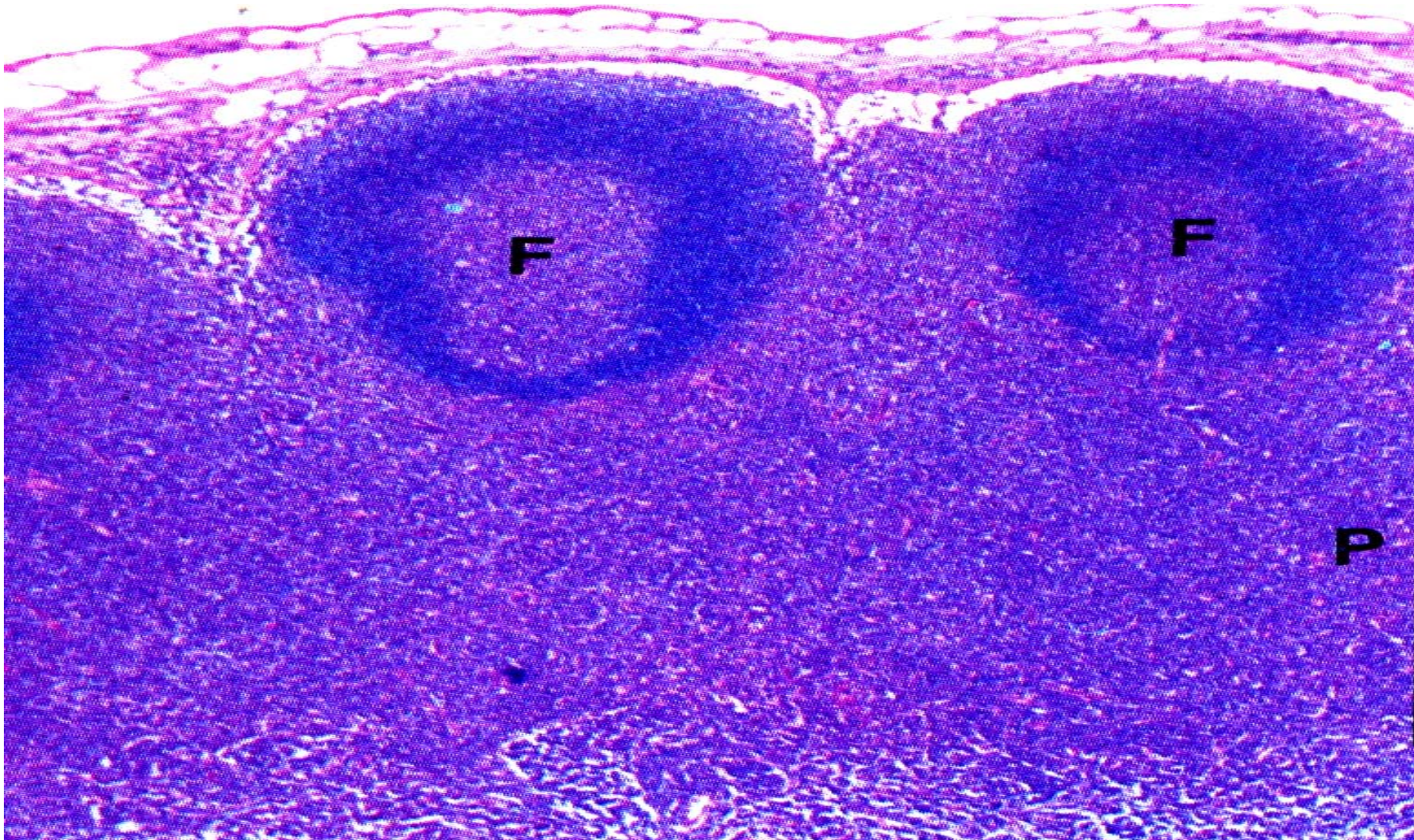
## ❖ Lymphatic nodule

- **Primary lymphoid nodule**
- **Secondary lymphoid nodule**
  - Germinal center
- 形态/组成/分类/分布/变化



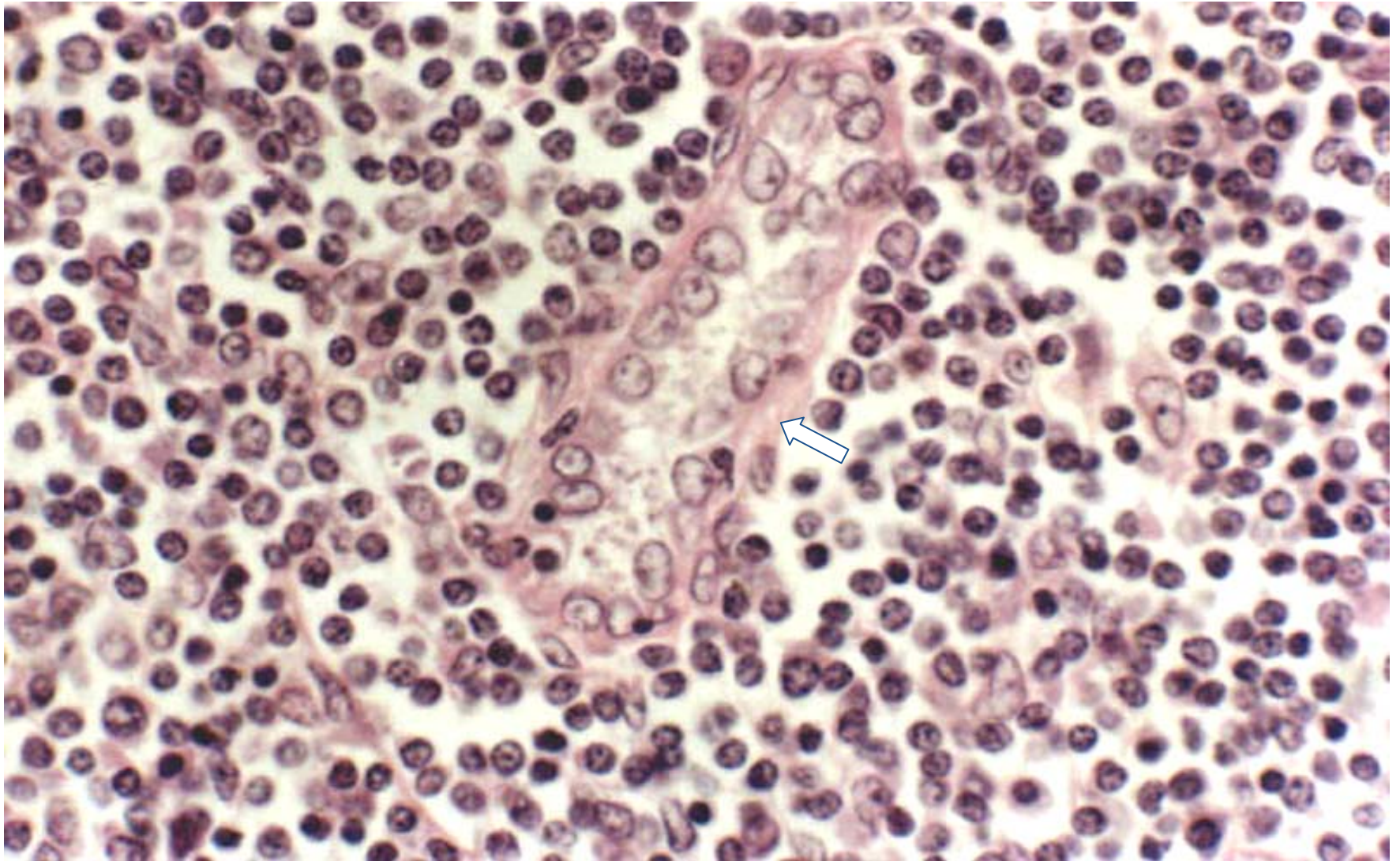
# Diffuse lymphoid tissue & Lymphoid nodule

The Immune System



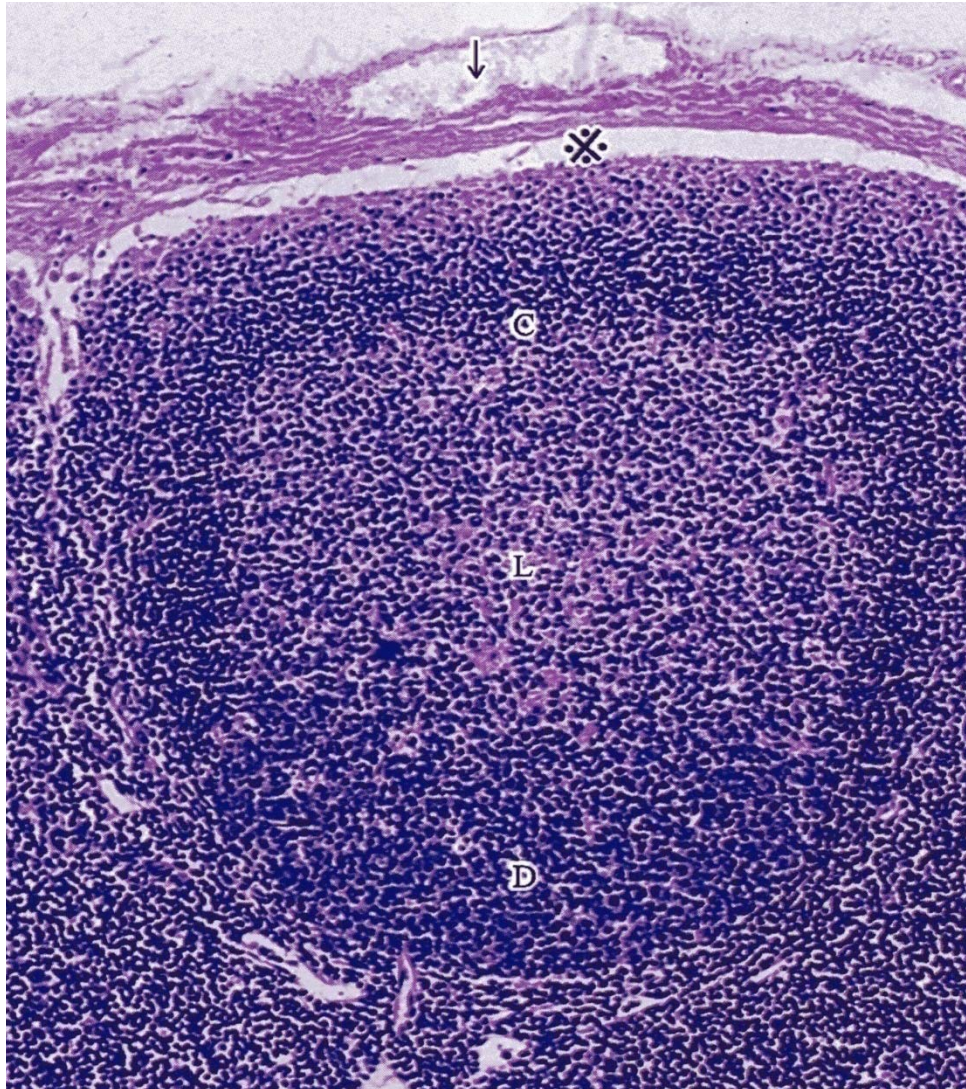
# Postcapillary venule

The Immune System



# Lymphoid nodule

## The Immune System



↓ : Afferent lymphatic vessels

\* : Subcapsular sinus

D : Dark zone

L : Light zone

C : Cap

# III. Lymphatic organ

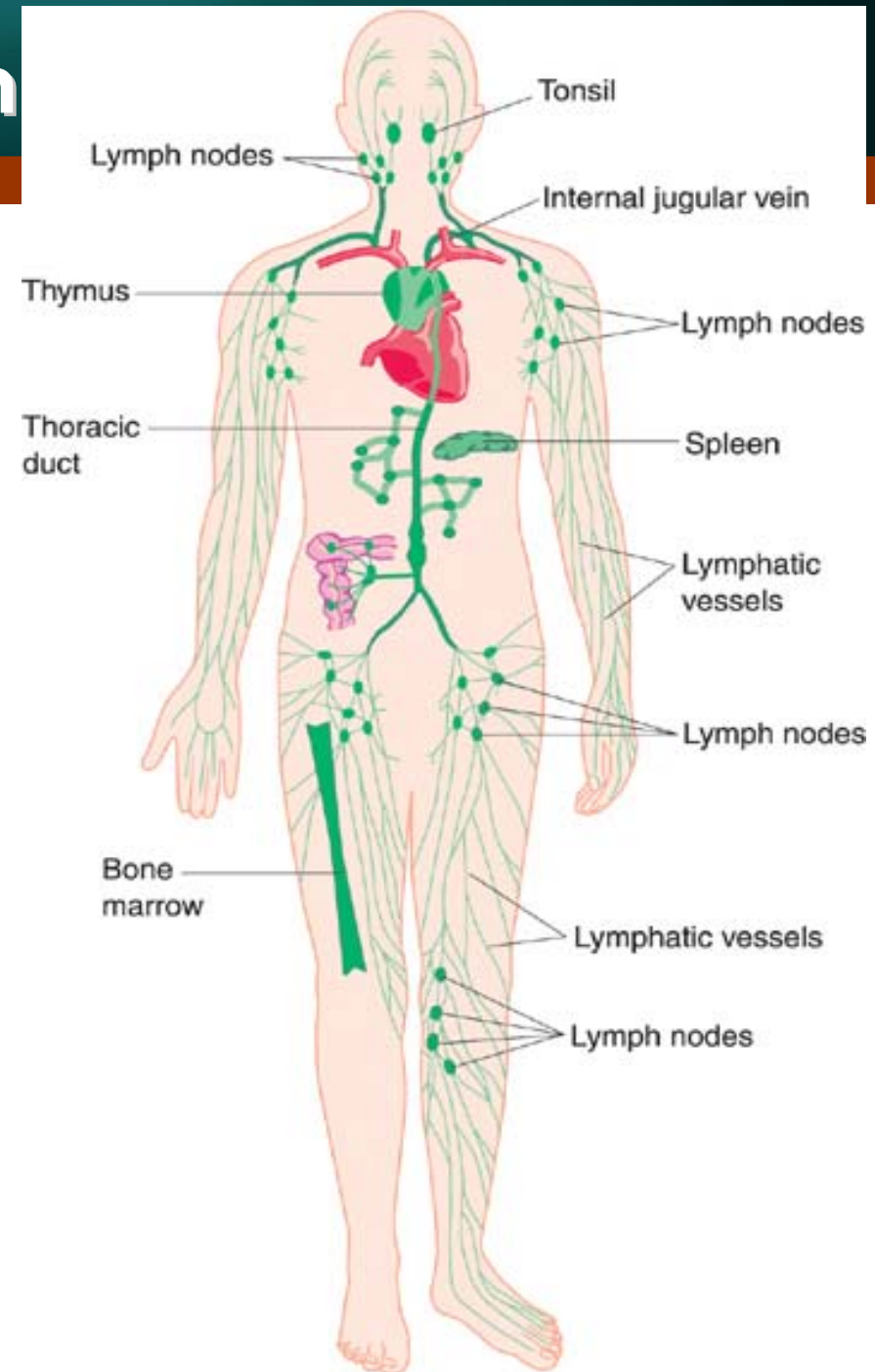
## The Immune System

### ❖ Central lymphatic organ

- Thymus
- Bone marrow

### ❖ Peripheral lymphatic organ

- Lymph node
- Spleen
- Tonsil



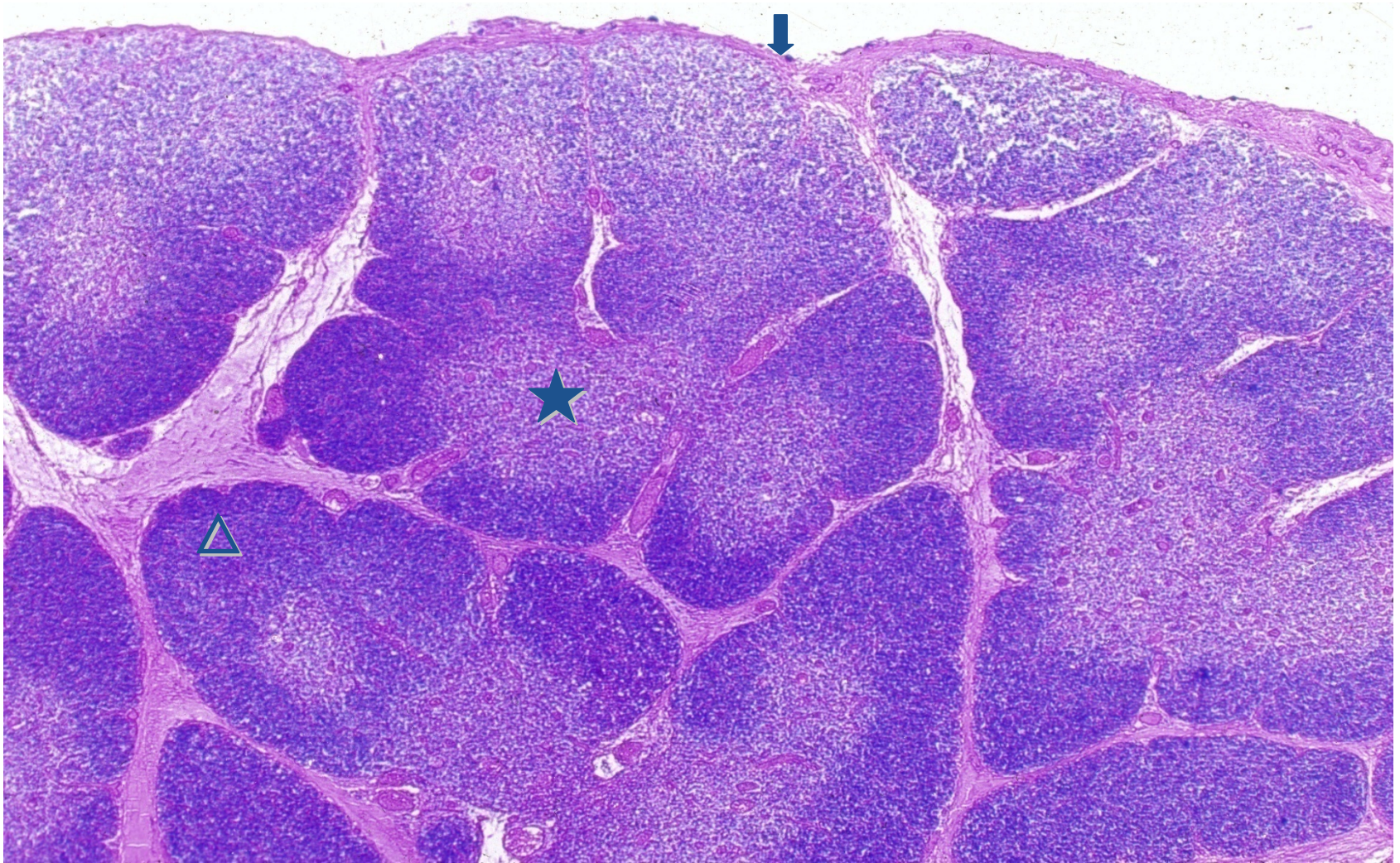
# 1. Thymus

## ❖ Structure of the thymus

- Capsule
  - Interlobular septum
- Parenchyma
  - Thymic lobule
    - Cortex ---- Dark staining
    - Medulla ---- Light staining

