

The Immune System

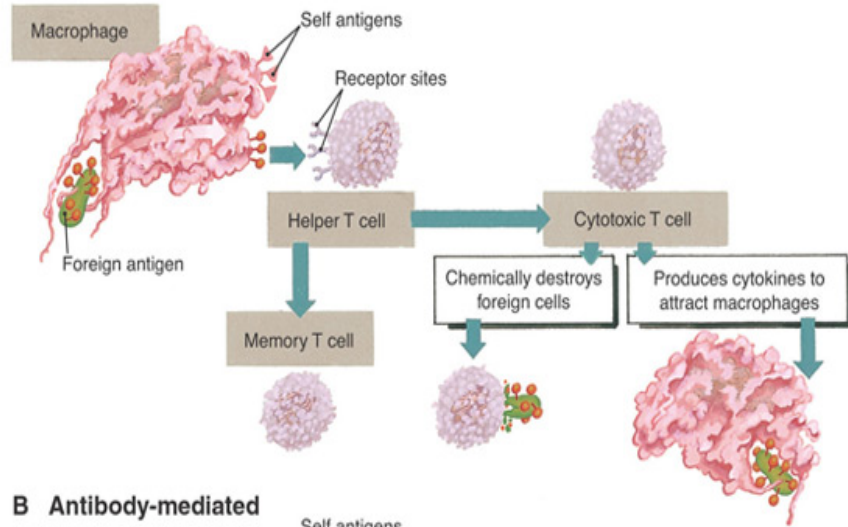
Xue Hui

Department of Histology & Embryology

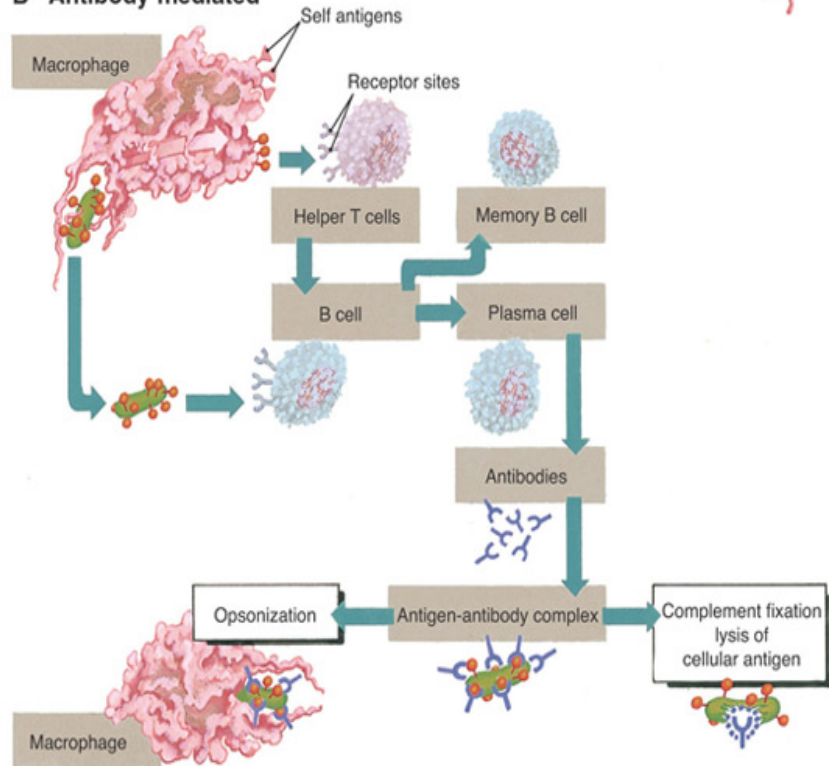
Introduction

- Components
- Function
- Mechanisms of Immunity

A Cell-mediated

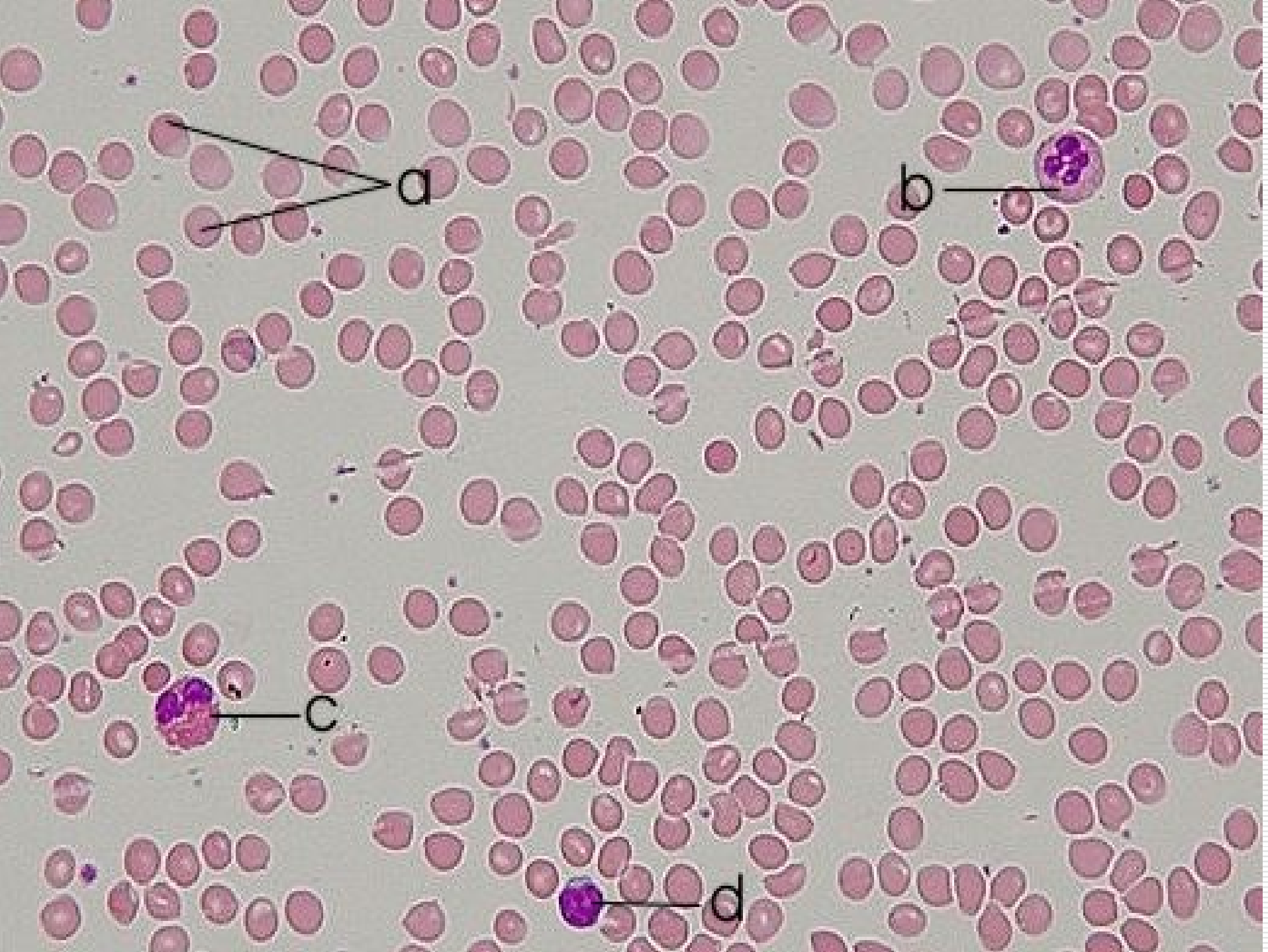


B Antibody-mediated



Structural components of the immune system

- ❑ Immune cell
 - Lymphocyte
 - Antigen presenting cell
 - Plasma cell
 - Granulocyte
 - ❑ Immune tissue (Lymphatic tissue)
 - Diffuse lymphoid tissue
 - Lymphoid nodule
 - ❑ Immune organ (Lymphatic organ)
 - Central lymphoid organ
 - Peripheral lymphoid organ
-



a

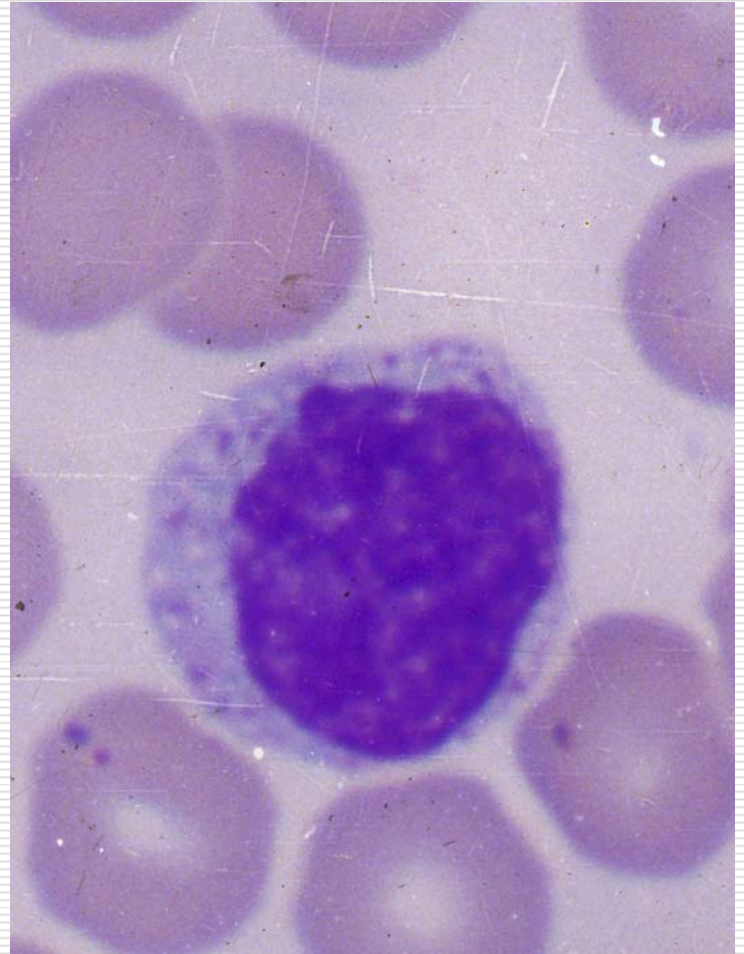
b

c

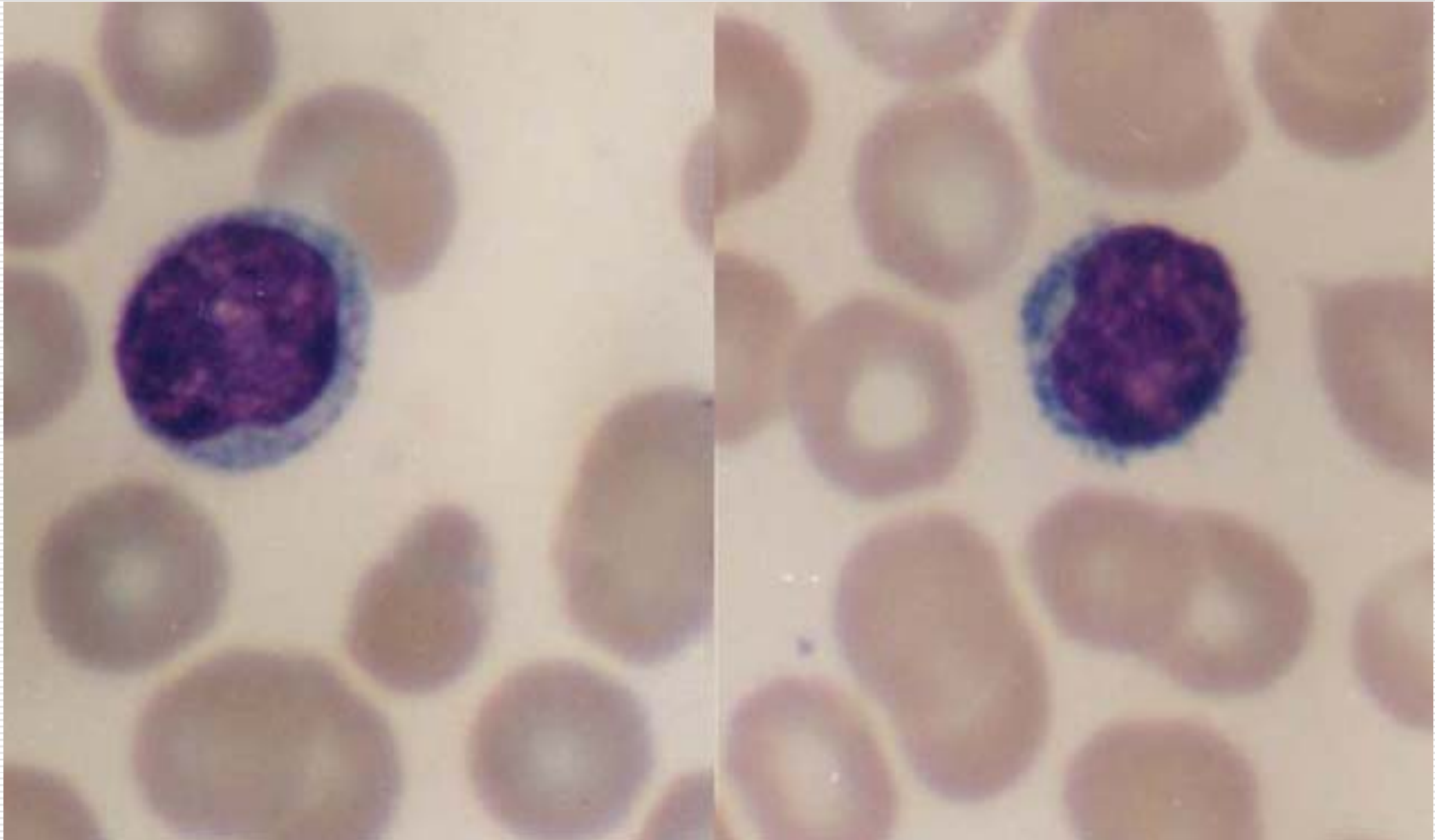
d

Lymphocyte

- ❑ **Small lymphocyte**
 - **Diameter: 6 ~ 8 μ m**
- ❑ **Medium - sized lymphocyte**
 - **Diameter: 9 ~ 12 μ m**
- ❑ **Large lymphocyte**
 - **Diameter: 13 ~ 20 μ m**

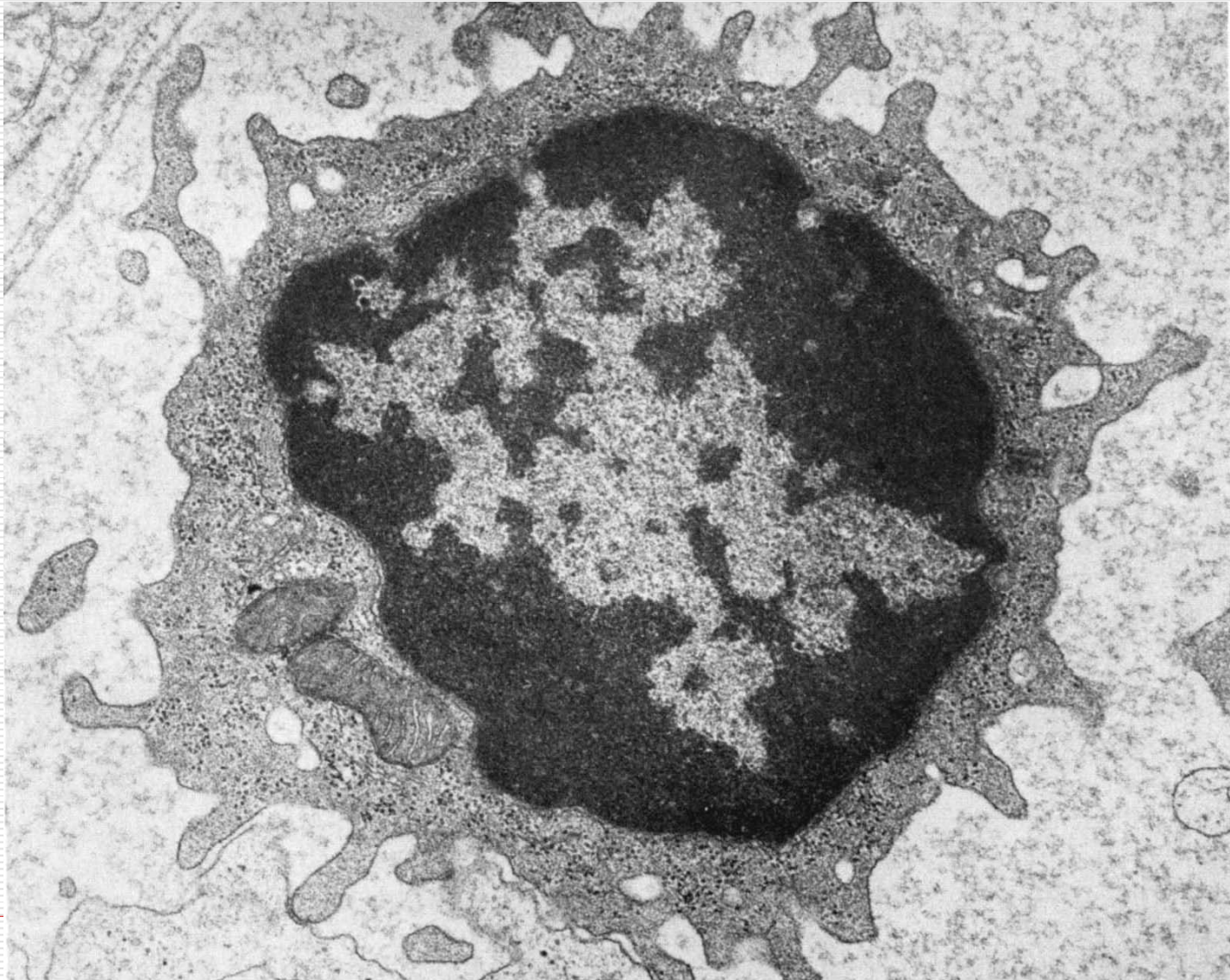


Lymphocyte



Medium - sized lymphocyte (Left) & Small lymphocyte (Right)

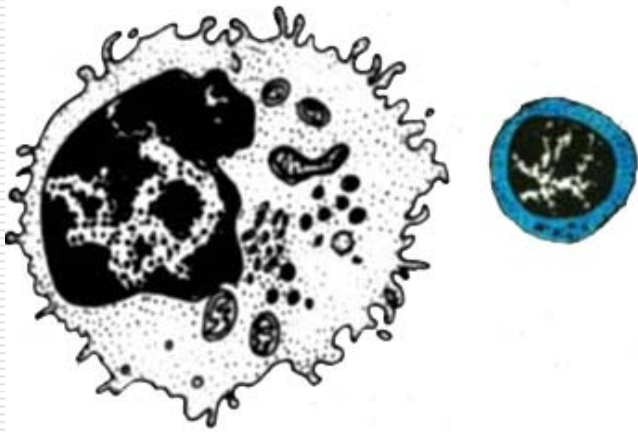
Lymphocyte



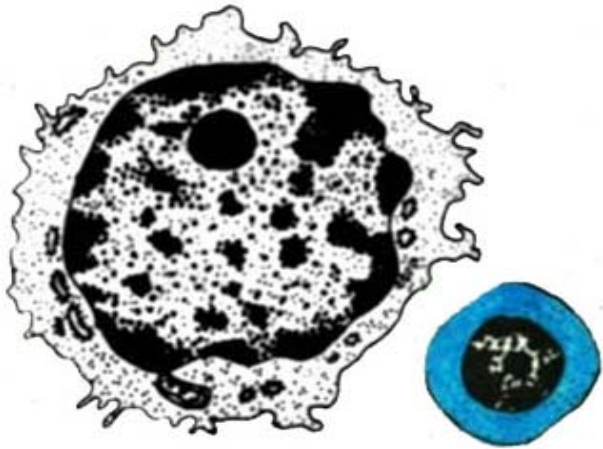
Lymphocyte

- Thymus dependent lymphocyte (T cell)
 - Helper cell (Th cell)
 - Cytotoxic cell (Tc cell)
 - Memory cell
 - Bone marrow dependent lymphocyte (B cell)
 - Natural killer cell (NK cell)
-

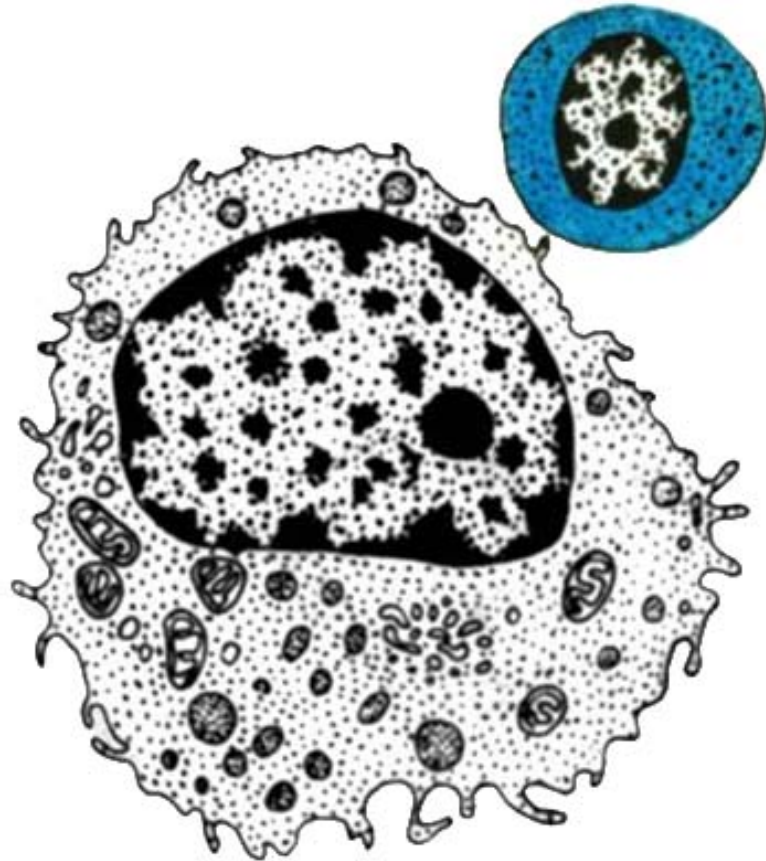
Lymphocyte



T Cell



B Cell



NK Cell

Structural Components of the immune system

- ❑ Immune cell
 - Lymphocyte
 - Antigen presenting cell (APC)
 - Plasma cell
 - Granulocyte
 - ❑ Immune tissue (Lymphatic tissue)
 - Diffuse lymphoid tissue
 - Lymphoid nodule
 - ❑ Immune organ (Lymphatic organ)
 - Central lymphoid organ
 - Peripheral lymphoid organ
-

