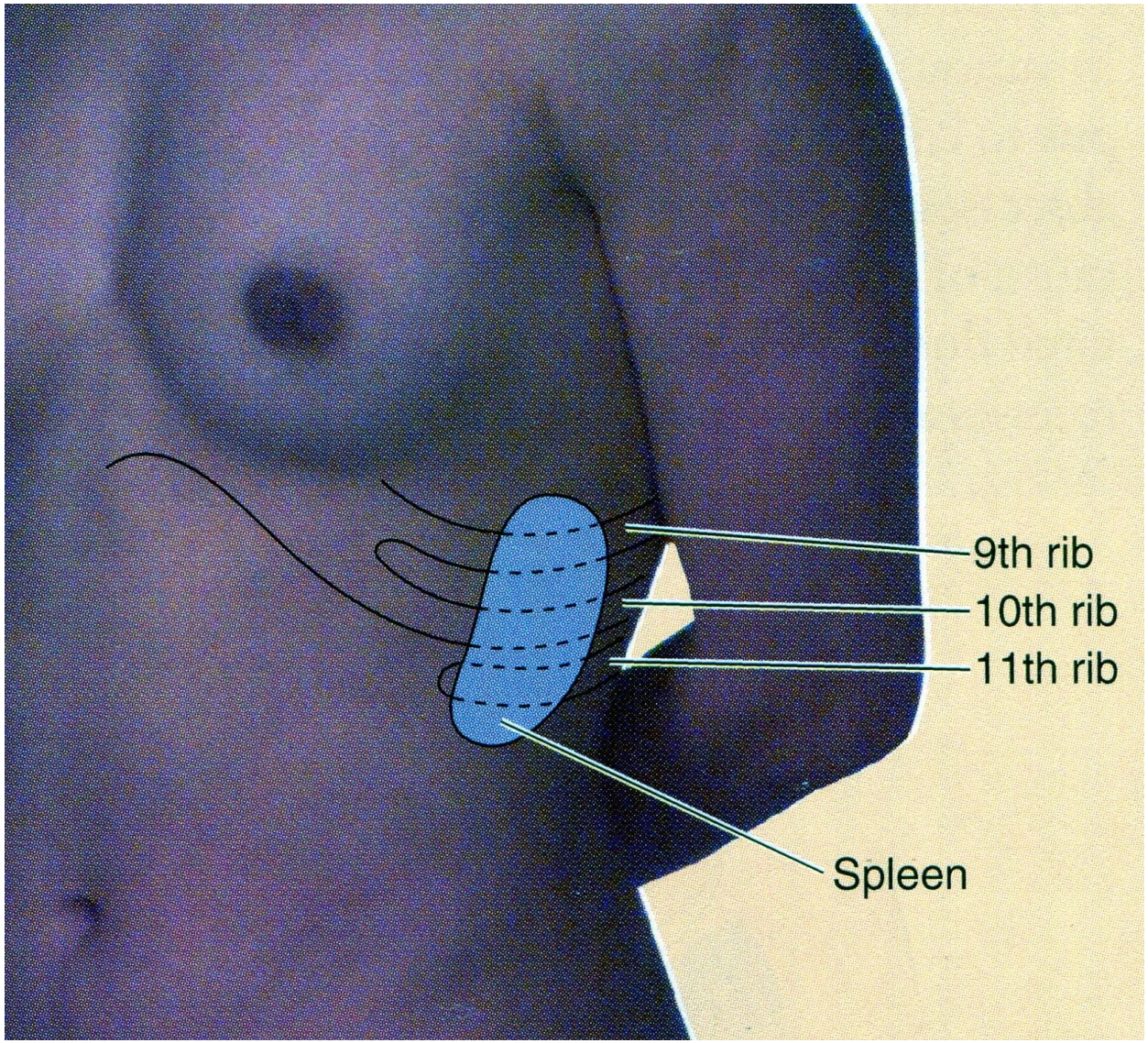
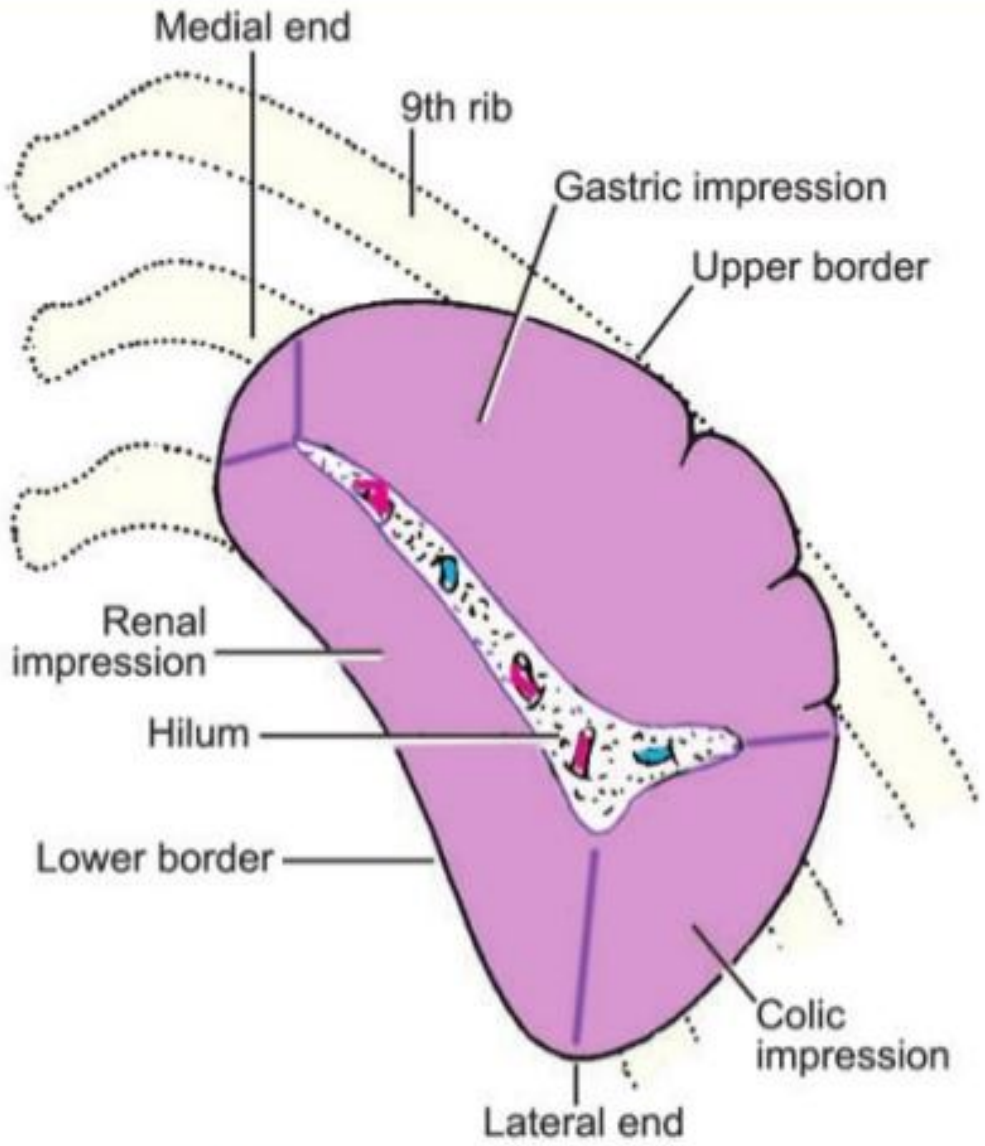

9th rib
10th rib
11th rib
Spleen



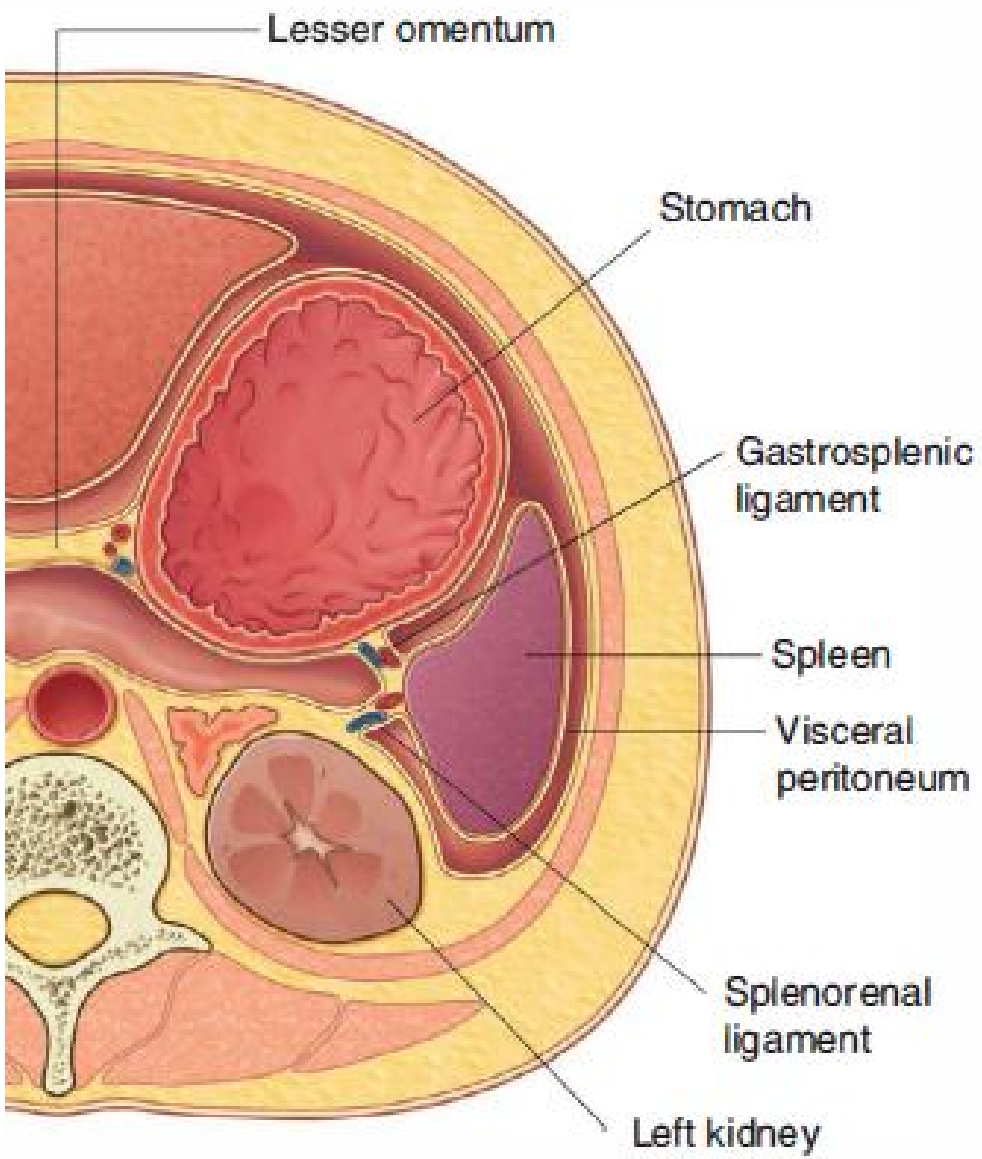
28.23: Spleen as seen from the front

The spleen is connected to the:

greater curvature of the stomach by the ***gastrosplenic ligament***, which contains the short gastric gastroomental vessels

left kidney by the ***splenorenal ligament***, which contains the splenic vessels

Both these ligaments are parts of ***the greater omentum***.



Splenic surfaces:

Lateral (diaphragmatic)
Medial (renal / colic / gastric)
Upper pole (postro superior)
Lower pole (antro inferior)

The spleen is surrounded by visceral peritoneum except in the area of the hilum on the medial surface of the spleen

The splenic hilum is the entry point for the splenic vessels, and occasionally the ***tail of the pancreas*** reaches this area.

The arterial supply to the spleen is the ***splenic artery from the celiac trunk.***

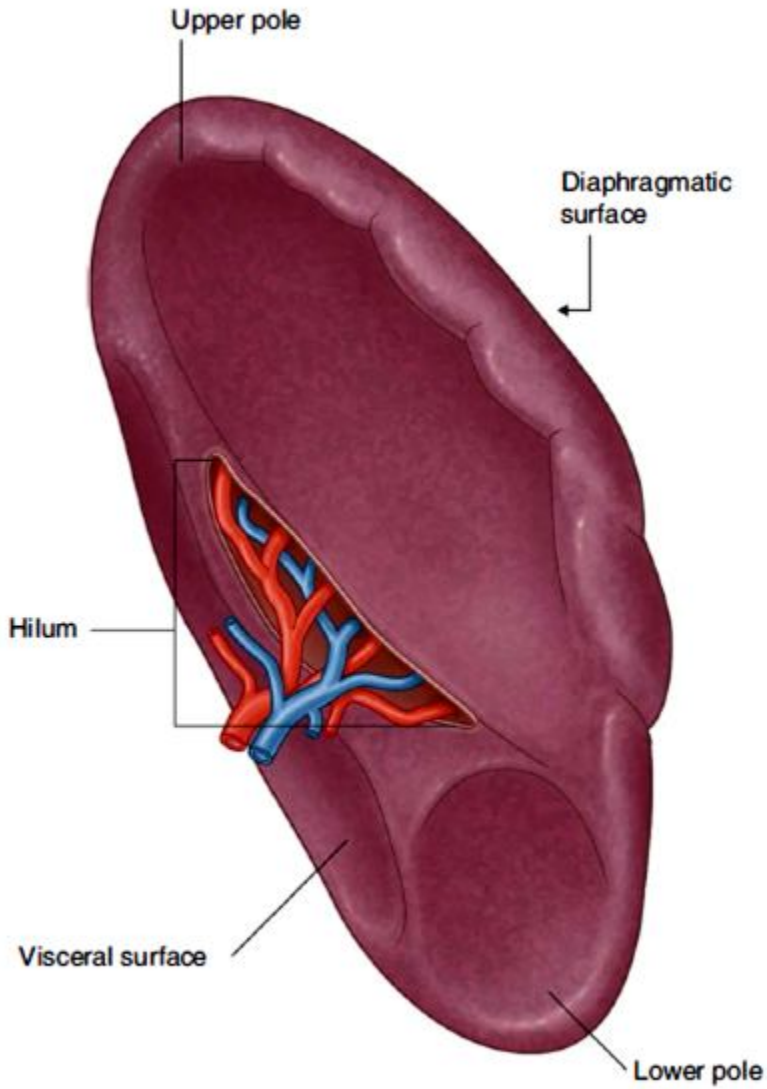
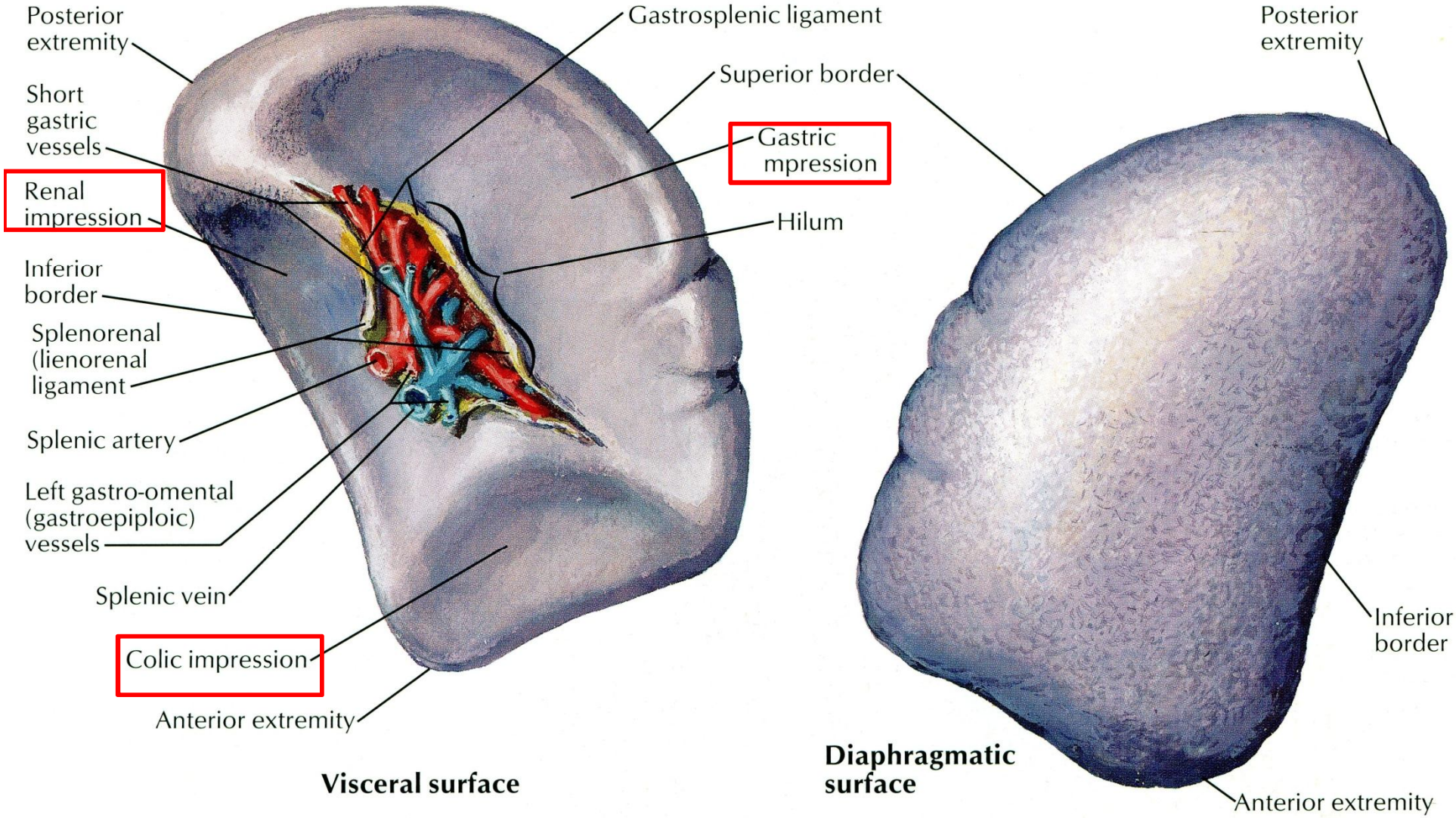


Fig. 4.105 Surfaces and hilum of the spleen.


