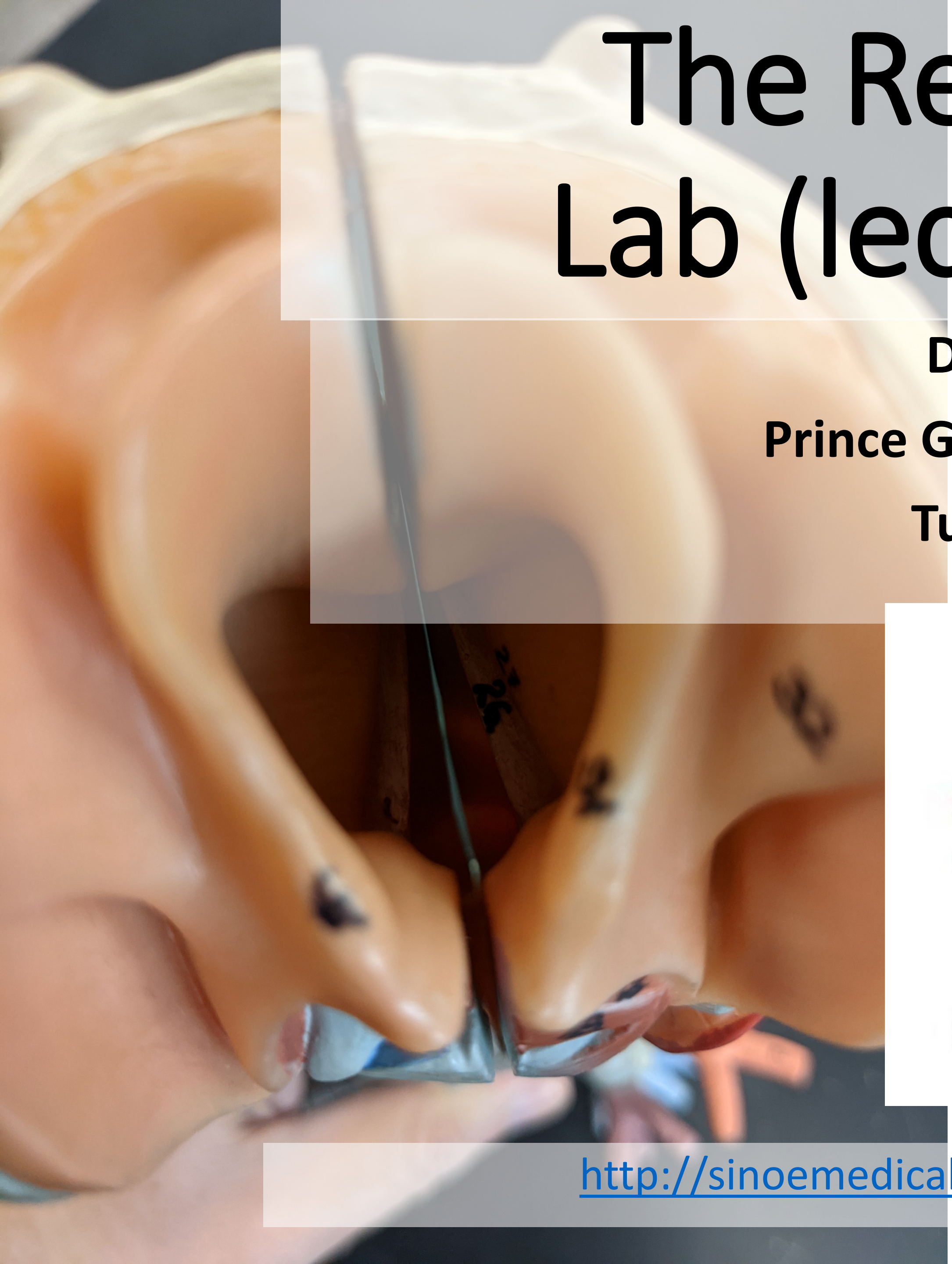
The Respiratory, GI Lab (lecture) Review



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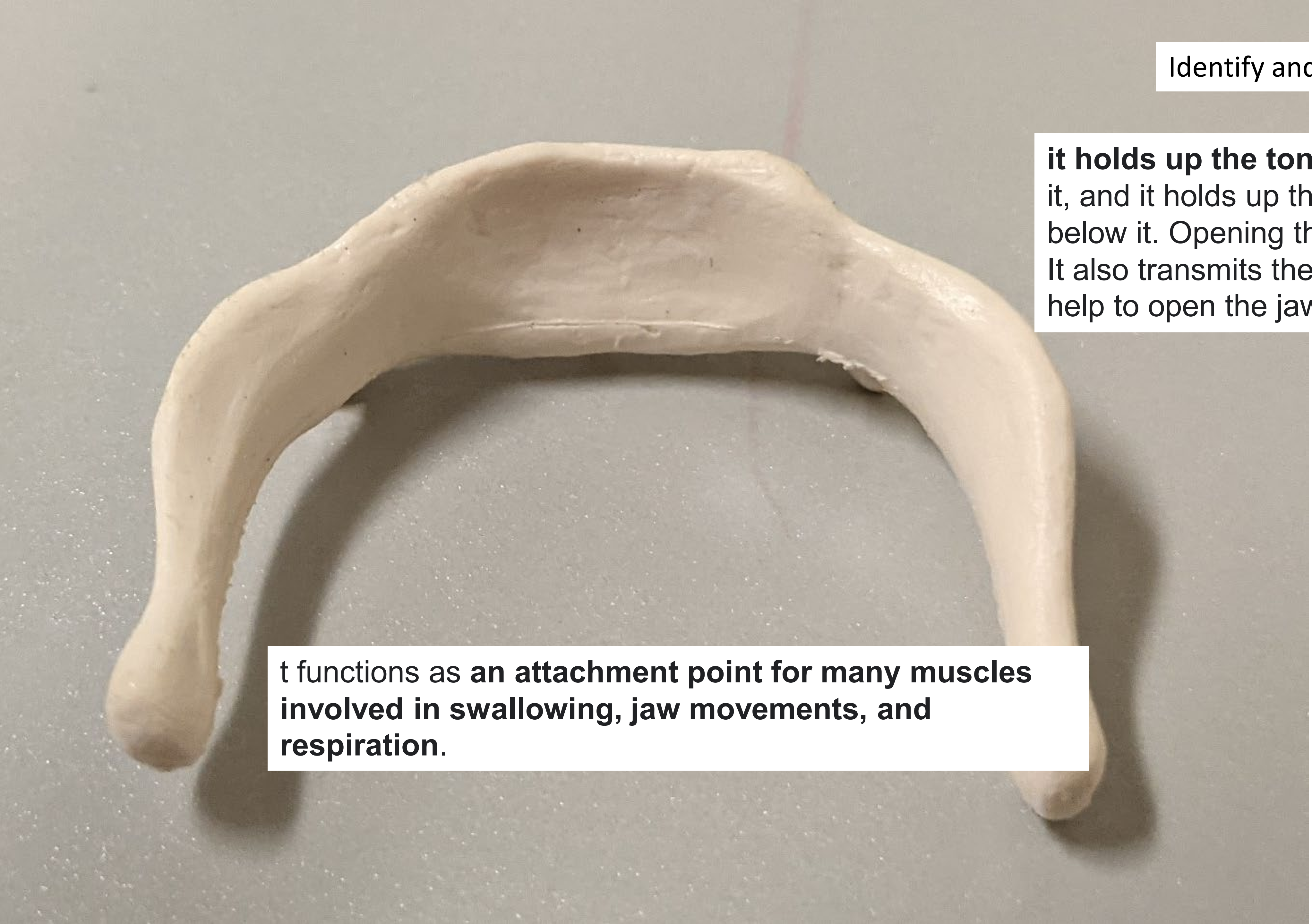
http://sinoemedicalassociation.org/anatomyphysiology

Respiratory Models part 1

Identify and function?

Identify and function?

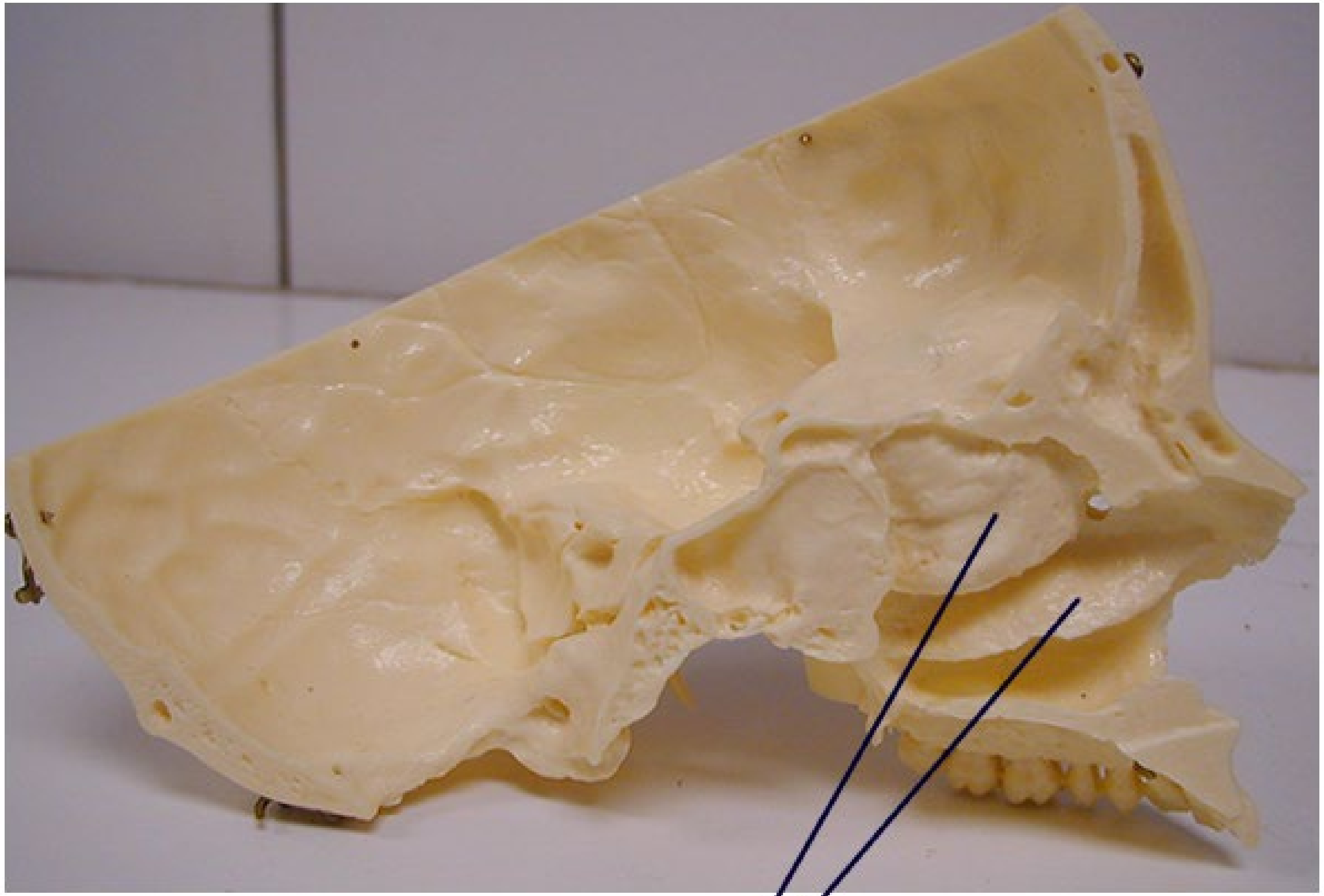


it holds up the tongue, which sits above it, and it holds up the larynx, which hangs below it. Opening the airway
It also transmits the force of muscles that help to open the jaw.

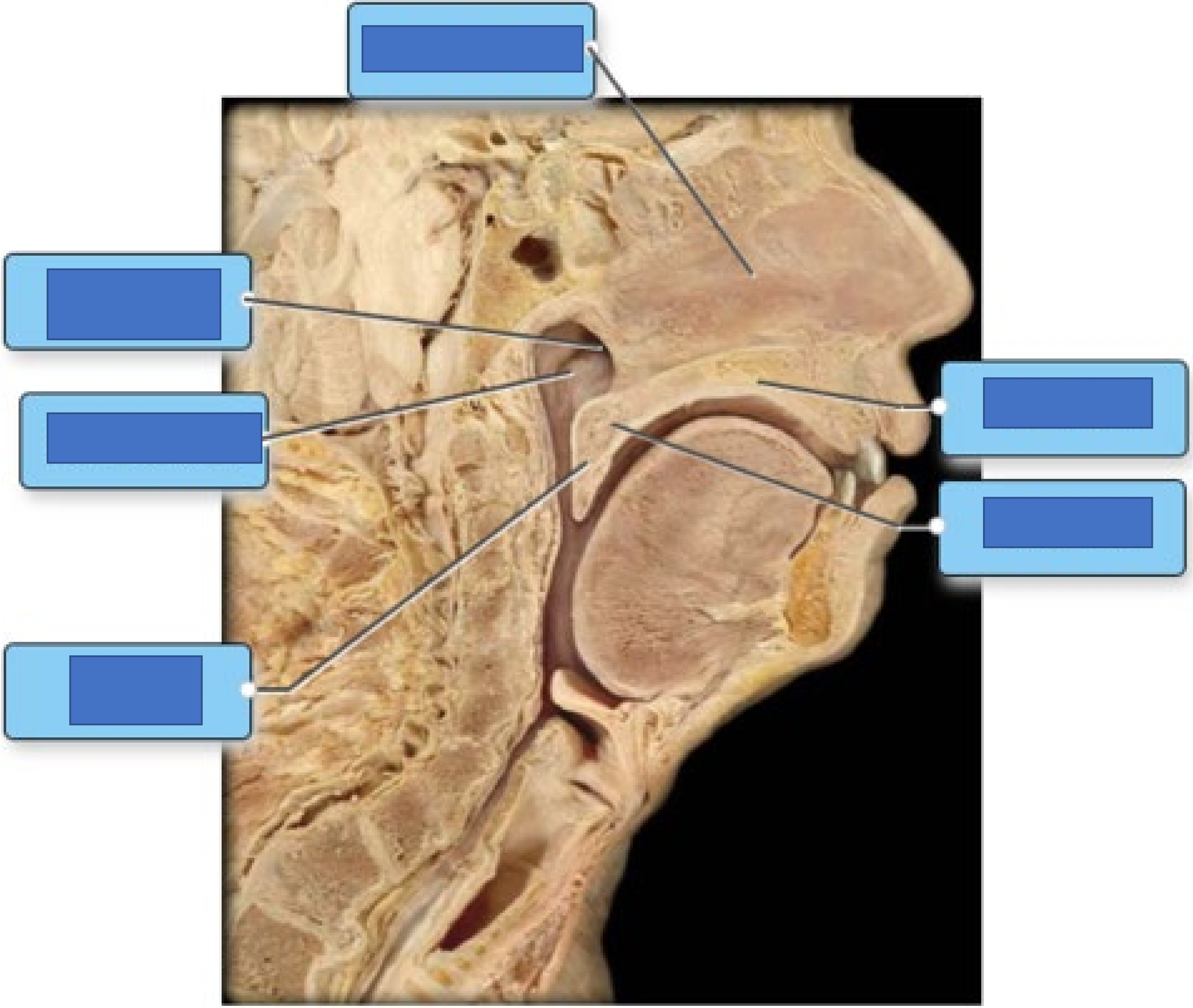
t functions as **an attachment point for many muscles involved in swallowing, jaw movements, and respiration**.

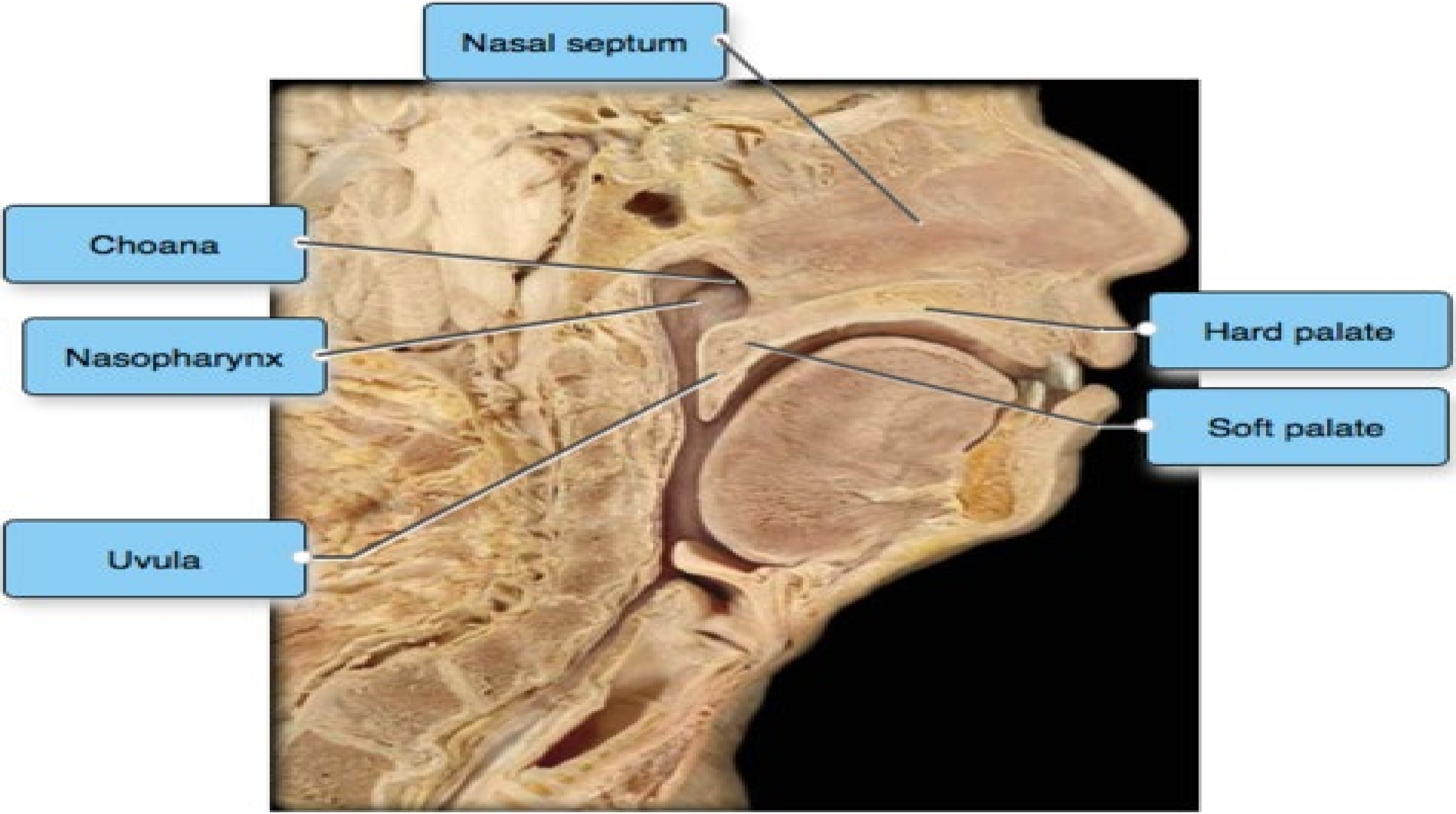
Respiratory Upper Conducting Passageway

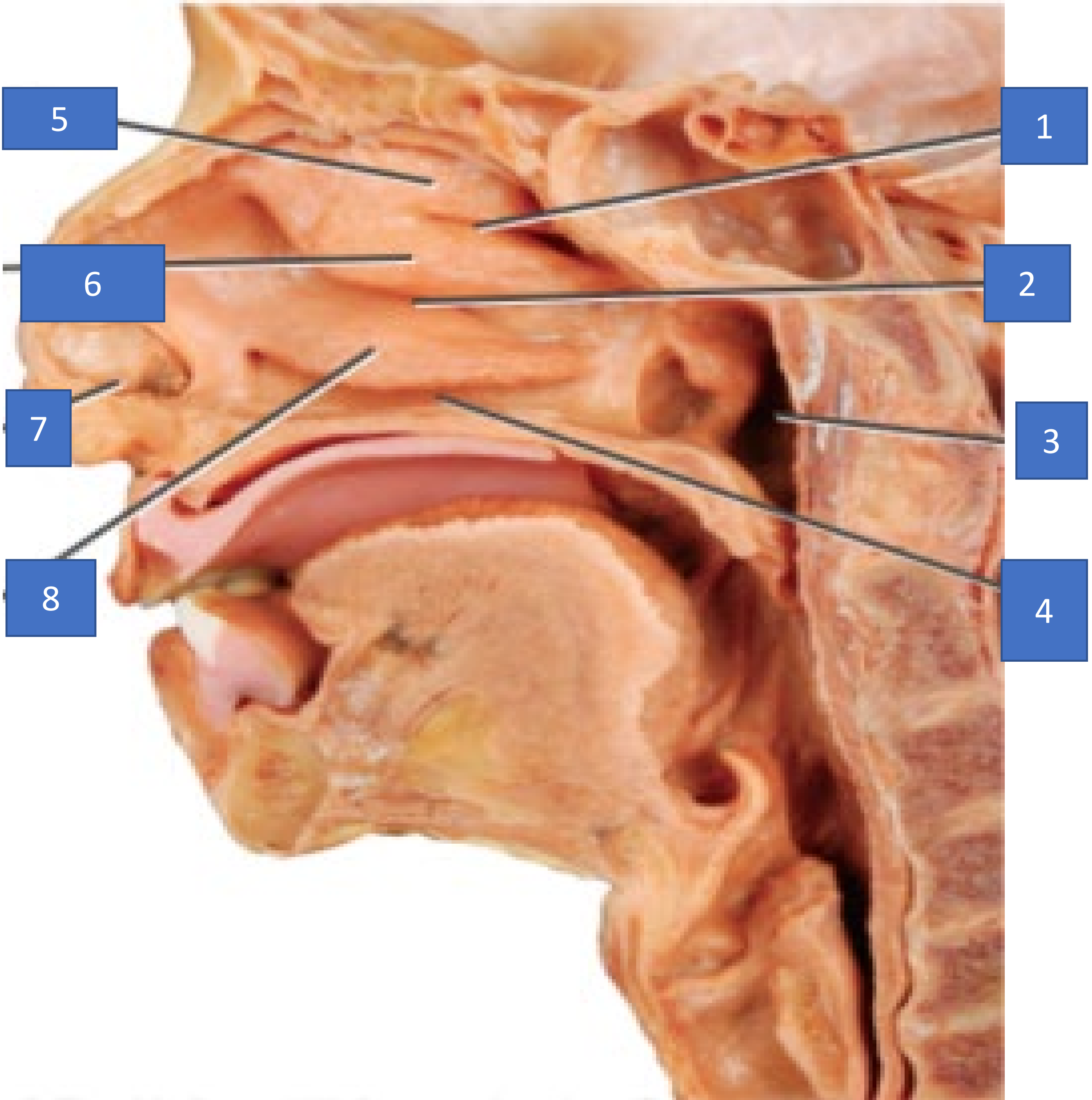
Respiratory Upper Conducting Passageway



Nasal Conchae

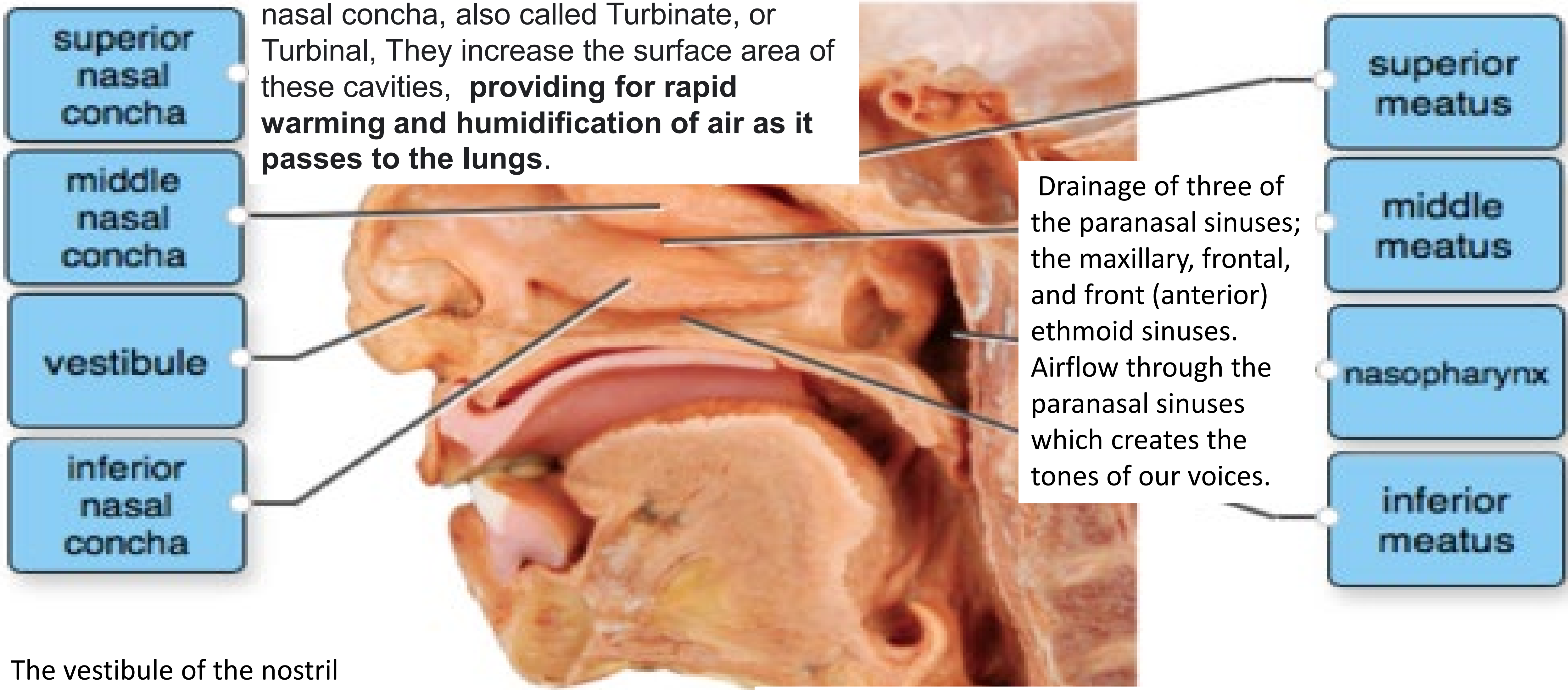



Nasal septum
Choana
Nasopharynx
Uvula
Hard palate
Soft palate



Identify these structures?

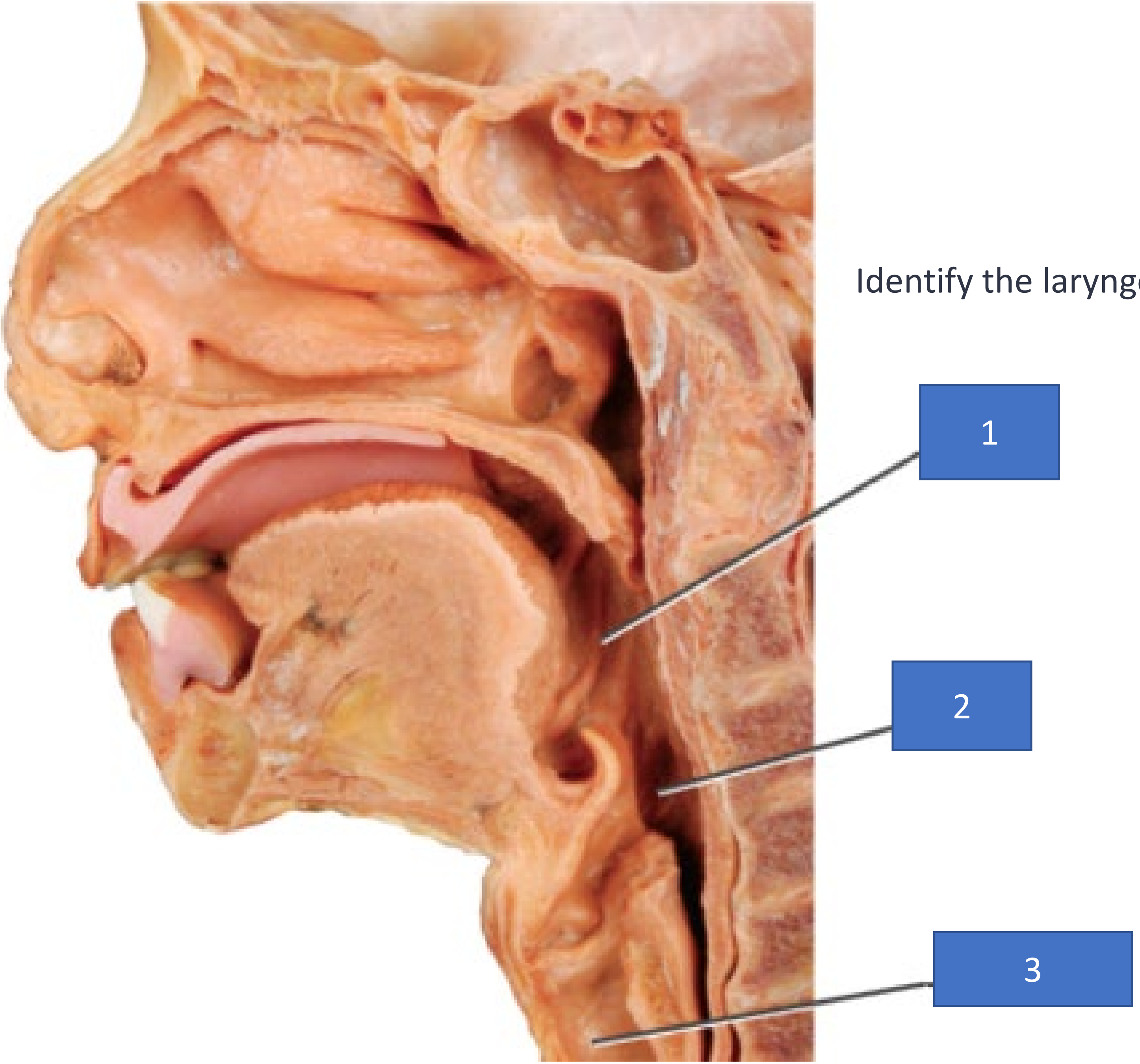
nasal concha, also called Turbinate, or Turbinal, They increase the surface area of these cavities, **providing for rapid warming and humidification of air as it passes to the lungs**.



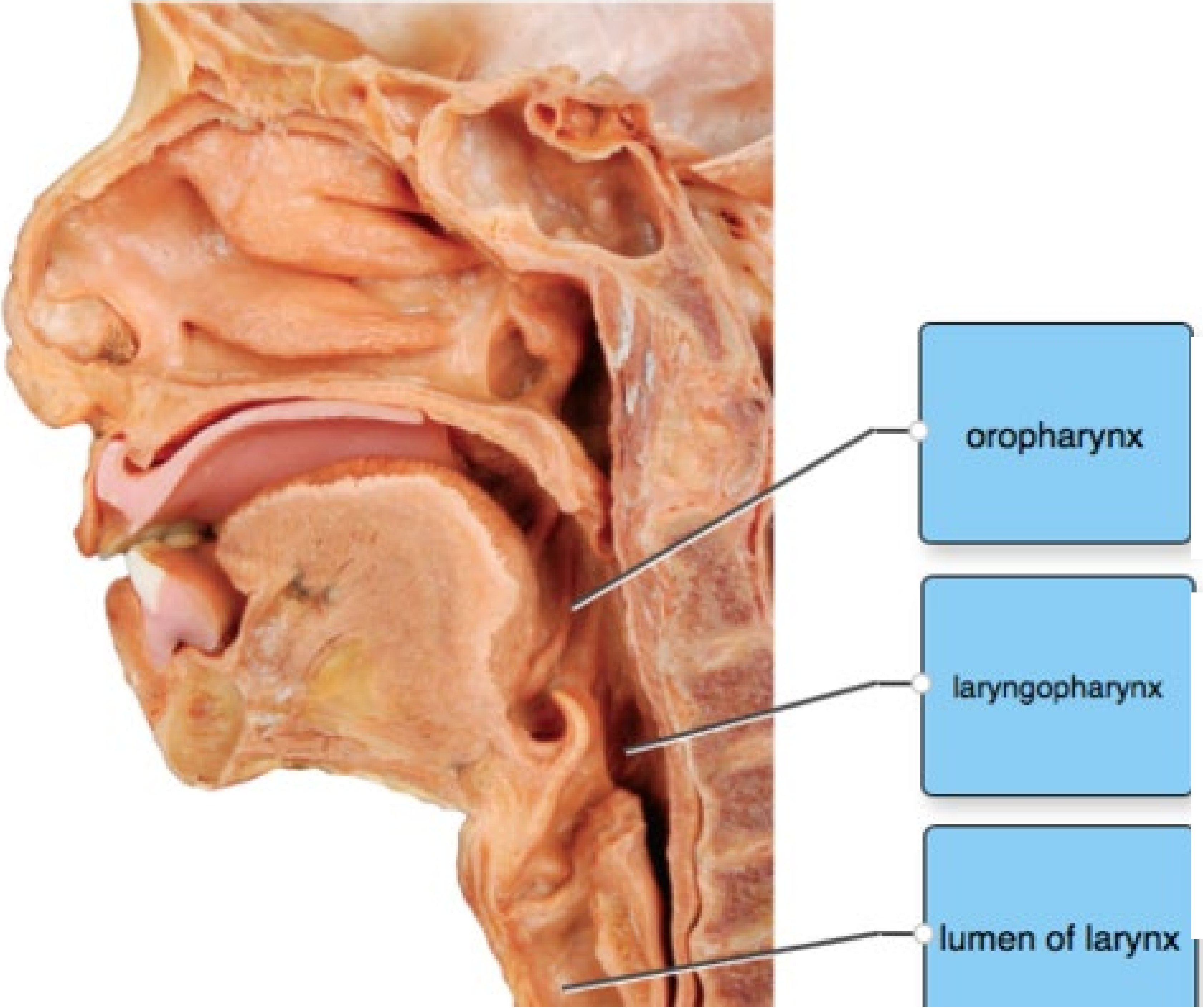
Drainage of three of the paranasal sinuses; the maxillary, frontal, and front (anterior) ethmoid sinuses. Airflow through the paranasal sinuses which creates the tones of our voices.

The vestibule of the nostril contains small, course hairs. These hairs help filter dust, sand, and other particles to keep them from entering the lungs.

The nasopharynx functions as an airway in the respiratory system. Also contained within the nasopharynx are the adenoids, or pharyngeal tonsils. The oropharynx is the middle portion of the pharynx, working with both the respiratory and digestive systems.

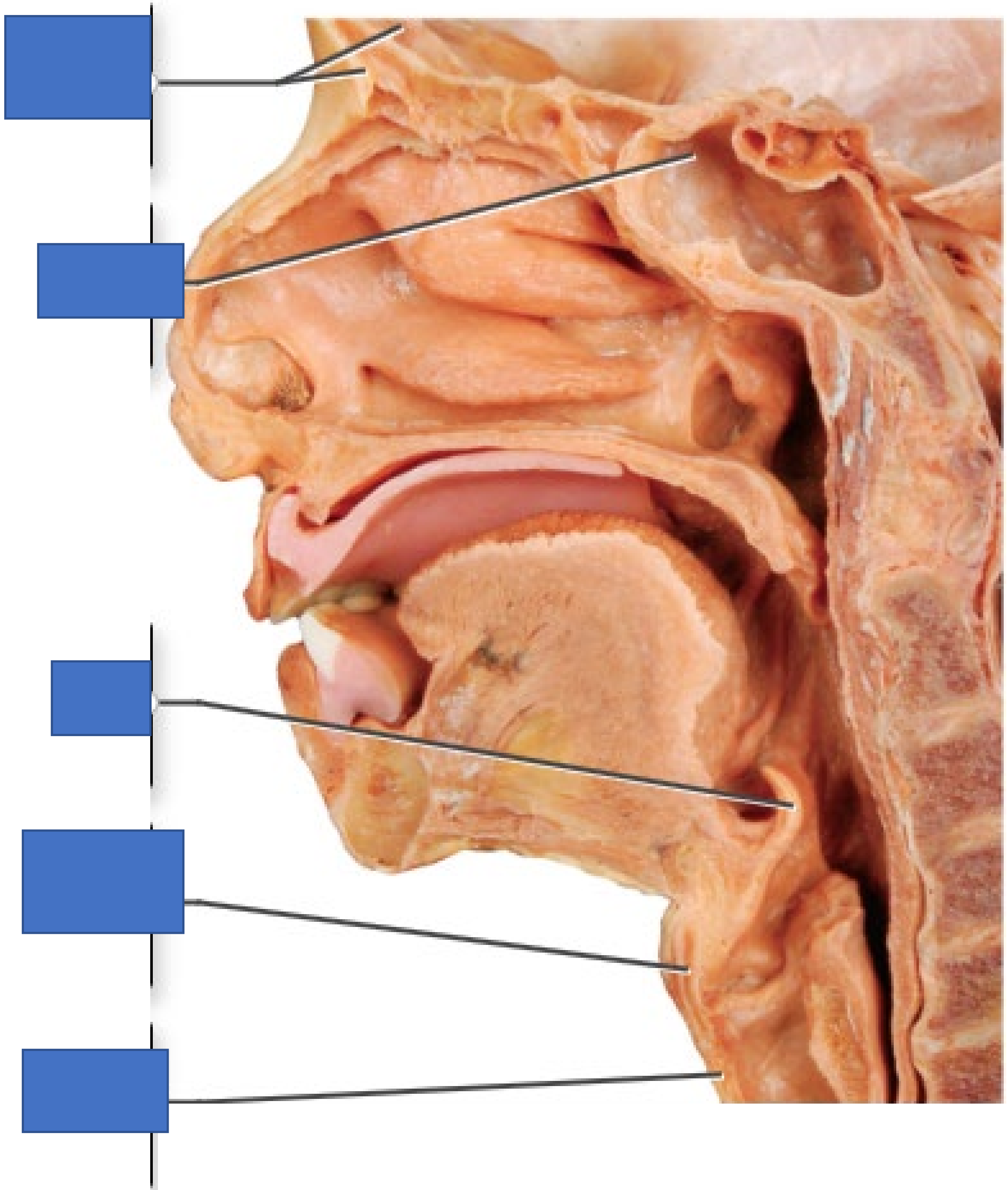


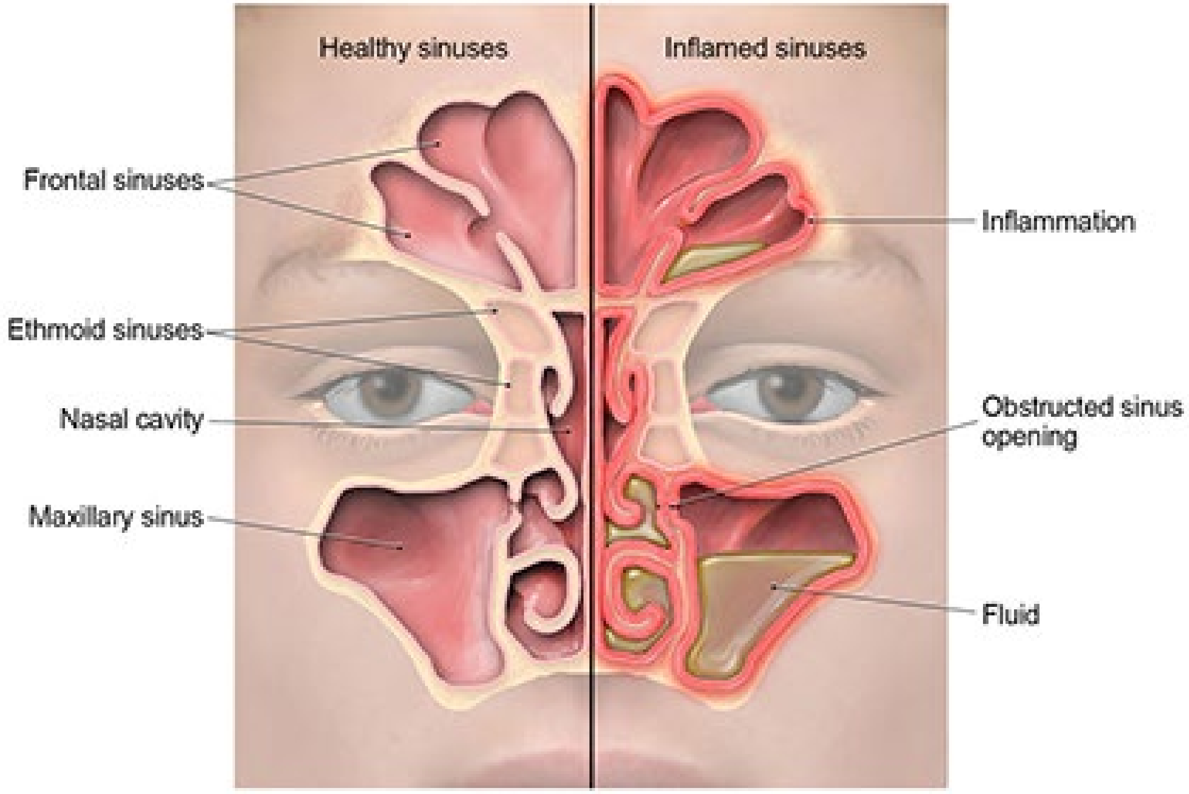
Identify the laryngopharynx, oropharynx, and lumen of larynx.



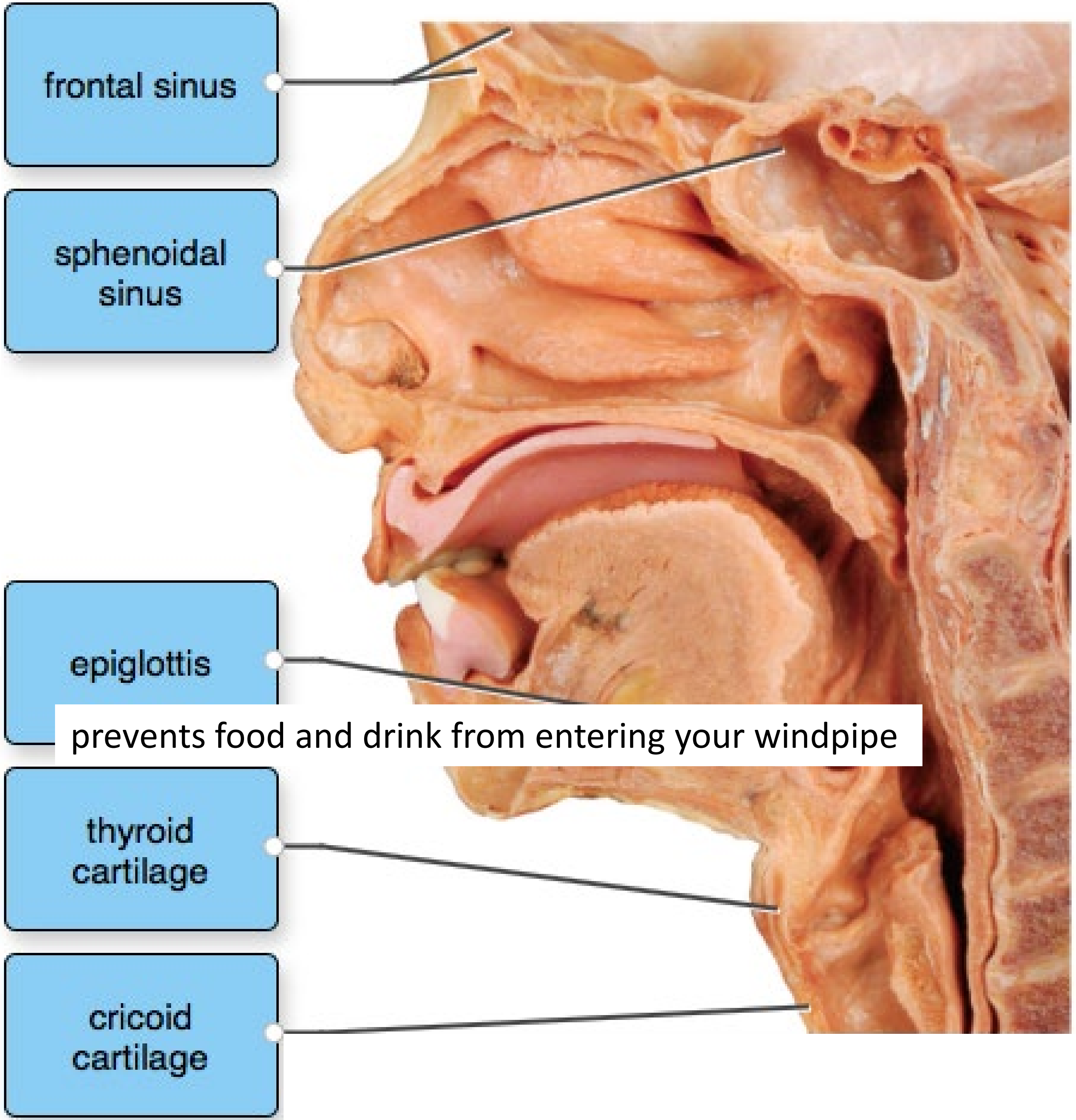
The oropharynx serves both the respiratory and digestive systems. The oropharynx is the critical region that joins the oral cavity and nasopharynx with the larynx and hypopharynx.