Lymphatic tissue

- Diffuse lymphatic tissue

 - Postcapillary venule

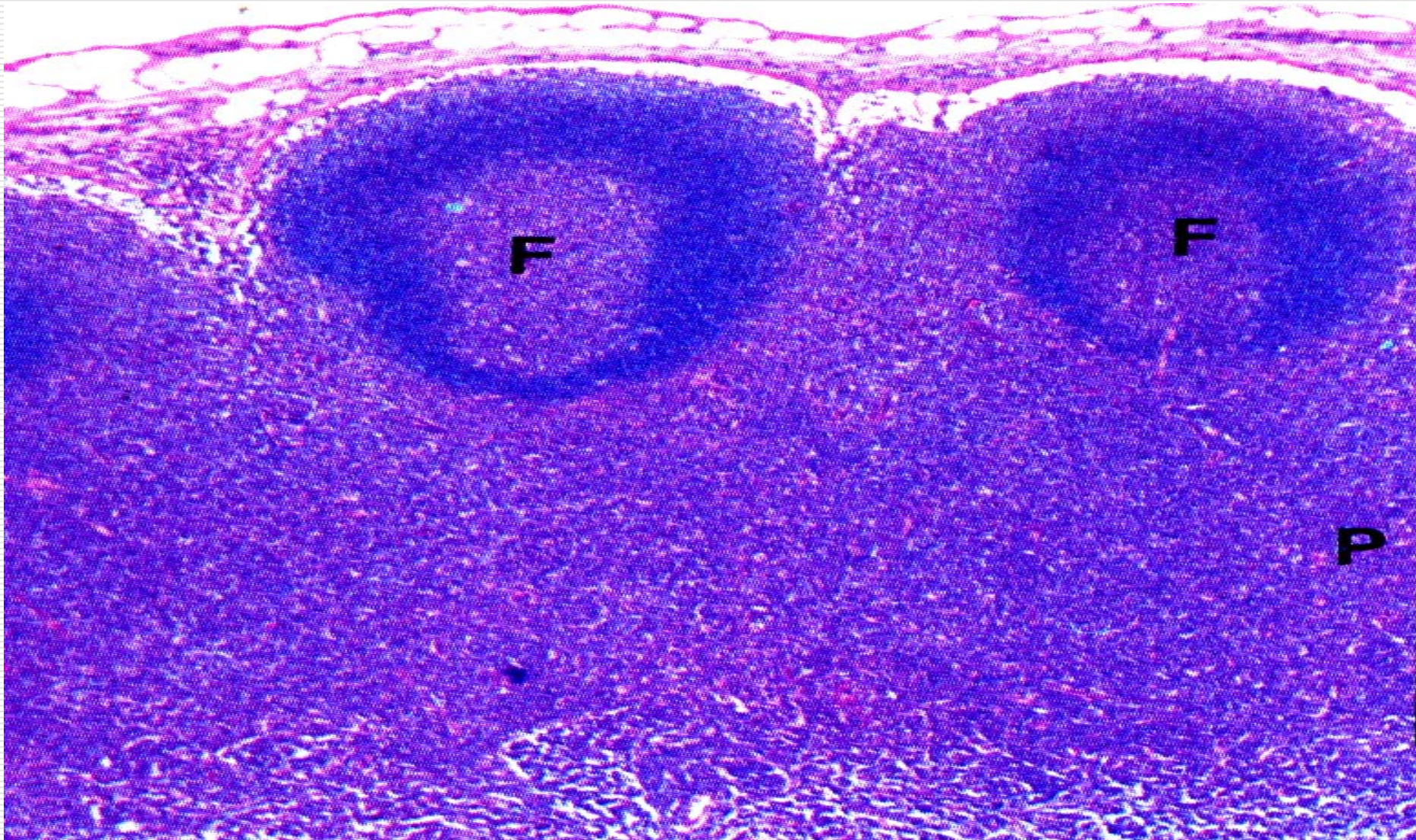
- Lymphatic nodule

 - **Primary lymphoid nodule**

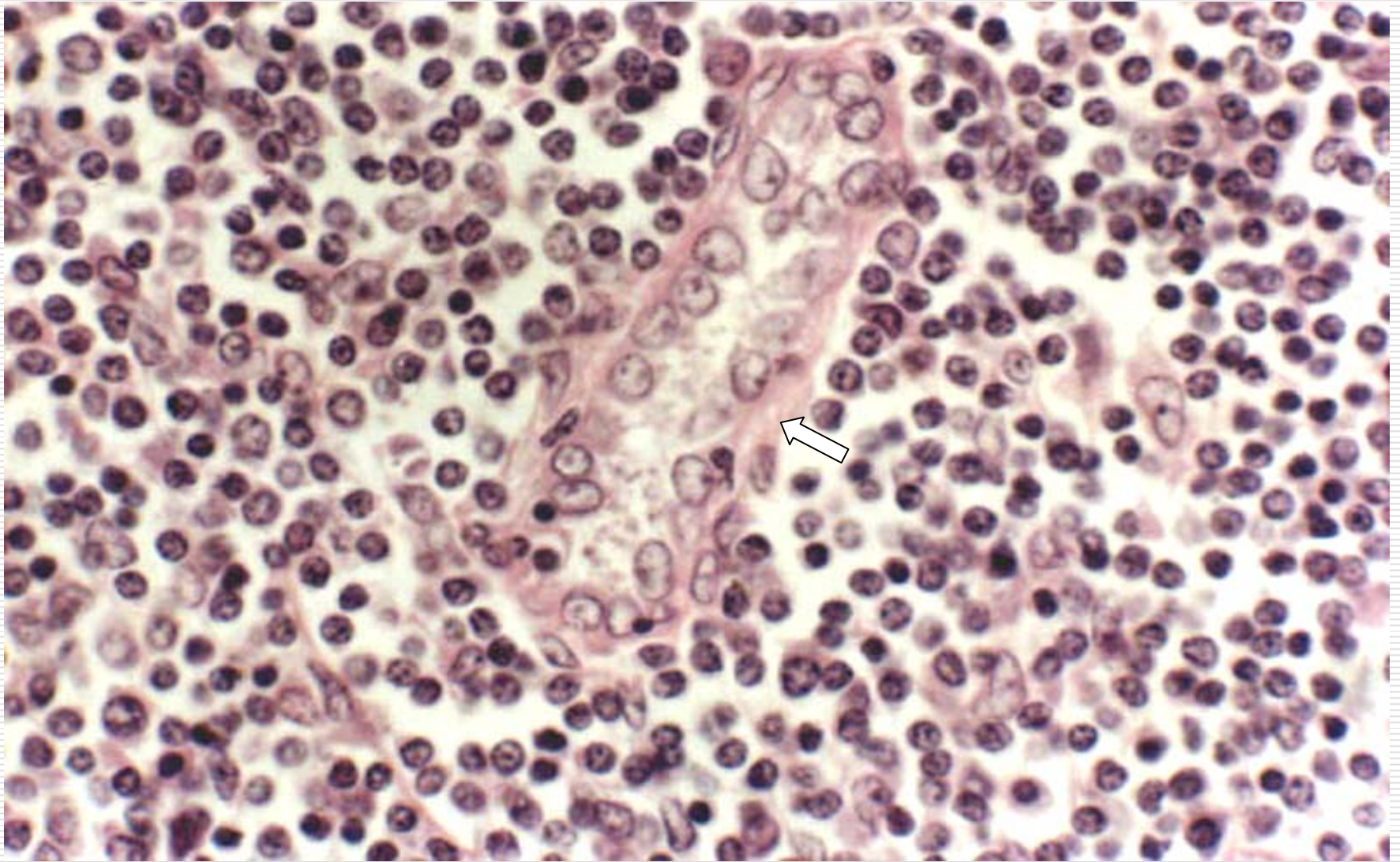
 - **Secondary lymphoid nodule**

 - Germinal center

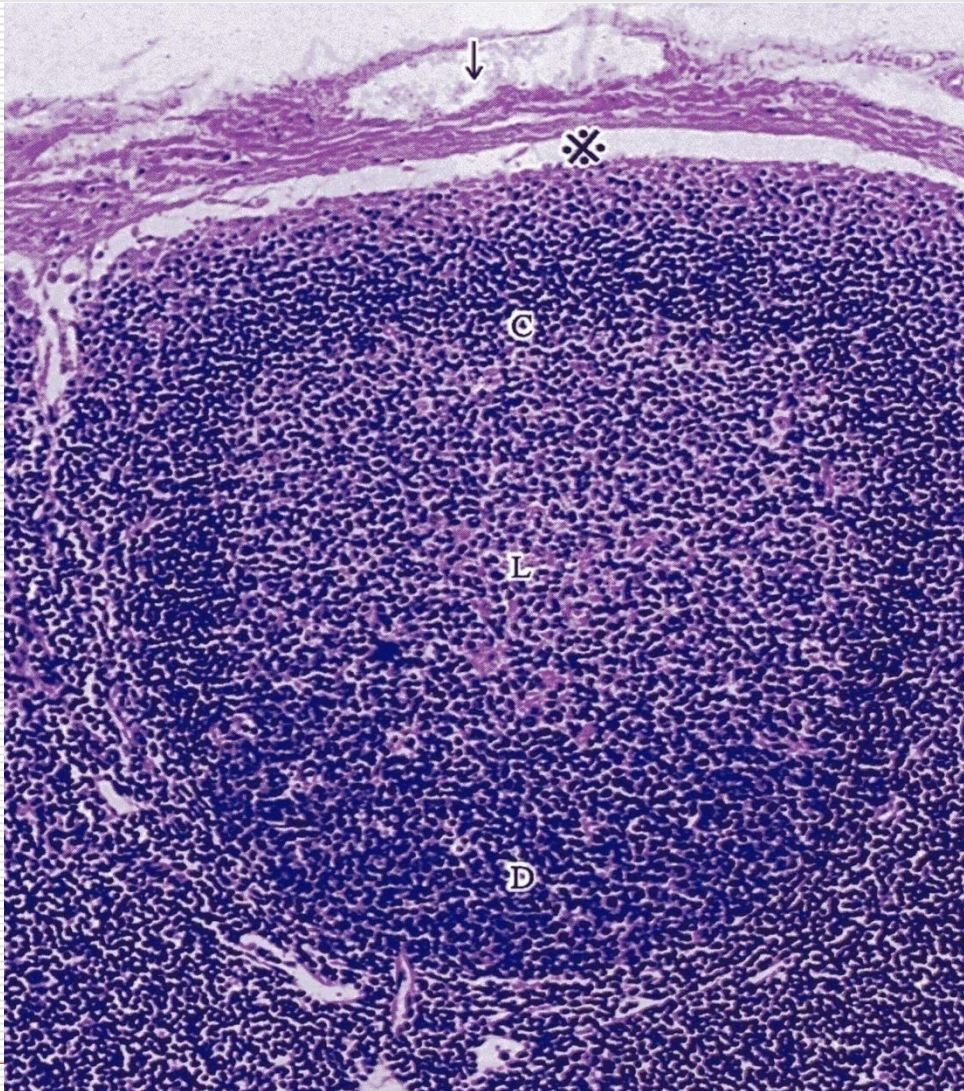
Diffuse lymphoid tissue & Lymphoid nodule



Postcapillary venule



Lymphoid nodule



↓ : Afferent lymphatic vessels

※ : Subcapsular sinus

D : Dark zone

L : Light zone

C : Cap

Lymphatic organ

□ Central lymphatic organ

- Thymus

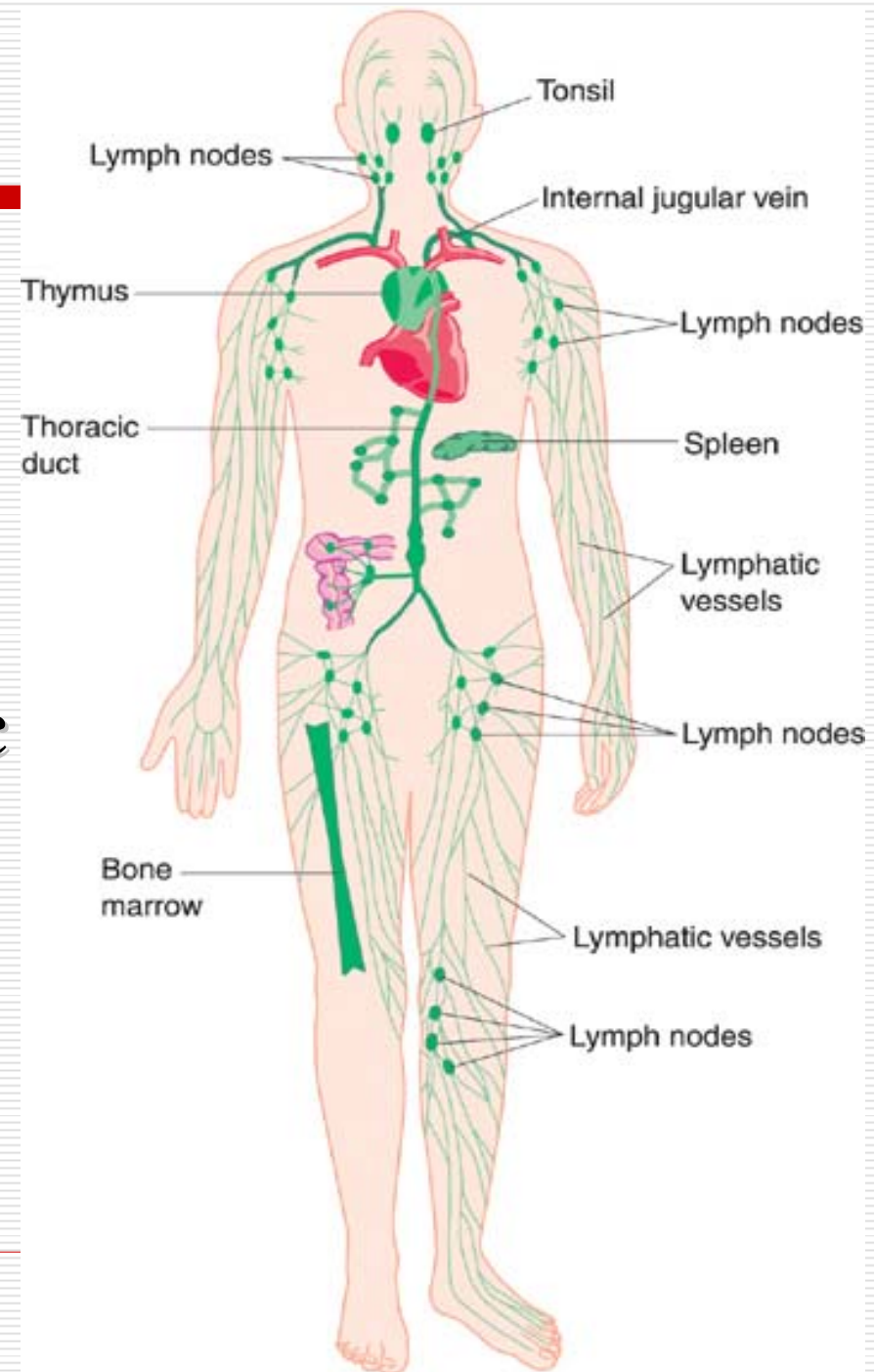
- Bone marrow

□ Peripheral lymphatic organ

- Lymph node

- Spleen

- Tonsil



Thymus

Structure of the thymus

■ Capsule

Interlobular septum

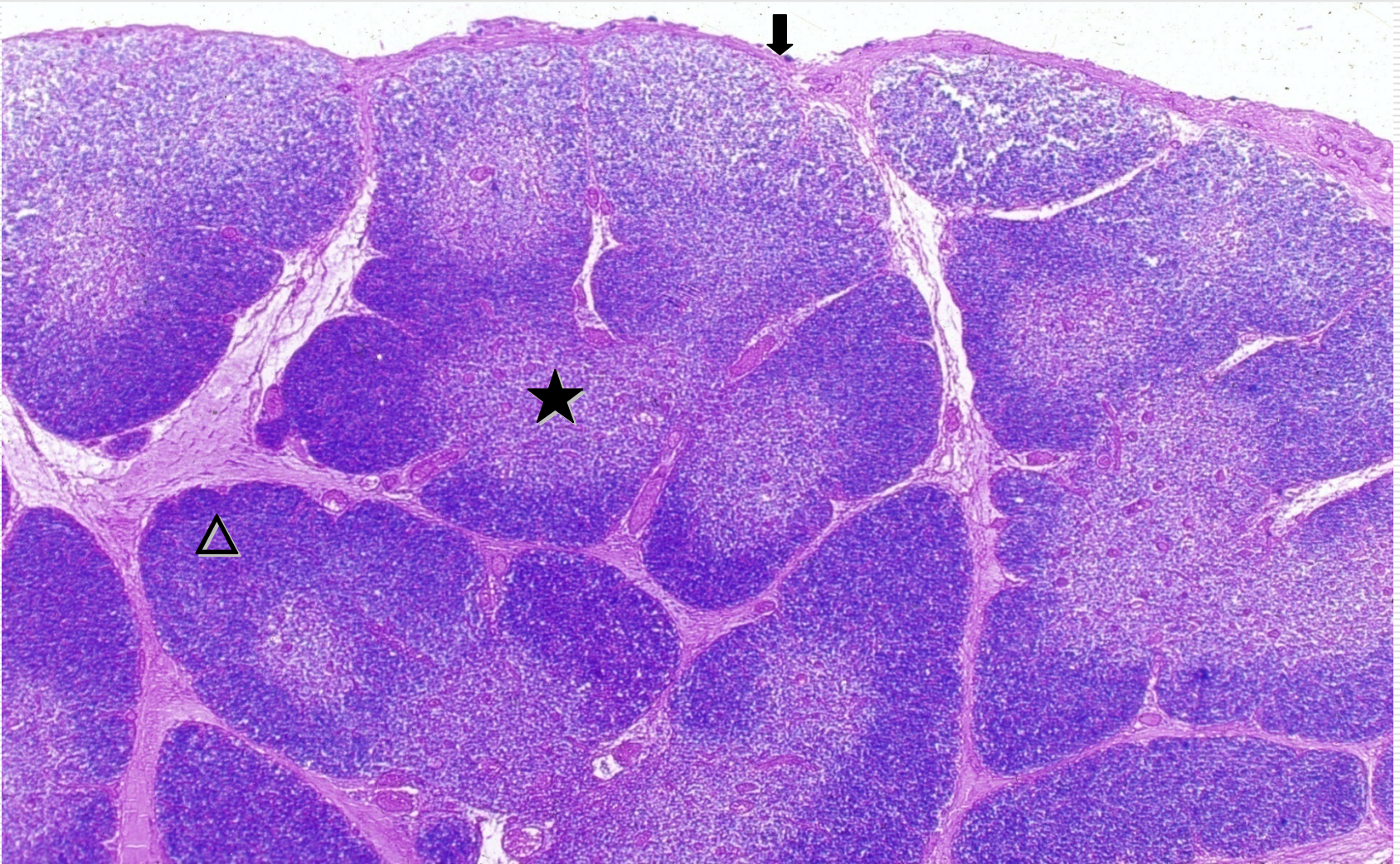
■ Parenchyma

Thymic lobule

■ Cortex ---- Dark staining

■ Medulla ---- Light staining

Thymus



↓ Capsule △ Cortex ★ Medulla

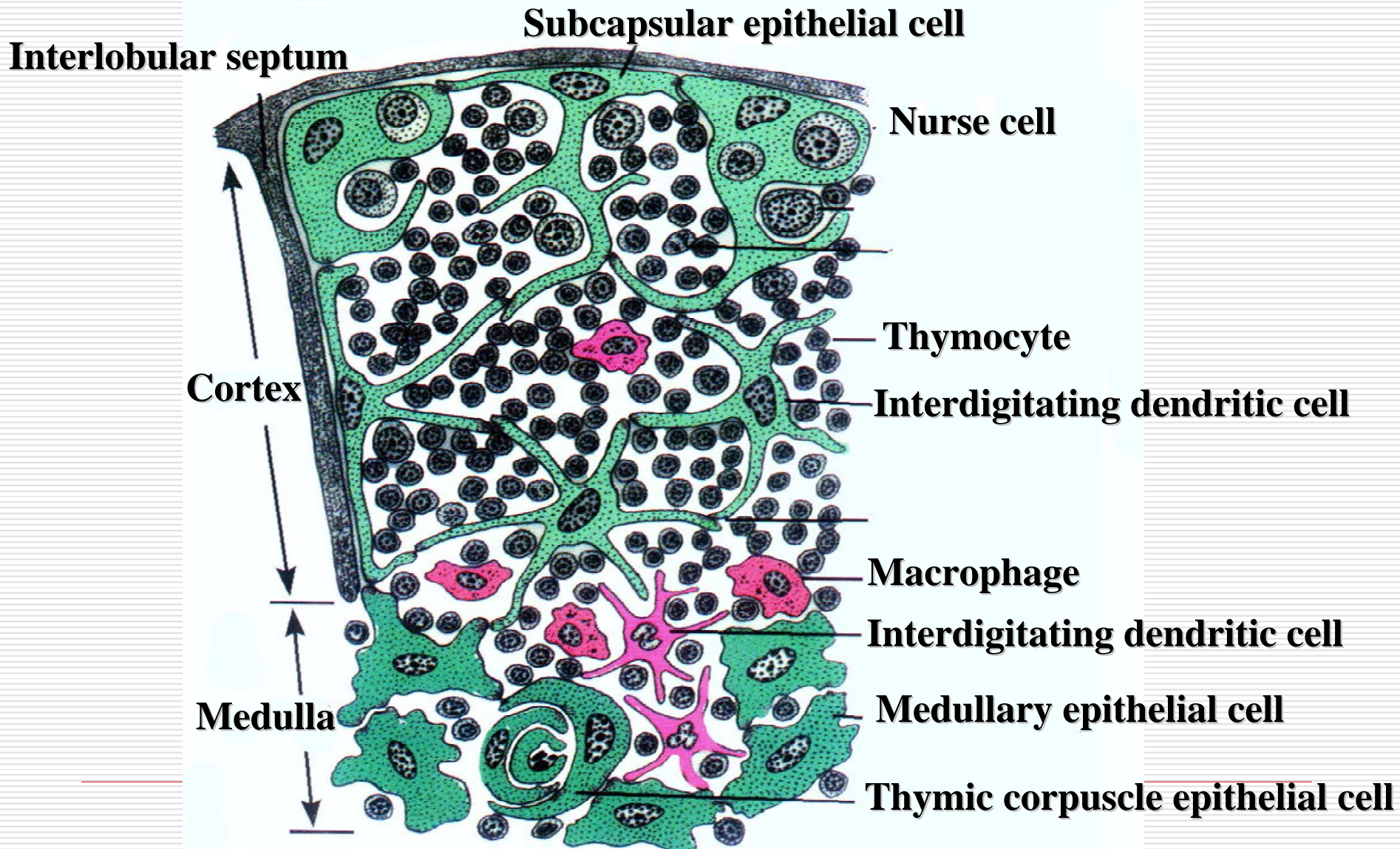
Thymus

- Structure of the thymus
 - Reticular connective tissue
 - Epithelial reticular cell
-