Posterior extremity
Short gastric vessels
Renal impression
Inferior border
Splenorenal (lienorenal ligament
Splenic artery
Left gastro-omental (gastroepiploic) vessels
Splenic vein
Colic impression
Anterior extremity
Gastrosplenic ligament
Superior border
Gastric mpression
Hilum
Visceral surface
Posterior extremity
Inferior border
Anterior extremity
Diaphragmatic surface

Splenic vesseles

- ***gastrosplenic ligament***, which contains the ***short gastric / gastroomental vessels***

- left kidney by the ***splenorenal ligament***, which contains the ***splenic vessels***

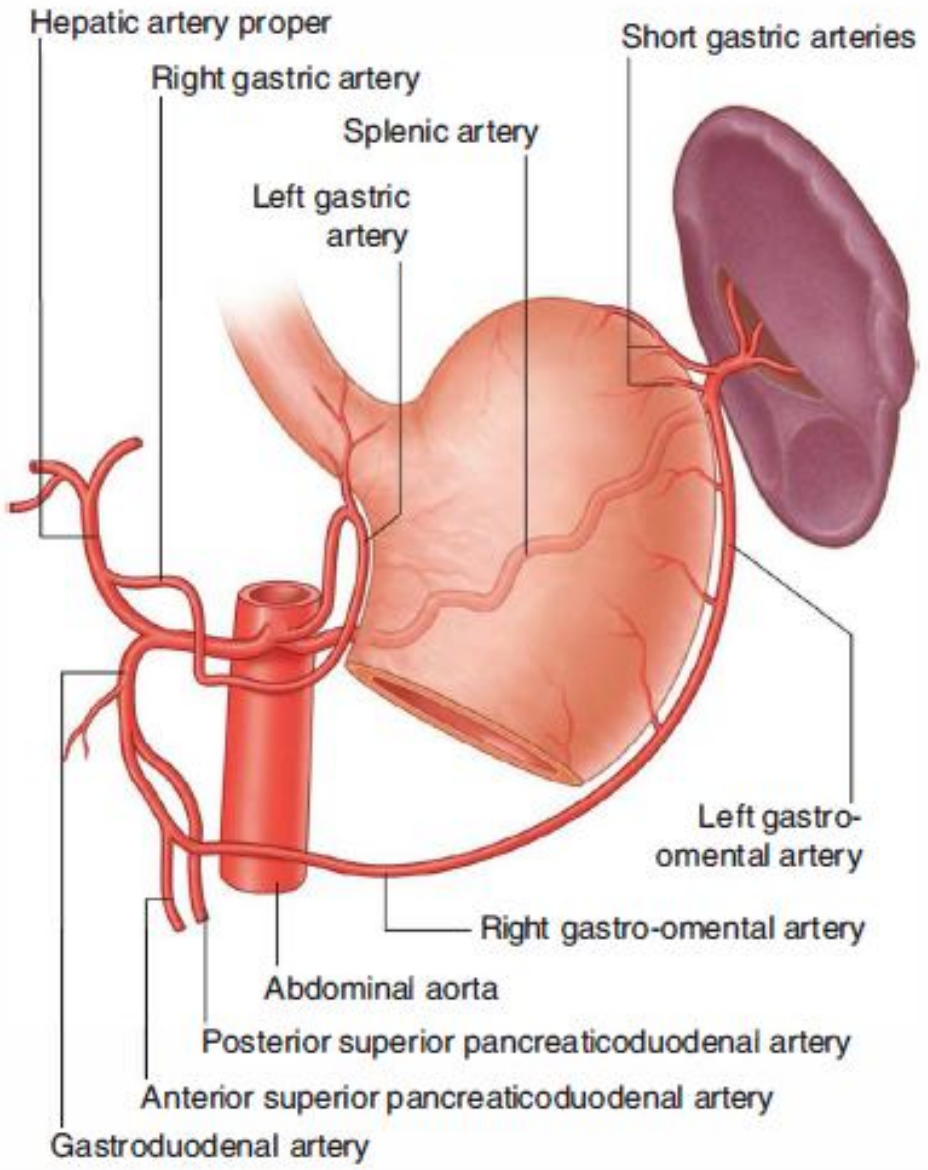


Fig. 4.106 Arterial supply to the spleen.

Spleen

- The **spleen** develops as a circumscribed condensation of *mesenchymal cells* between the layers of the *dorsal mesentery*.
- Mesenchymal cells in the developing spleen differentiate to form the ***capsule***, ***trabeculae***, and ***reticular framework***.
- Development involves establishment of mesenchymal trabeculae within a blood vascular network consisting of a large number of endothelial sinuses.
- The splenic artery supplies the sinuses.
- The spleen initially consists of ***several mesenchymal masses*** that later ***incompletely fuse***.

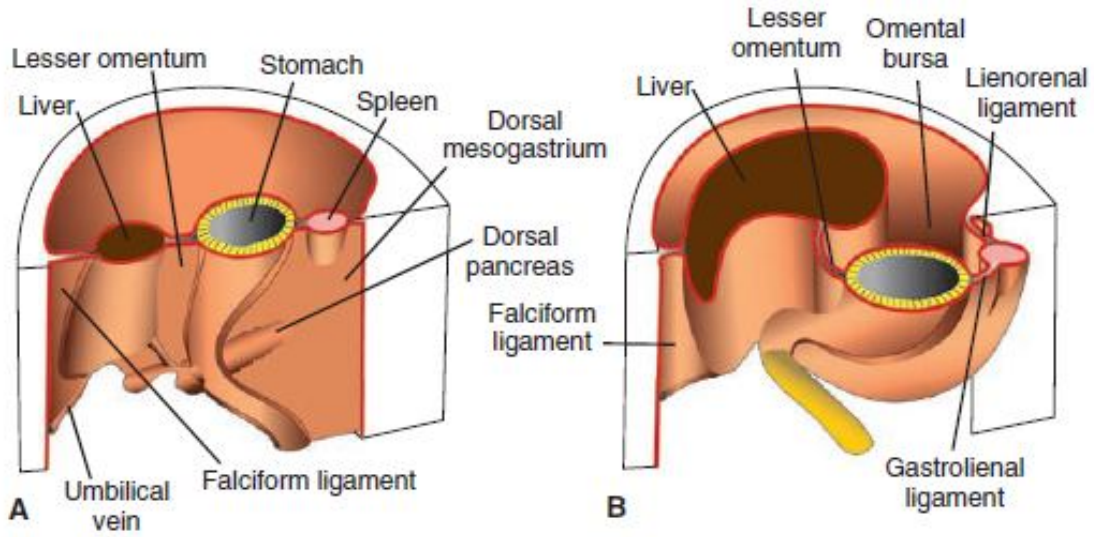
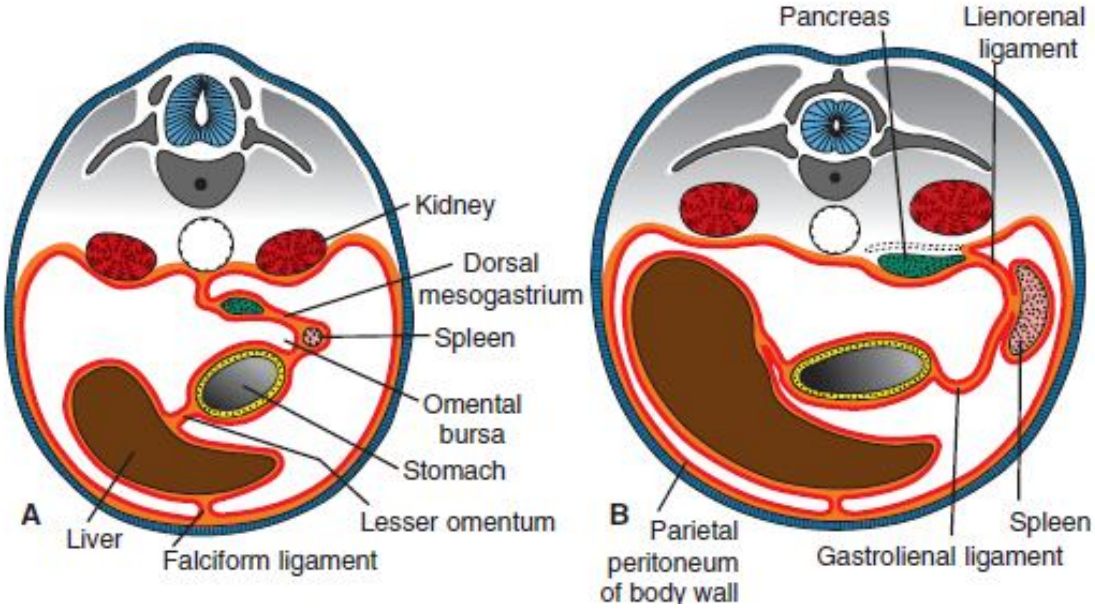
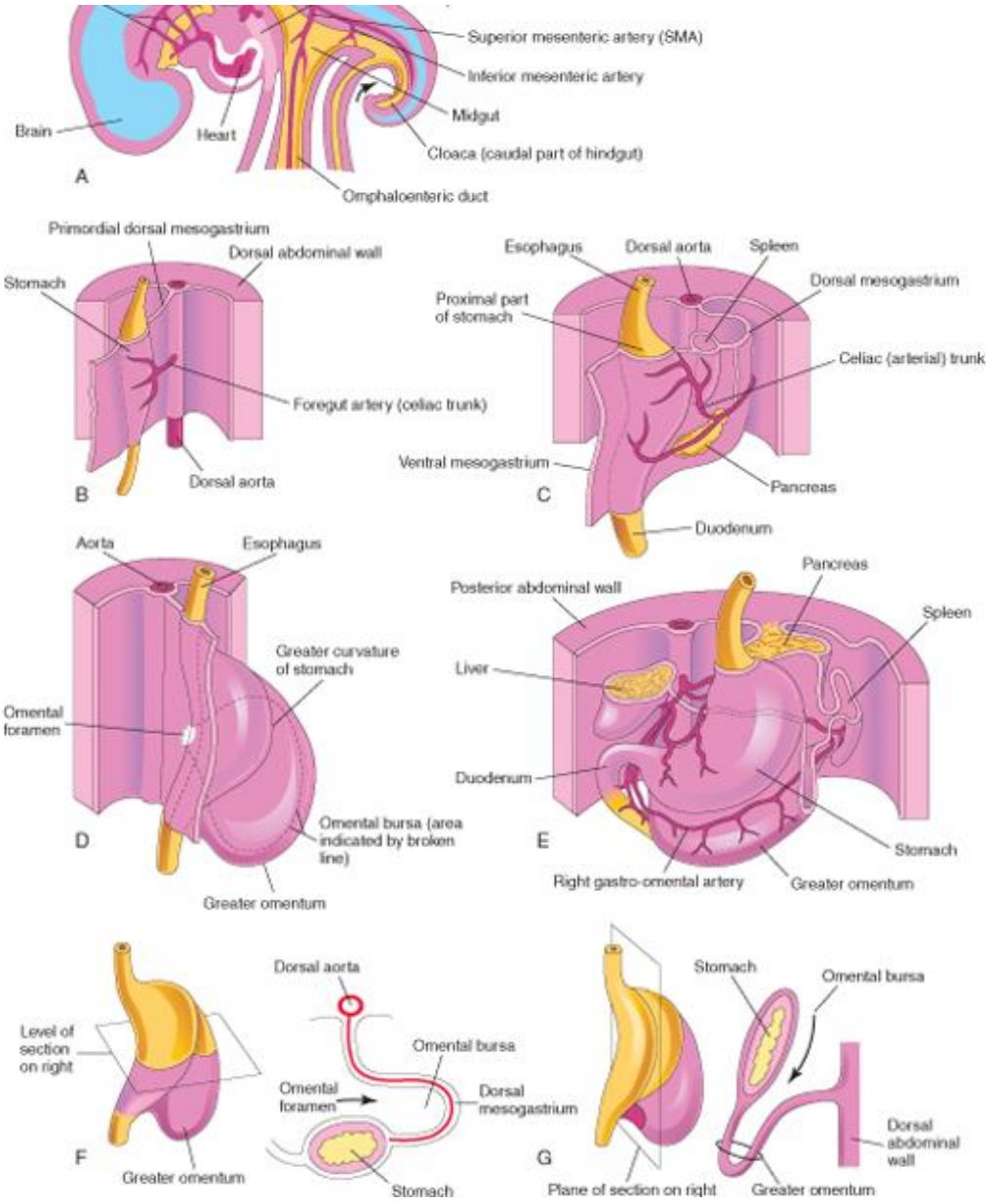


Figure 15.10 **A.** The positions of the spleen, stomach, and pancreas at the end of the fifth week. Note the position of the spleen and pancreas in the dorsal mesogastrium. **B.** Position of spleen and stomach at the 11th week. Note formation of the omental bursa (lesser peritoneal sac).




Superior mesenteric artery (SMA)
Inferior mesenteric artery
Midgut
Cloaca (caudal part of hindgut)
Brain
Heart
A
Omphaloenteric duct
Primordial dorsal mesogastrium
Dorsal abdominal wall
Stomach
Foregut artery (celiac trunk)
Dorsal aorta
B
Esophagus
Dorsal aorta
Spleen
Dorsal mesogastrium
Proximal part of stomach
Celiac (arterial) trunk
Ventral mesogastrium
Pancreas
Duodenum
C
Aorta
Esophagus
Greater curvature of stomach
Omental foramen
Omental bursa (area indicated by broken line)
D
Greater omentum
Pancreas
Posterior abdominal wall
Spleen
Liver
Duodenum
Stomach
E
Right gastro-omental artery
Greater omentum
Level of section on right
F
Greater omentum
Dorsal aorta
Omental bursa
Omental foramen
Dorsal mesogastrium
Stomach
Stomach
Omental bursa
Dorsal abdominal wall
G
Plane of section on right
Greater omentum

Spleen Histology

Blood filtration
Secondary lymphatic organ
Capsule: Connective tissue + *smooth muscle*
Trabeculae
Delete old RBC & platelets
reticular tissue (reticular cell + reticular fiber)
Lymphocyte
Macrophage
APCs