# Thymus

The Immune System



↓ Capsule    △ Cortex    ★ Medulla

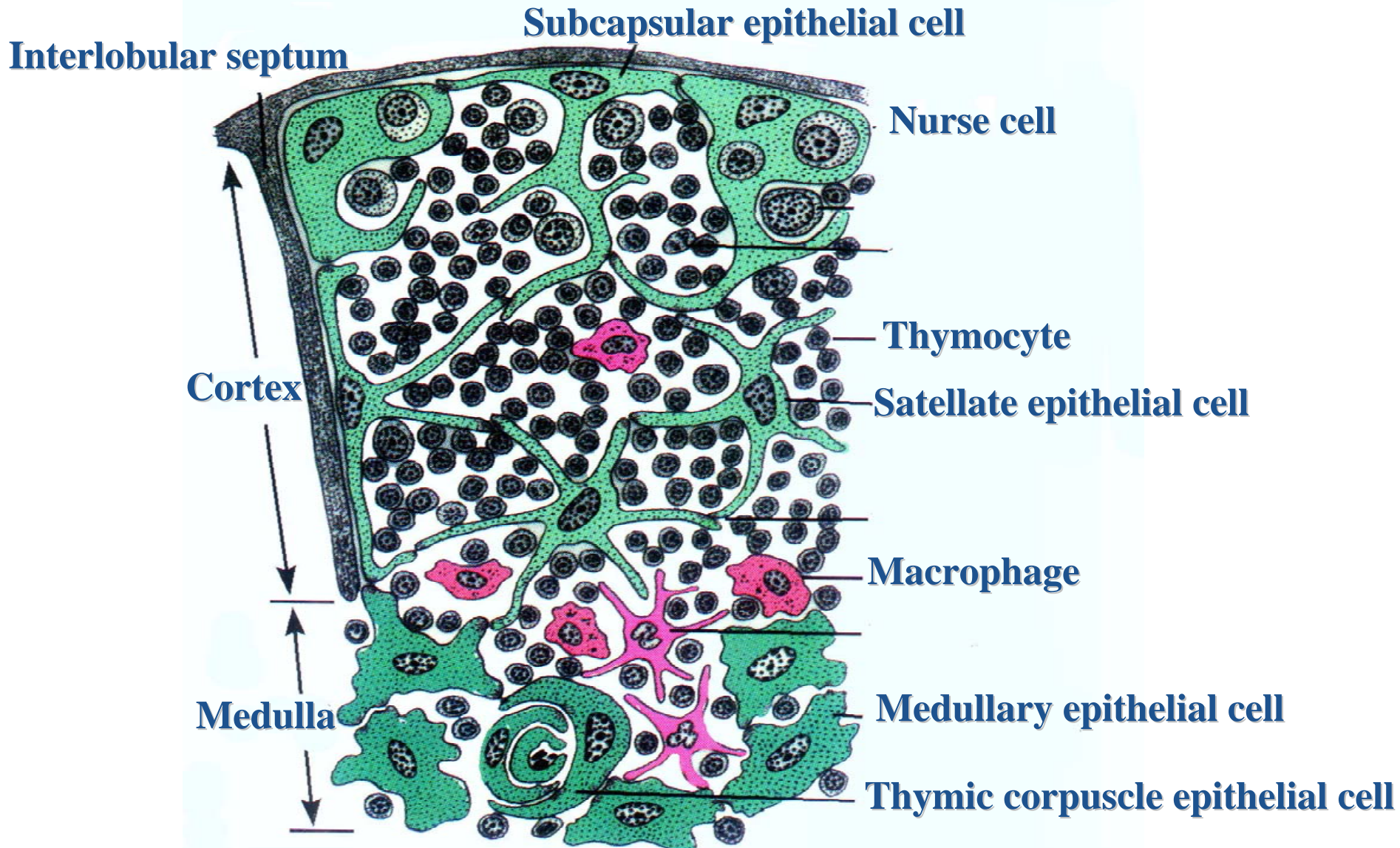
# Thymus cortex

## The Immune System

- ❖ **Thymus epithelial cell**  
**(epithelial reticular cell)**
  - **Subcapsular epithelial cell**
    - **Nurse cell**
  - **Satellite epithelial cell**
- ❖ **Thymocyte**
- ❖

# Thymus

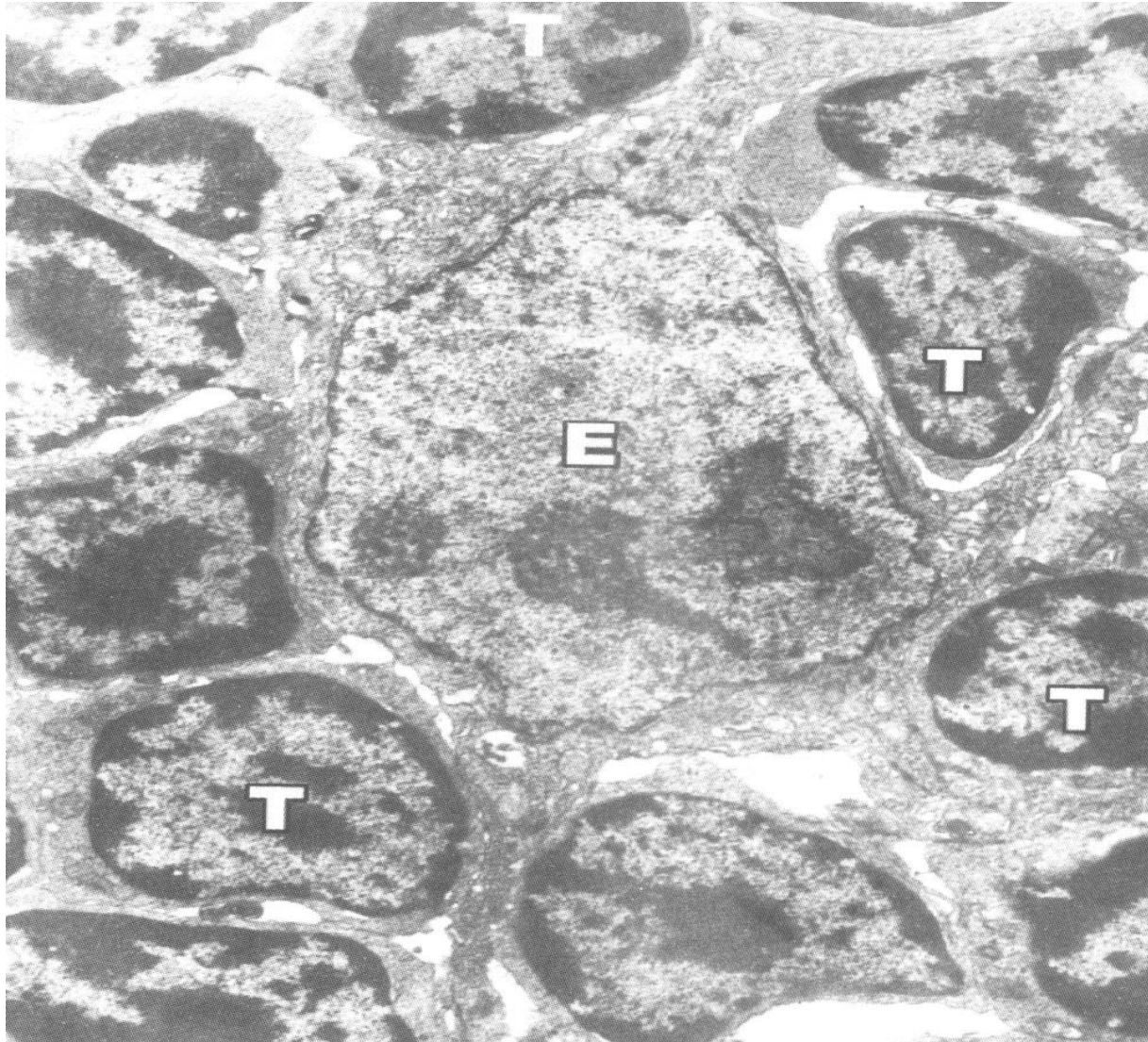
The Immune System





# Thymus

The Immune System



**E: Epithelial  
reticular cell**

**T: Thymocyte**

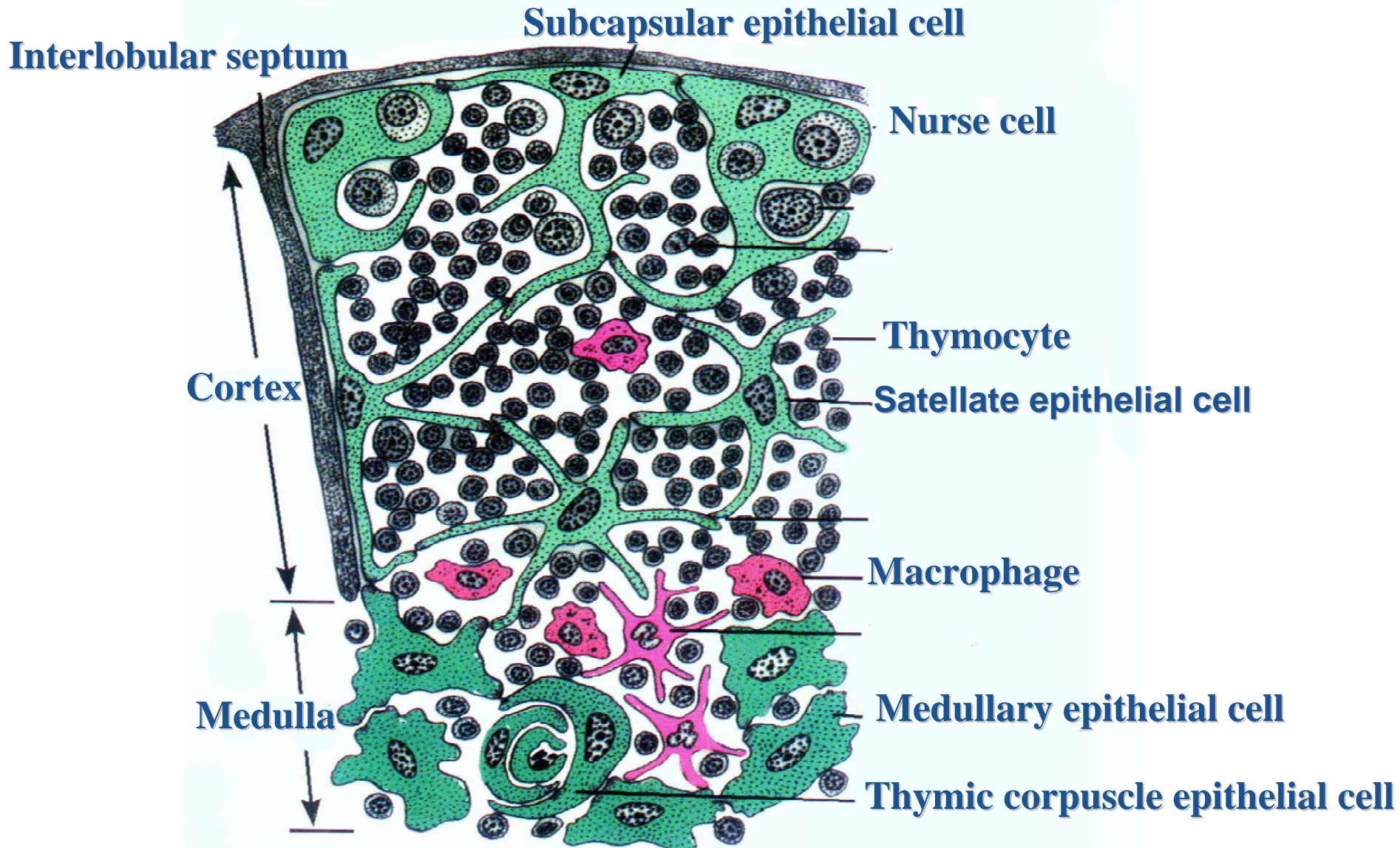
# Thymus medulla

## The Immune System

- ❖ **Thymus epithelial cell**
  - **Medullary epithelial cell**
  - **Thymic corpuscle epithelial cell**
    - **Thymic corpuscle ( or Hassall's corpuscle )**
- ❖ **Mature thymocyte**
- ❖ **Macrophage**