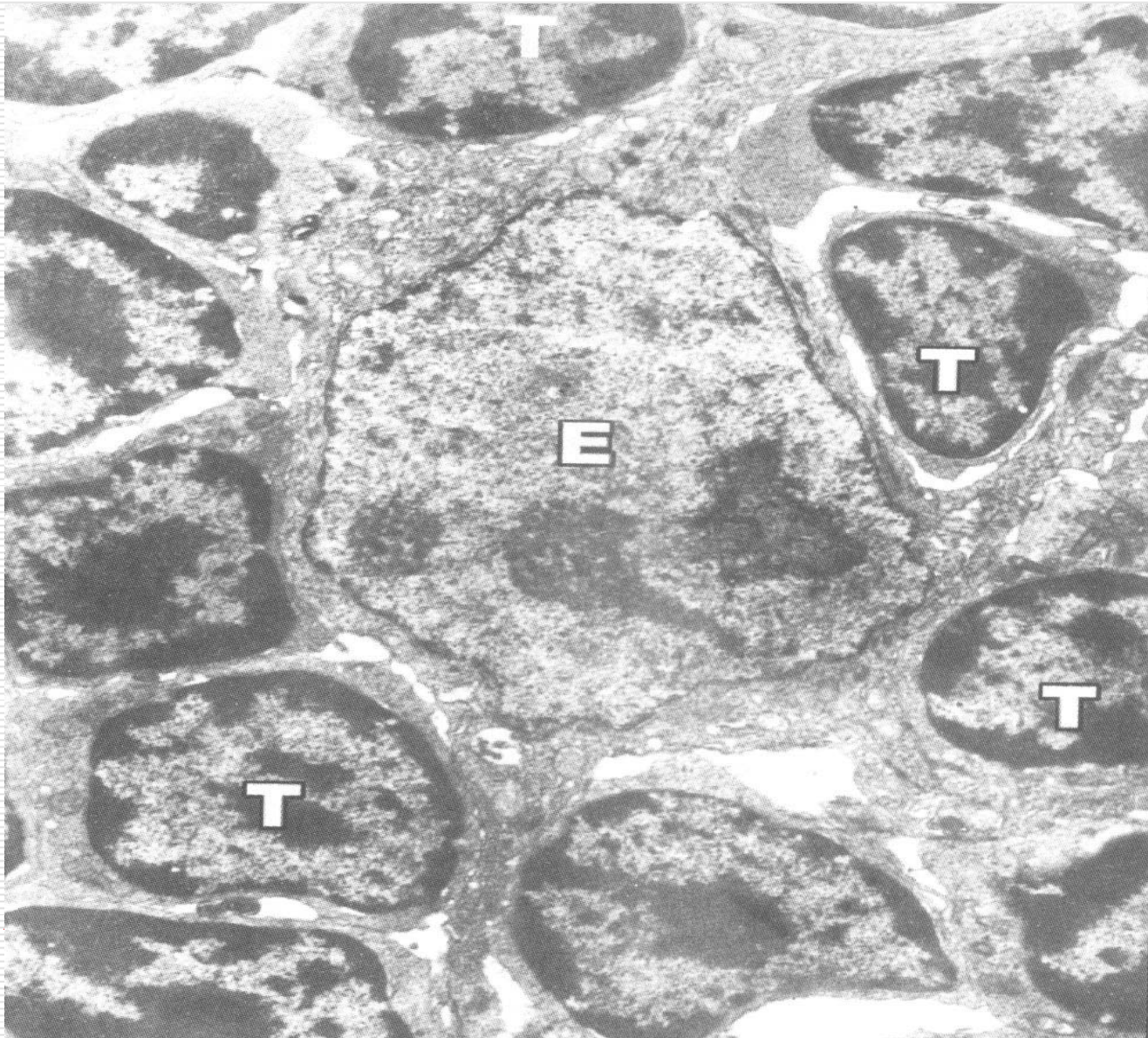
Thymus cortex

- ❑ **Thymus epithelial cell**
(epithelial reticular cell)
 - **Subcapsular epithelial cell**
 - ❑ **Nurse cell**
 - **Interdigitating dendritic cell**
 - ❑ **Thymocyte**
 - ❑ **Thymus matrix cell**
-