White pulp (20%) = lymphatic nodule + PALS
Red pulp = sinusoid + splenic cord

Histology

Spleen

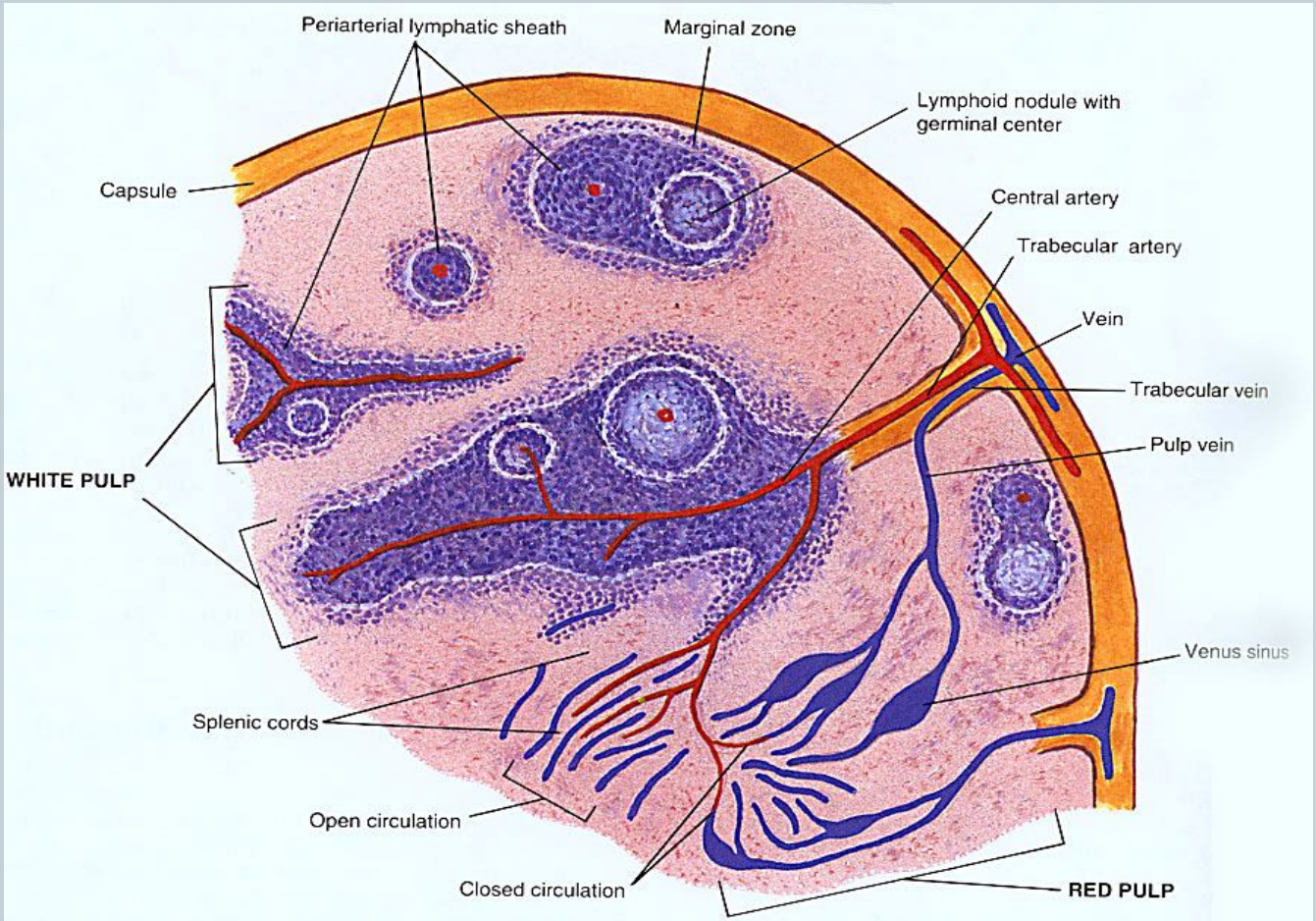
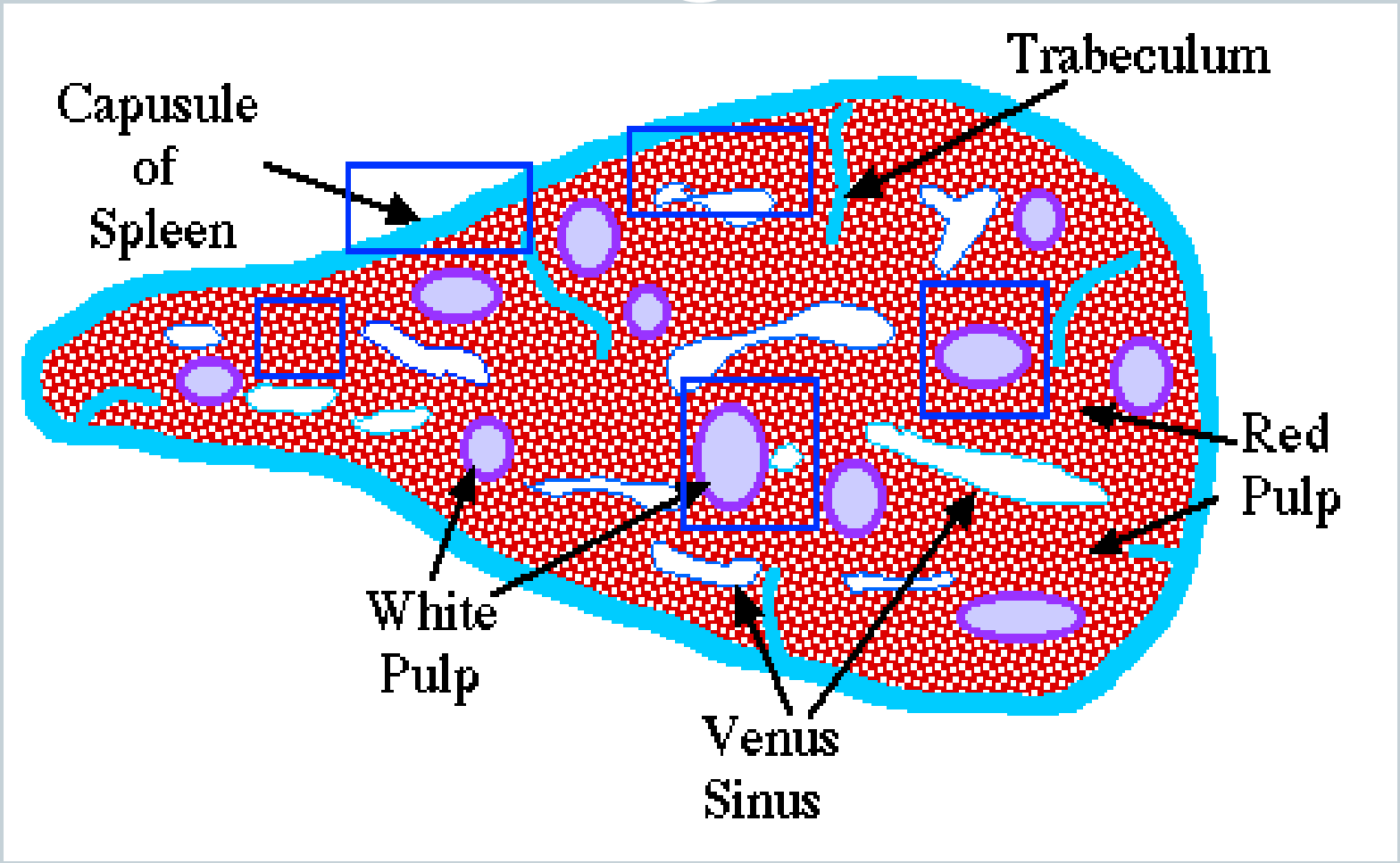
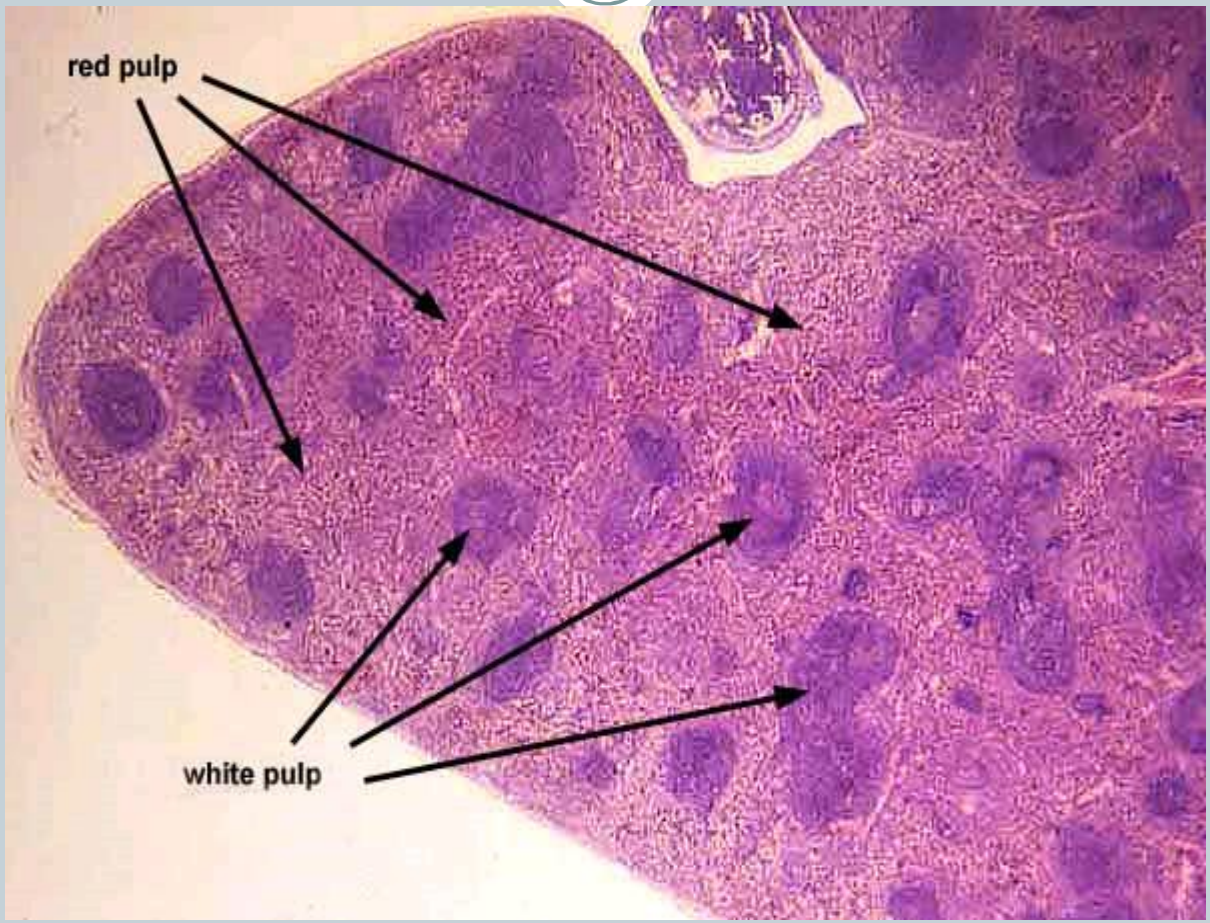


FIGURE 20-13
Structure of the normal spleen.

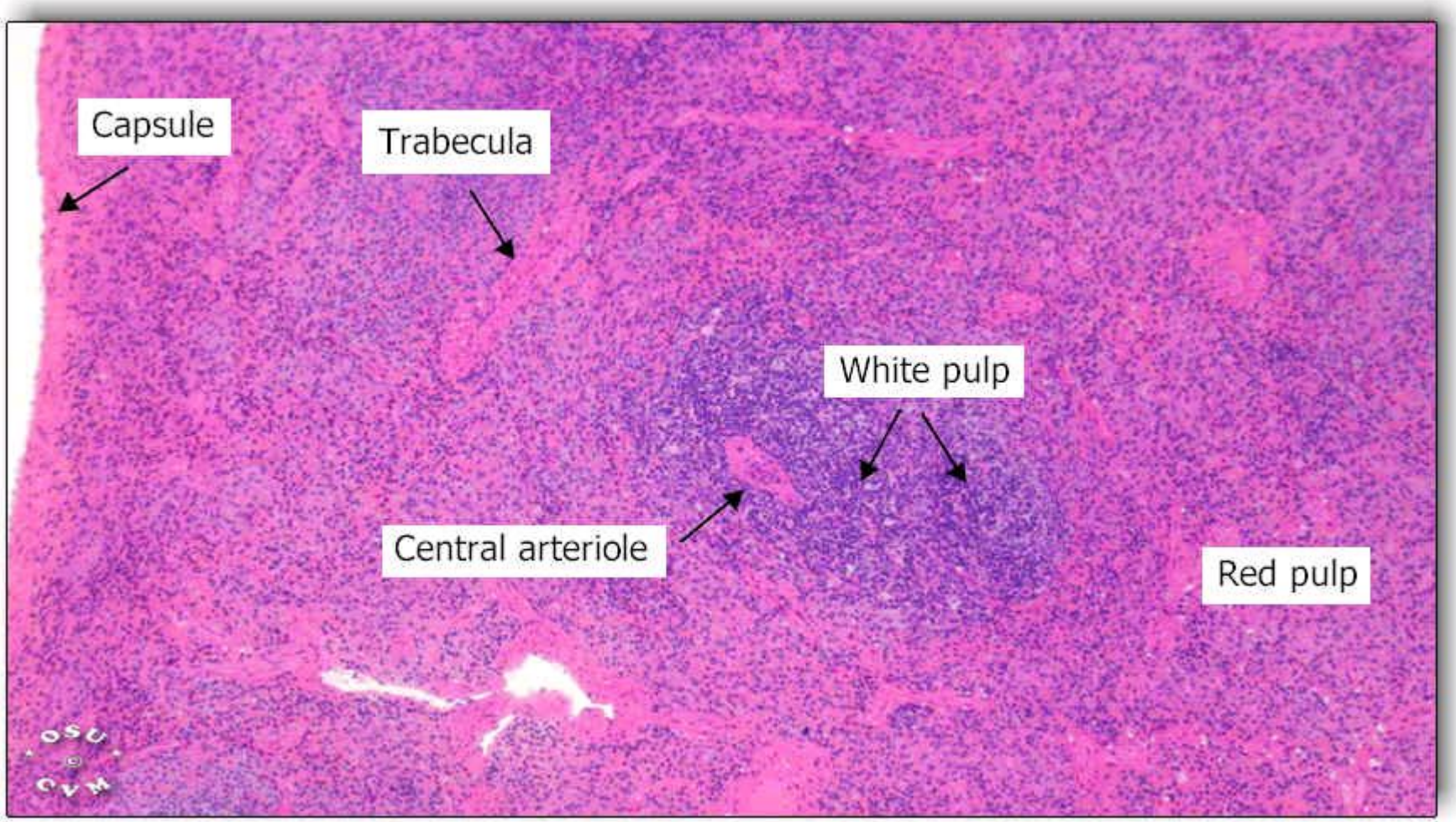
Spleen


Trabeculum
Capusule
of
Spleen
Red
Pulp
White
Pulp
Venus
Sinus

spleen

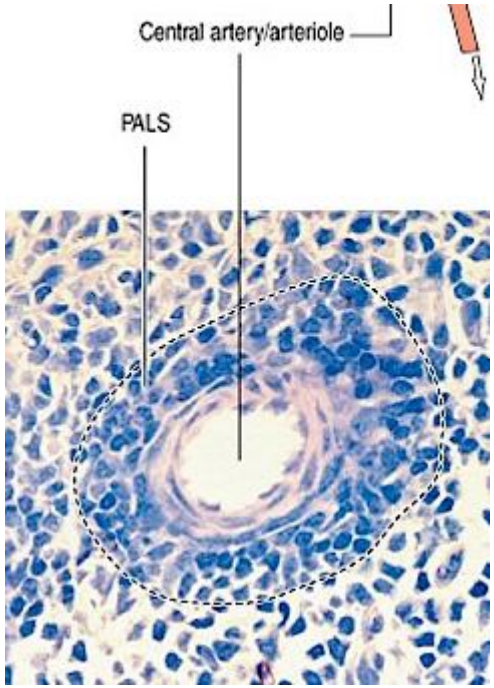


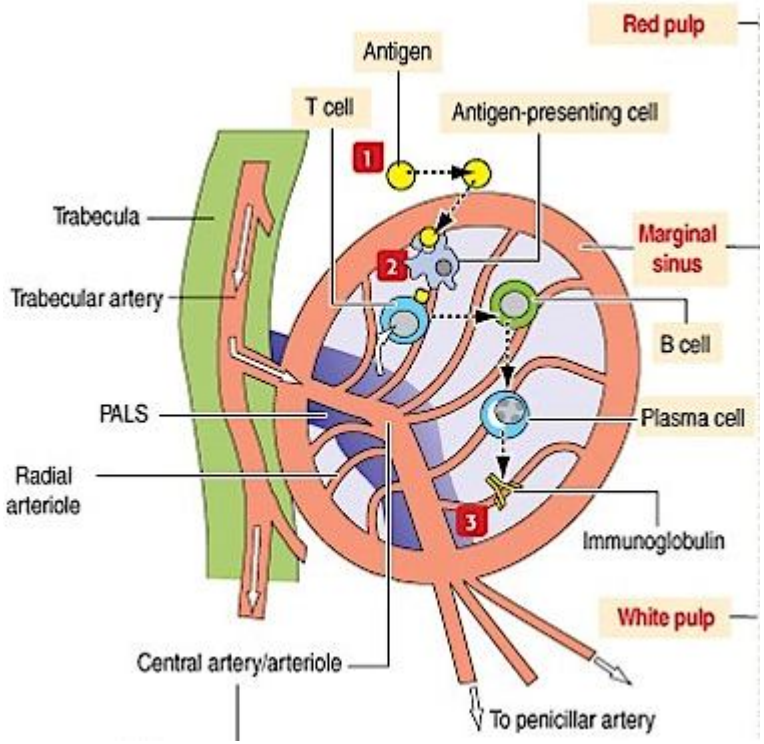
spleen


Capsule
Trabecula
White pulp
Central arteriole
Red pulp
OSU
CVM

White pulp

- Central artery & radial arteriole
- PALS: T-cell / macrophage / DCs / plasma cell
- Lymphatic nodule with germinal center : B-cell
- Marginal zone
- Marginal zone sinus: macrophage / DCs / T-cell/ B-cell / plasma cell





Red pulp

- *Splenic Sinusoid:*

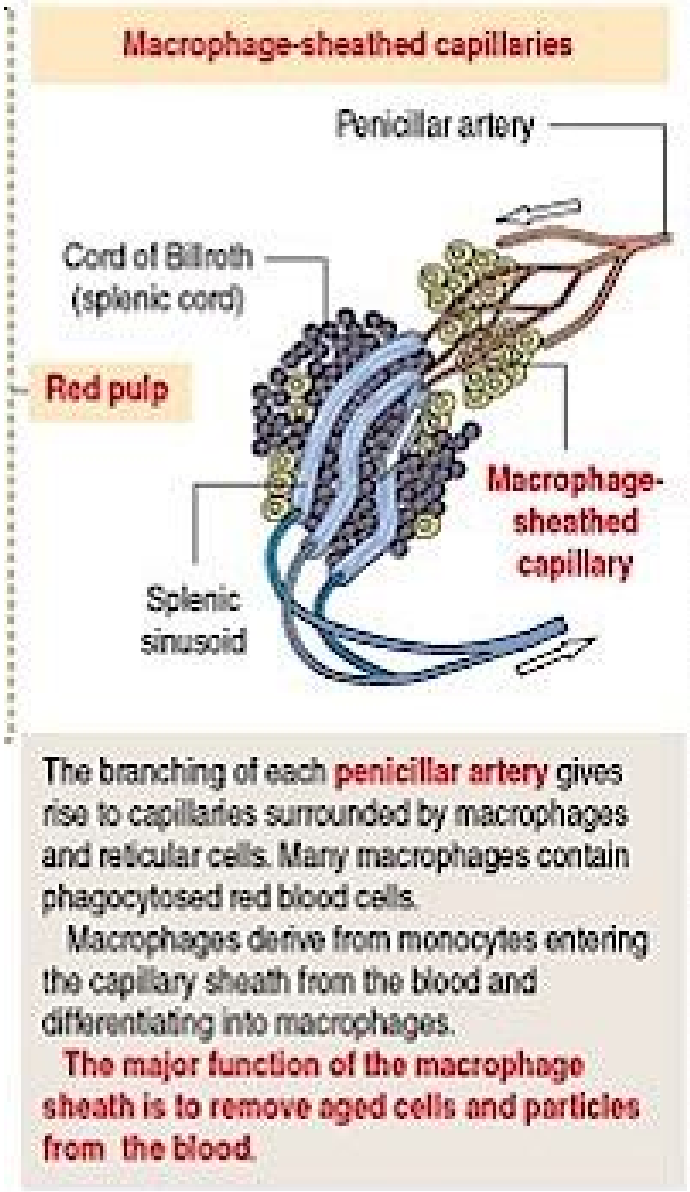
Endothelial cells (stave cell)
Reticular fiber(wooden barrel)
Fenestrate basal lamina

- *splenic cord (cord of Billroth) :*

Reticular cell & fiber
Lymphocyte
Macrophage
Blood cells

- *Penicillar arteriole*
- *Capillary(sheathed)* : APC

(macrophage + reticular cell & fiber)



The branching of each penicillar artery gives rise to capillaries surrounded by macrophages and reticular cells. Many macrophages contain phagocytosed red blood cells.