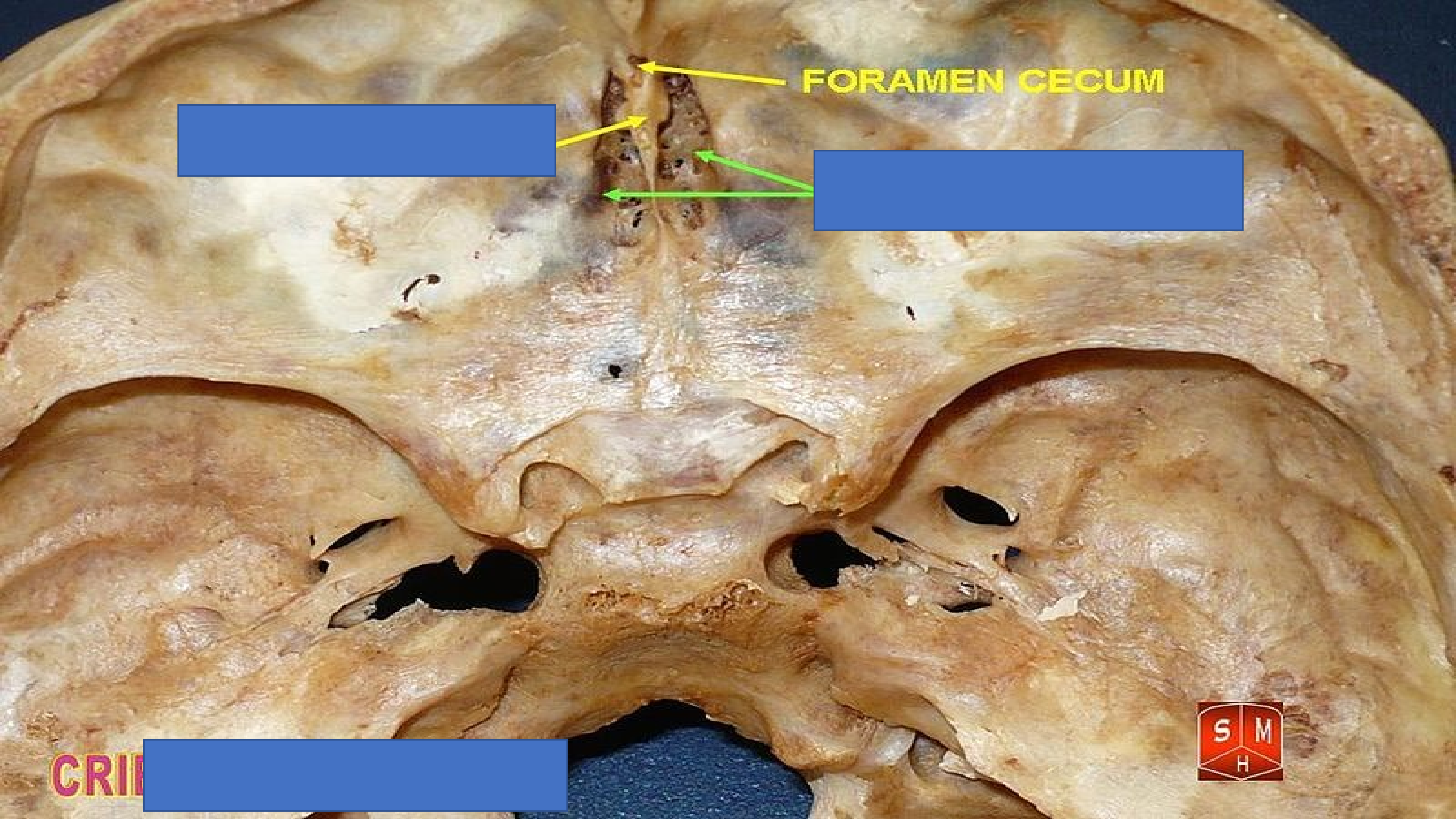
The laryngopharynx, also referred to as the hypopharynx, is the most caudal portion of the pharynx and is a crucial connection point through which food, water, and air pass. Specifically, it refers to the point at which the pharynx divides anteriorly into the larynx and posteriorly into the esophagus.

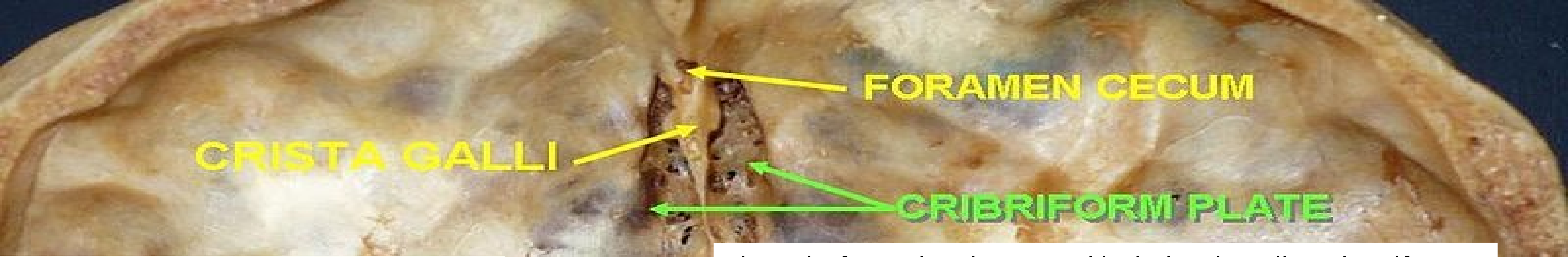




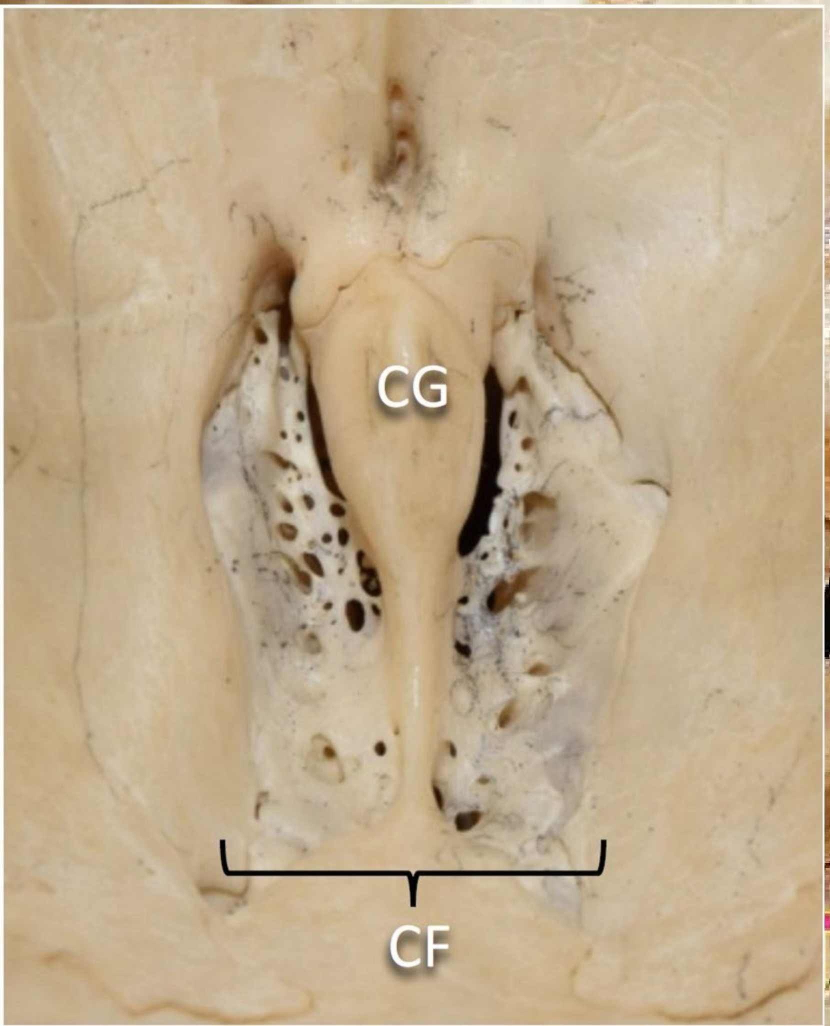
The sinuses make thin mucus that drains out of the channels of the nose. This drainage helps keep the nose clean and free of bacteria. Normally filled with air, the sinuses can get blocked and filled with fluid

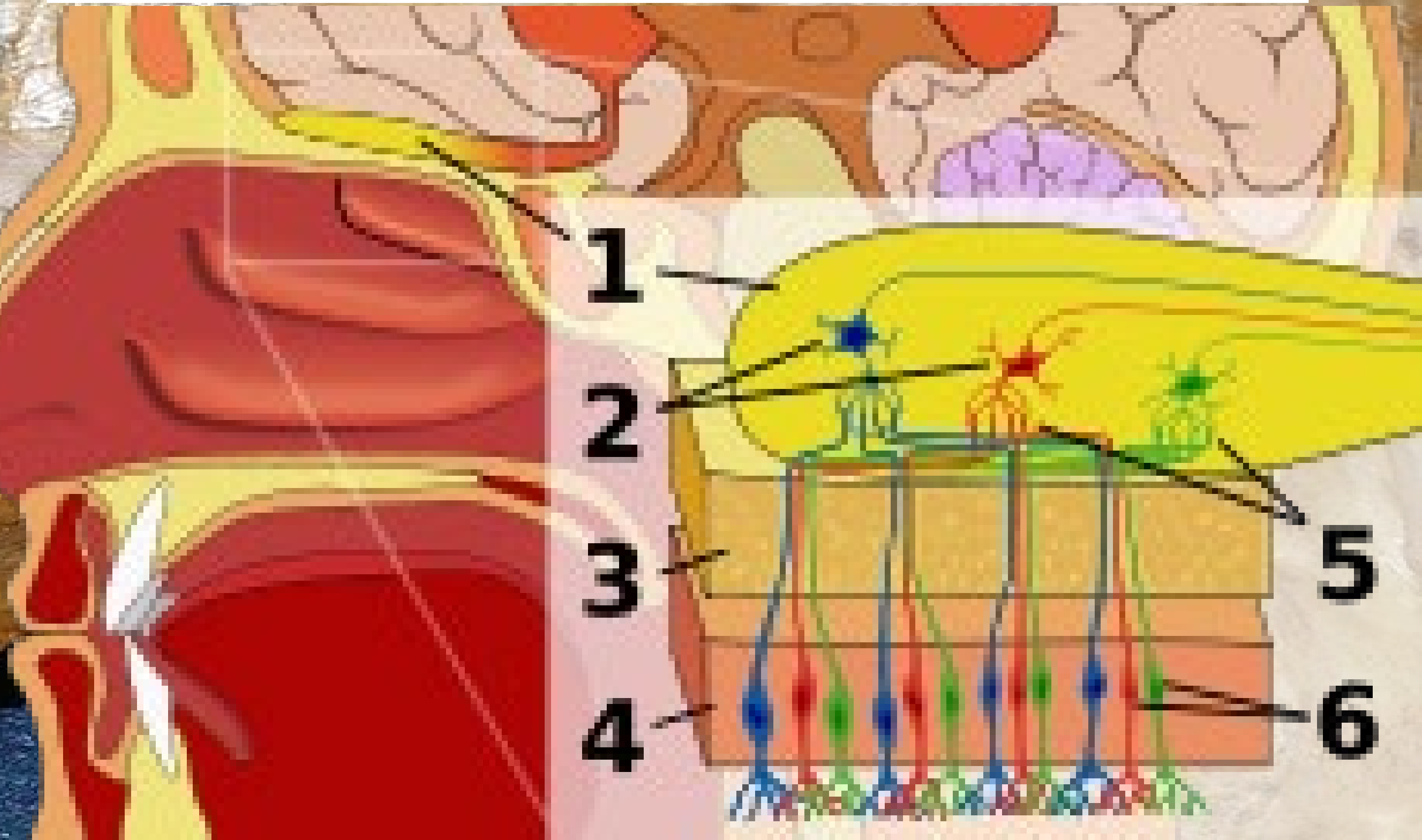


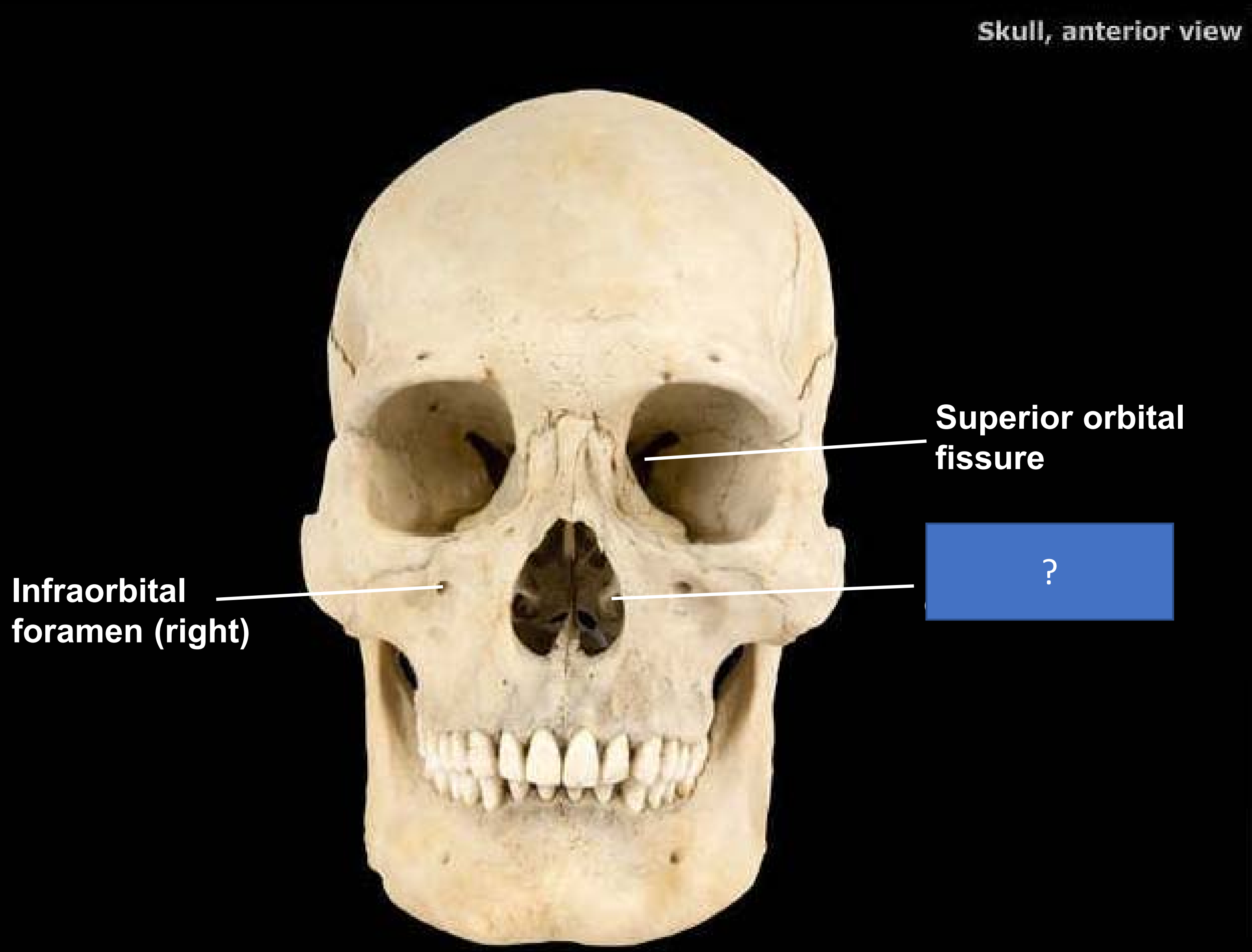

FORAMEN CECUM



The cribriform plate has sieve-like holes that allow the olfactory nerves to locate in your nose so that you can smell things and also plays a role in your ability to taste.

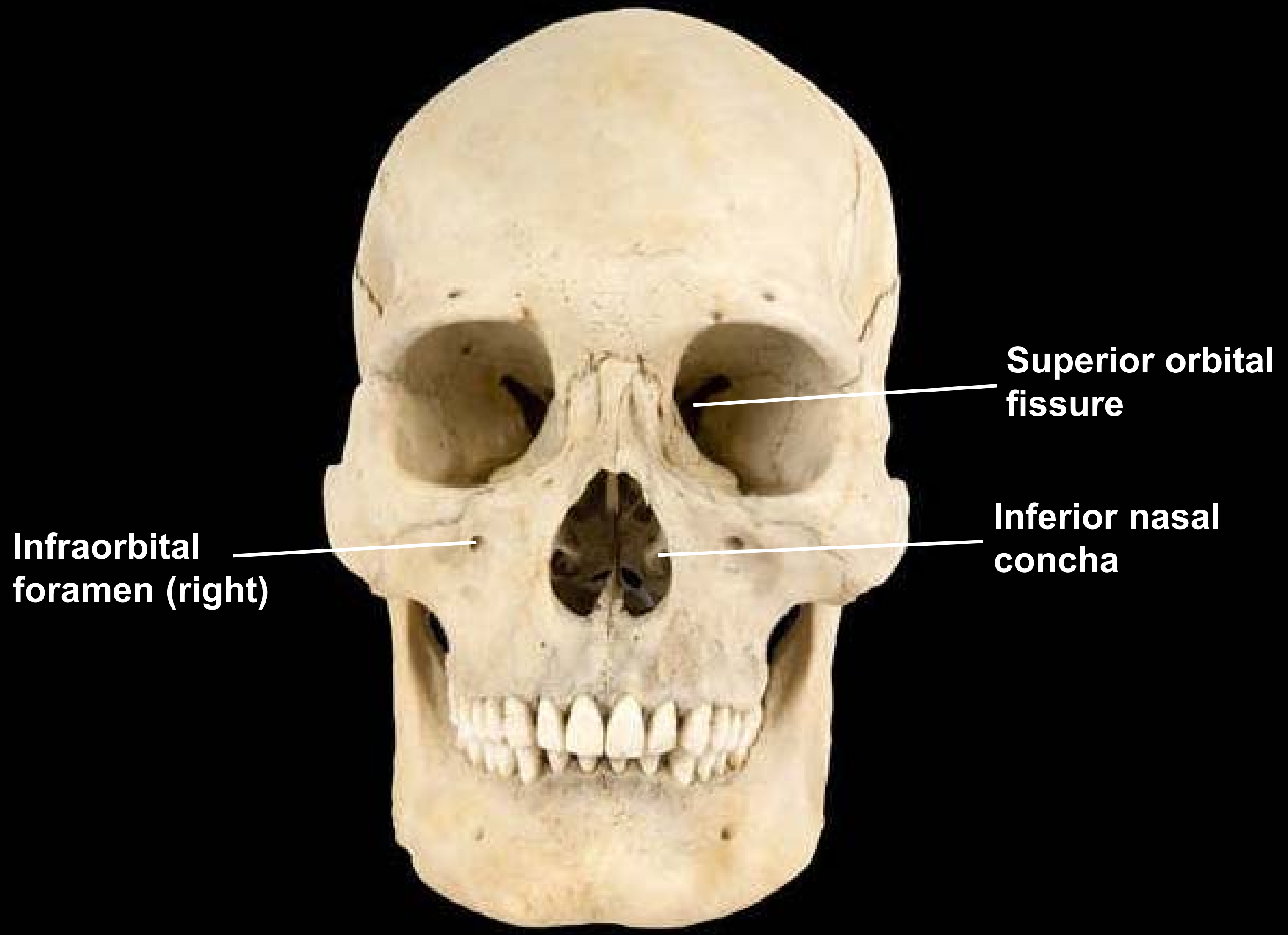


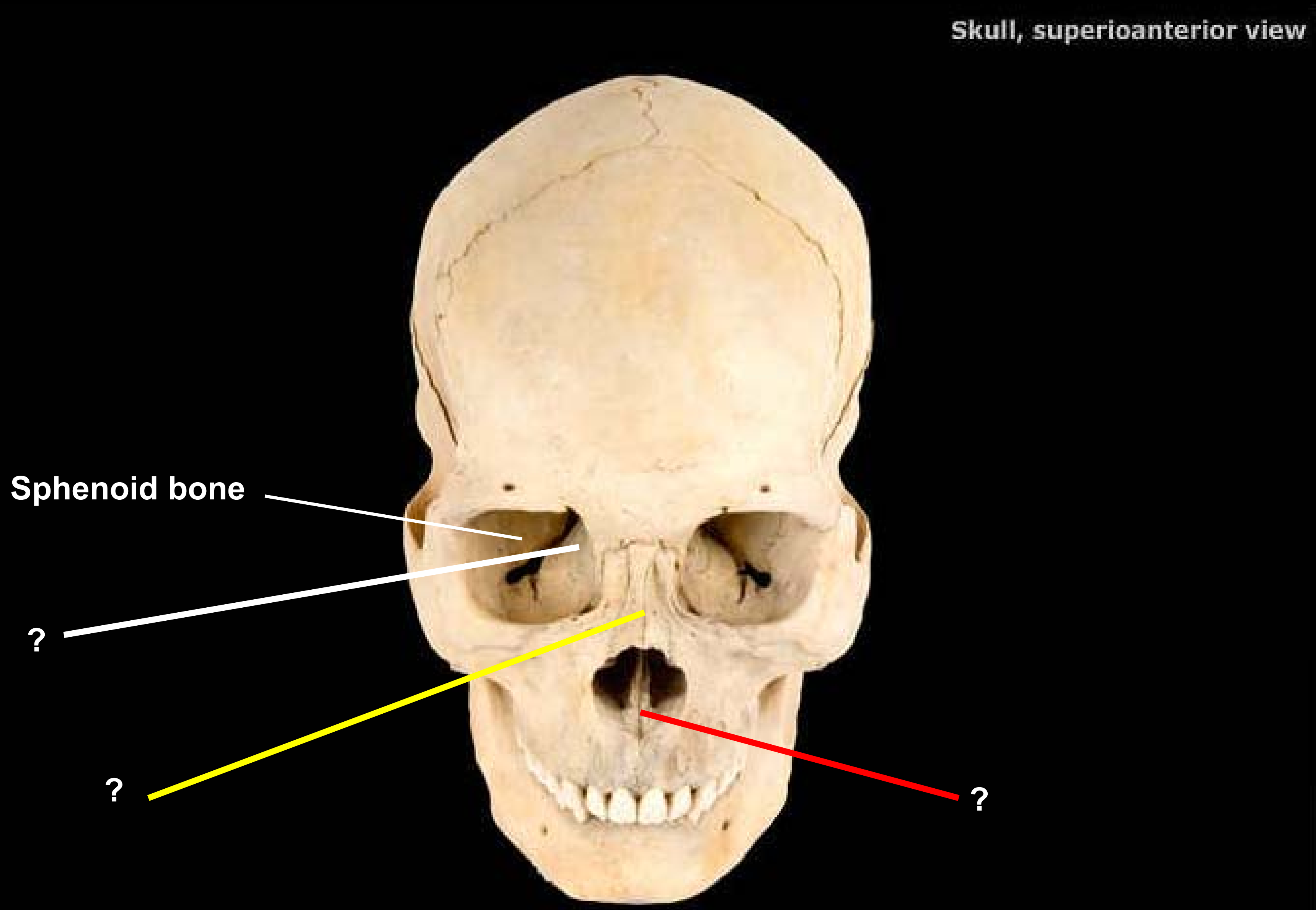


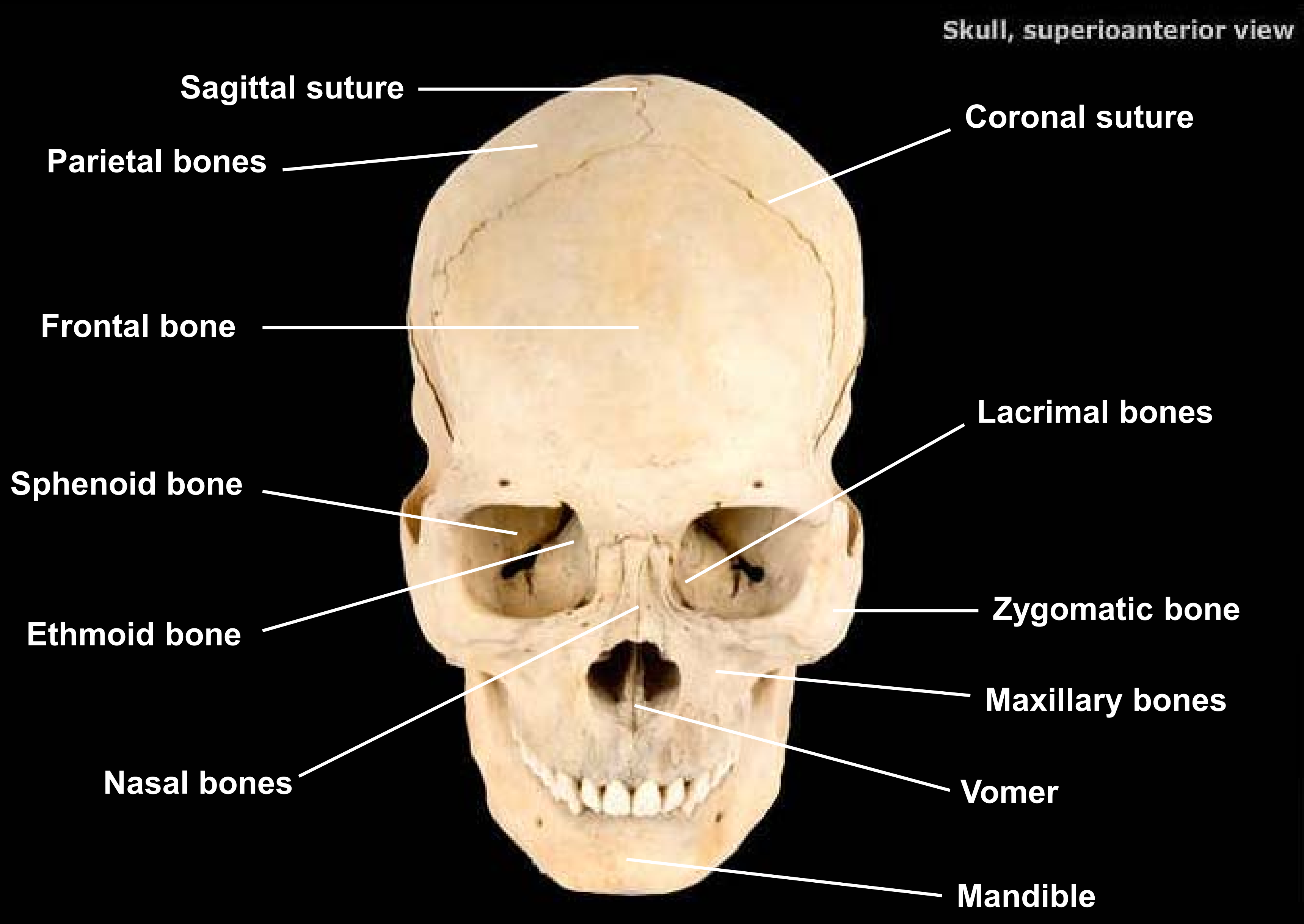


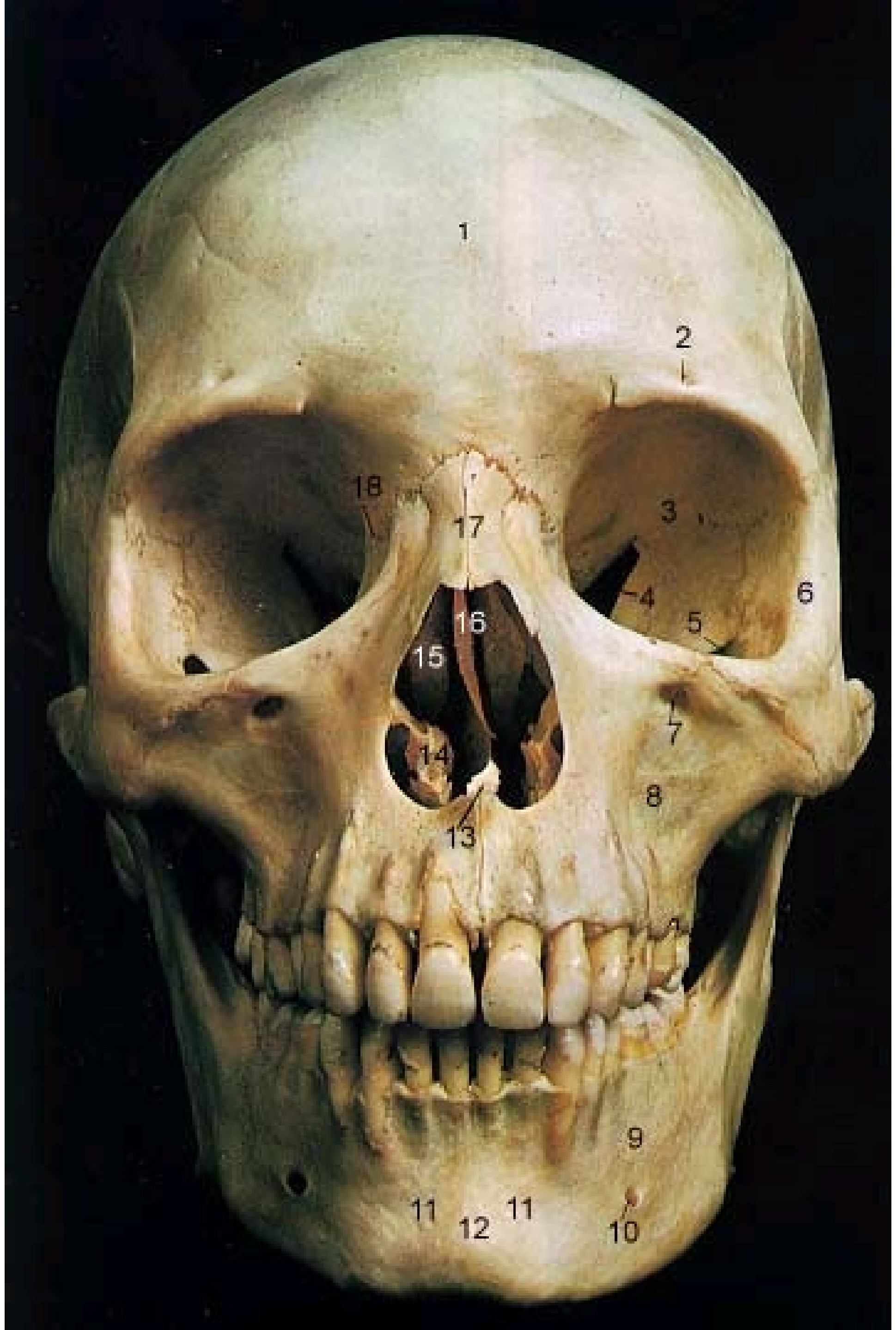
Skull, anterior view
Superior orbital fissure
Infraorbital foramen (right)
?

Skull, anterior view




Skull, superioanterior view
Sphenoid bone
?
?
?


Skull, superioanterior view
Sagittal suture
Parietal bones
Frontal bone
Sphenoid bone
Ethmoid bone
Nasal bones
Coronal suture
Lacrimal bones
Zygomatic bone
Maxillary bones
Vomer
Mandible



?

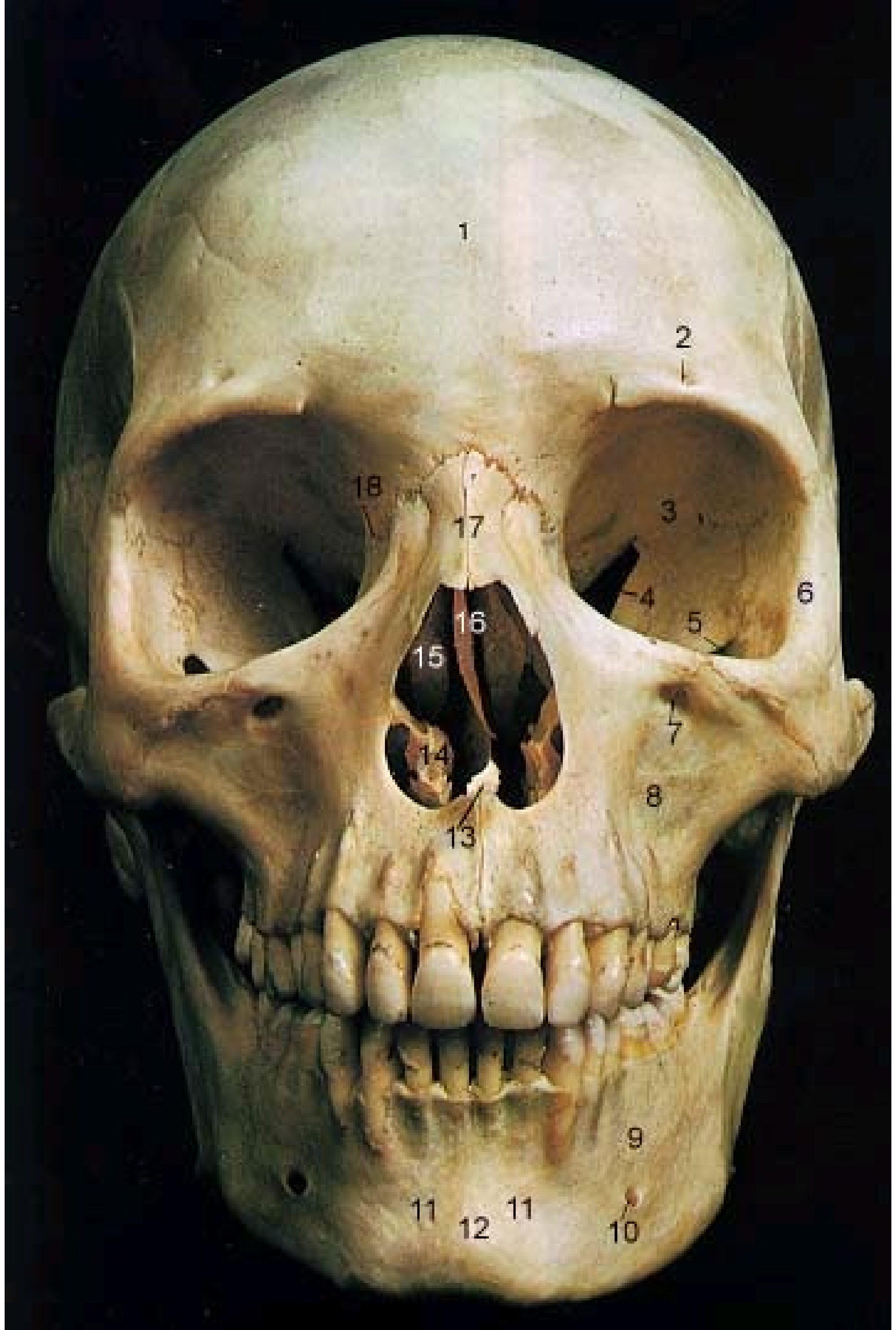
13.

14.

15.

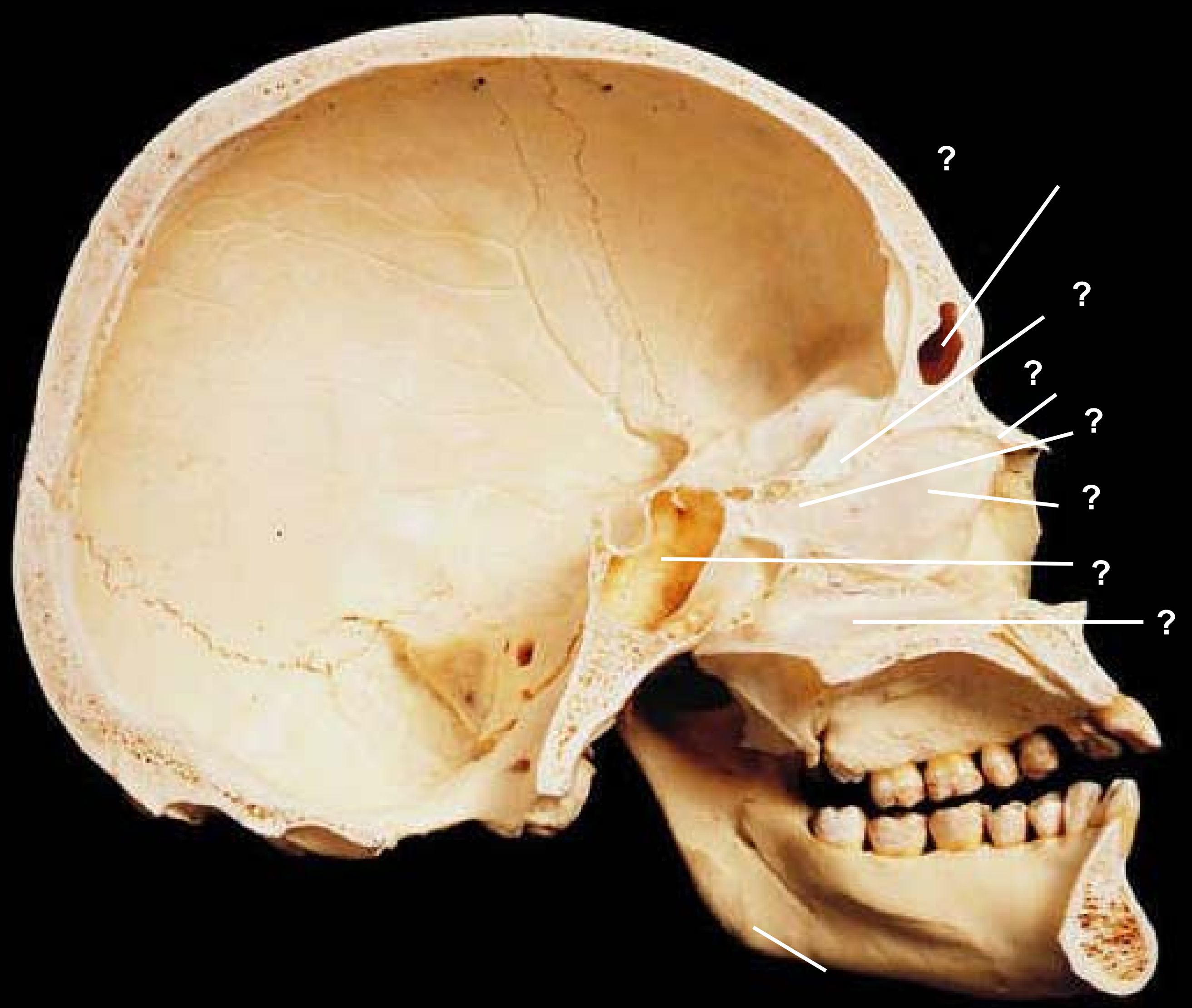
16.

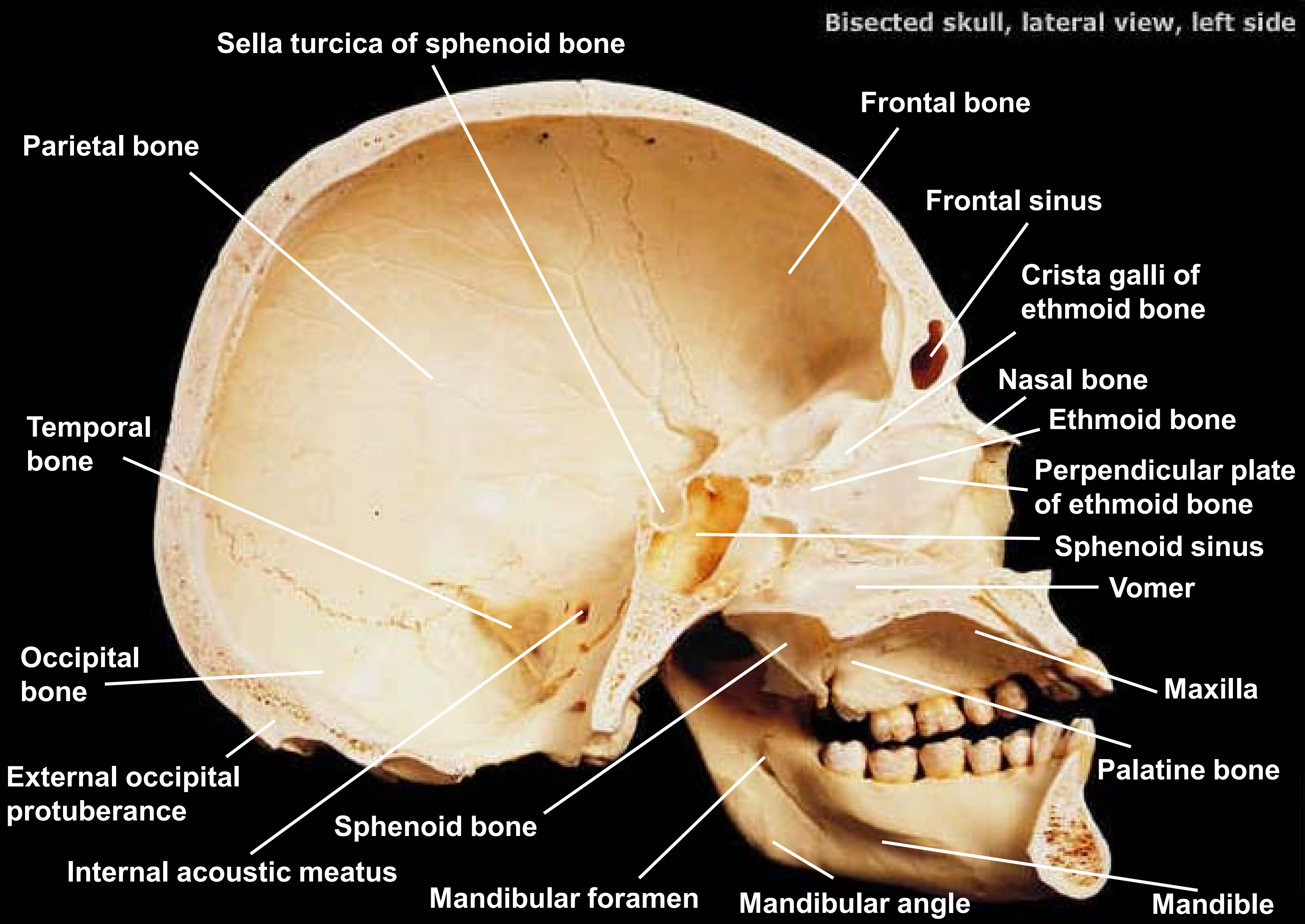
17.