Thymus



Thymus



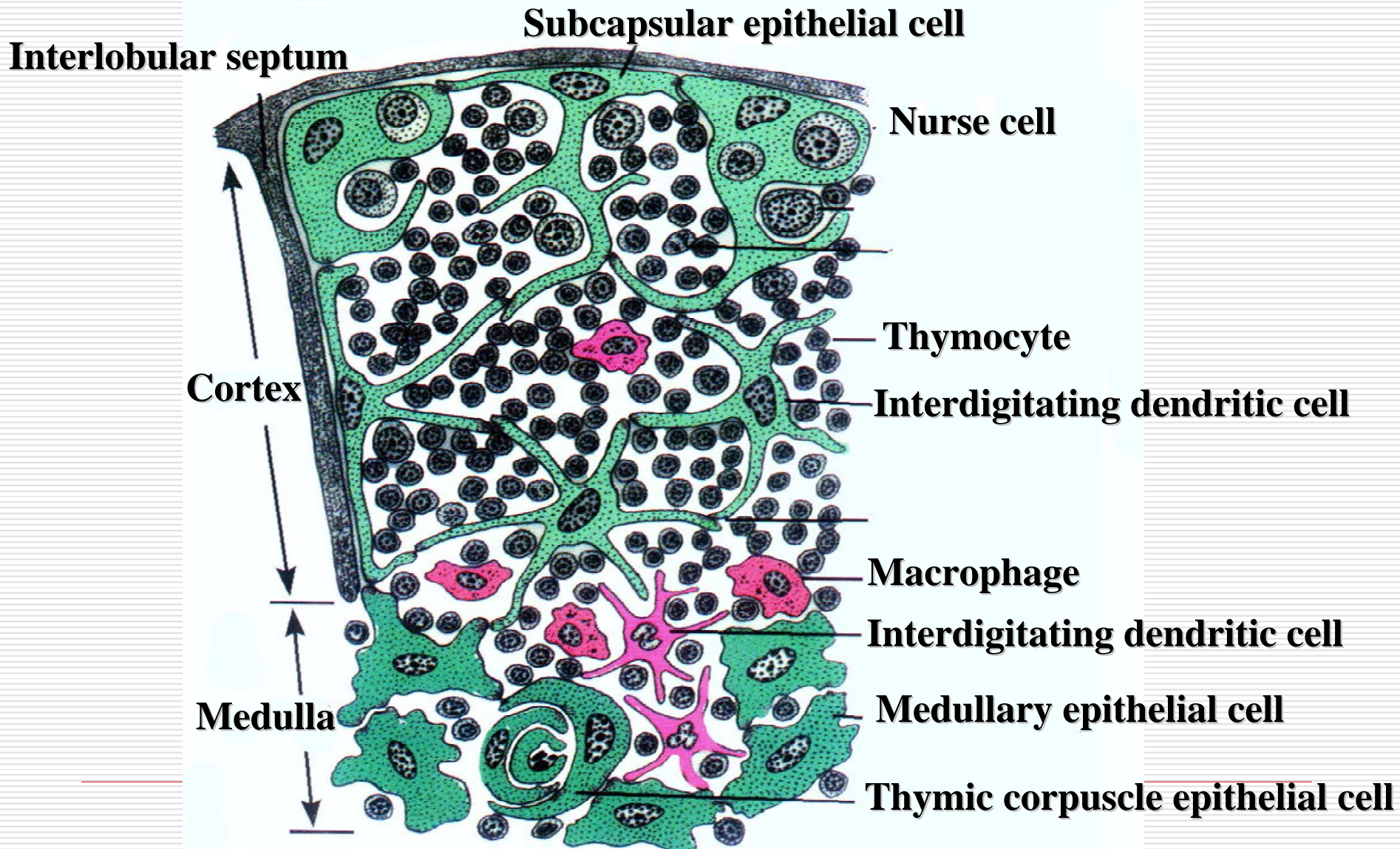
**E: Epithelial
reticular cell**

T: Thymocyte

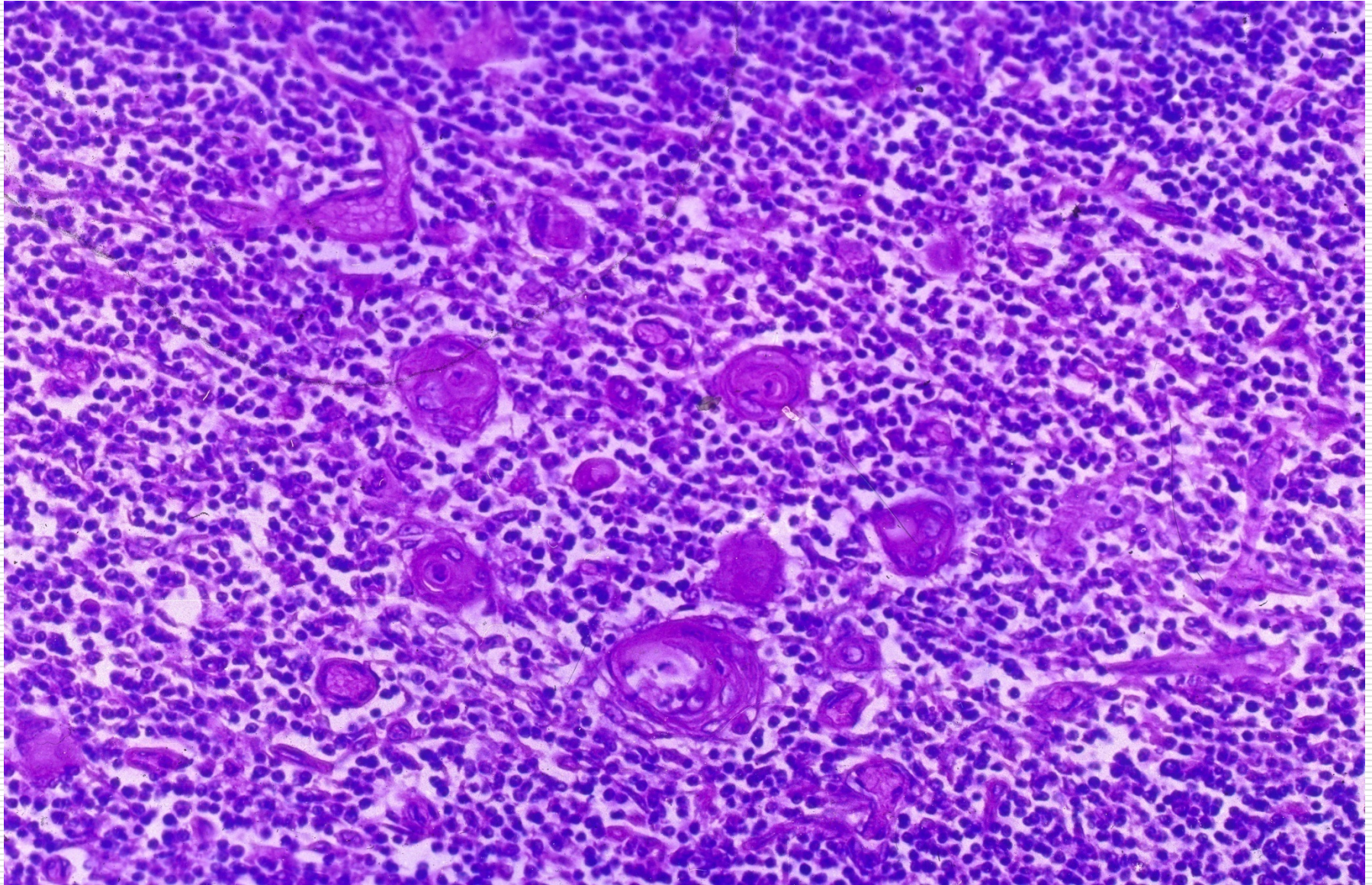
Thymus medulla

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

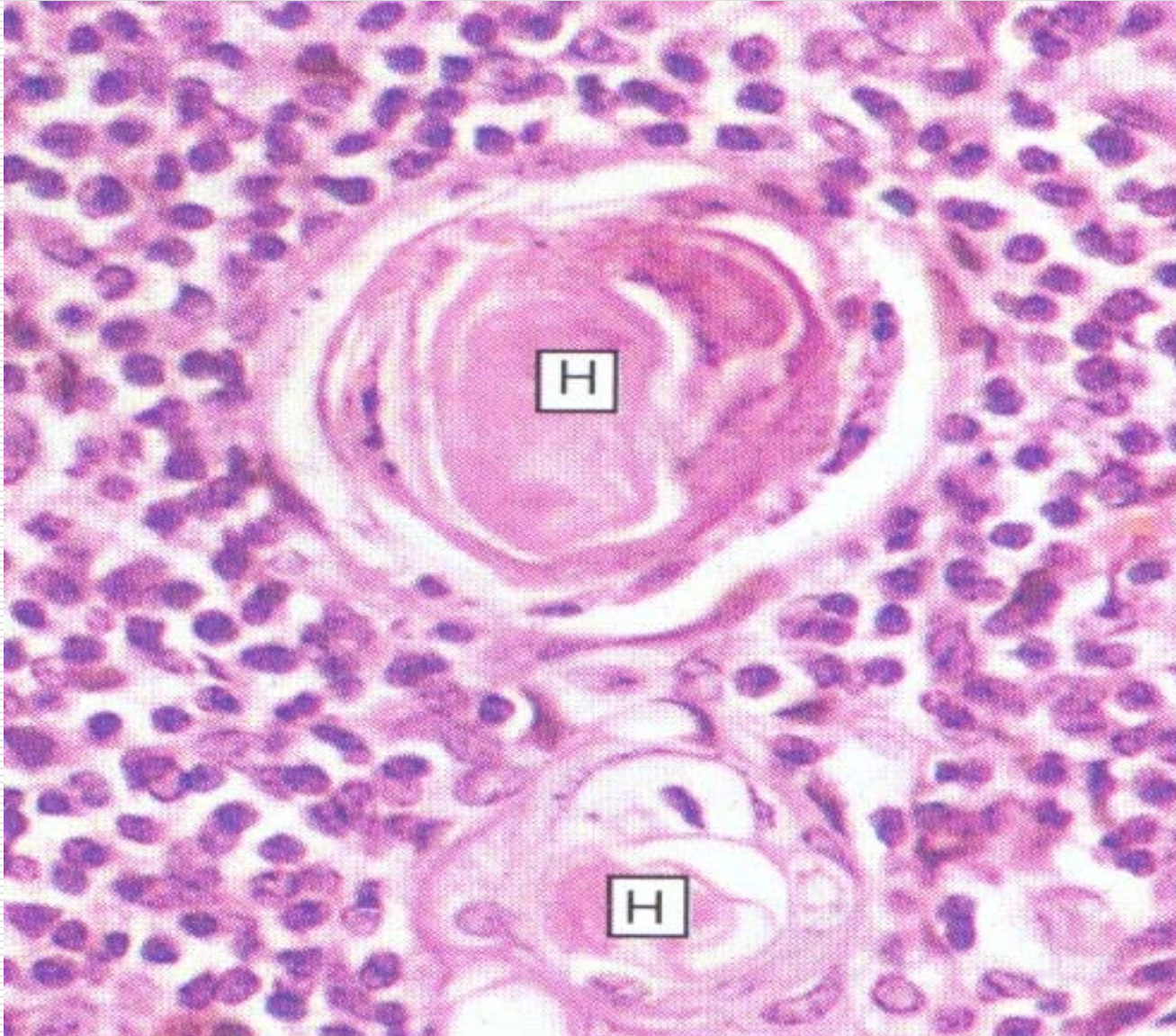
Thymus



Thymus medulla



Thymic corpuscle

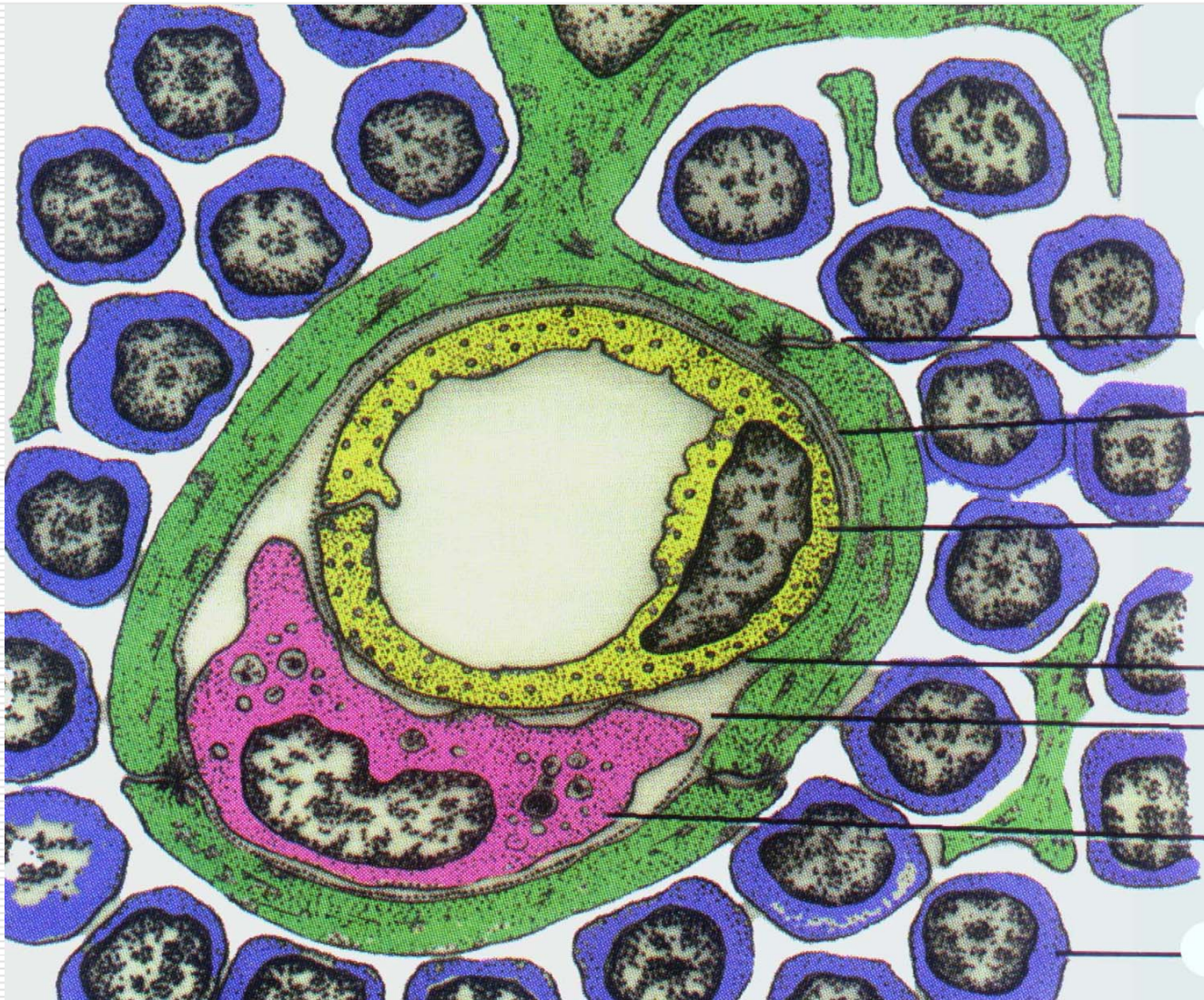


H: Thymic corpuscle or Hassall corpuscle

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



Processes of epithelial reticular cells

Cell junction

Basement membrane of epithelial reticular cells

Endothelium of continuous capillary

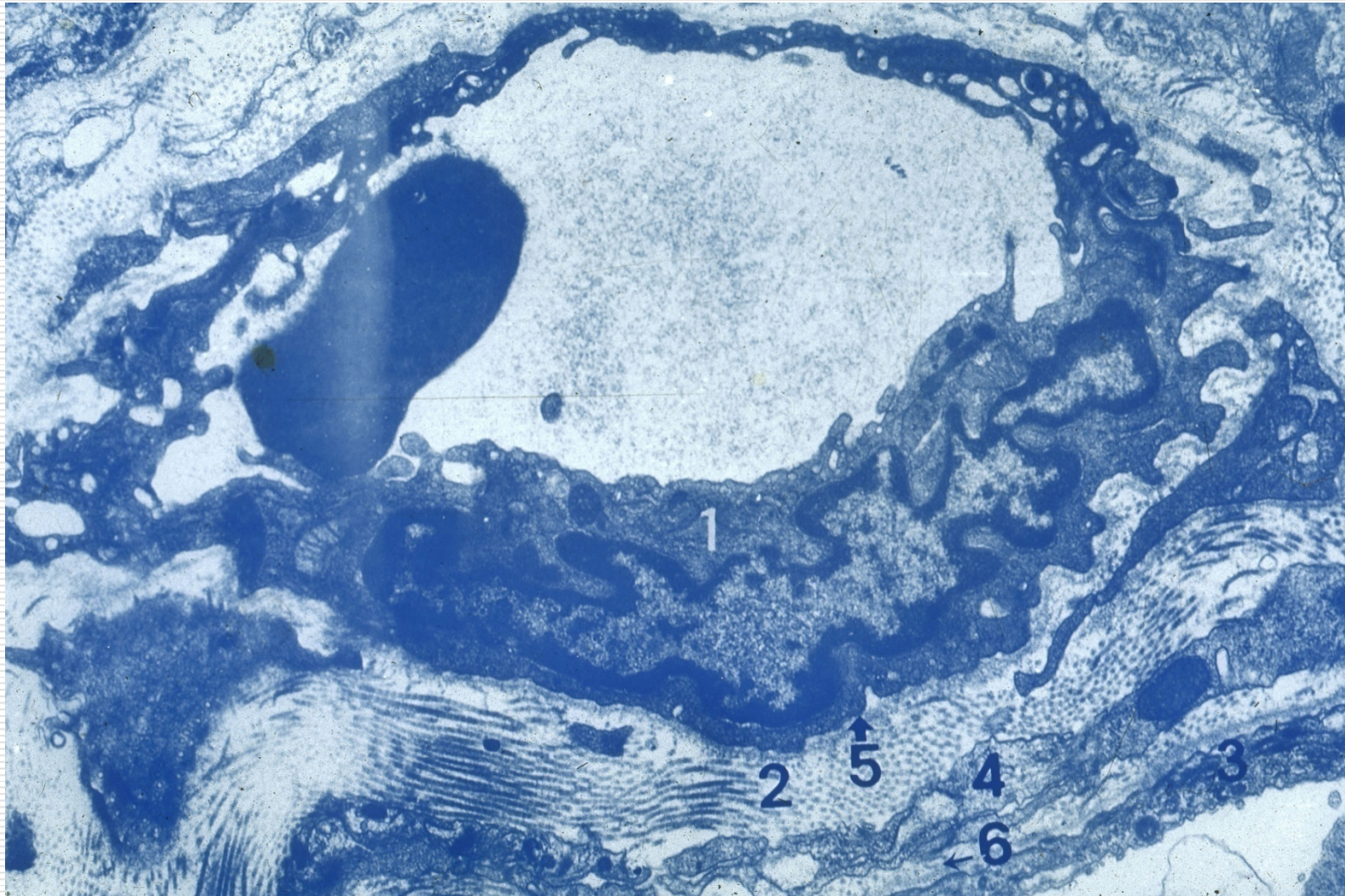
Basement membrane around endothelium

Peri-vessel space

Macrophage

Lymphocyte

Blood – thymus barrier



Function of the thymus

- ❑ **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

□ Central lymphoid organ

- Thymus

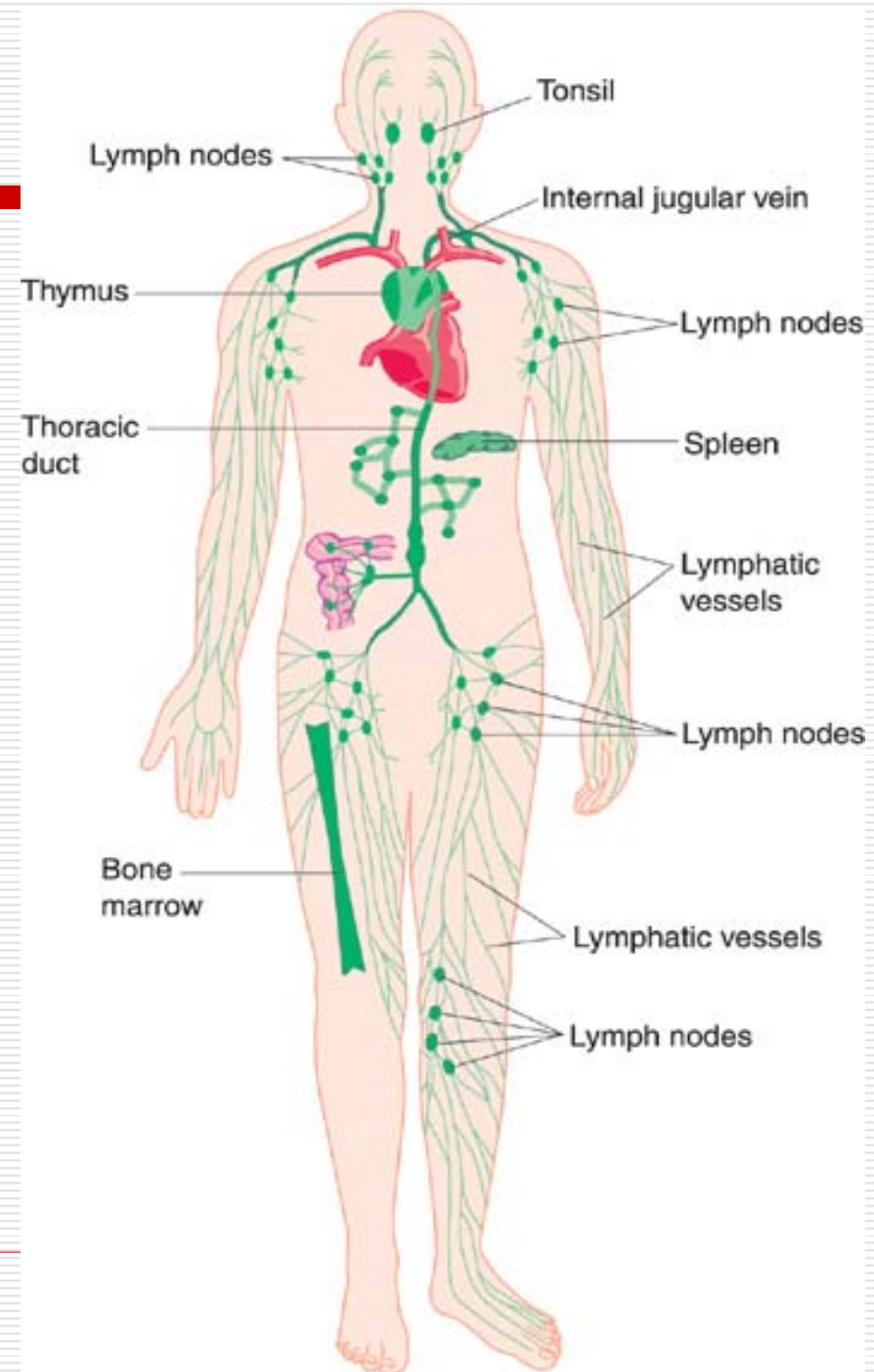
- Bone marrow

□ Peripheral lymphoid organ

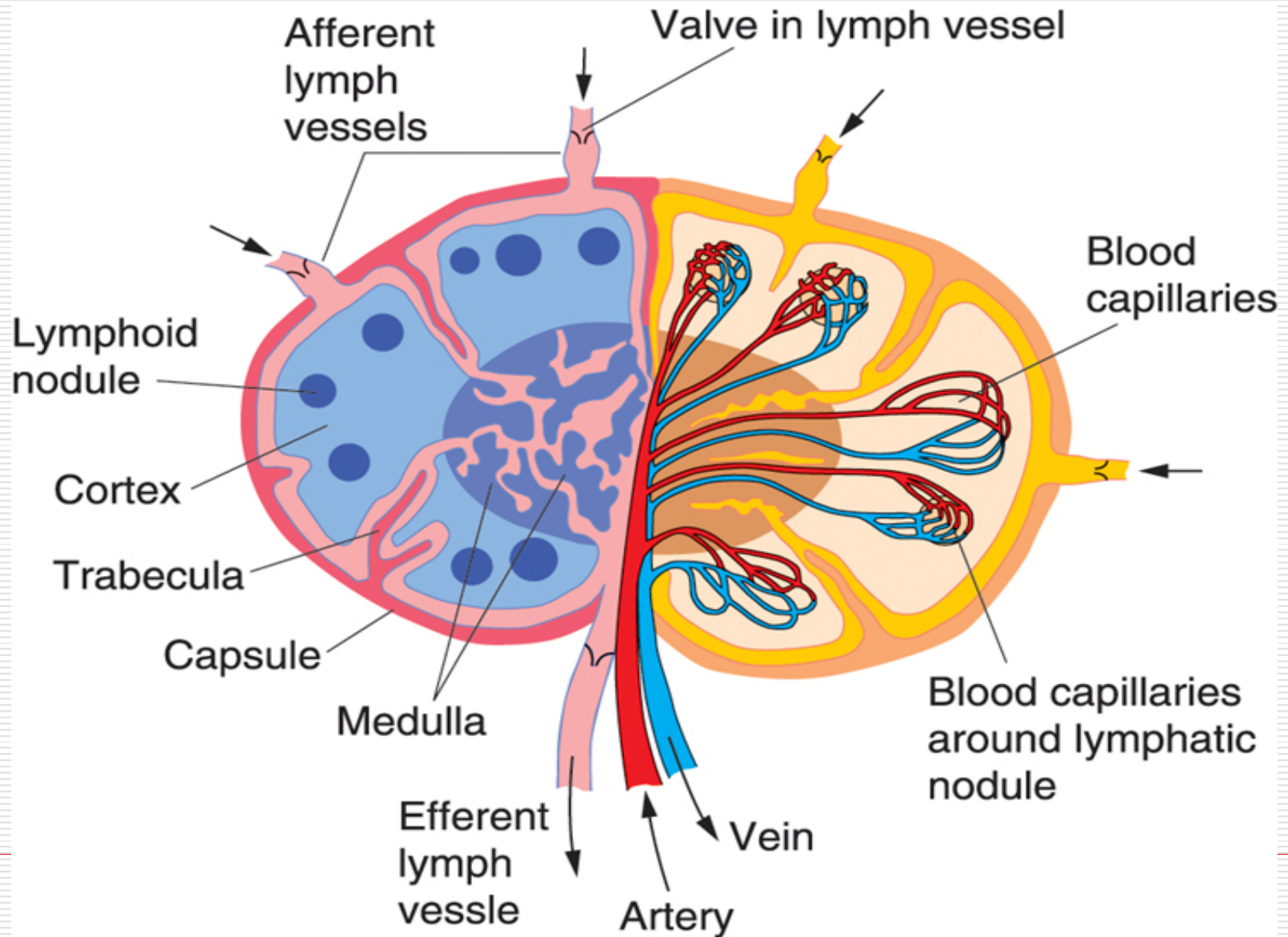
- Lymph node

- Spleen

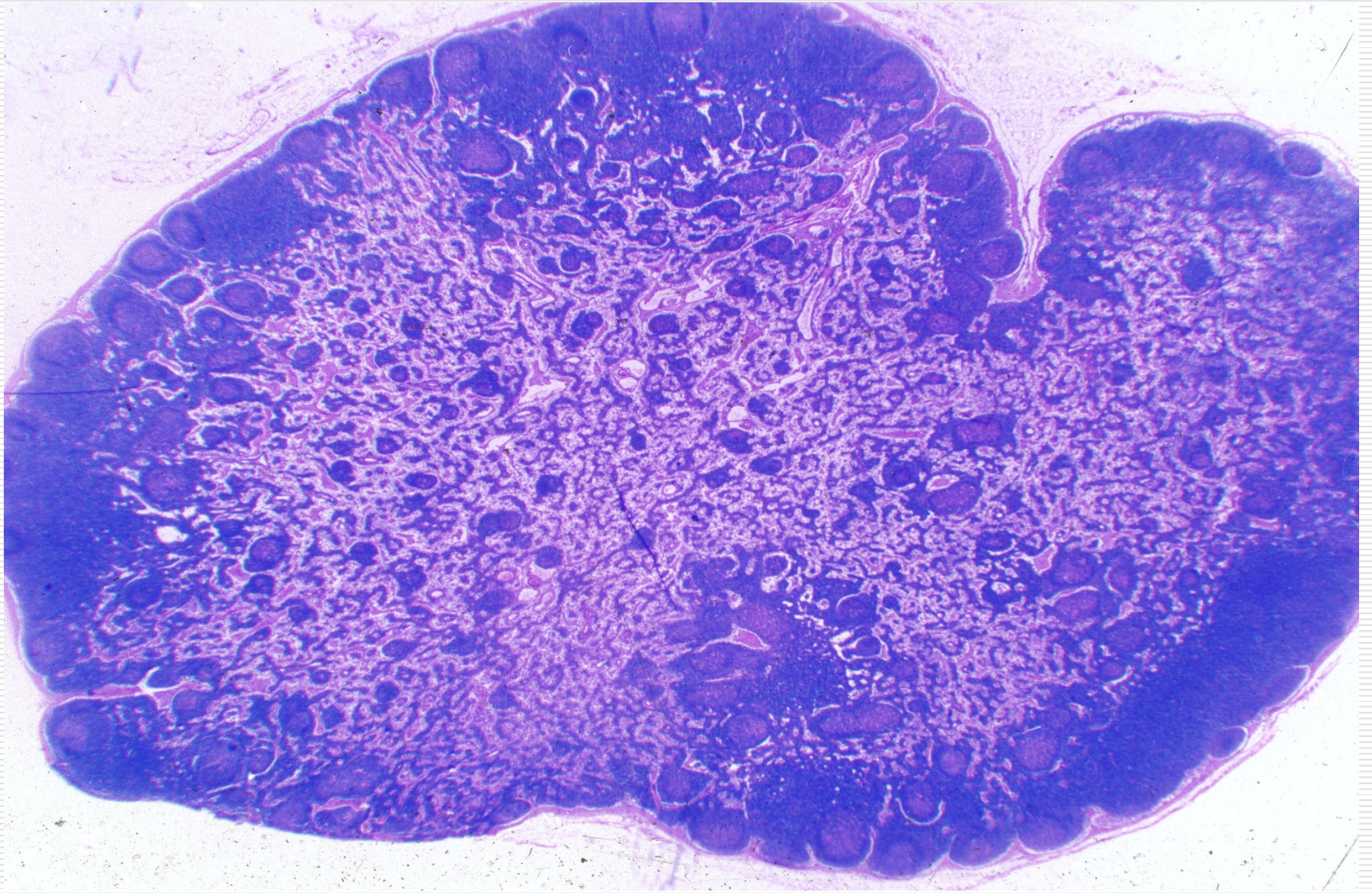
- Tonsil



Lymph node



Lymph node



Parenchyma of the lymph node

Cortex

Superficial cortex

Lymphoid nodule

Diffuse lymphoid tissue

Paracortex zone (Deep cortex unit)

Postcapillary venule

Cortical sinus

Subcapsular sinus

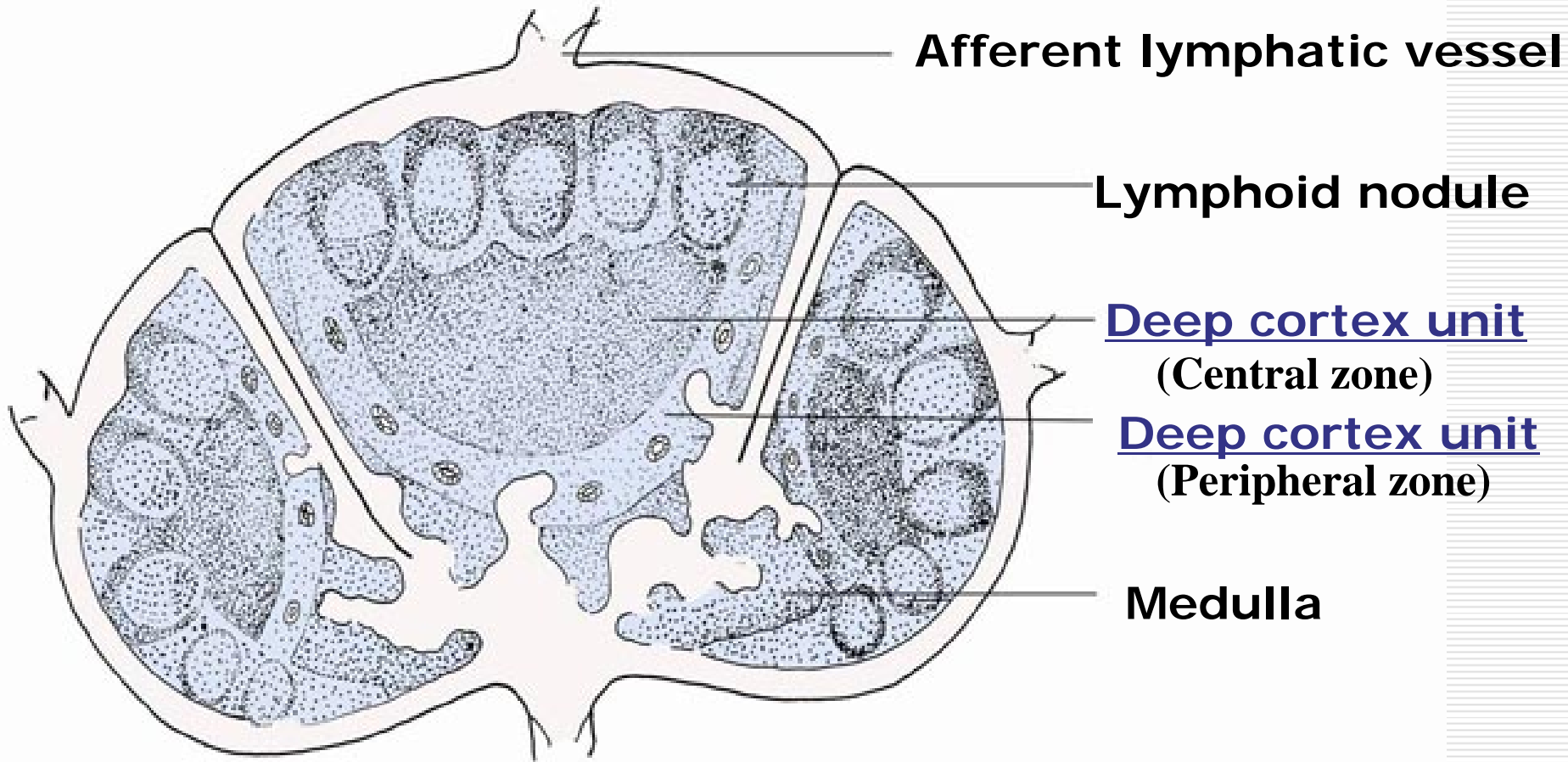
Peritrabecular sinus

Medulla

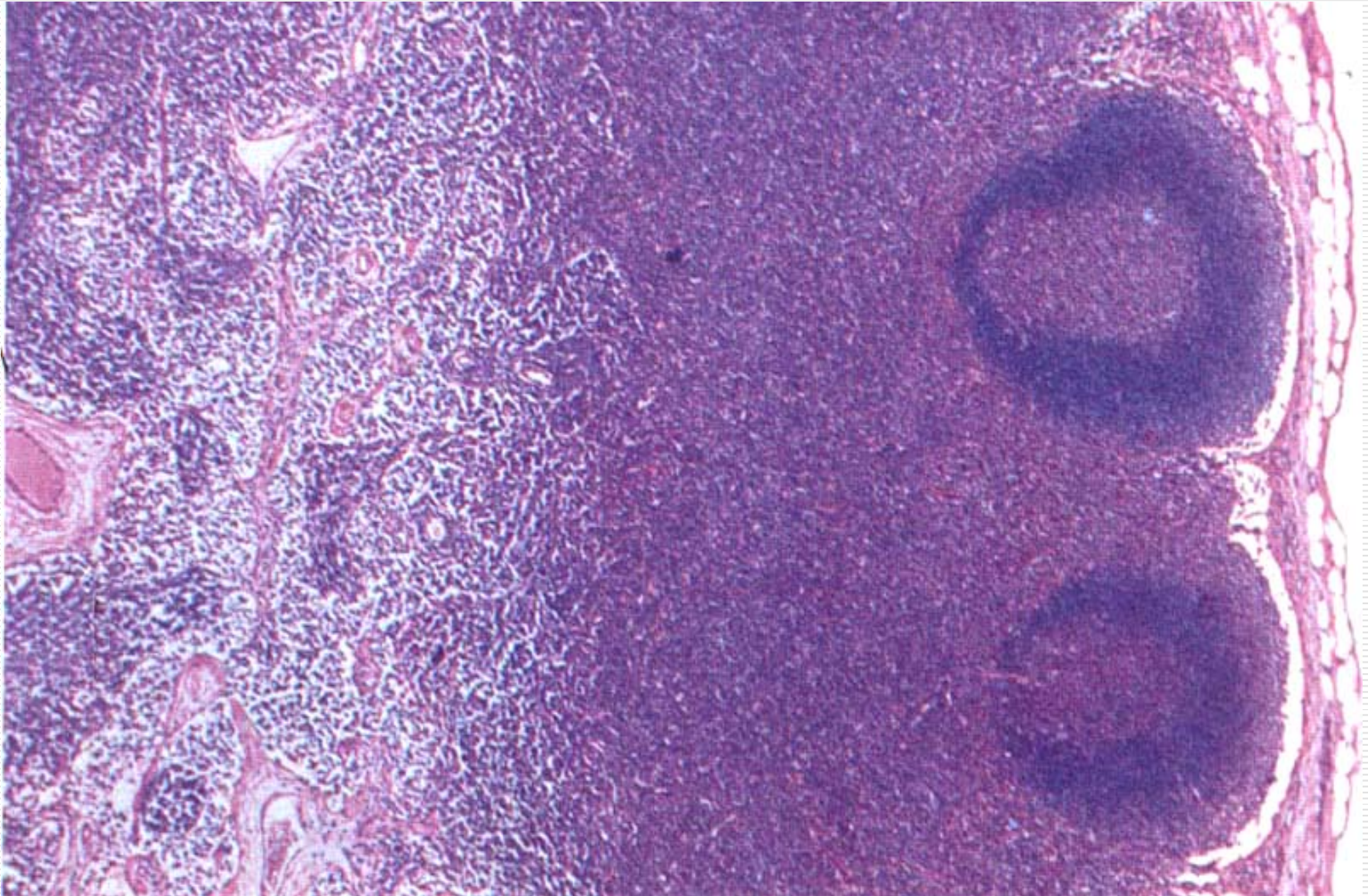
Medullary cord

Medullary sinus

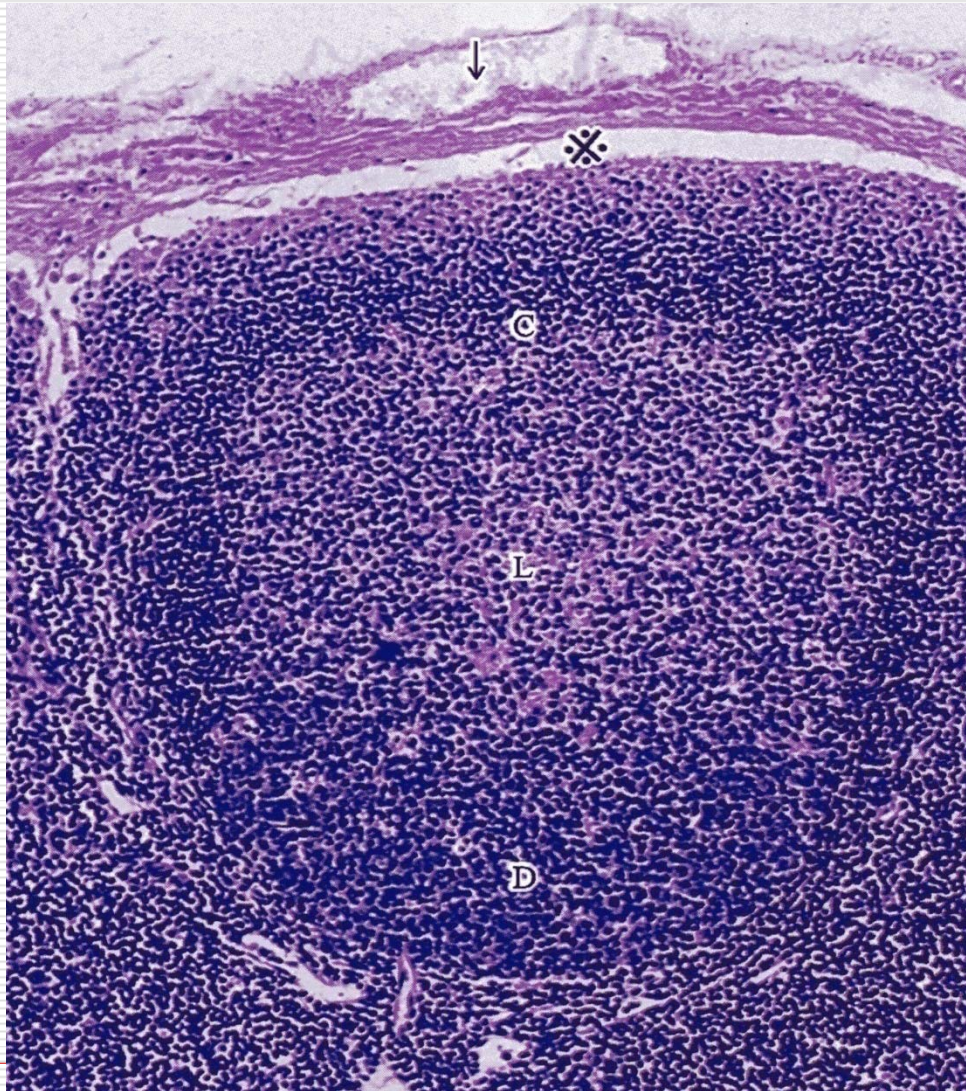
Superficial cortex and deep cortex unit of lymph node