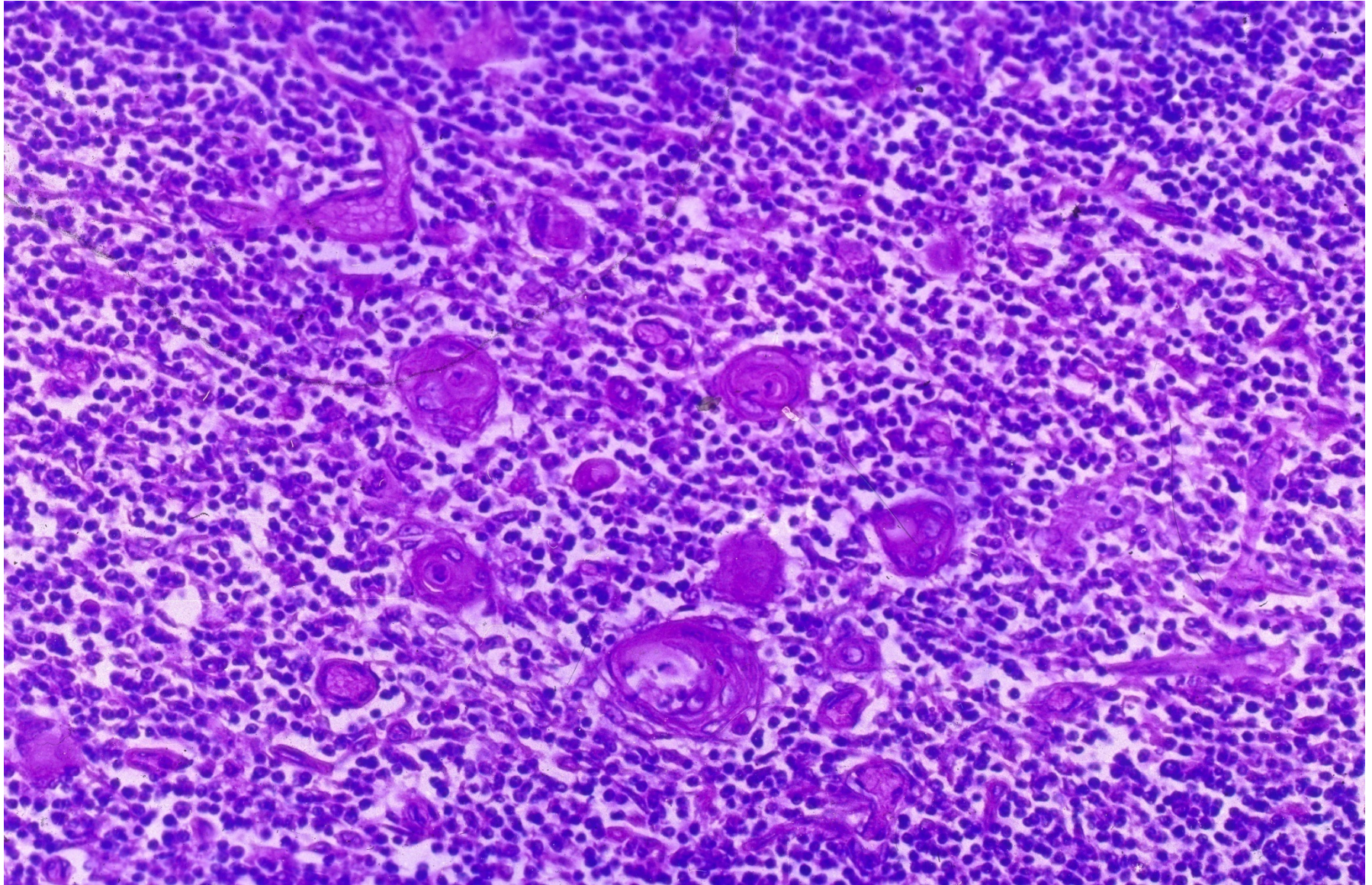
# Thymus

The Immune System



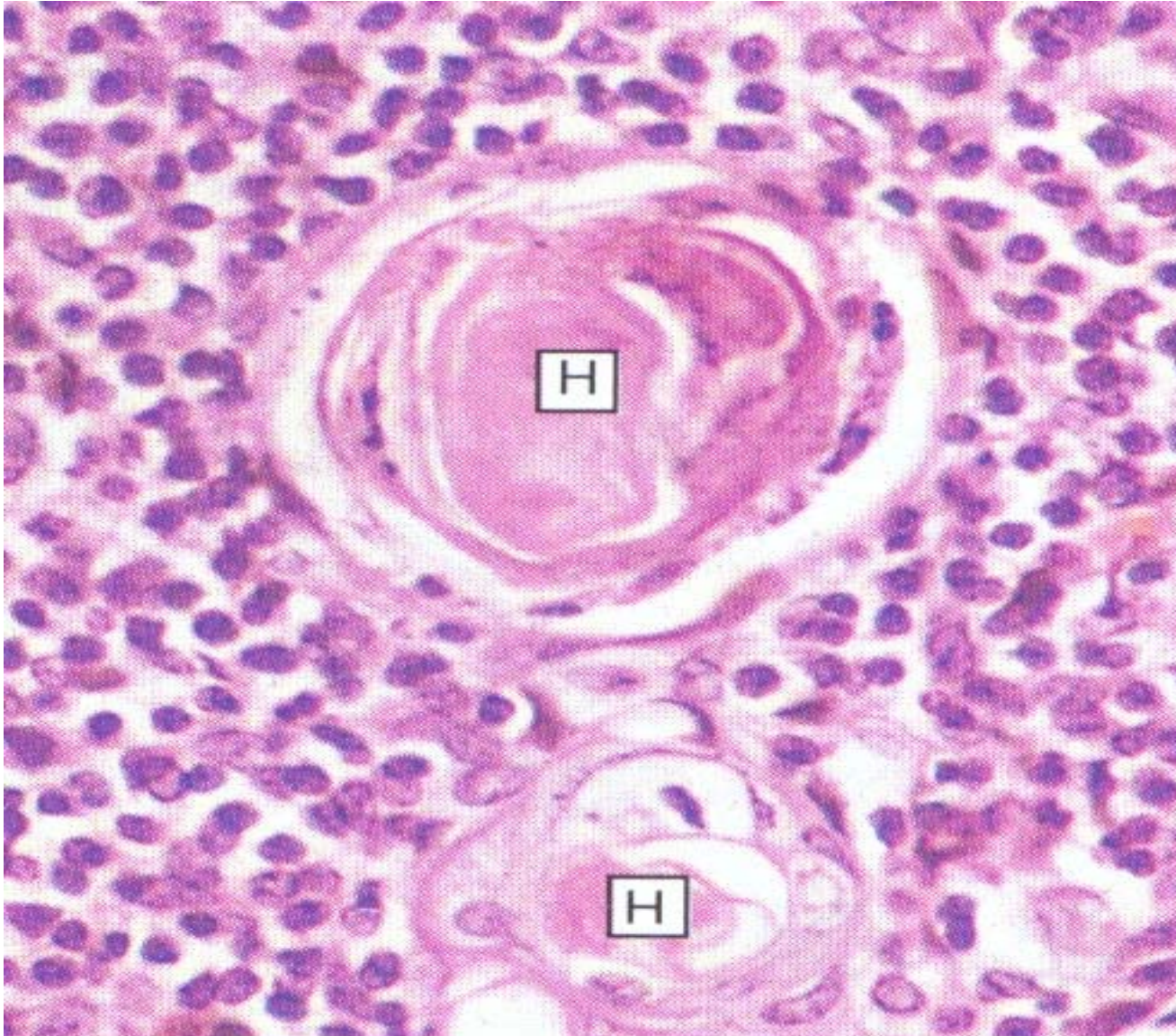
# Thymus medulla

The Immune System



# Thymic corpuscle

The Immune System



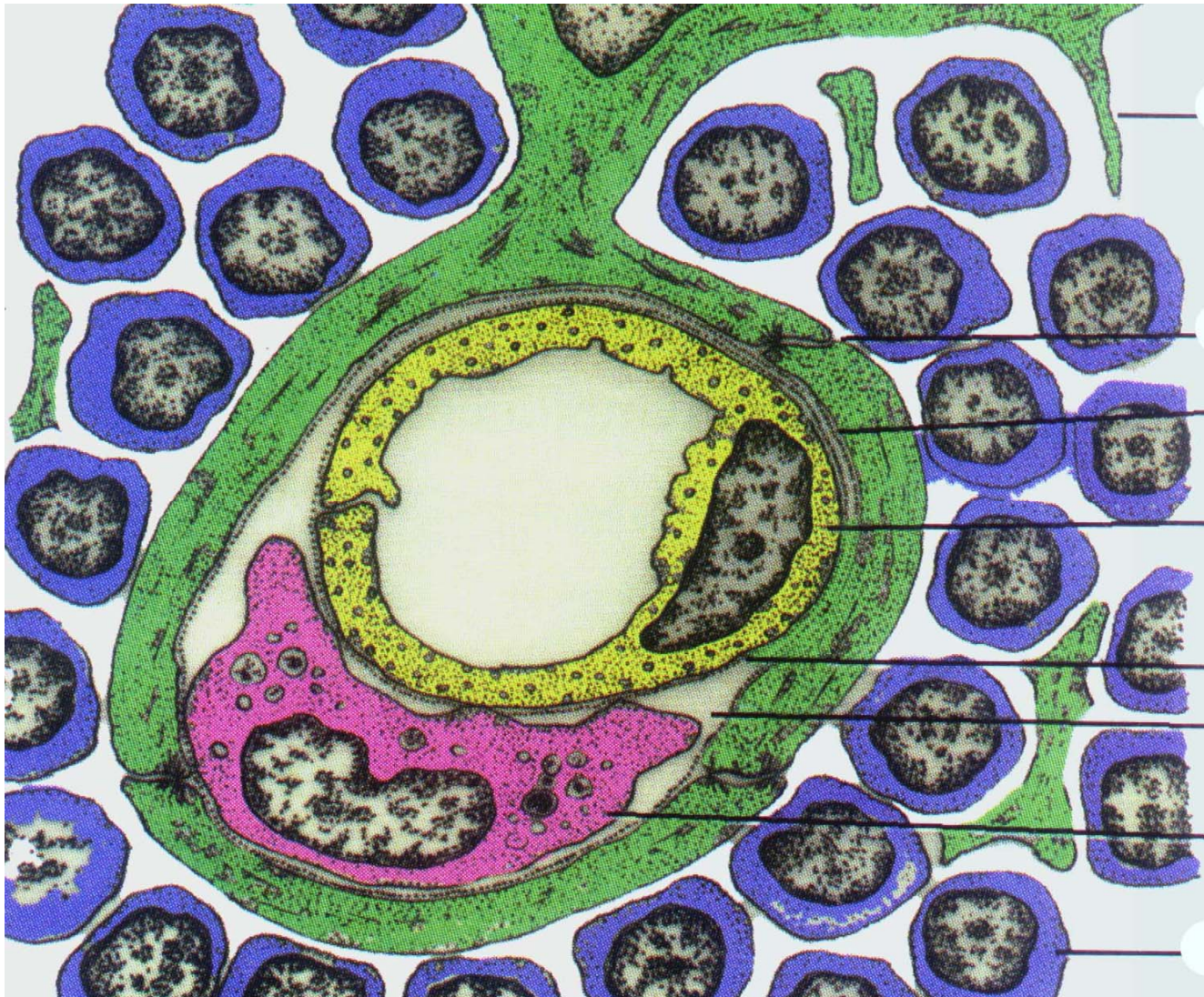
**H: Thymic corpuscle or Hassall corpuscle**

# Blood provision

- ❖ **Blood – thymus barrier**
  - **Endothelium of continuous capillary**
  - **Basement membrane around endothelium**
  - **Peri-vessel space around capillary , which contains macrophages**
  - **Basement membrane of epithelial reticular cells**
  - **Processes of epithelial reticular cells**

# Blood – thymus barrier

The Immune System



Processes of epithelial reticular cells

Cell junction

Basement membrane of epithelial reticular cells

Endothelium of continuous capillary

Basement membrane around endothelium

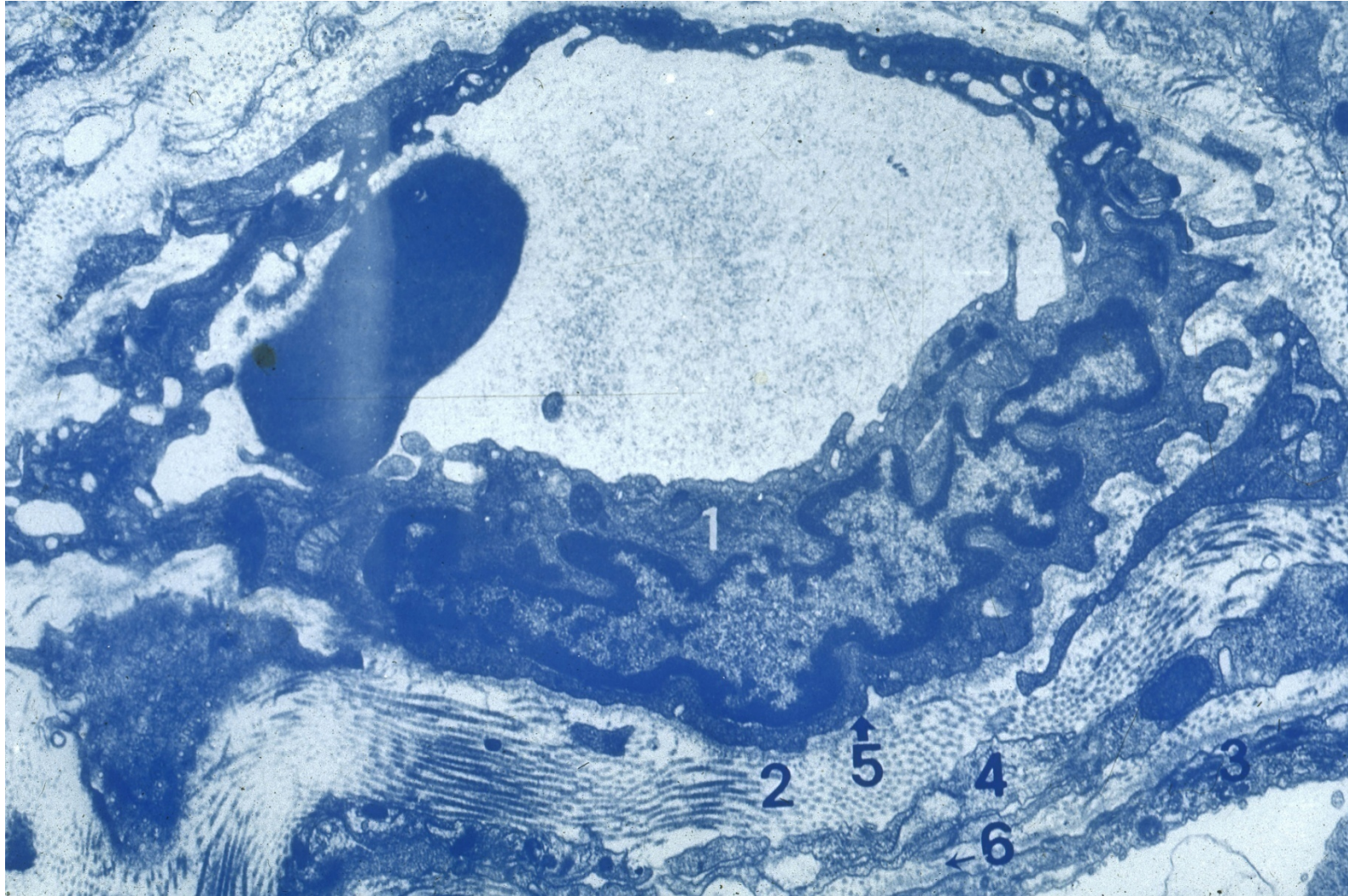
Peri-vessel space

Macrophage

Lymphocyte

# Blood – thymus barrier

The Immune System





# Function of the thymus

## The Immune System

- ❖ **The thymus is the site of the terminal differentiation and selection of T lymphocytes.**
- ❖ **The thymus produce several proteins that act as growth factors to stimulate proliferation and differentiation of T lymphocytes.**