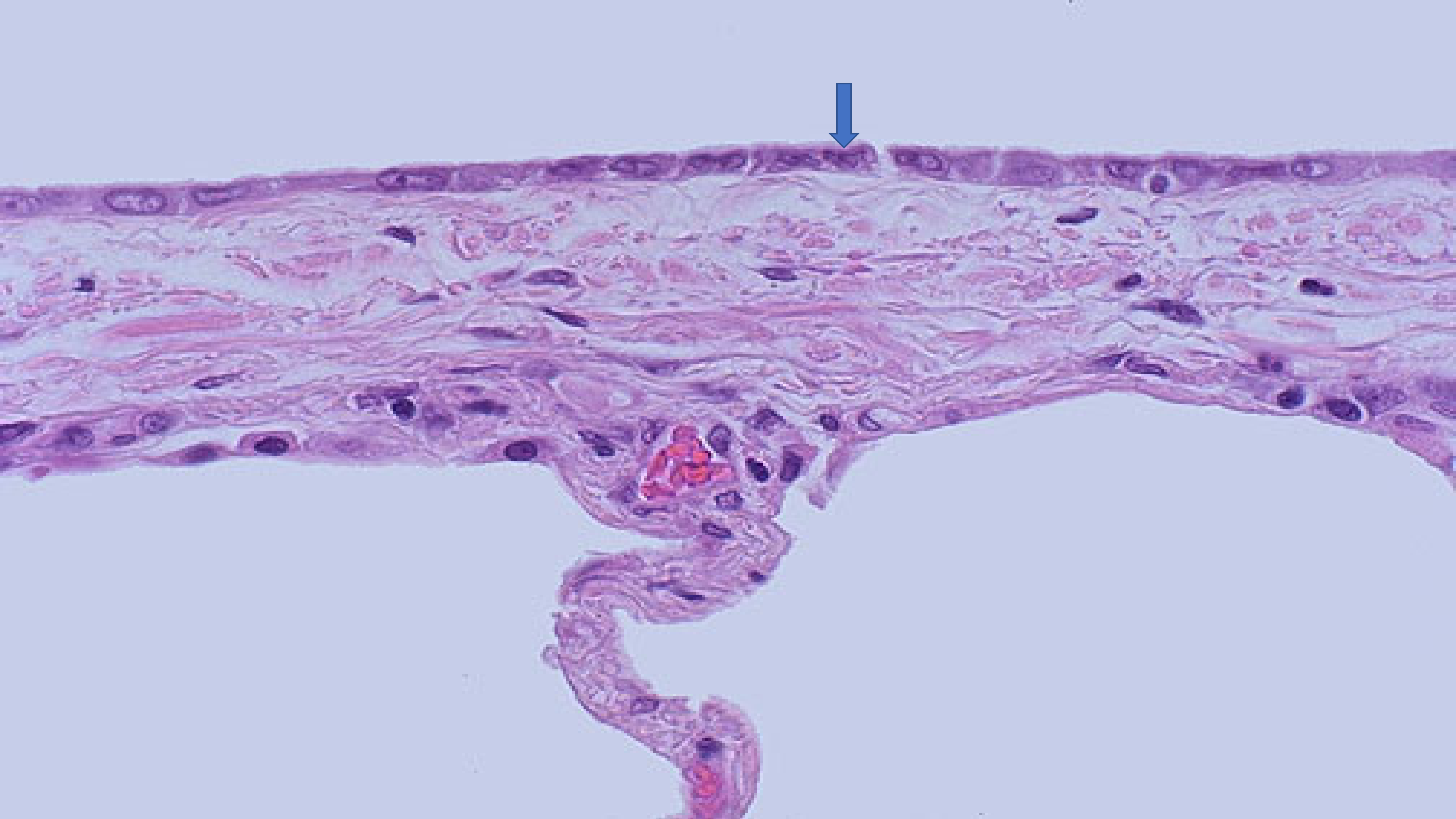


13.	Vomer
14.	Inferior Nasal Concha
15.	Middle Nasal Concha
16.	Perpendicular Plate of Ethmoid
17.	Nasal Bone

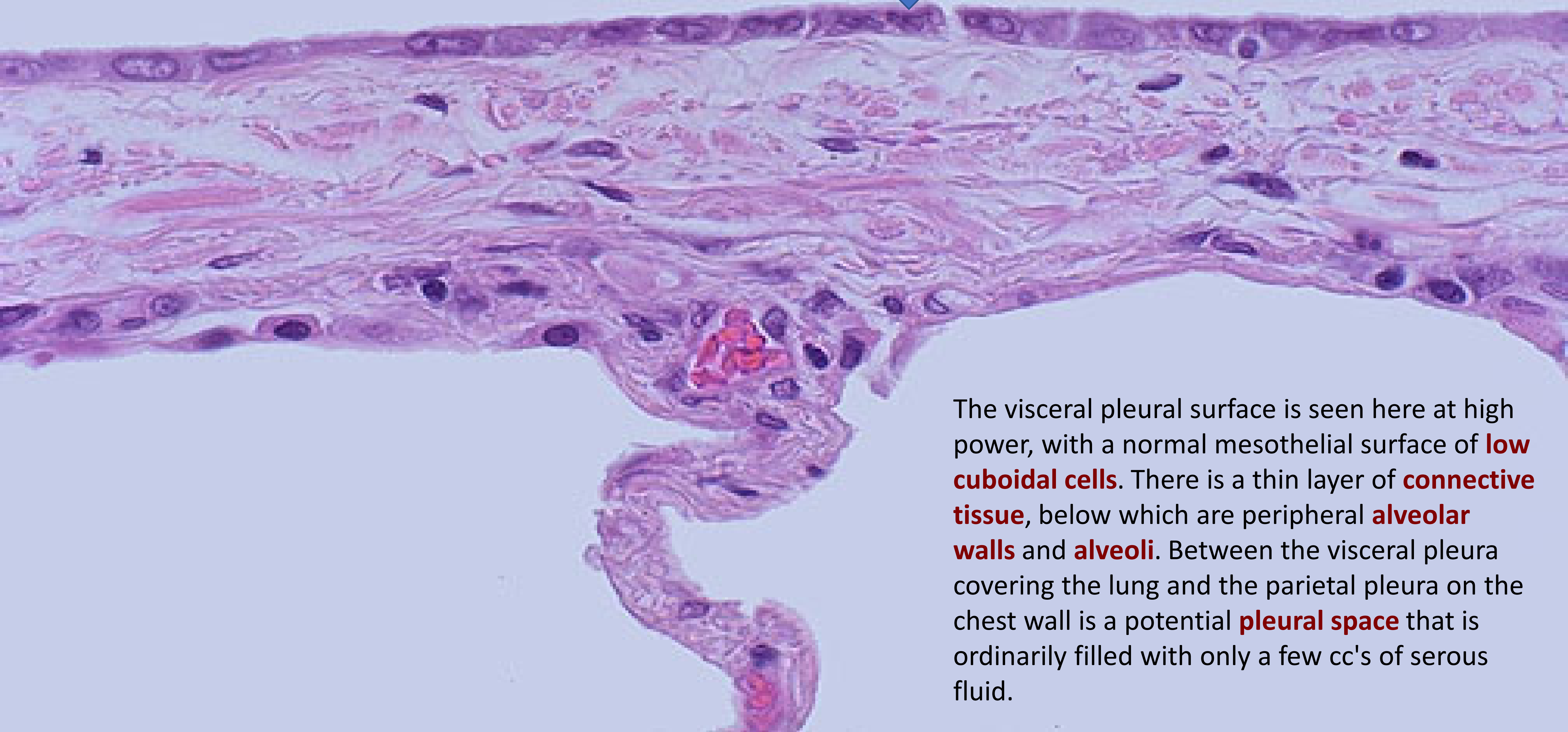
Bisected skull, lateral view, left side




Bisected skull, lateral view, left side
Sella turcica of sphenoid bone
Frontal bone
Parietal bone
Frontal sinus
Crista galli of
ethmoid bone
Nasal bone
Ethmoid bone
Temporal
bone
Perpendicular plate
of ethmoid bone
Sphenoid sinus
Vomer
Occipital
bone
Maxilla
Palatine bone
External occipital
protuberance
Sphenoid bone
Internal acoustic meatus
Mandibular foramen
Mandibular angle
Mandible

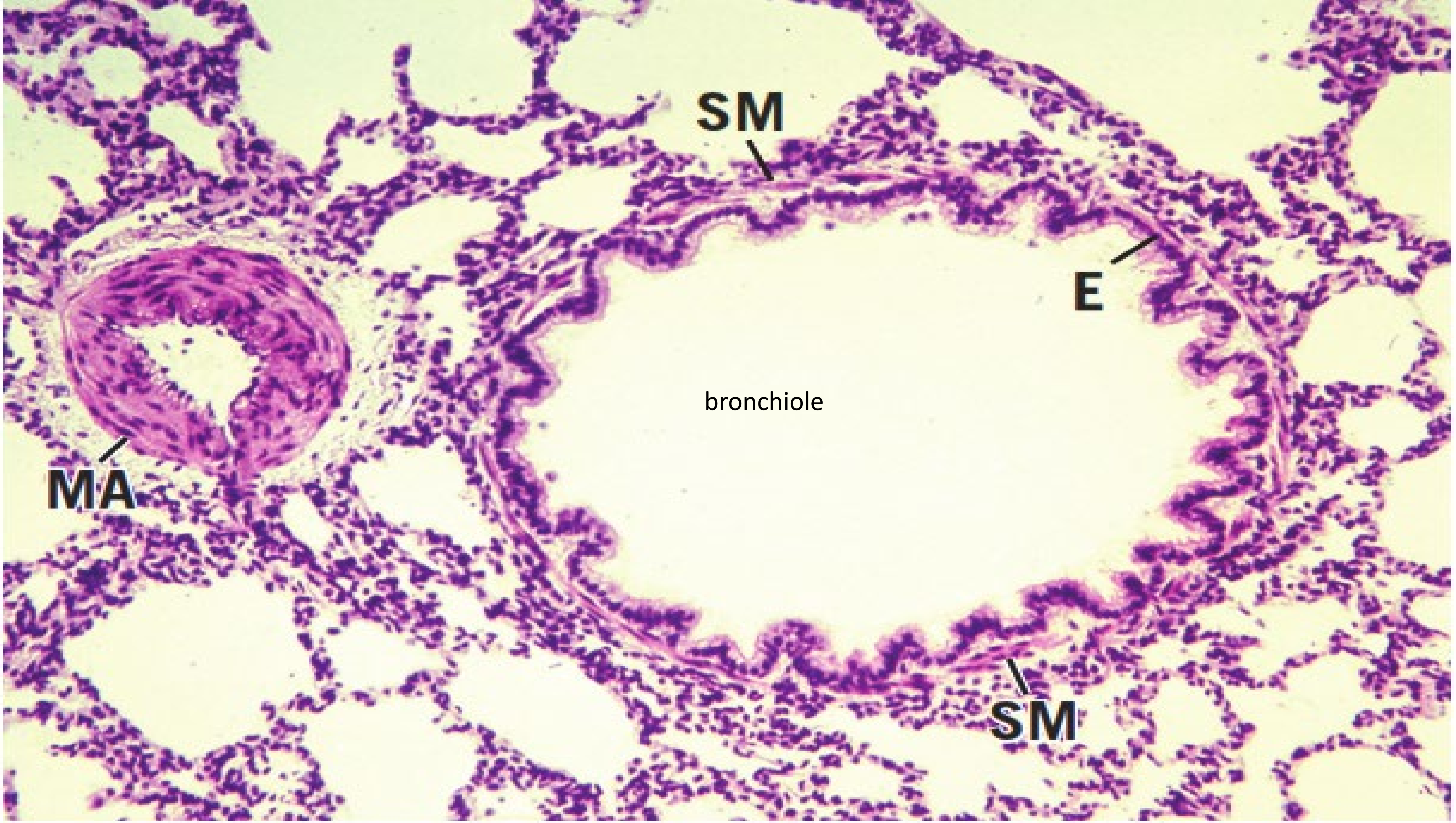


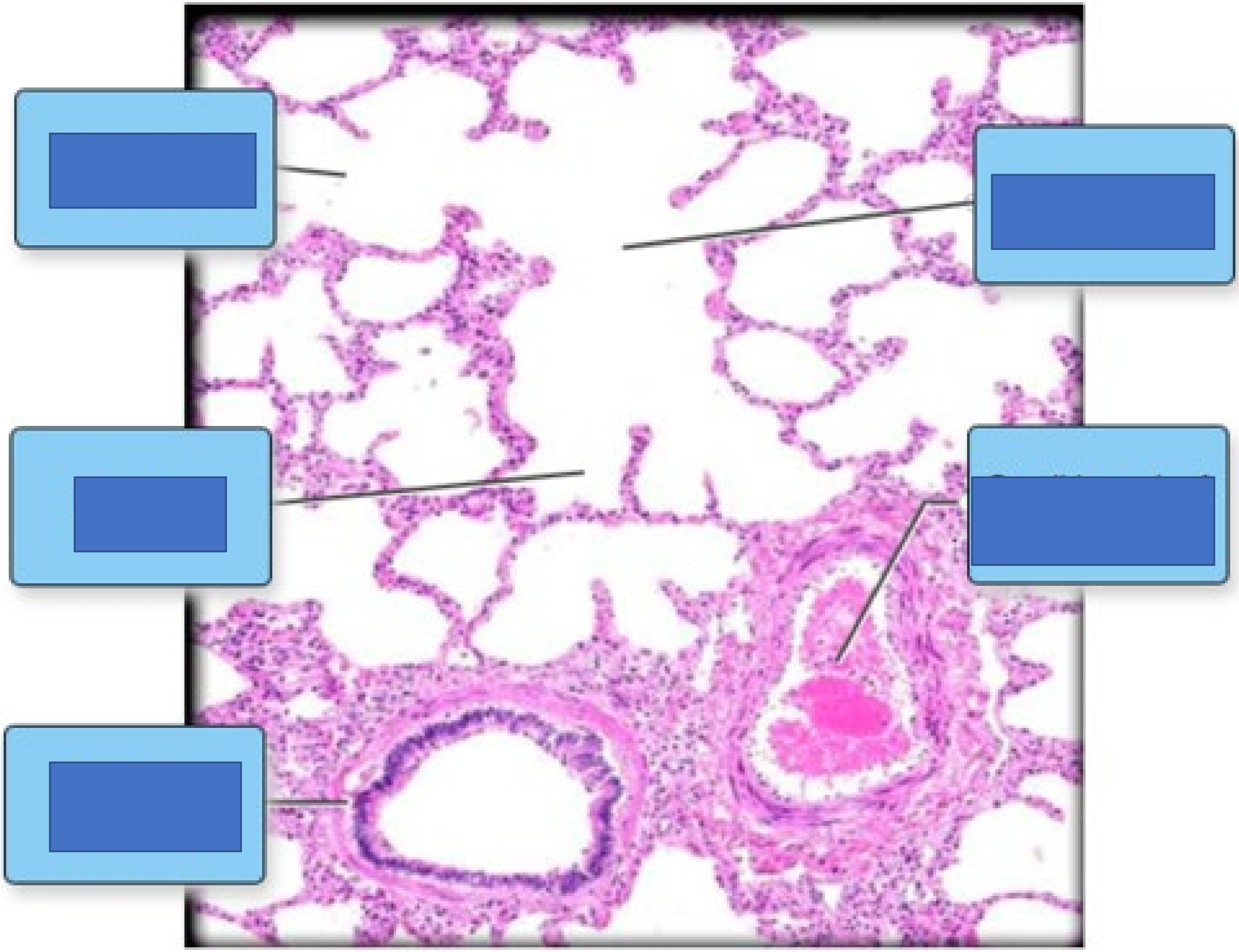
Visceral pleura = serous membrane= mesothelium



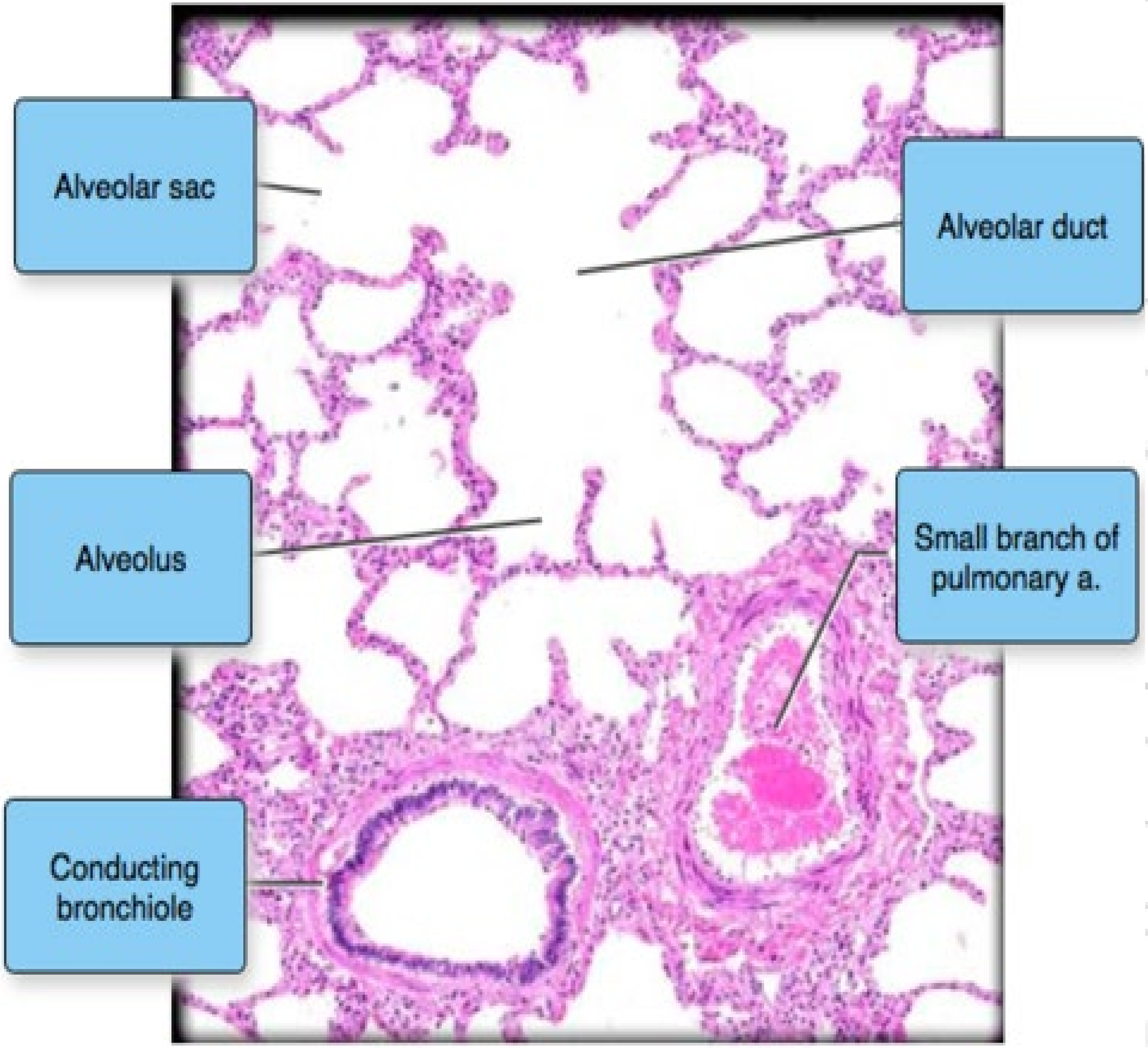
The visceral pleural surface is seen here at high power, with a normal mesothelial surface of **low cuboidal cells**. There is a thin layer of **connective tissue**, below which are peripheral **alveolar walls** and **alveoli**. Between the visceral pleura covering the lung and the parietal pleura on the chest wall is a potential **pleural space** that is ordinarily filled with only a few cc's of serous fluid.

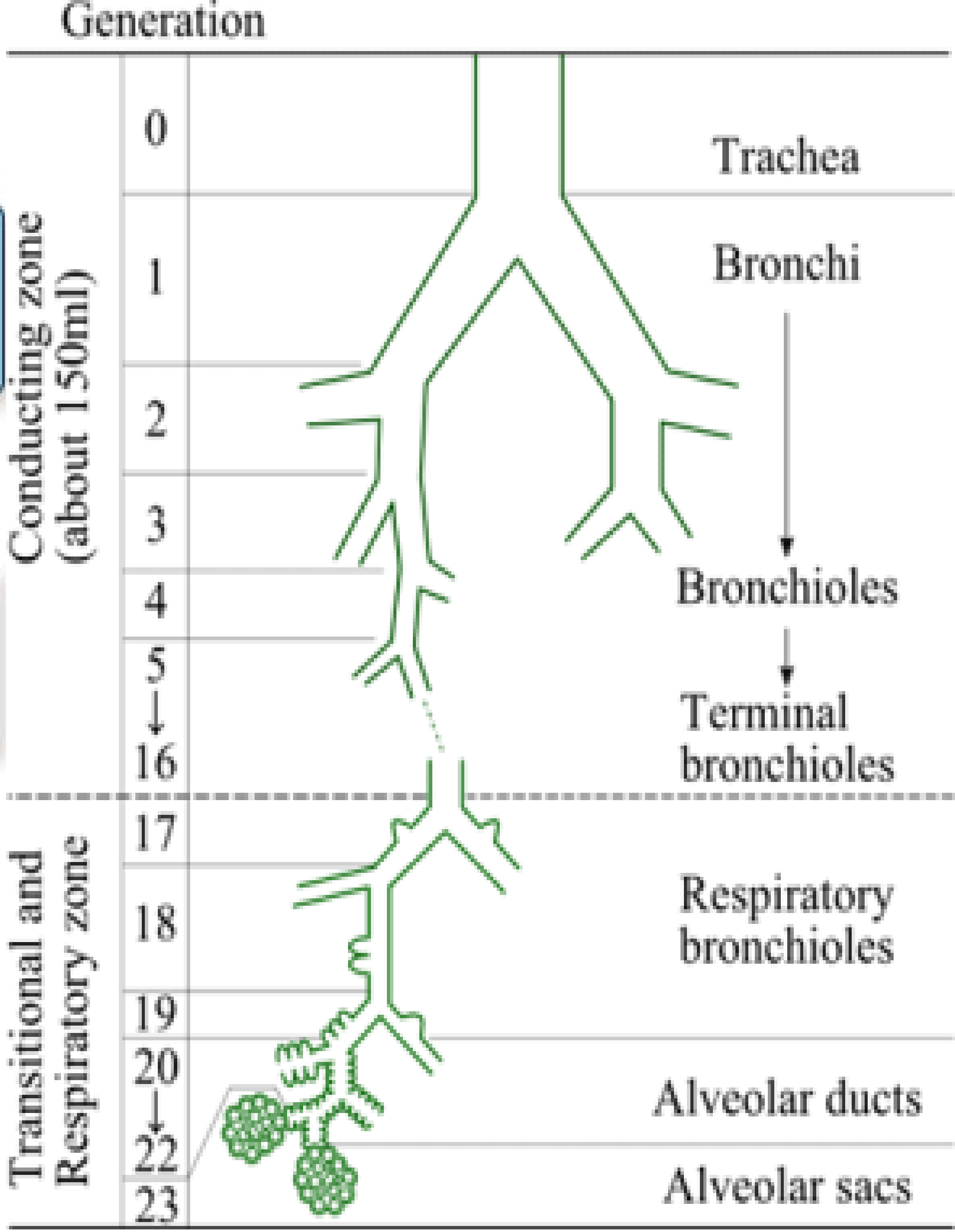

SM
E
MA
SM

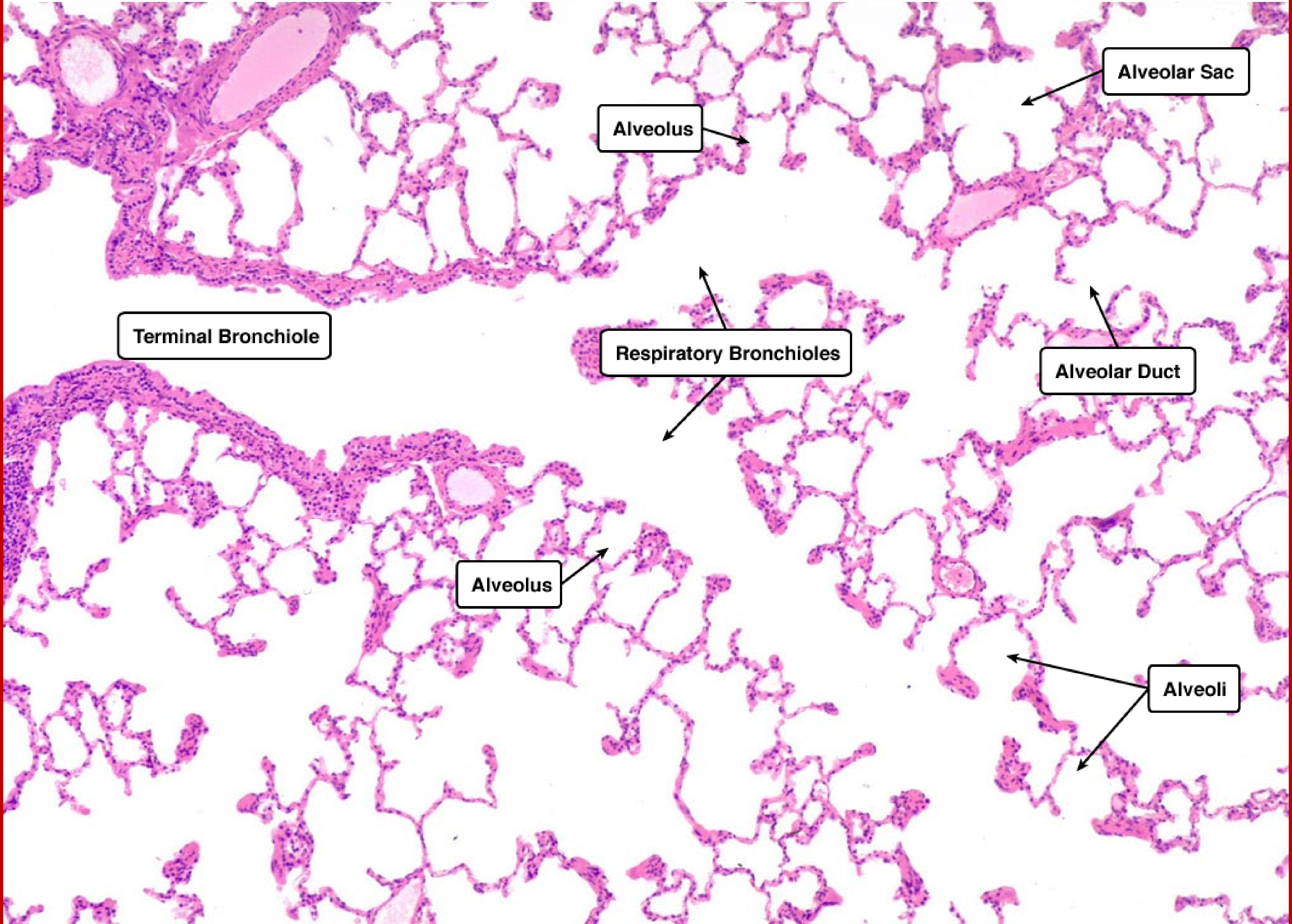

SM
E
bronchiole
MA
SM



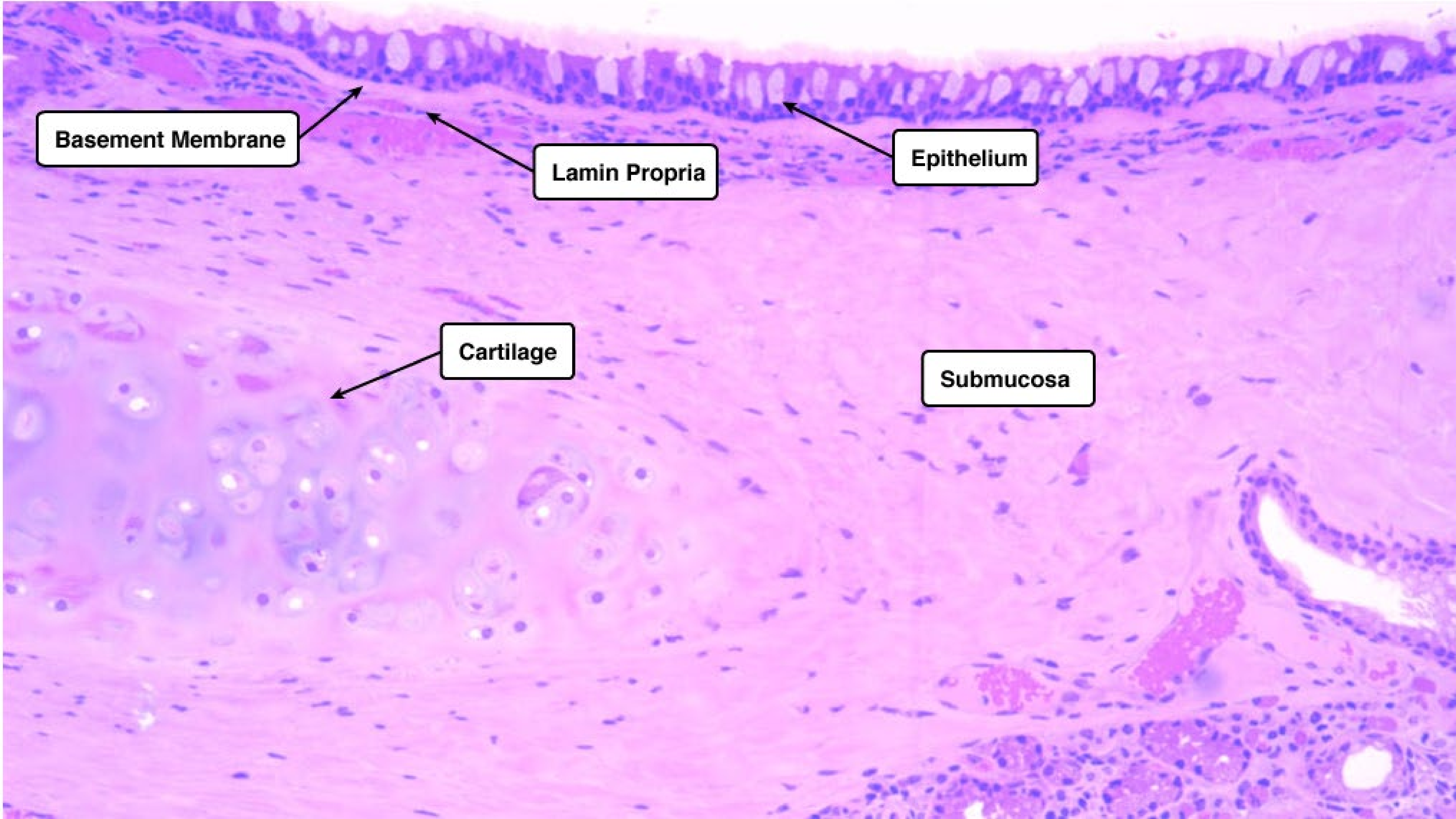
Label the following histo slide?

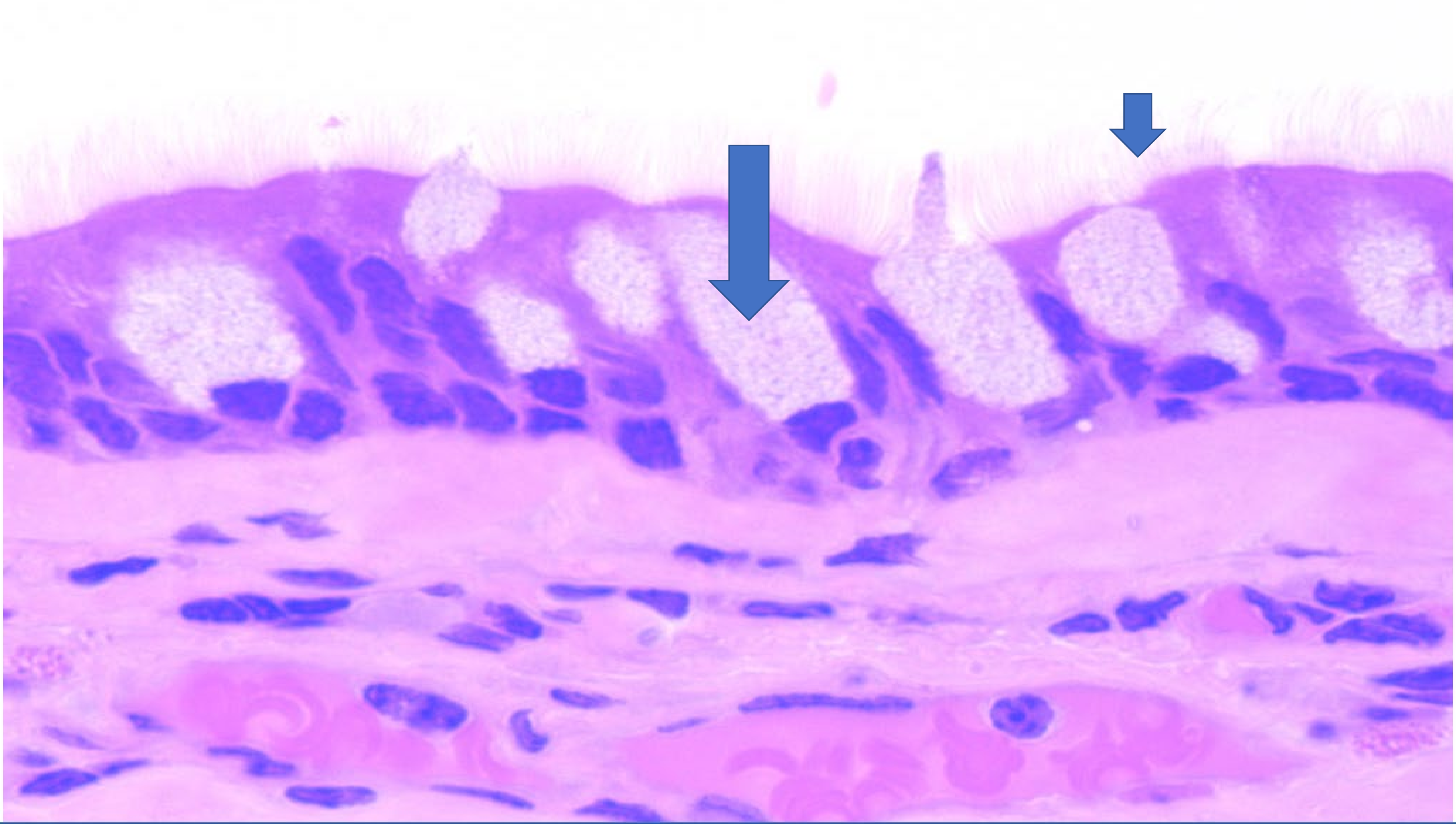

Alveolar sac
Alveolar duct
Alveolus
Small branch of pulmonary a.
Conducting bronchiole

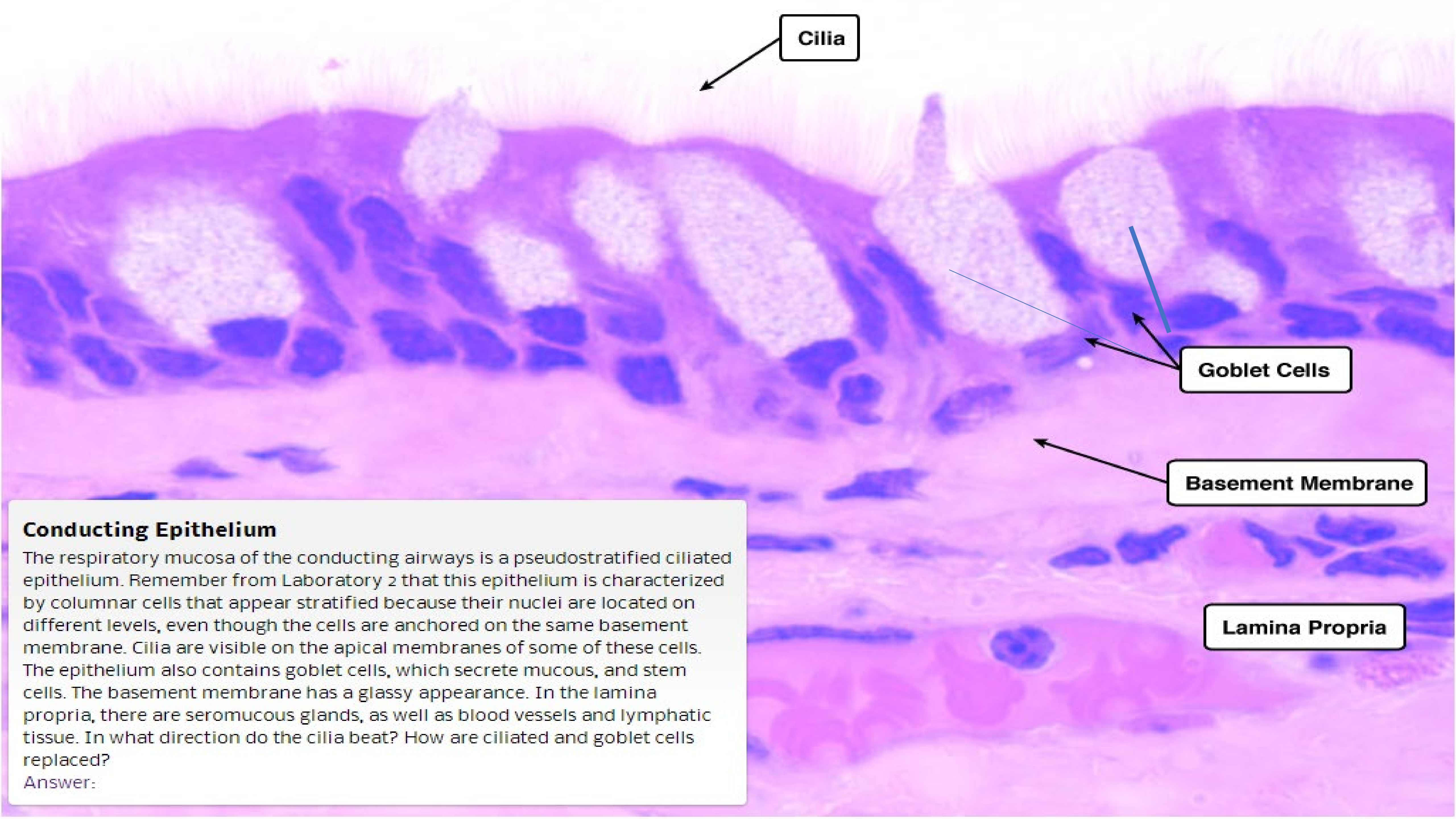

Generation
0
1
2
3
4
5
16
17
18
19
20
22
23
Conducting zone (about 150ml)
Transitional and Respiratory zone
Trachea
Bronchi
Bronchioles
Terminal bronchioles
Respiratory bronchioles
Alveolar ducts
Alveolar sacs



Alveolar Sac
Alveolus
Terminal Bronchiole
Respiratory Bronchioles
Alveolar Duct
Alveolus
Alveoli


Basement Membrane
Lamin Propria
Epithelium
Cartilage
Submucosa

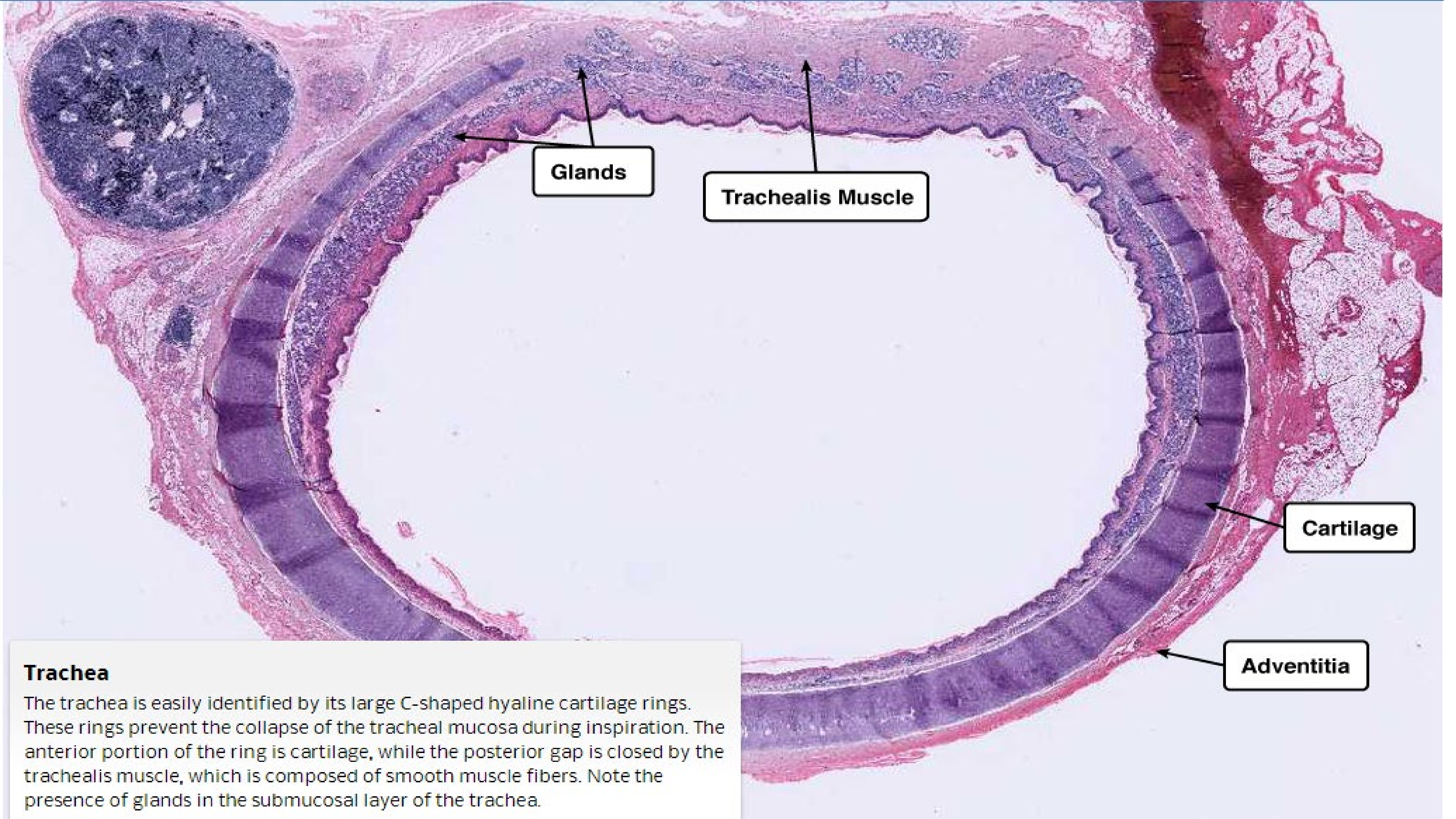




Conducting Epithelium

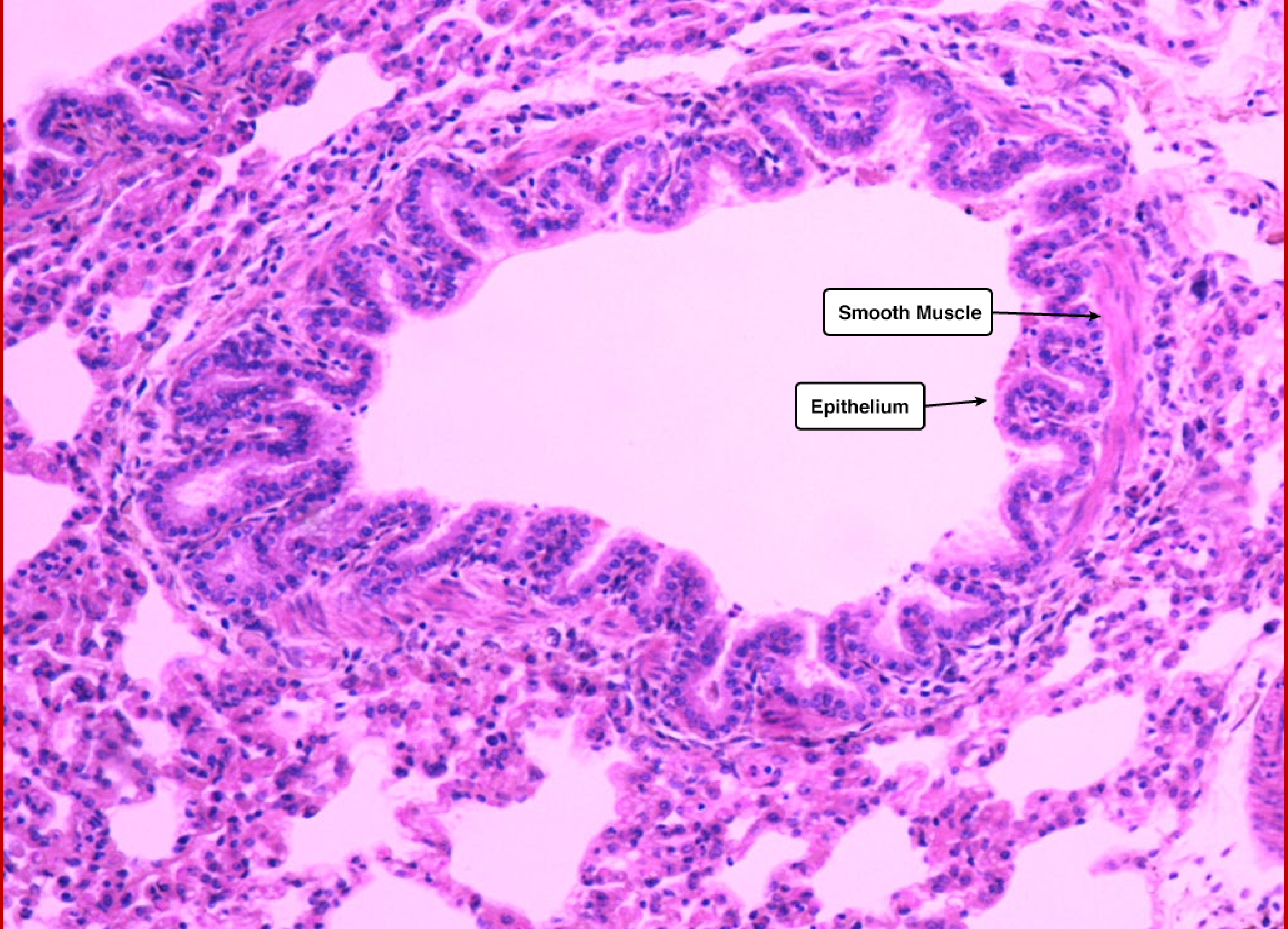
The respiratory mucosa of the conducting airways is a pseudostratified ciliated epithelium. Remember from Laboratory 2 that this epithelium is characterized by columnar cells that appear stratified because their nuclei are located on different levels, even though the cells are anchored on the same basement membrane. Cilia are visible on the apical membranes of some of these cells. The epithelium also contains goblet cells, which secrete mucous, and stem cells. The basement membrane has a glassy appearance. In the lamina propria, there are seromucous glands, as well as blood vessels and lymphatic tissue. In what direction do the cilia beat? How are ciliated and goblet cells replaced?