Lymph node



Superficial cortex of the lymphoid nodule



↓ : Afferent lymphatic vessels

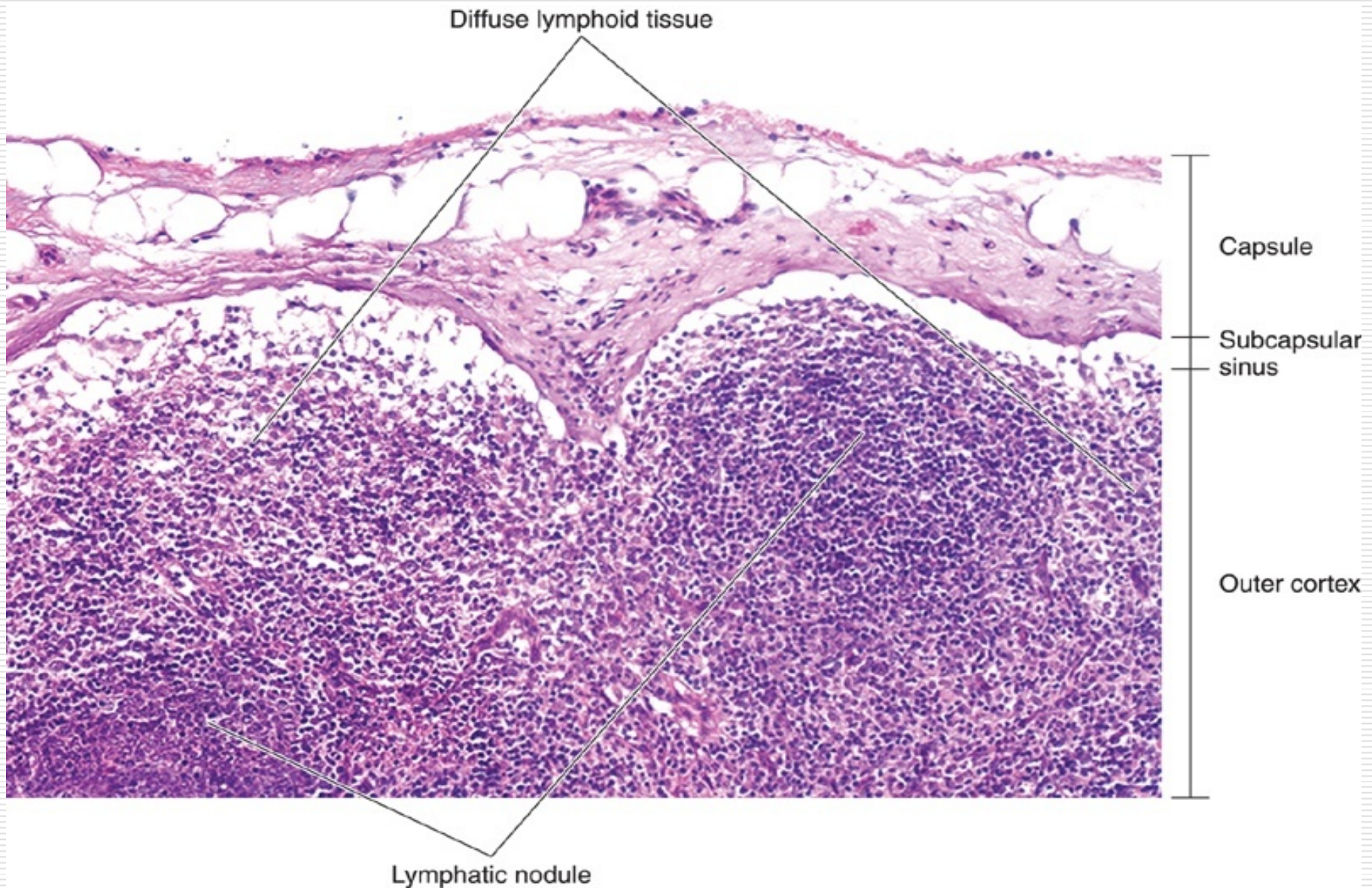
※ : Subcapsular sinus

D : Dark zone

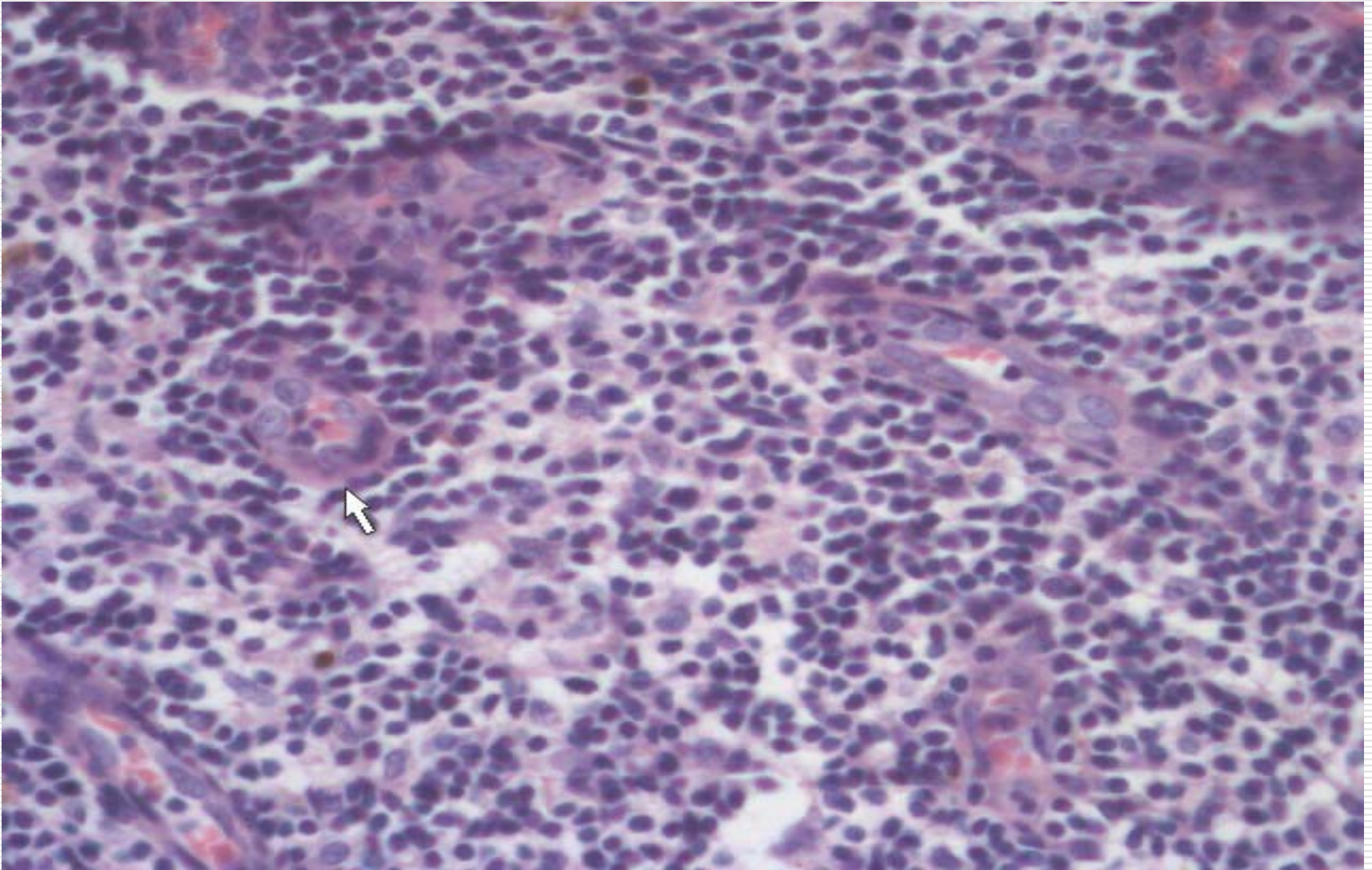
L : Light zone

C : Cap

Cortex of the lymph node

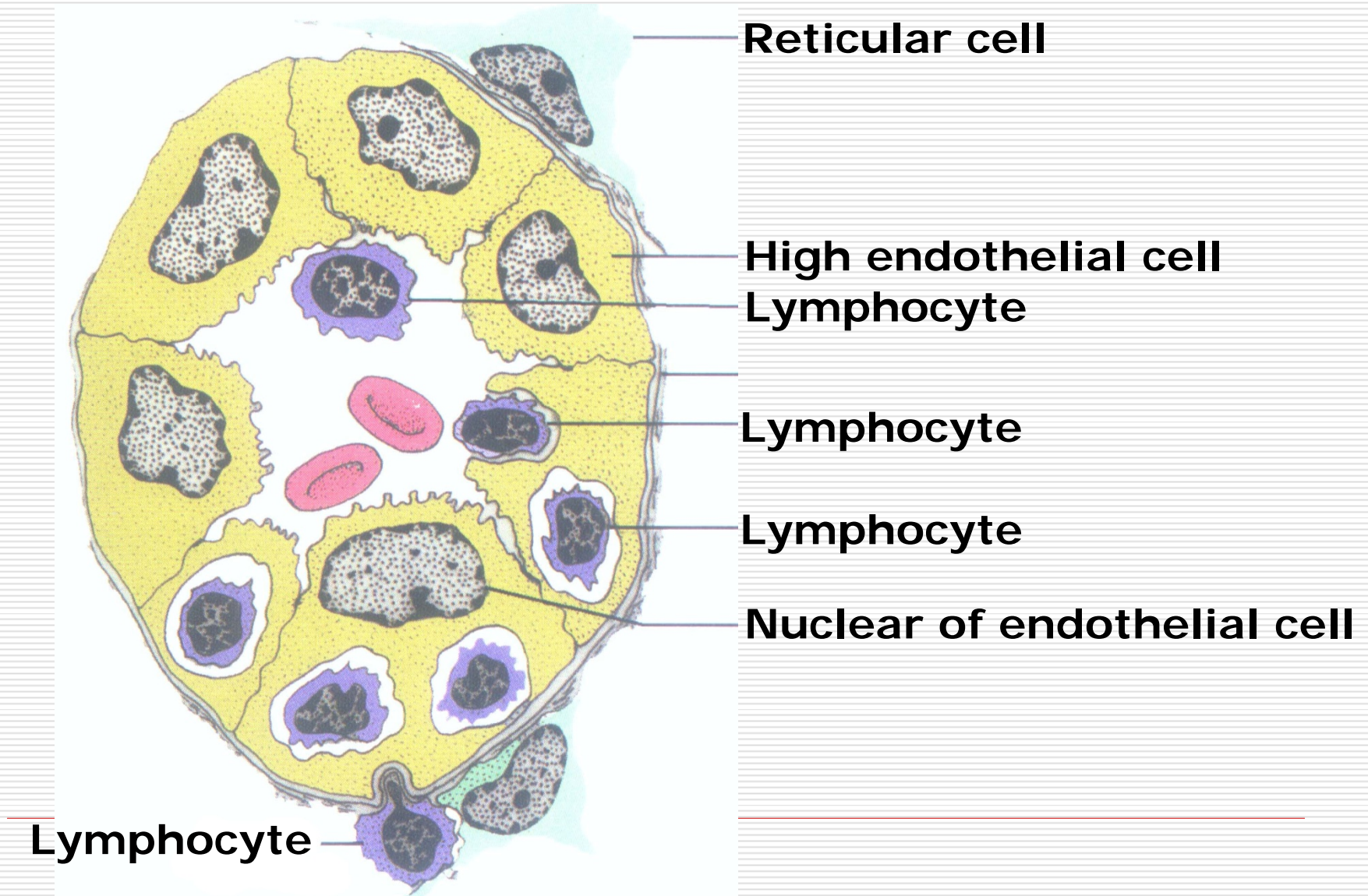


Paracortex zone of the lymph node

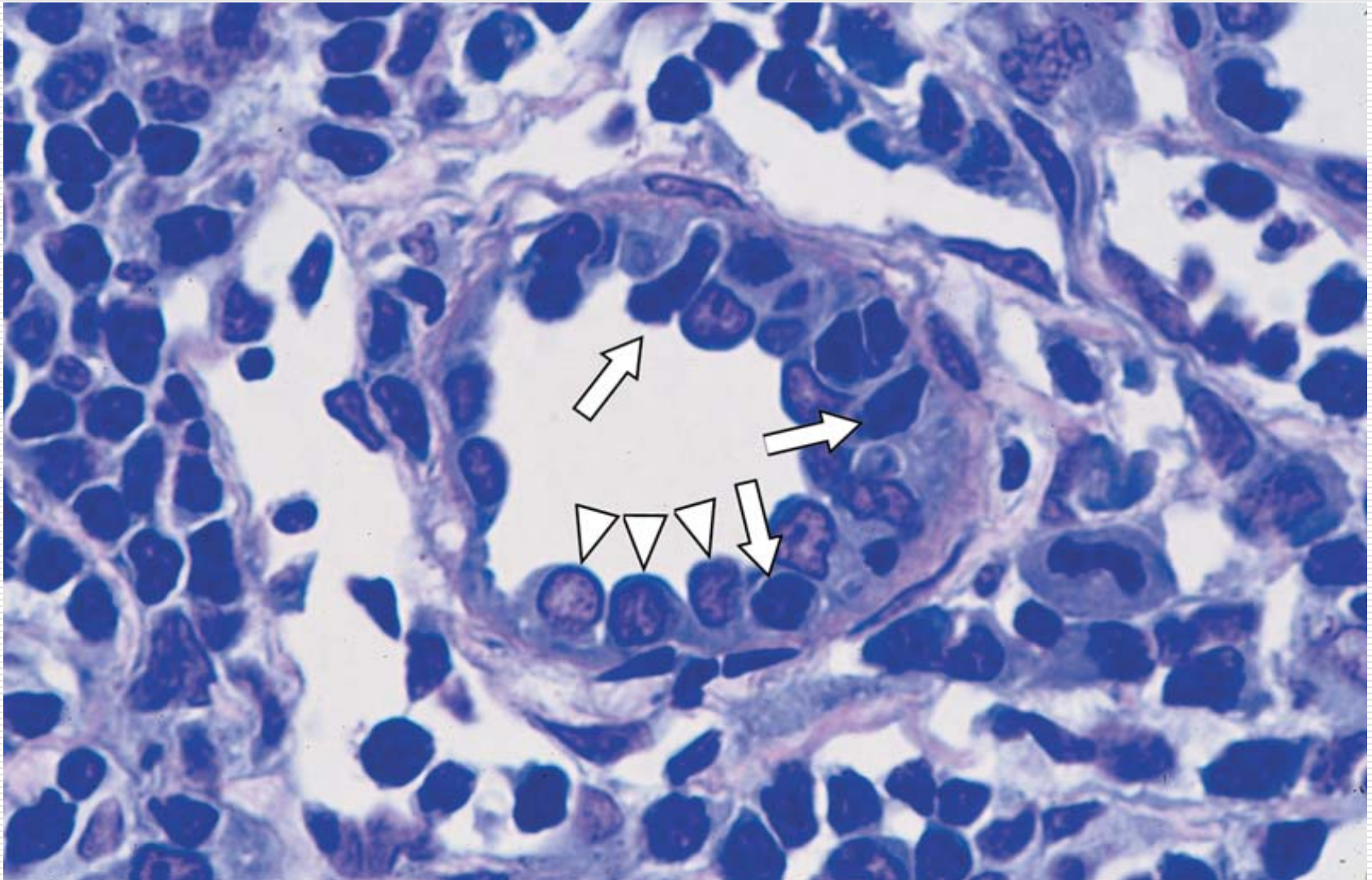


↑ Postcapillary venule

Postcapillary venule in the lymph node

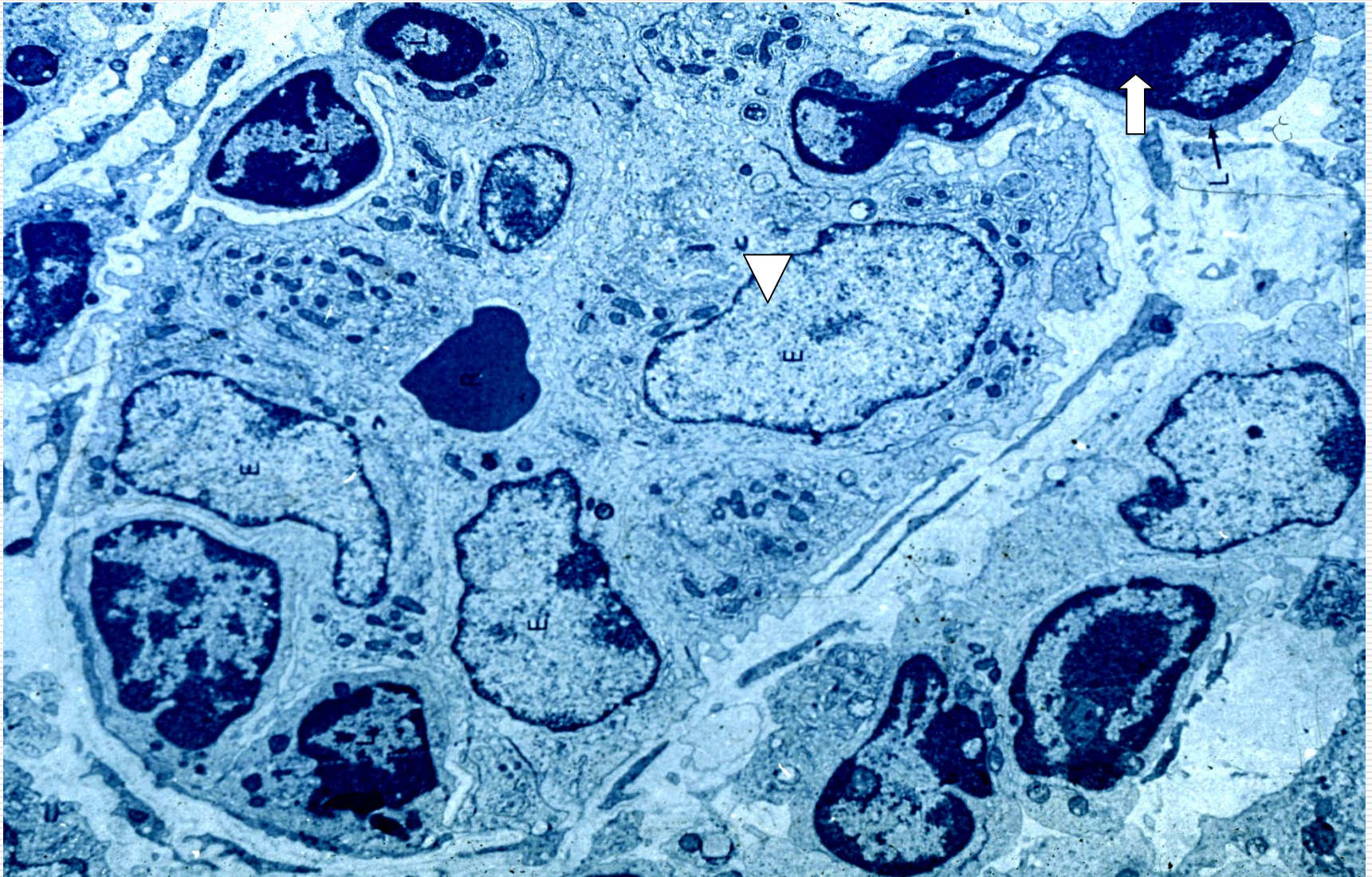


Postcapillary venule in the lymph node



▽ Postcapillary venule ↑ lymphocyte

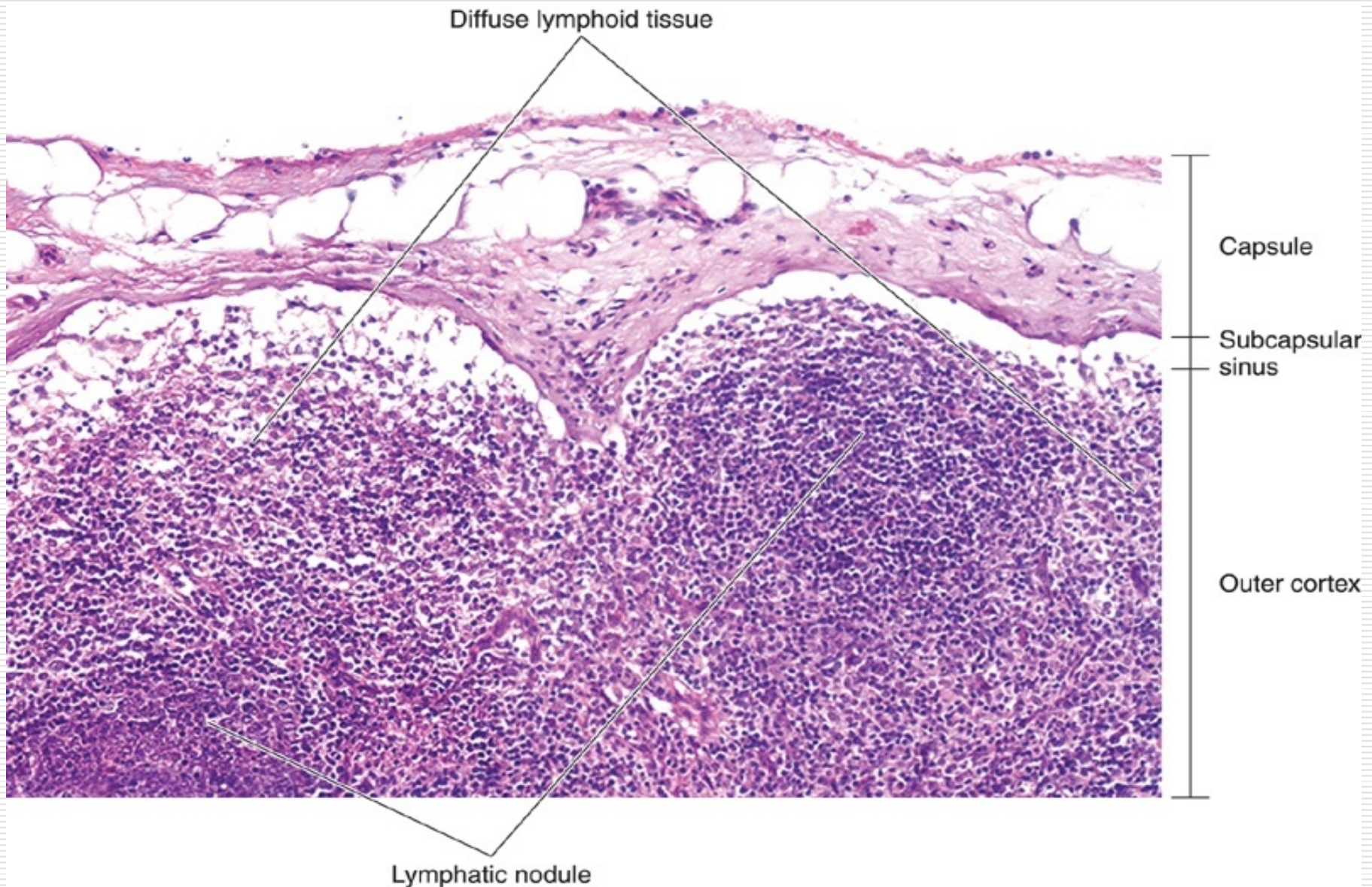
Postcapillary venule in the lymph node