Macrophages derive from monocytes entering the capillary sheath from the blood and differentiating into macrophages.

The major function of the macrophage sheath is to remove aged cells and particles from the blood.

Red pulp

Splenic Sinusoid:

Endothelial cells (stave cell)
Reticular fiber(wooden barrel)
Fenestrate basal lamina

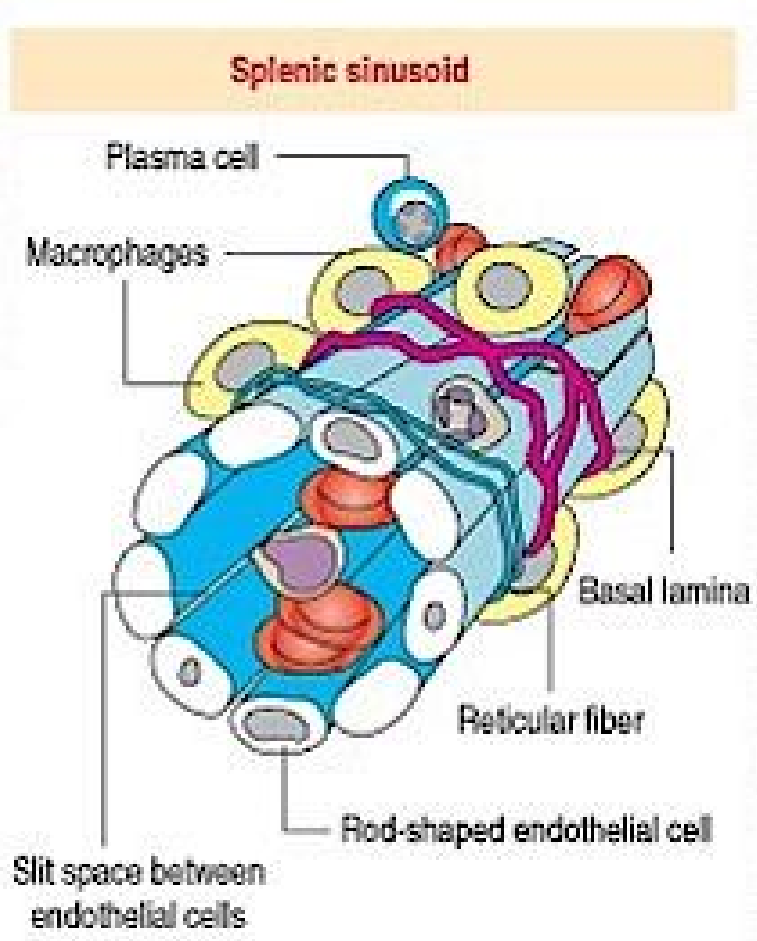
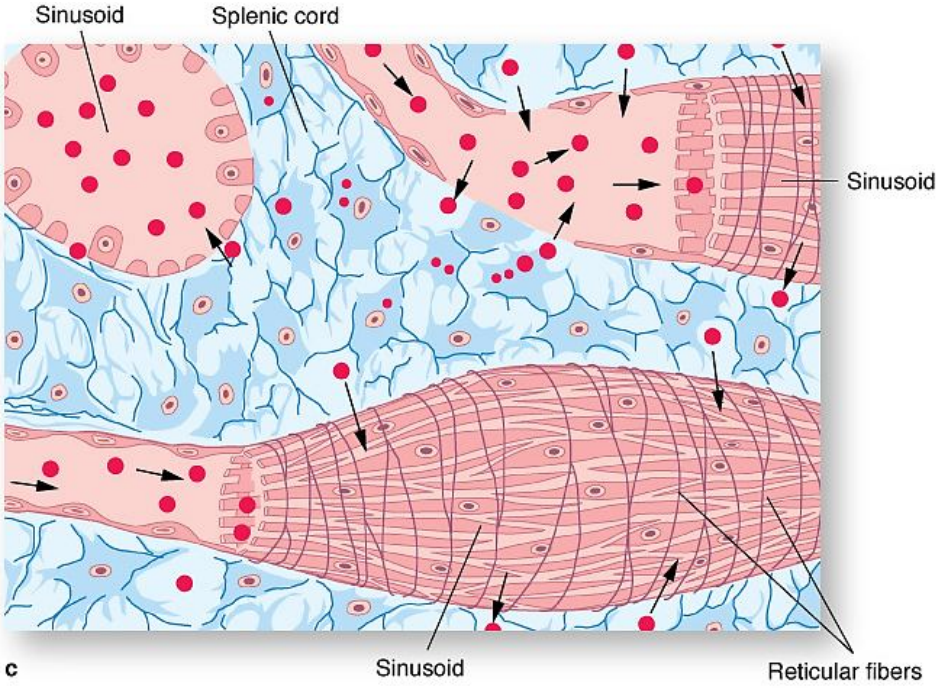


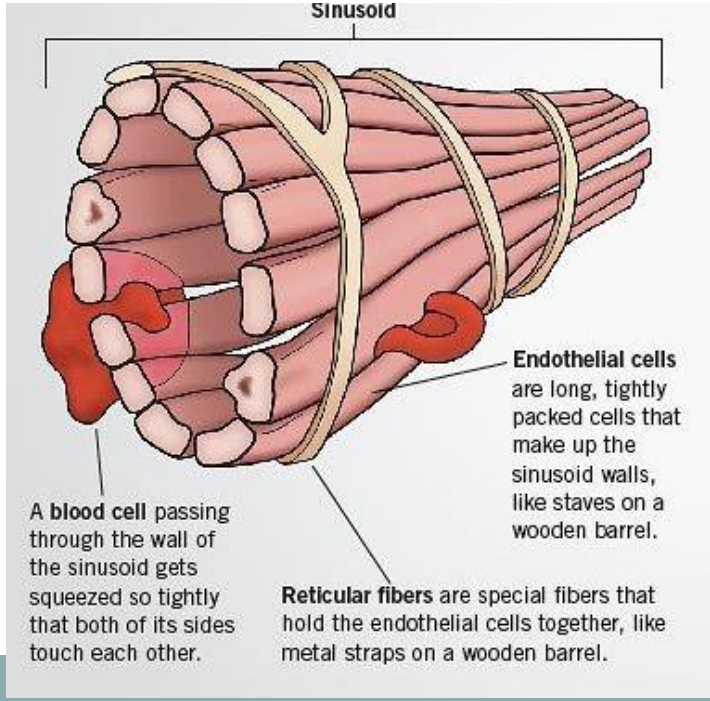
Diagram showing these components of ***splenic sinuses*** schematically, with the structures resembling a loosely organized ***wooden barrel***.

In the open circulation mode of blood flow, blood cells dumped into the cords of the red pulp move under pressure or by their own activity through the spaces between stave cells

reentering the vasculature and soon leaving the spleen via ***the splenic vein.***

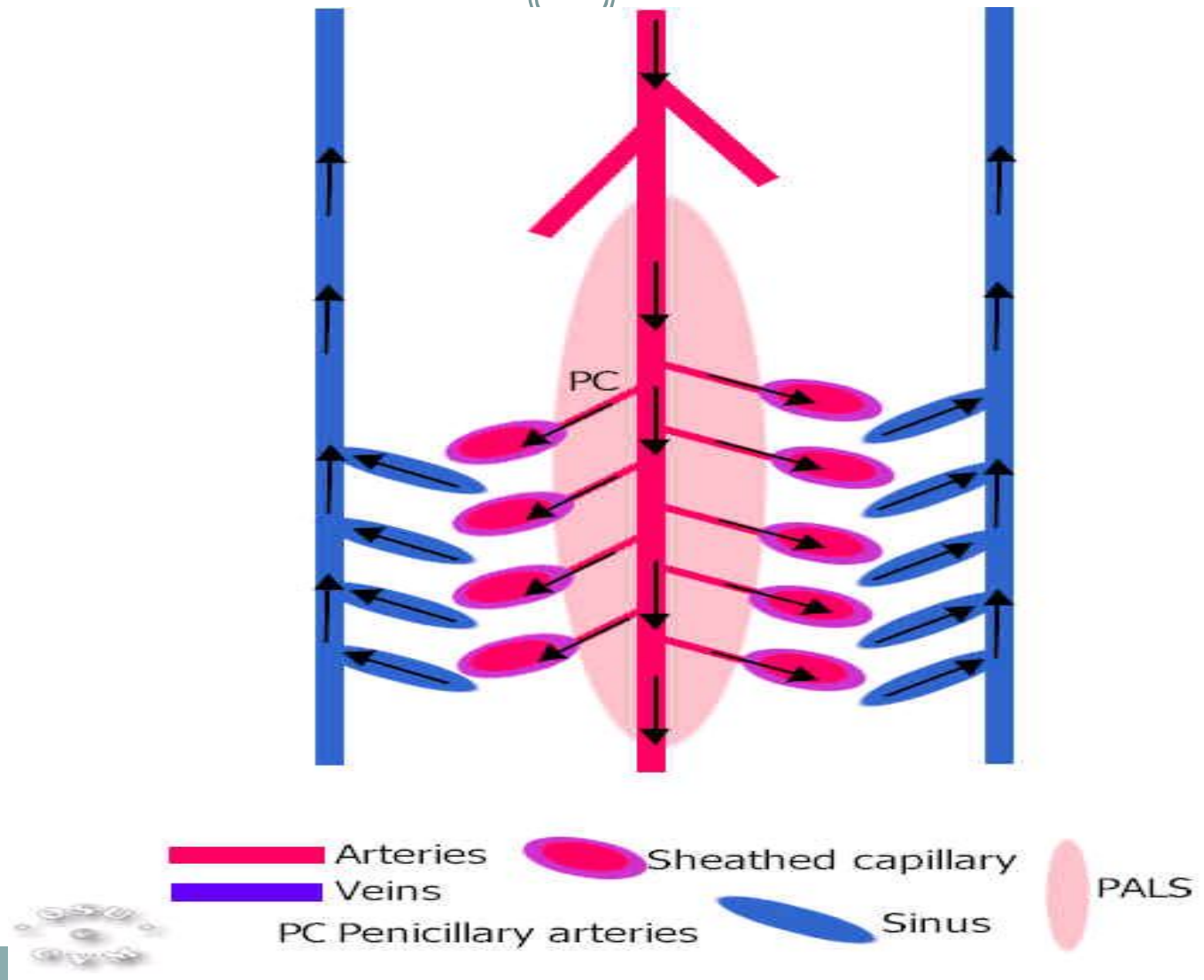
Cells that cannot squeeze between the **stave cells (Special elongated endothelial cells)**, mainly effete erythrocytes, are removed by macrophages.



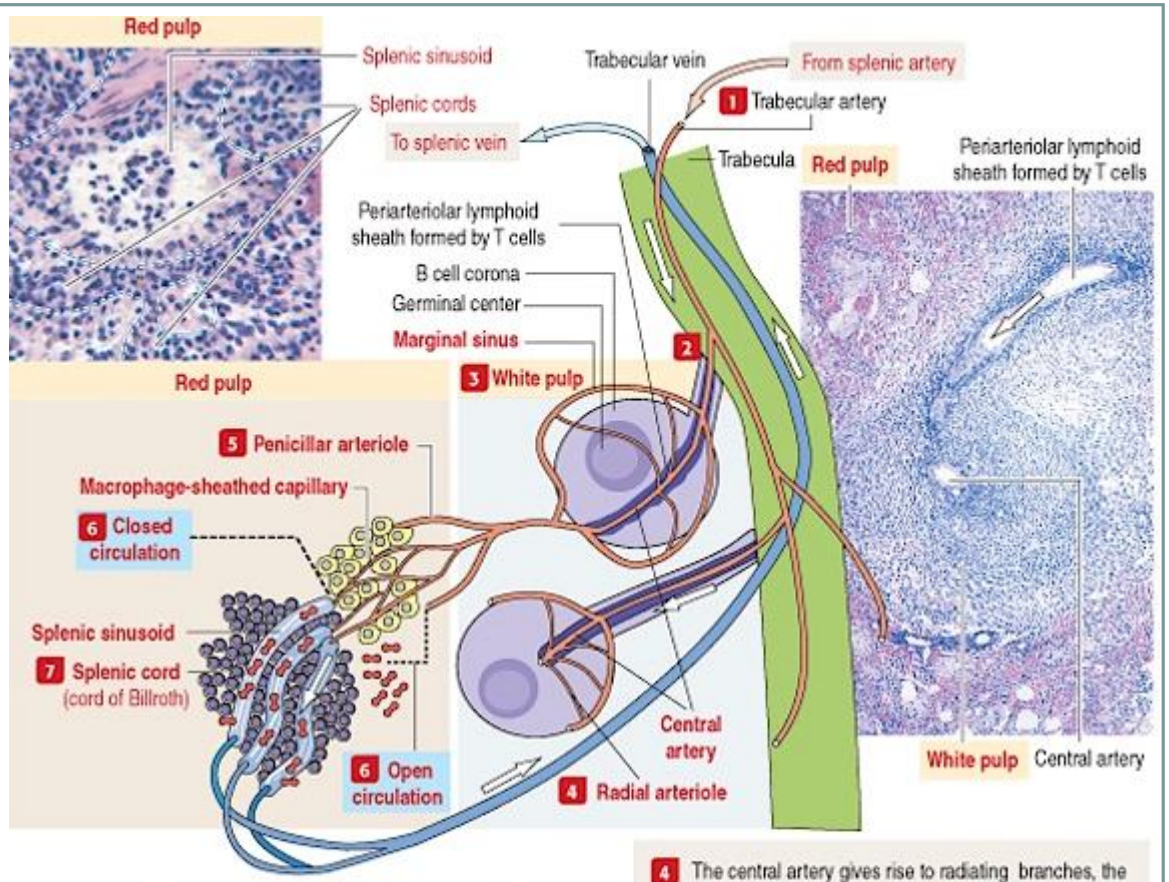


spleen

- *Capillary(sheathed)* : APC
(macrophage + reticular cell & fiber)



Vascularization of the spleen



1 The **trabecular artery** enters the spleen through the connective tissue trabecula (derived from the splenic capsule).

2 When the trabecular artery leaves the trabecula, it becomes invested within the white pulp by T cells forming the **periarteriolar lymphoid sheath** (PALS). The trabecular artery is now the **central artery/arteriole** of the white pulp.

3 The white pulp consists of four components: (1) the **central arteriole**; (2) the **PALS**; (3) the **corona** formed by B cells and antigen-presenting cells; and (4) the **germinal center**.

The white pulp has the structural characteristics of an immune component (B and T cells and antigen-presenting cells).

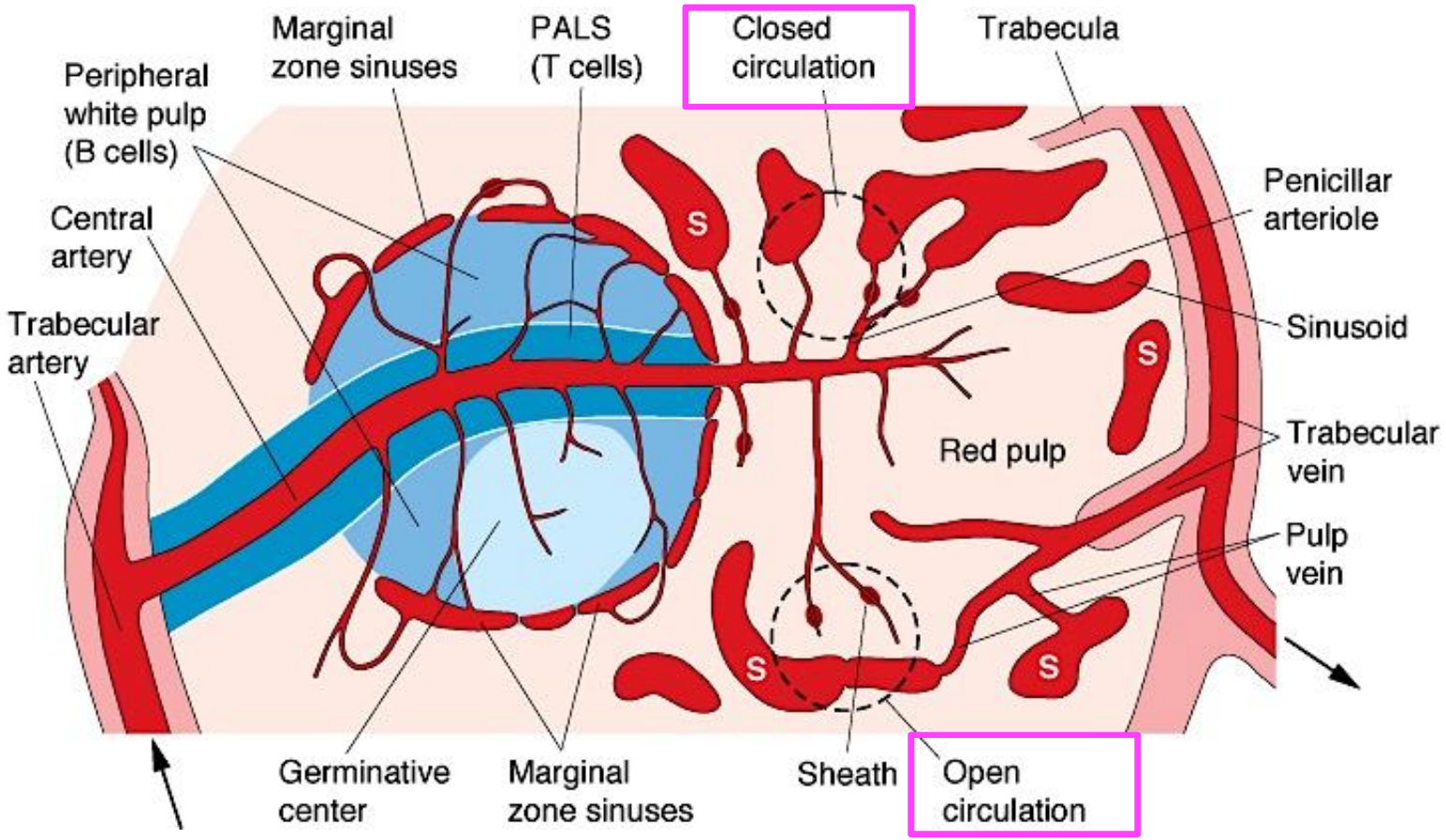
4 The central artery gives rise to radiating branches, the **radial arterioles**, ending in the **marginal sinus** surrounding the white pulp.