Answer:

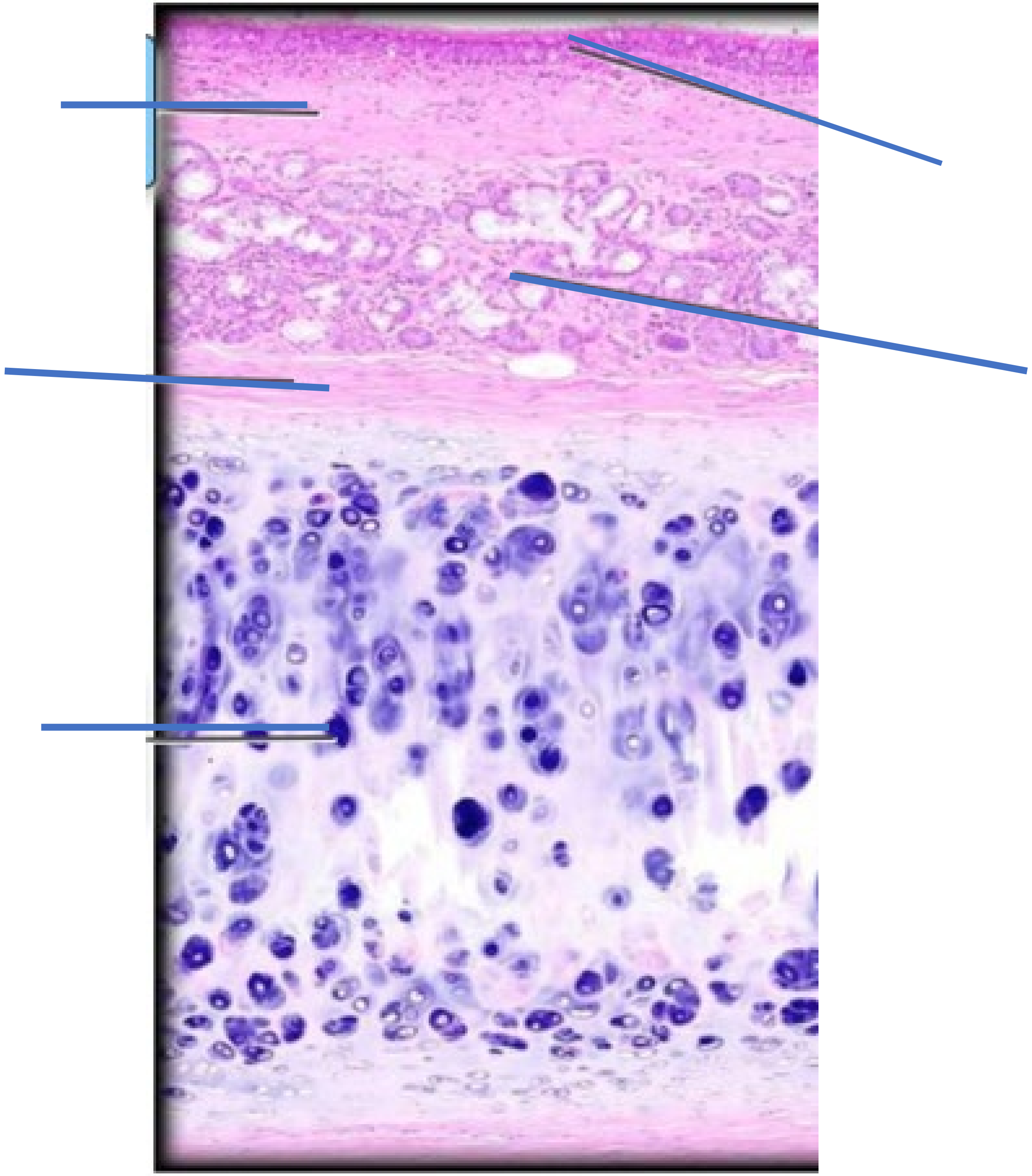


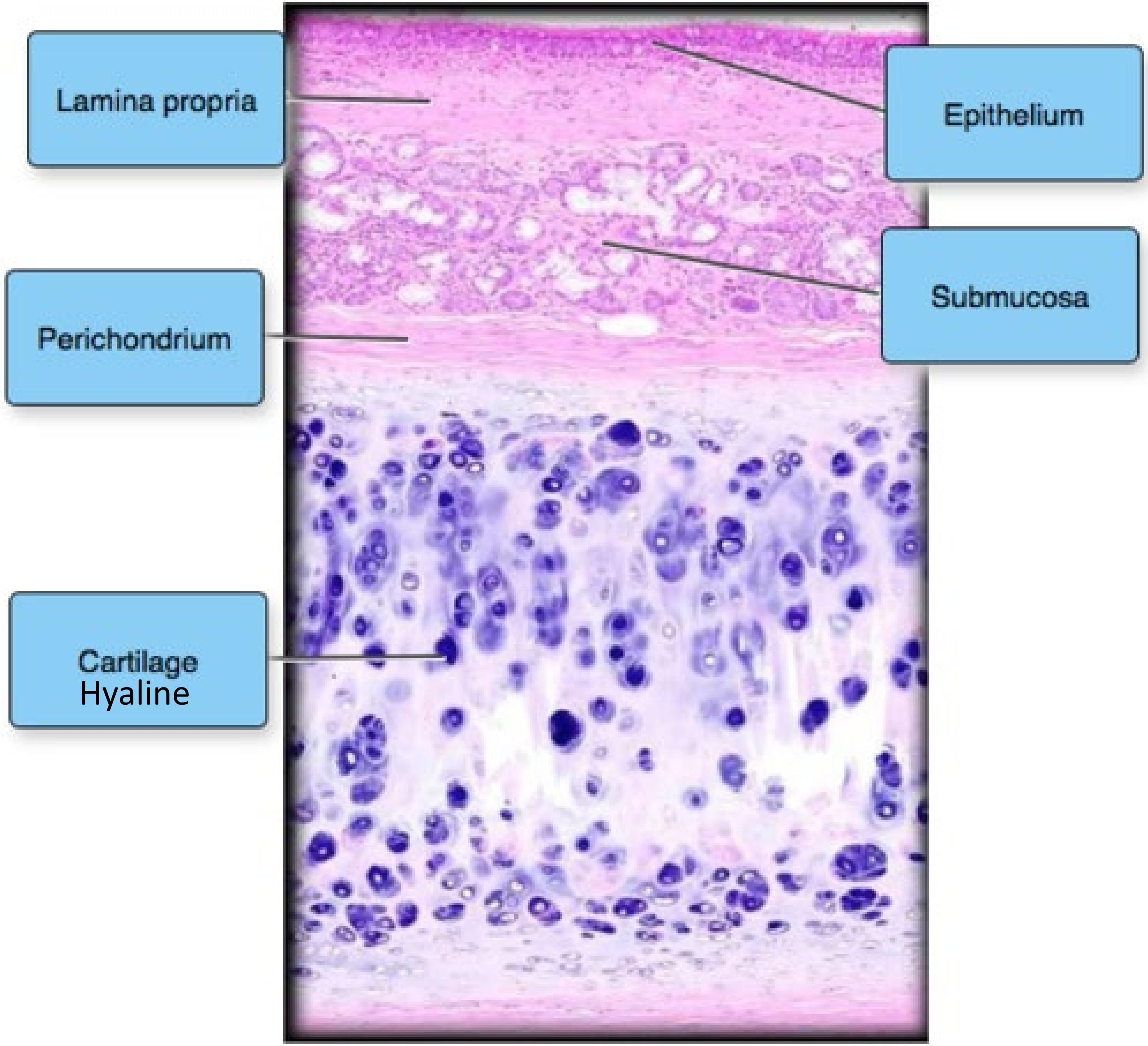
Trachea

The trachea is easily identified by its large C-shaped hyaline cartilage rings. These rings prevent the collapse of the tracheal mucosa during inspiration. The anterior portion of the ring is cartilage, while the posterior gap is closed by the trachealis muscle, which is composed of smooth muscle fibers. Note the presence of glands in the submucosal layer of the trachea.

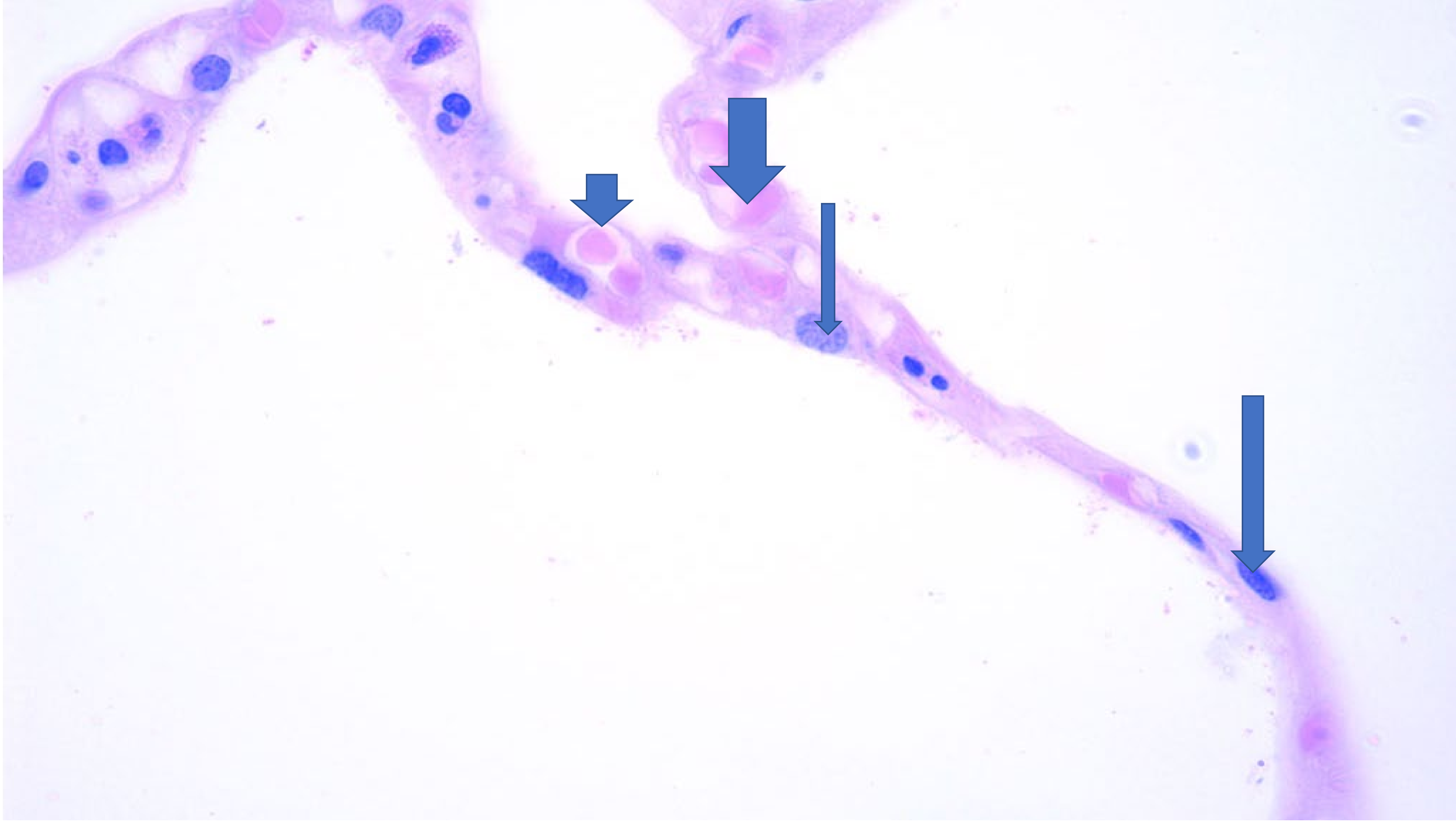

Smooth Muscle
Epithelium

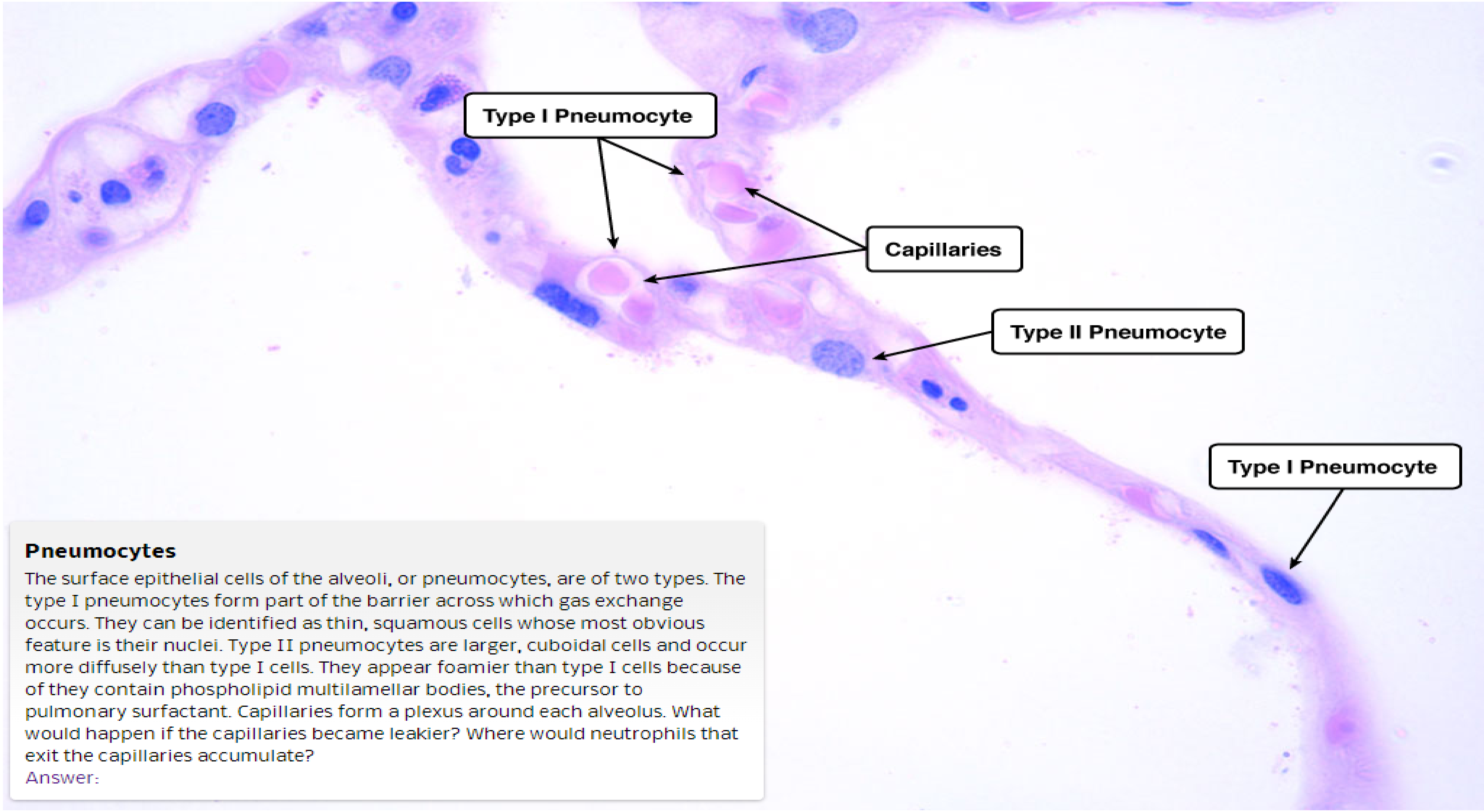
Cartilage Plate
Bronchiole
Bronchus
Pulmonary Vessel





Ciliated pseudostratified columnar epithelium

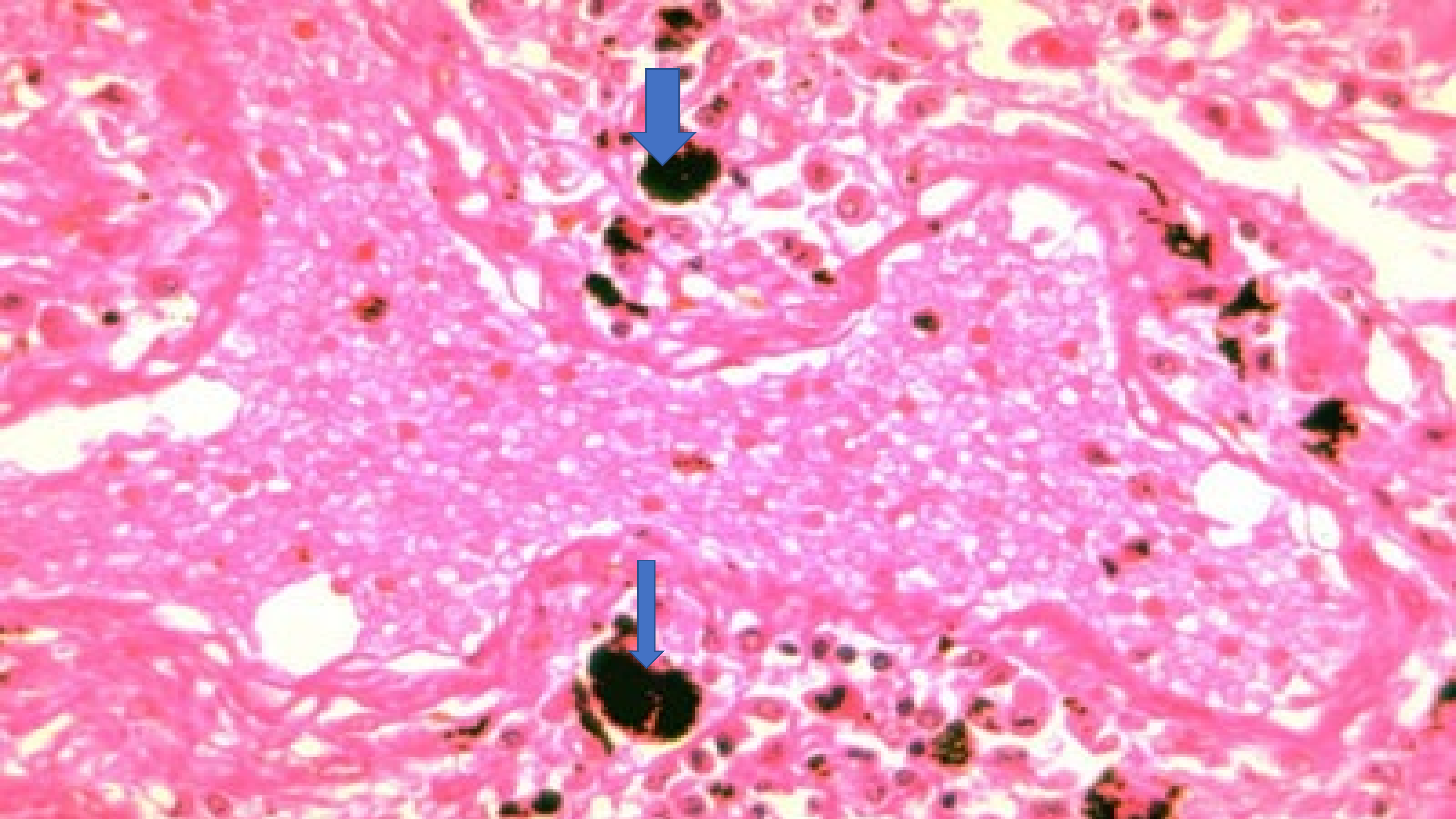


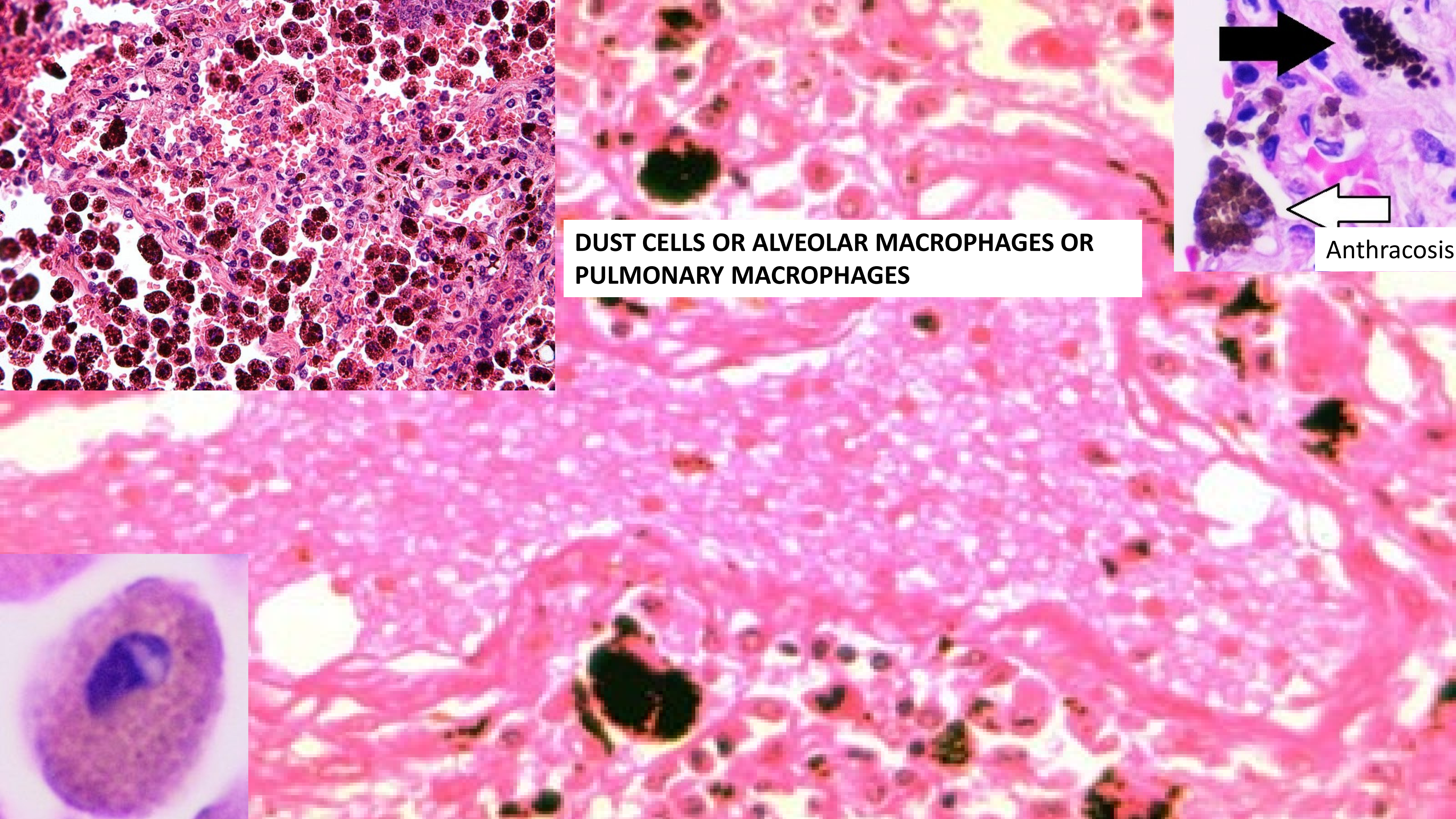


Pneumocytes

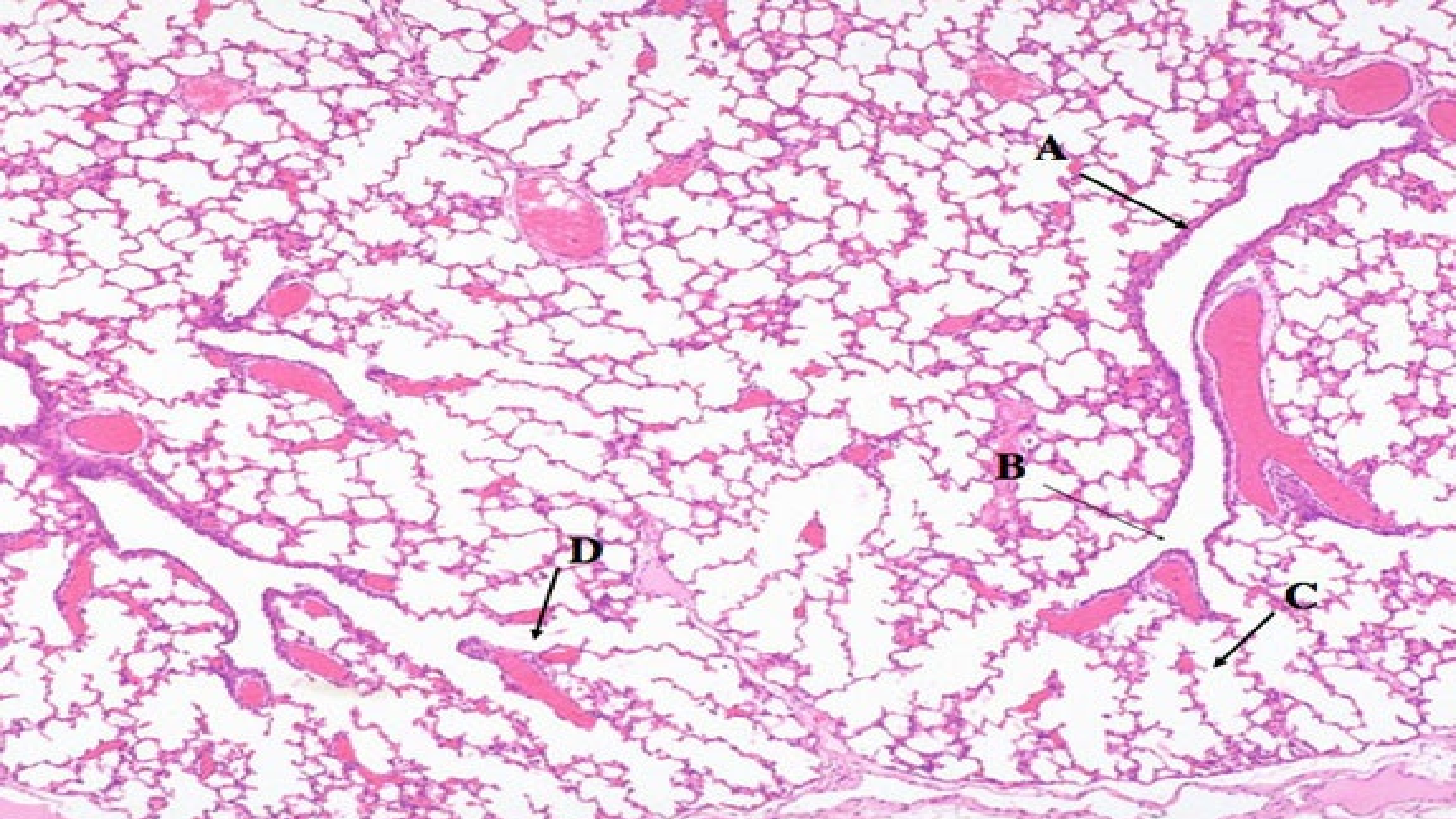
The surface epithelial cells of the alveoli, or pneumocytes, are of two types. The type I pneumocytes form part of the barrier across which gas exchange occurs. They can be identified as thin, squamous cells whose most obvious feature is their nuclei. Type II pneumocytes are larger, cuboidal cells and occur more diffusely than type I cells. They appear foamier than type I cells because of they contain phospholipid multilamellar bodies, the precursor to pulmonary surfactant. Capillaries form a plexus around each alveolus. What would happen if the capillaries became leakier? Where would neutrophils that exit the capillaries accumulate?

Answer:

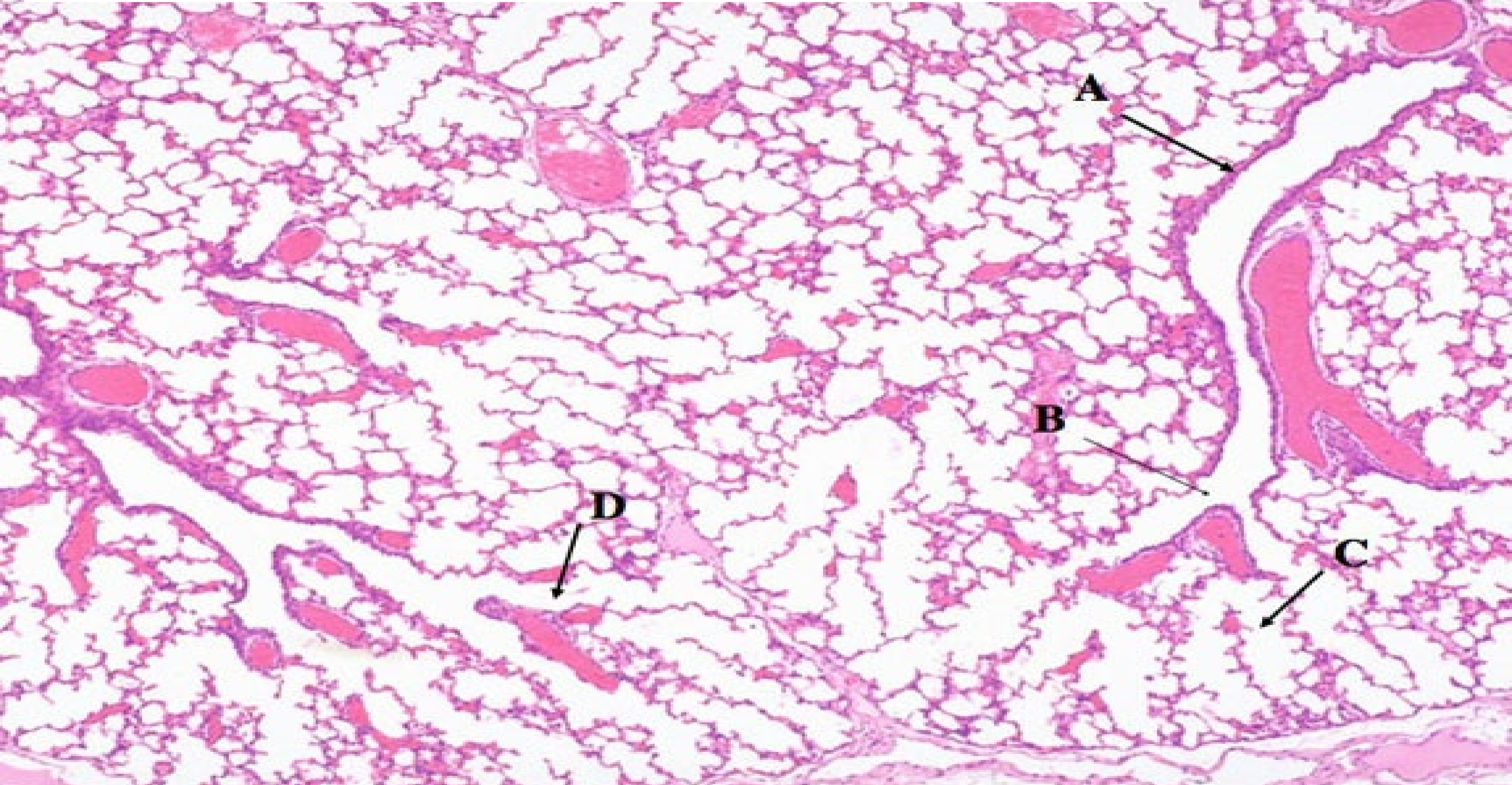


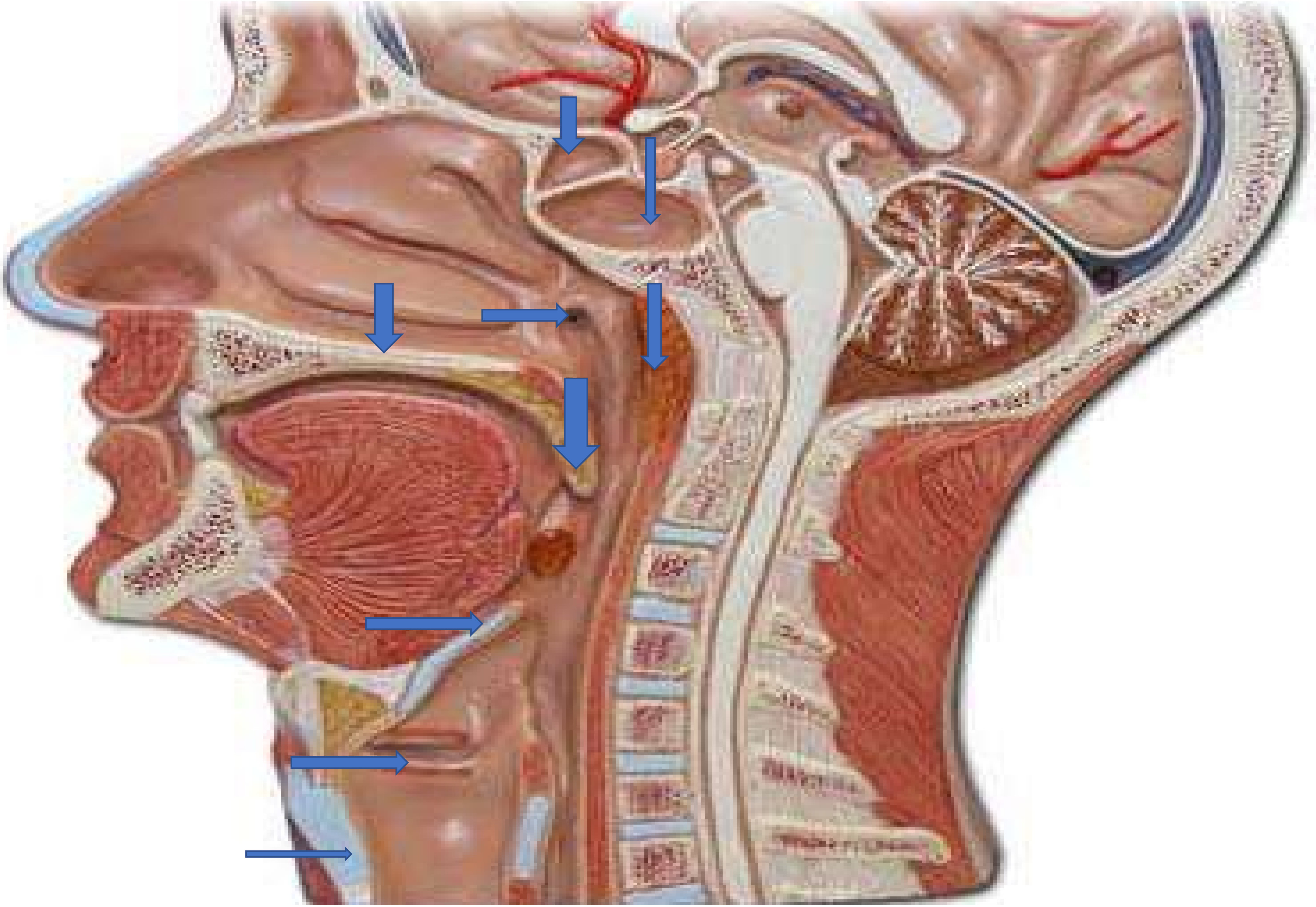


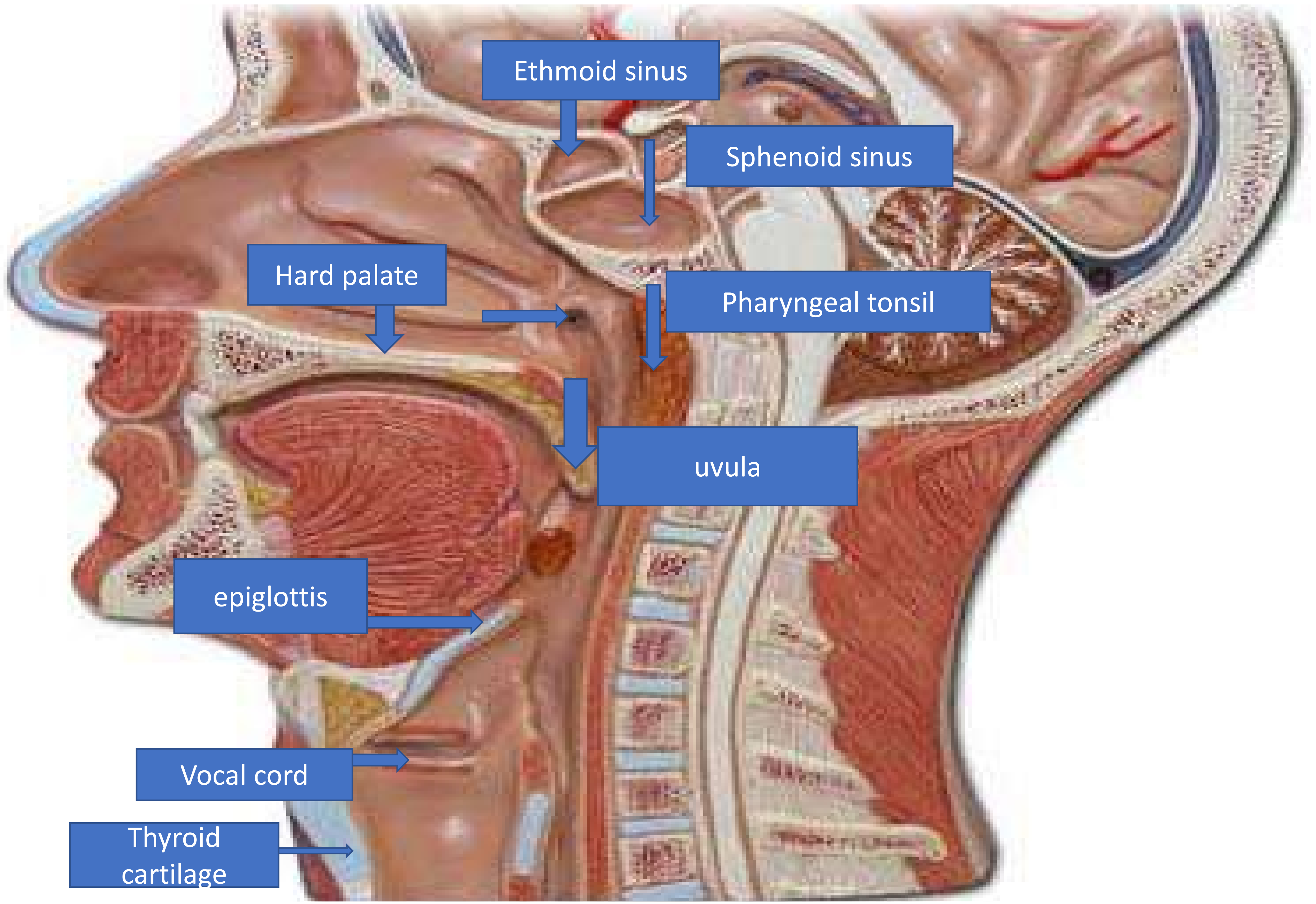
DUST CELLS OR ALVEOLAR MACROPHAGES OR PULMONARY MACROPHAGES


A
B
C
D

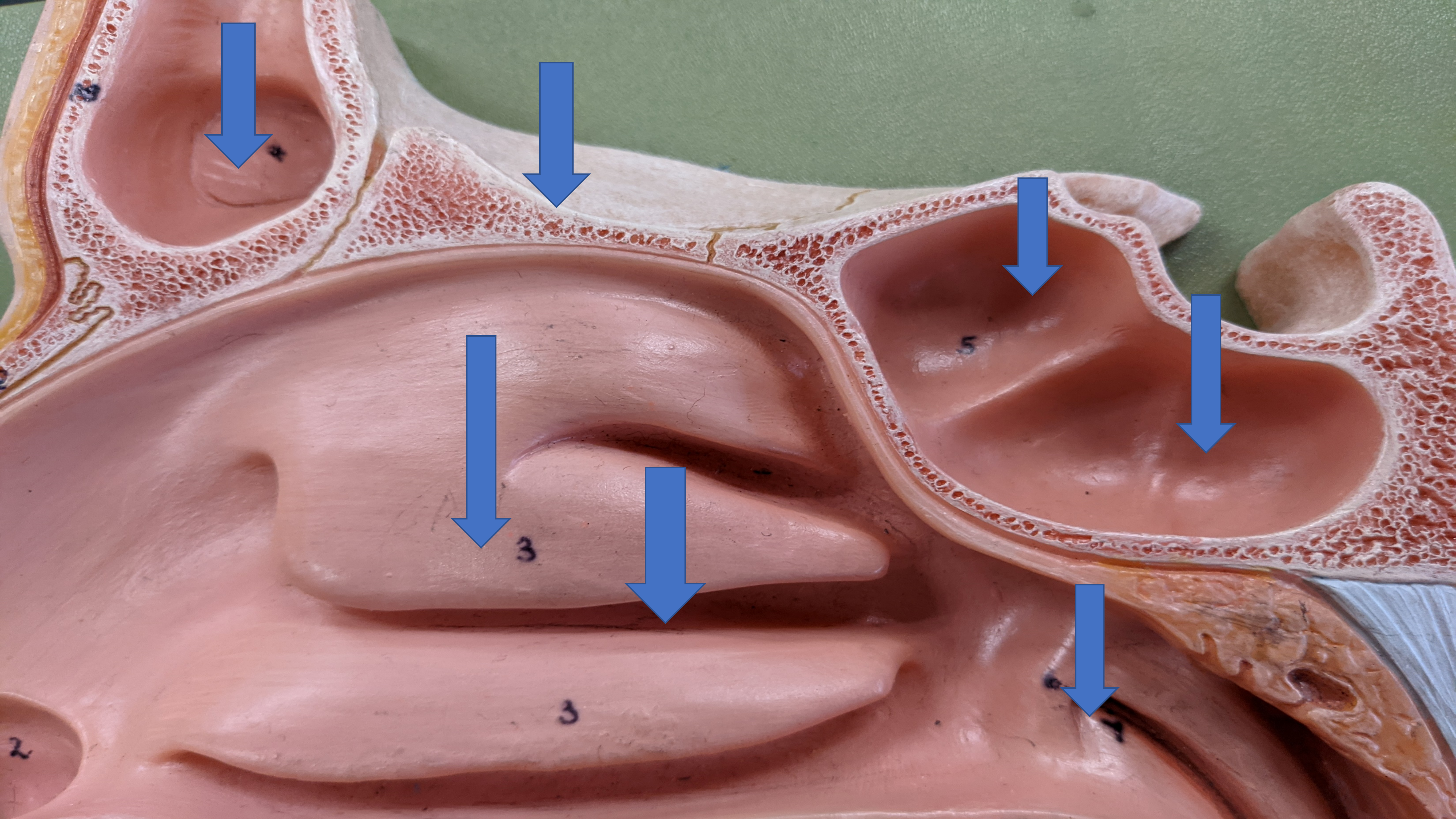
A: Terminal Bronchiole B: Respiratory Bronchiole C: Alveolar Sac D: Alveolar Duct