# Lymphoid organ

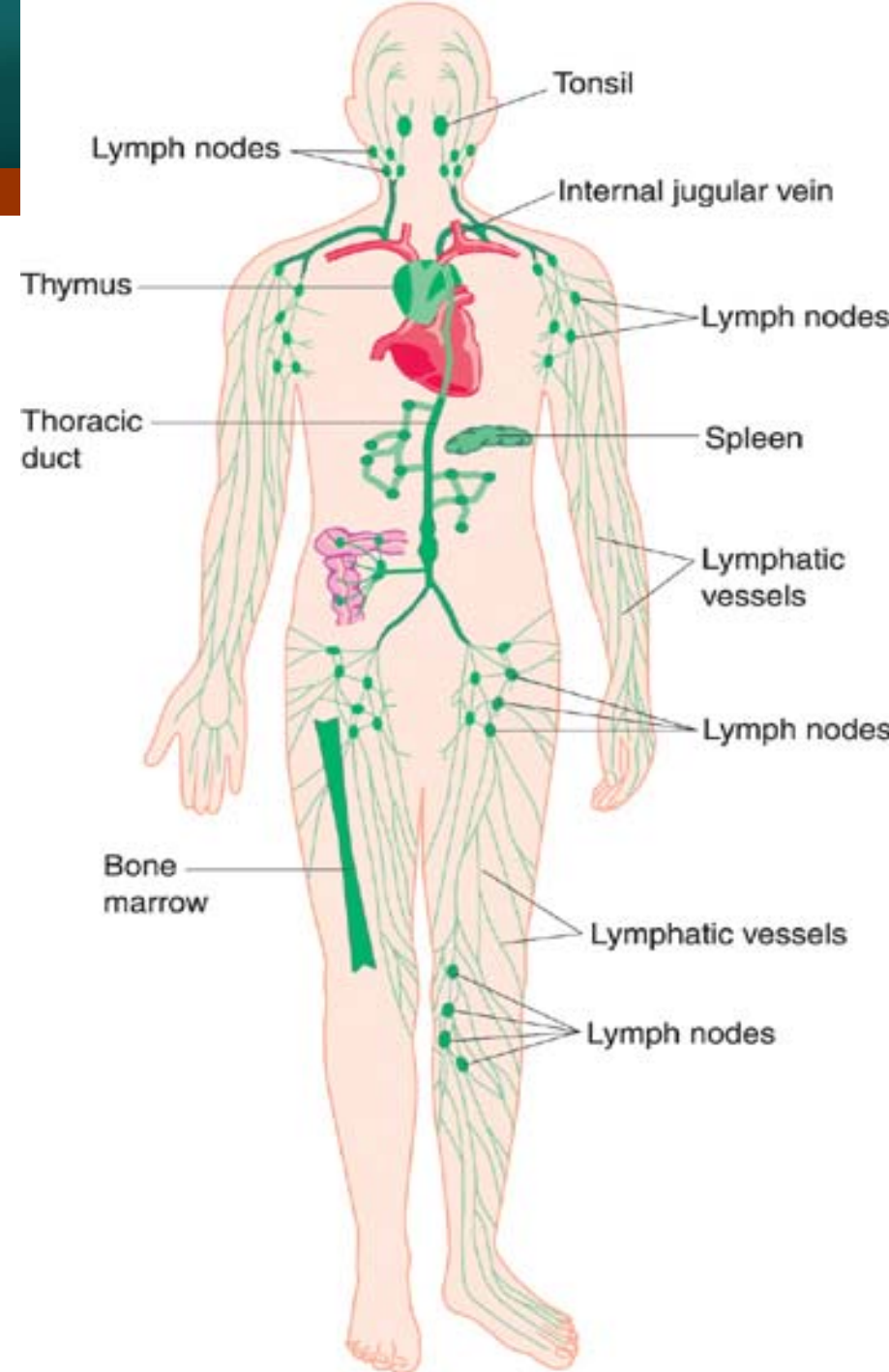
## The Immune System

### ❖ Central lymphoid organ

- Thymus
- Bone marrow

### ❖ Peripheral lymphoid organ

- Lymph node
- Spleen
- Tonsil

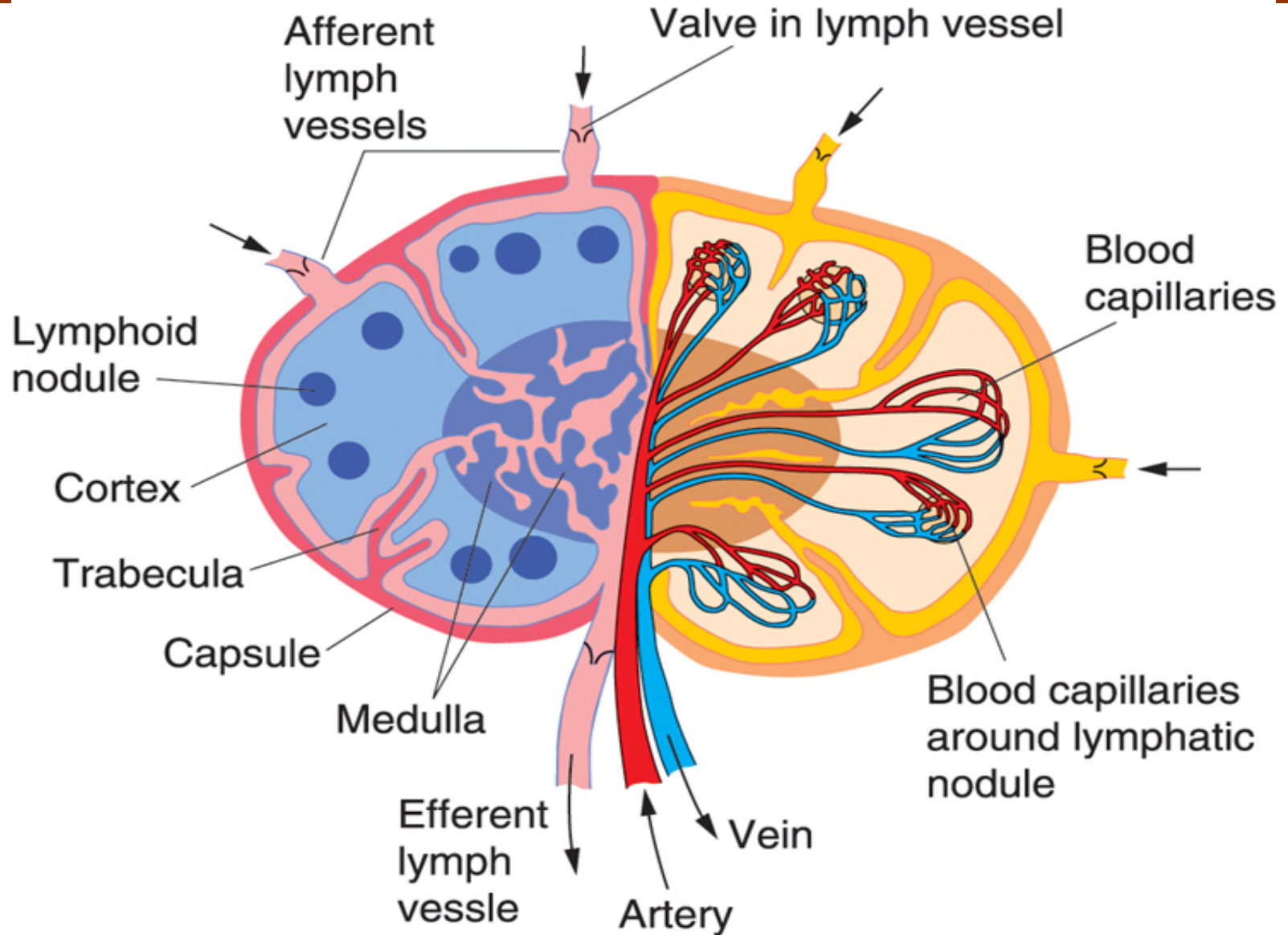


## 2. Lymph node

- ❖ **Structure**
- ❖ **Recirculation of lymphocyte**
- ❖ **Functions**

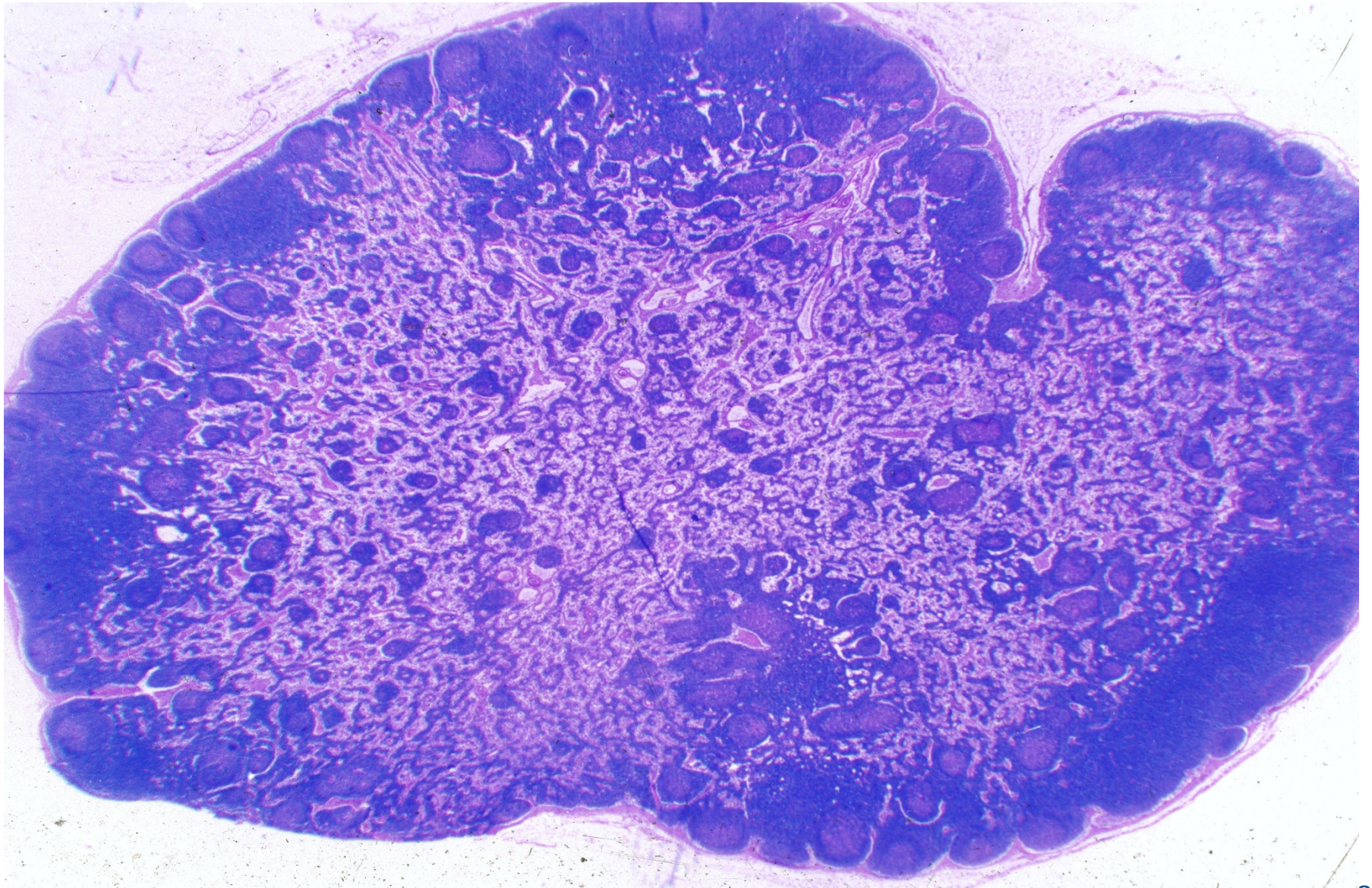
# 2. Lymph node

The Immune System



# Lymph node

The Immune System



# Parenchyma of the lymph node

## The Immune System

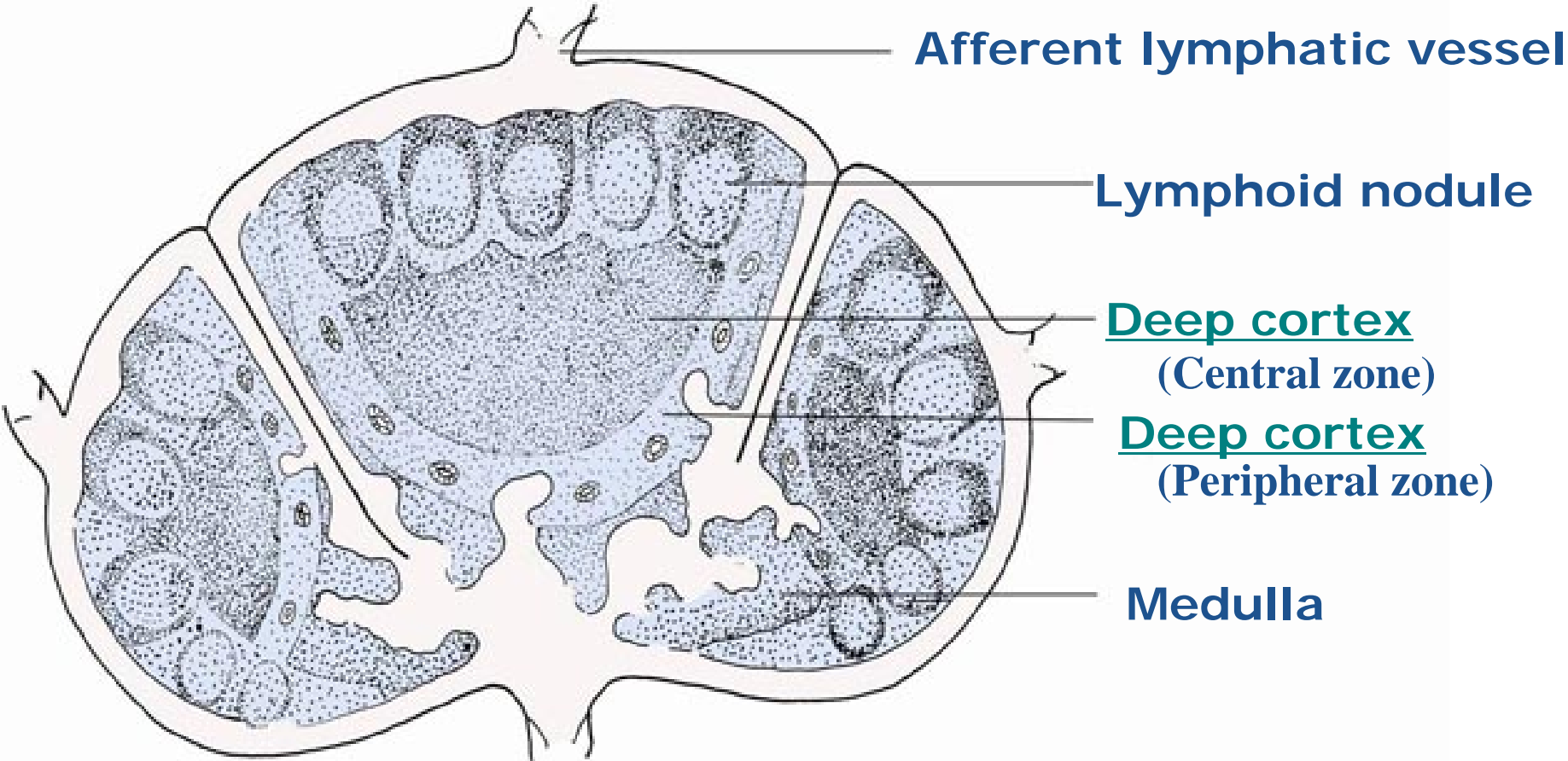
### ❖ Cortex

- Superficial cortex
  - Lymphoid nodule —B cells
  - Diffuse lymphoid tissue —T cells
- Paracortical zone (Deep cortex)
  - [T cells, reticular cells, interdigitating cells]  
postcapillary venule
- Cortical sinus
  - Subcapsular sinus
  - Peritrabecular sinus  
[Endothelial cell, Reticular cell, Lymphocyte,  
Macrophage, Veiled cell]

### ❖ Medulla

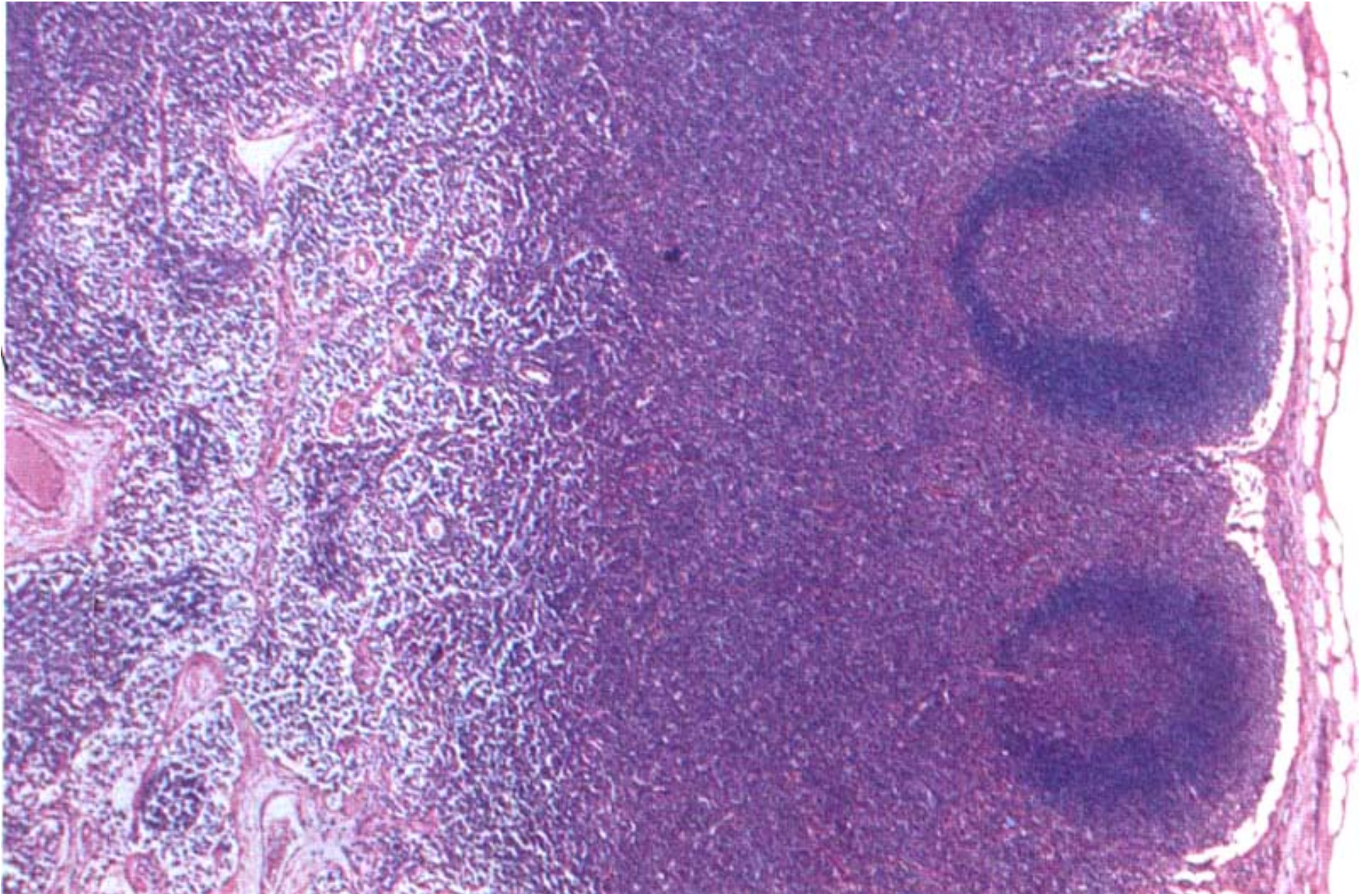
- Medullary cord — [B cells, plasma cells, macrophages]
- Medullary sinus — [Macrophages]