5 Blood from the marginal sinus and the central arteriole is transported into the **penicillar arterioles**, which end in a capillary network surrounded by macrophages. The capillary network is called **macrophage-sheathed capillaries**.

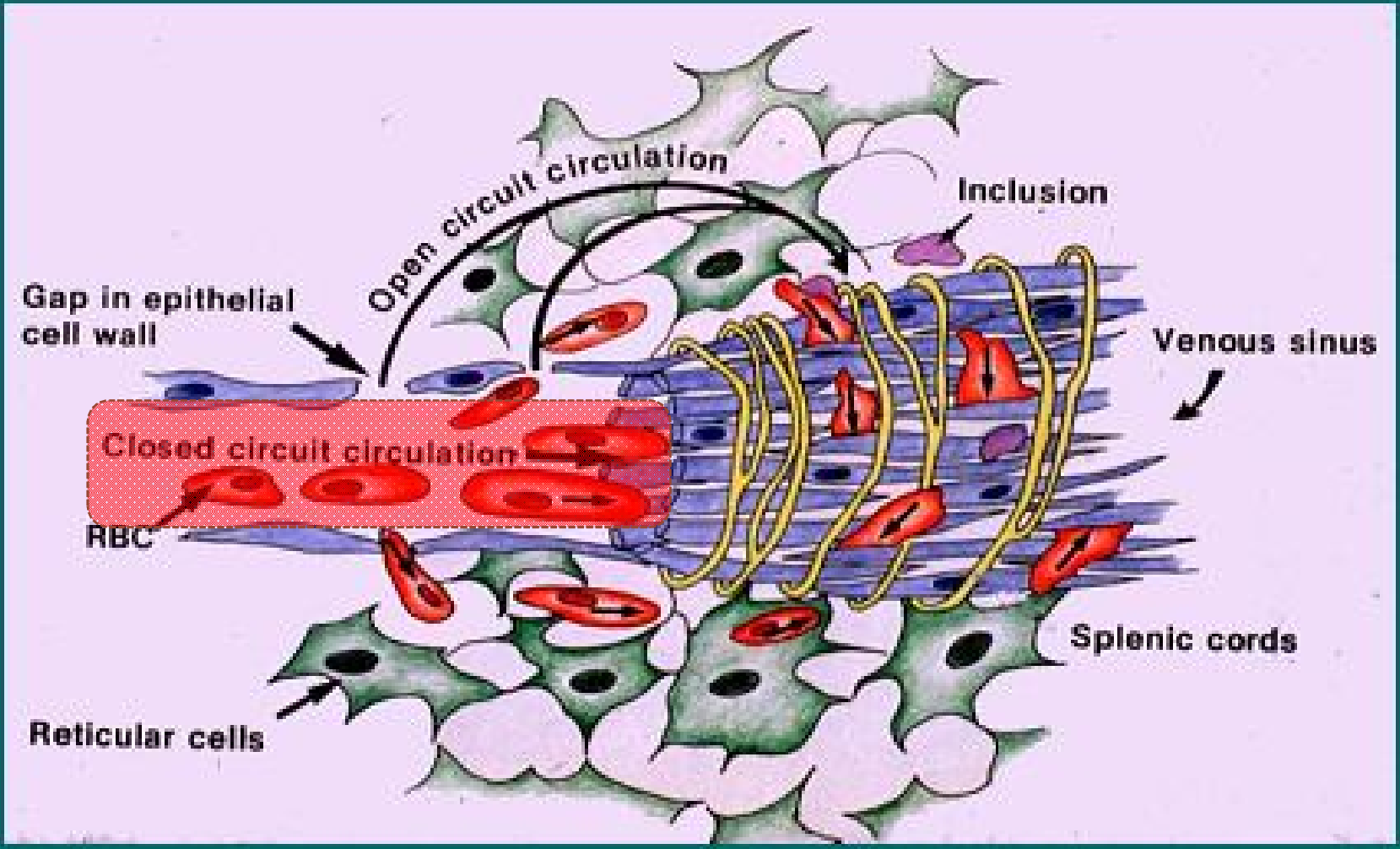
6 The macrophage-sheathed capillaries drain into the **splenic sinusoids** (**closed circulation**) or into the stroma of the red pulp (**open circulation**).

7 The **red pulp** is formed by (1) the **penicillar arteriole**; (2) the **macrophage-sheathed capillaries**; (3) the **splenic sinusoids**; (4) **reticular cells** forming the **stroma** of the **splenic cords** (also known as **cords of Billroth**); and (5) **all cell types of the circulating blood**.

Open circulation (human)
Closed circulation

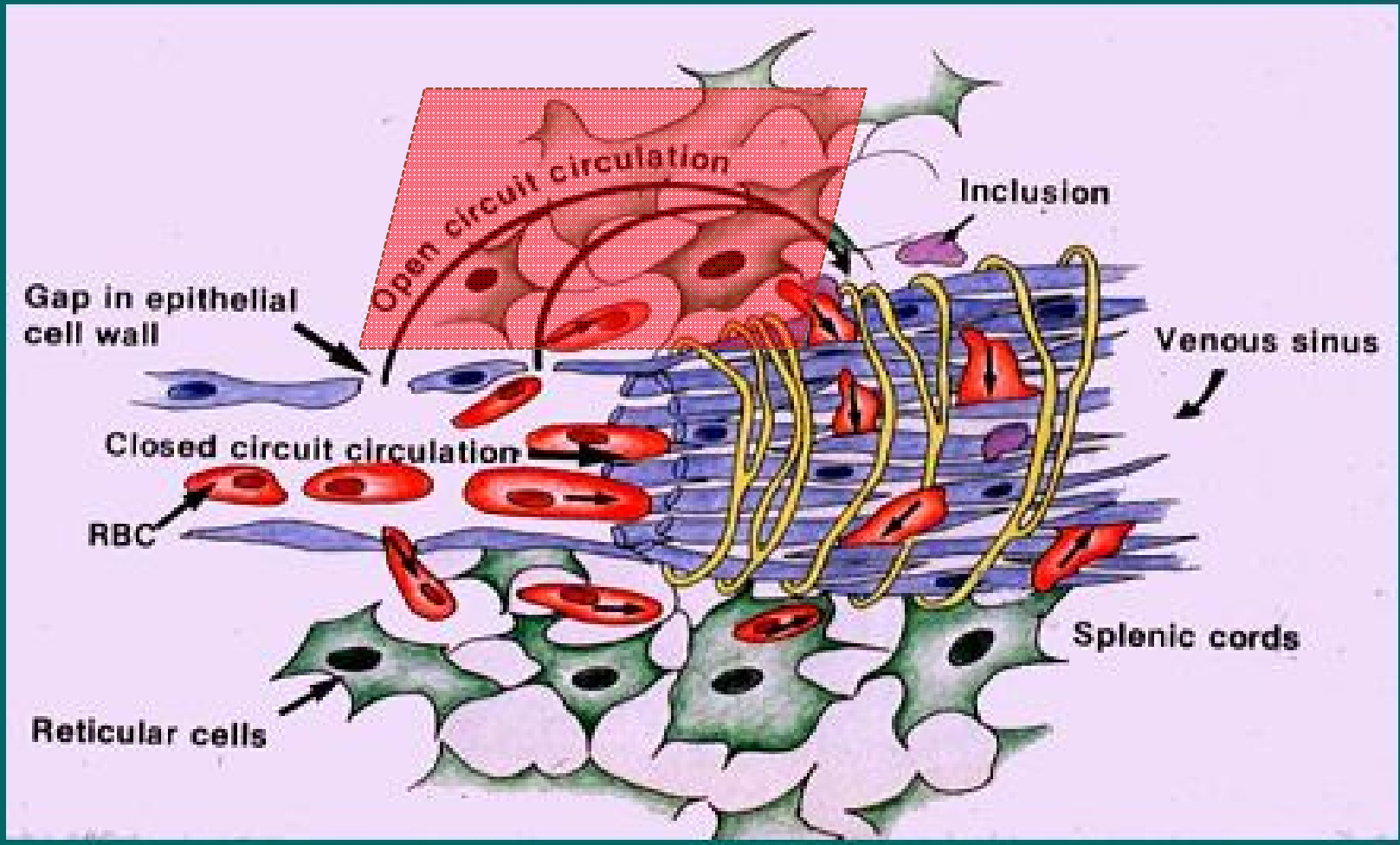


- **CLOSED: Arterioles terminate directly in sinuses**
  - Circulatory loop is closed
  - BUT: no hemopoiesis in the cords!

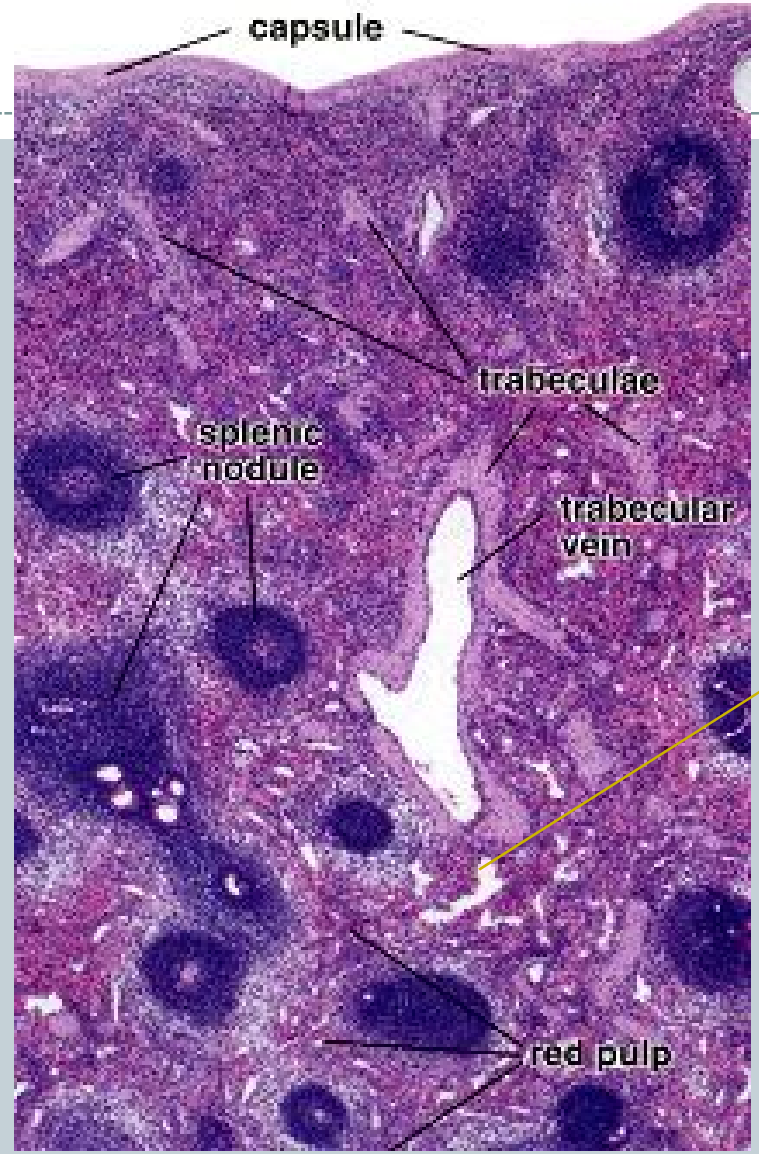


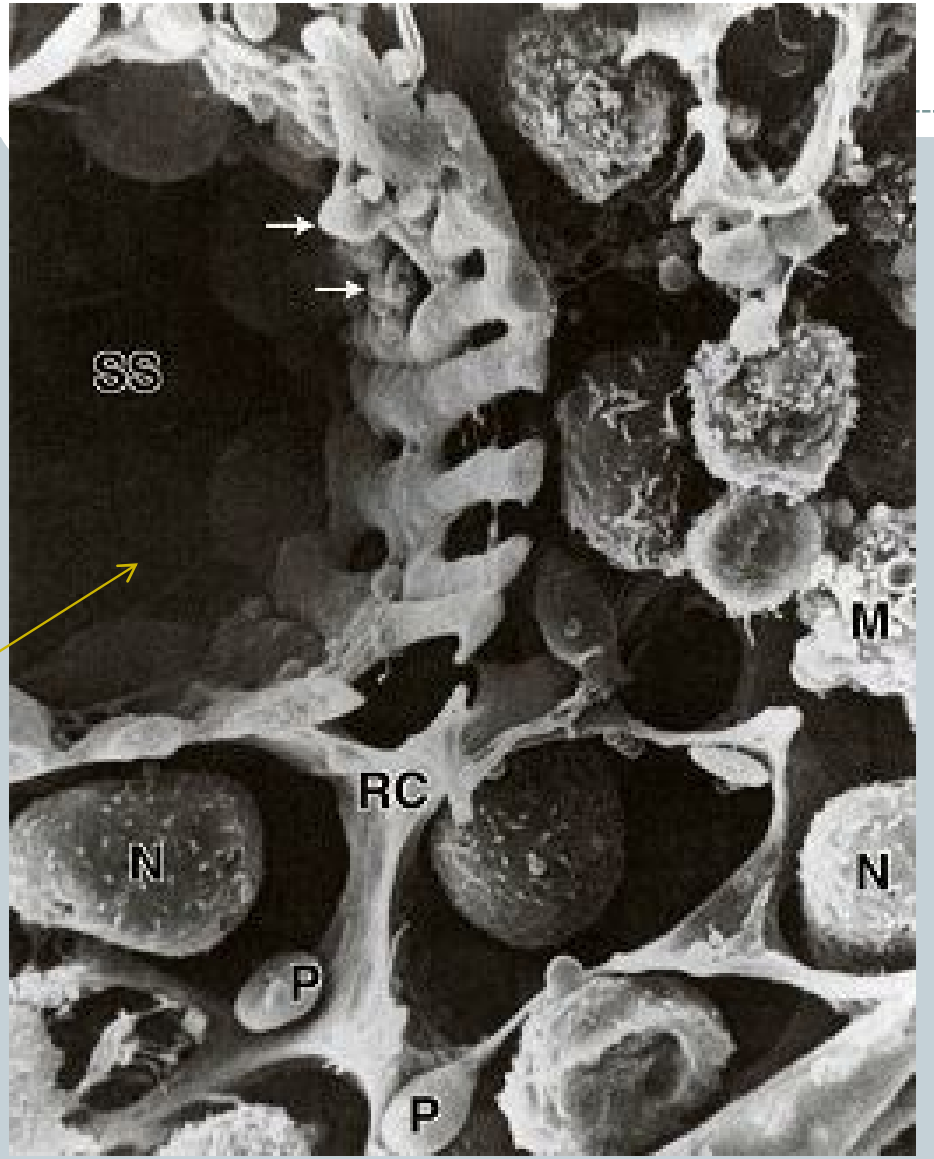
- **OPEN: Arterioles terminate in the cords, blood moves into sinuses, thence to venous drainage**

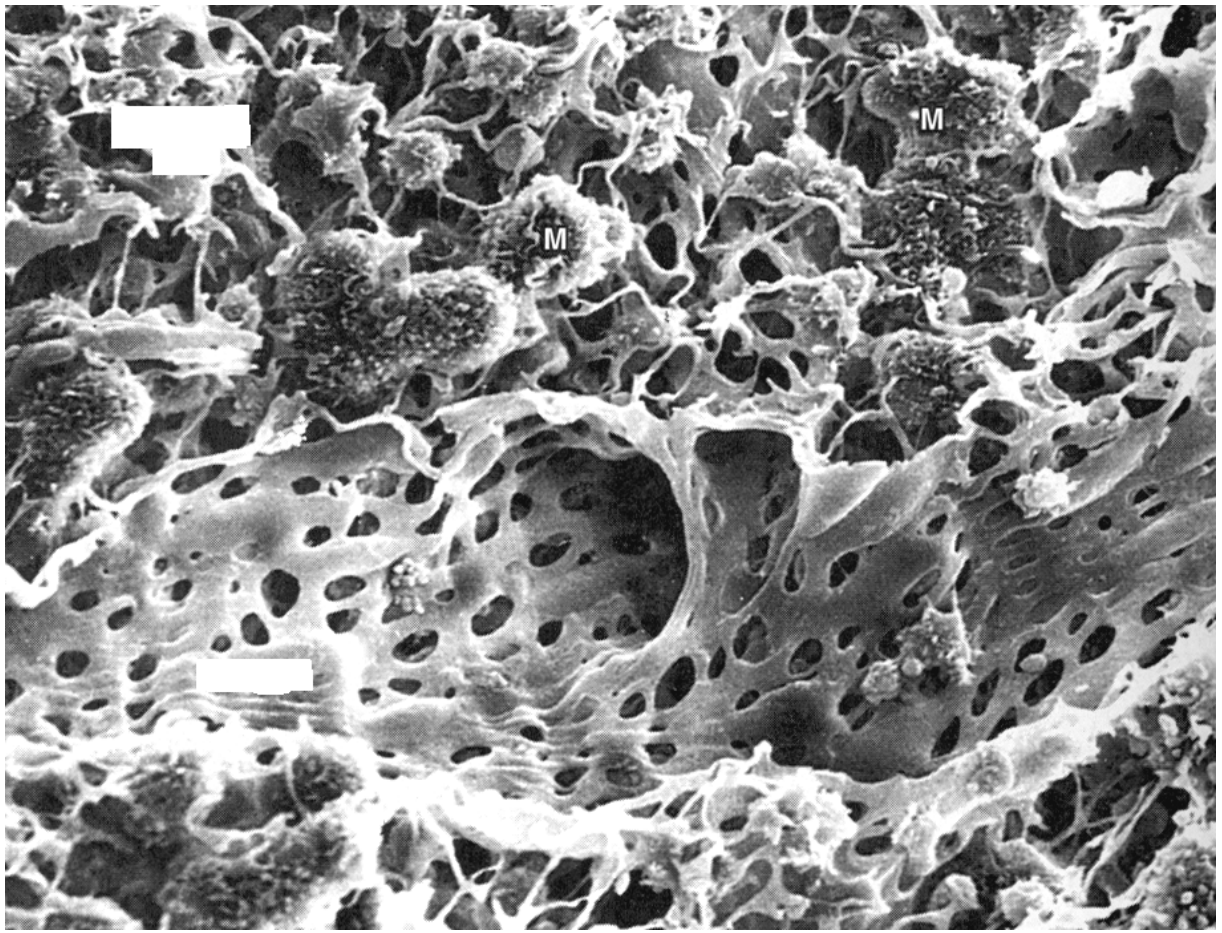
  BUT: this would mean a continuous state of hemorrhage!