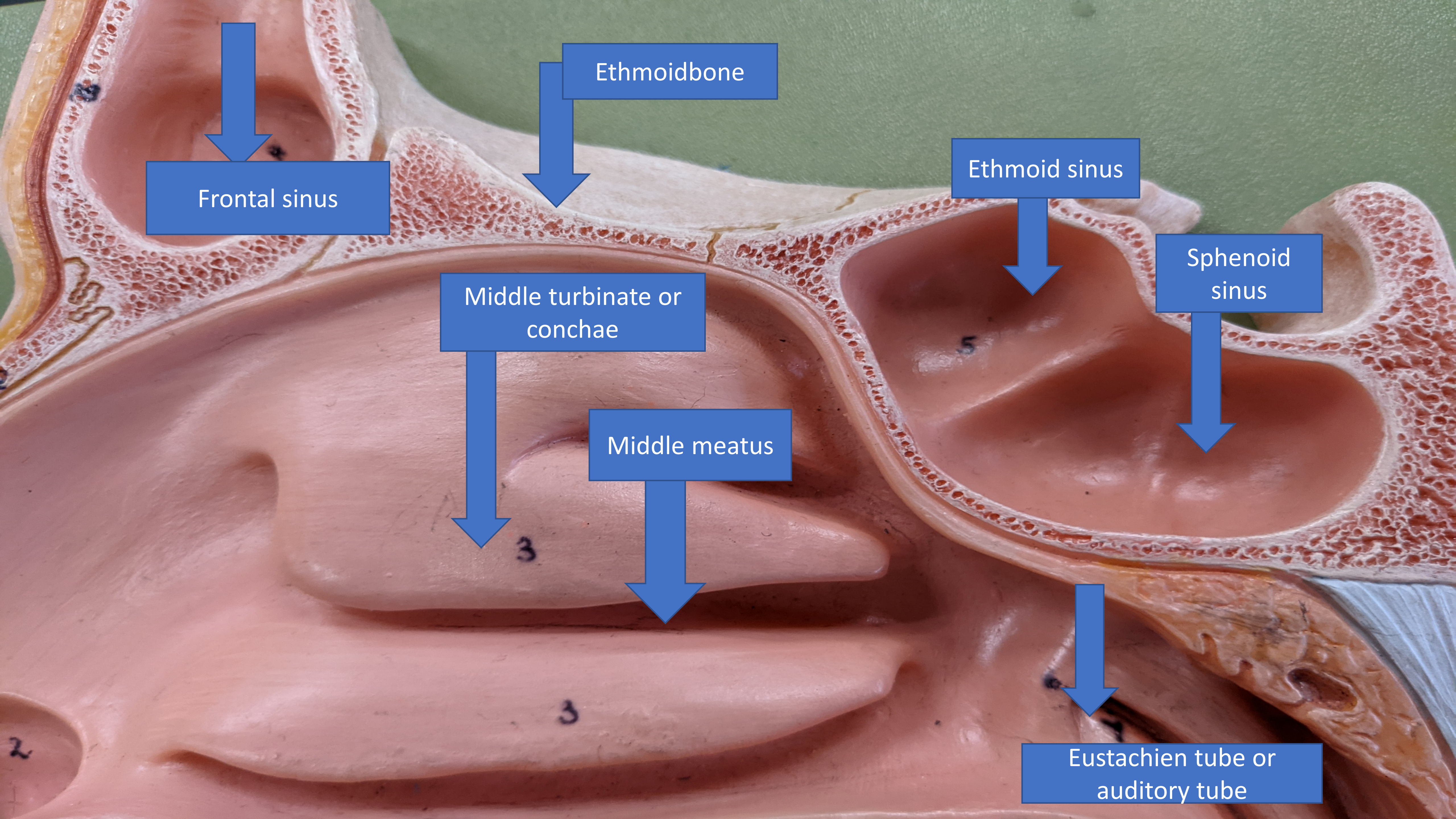


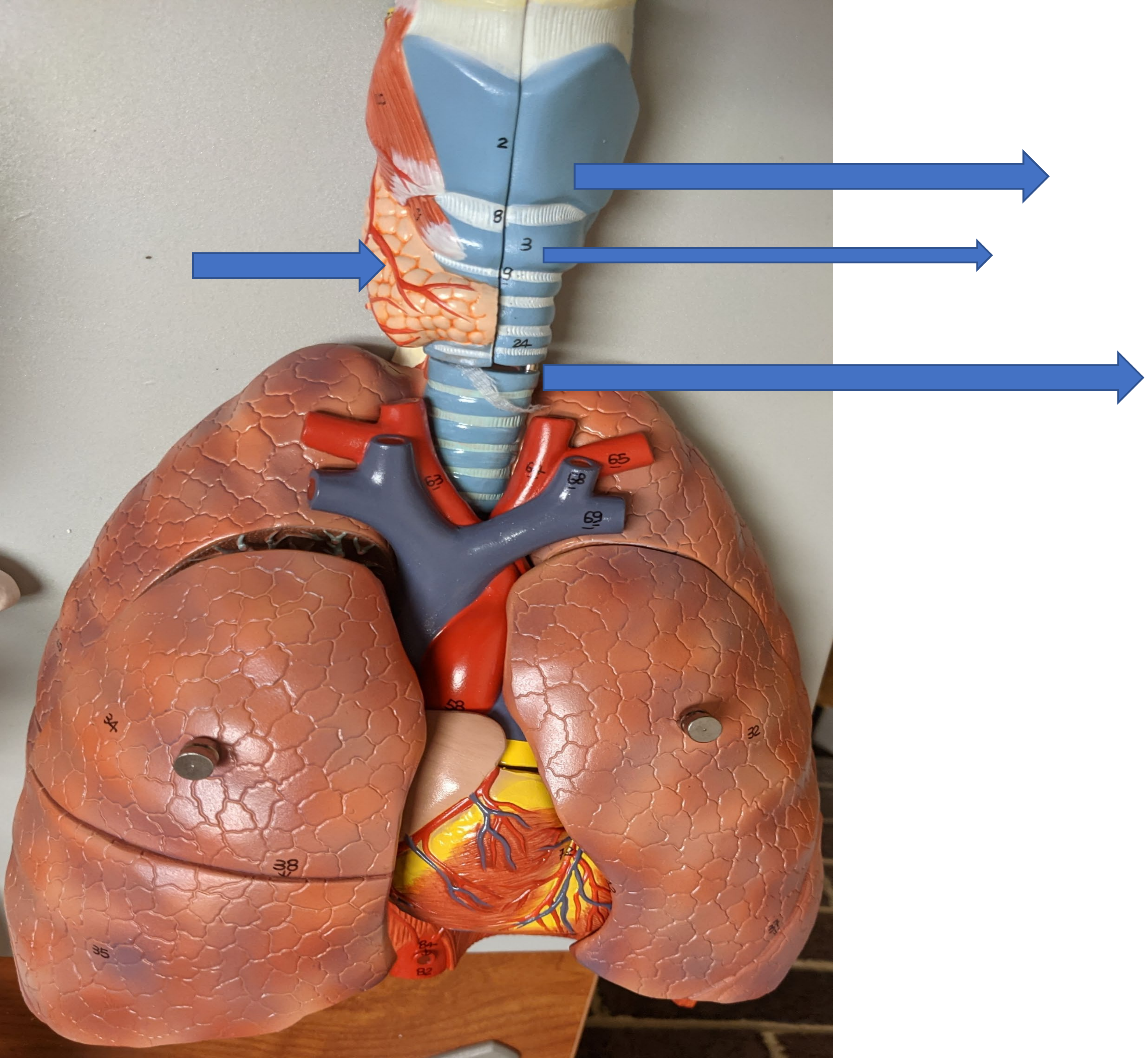


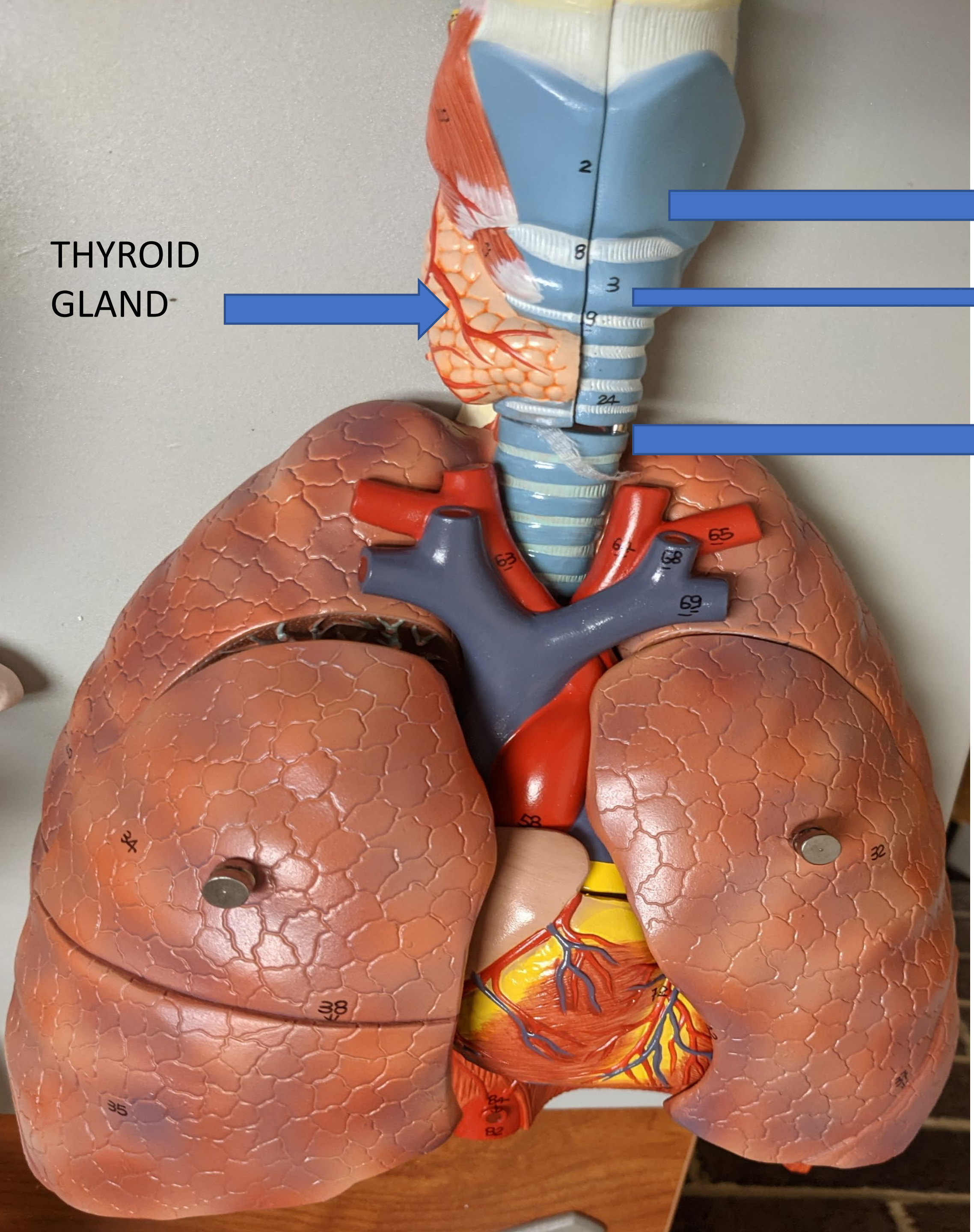
Ethmoid sinus
Sphenoid sinus
Hard palate
Pharyngeal tonsil
uvula
epiglottis
Vocal cord
Thyroid cartilage



5
3
3
2


Ethmoidbone
Frontal sinus
Ethmoid sinus
Sphenoid sinus
Middle turbinate or conchae
Middle meatus
Eustachien tube or auditory tube
5
3
3
2



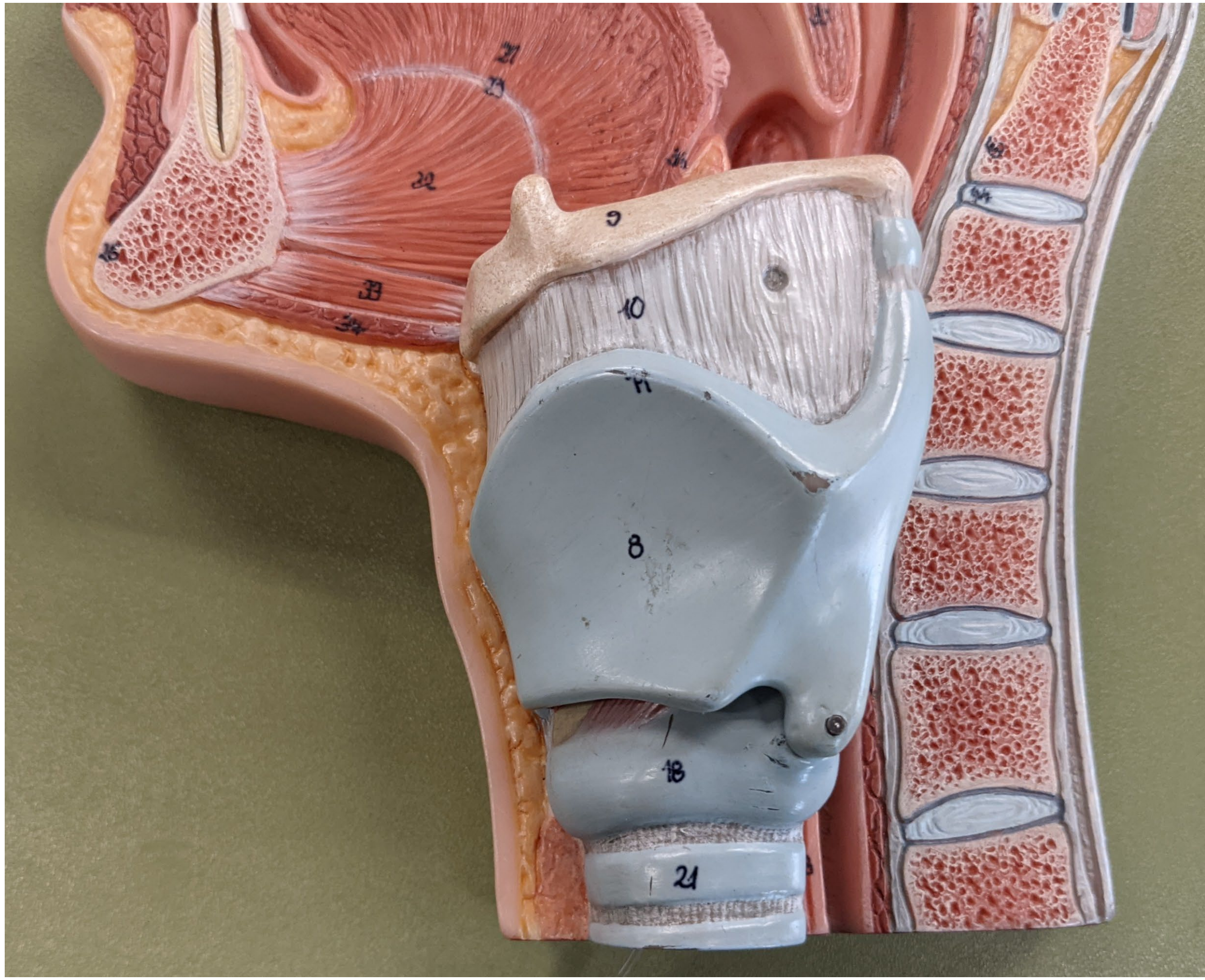

THYROID GLAND
Thyroid cartilage
Cricoid cartilage
C RING CARTILAGE OF THE TRACHEA

Identify the cartilaginous anatomical structures shown in the anterior view of the superior portion of the lower respiratory system.

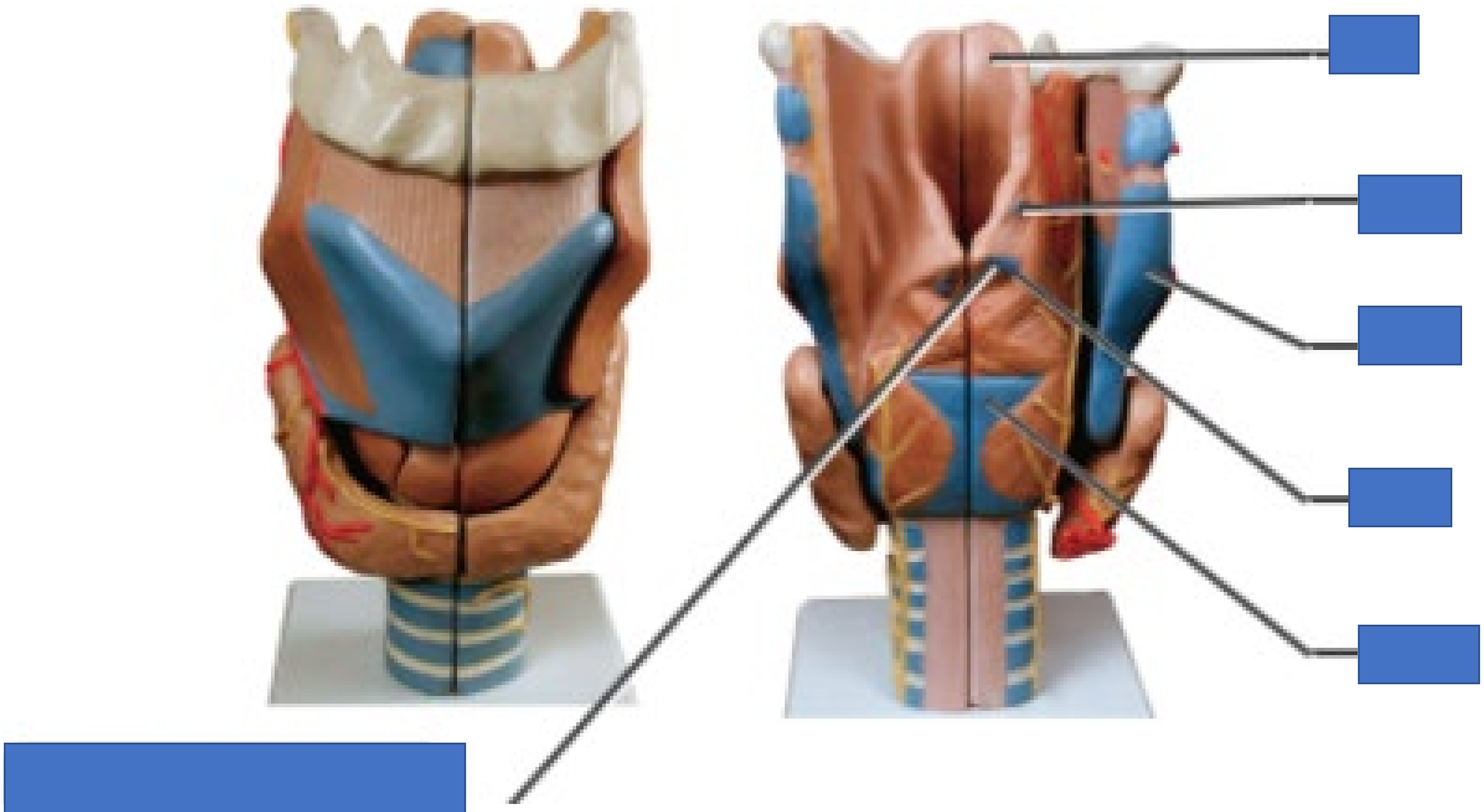
2?
3?
24?

Identify the cartilaginous anatomical structures shown in the anterior view of the superior portion of the lower respiratory system.

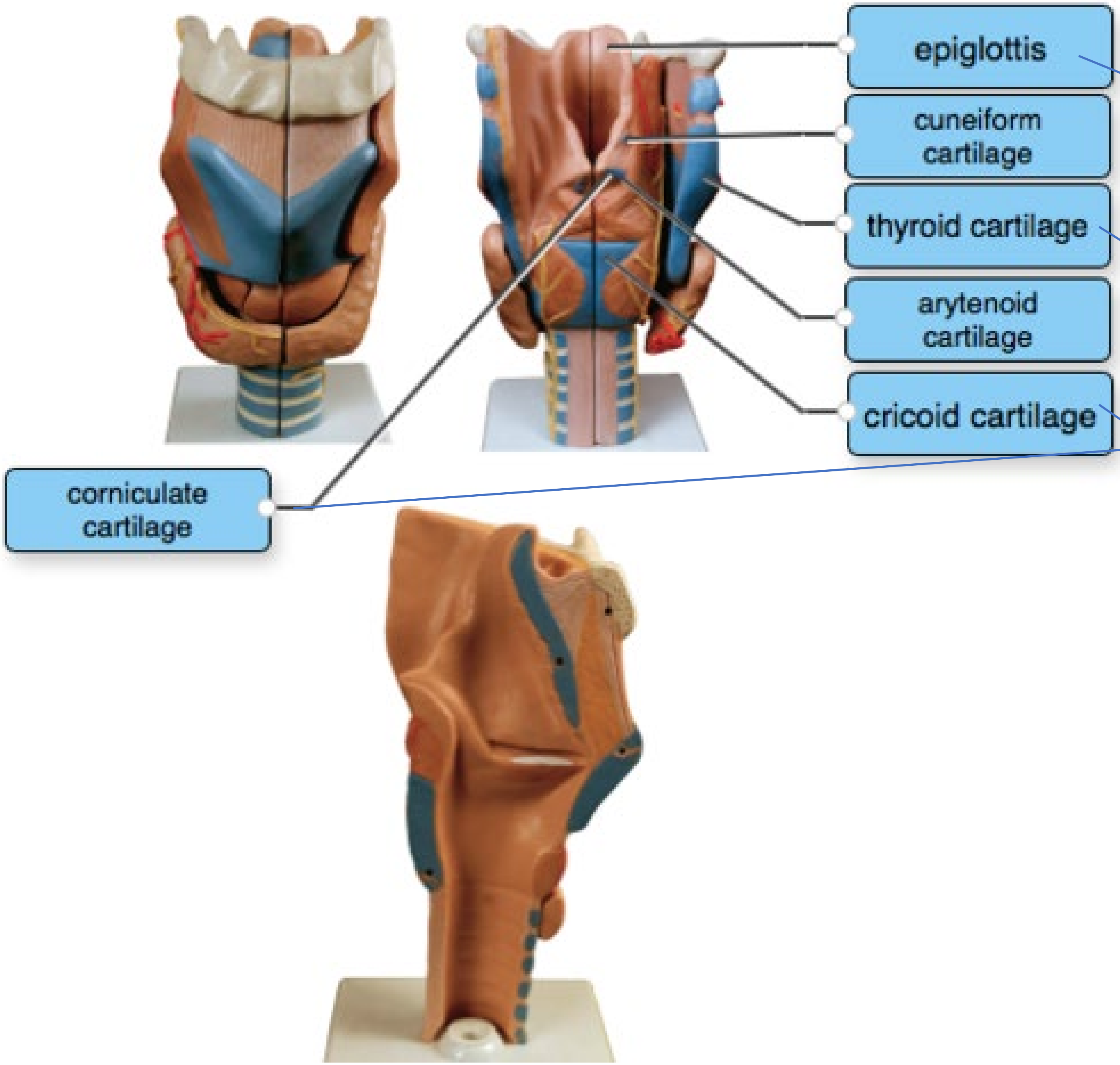
2. Thyroid cartilage
3. Cricoid cartilage
24. C ring of the trachea

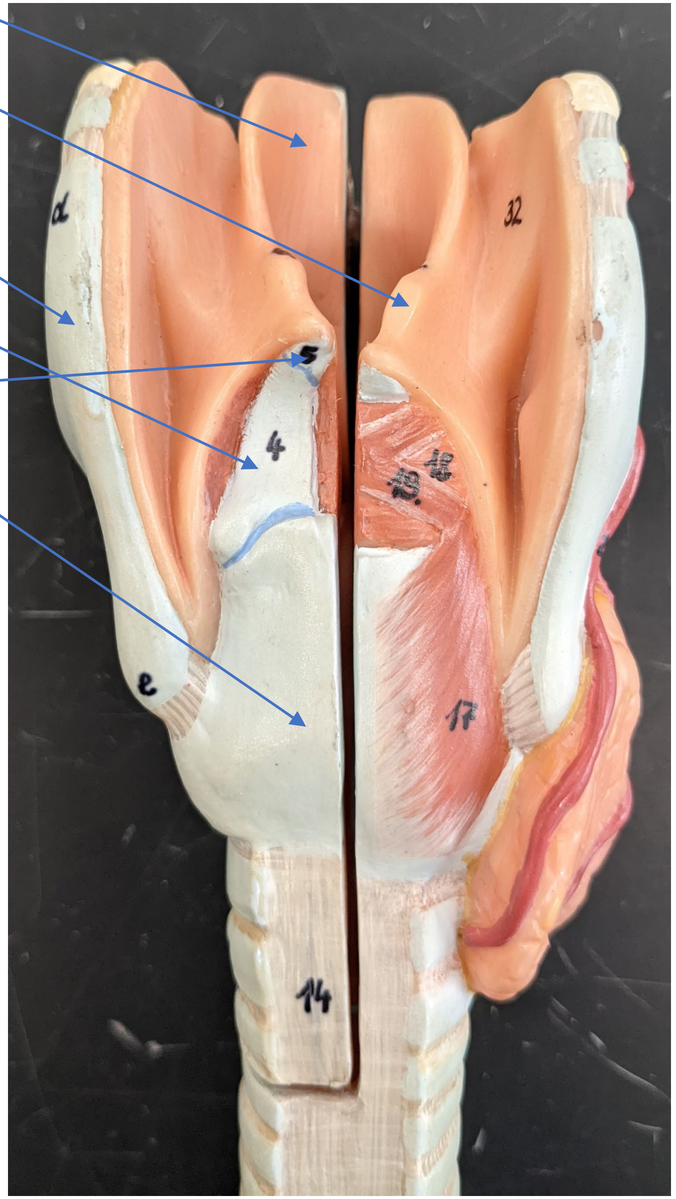


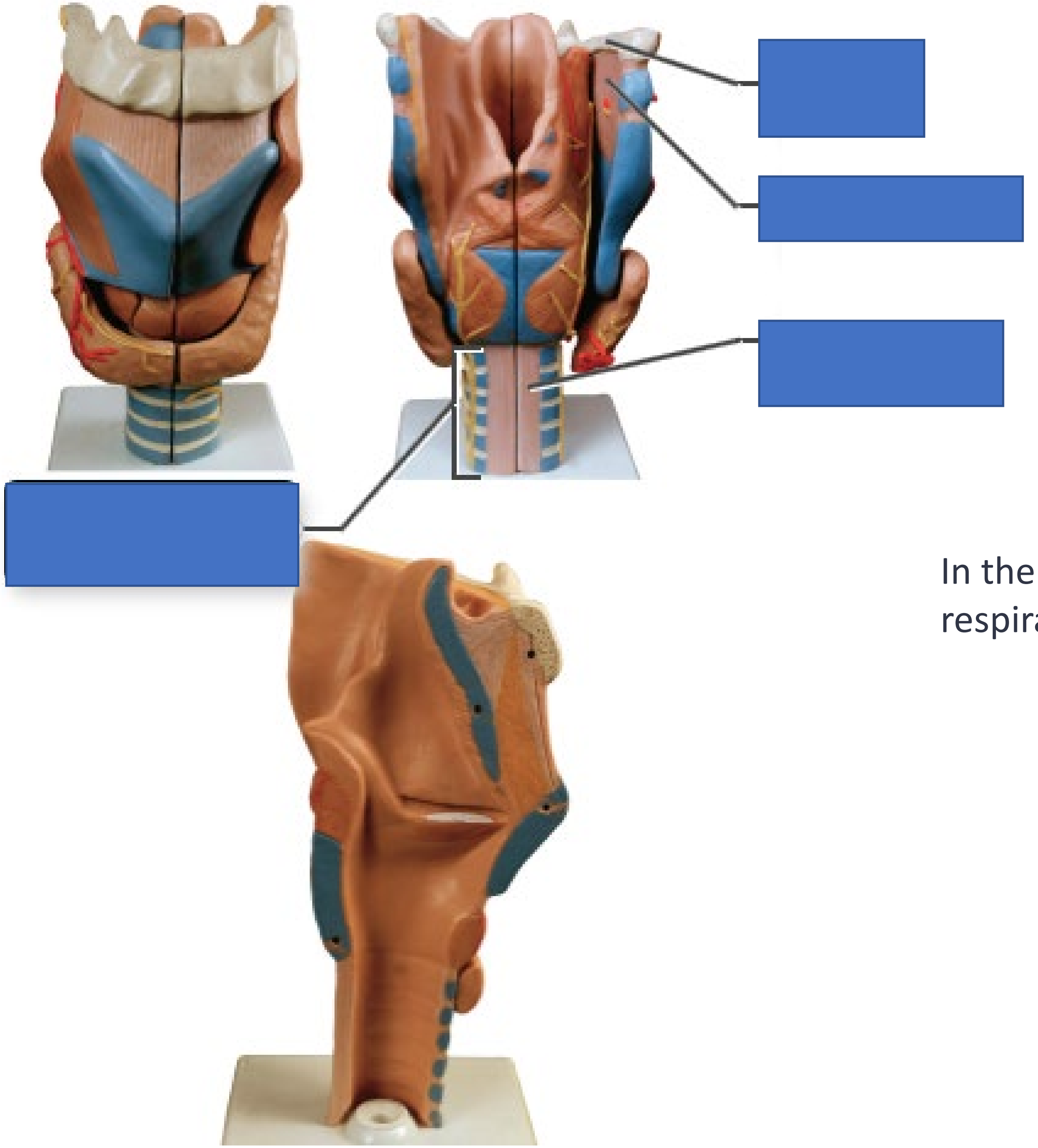
Identify the cartilaginous anatomical structures shown in the posterior view of the superior portion of the lower respiratory system.



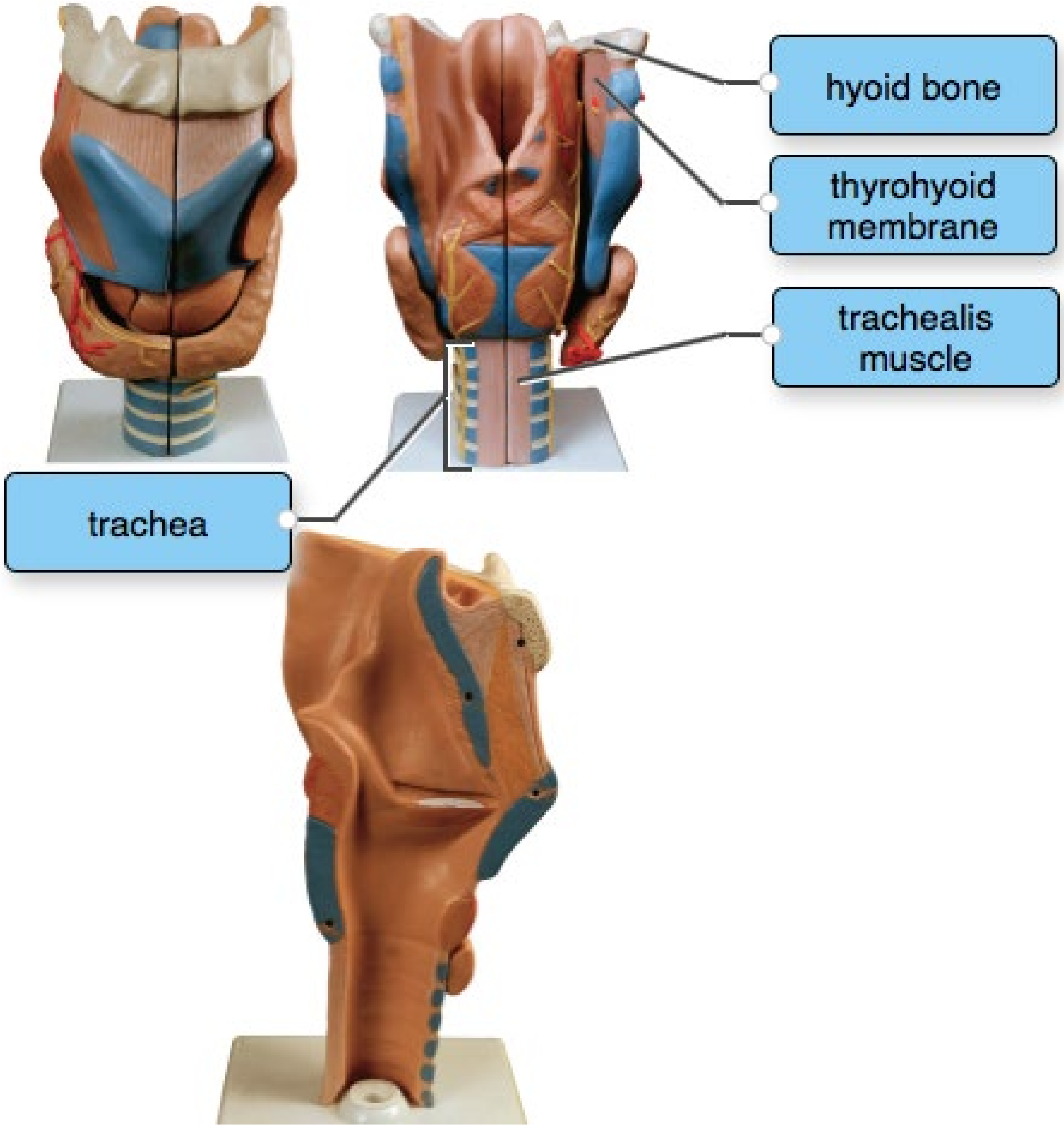
Identify the cartilaginous anatomical structures shown in the posterior view of the superior portion of the lower respiratory system.

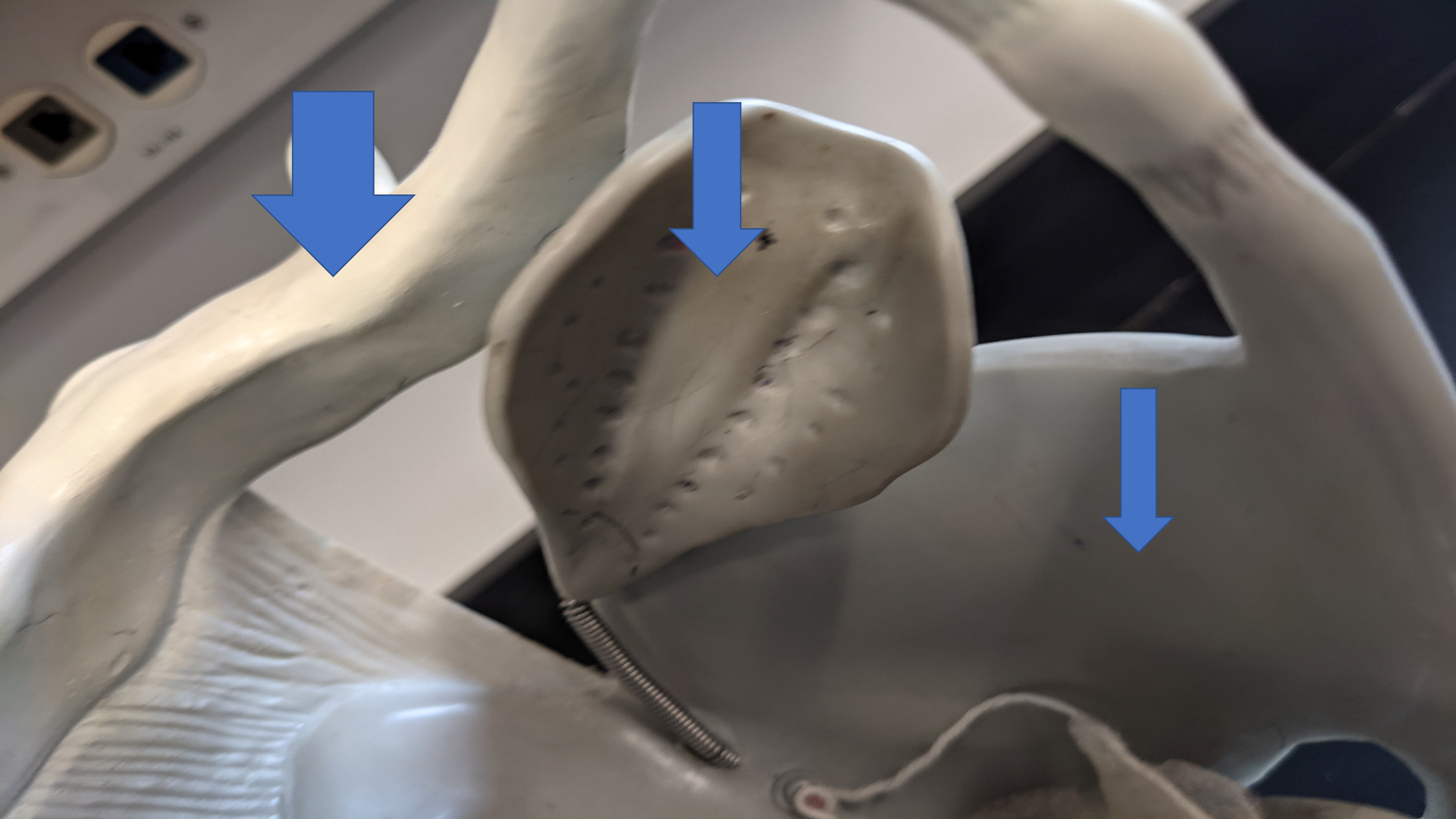


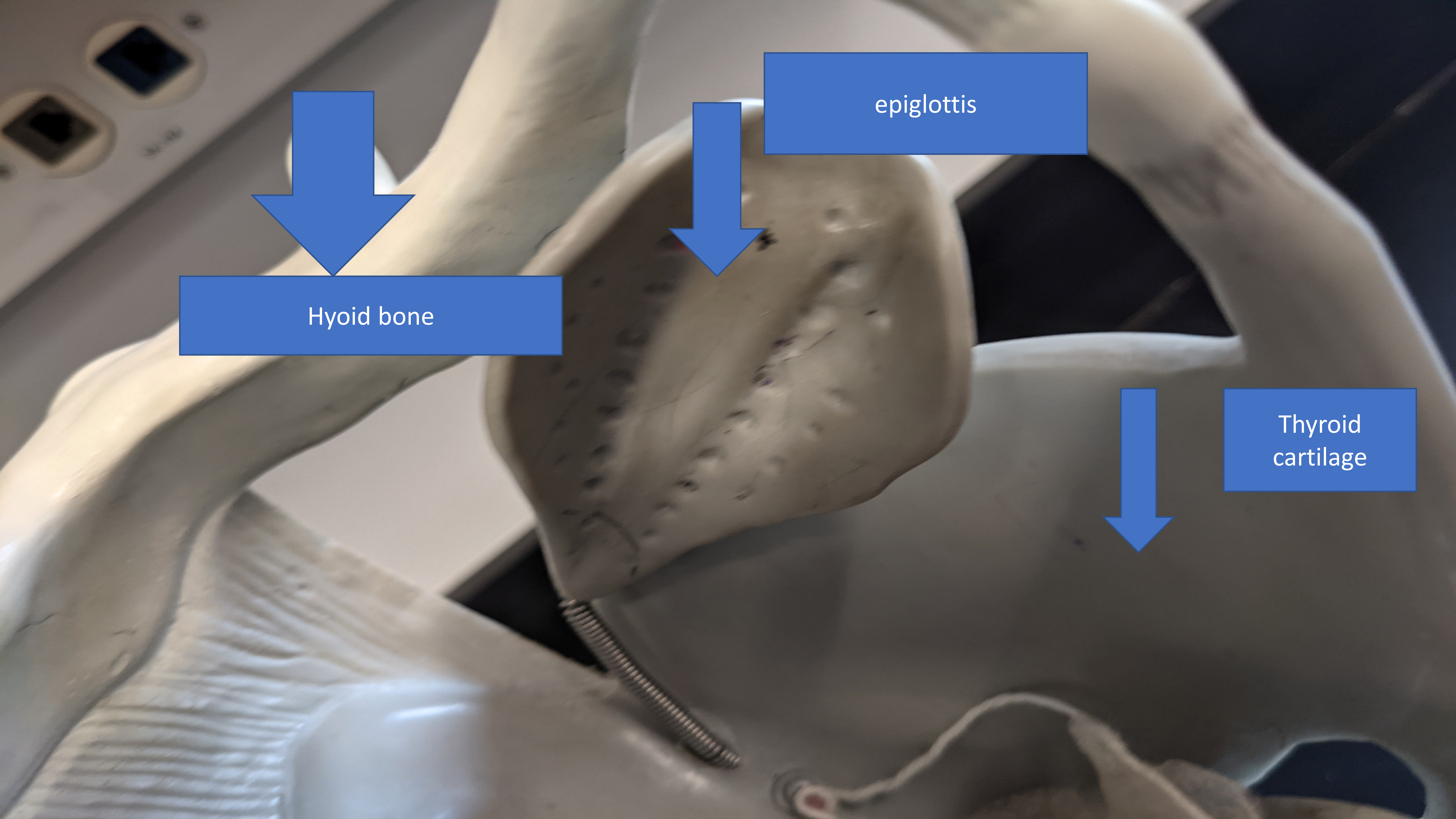


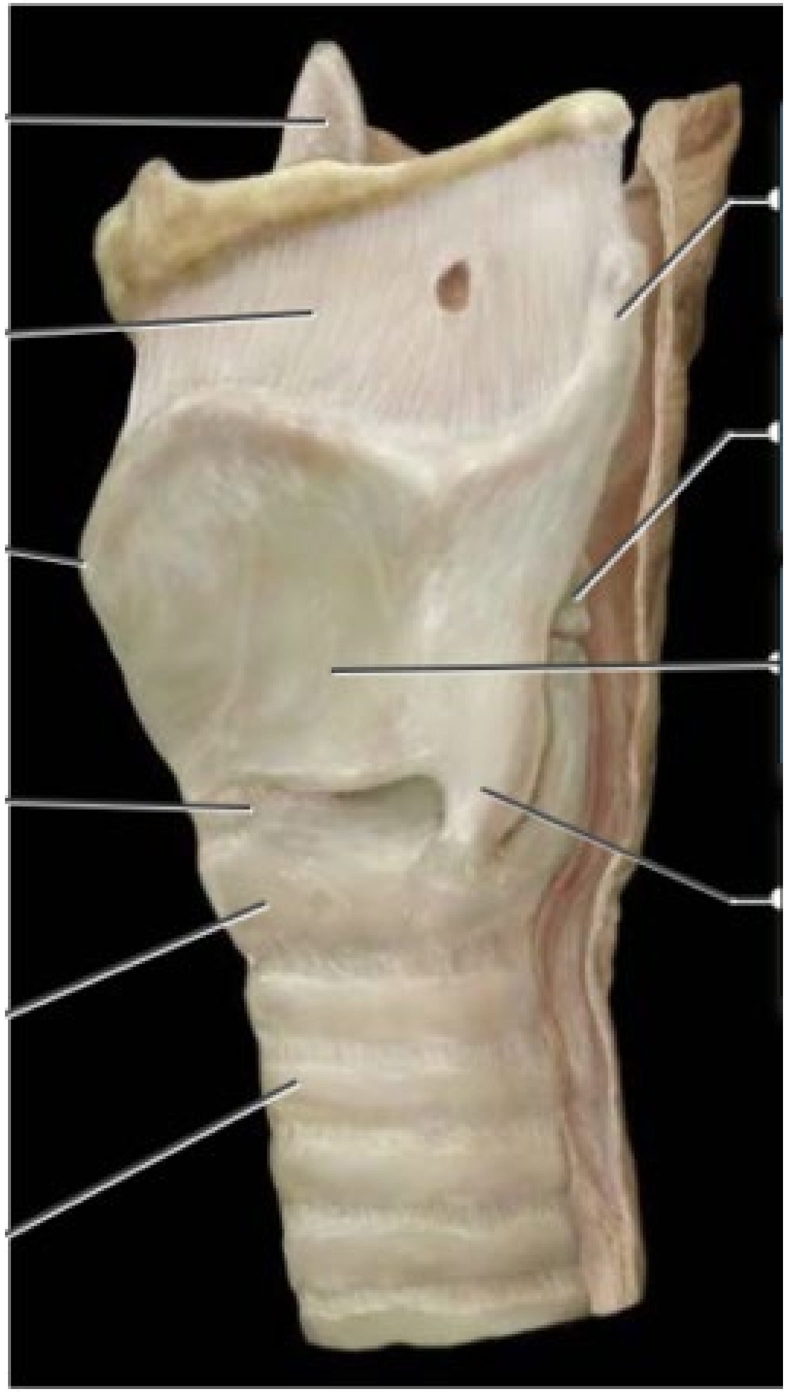


In the posterior view of the superior portion of the lower respiratory system, identify these structures.