# Superficial cortex and deep cortex unit of lymph node



# Lymph node

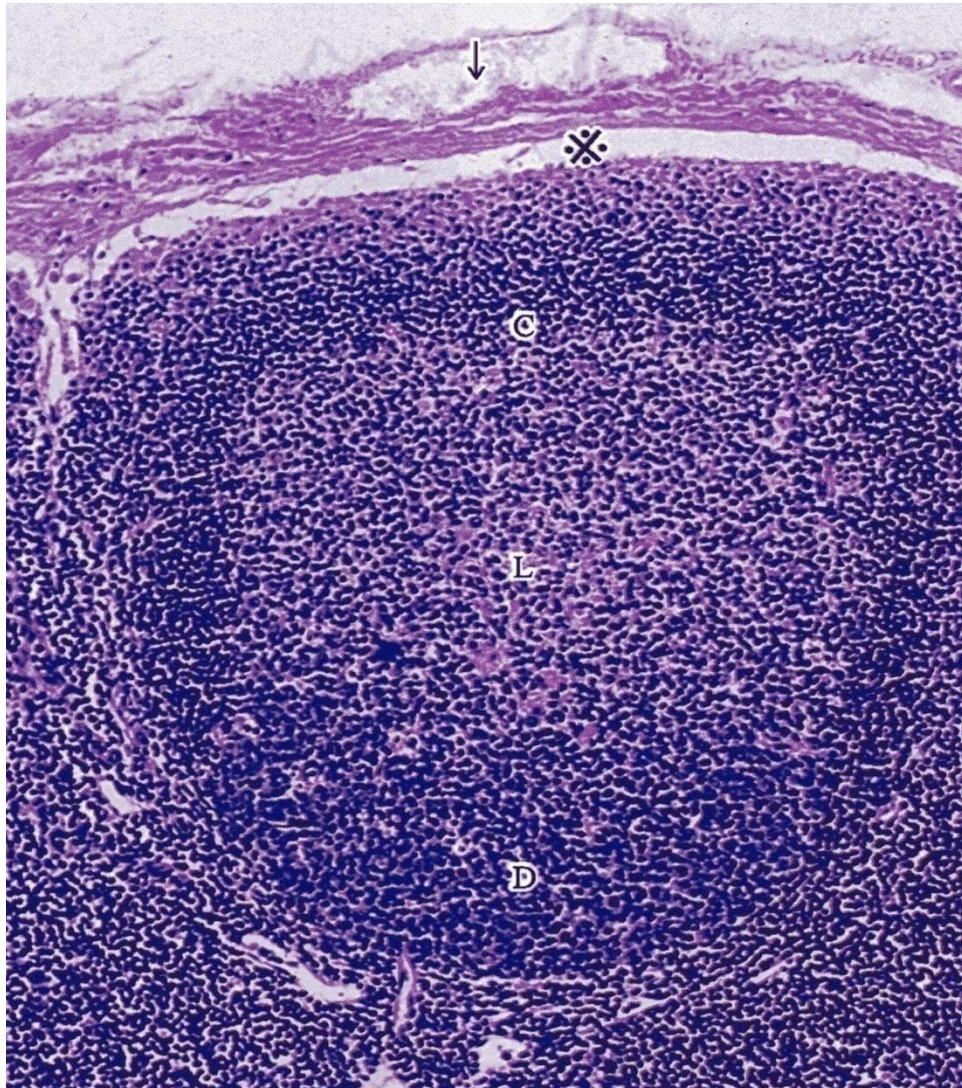
The Immune System





# Superficial cortex of the lymphoid nodule

The Immune System



↓ : Afferent lymphatic vessels

※ : Subcapsular sinus

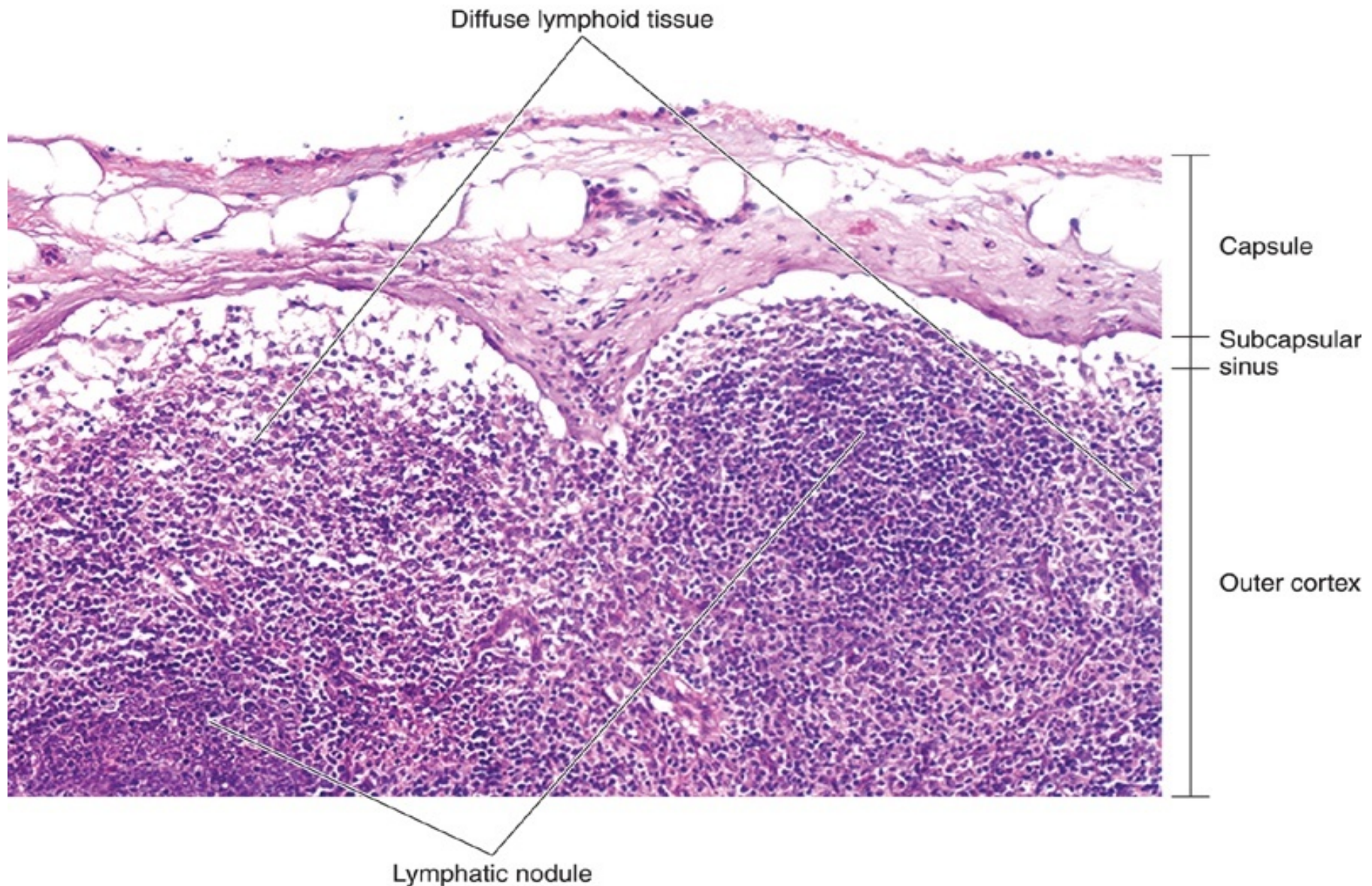
D : Dark zone

L : Light zone

C : Cap

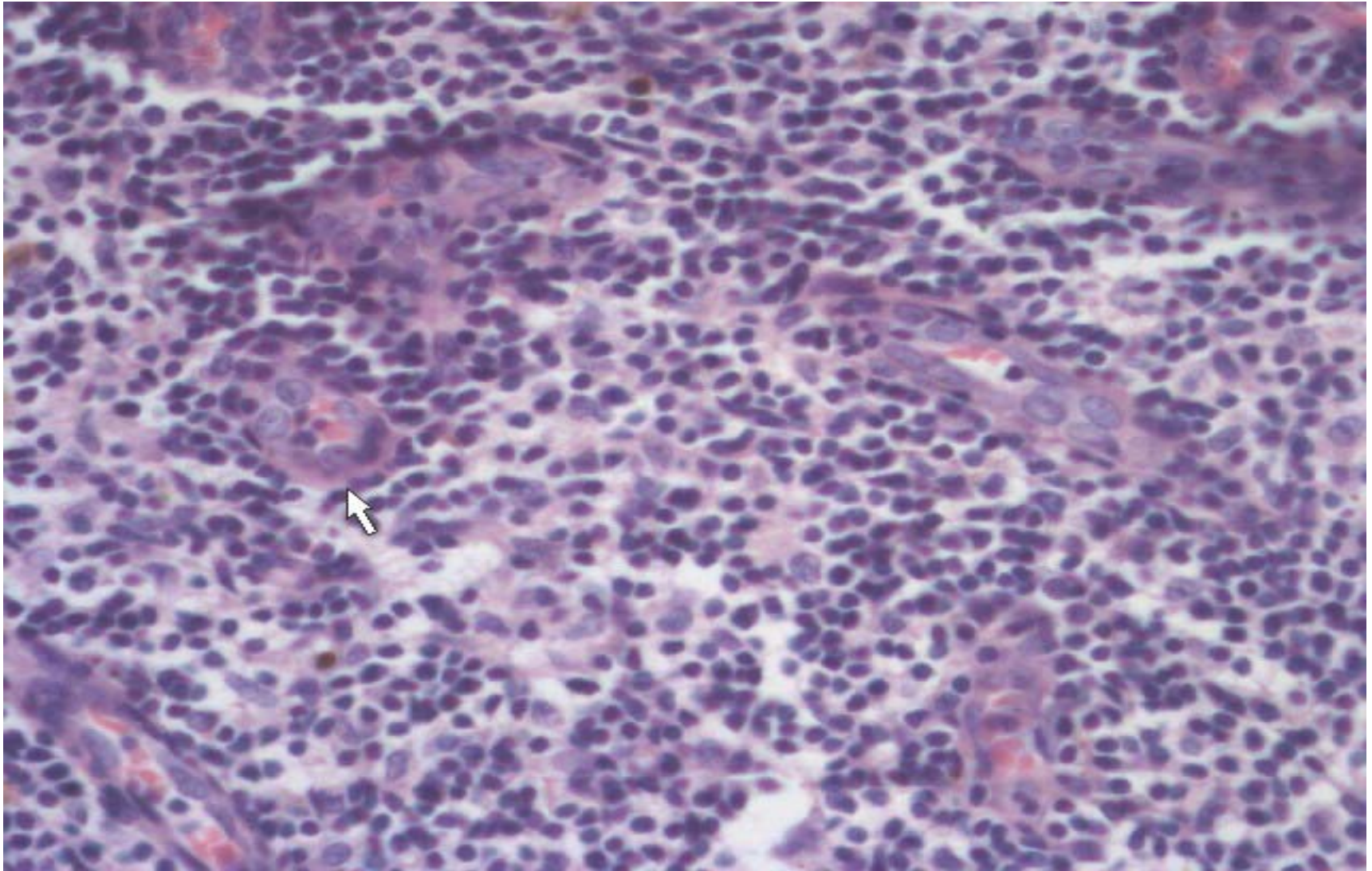
# Cortex of the lymph node

The Immune System



# Paracortex zone of the lymph node

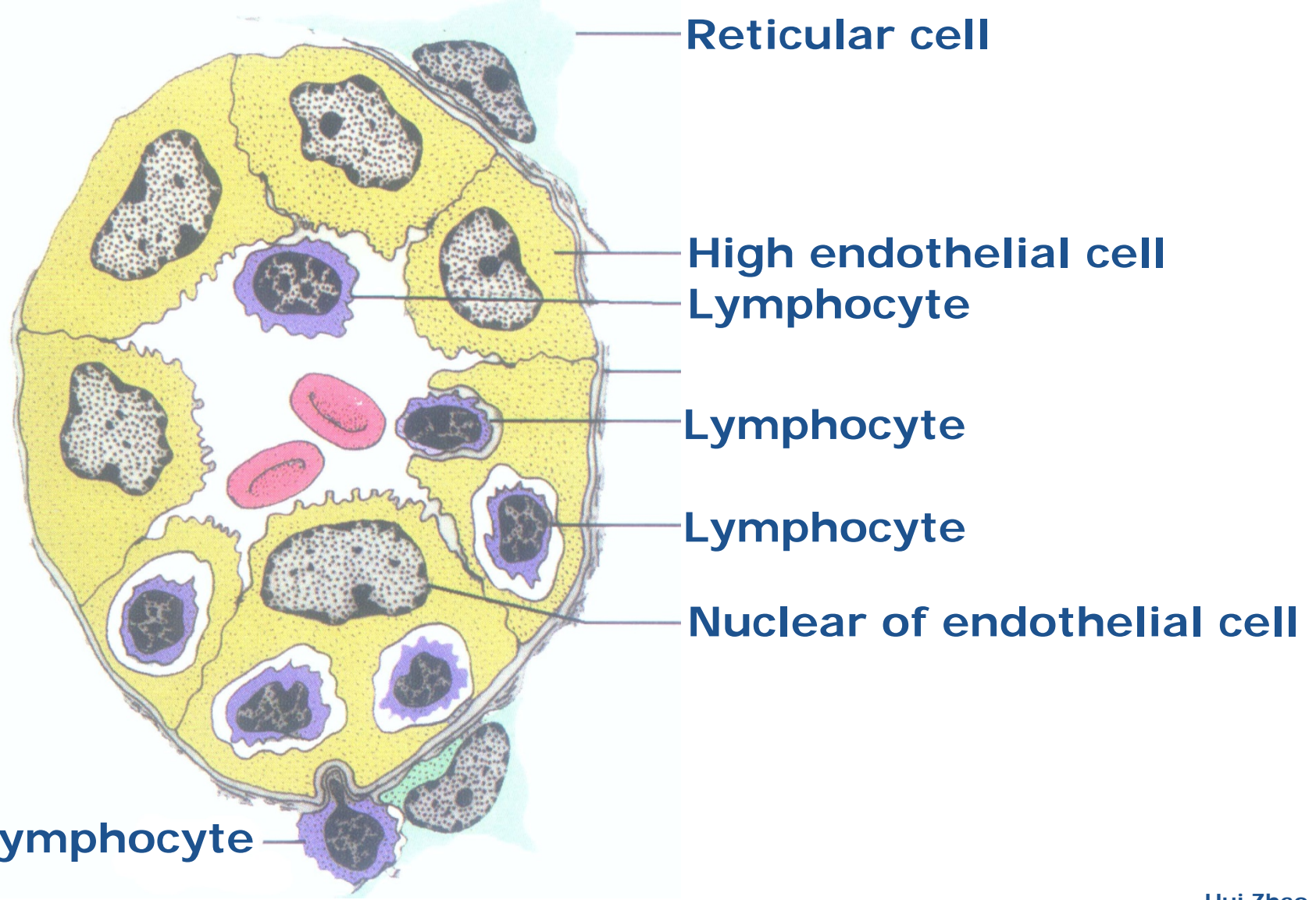
The Immune System



↑ Postcapillary venule

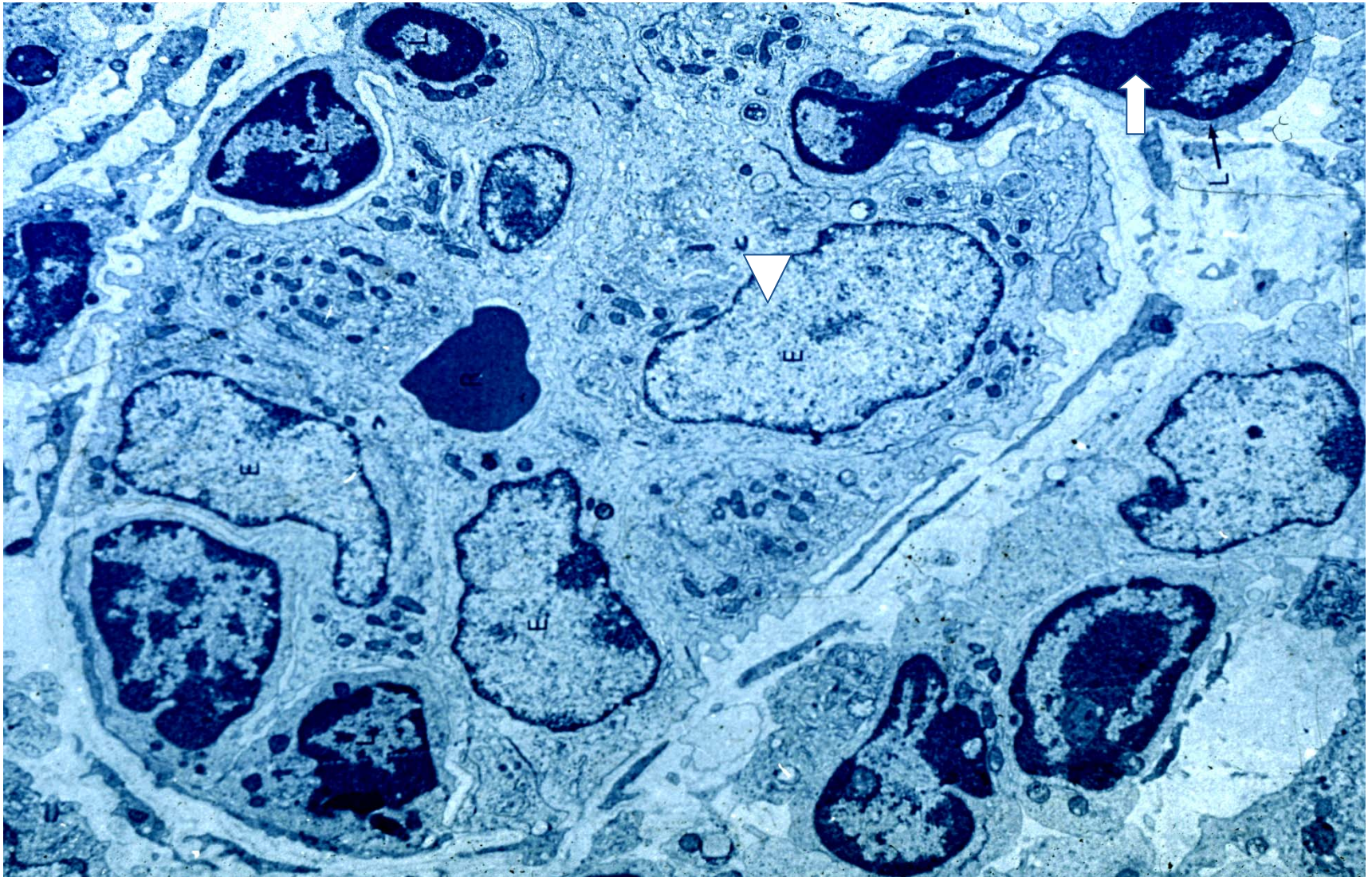
# Postcapillary venule in the lymph node