Lymphatic Tissues & Organs- Spleen

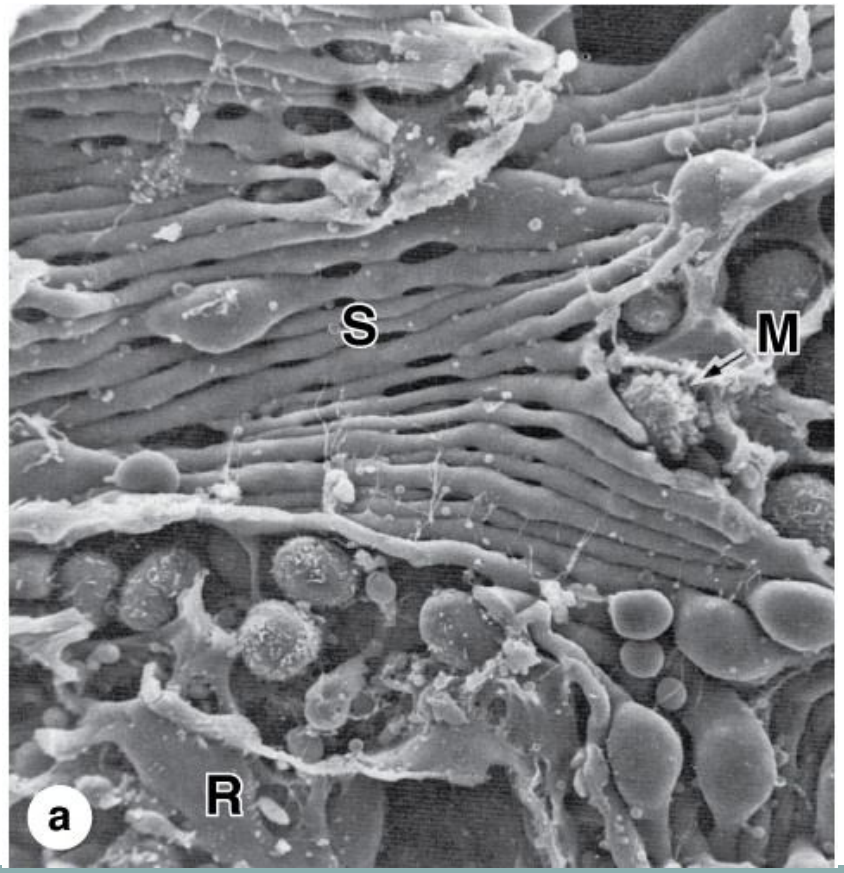


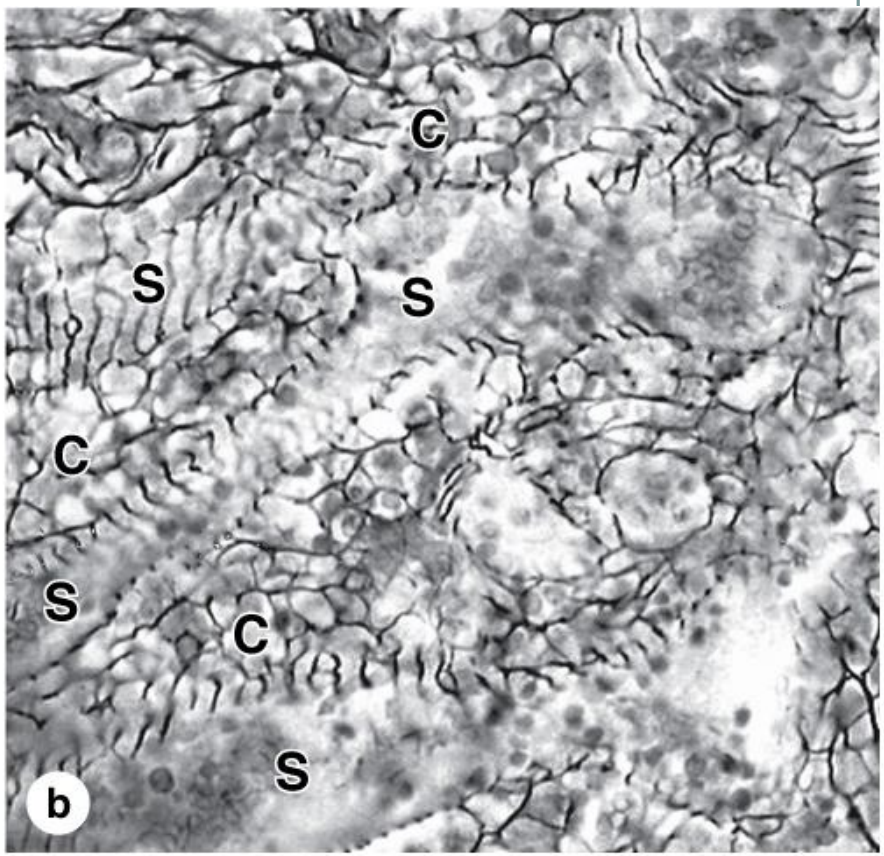




Spleen sinus - ME

- **Structure and function of splenic sinusoids.**
- The endothelial stave cells that line venous sinuses in red pulp are long cells oriented lengthwise along the sinuses. The elongated shape of the cells is difficult to appreciate from light micrographs (see Figure 14–26). **(a):** SEM clearly shows the parallel alignment of the stave cells (S), as well as many macrophages (M) in the surrounding red pulp (R). X500. **b):** Silver-stained sections of spleen show black reticular fibers surrounding the sinuses, oriented 90 degrees to the long axis of the sinuses (S). These fibers appear similar to those in the surrounding splenic cords (C). The basement membrane of the stave cells is incomplete and open to the passage of cells. X400. Silver.





tonsils

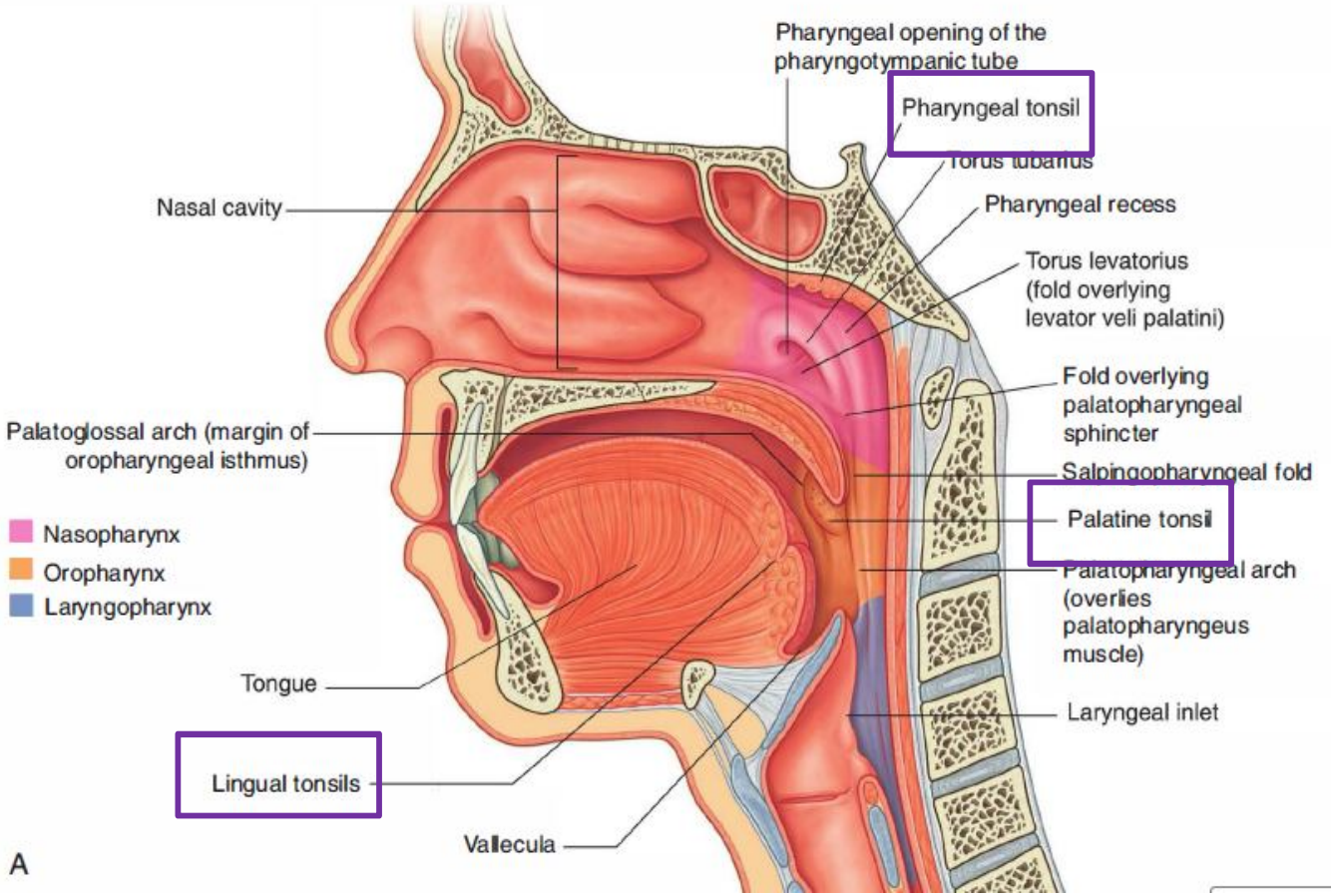
ANATOMY
EMBRYOLOGY
HISTOLOGY

Tonsils

Anatomy

Collections o f lymphoid tissue in the mucosa o f the pharynx surrounding the openings of the nasal and oral cavities are part of the body's defense system.

The largest of these collections form distinct masses (tonsils) .



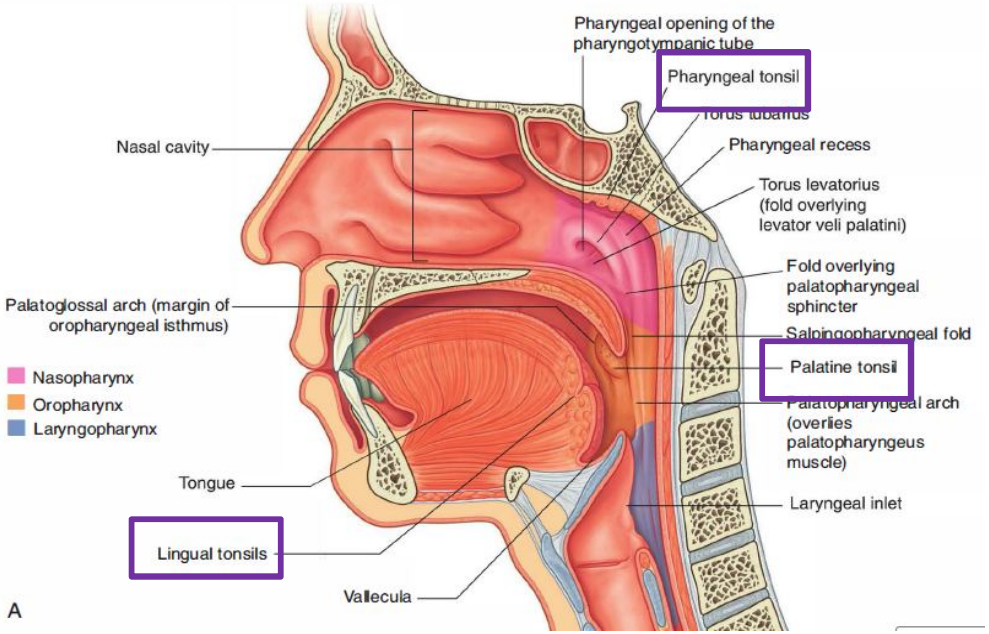
Tonsils occur mainly in three areas:

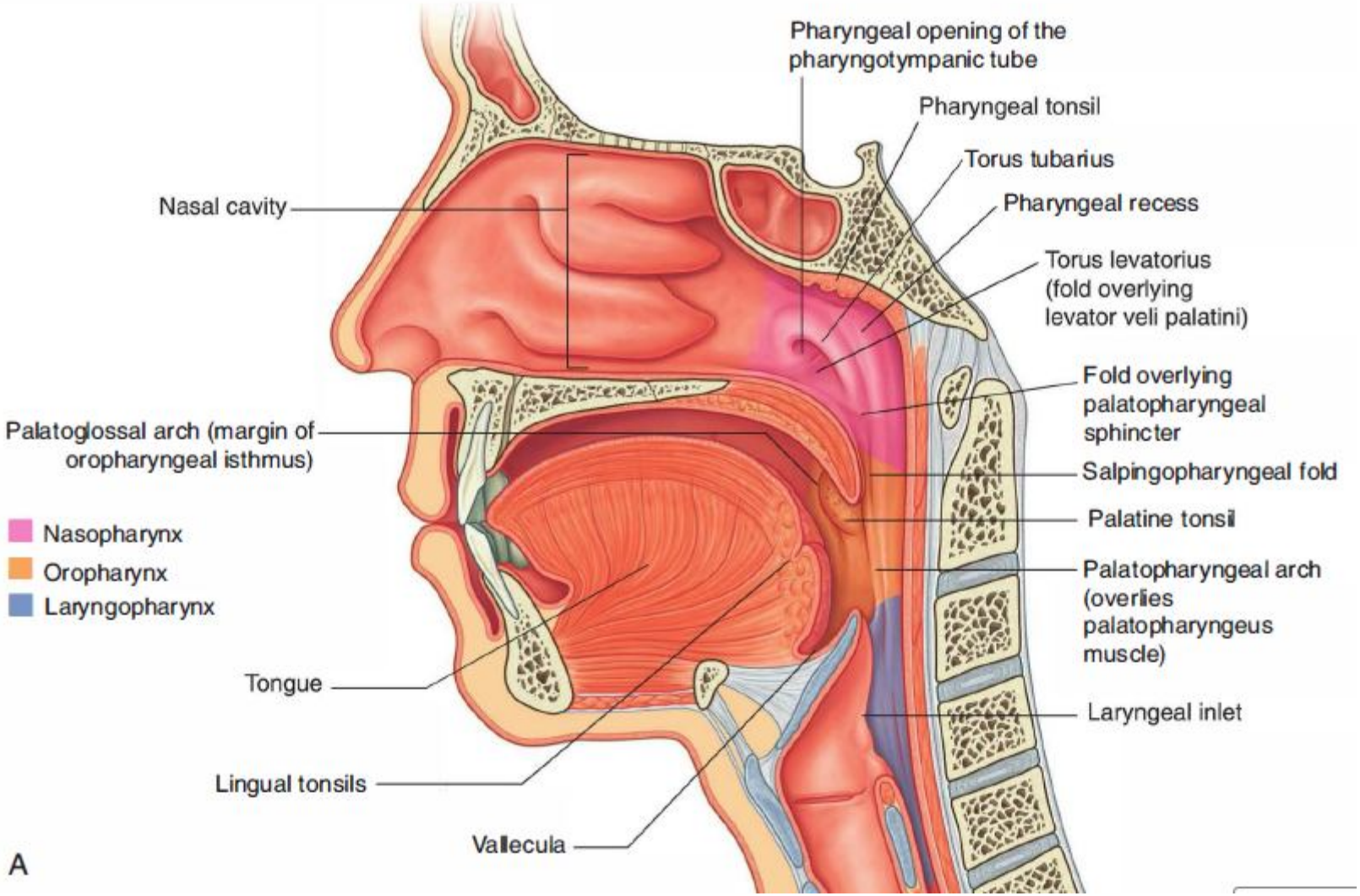
• ***The pharyngeal tonsil,*** known a s adenoids when enlarged, is in the midline on the roof of the nasopharynx.

• ***The palatine tonsils*** are on each side of the oropharynx between the palatoglossal and palatopharyngeal arches just posterior to the oropharyngeal isthmus. (The palatine tonsils are visible through the open mouth of a patient when the tongue is depressed.)

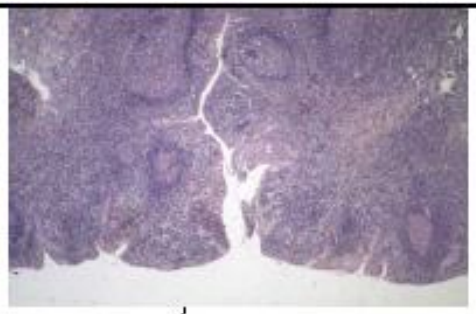
• ***The lingual tonsils*** refer collectively to numerous lymphoid nodules on the posterior one-third of the tongue.