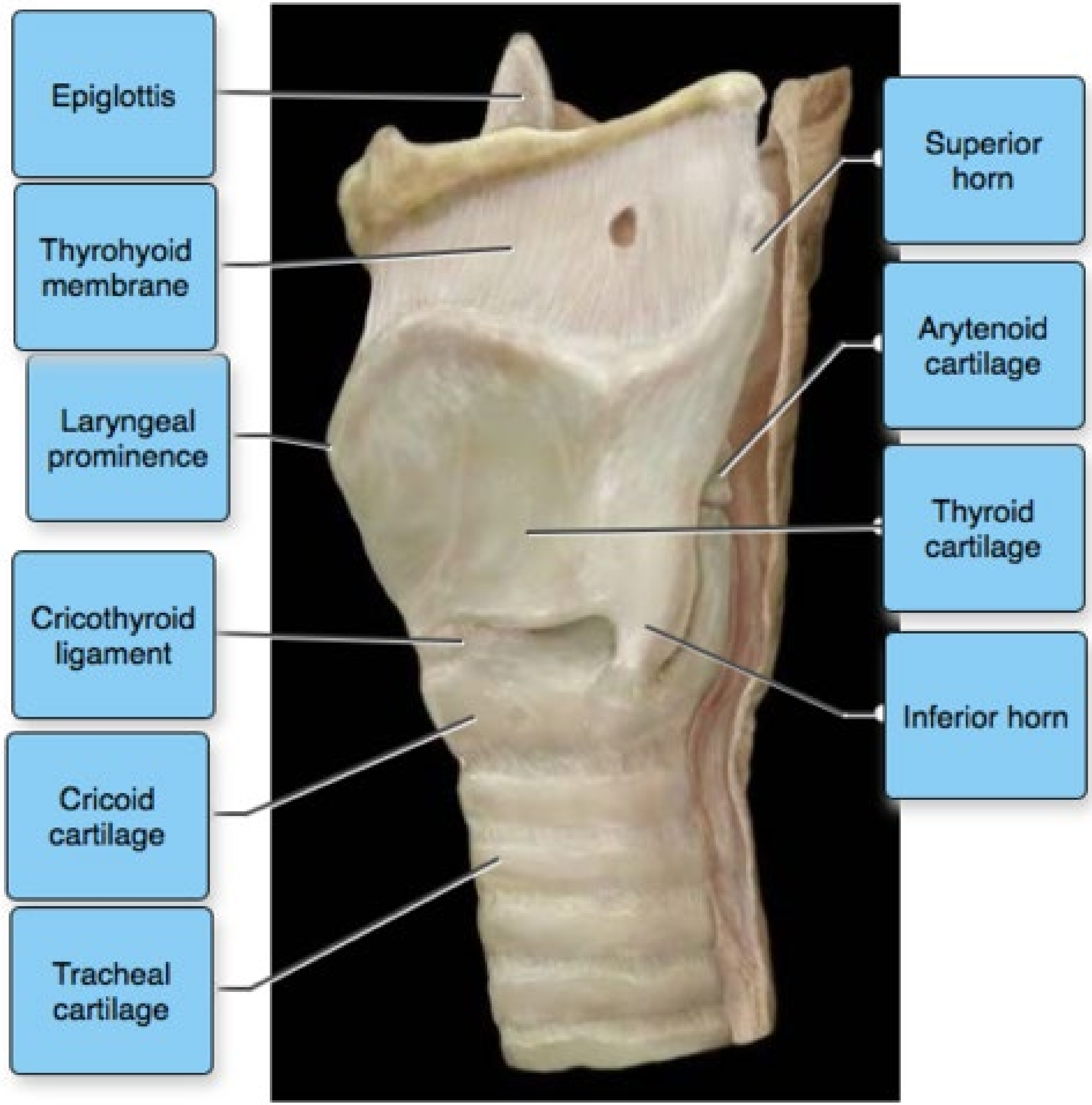

hyoid bone
thyrohyoid membrane
trachealis muscle
trachea

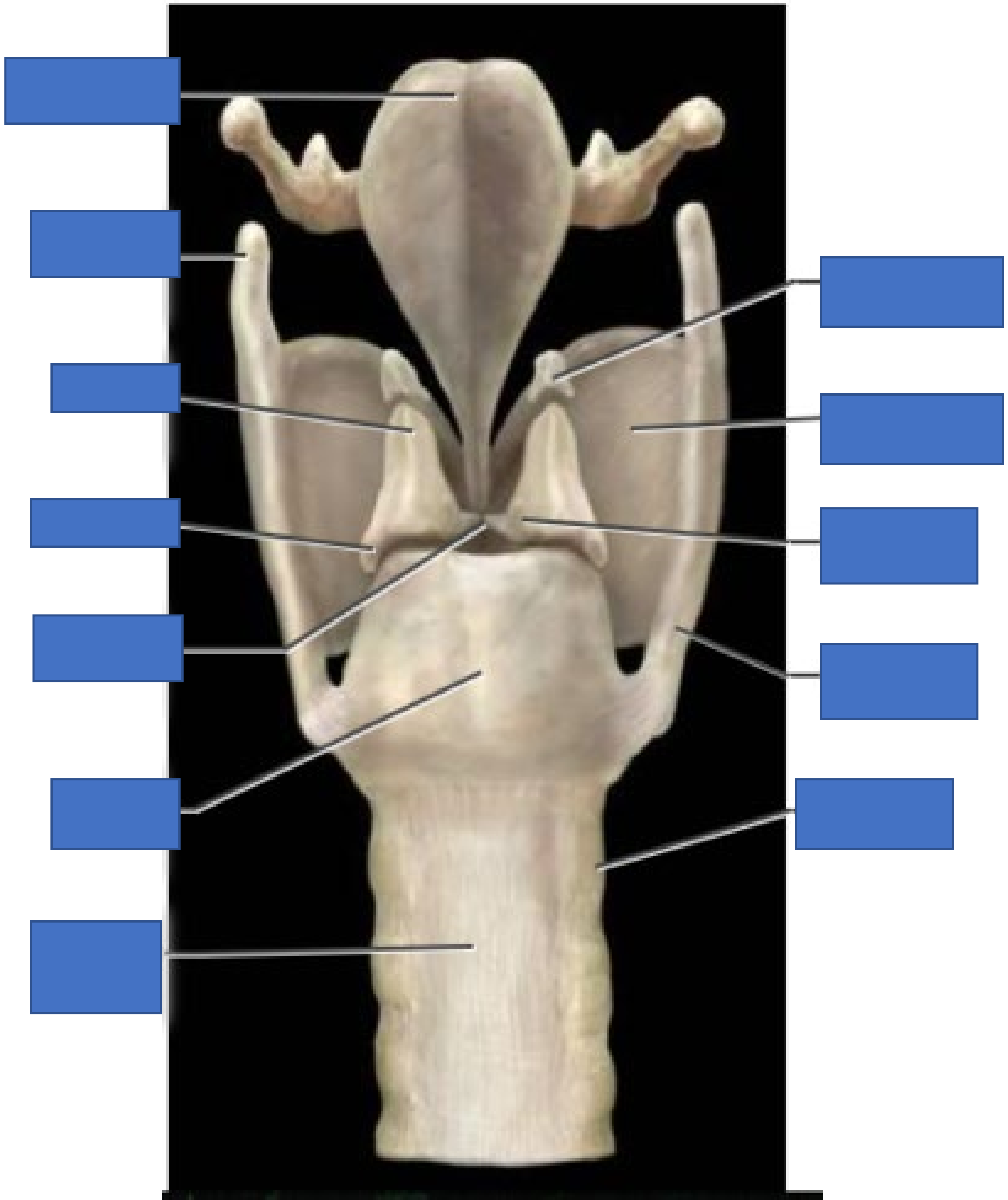


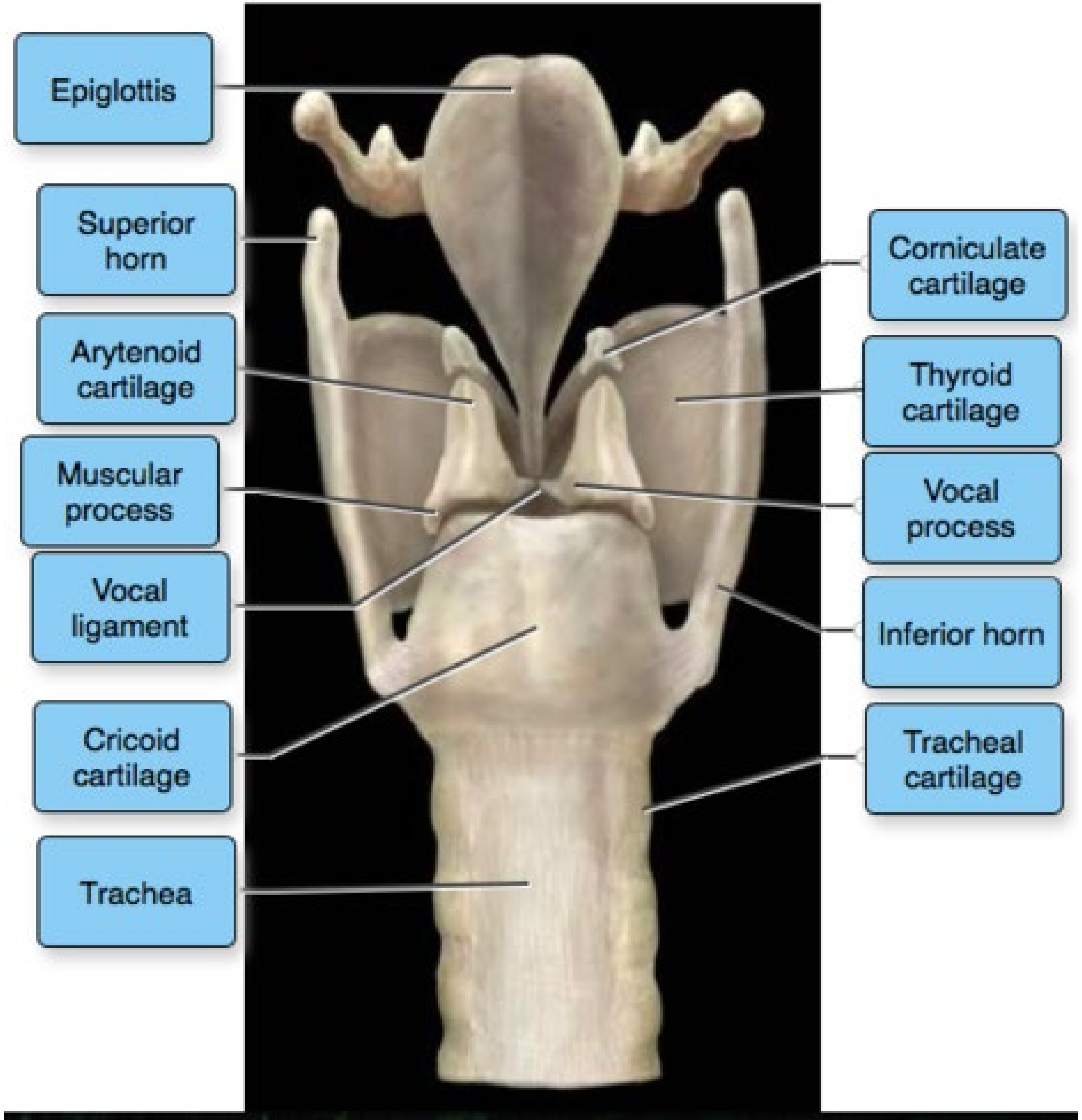

epiglottis
Hyoid bone
Thyroid cartilage



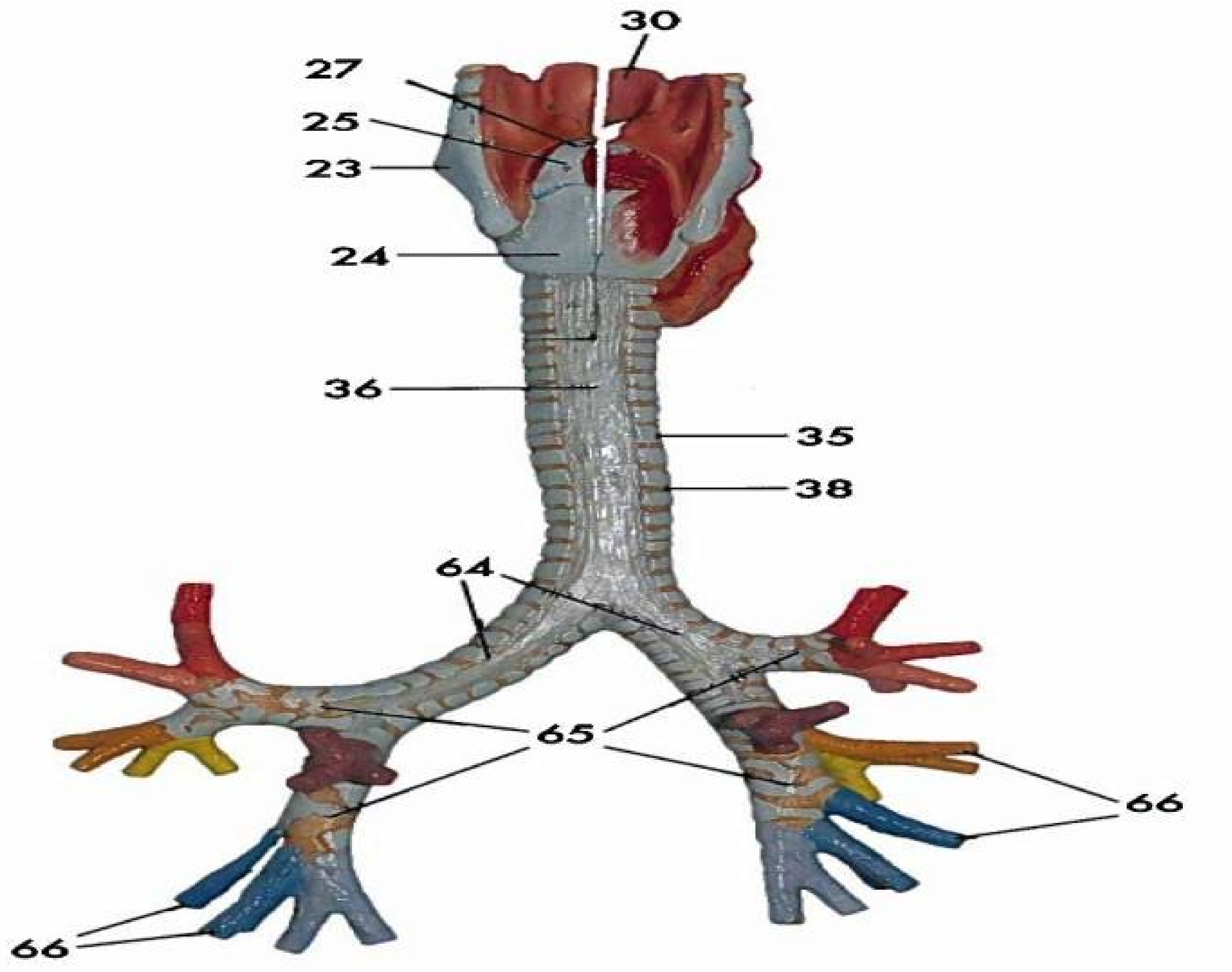
Label the lateral view of the larynx based on the hints if provided.

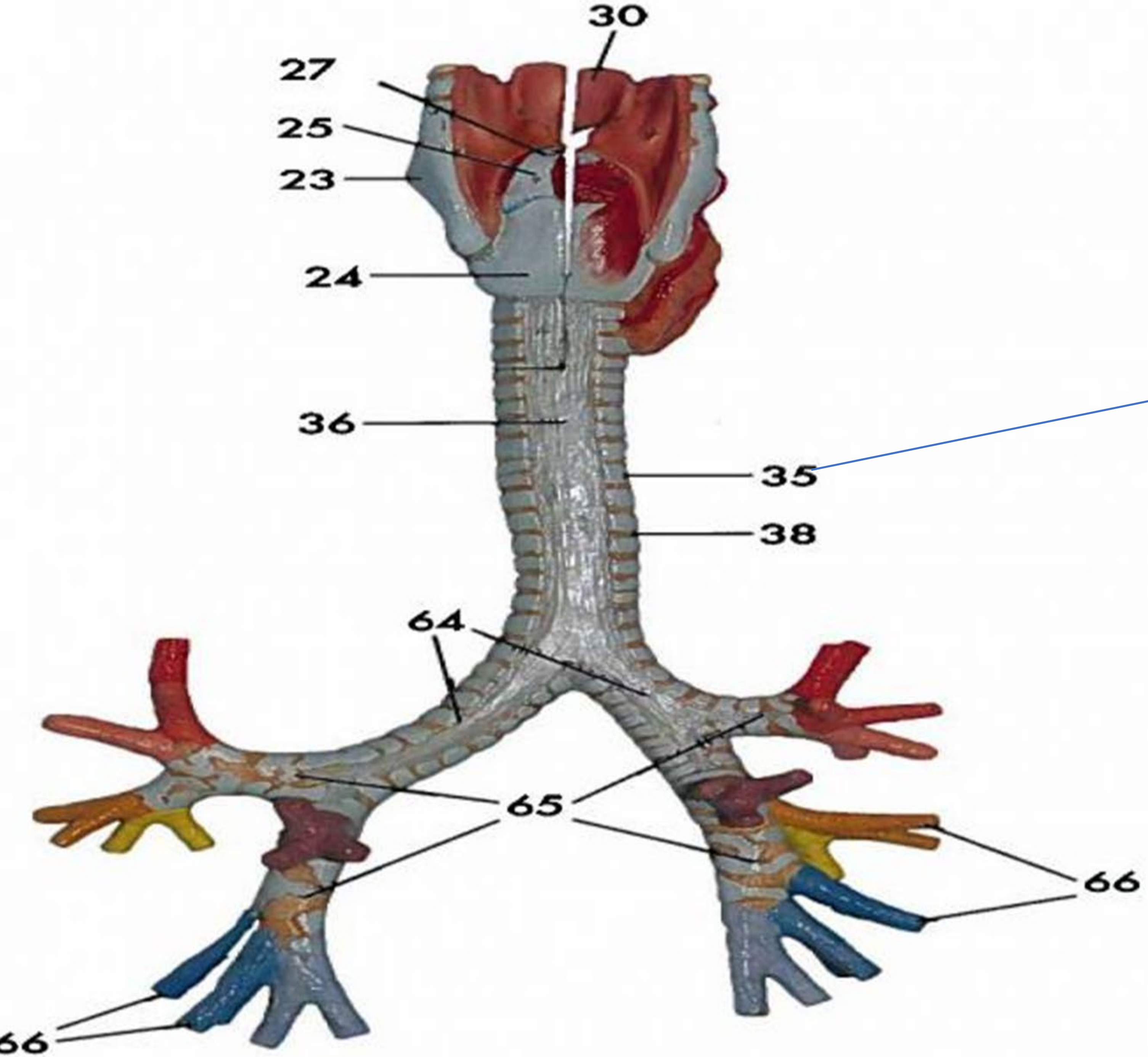

Epiglottis
Thyrohyoid membrane
Laryngeal prominence
Cricothyroid ligament
Cricoid cartilage
Tracheal cartilage
Superior horn
Arytenoid cartilage
Thyroid cartilage
Inferior horn





Epiglottis
Superior horn
Arytenoid cartilage
Muscular process
Vocal ligament
Cricoid cartilage
Trachea
Corniculate cartilage
Thyroid cartilage
Vocal process
Inferior horn
Tracheal cartilage


30
27
25
23
24
36
35
38
64
65
66
66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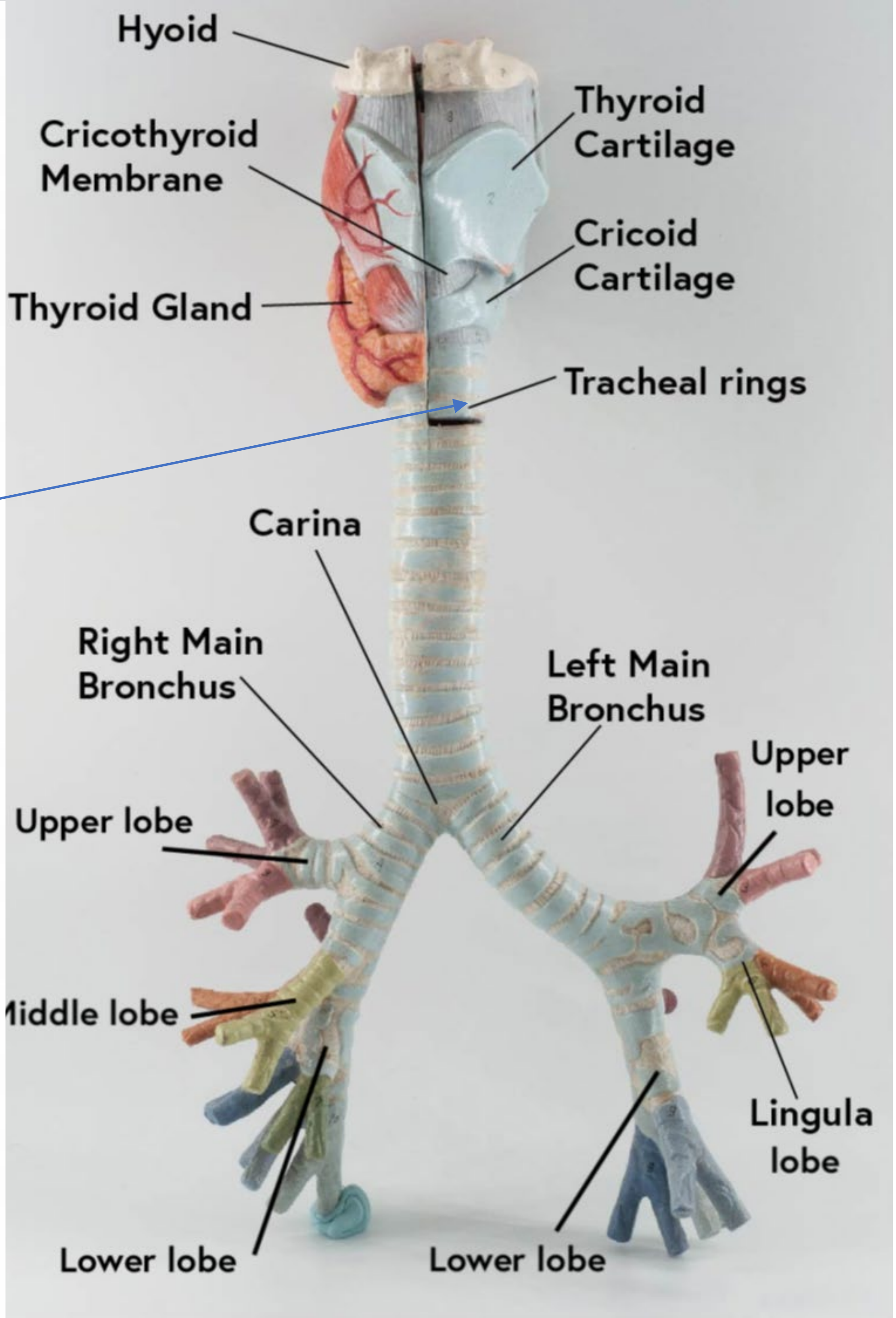
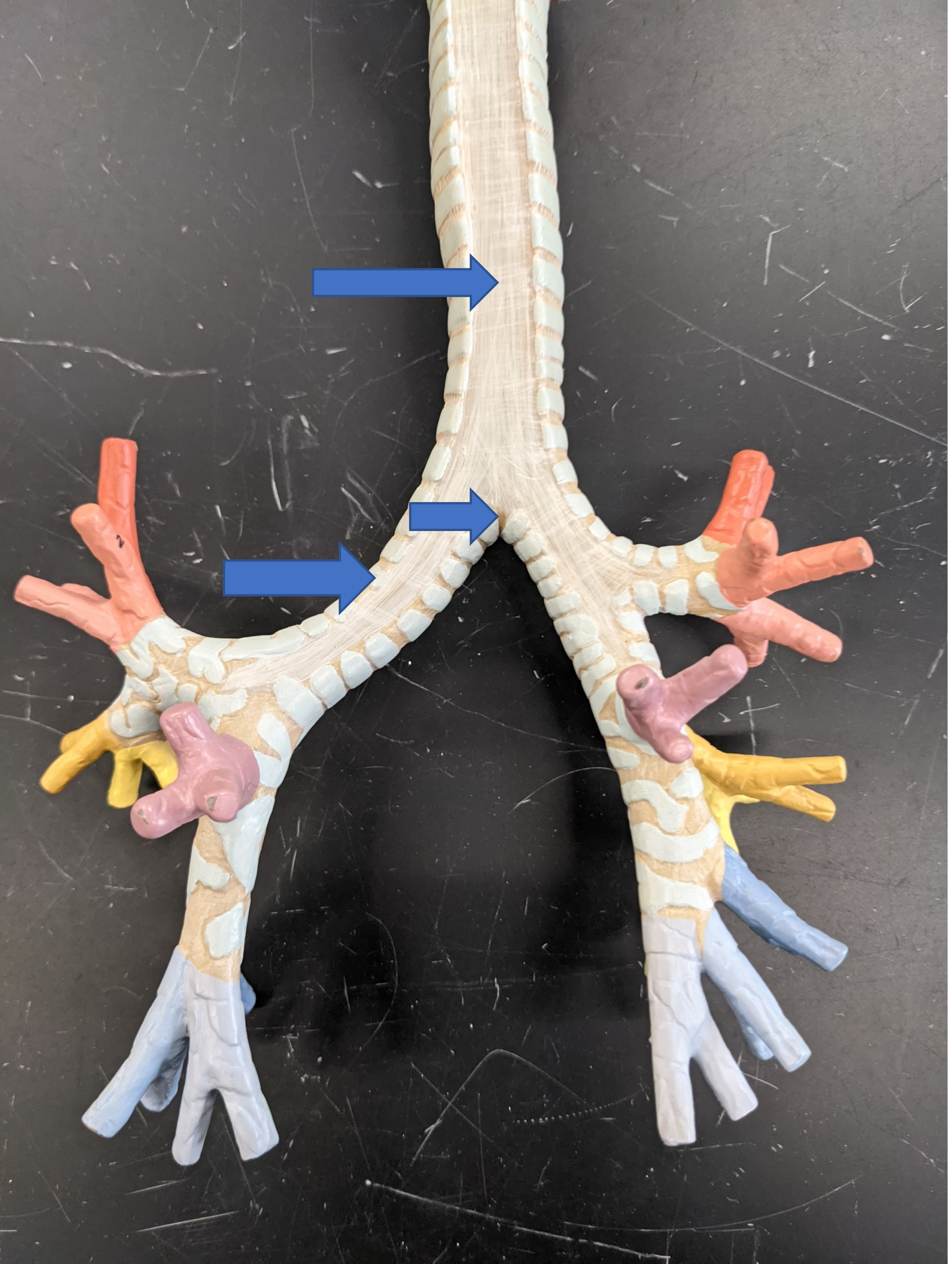
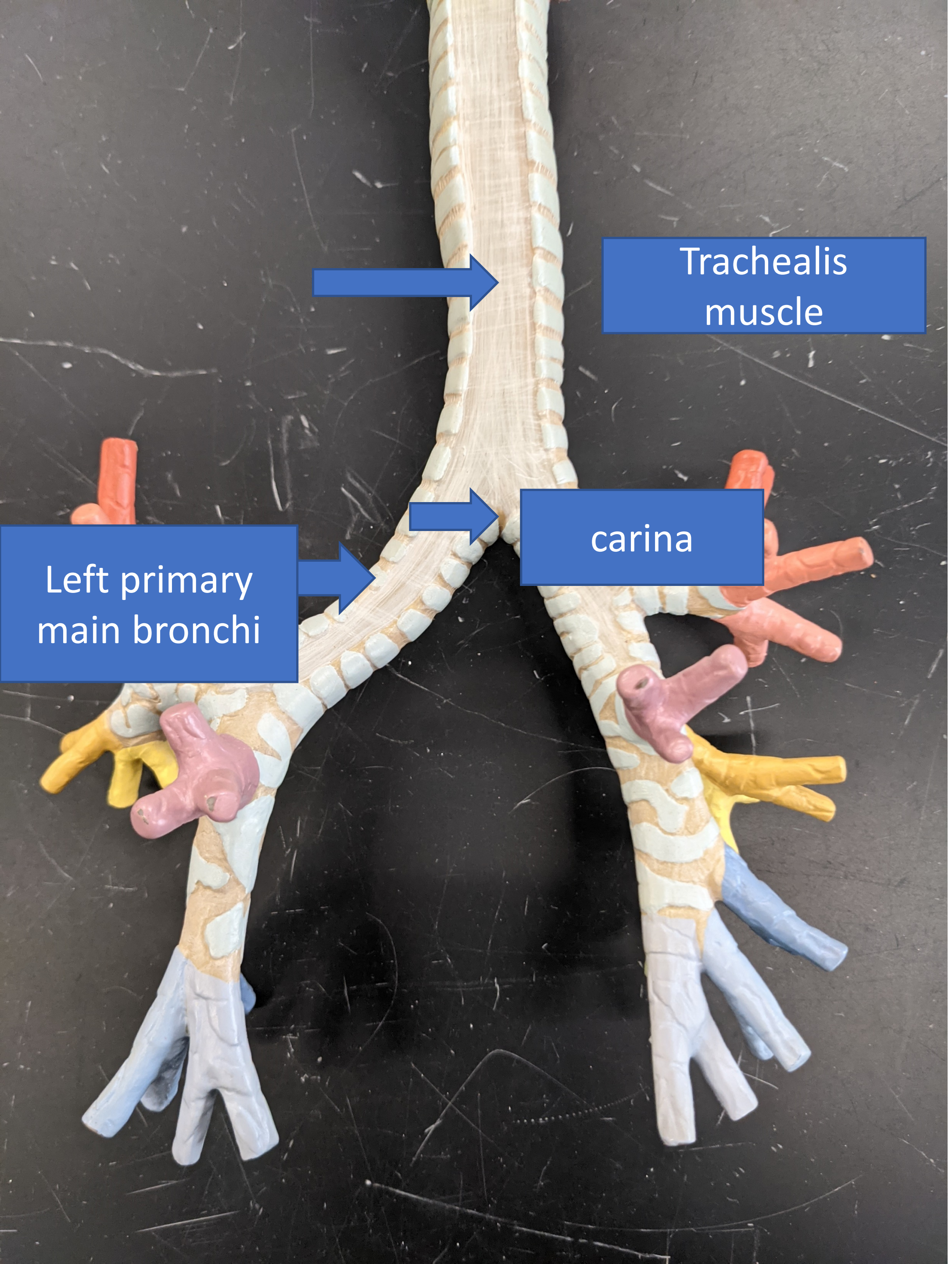
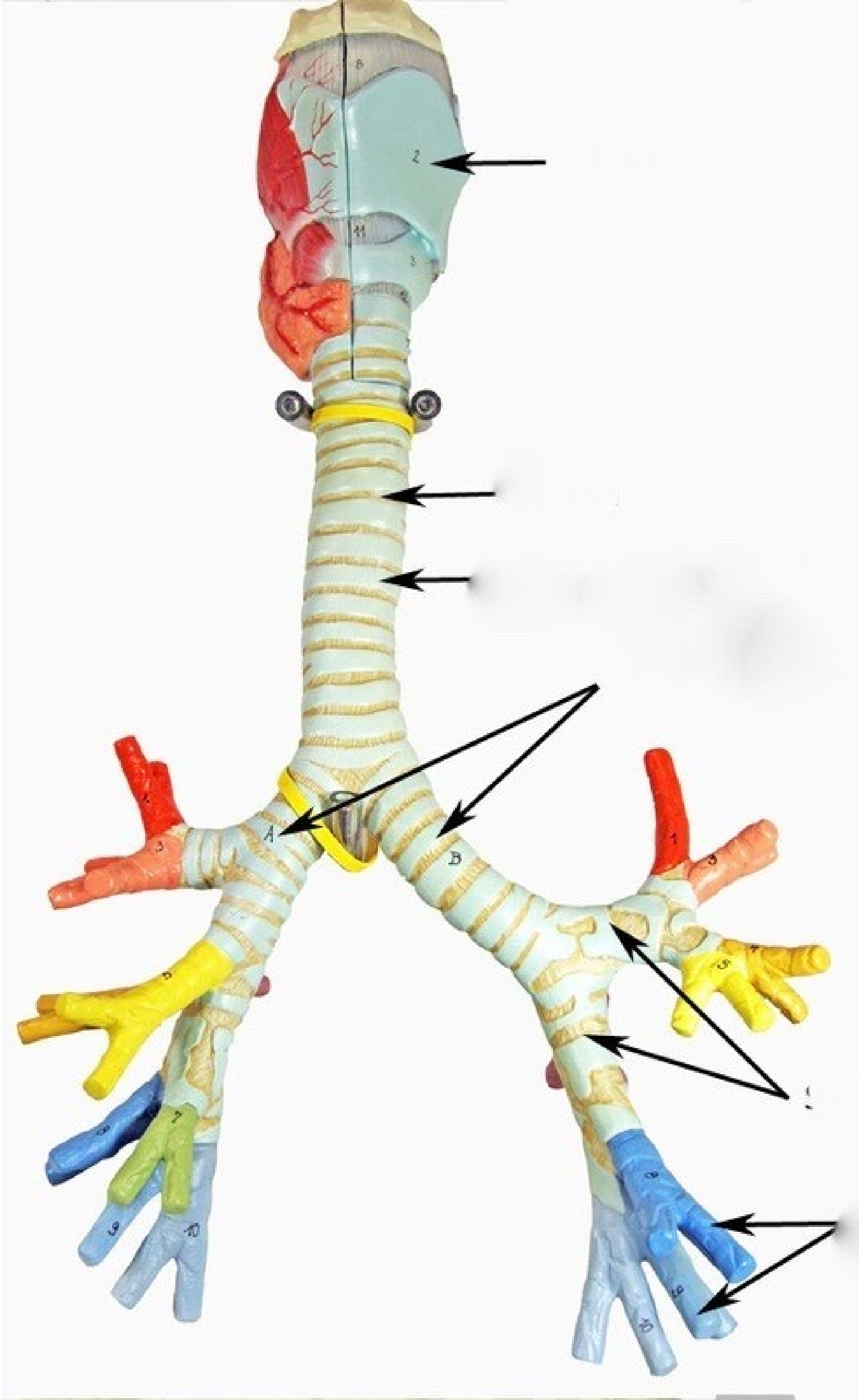
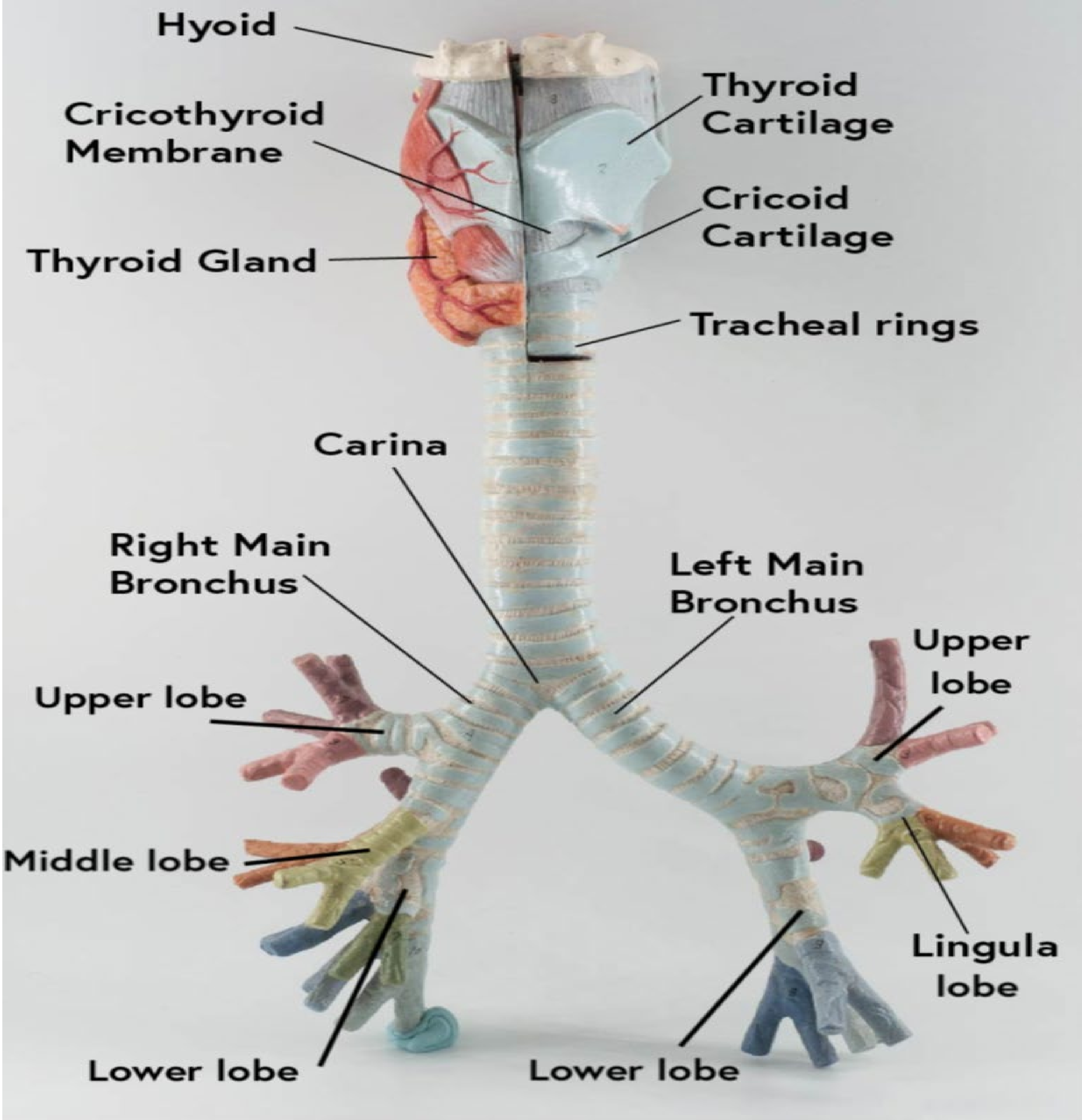
66
66


Hyoid
Thyroid Cartilage
Cricothyroid Membrane
Cricoid Cartilage
Thyroid Gland
Tracheal rings
Carina
Right Main Bronchus
Left Main Bronchus
Upper lobe
Upper lobe
Middle lobe
Lingula lobe
Lower lobe
Lower lobe