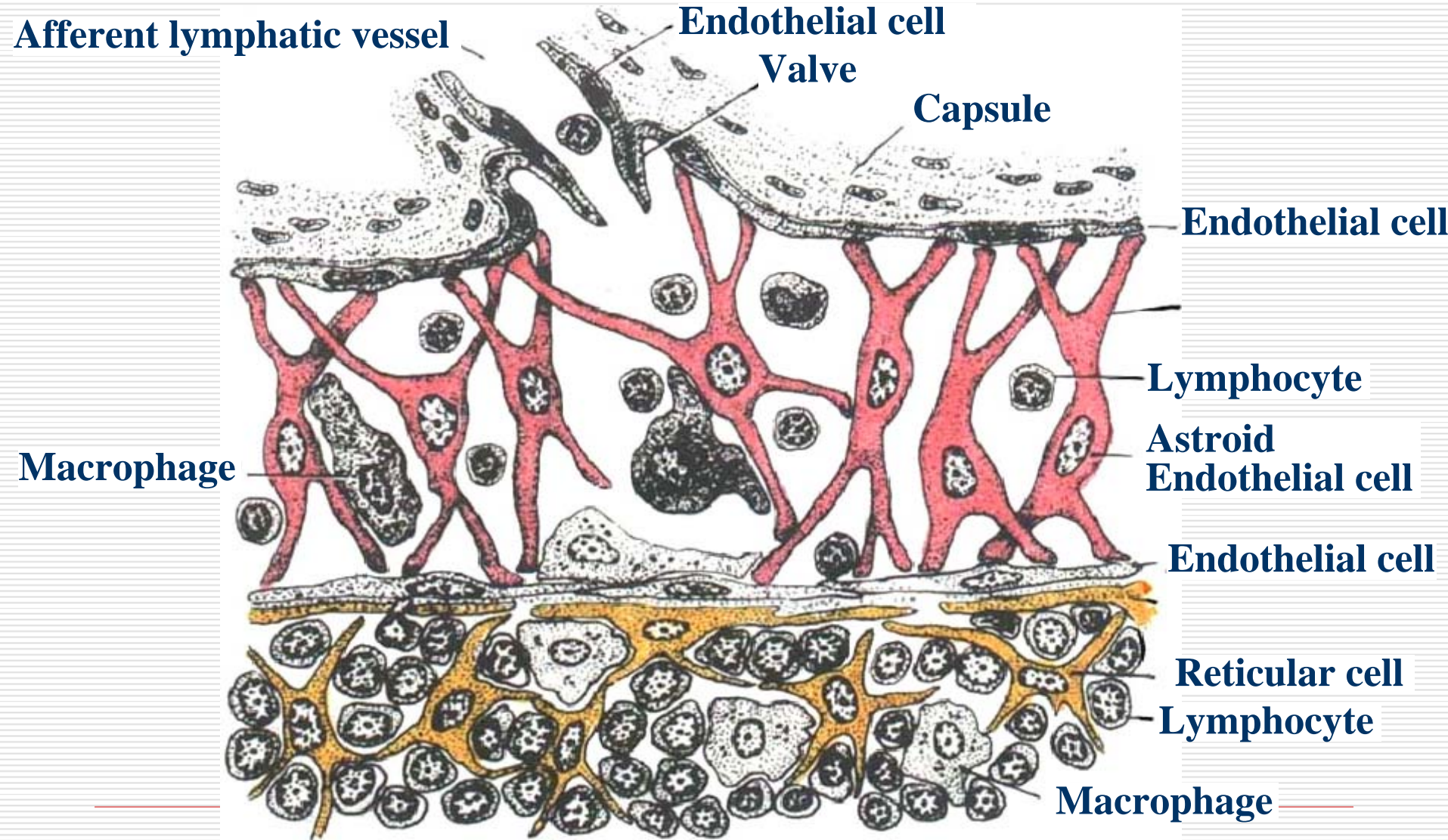
▽ Postcapillary venule

↑ lymphocyte

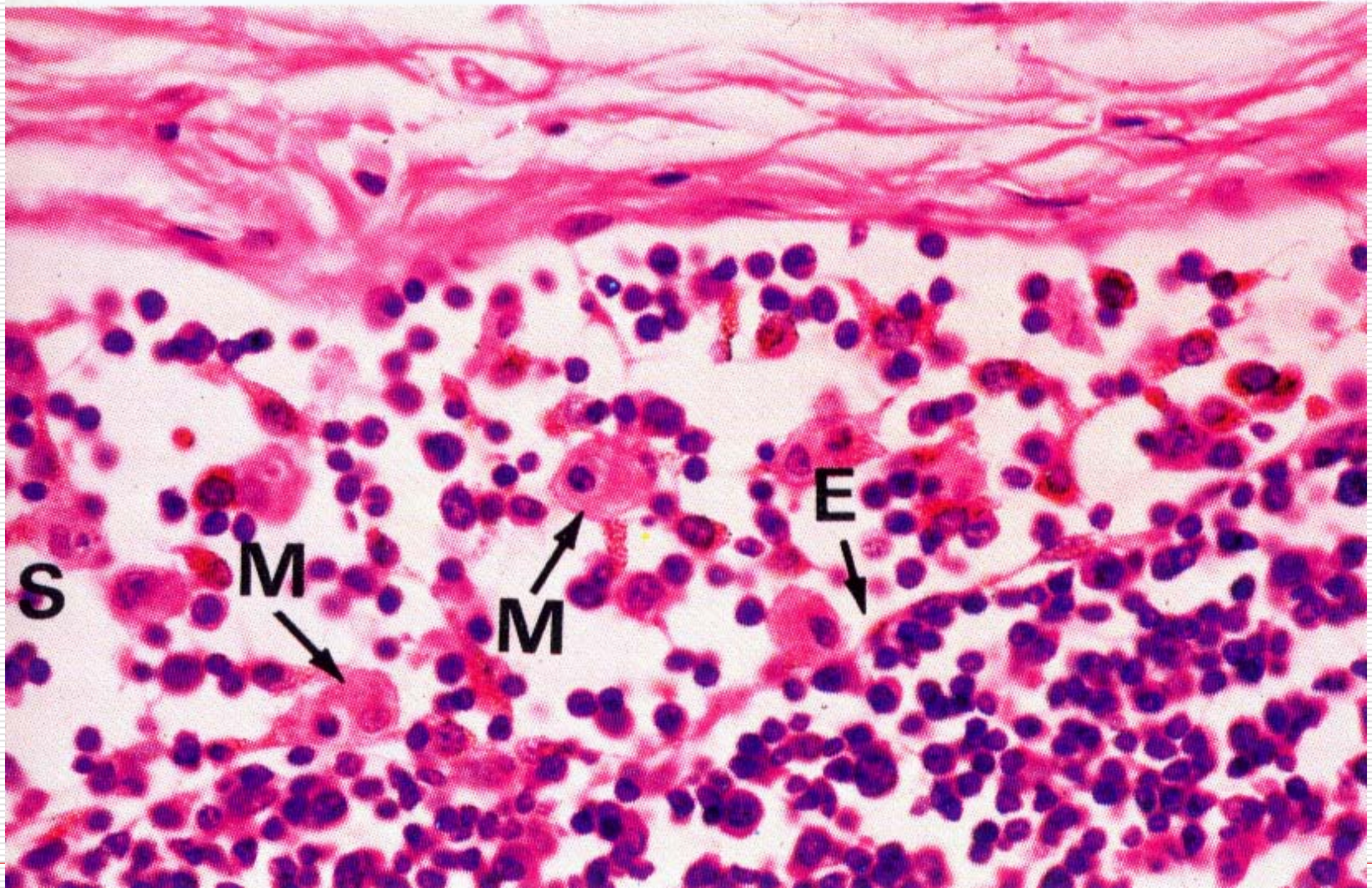
Cortex of the lymph node



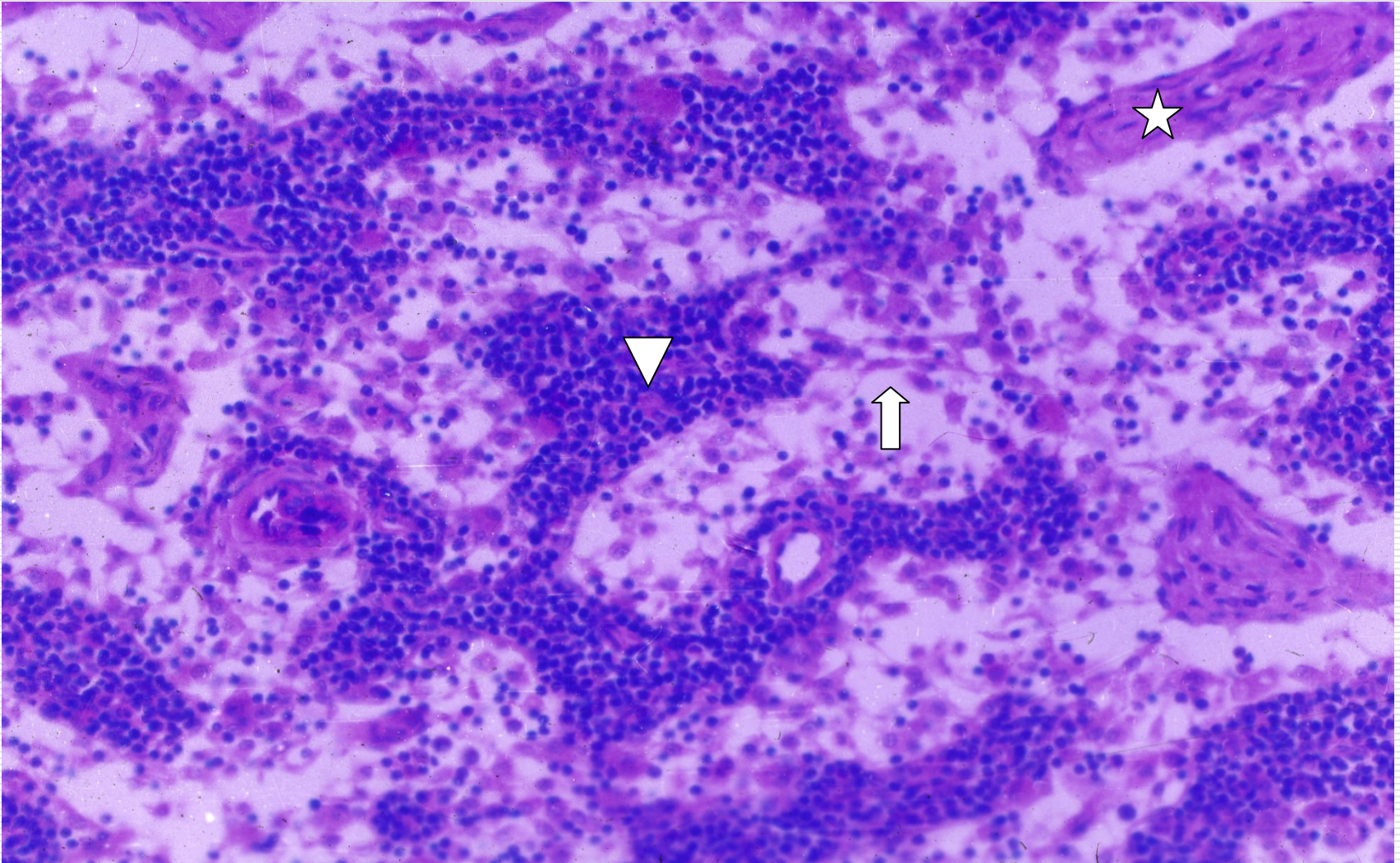
Subcapsular sinus of the lymph node



Subcapsular sinus of the lymph node



Medulla of the lymph node

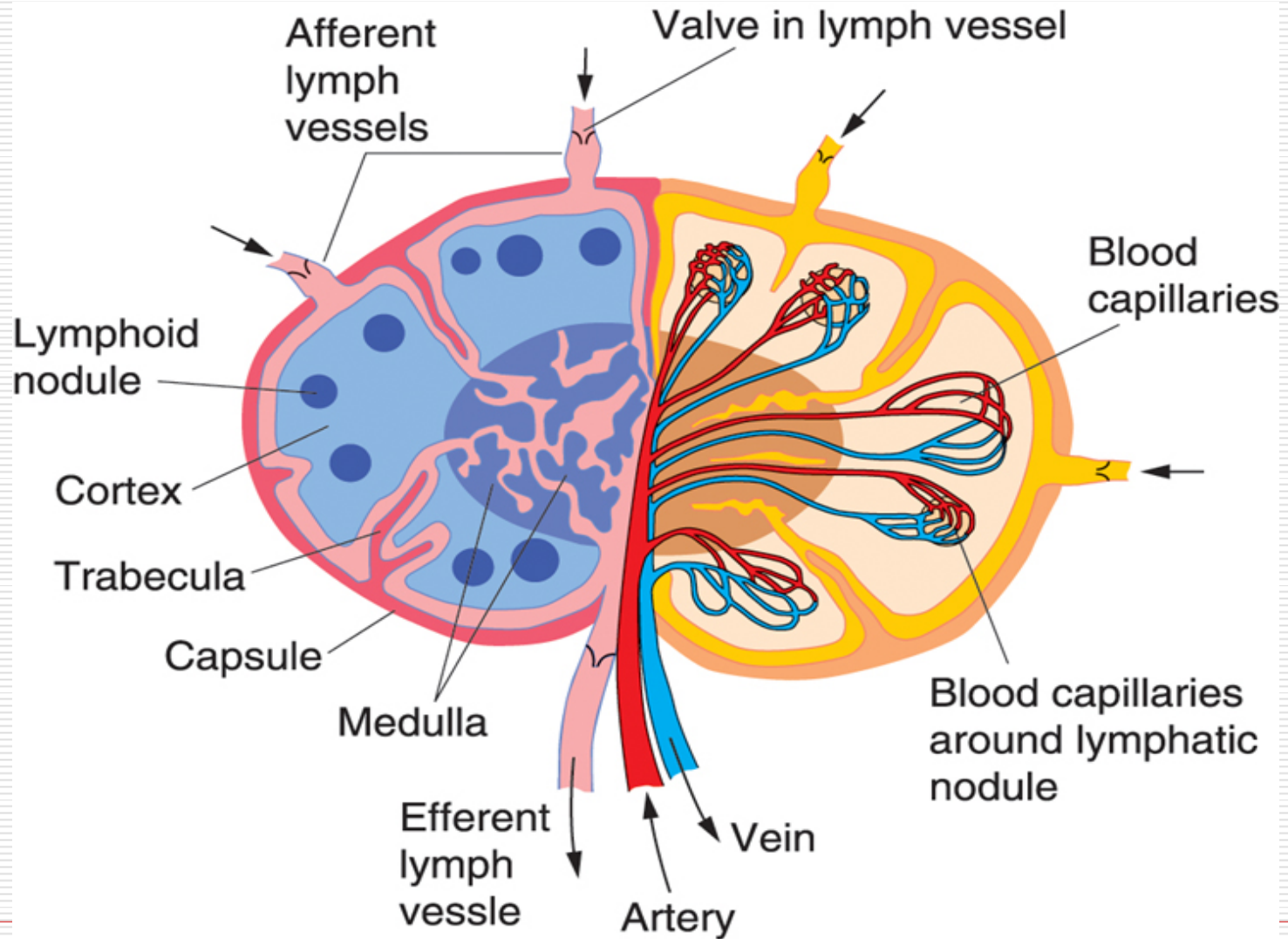


▽ Medullary cord

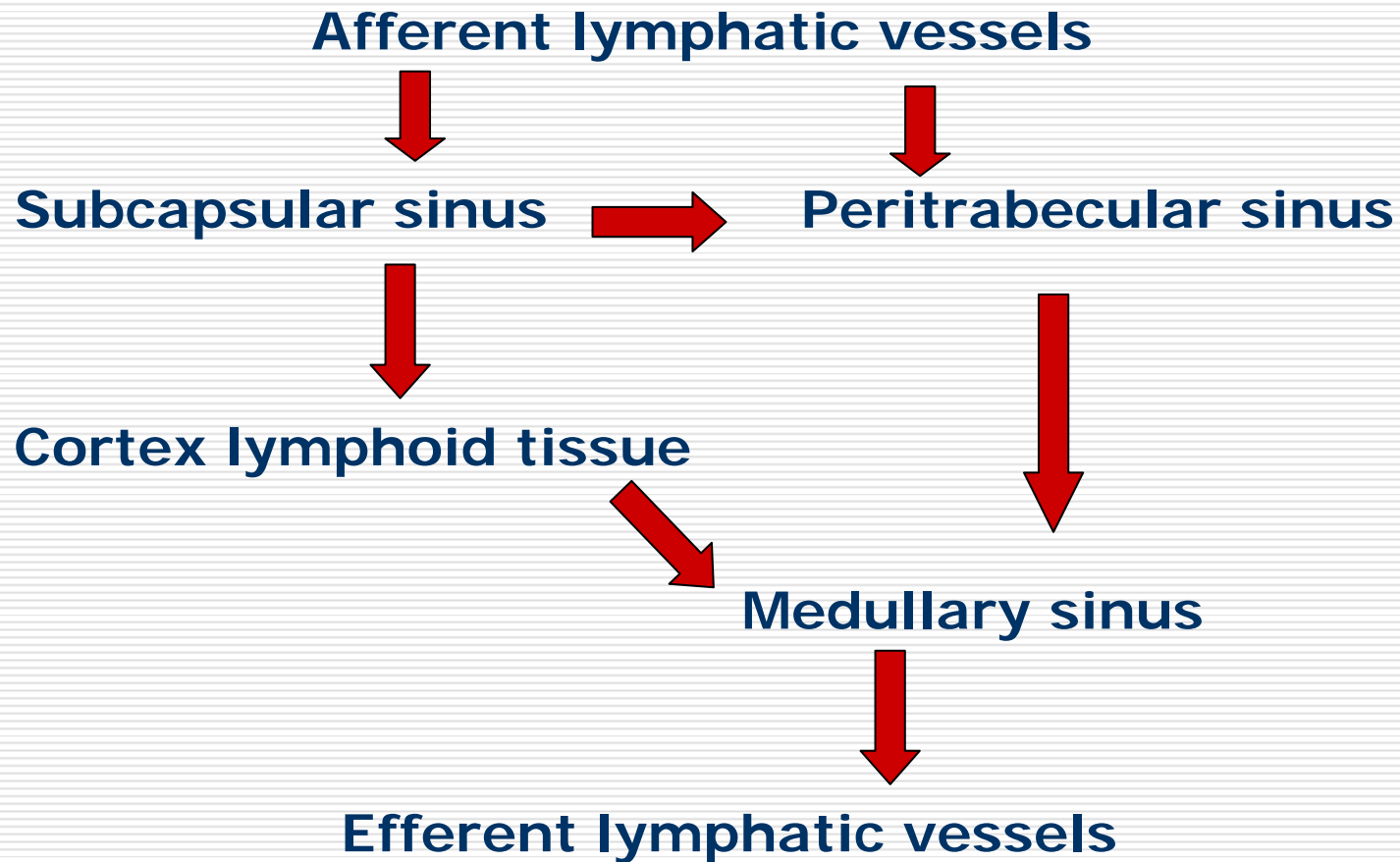
↑ Medullary sinus

☆ Trabecula

Lymph circulation in the lymph node



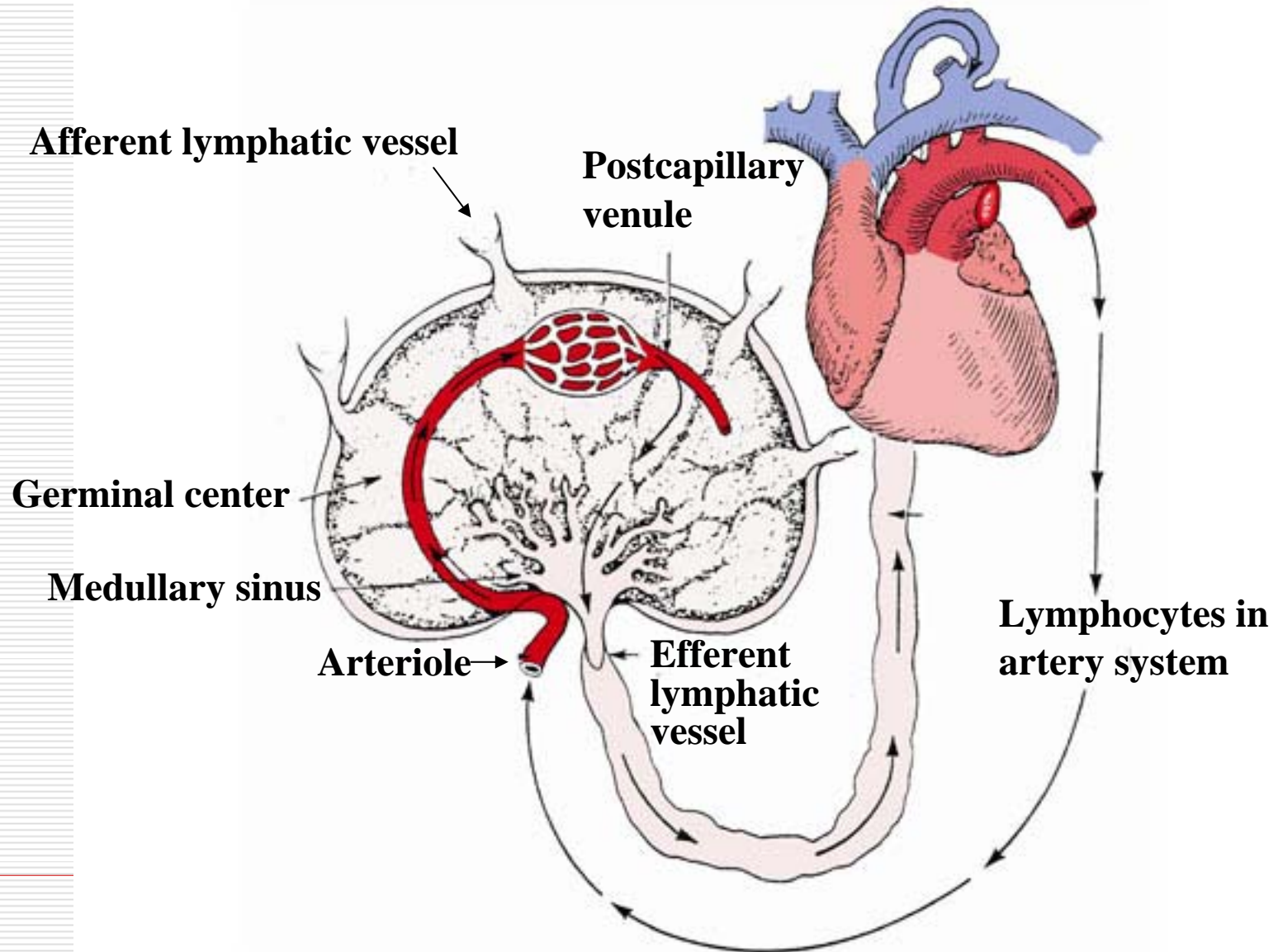
Lymph circulation in lymph node



Function of the lymph node

- ❑ Filter lymphoid fluid
 - ❑ Participate in immune response
 - ❑ Participate in recirculation of lymphocytes
-