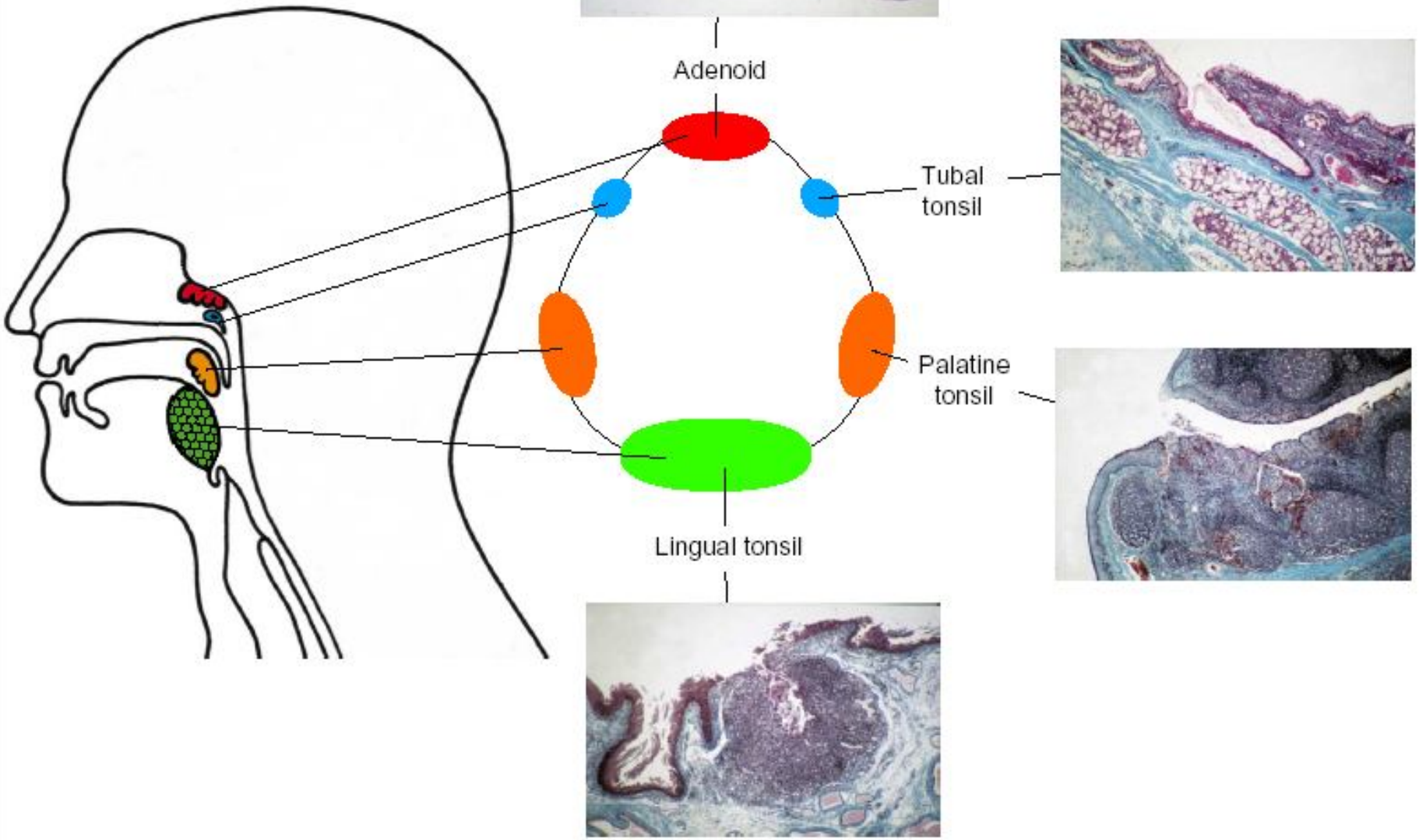
Small lymphoid nodules also occur in the pharyngotympanic tube near its opening into the nasopharynx, and on the upper surface of the soft palate




Pharyngeal opening of the pharyngotympanic tube
Pharyngeal tonsil
Torus tubarius
Pharyngeal recess
Torus levatorius (fold overlying levator veli palatini)
Nasal cavity
Fold overlying palatopharyngeal sphincter
Palatoglossal arch (margin of oropharyngeal isthmus)
Salpingopharyngeal fold
Palatine tonsil
Nasopharynx
Oropharynx
Laryngopharynx
Palatopharyngeal arch (overlies palatopharyngeus muscle)
Tongue
Laryngeal inlet
Lingual tonsils
Vallecula
A

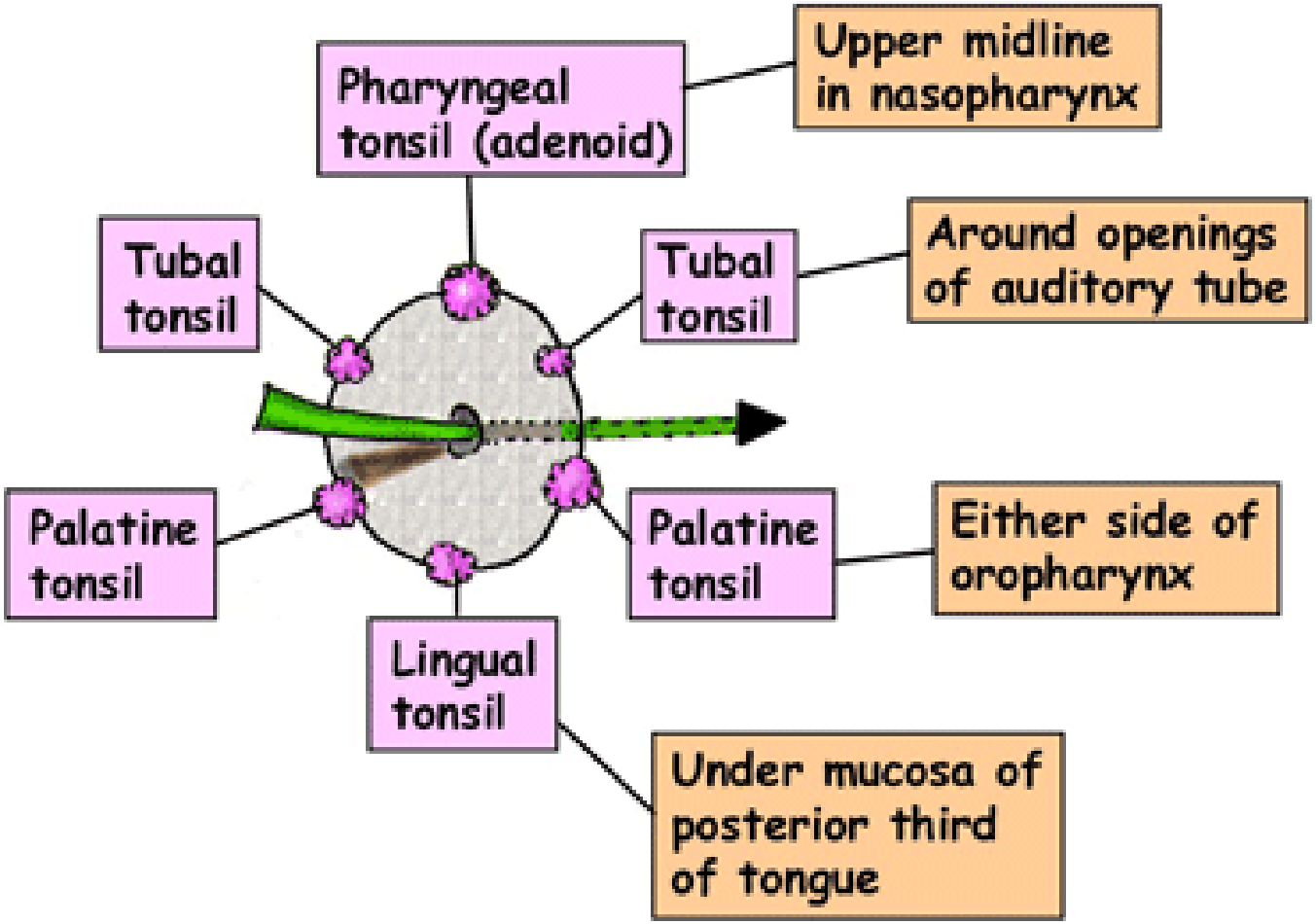
Waldeyers ring





WALDEYER'S RING

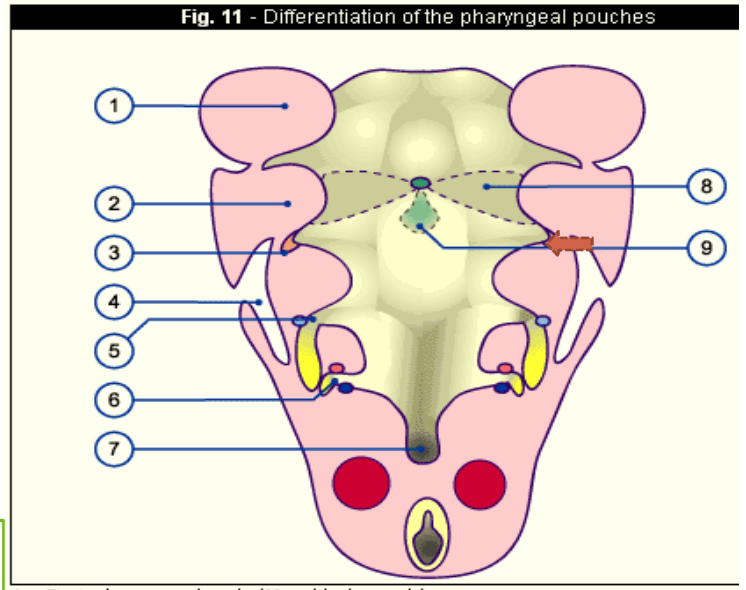
An interrupted circle of protective lymphoid tissue at the upper ends of the respiratory and alimentary tracts



Embryology

palatine tonsil

- The epithelial lining of the second pharyngeal pouch proliferates and forms buds that penetrate into the surrounding mesenchyme
- The buds are secondarily invaded by mesodermal tissue, forming the primordium of the **palatine tonsils**
- **During** the third and fifth months, the tonsil is infiltrated by lymphatic tissue
- Part of the pouch remains and is found in the adult as the **tonsillar fossa.**



1 First pharyngeal arch (Mandibular arch)
2 Second pharyngeal arch
3 Anlage of the palatine tonsil
4 Entrance to the cervical sinus
5 3rd pharyngeal pouch (thymus anlage)
6 4th pharyngeal pouch (thymus anlage)
7 Throat (pharynx)
8 Lingual tonsil anlage region
9 Thyroid

Histology

MALT = mucous associated lymphocyte tissue

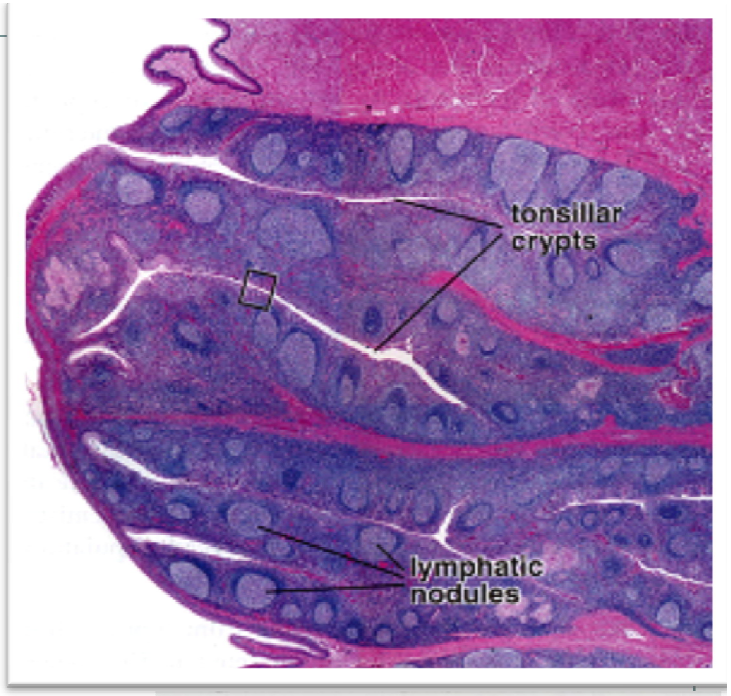
Lymphocyte (B- cell) / T- helper CD4+
Plasma cell
APC

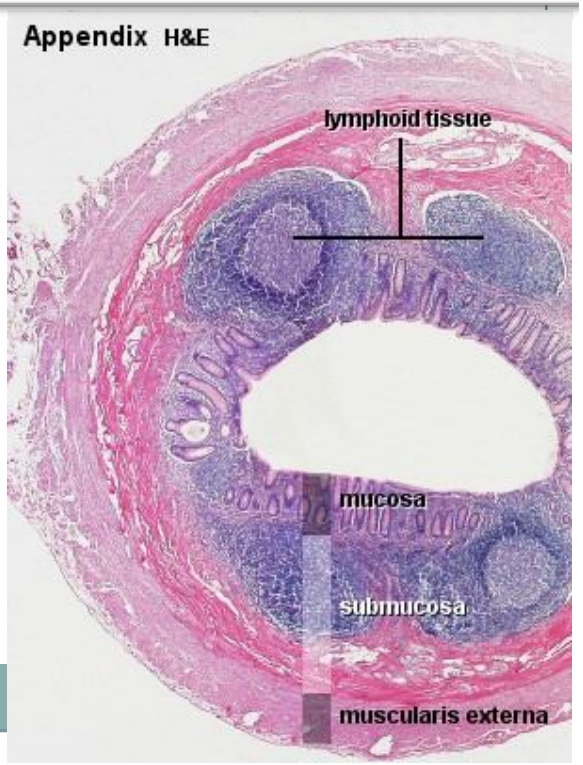
Type MALT:

Diffuse lymphoid tissue
Lymphoid nodule

Lymphoid nodule in:

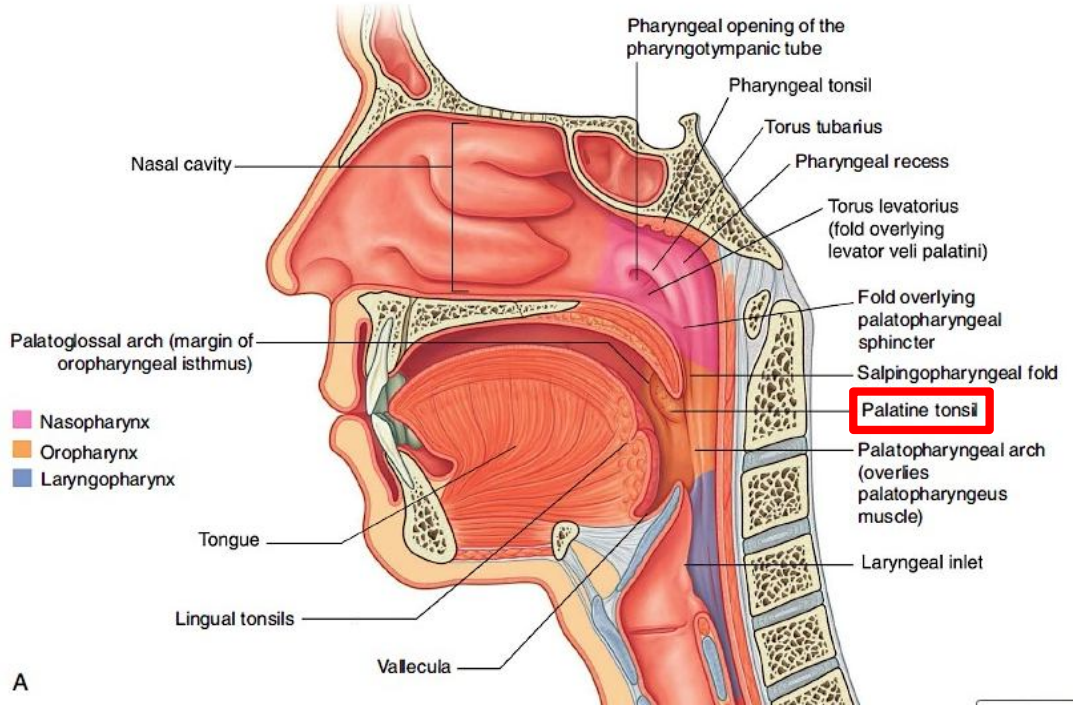
Tonsils
Peyer patches
appendix

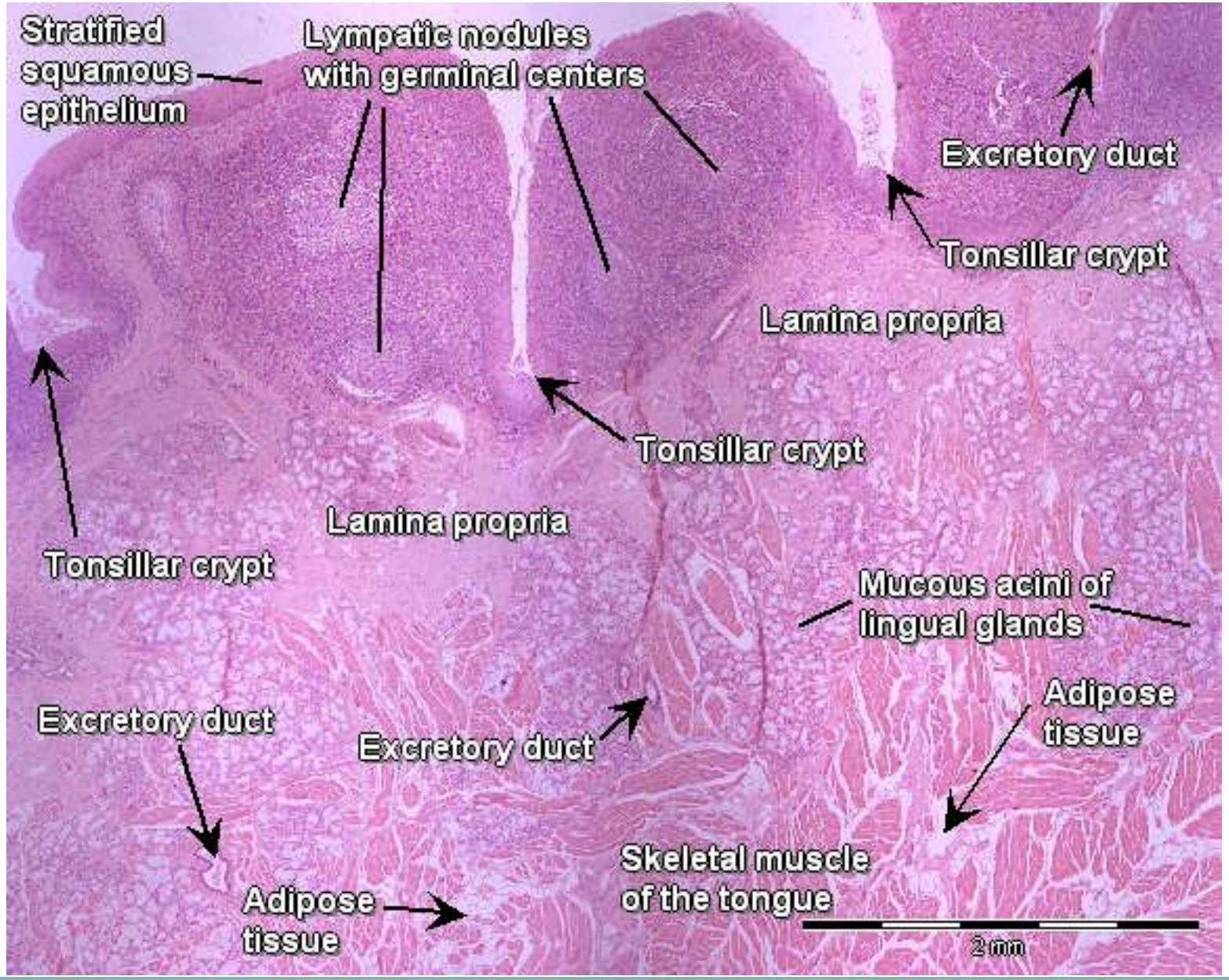




Palatine tonsils:

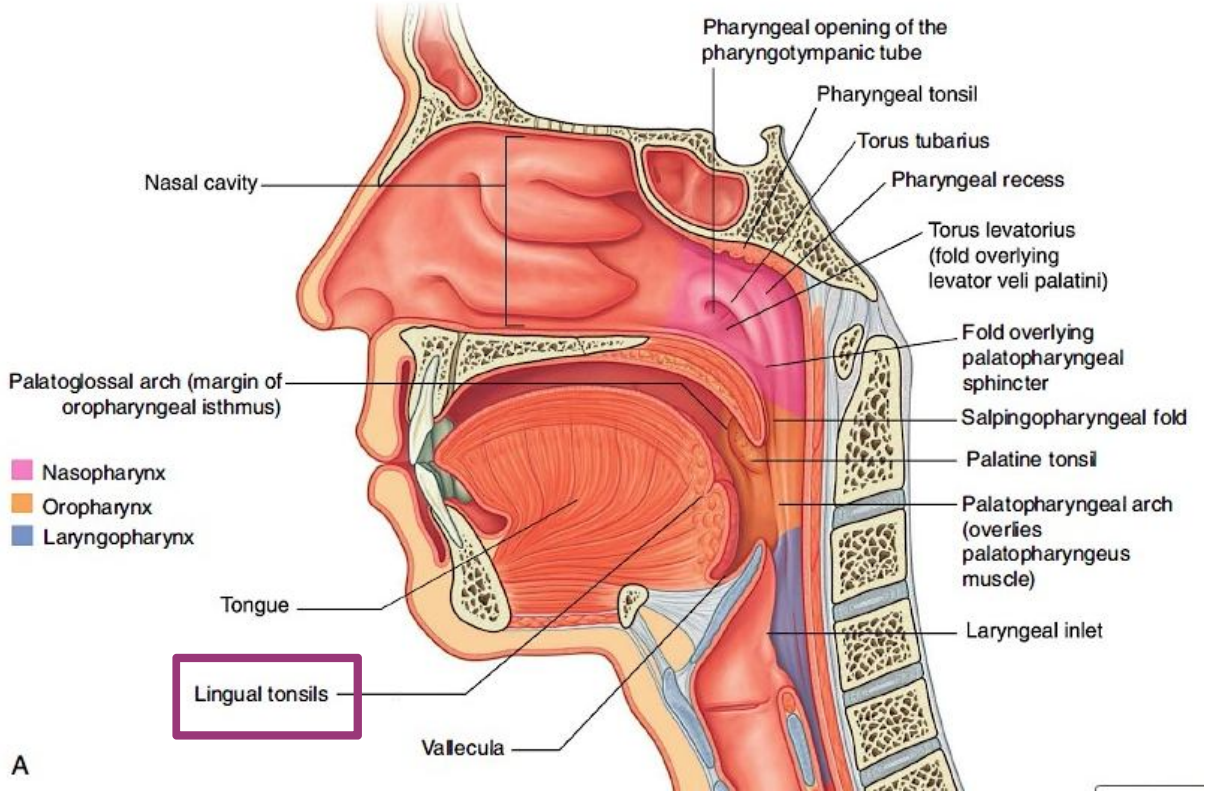
Squamous epithelium
Tonsillar crypts (10-20)
Incomplete capsule
Lymphatic nodule

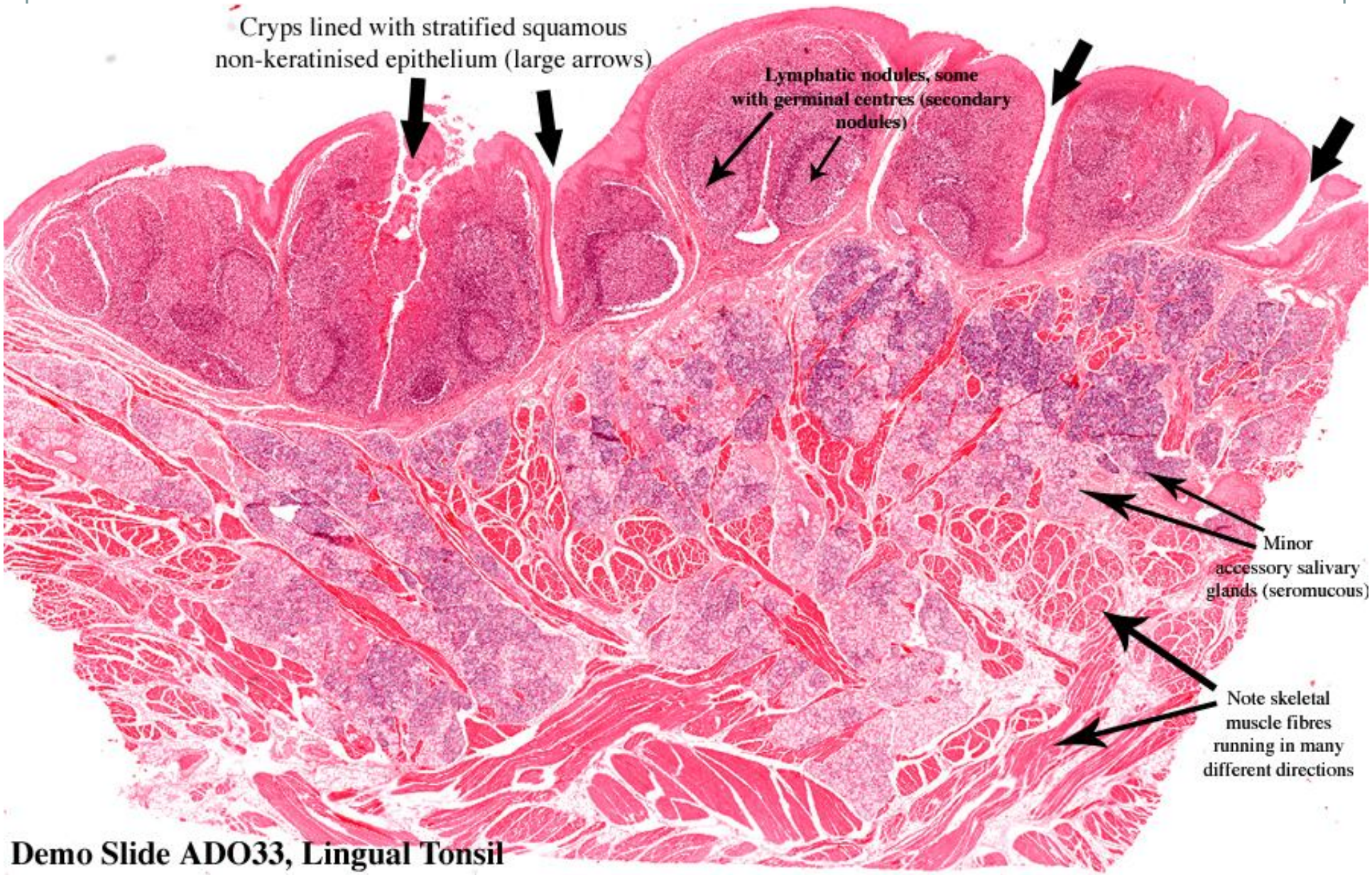



Stratified squamous epithelium
Lympatic nodules with germinal centers
Excretory duct
Tonsillar crypt
Lamina propria
Tonsillar crypt
Tonsillar crypt
Lamina propria
Mucous acini of lingual glands
Adipose tissue
Excretory duct
Excretory duct
Skeletal muscle of the tongue
Adipose tissue
2 mm

Lingual tonsils:

Stratified squamous epithelium
Tonsillar crypts
NO capsule

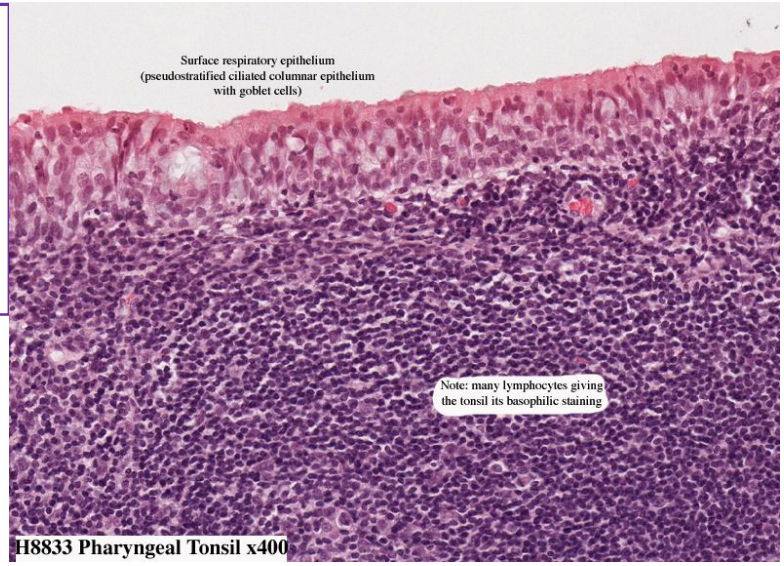




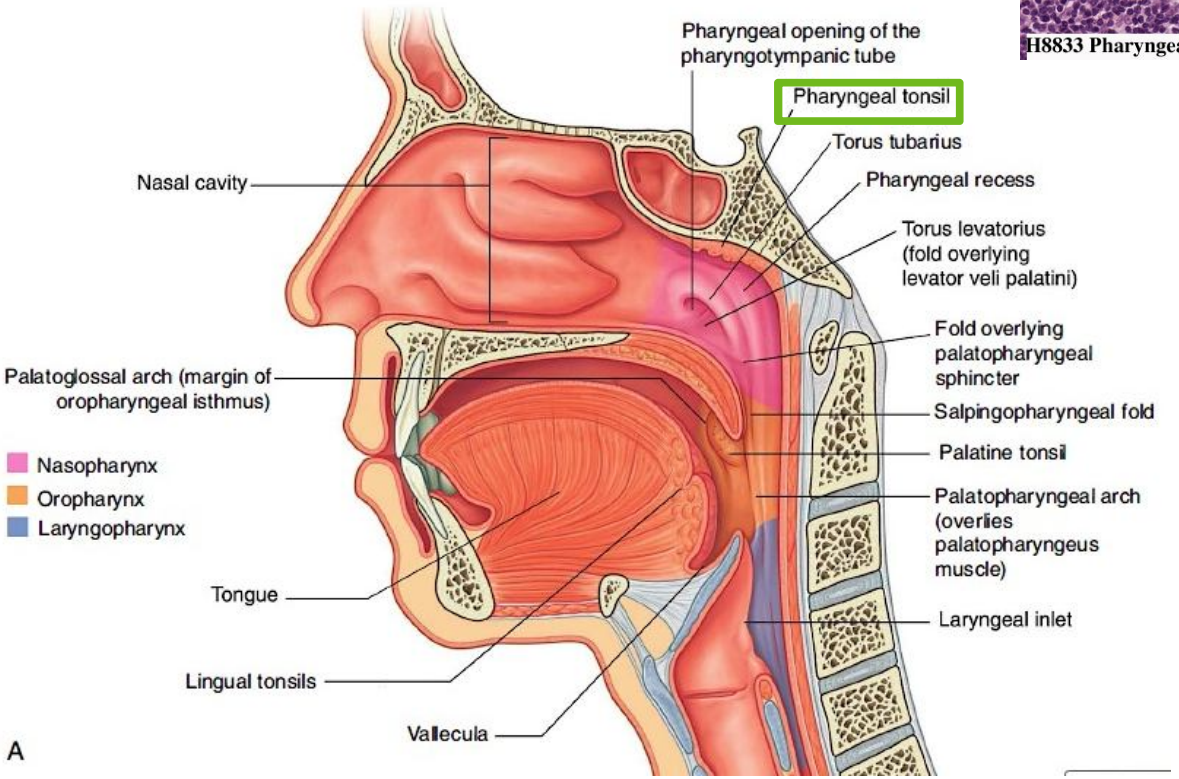
Demo Slide ADO33, Lingual Tonsil

Pharyngeal tonsil:

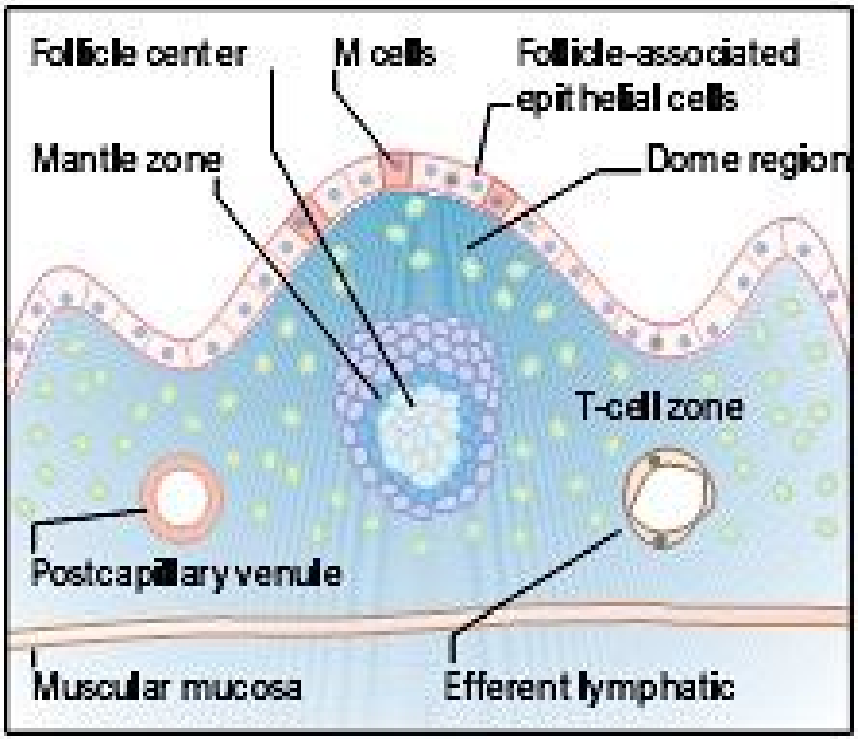
Cilliary pseudo stratified columnar epithelium
Lymphatic nodule
NO crypt



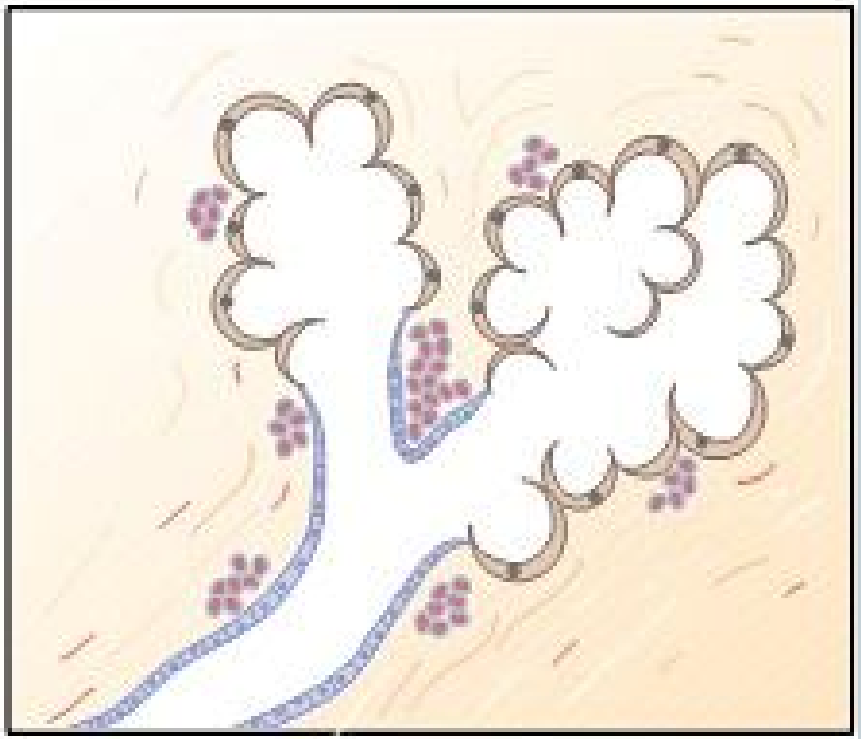
H8833 Pharyngeal Tonsil x400



GALT / BALT



1. GALT: Gut-associated lymphoid tissue; Peyer's patch



2. BALT: Bronchus-associated lymphoid tissue

C. Mucosa-associated lymphoid tissue

Cells of the Immune System

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