The Immune System



# Postcapillary venule in the lymph node

The Immune System

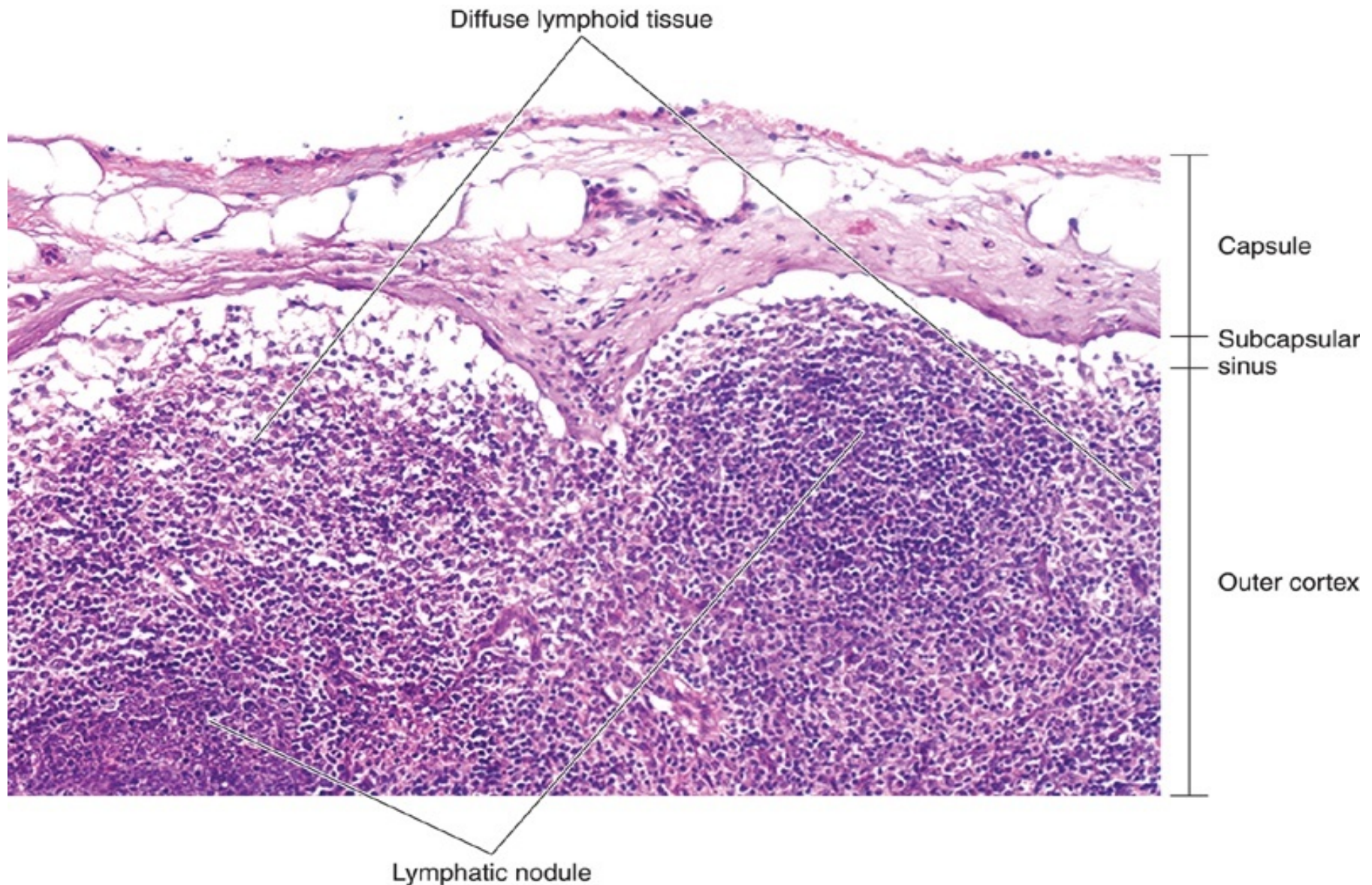


▽ Postcapillary venule

↑ lymphocyte

# Cortex of the lymph node

The Immune System



# Subcapsular sinus of the lymph node

The Immune System

Afferent lymphatic vessel

Endothelial cell

Valve

Capsule

Endothelial cell

Lymphocyte

Reticular cell

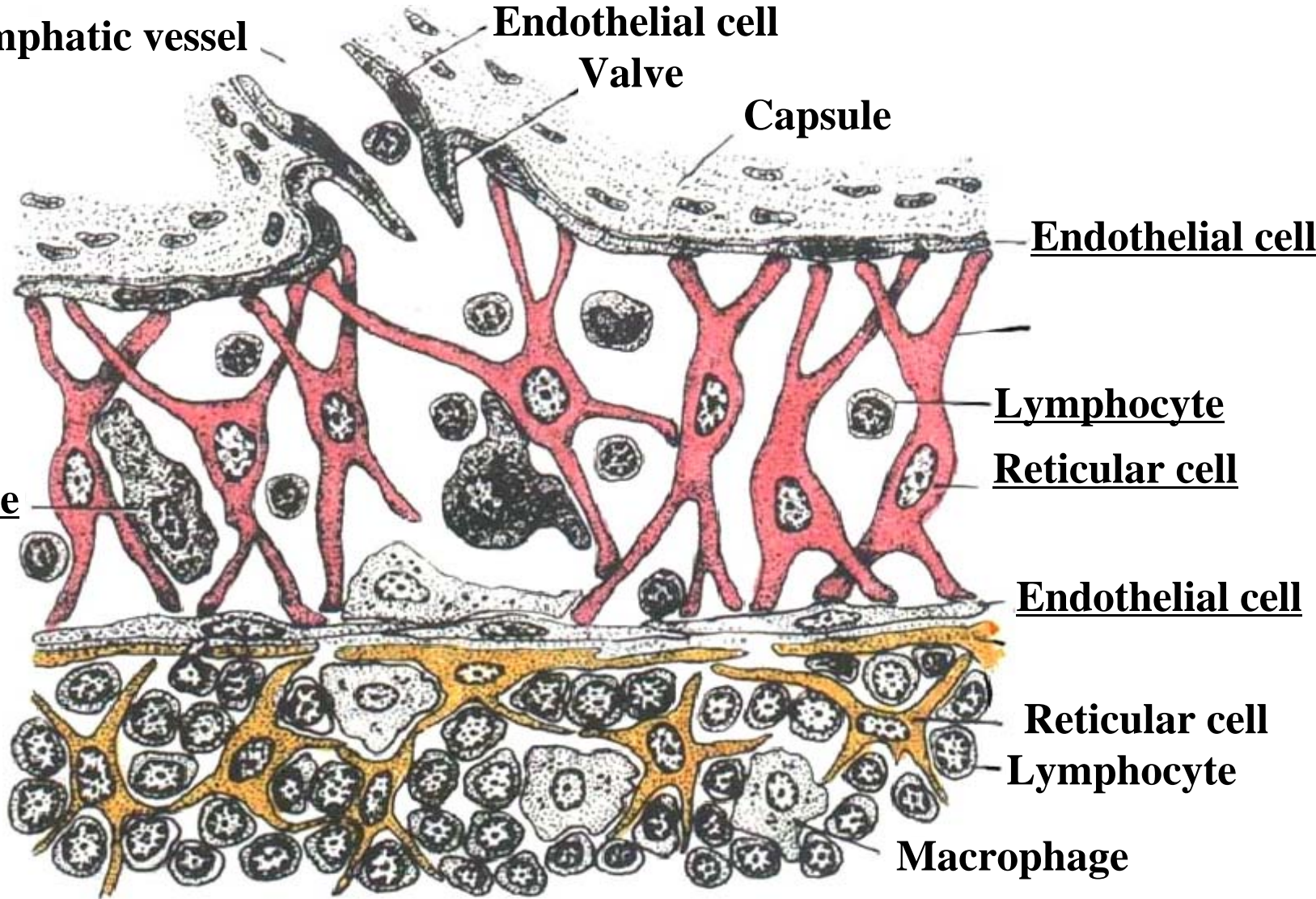
Macrophage

Endothelial cell

Reticular cell

Lymphocyte

Macrophage



# Subcapsular sinus of the lymph node

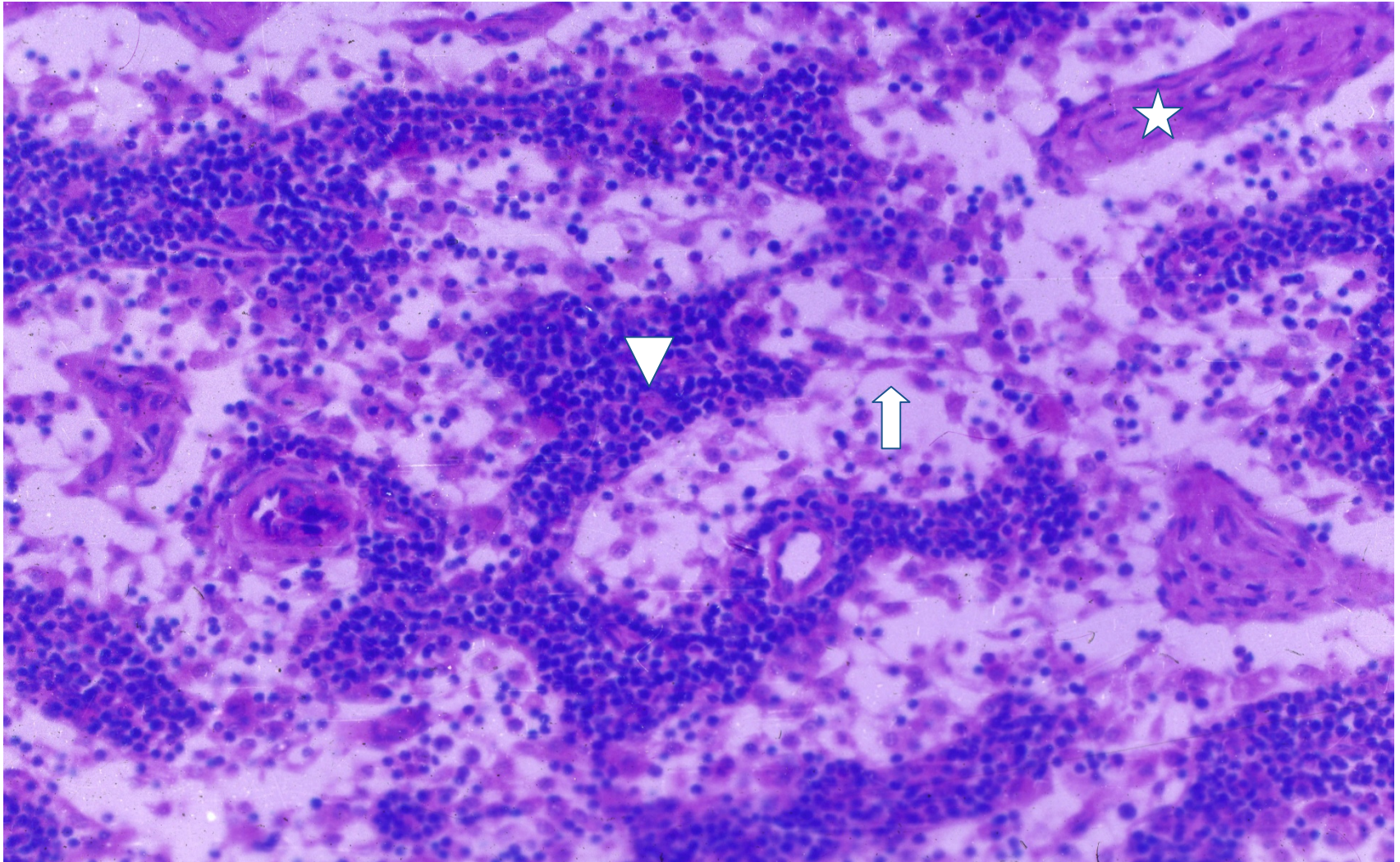
The Immune System





# Medulla of the lymph node

The Immune System



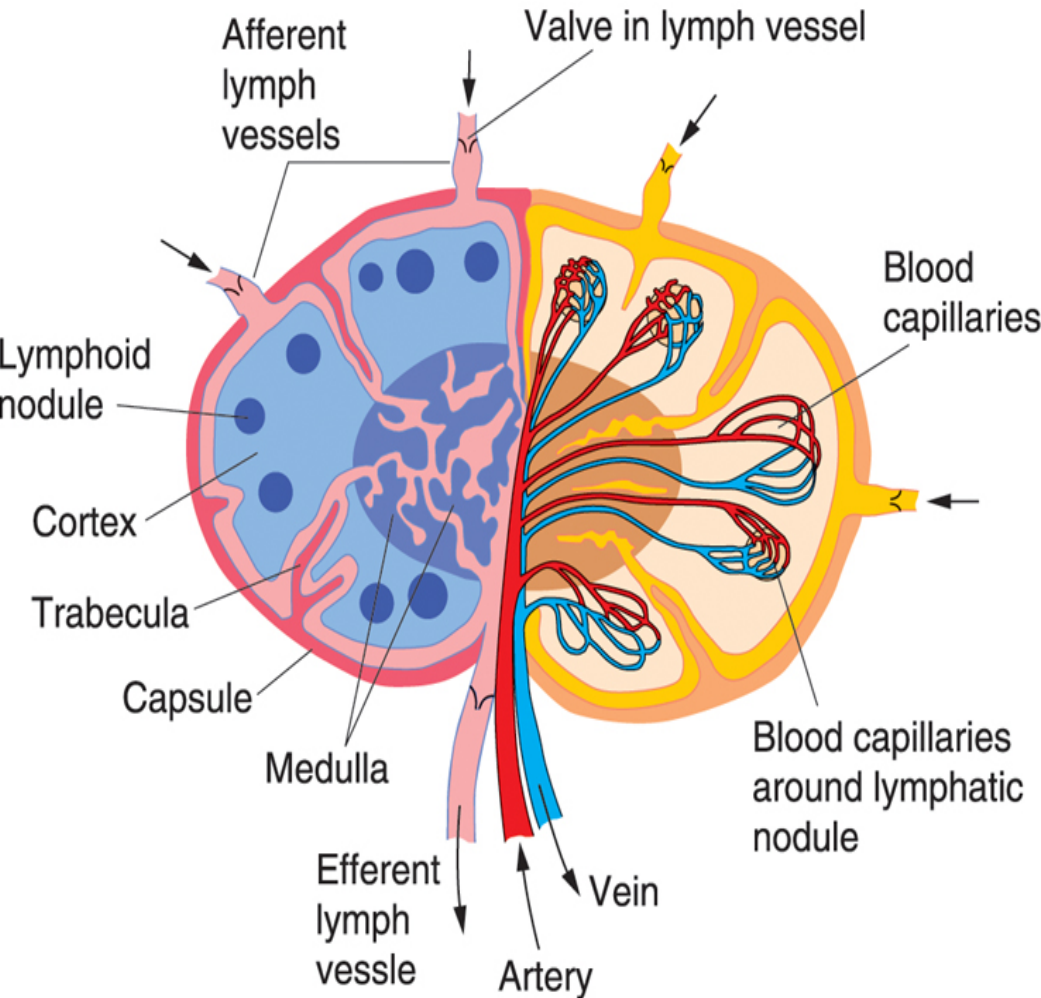
▽ Medullary cord

↑ Medullary sinus

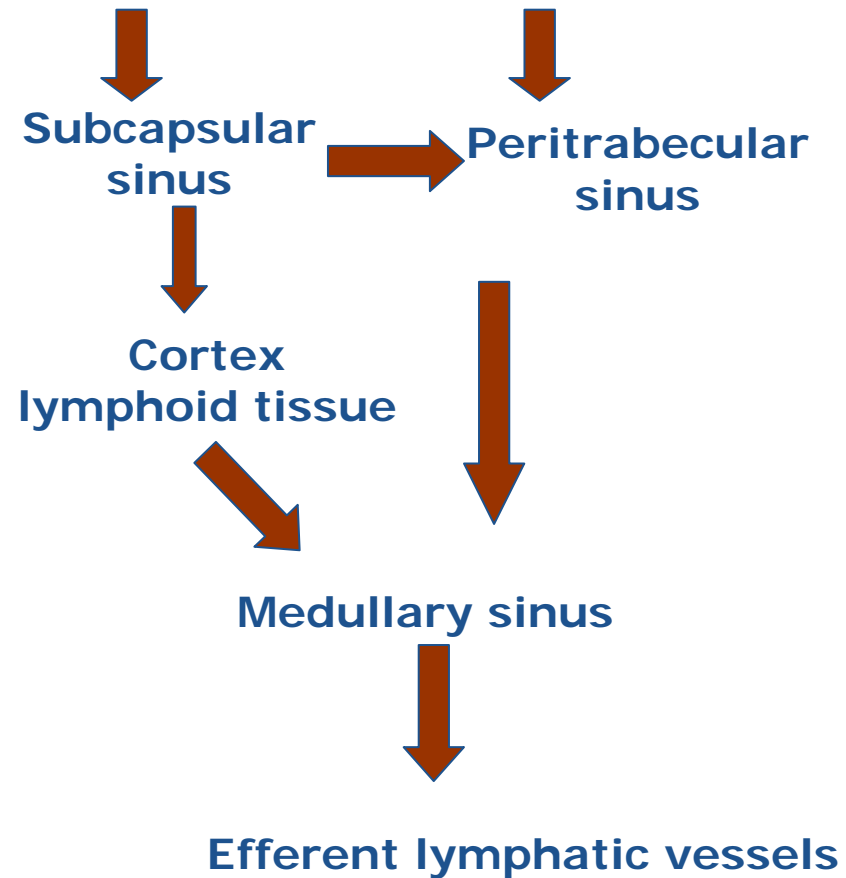
☆ Trabecula

# Lymph circulation in the lymph node

The Immune System

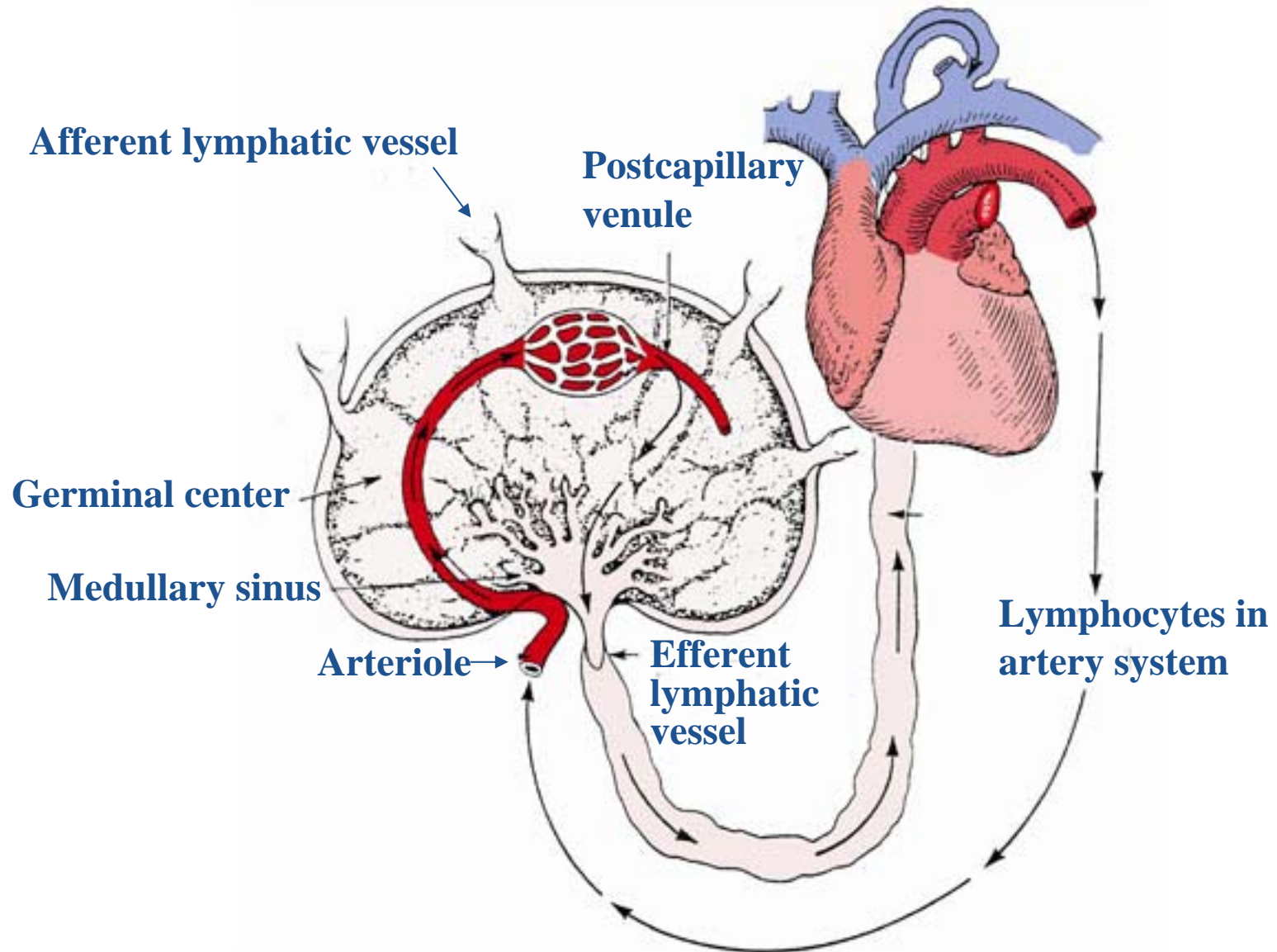


Afferent lymphatic vessels



# Recirculation of lymphocytes

The Immune System



# Function of the lymph node

## The Immune System

- ❖ **Filter lymphoid fluid**
  - **Reticular tissue, macrophages**
- ❖ **Participate in immune response**
  - **Humoral immunity – Lymphoid nodule**
  - **Cellular immunity – Paracortical zone**

# Lymphoid organ

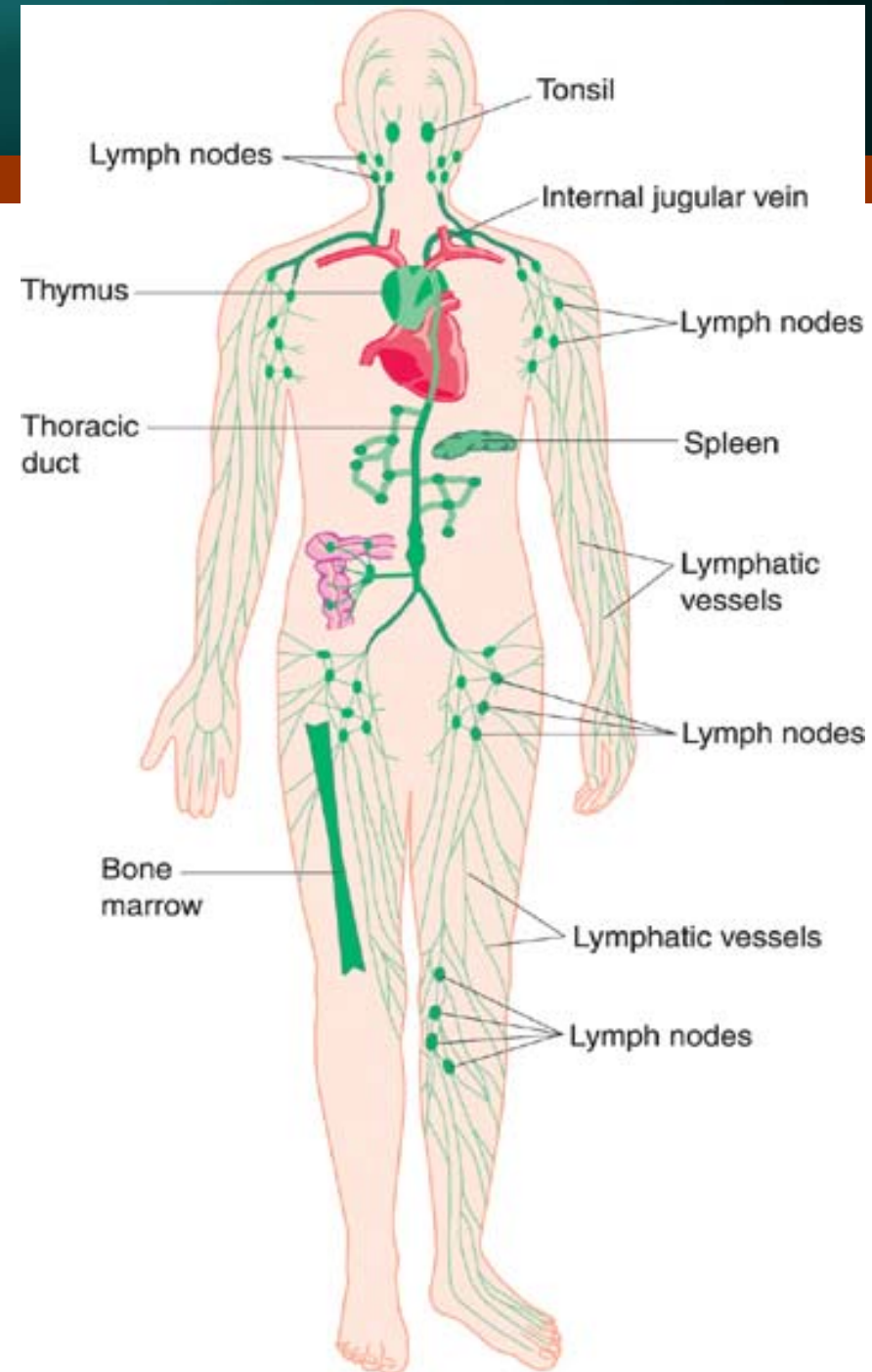
## The Immune System

### ❖ Central lymphoid organ

- Thymus
- Bone marrow

### ❖ Peripheral lymphoid organ

- Lymph node
- Spleen
- Tonsil



# 3. Spleen

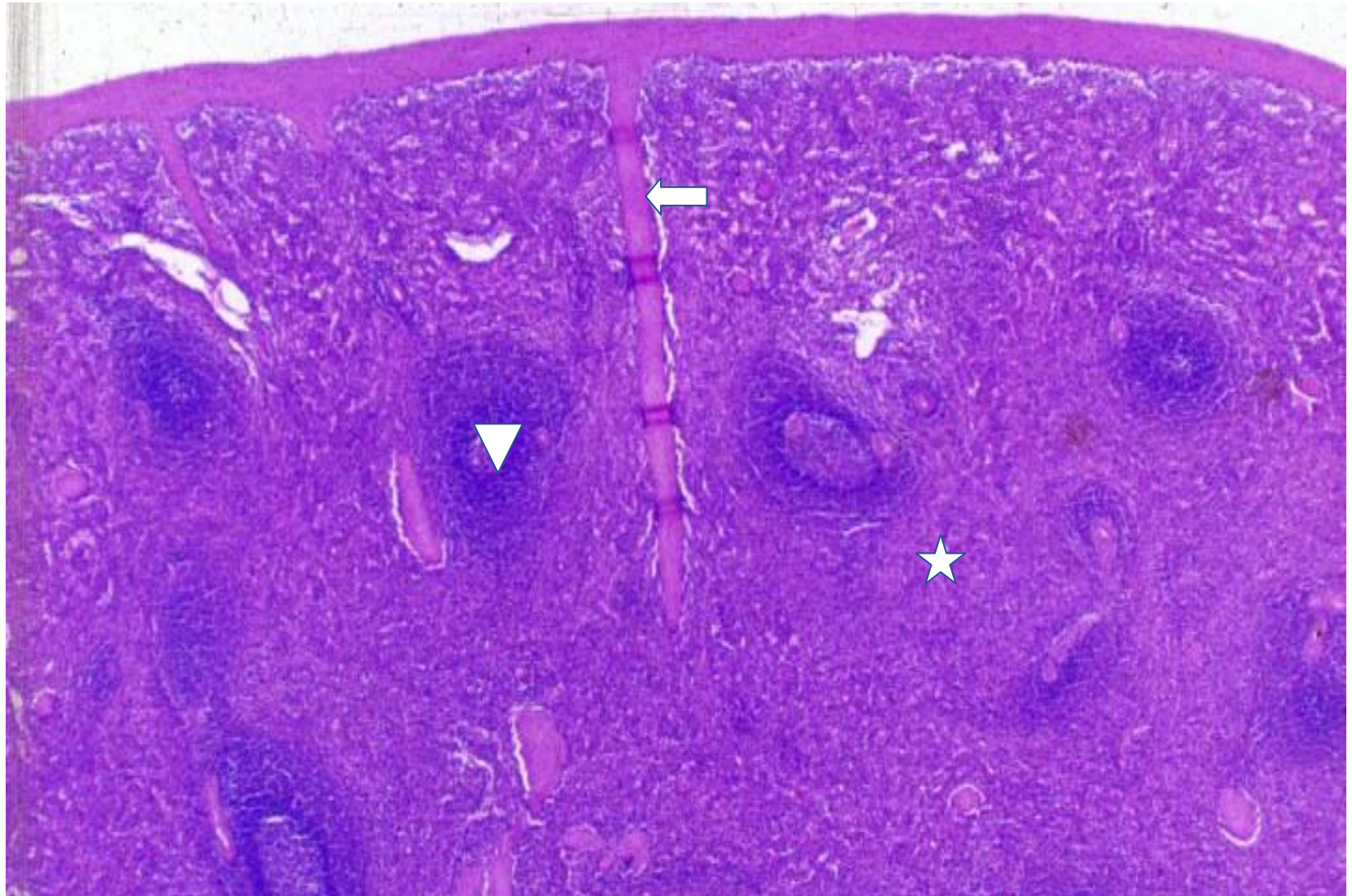
- ❖ Structure
- ❖ **Blood circulation of the spleen**
- ❖ **Functions**