Recirculation of lymphocytes



Lymphoid organ

□ Central lymphoid organ

- Thymus

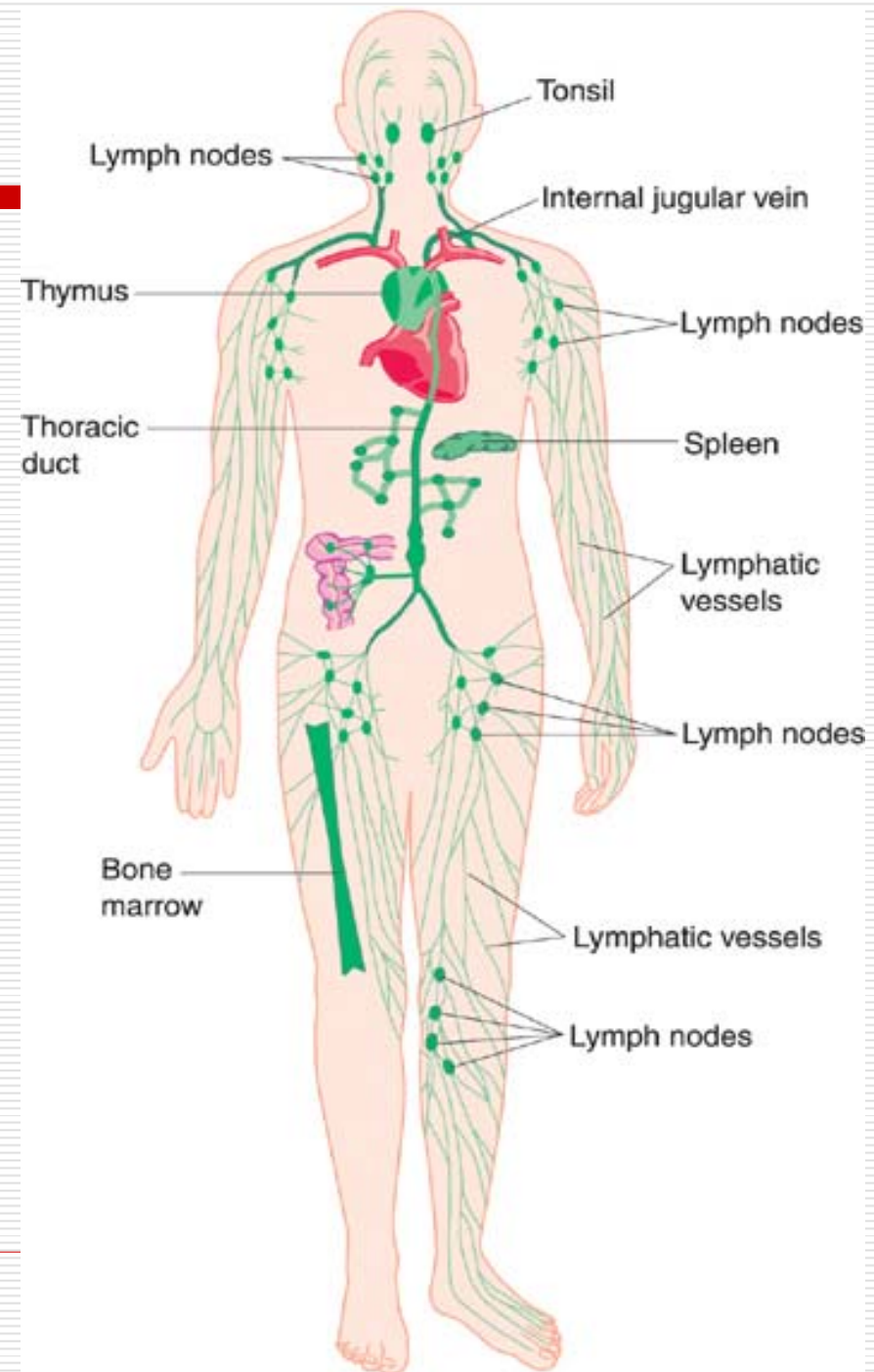
- Bone marrow

□ Peripheral lymphoid organ

- Lymph node

- Spleen

- Tonsil



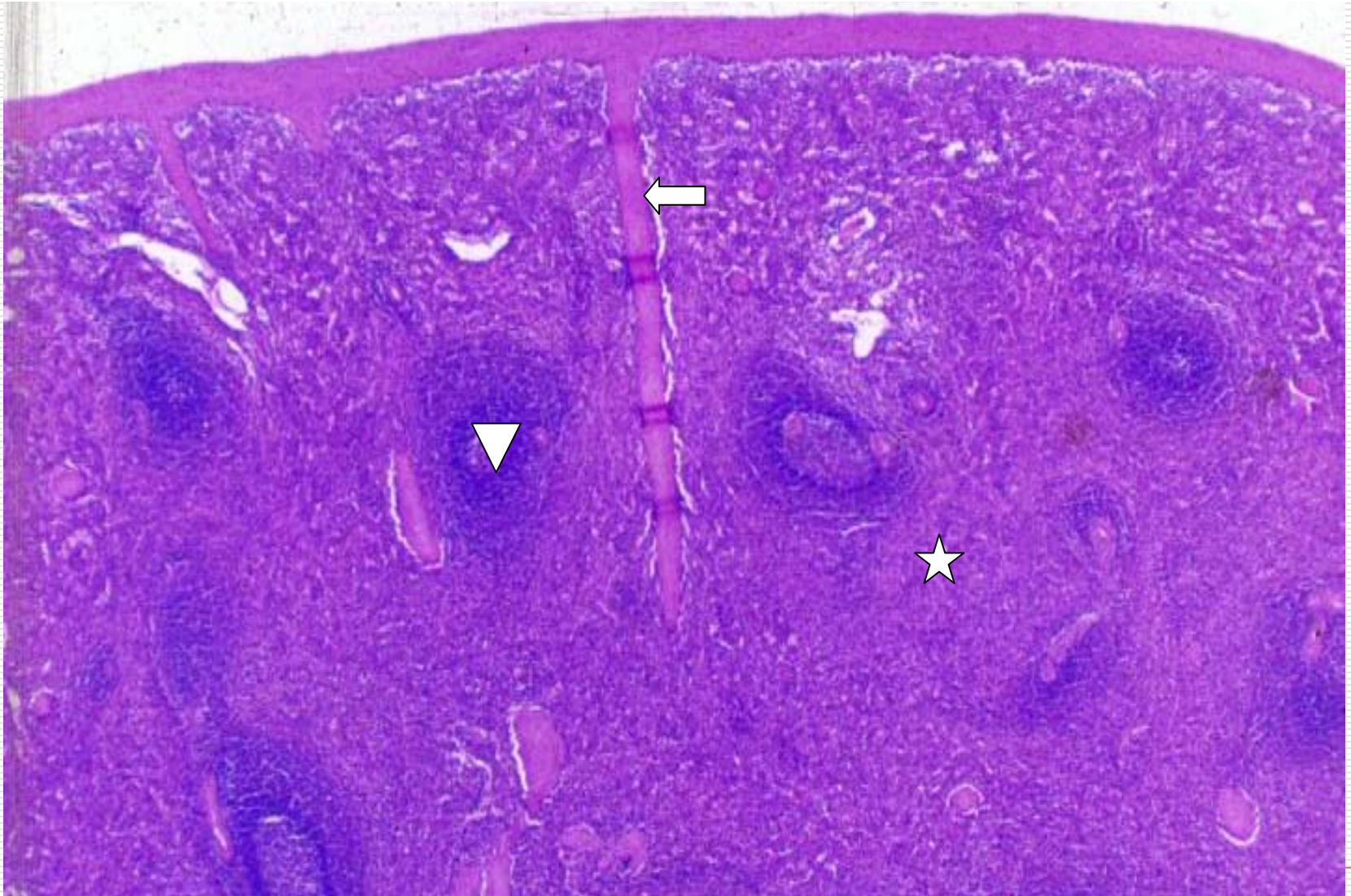
Spleen

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

Structure of the spleen

- Capsule & trabecula
 - **Parenchyma**
 - White pulp
 - **Periarterial lymphatic sheath**
 - **Splenic corpuscle**
 - Marginal zone
 - Red pulp
 - **Splenic cord**
 - **Splenic sinusoid**
-