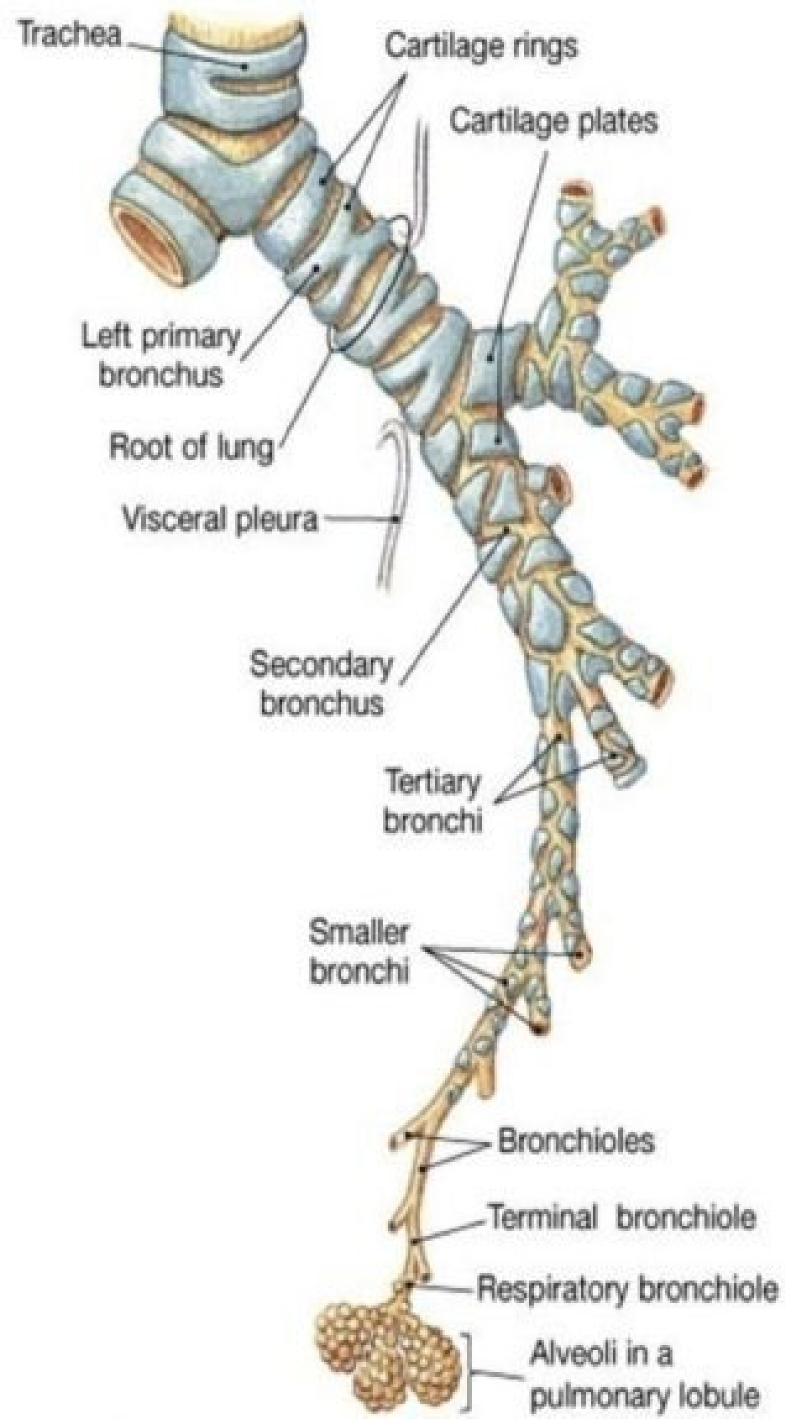


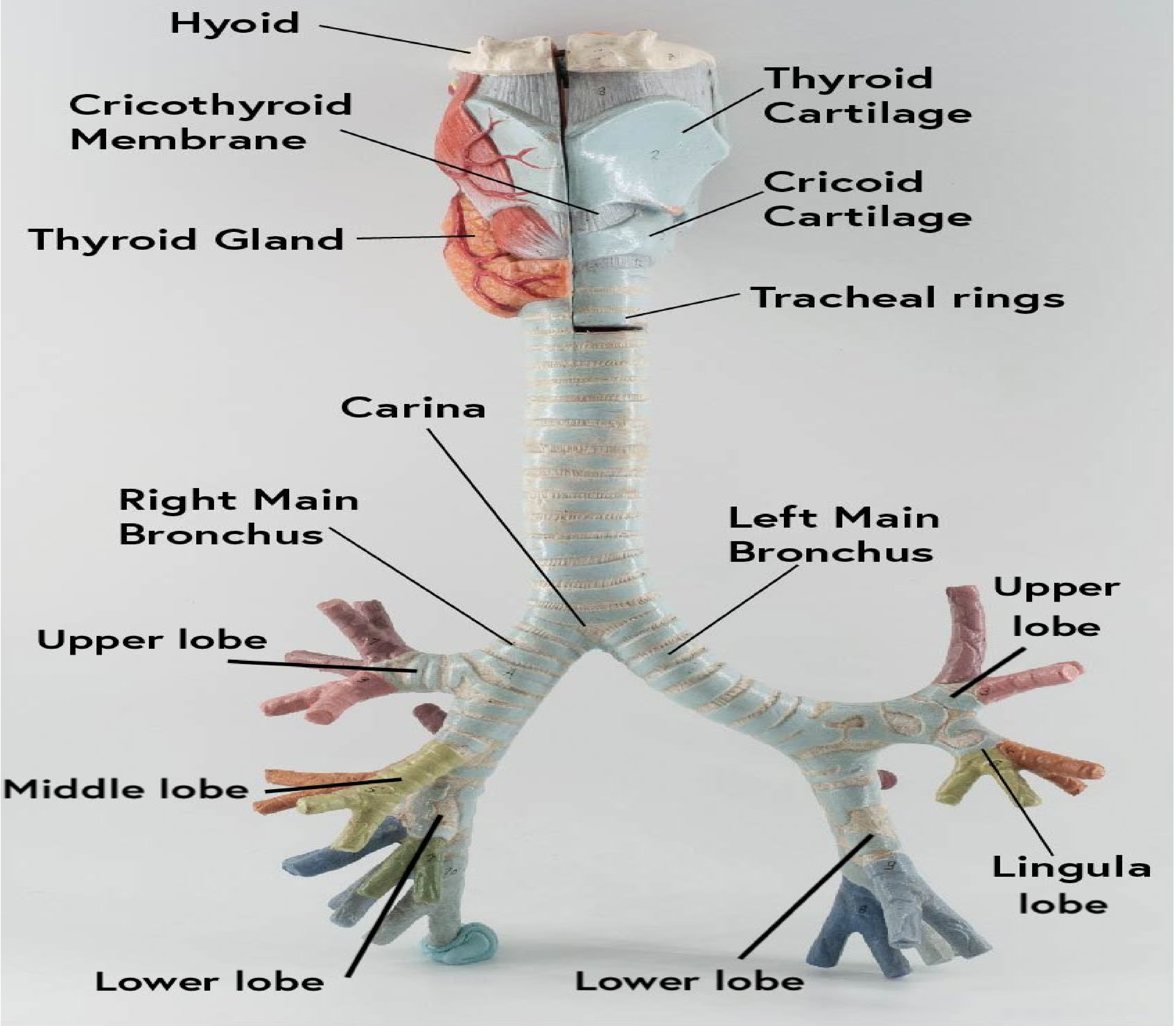

Trachealis
muscle
carina
Left primary
main bronchi

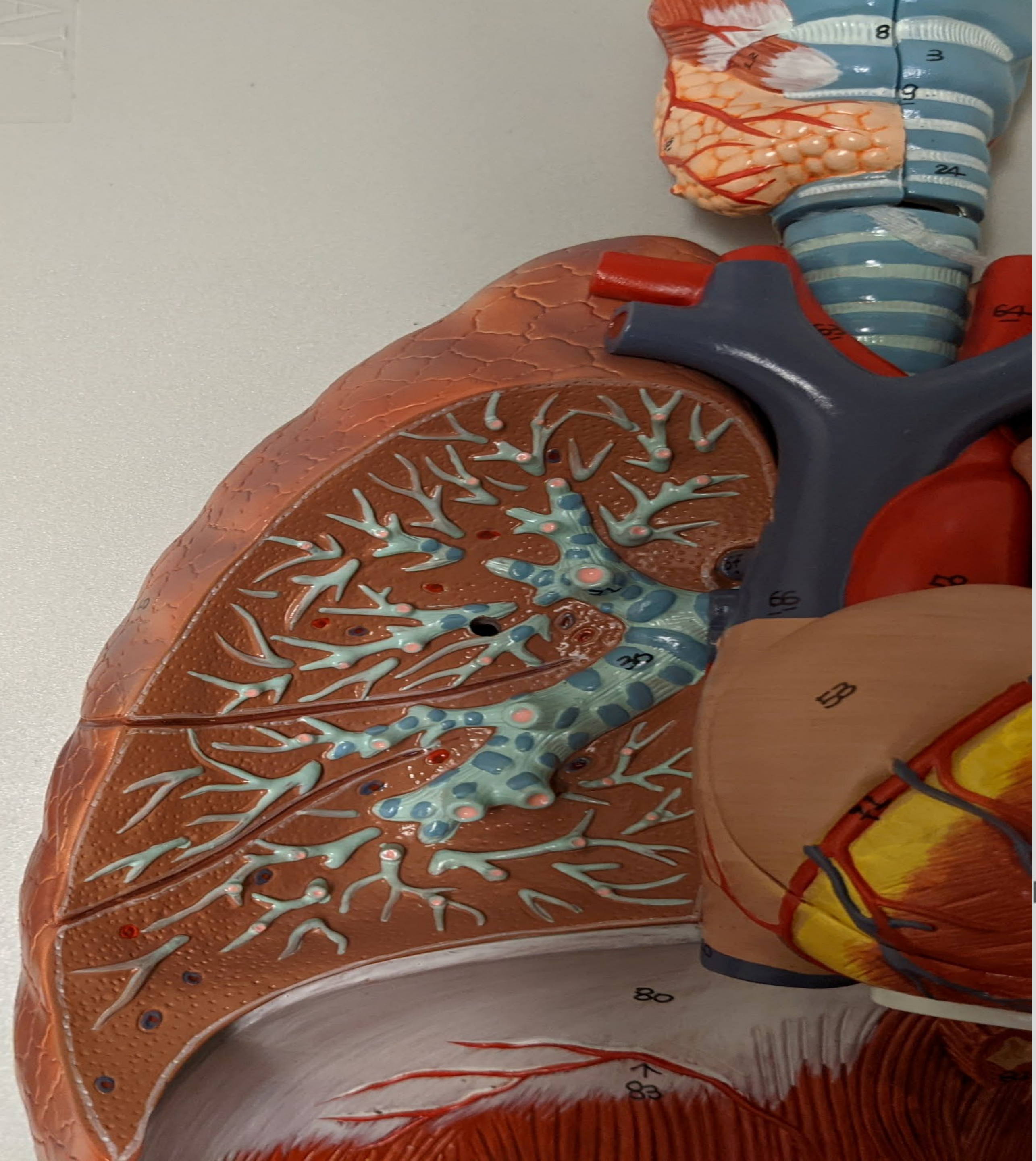


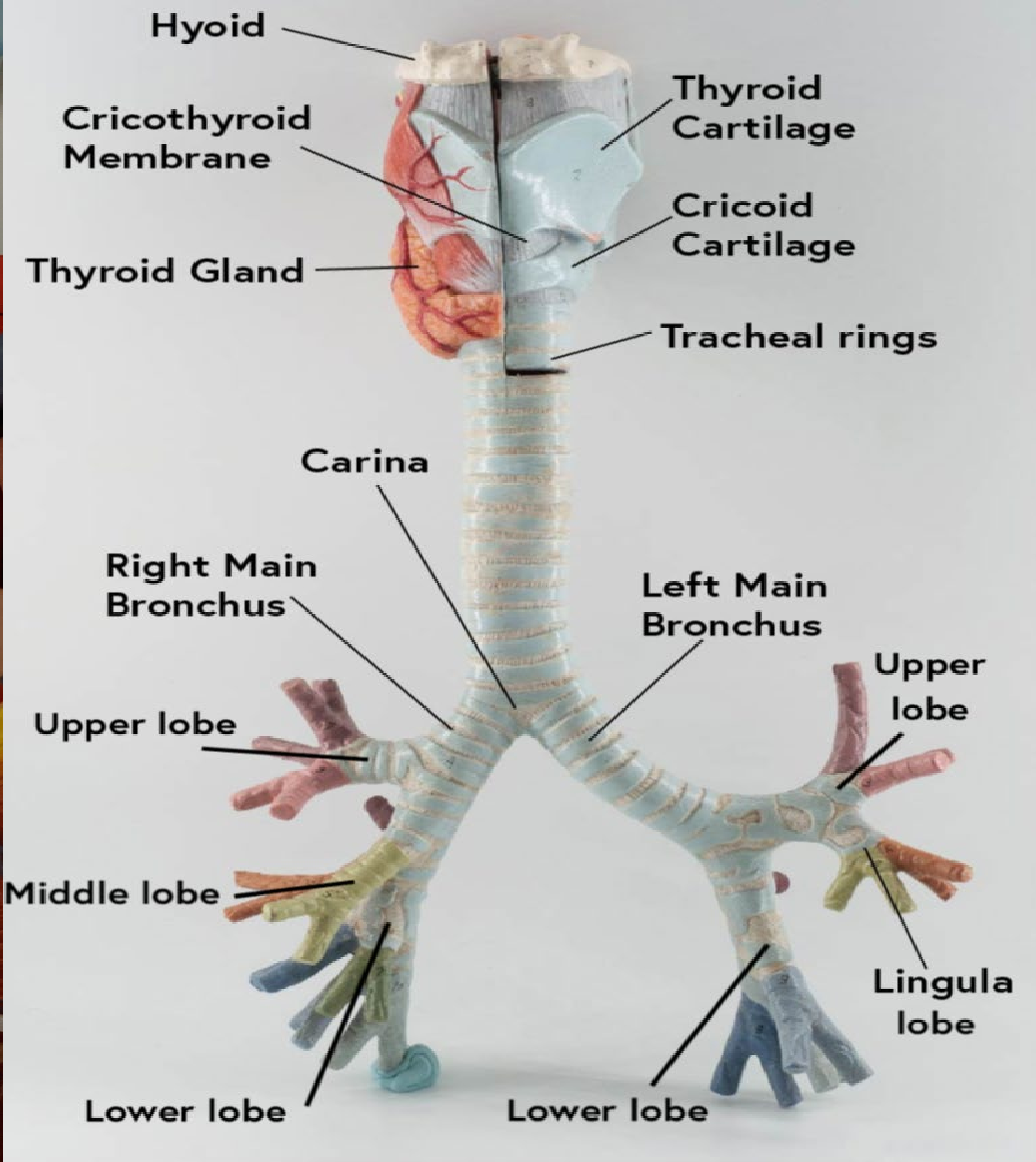


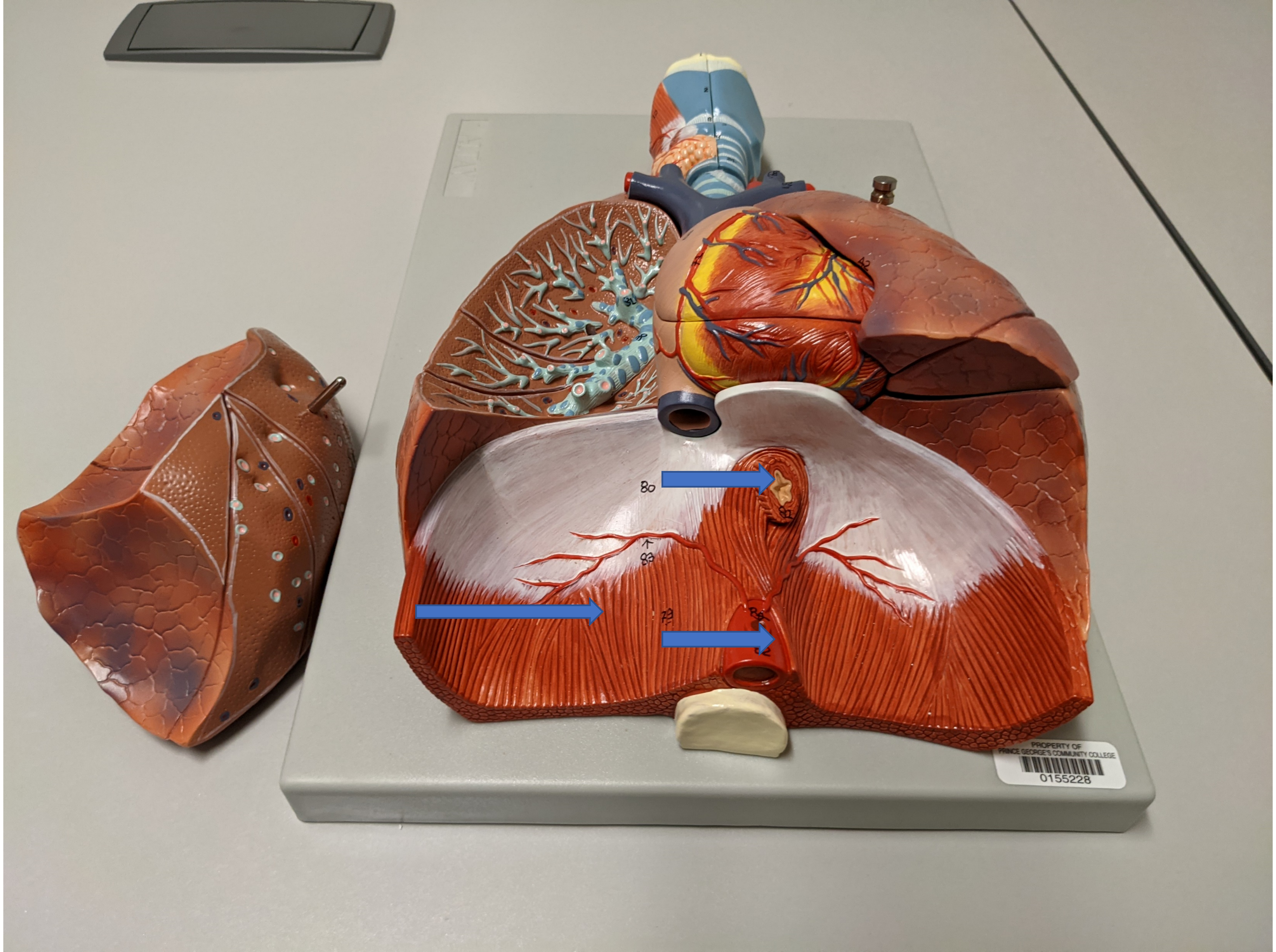
Hyoid
Thyroid Cartilage
Cricothyroid Membrane
Cricoid Cartilage
Thyroid Gland
Tracheal rings
Carina
Right Main Bronchus
Left Main Bronchus
Upper lobe
Upper lobe
Middle lobe
Lingula lobe
Lower lobe
Lower lobe

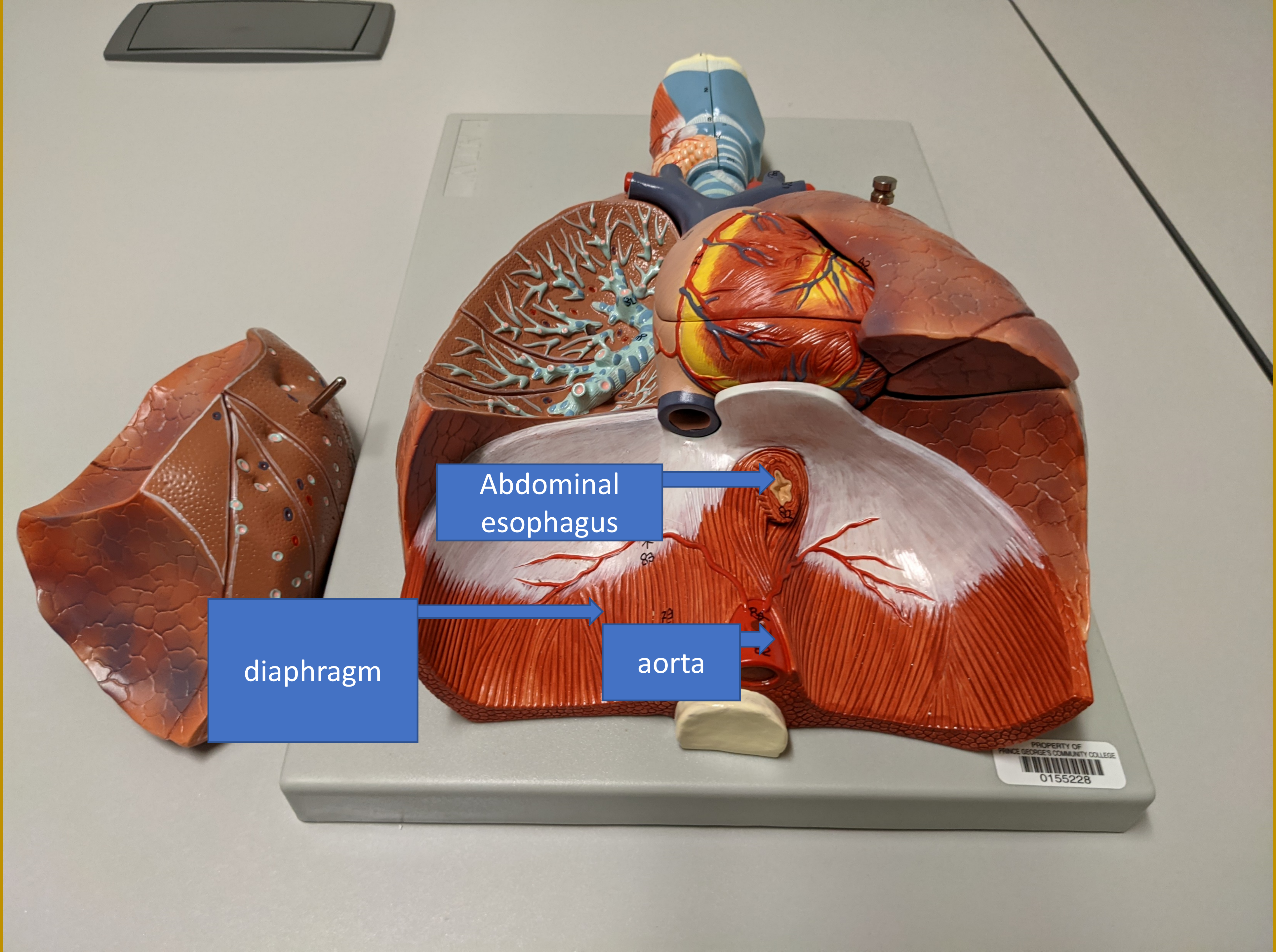

Trachea
Cartilage rings
Cartilage plates
Left primary bronchus
Root of lung
Visceral pleura
Secondary bronchus
Tertiary bronchi
Smaller bronchi
Bronchioles
Terminal bronchiole
Respiratory bronchiole
Alveoli in a pulmonary lobule

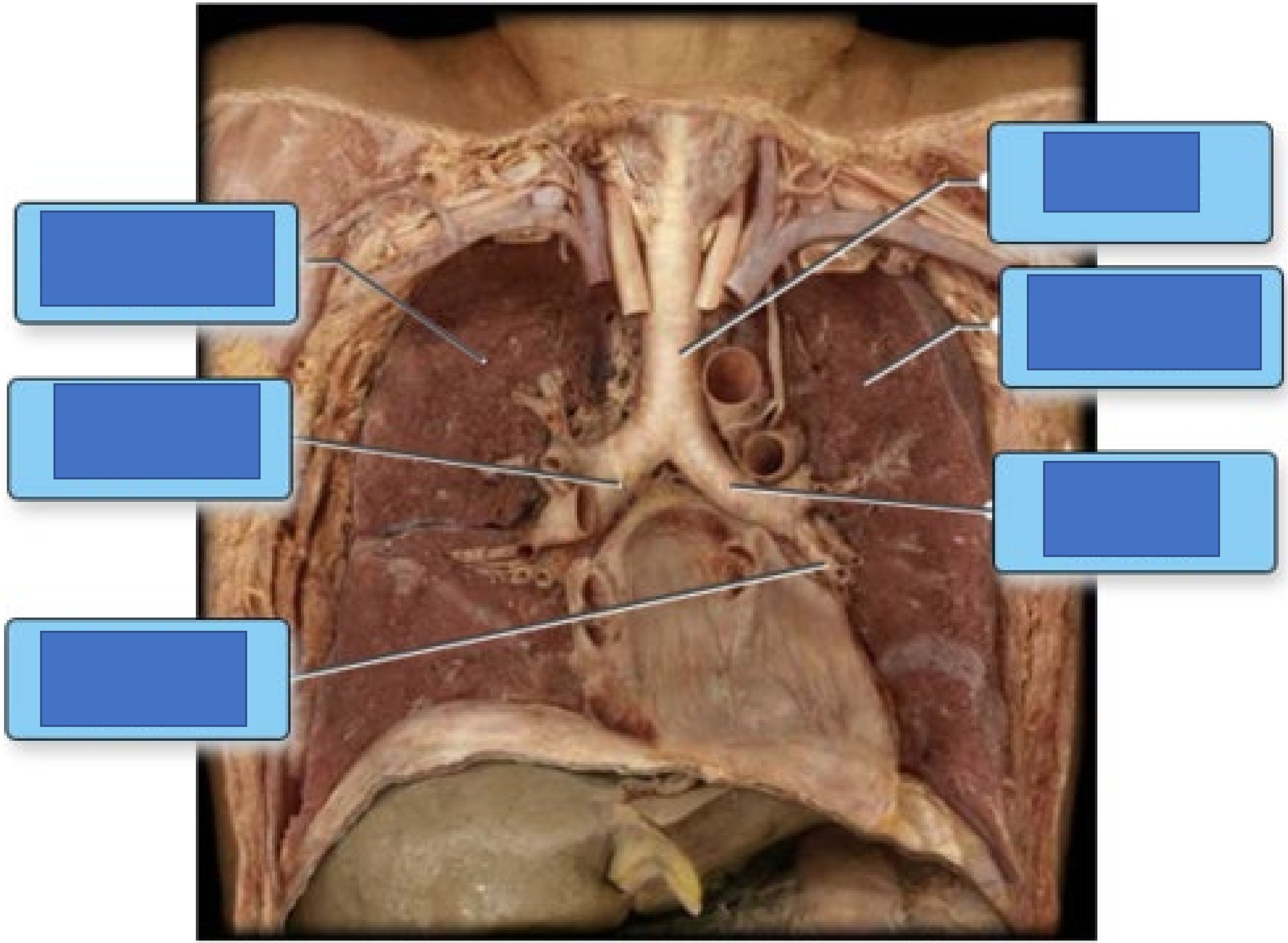

Hyoid
Thyroid Cartilage
Cricothyroid Membrane
Cricoid Cartilage
Thyroid Gland
Tracheal rings
Carina
Right Main Bronchus
Left Main Bronchus
Upper lobe
Upper lobe
Middle lobe
Lingula lobe
Lower lobe
Lower lobe



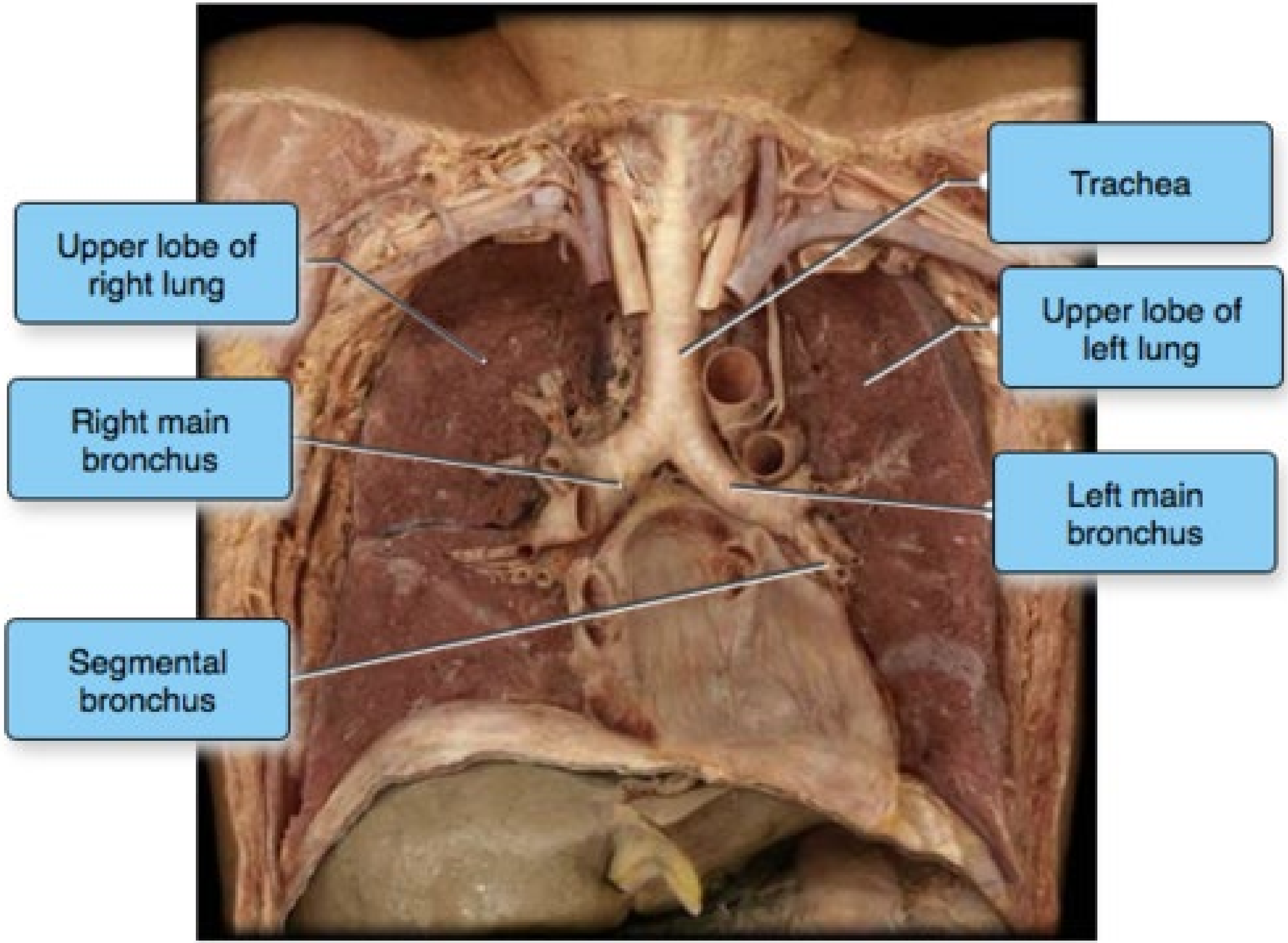

Hyoid
Thyroid Cartilage
Cricothyroid Membrane
Cricoid Cartilage
Thyroid Gland
Tracheal rings
Carina
Right Main Bronchus
Left Main Bronchus
Upper lobe
Upper lobe
Middle lobe
Lingula lobe
Lower lobe
Lower lobe


80
83
79
PROPERTY OF
PRINCE GEORGE'S COMMUNITY COLLEGE
0155228

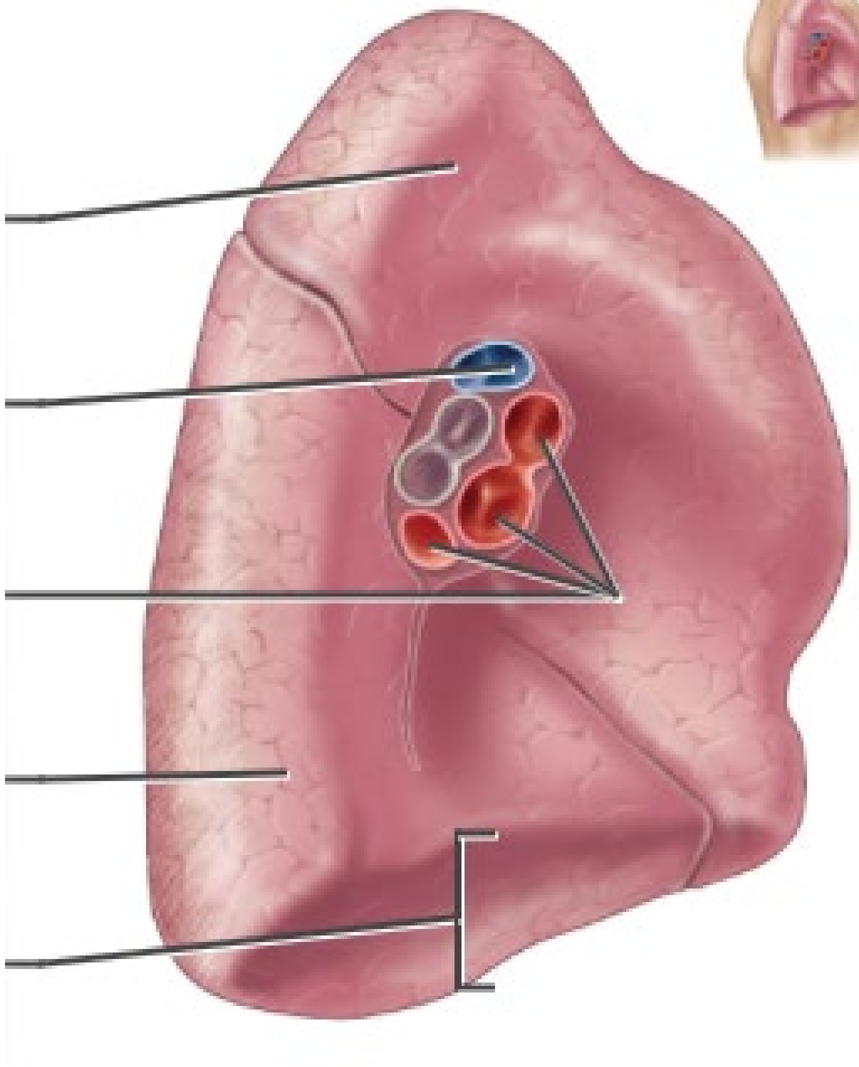

Abdominal esophagus
diaphragm
aorta
PROPERTY OF
PRINCE GEORGE'S COMMUNITY COLLEGE
0155228



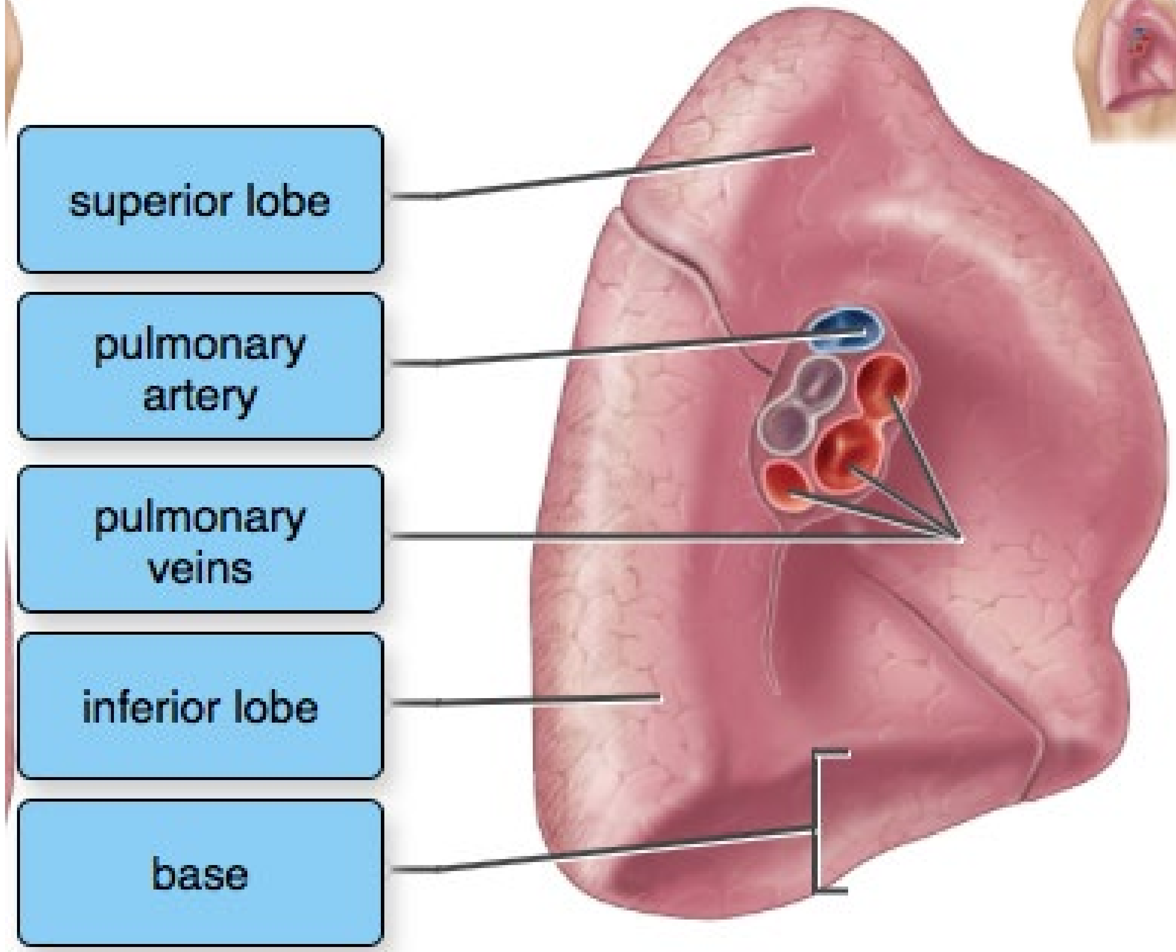
Label the anterior view of the lower respiratory tract based on the hints if provided.

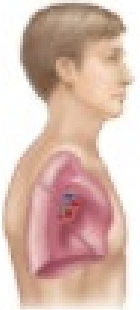


Label the anterior view of the lower respiratory tract based on the hints if provided.

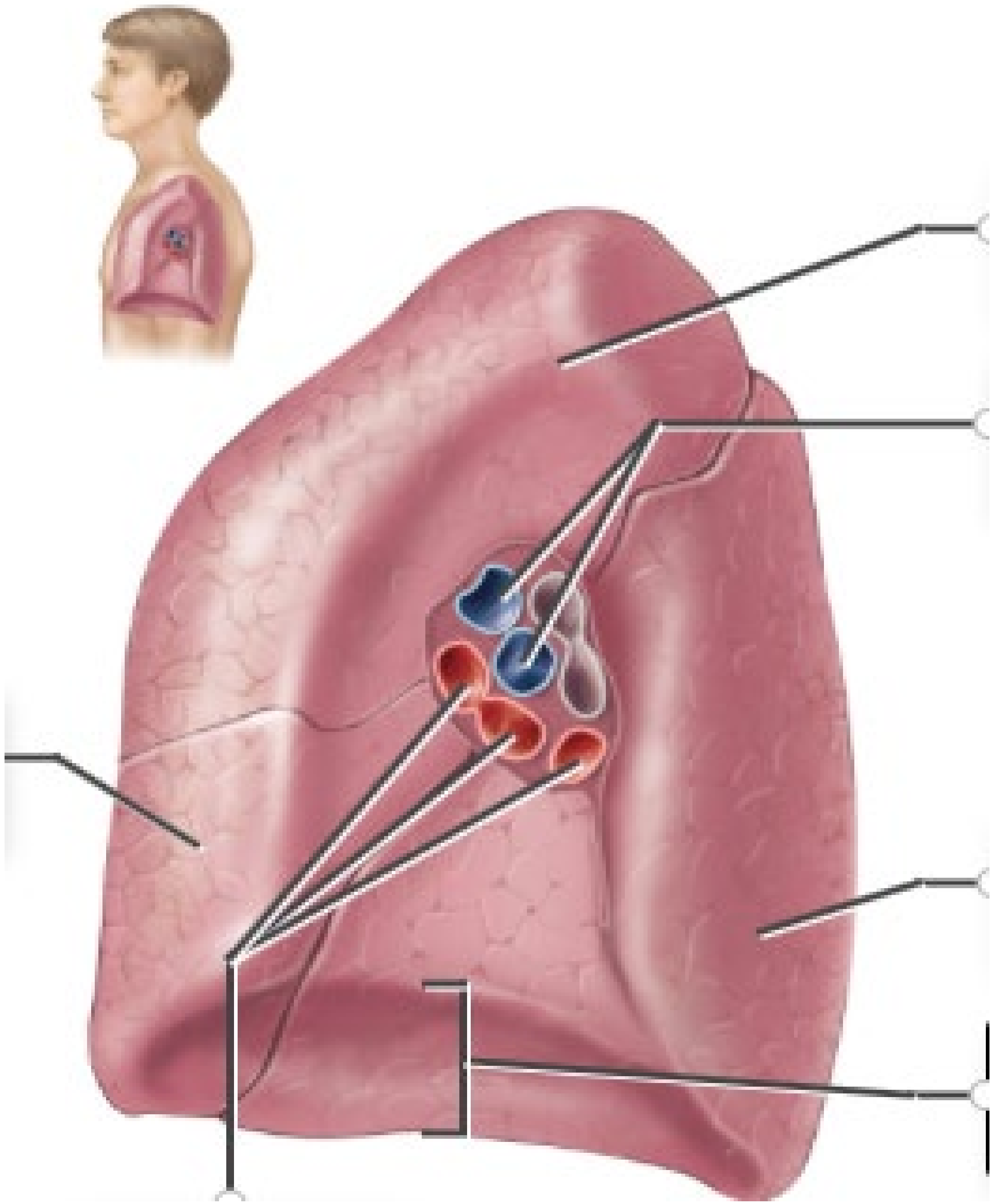


In the medial view of the left lung, identify the lobes of the lung, blood vessels, and lung base.

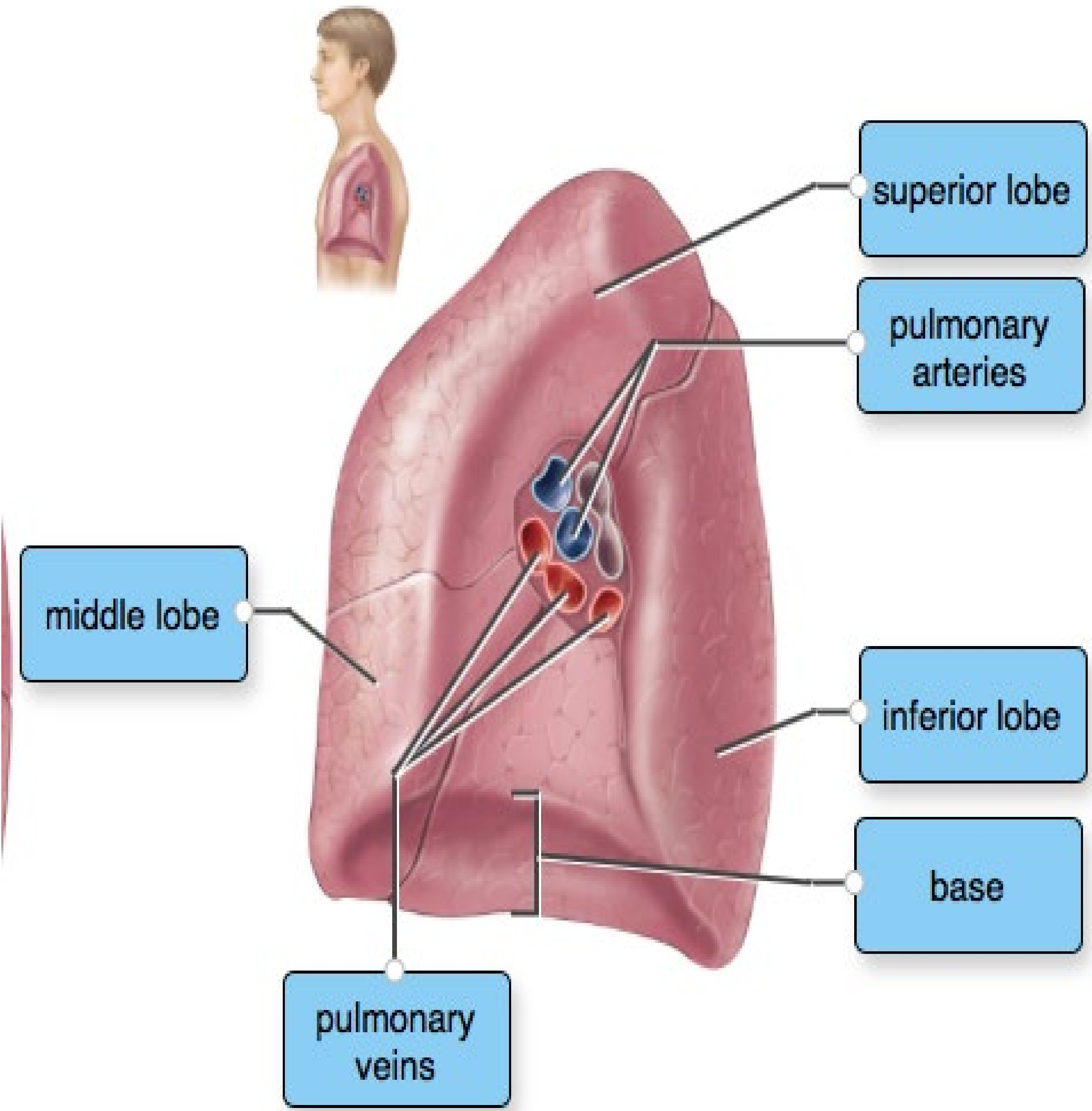




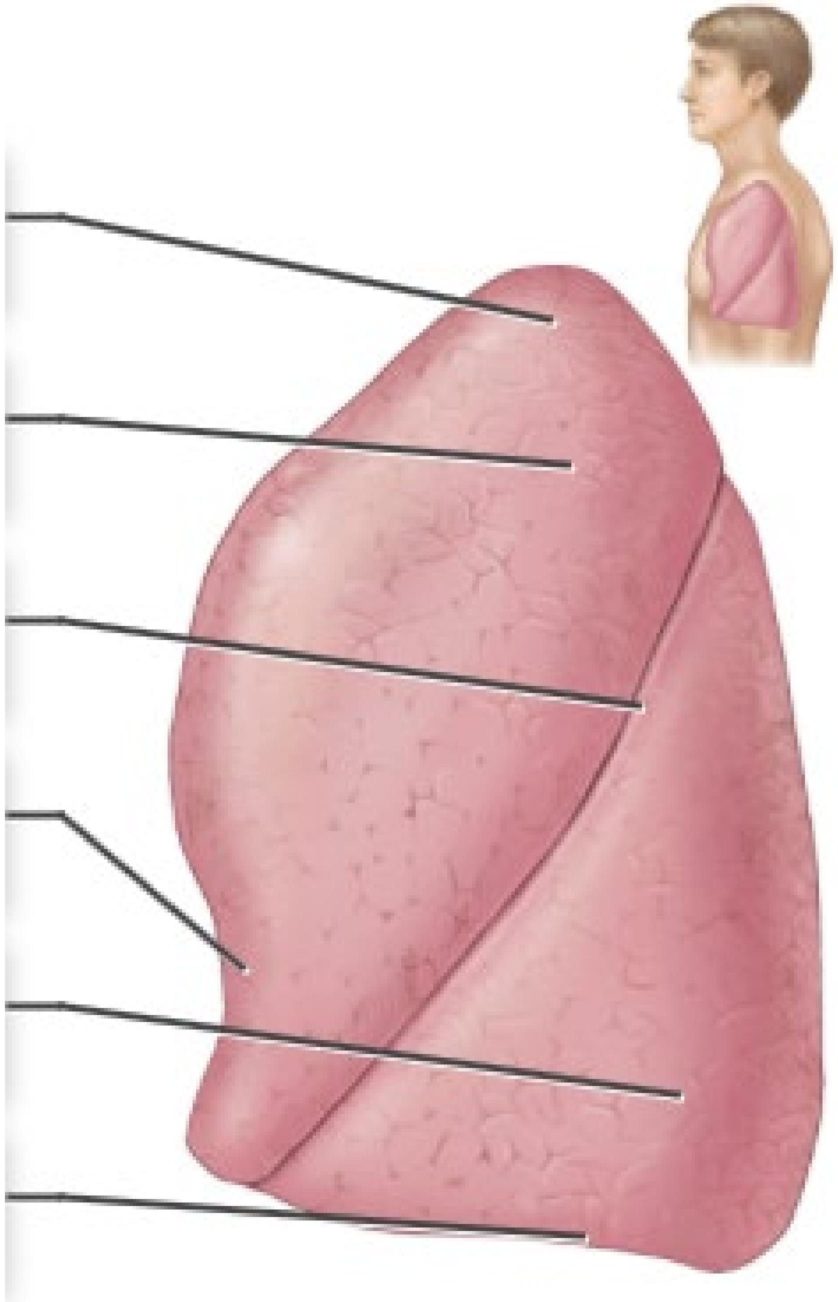
In the medial view of the left lung, identify the lobes of the lung, blood vessels, and lung base.

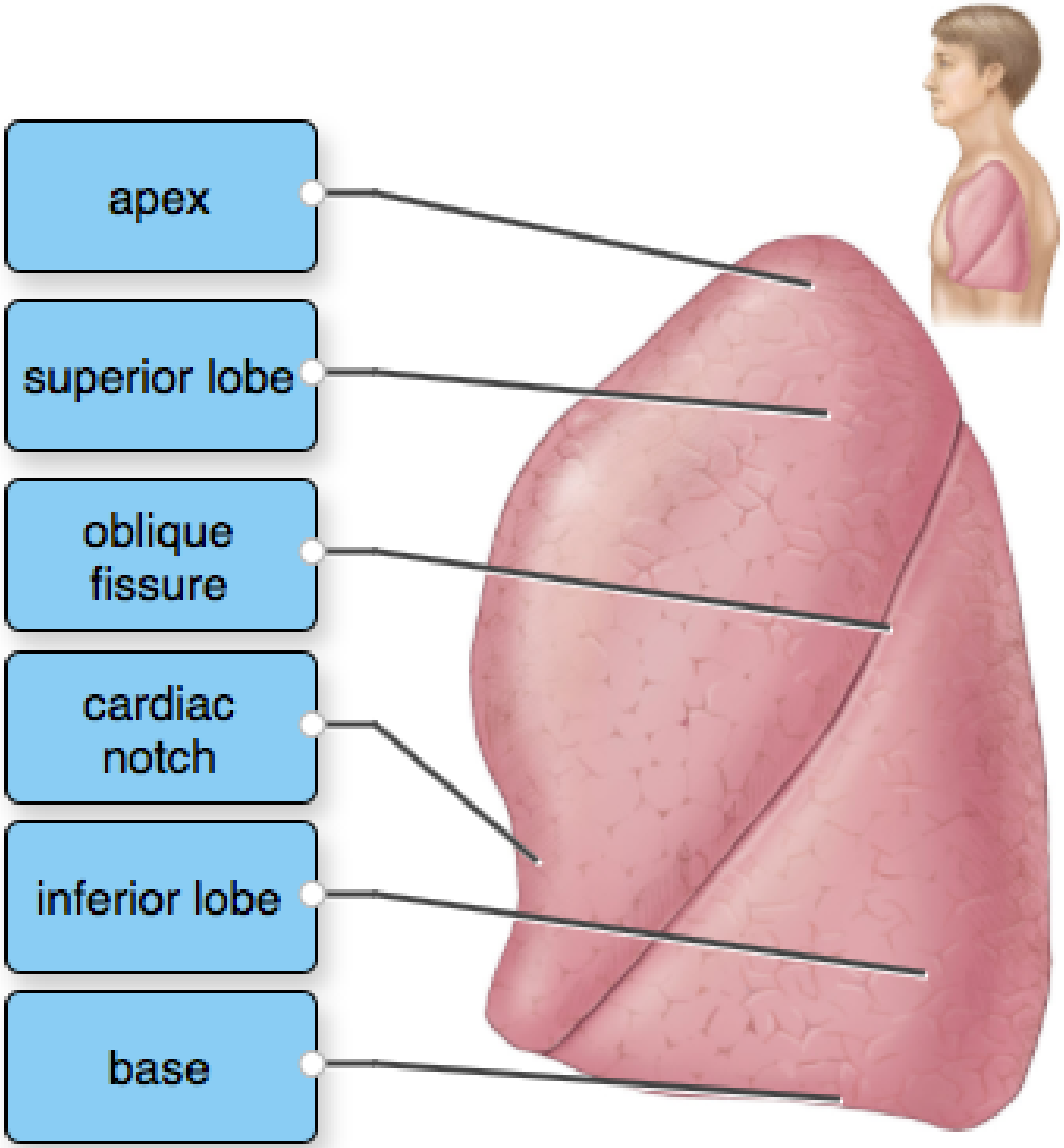


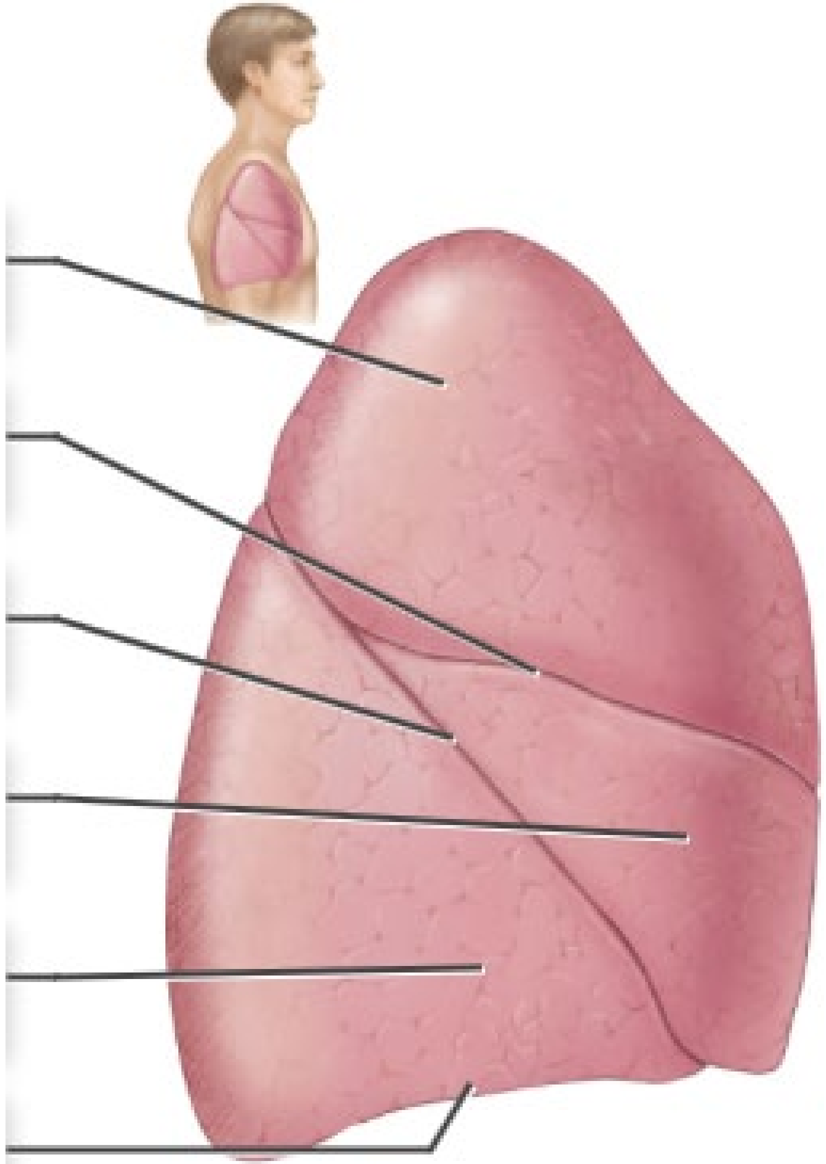
In the medial view of the right lung, identify the lobes of the lung, blood vessels, and lung base.