# Structure of the spleen

- ❖ Capsule & trabecula
- ❖ **Parenchyma**
  - White pulp
    - **Periarterial lymphatic sheath**
      - [T cells, macrophages, interdigitating cells]
    - **Splenic corpuscle --[B cells]**
  - Marginal zone -- [T cells, B cells, macrophages]
  - Red pulp
    - **Splenic cord -- [B cells, plasma cells, macrophages, blood cells]**
    - **Splenic sinusoid**

# Spleen

The Immune System



↓ Trabecula

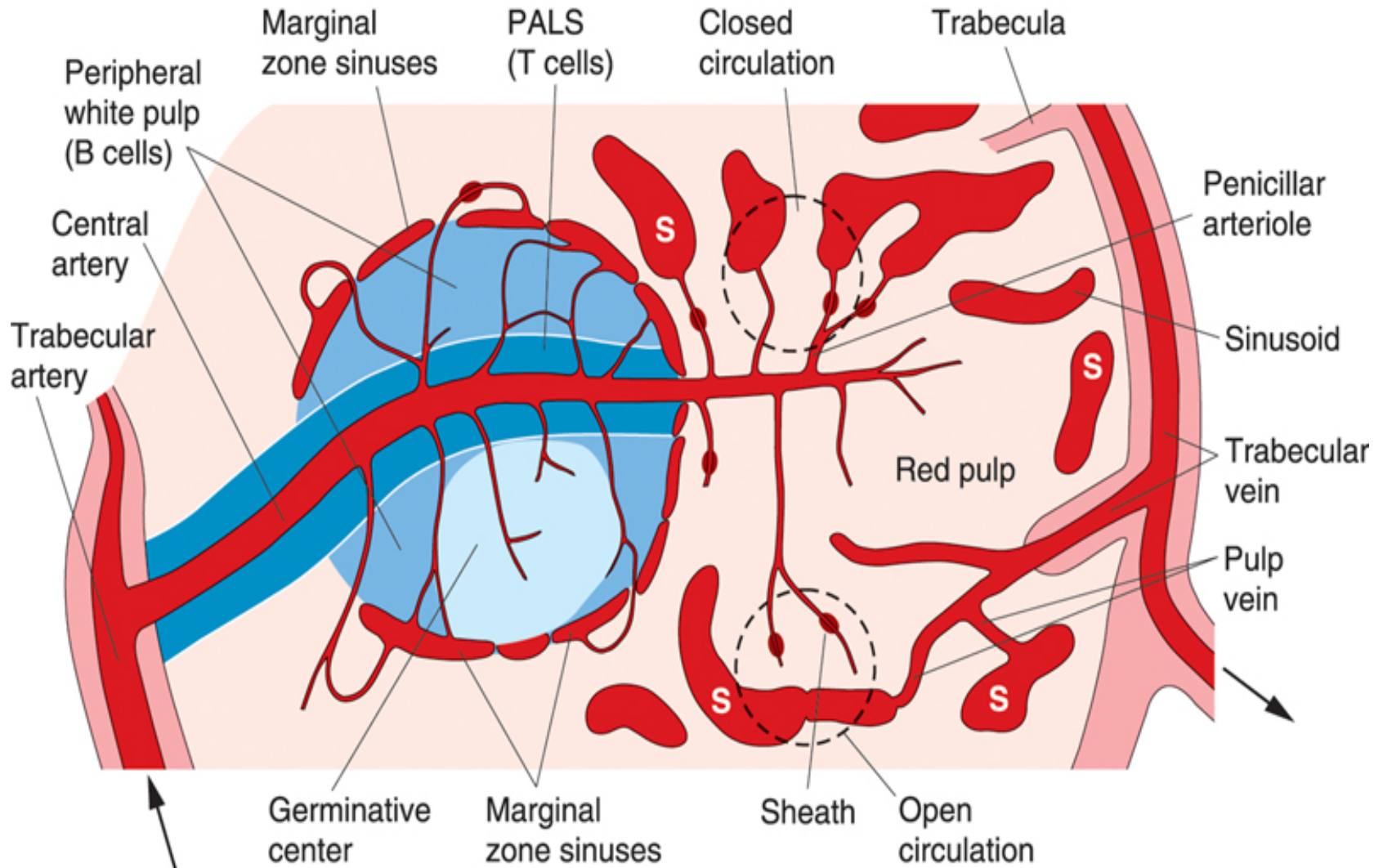
▽ White pulp

☆ Red pulp



# Structure of the spleen

The Immune System



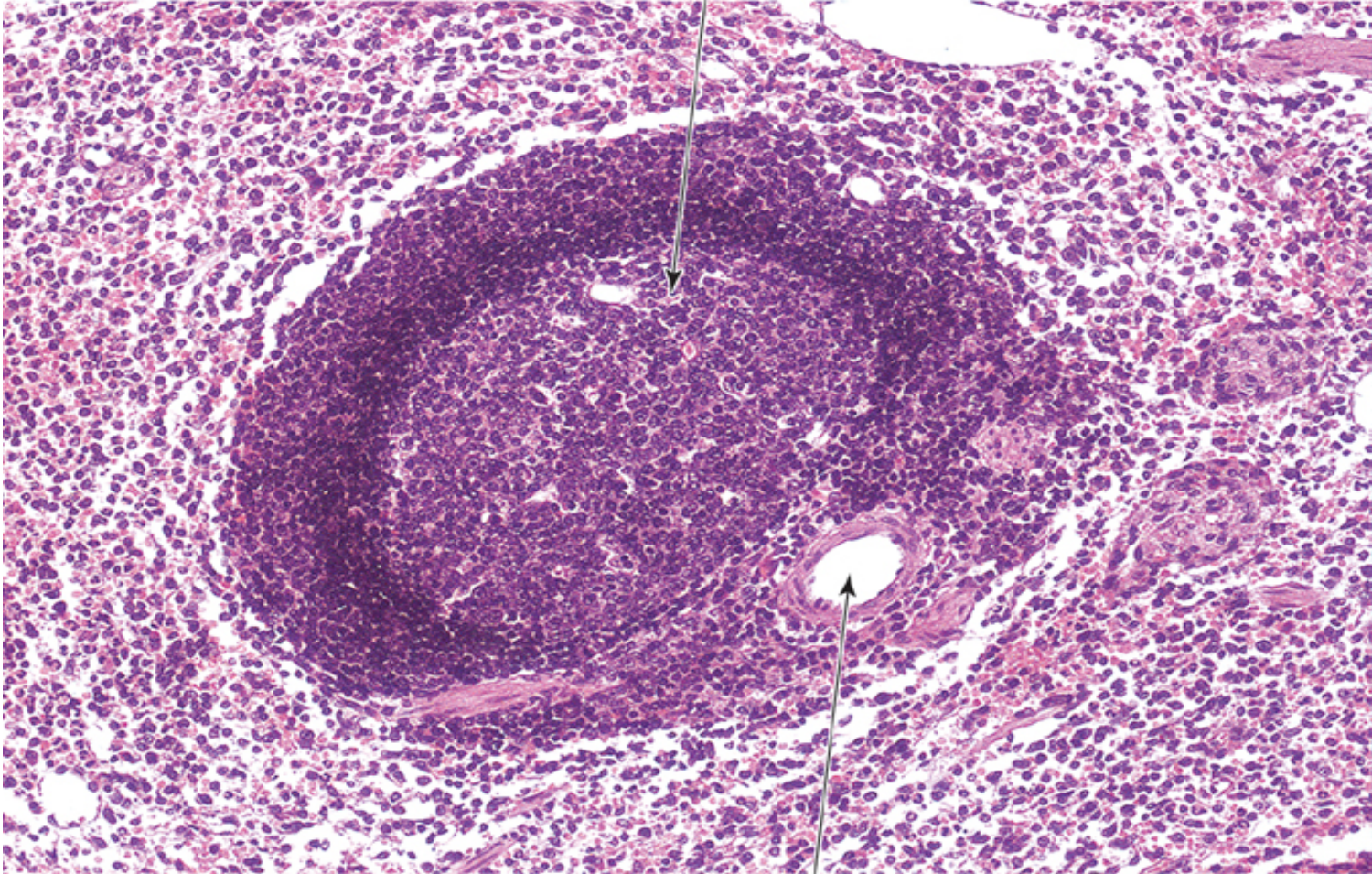
**S: Splenic sinus**

Hui Zhao

# Splenic corpuscle

The Immune System

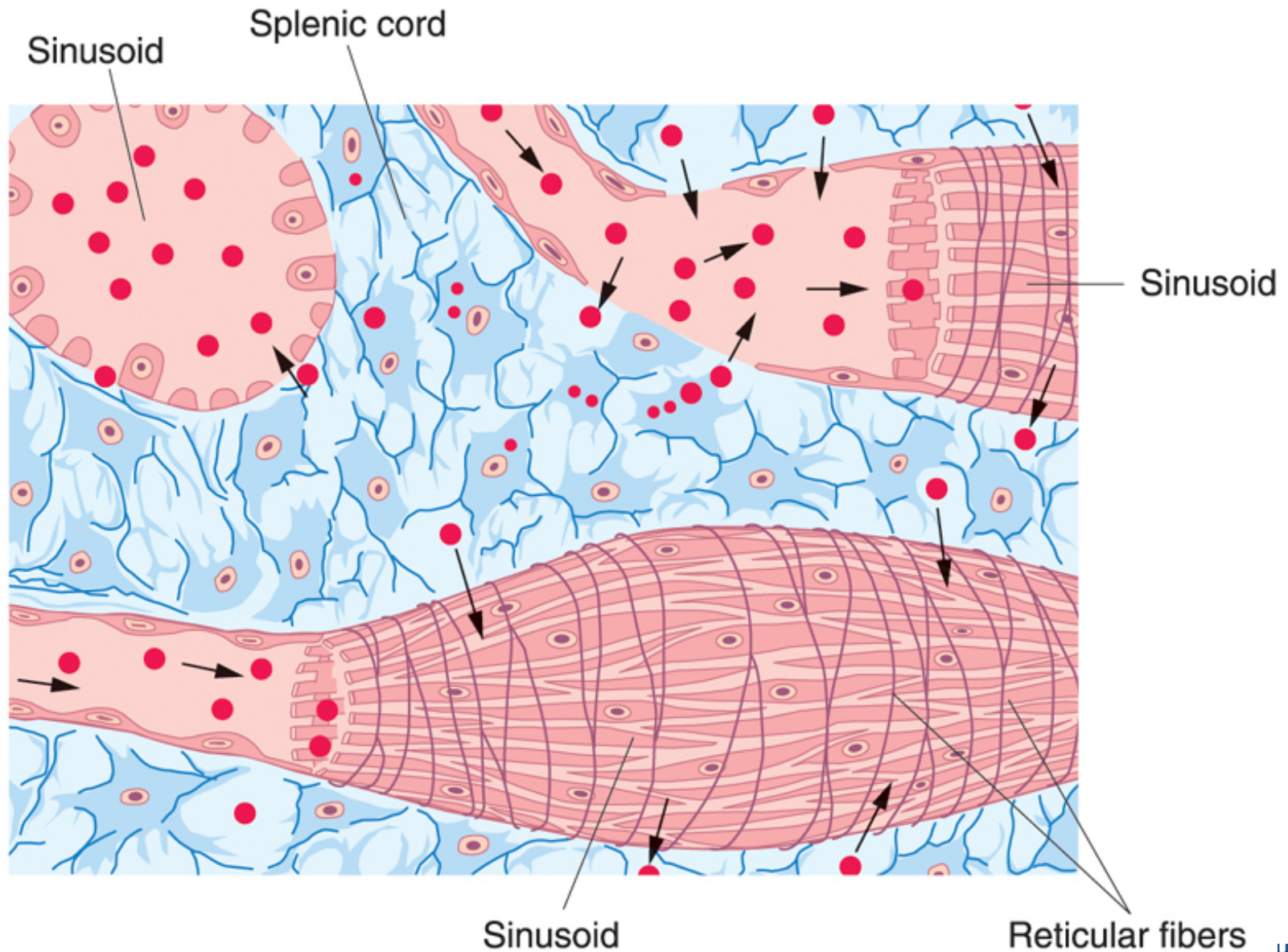
Germinative center



Central artery

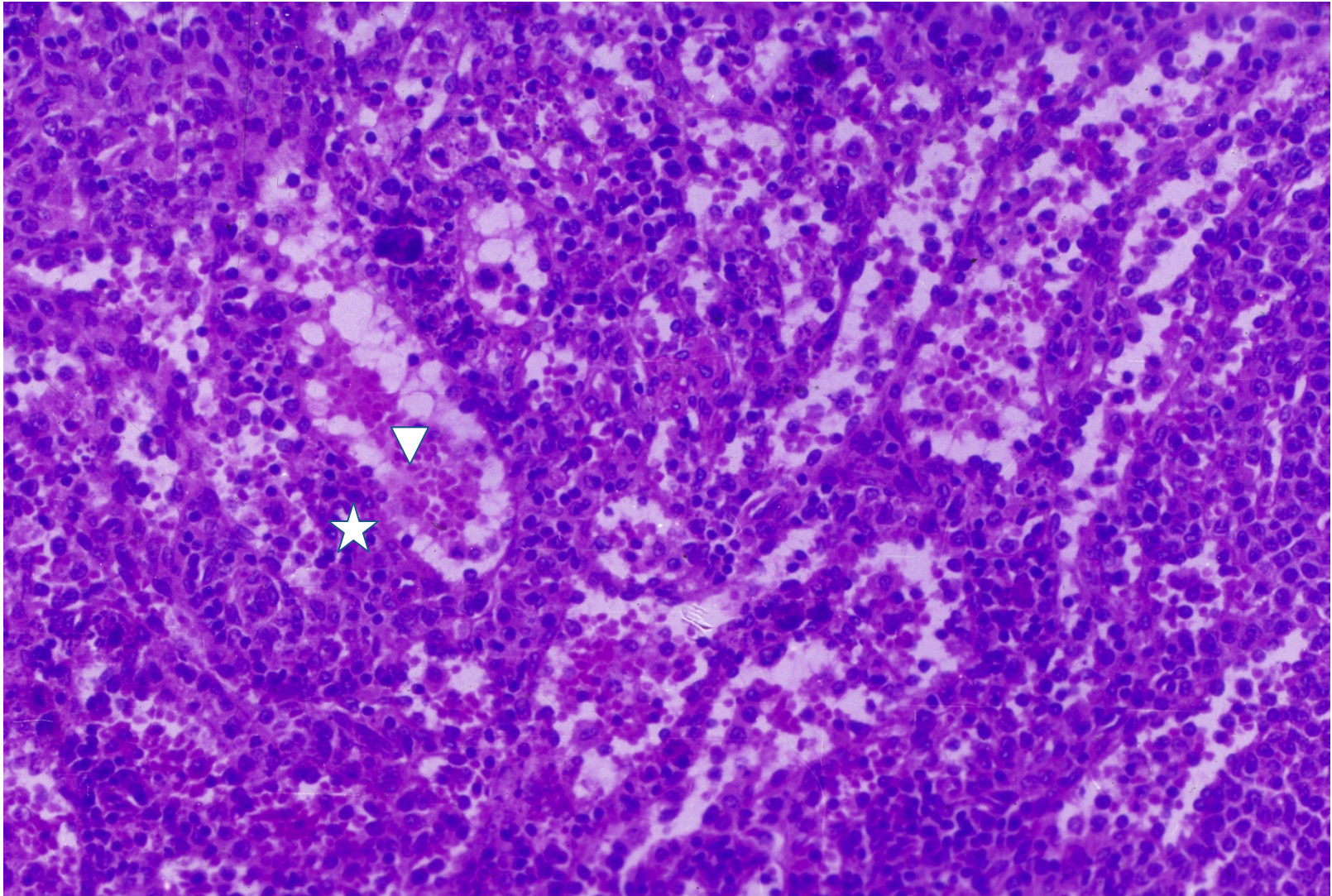
# Red pulp of the spleen

The Immune System



# Red pulp of the spleen

The Immune System



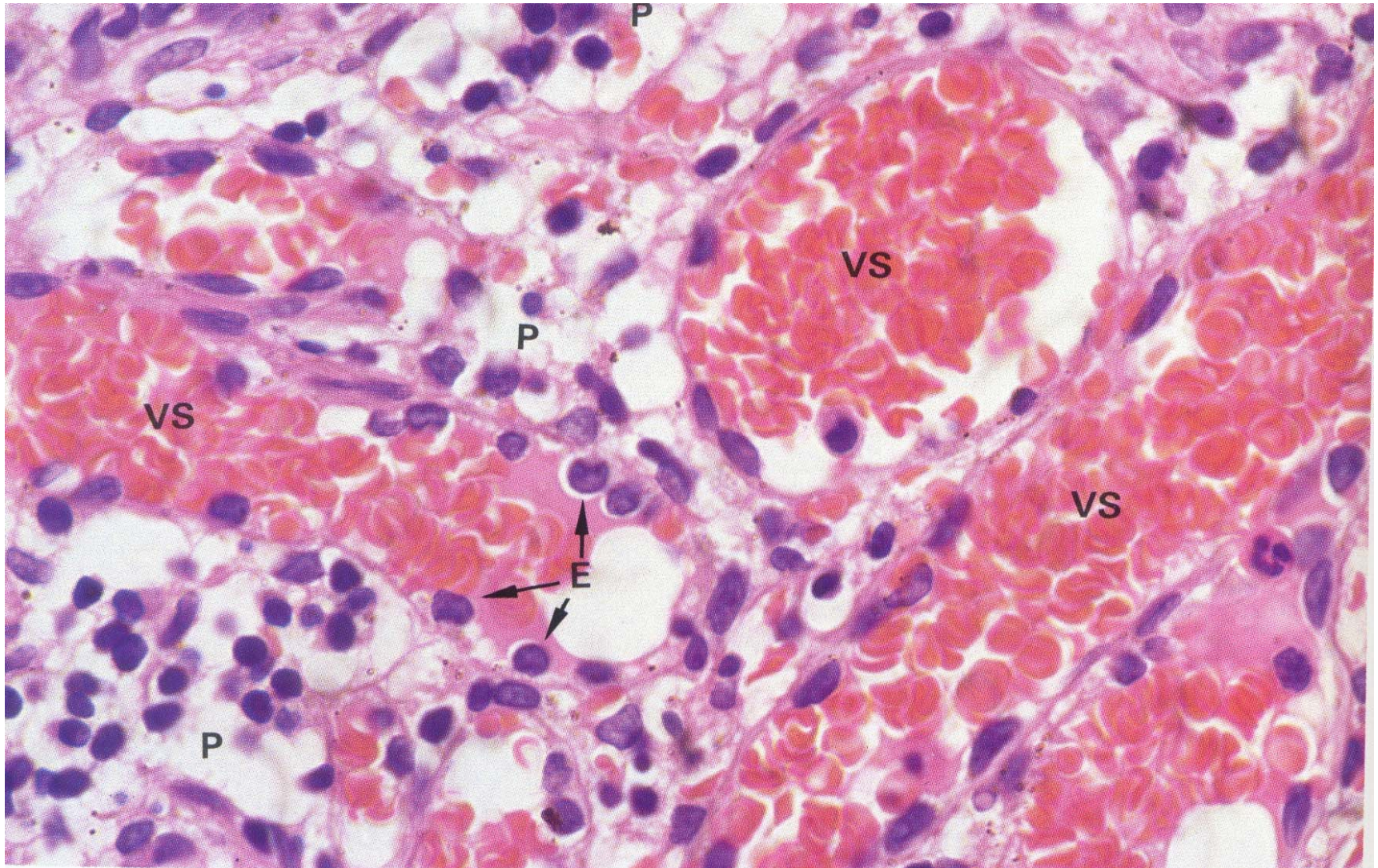
**Splenic cord**



**Splenic sinusoid**

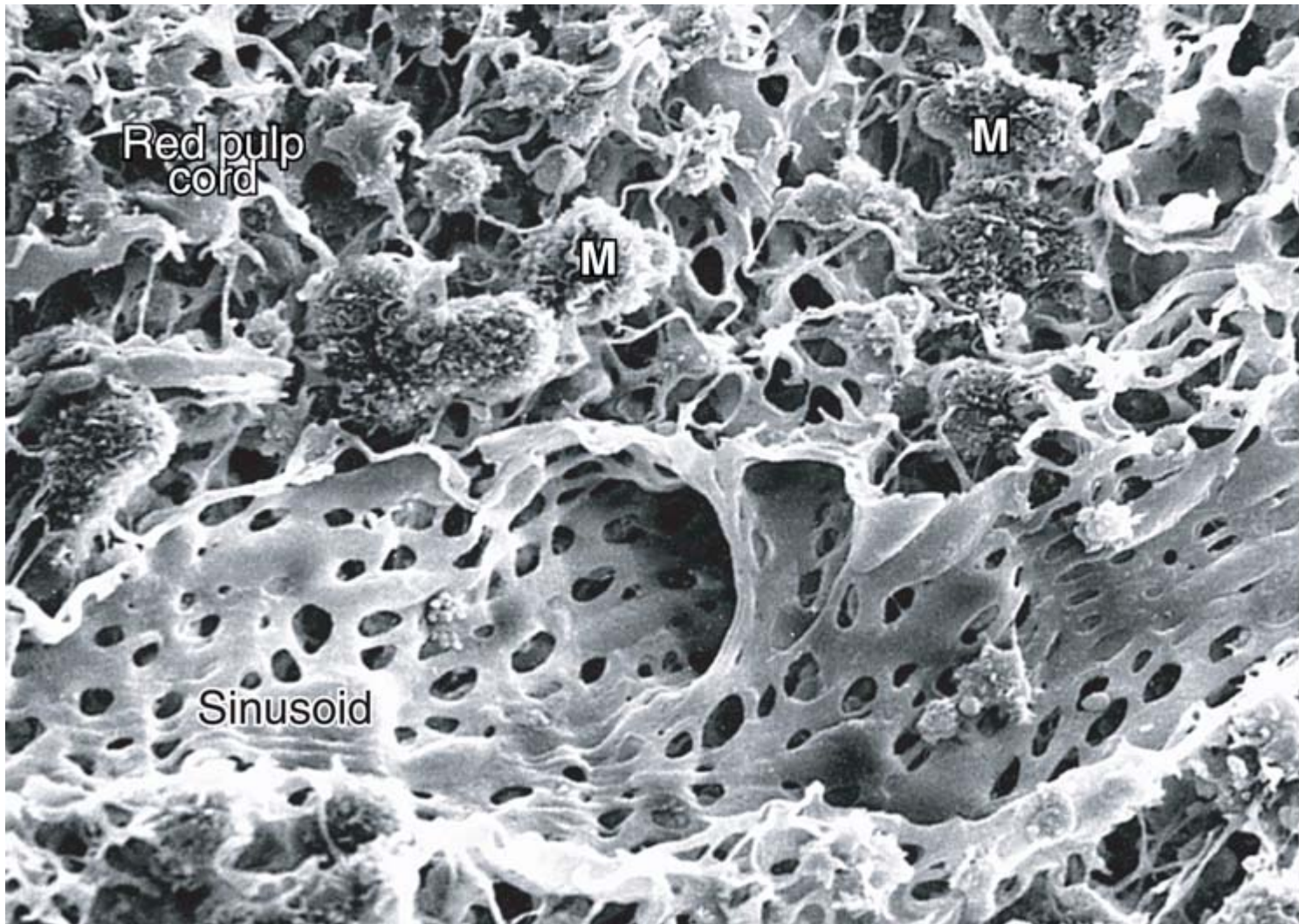