Spleen

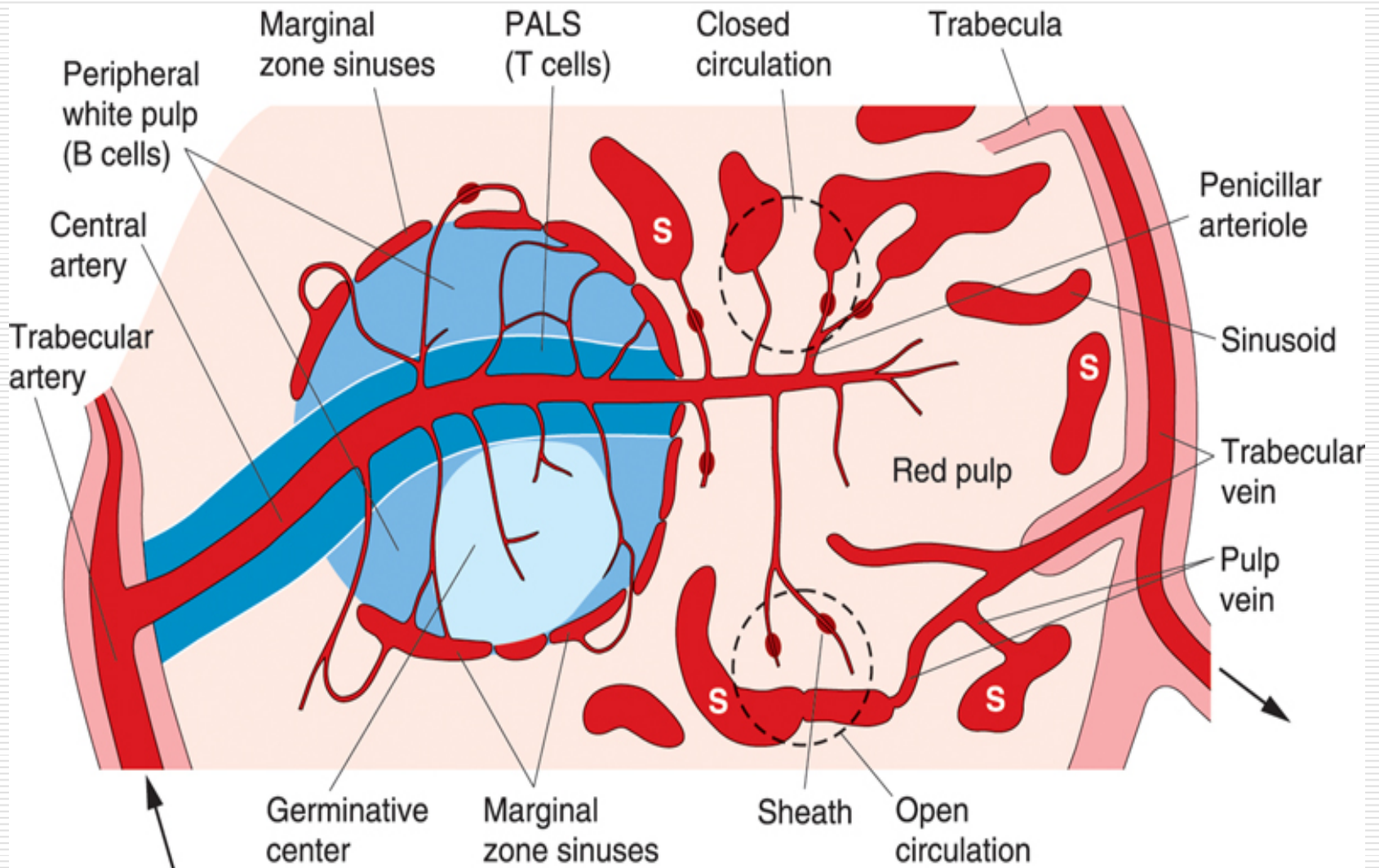


↓ Trabecula

▽ White pulp

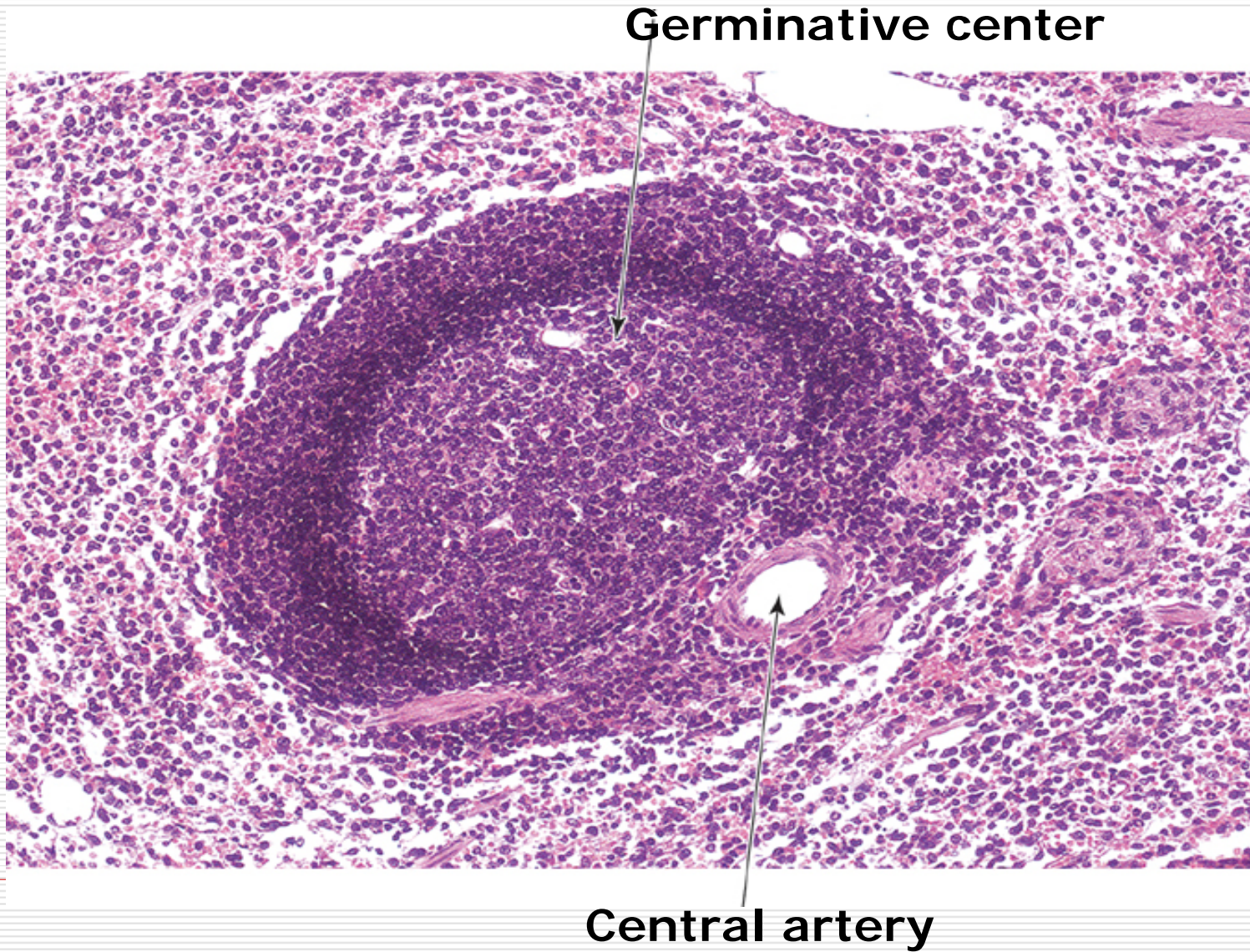
☆ Red pulp

Structure of the spleen

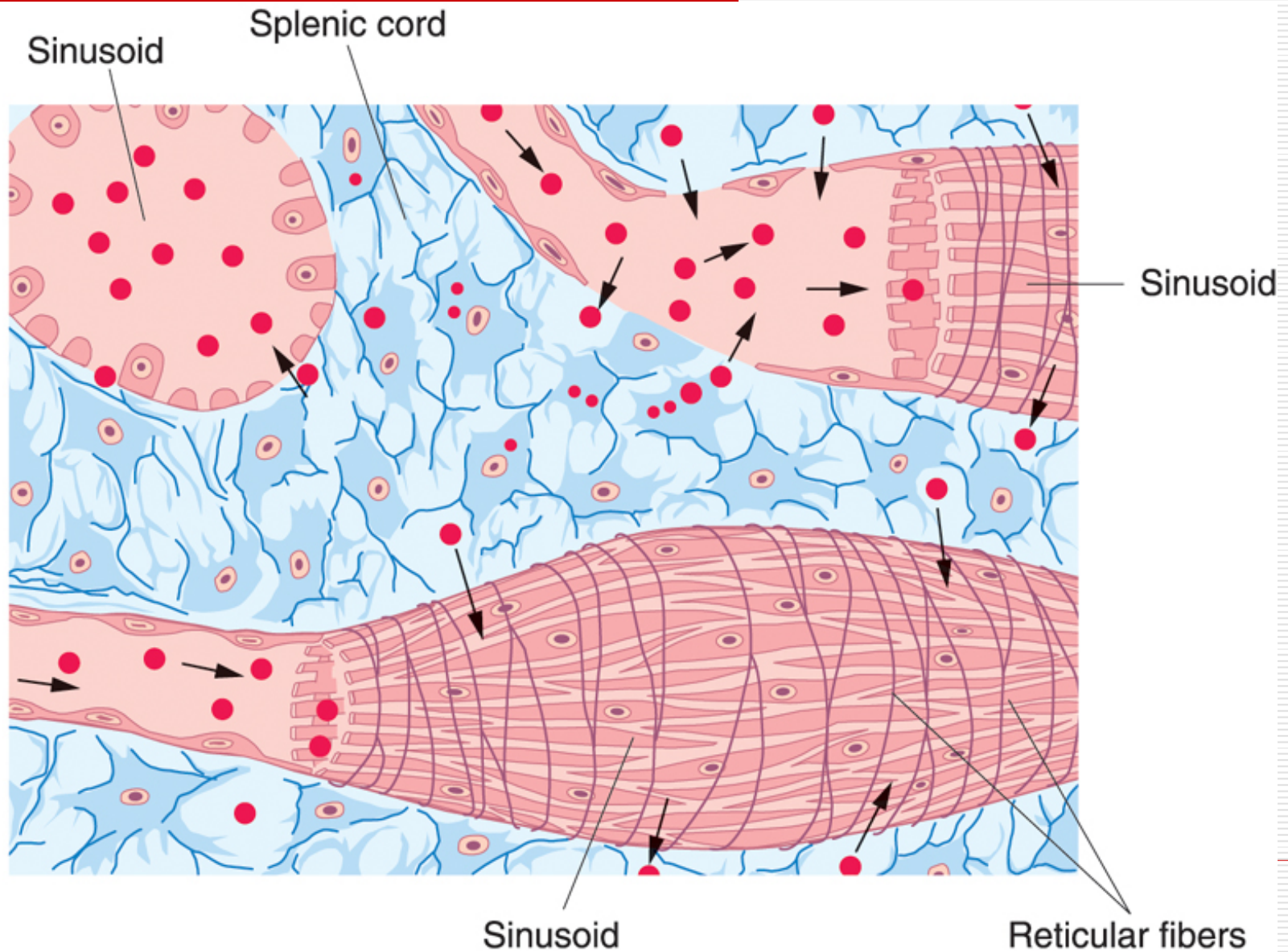


S: Splenic sinus

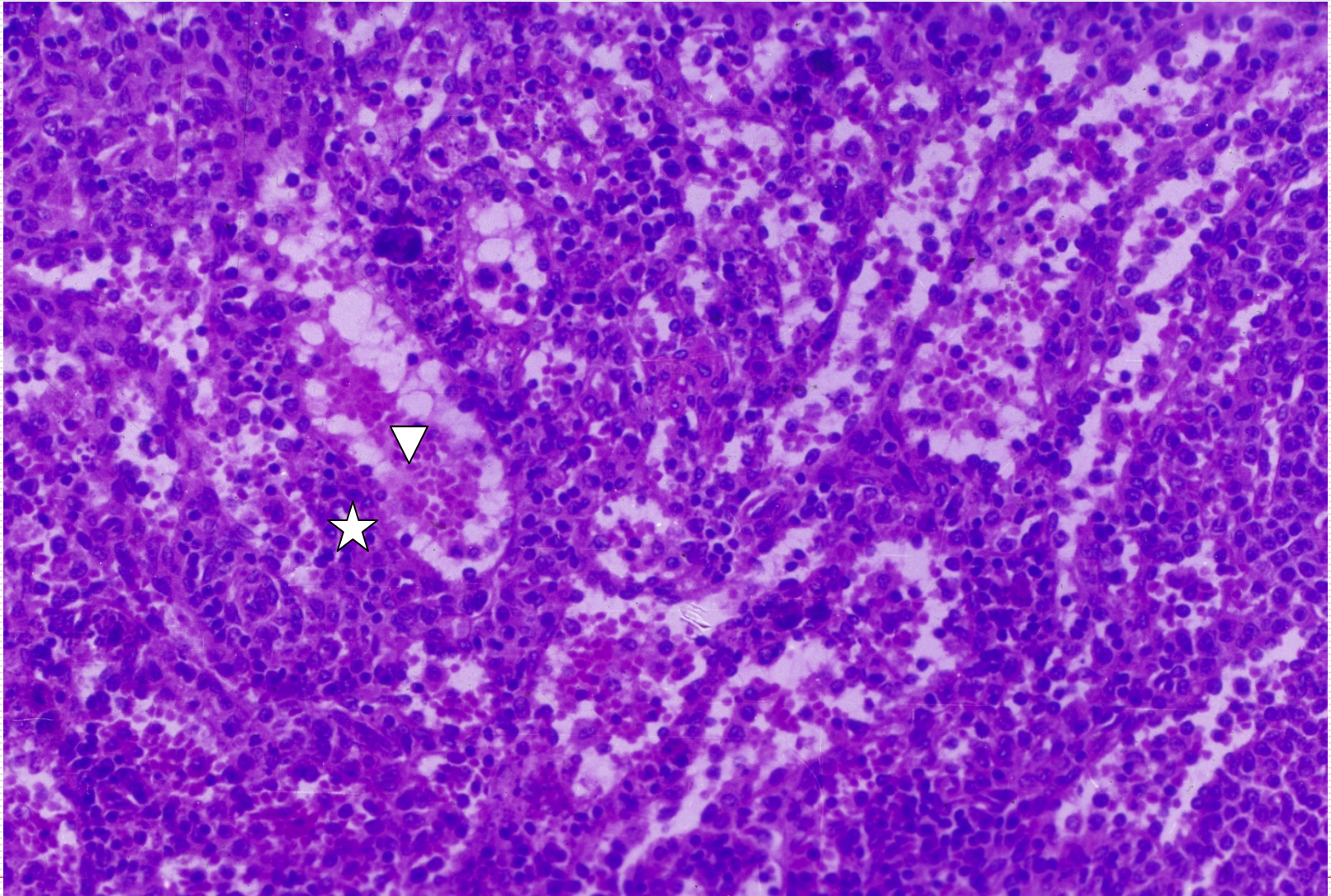
Splenic corpuscle



Red pulp of the spleen



Red pulp of the spleen

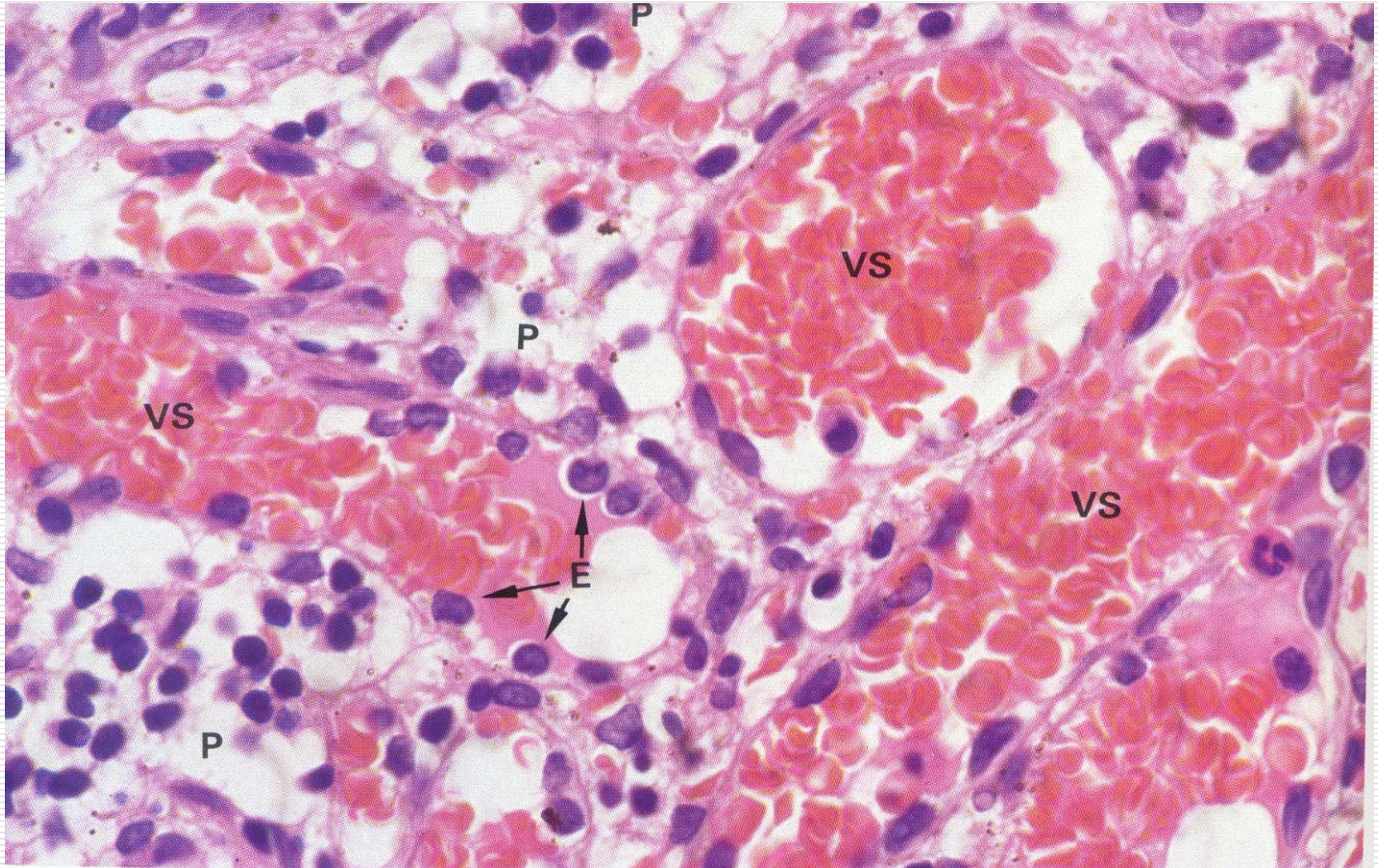


Splenic cord

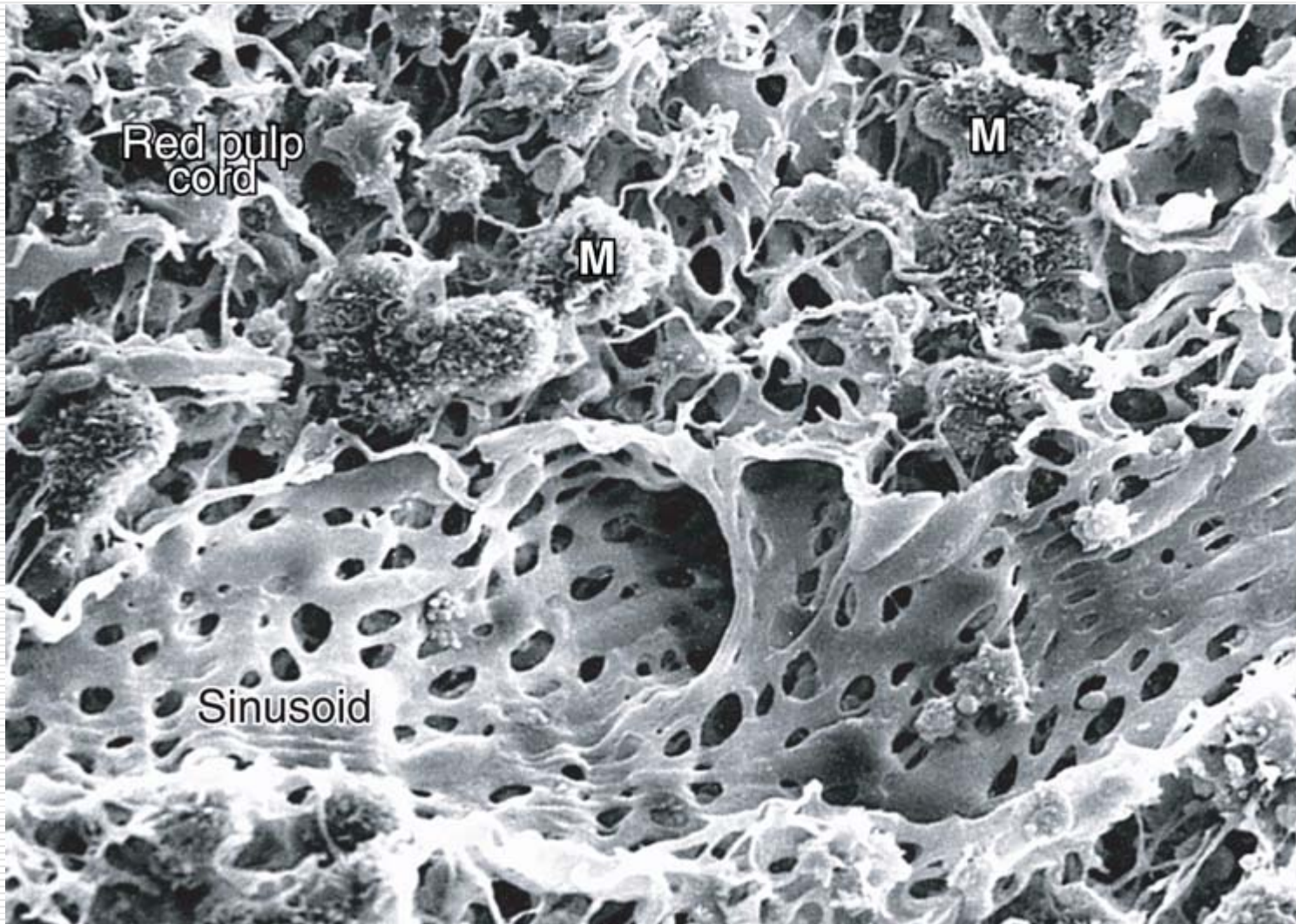


Splenic sinusoid

Red pulp of the spleen



Red pulp of the spleen



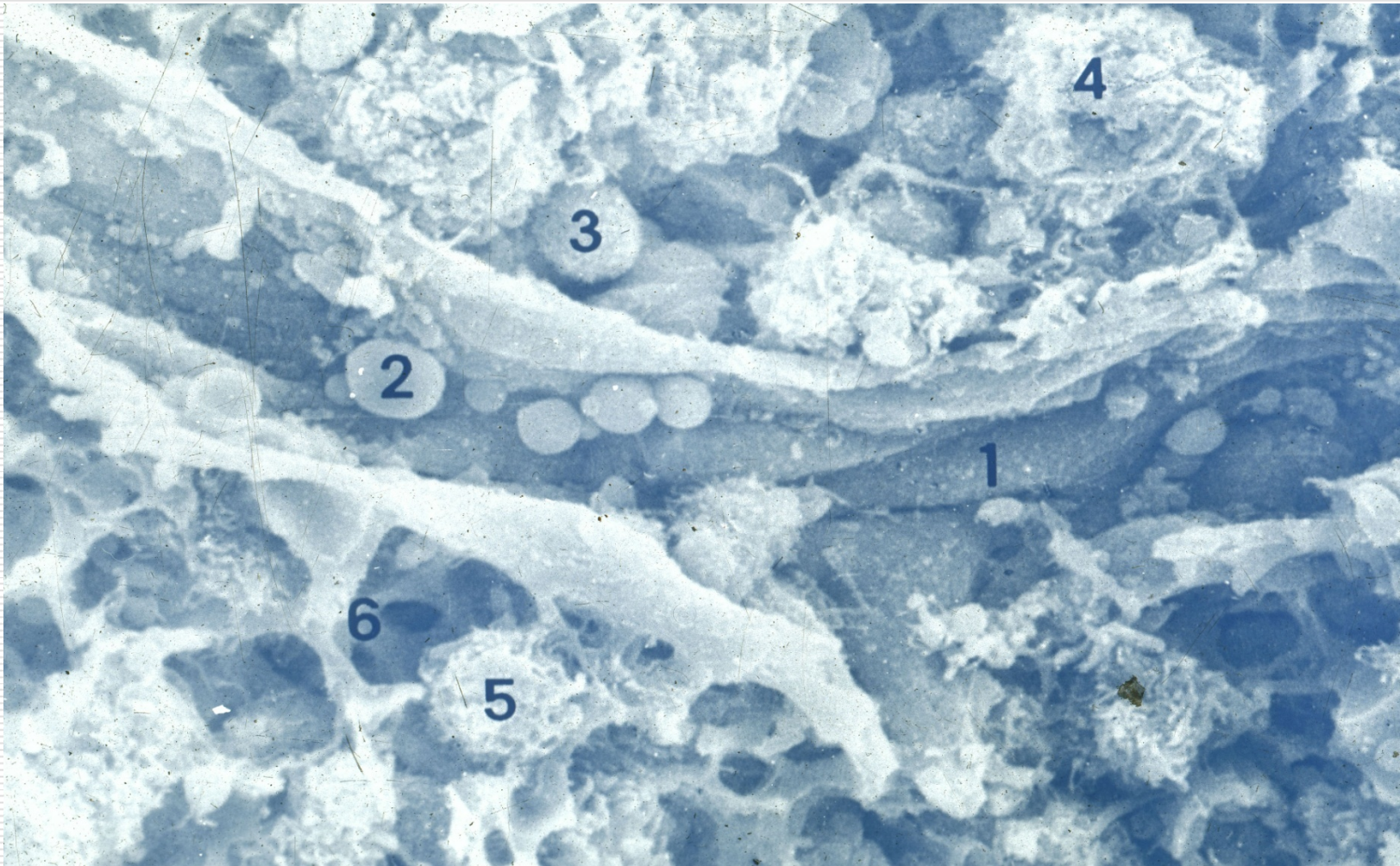
M: Macrophage

Splenic sinusoid



M: Macrophage

Splenic sinusoid

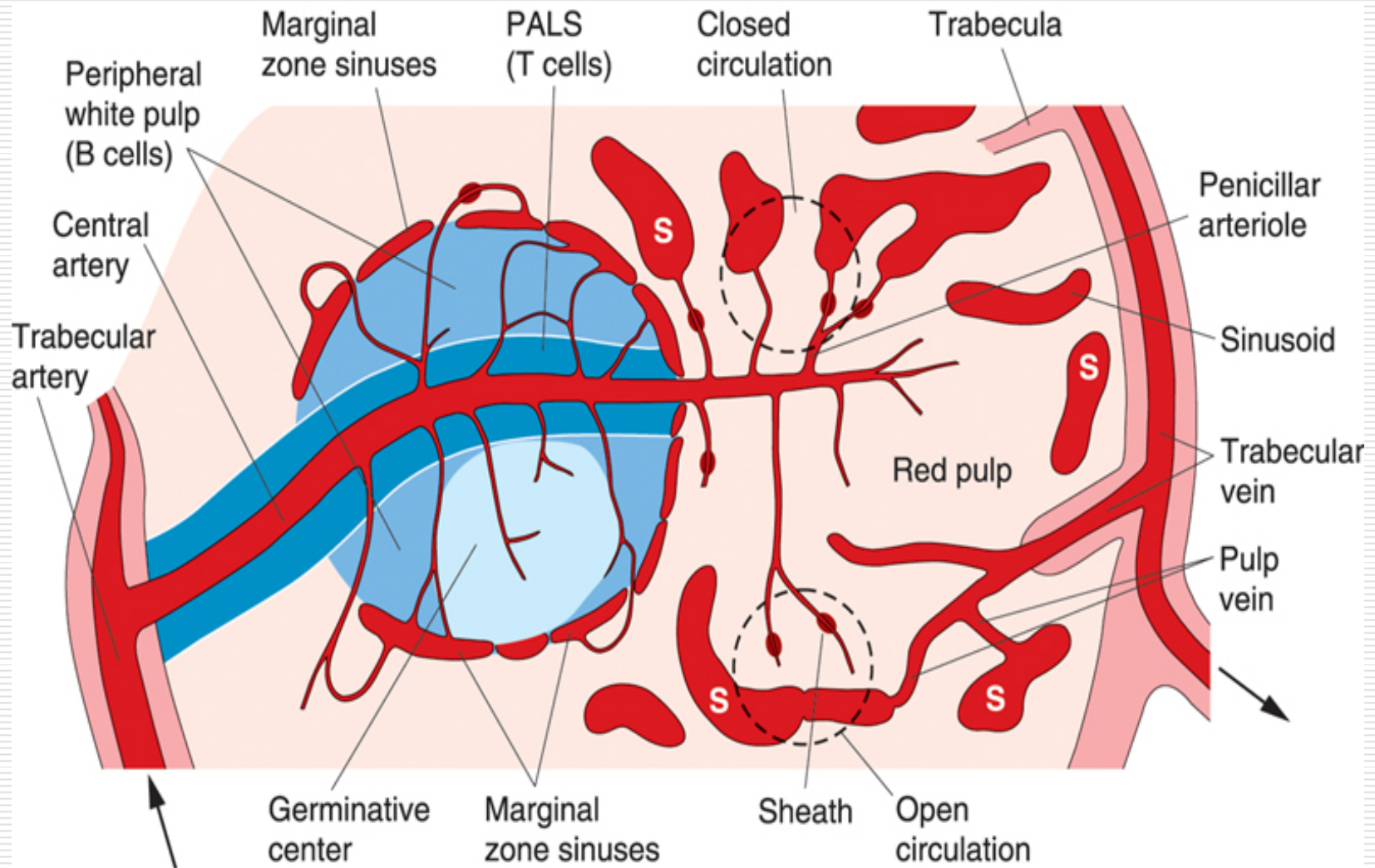


-
- | | | |
|---------------------|-------------------|-------------------|
| 1. Endothelial cell | 2. Red blood cell | 3. Lymphocyte |
| 4. Macrophage | 5. Granulocyte | 6. Reticular cell |

Spleen

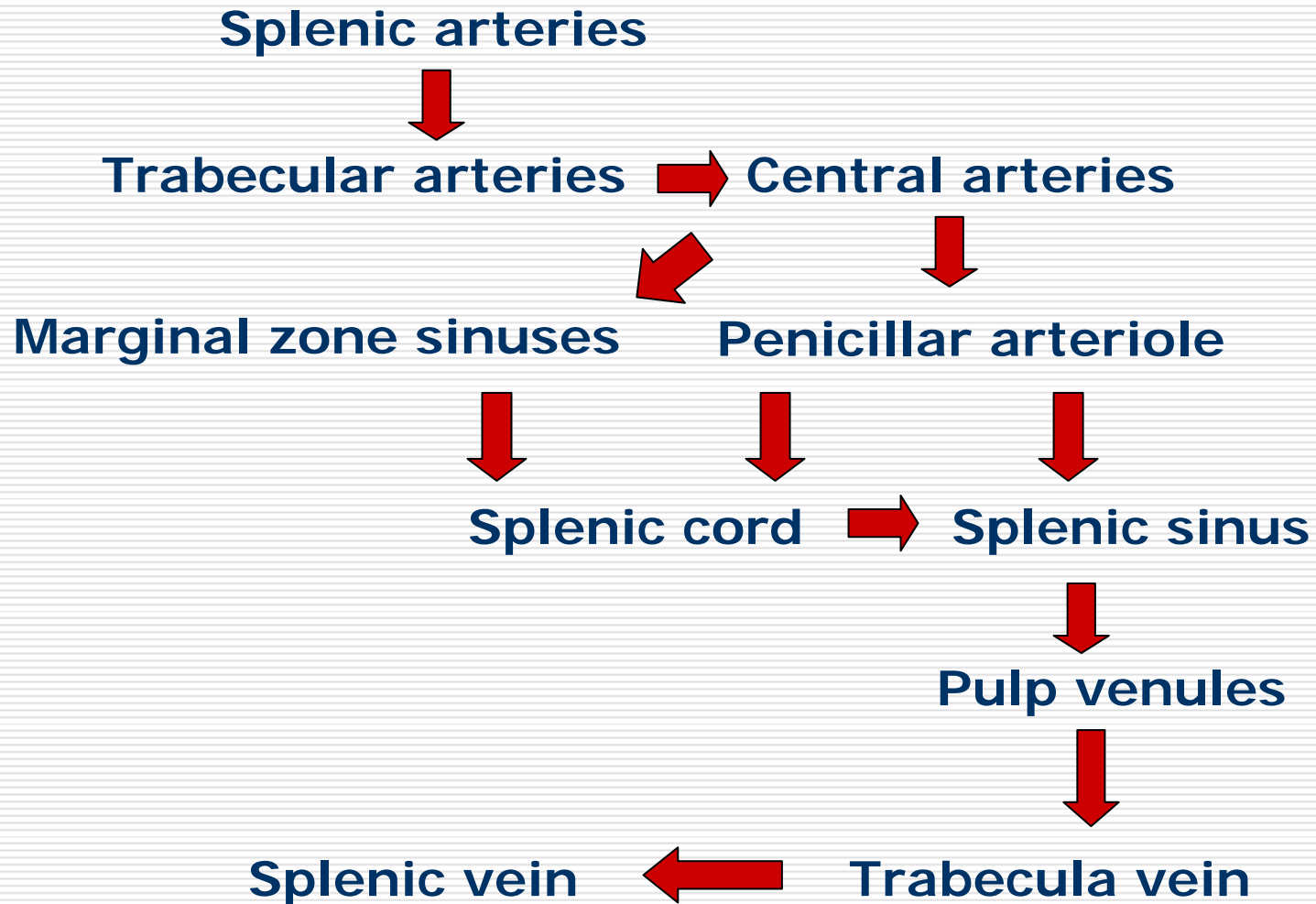
- ❑ **Structure of the spleen**
 - ❑ **Blood circulation of the spleen**
 - ❑ **Function of the spleen**
-

Blood circulation of the spleen



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

- Blood filter**
 - Immunological defence**
 - Production of blood cells**
 - Blood storage**
-

Mononuclear phagocytic system, MPS

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

Summary

- Master the classification and functions of lymphocyte .**
 - Understand mononuclear phagocytic system.**
 - Master main structure and functions of thymus, lymph node and spleen.**
 - Understand the composition and main functions of immune system.**
 - Understand the structure and functions of diffuse lymphoid tissue and lymphoid nodules**
-