# Red pulp of the spleen

The Immune System



# Red pulp of the spleen

The Immune System



**M: Macrophage**

# Splenic sinusoid

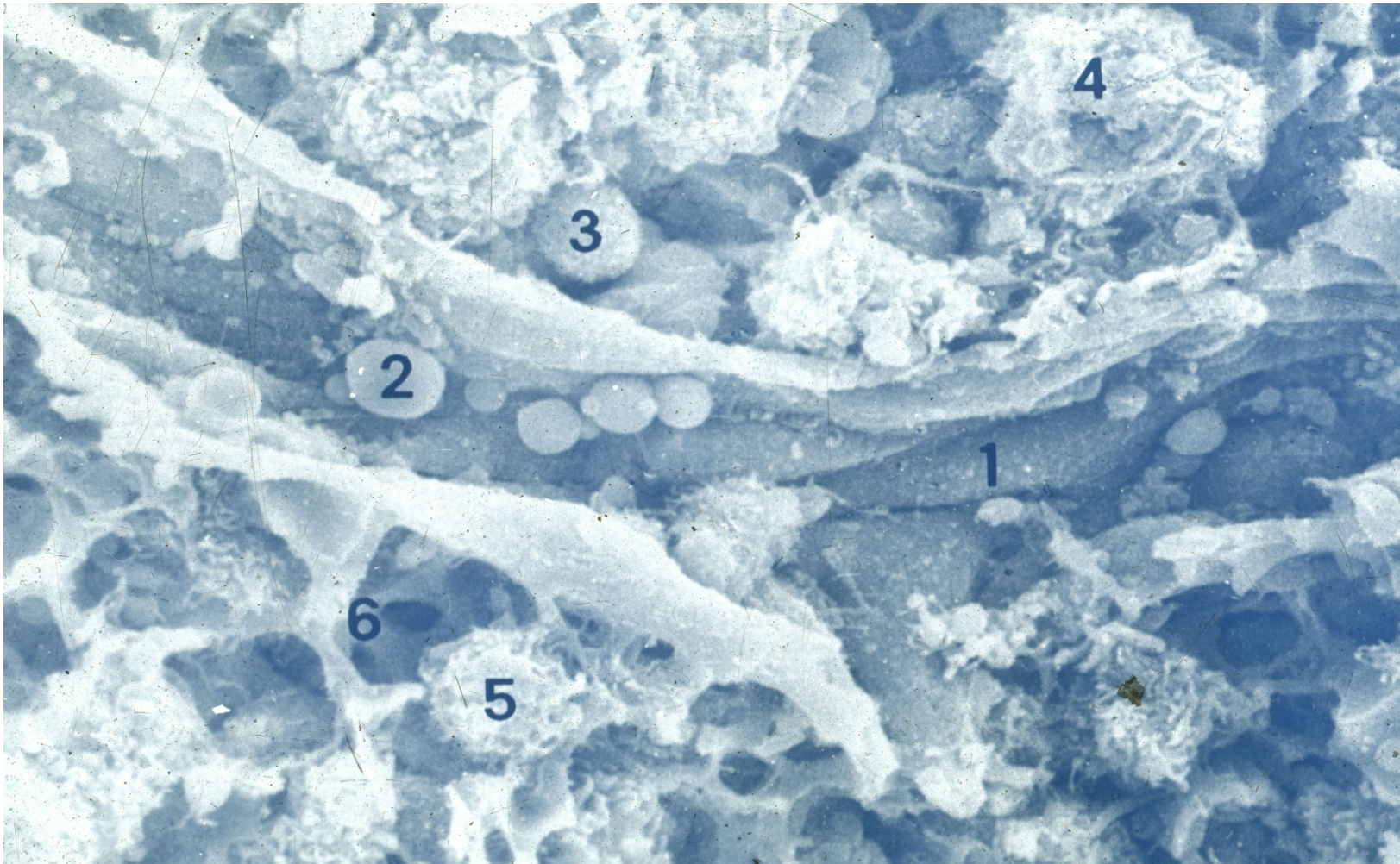
The Immune System



**M: Macrophage**

# Splenic sinusoid

The Immune System



- 1. Endothelial cell
- 2. Red blood cell
- 3. Lymphocyte
- 4. Macrophage
- 5. Granulocyte
- 6. Reticular cell

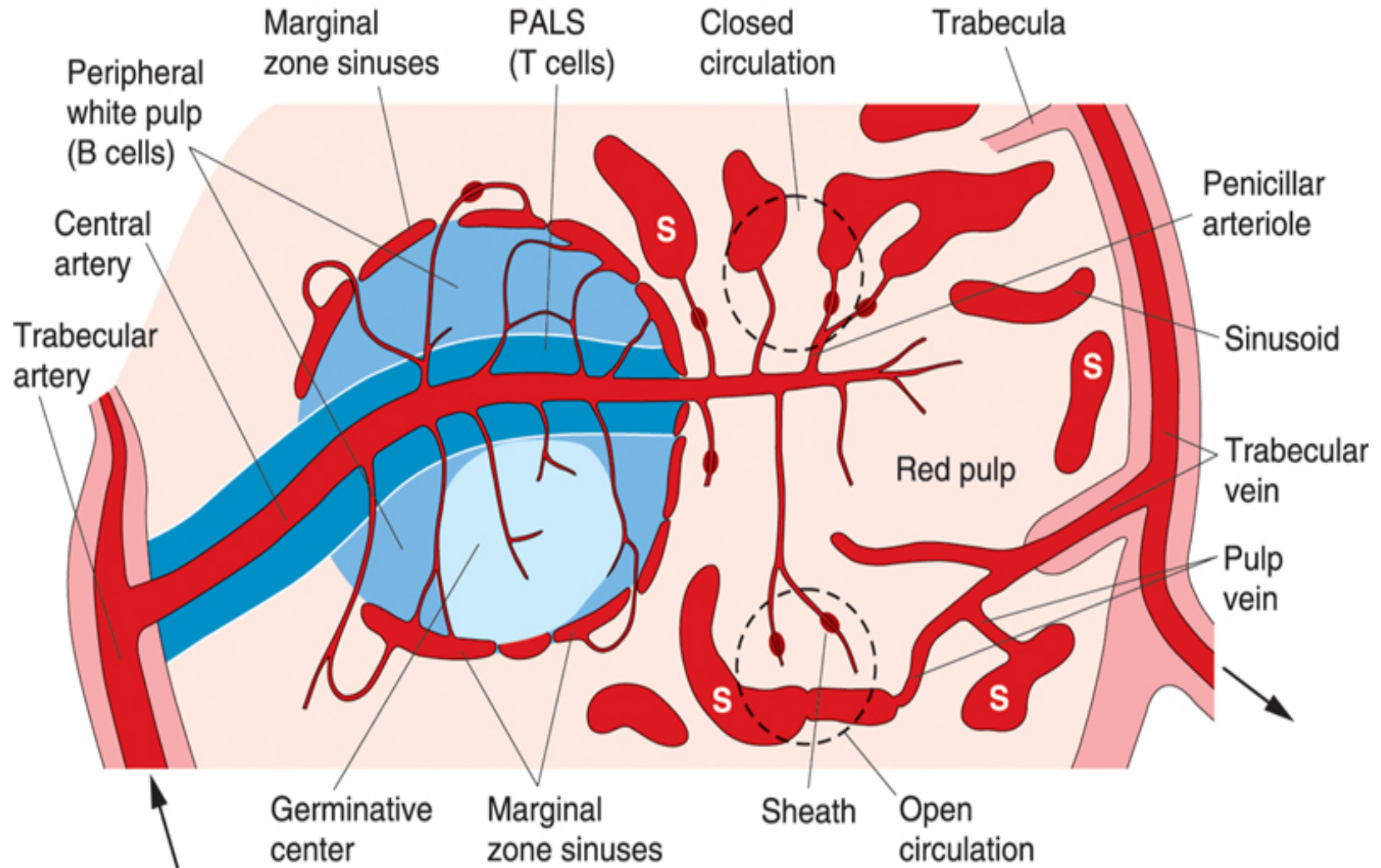


# Spleen

- ❖ **Structure of the spleen**
- ❖ **Blood circulation of the spleen**
- ❖ **Function of the spleen**

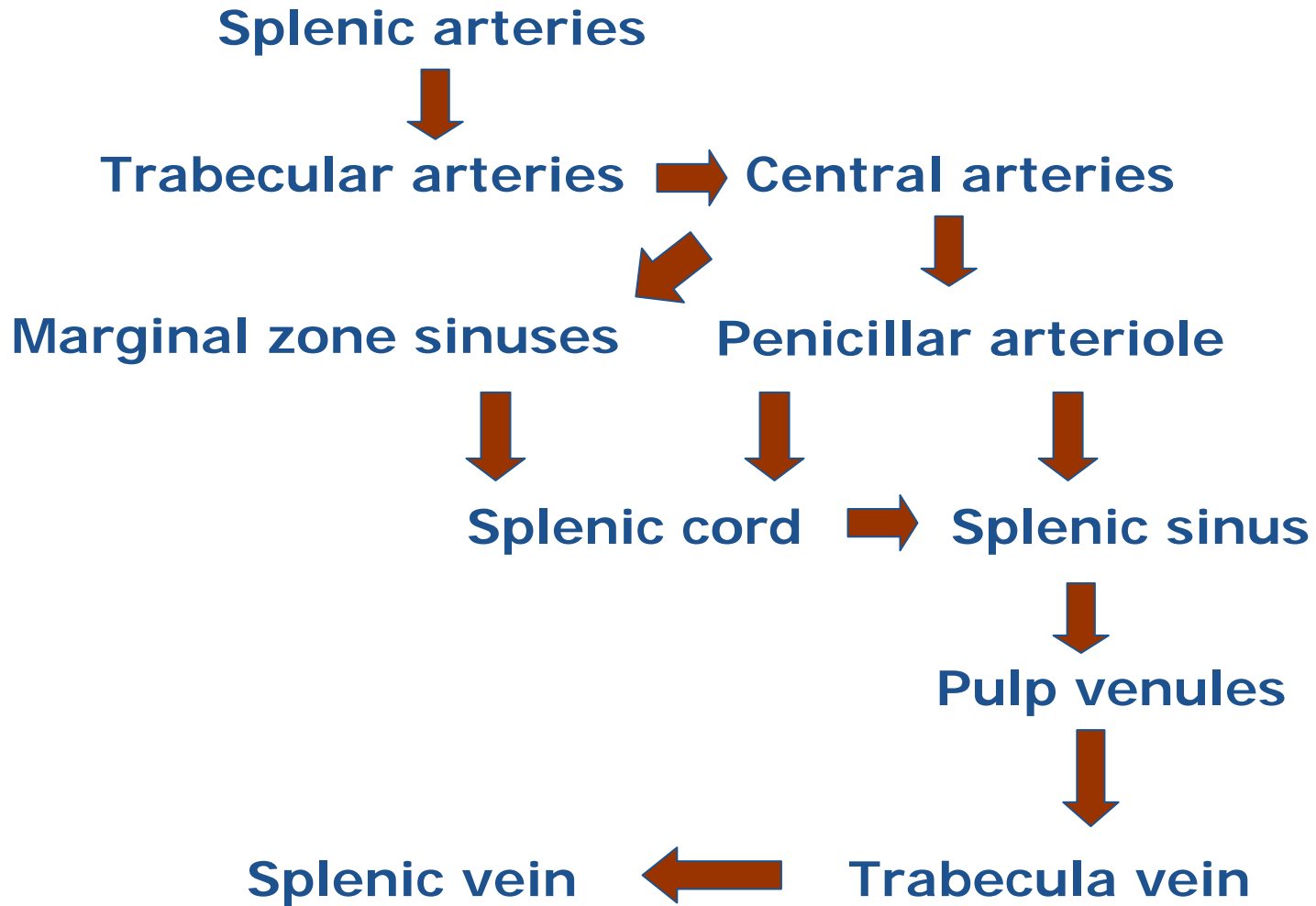
# Blood circulation of the spleen

The Immune System



**S: Splenic sinus**

# Blood circulation of the spleen



# Spleen

- ❖ **Structure of the spleen**
- ❖ **Blood circulation of the spleen**
- ❖ **Function of the spleen**

# Function of the spleen

## The Immune System

- ❖ **Blood filter**
- ❖ **Blood storage**
- ❖ **Blood production**
- ❖ **Immunological defense**



**Thank You !**