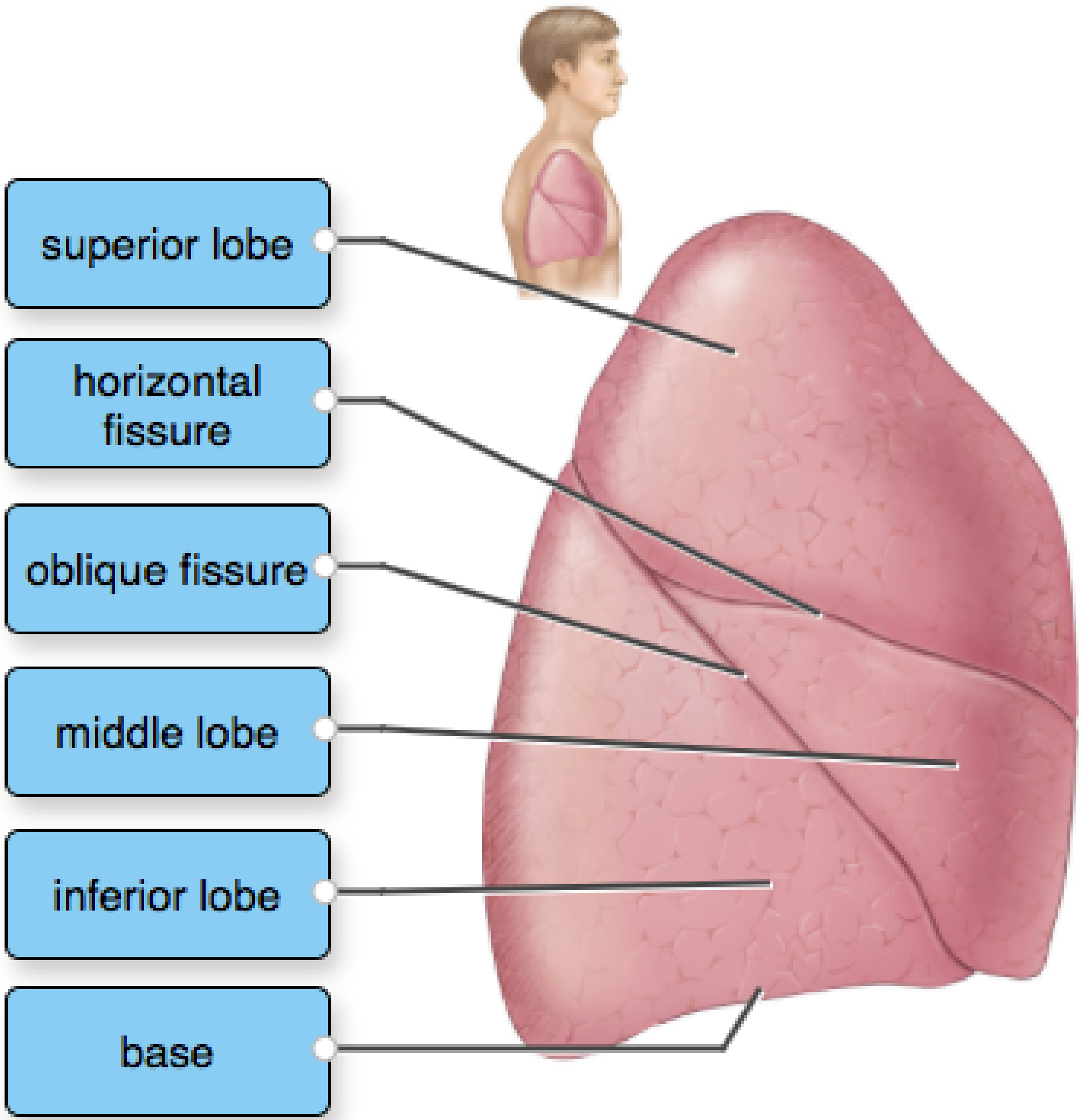


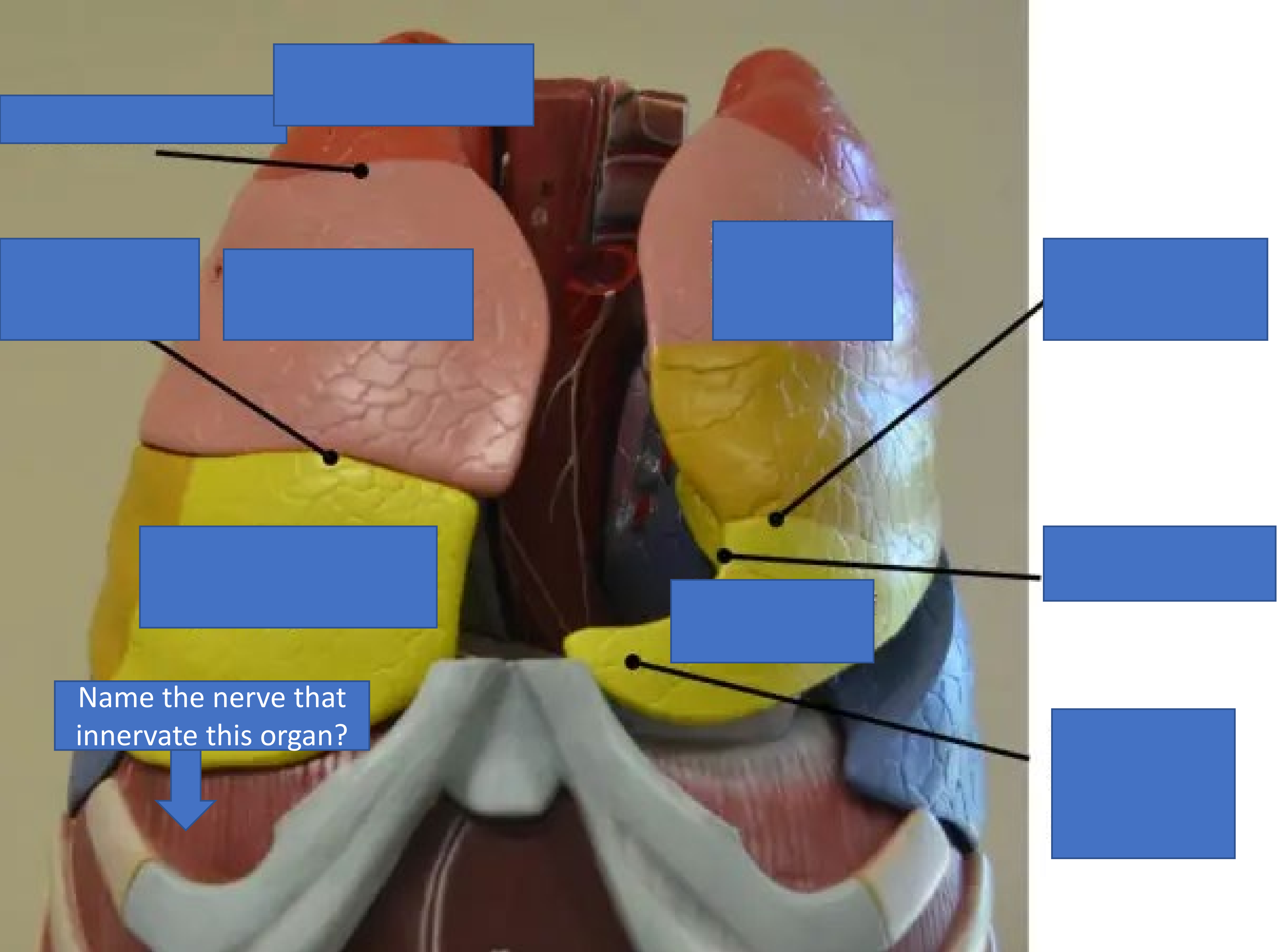
In the medial view of the right lung, identify the lobes of the lung, blood vessels, and lung base.

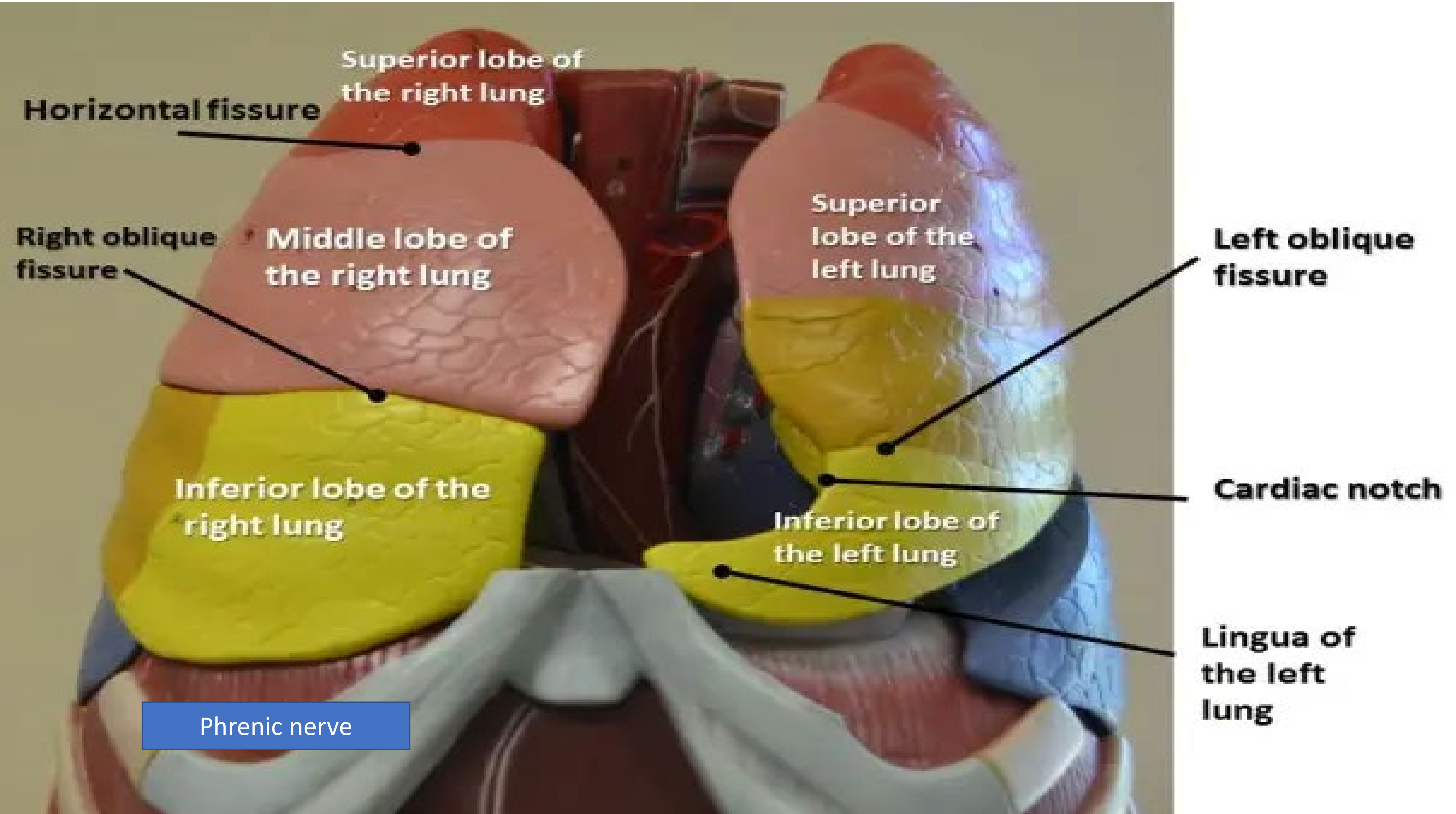


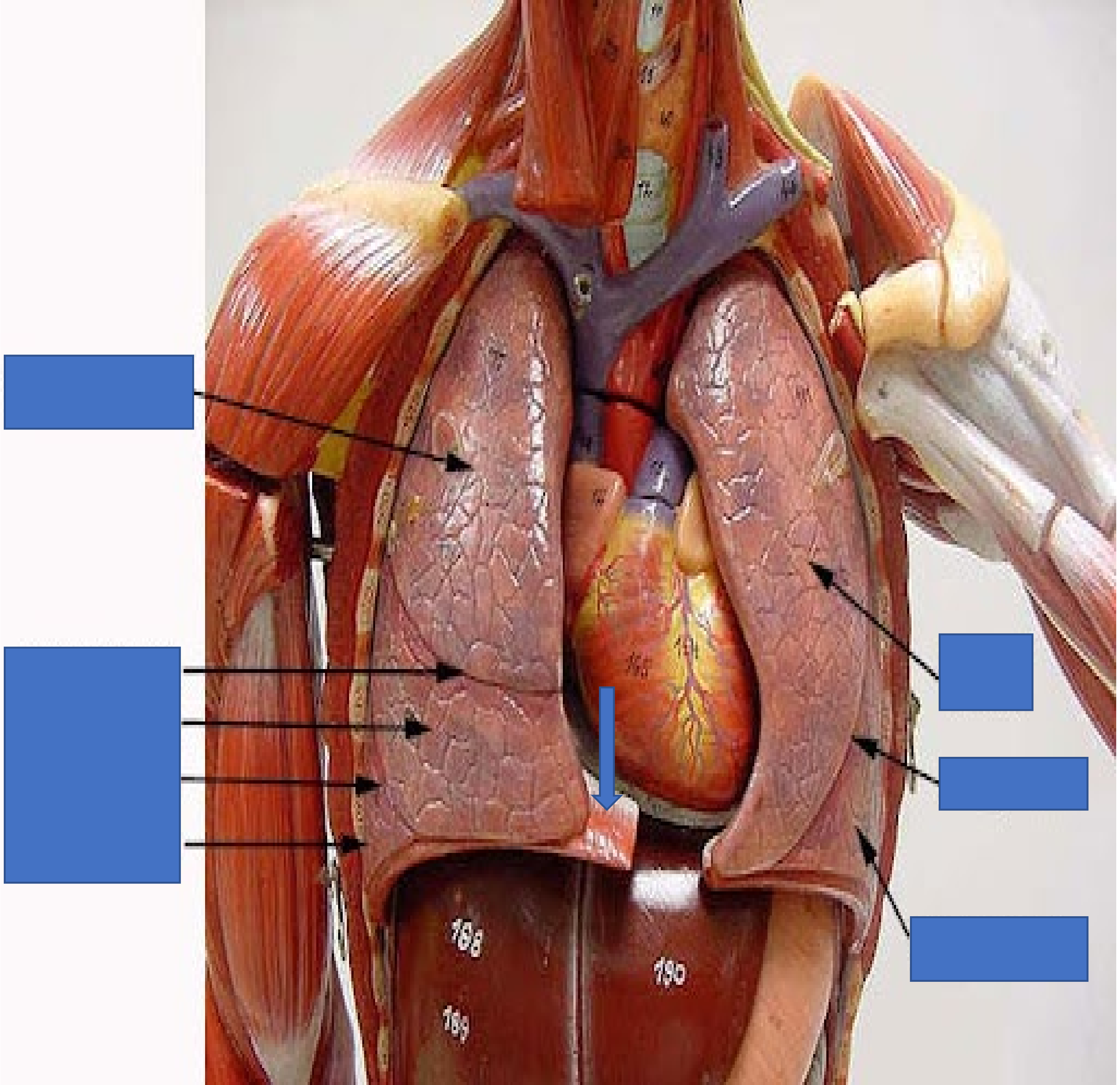

apex
superior lobe
oblique fissure
cardiac notch
inferior lobe
base

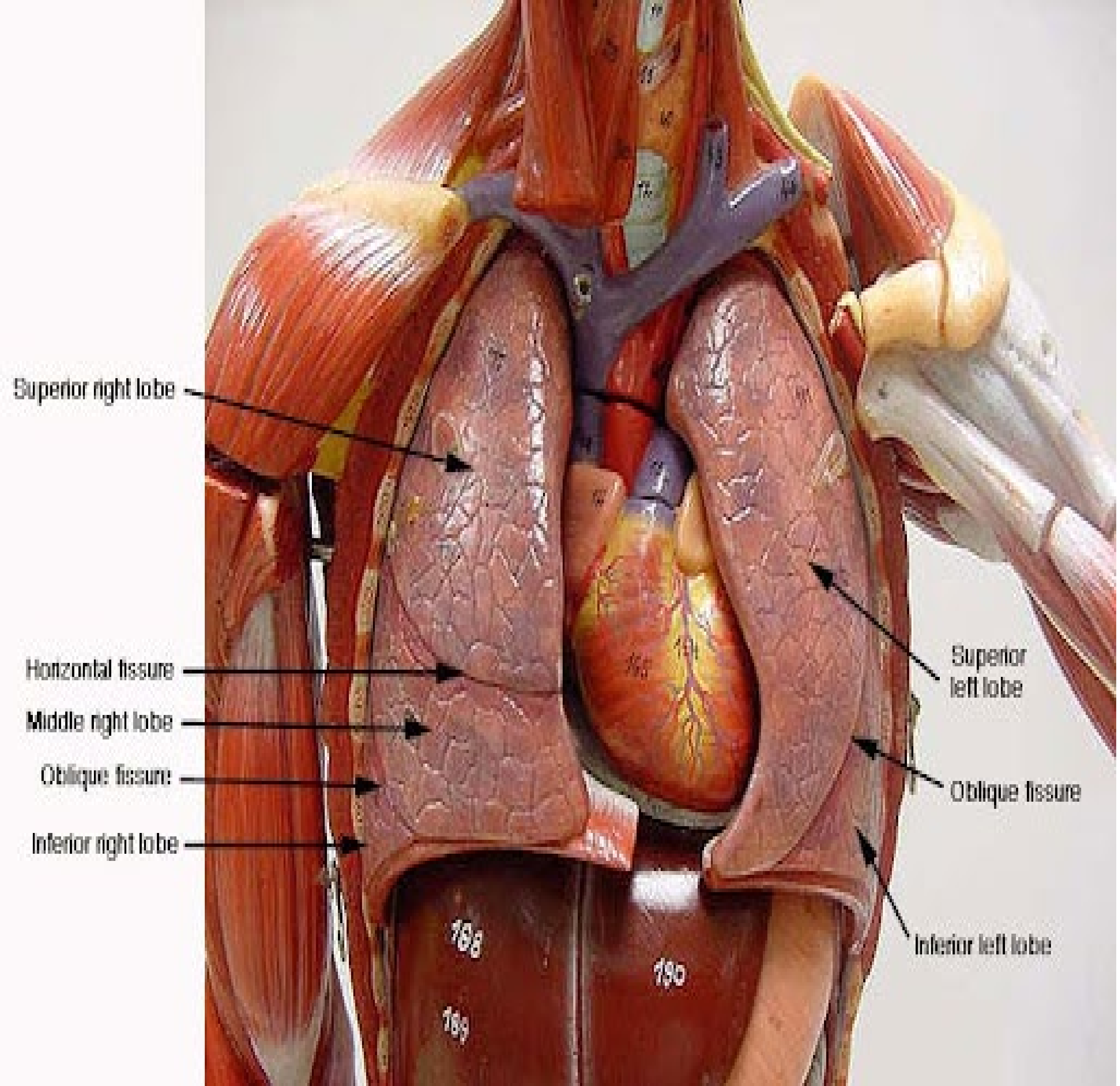



superior lobe
horizontal fissure
oblique fissure
middle lobe
inferior lobe
base

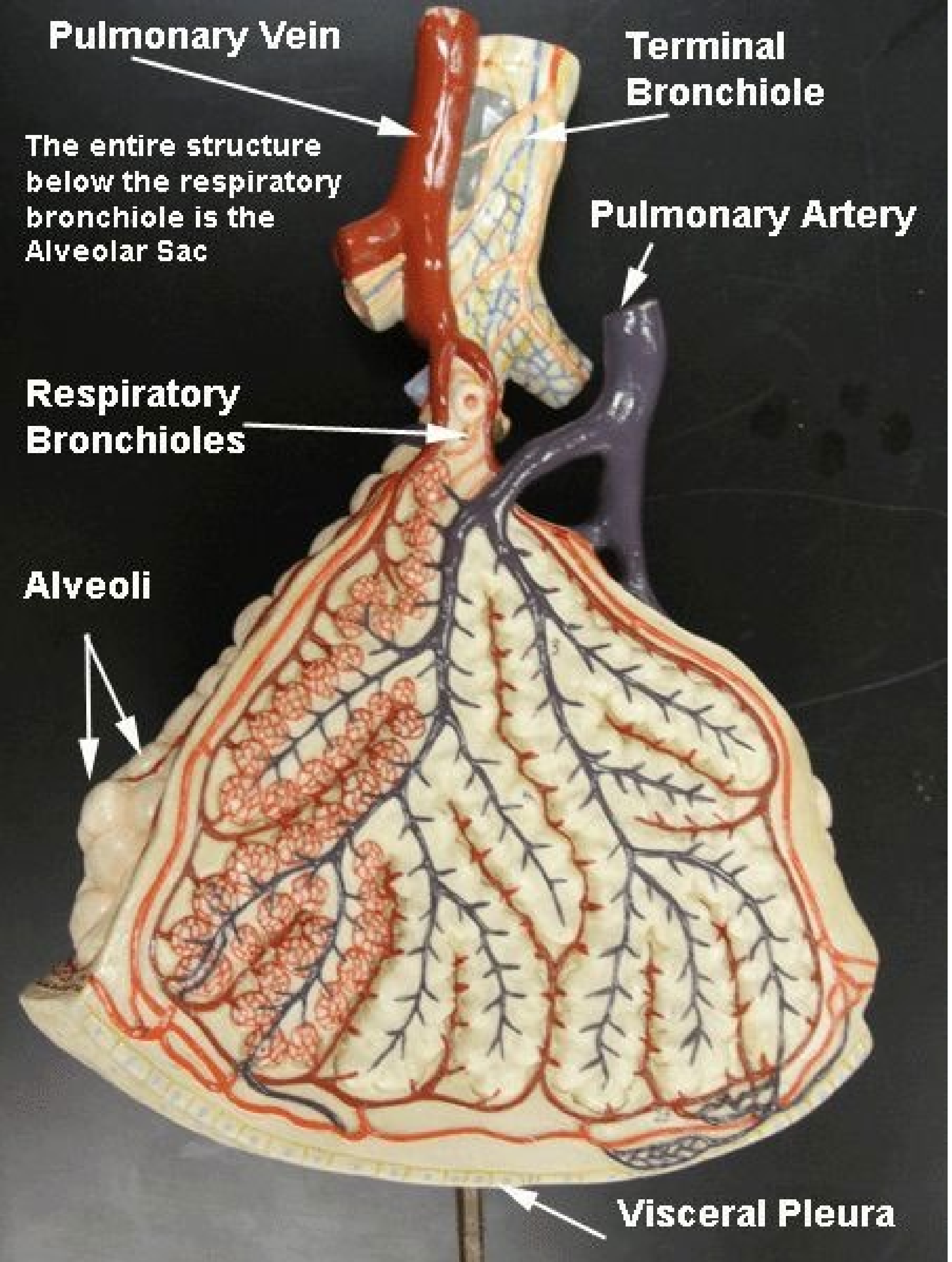

Name the nerve that innervate this organ?

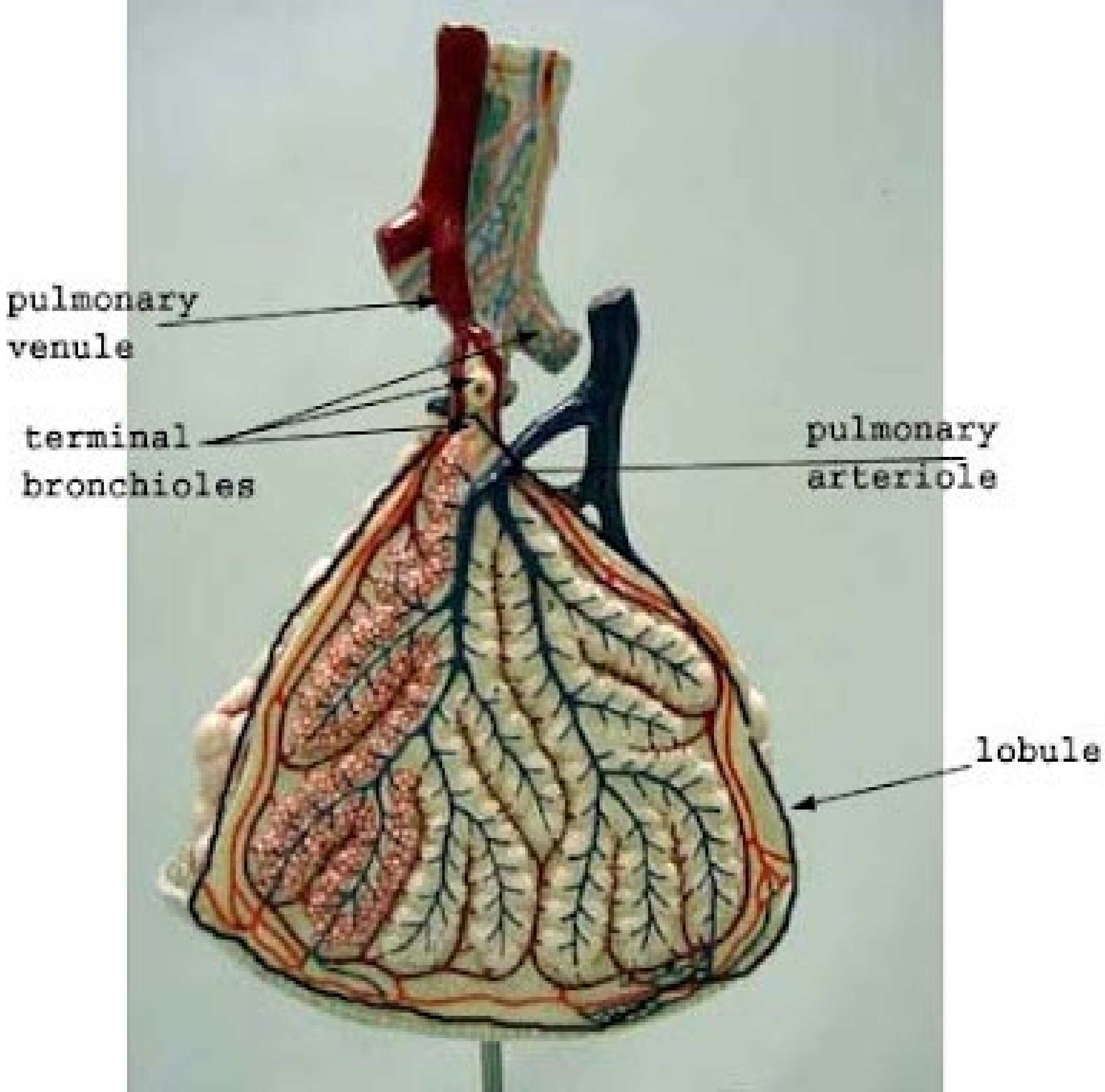

Superior lobe of
the right lung
Horizontal fissure
Right oblique
fissure
Middle lobe of
the right lung
Superior
lobe of the
left lung
Left oblique
fissure
Inferior lobe of the
right lung
Cardiac notch
Inferior lobe of
the left lung
Lingua of
the left
lung
Phrenic nerve





Superior right lobe
Horizontal fissure
Middle right lobe
Oblique fissure
Inferior right lobe
Superior left lobe
Oblique fissure
Inferior left lobe


Pulmonary Vein
Terminal Bronchiole
The entire structure below the respiratory bronchiole is the Alveolar Sac
Pulmonary Artery
Respiratory Bronchioles
Alveoli
Visceral Pleura


pulmonary venule
terminal bronchioles
pulmonary arteriole
lobule

Respiratory calculation part 2

Division	Support	Glands	Epithelium	Ciliated Cells	Goblet Cells	Special Features
Nasal cavity						
Vestibule	Hyaline cartilage	Sebaceous and sweat glands	Stratified squamous keratinized	No	No	Vibrissae
Respiratory	Bone and hyaline cartilage	Seromucous	Pseudostratified ciliated columnar	Yes	Yes	Large venous plexuses
Olfactory	Nasal conchae (bone)	Bowman glands	Pseudostratified ciliated columnar (tall)	Yes	No	Bipolar olfactory cells, sustentacular cells, basal cells, nerve fibers
Nasopharynx	Muscle	Seromucous	Pseudostratified ciliated columnar	Yes	Yes	Pharyngeal tonsil, entrance of eustachian tube
Larynx	Hyaline, elastic cartilage	Mucous, seromucous	Stratified squamous nonkeratinized, pseudostratified ciliated columnar	Yes	Yes	Vocal cords, striated muscle (vocalis), epiglottis
Trachea Primary bronchi	C-shaped hyaline cartilage rings	Mucous, seromucous	Pseudostratified ciliated columnar	Yes	Yes	Trachealis (smooth) muscle, elastic lamina, two mucous cell types, short cells, diffuse endocrine cells

Intrapulmonary bronchi	Plates of hyaline cartilage	Seromucous	Pseudostratified ciliated columnar	Yes	Yes	Two helically oriented ribbons of smooth muscle
Primary bronchioles	Smooth muscle	None	Simple ciliated columnar to simple cuboidal	Yes	Only in larger ones	Clara cells (club cells)
Terminal bronchioles	Smooth muscle	None	Simple cuboidal	Some	None	Clara cells (club cells)
Respiratory bronchioles	Some smooth muscle	None	Simple cuboidal except where interrupted by alveoli	Some	None	Occasional alveoli, Clara cells (club cells)
Alveolar ducts	Smooth muscle at alveolar openings, some reticular fibers	None	Simple squamous	None	None	Linear structure formed by adjacent alveoli, type I and II pneumocytes, alveolar macrophages
Alveoli	Reticular fibers, elastic fibers at alveolar openings	None	Simple squamous	None	None	Type I and II pneumocytes, alveolar macrophages

Boyle's Law:

For a fixed mass of gas at constant temperature, the pressure (P) and volume (V) are inversely proportional, such that $P \times V = k$, where k is a constant.

Physiologic dead space (VD): volume of inspired air that does not participate in gas exchange
VD is the sum of the anatomic dead space and the alveolar dead space

Anatomic dead space: the volume of air in the conducting zone, e.g., **mouth, trachea (approx. ⅓ of the resting tidal volume)**
Alveolar dead space: the sum of the volumes of alveoli that do not participate in gas exchange (mainly apex of the lungs); These alveoli are ventilated but not perfused

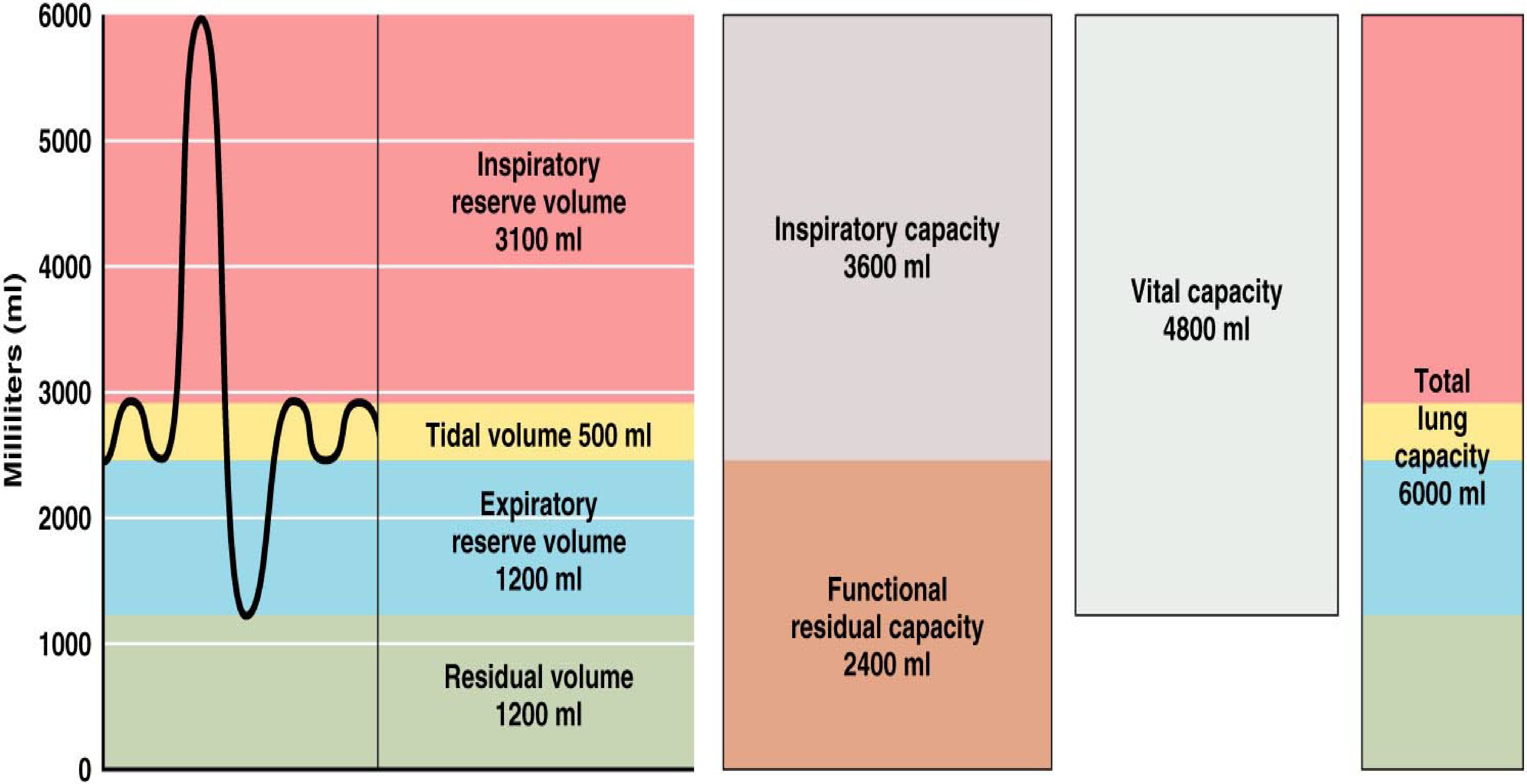
.

Bohr equation determines the physiologic dead space : **VD** = VT x ($PaCO_2$ - $PeCO_2$)/($PaCO_2$)

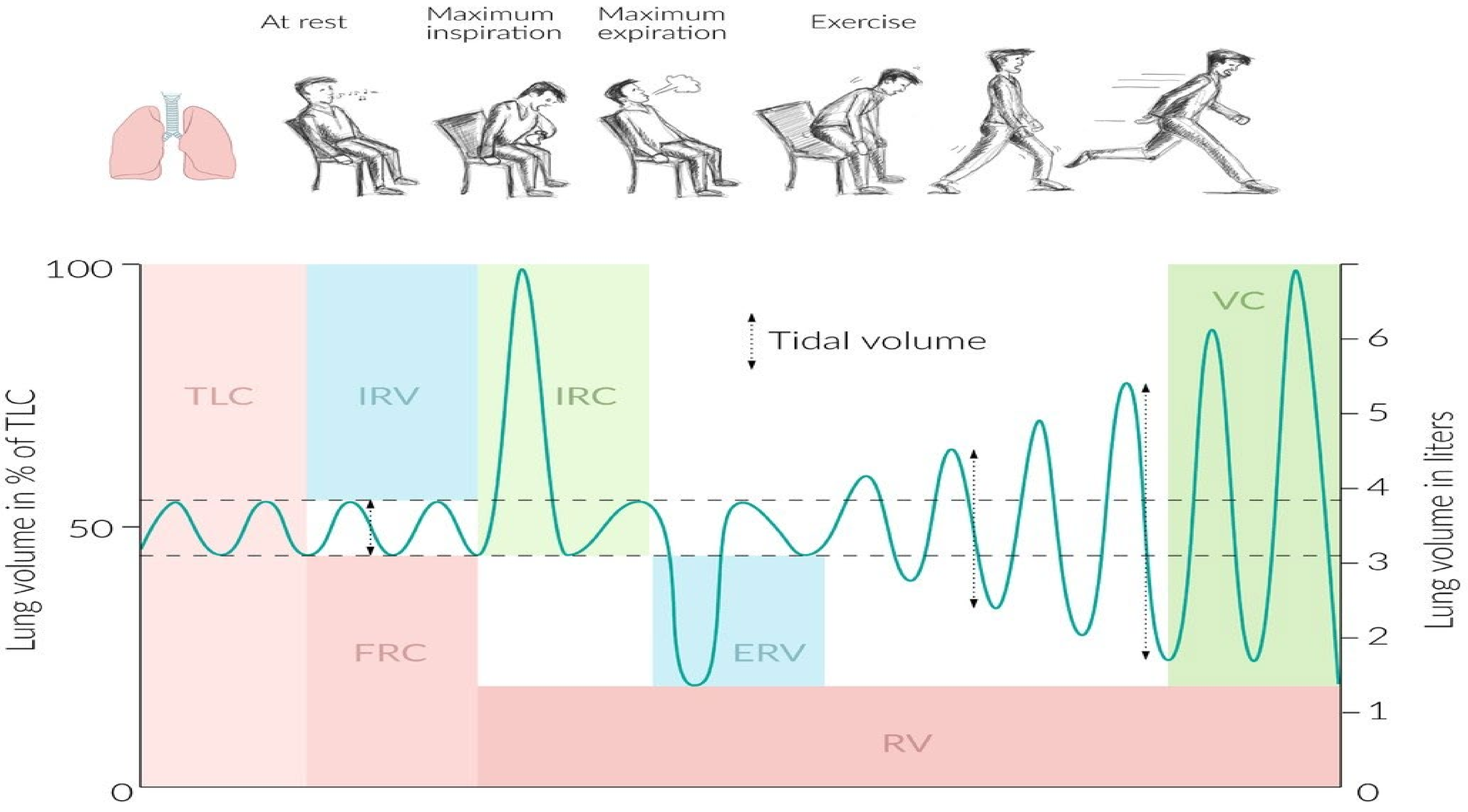
In a healthy lung, VD equals the anatomic dead space (normal value: approx. 150 mL/breath).

	Measurement	Adult male average value	Adult female average value	Description
Respiratory volumes	Tidal volume (TV)	500 ml	500 ml	Amount of air inhaled or exhaled with each breath under resting conditions
	Inspiratory reserve volume (IRV)	3100 ml	1900 ml	Amount of air that can be forcefully inhaled after a normal tidal volume inhalation
	Expiratory reserve volume (ERV)	1200 ml	700 ml	Amount of air that can be forcefully exhaled after a normal tidal volume exhalation
	Residual volume (RV)	1200 ml	1100 ml	Amount of air remaining in the lungs after a forced exhalation
Respiratory capacities	Total lung capacity (TLC)	6000 ml	4200 ml	Maximum amount of air contained in lungs after a maximum inspiratory effort: TLC = TV + IRV + ERV + RV
	Vital capacity (VC)	4800 ml	3100 ml	Maximum amount of air that can be expired after a maximum inspiratory effort: VC = TV + IRV + ERV (should be 80% TLC)
	Inspiratory capacity (IC)	3600 ml	2400 ml	Maximum amount of air that can be inspired after a normal expiration: IC = TV + IRV
	Functional residual capacity (FRC)	2400 ml	1800 ml	Volume of air remaining in the lungs after a normal tidal volume expiration: FRC = ERV + RV

(b) Summary of respiratory volumes and capacities for males and females



(a) Spirographic record for a male


At rest
Maximum inspiration
Maximum expiration
Exercise
100
50
0
Lung volume in % of TLC
TLC
IRV
IRC
VC
Tidal volume
FRC
ERV
RV
6
5
4
3
2
1
0
Lung volume in liters

Lung volume	Definition	Normal range
Total lung capacity (TC, TLC)	•Volume of air in the lungs after maximal inhalation **TC = VC + RV**	•6–6.5 L
Vital capacity (VC)	•Difference in lung volume between maximal exhalation and maximal inhalation **VC = TV + IRV + ERV**	•4.5–5 L
Residual volume (RV)	•Volume of air that remains in the lungs after a maximal exhalation	•1–1.5 L
Tidal volume (TV)	•Volume of air that is inhaled and exhaled in a normal breath at rest	•~ 500 mL or 7 mL/kg
Inspiratory reserve volume (IRV)	•Maximum volume of air that can still be forcibly inhaled following the inhalation of a normal TV	•3–3.5 L
Inspiratory capacity (IC)	•Maximum volume of air that can be inhaled after the exhalation of a normal TV **IRC = IRV + TV**	•3.5–4 L
Expiratory reserve volume (ERV)	•Maximum volume of air that can still be forcibly exhaled after the exhalation of a normal TV	•1.5 L
Expiratory capacity (EC)	•Maximum volume of air that can be exhaled after the inspiration of a normal TV **ERC = ERV + TV**	•2 L
Functional residual capacity (FRC)	•Volume of air that remains in the lungs after the exhalation of a normal TV **FRC = RV + ERV**	•2.5–3 L

CALCULATION POSSIBILITIES USING THE FORMULAS

- **IC= IRV+TV INSPIRATORY CAPACITY = INSPIRATORY RESERVE VOLUME + TIDAL VOLUME = 3100+500= 3600 ml**
- **IC= TLC – FRC**

- **FRC = ERV + RV FUNCTIONAL RESIDUAL CAPACITY = EXPIRATORY RESERVE VOLUME + RESIDUAL VOLUME= 1200+1200=2400 ml**
- **FRC = TLC - IC**

- **VC= IRV+TV+ERV VITAL CAPACITY= INSP RESERVE VOLUME+ TIDAL VOLUME + EXPIRATORY RESERVE VOLUME = 3100+ 500+ 1200 = 4800 ml**

- **VC= IC + ERV**
- **VC = TLC – RV**

- **TLC= IRV+TV+ERV+RV = 3100+500+1200+1200= 6000 ml TLC = TOTAL LUNG CAPACITY**
- **TLC= IC + FRC = 3600 + 2400 = 6000 ml**
- **TLC= VC + RV = 4800 + 1200 = 6000 ml**

•**Flow = volume / time.**

•**Volume = flow × time.**

•**Pressure = flow × resistance.**

•**Resistance = change in pressure / flow.**

•**Compliance = volume / change in pressure.**

•**Work of breathing = pressure × volume.**

Lung compliance

•**Definition**: the ability of the lungs to distend under pressure

•**Measurement**: change in volume of the lung per unit change in pressure ($C = \Delta V/\Delta P$)

AVR = frequency x (TV – dead space) = Aveolar ventilation rate

VE = TV x RR Minute ventilation = total volume of gas entering lungs per min

Minute ventilation = **tidal volume x respiratory rate** (normal is 4-6 L/min)

Tidal volume = alveolar space + dead space.

the amount of air breathed per minute, which equals about 6 liters (about 2 liters stay in the anatomic dead space consisting of the upper airway and the mouth, and 4 liters participate in gas exchange in the millions of alveoli constituting alveolar ventilation).

Overview of normal and pathologic ventilation			
Parameter	**Normal**	**Decreased**	**Increased**
Respiratory rate (RR)	12–20/min	Bradypnea (< 12/min)	Tachypnea (> 20/min)
Tidal volume (VT OR TV)	0.5 L/breath	Hypopnea	Hyperpnea
Minute ventilation (VE)	7.5 L/min	Hypoventilation	Hyperventilation

If alveolar ventilation increases (i.e., hyperventilation), more CO_2 is exhaled and the $PaCO_2$ decreases.

If alveolar ventilation decreases (i.e. hypoventilation), $PaCO_2$ increases.

Partial pressure during the respiratory cycle (% of total gas composition)			
Gases	**In inspired air** [2]	**In alveoli**	**In expired air**
N_2	593 mmHg (≈ 79%)	573 mmHg (≈ 75%)	593 mmHg (≈ 79%)
O_2	160 mmHg (≈ 21%)	104 mmHg (≈ 14%)	116 mmHg (≈ 16%)
H_2O	3.0 mmHg (≈ 0.5%)	47 mmHg (≈ 6%)	47 mmHg (≈ 6%)
CO_2	0.3 mmHg (≈ 0.04%)	40 mmHg (≈ 5%)	28.5 mmHg (≈ 4%)
Total of all gases	760 mmHg (= 100%)		

Partial pressure of O_2 and CO_2 across the blood-air barrier		
	In the alveoli	**In the pulmonary capillaries**
Partial pressure of O_2	104 mm Hg	40 mm Hg
Partial pressure of CO_2	40 mm Hg	45 mm

- **Mean pulmonary arterial pressure** (mPAP): normal 10–14 mmHg
- **Pulmonary capillary pressure**: ~ 8 mmHg

Pulmonary vascular resistance (PVR): the resistance offered by the pulmonary circulatory system that must be overcome to create blood flow

PVR = Ppulm artery - PL atrium/CO

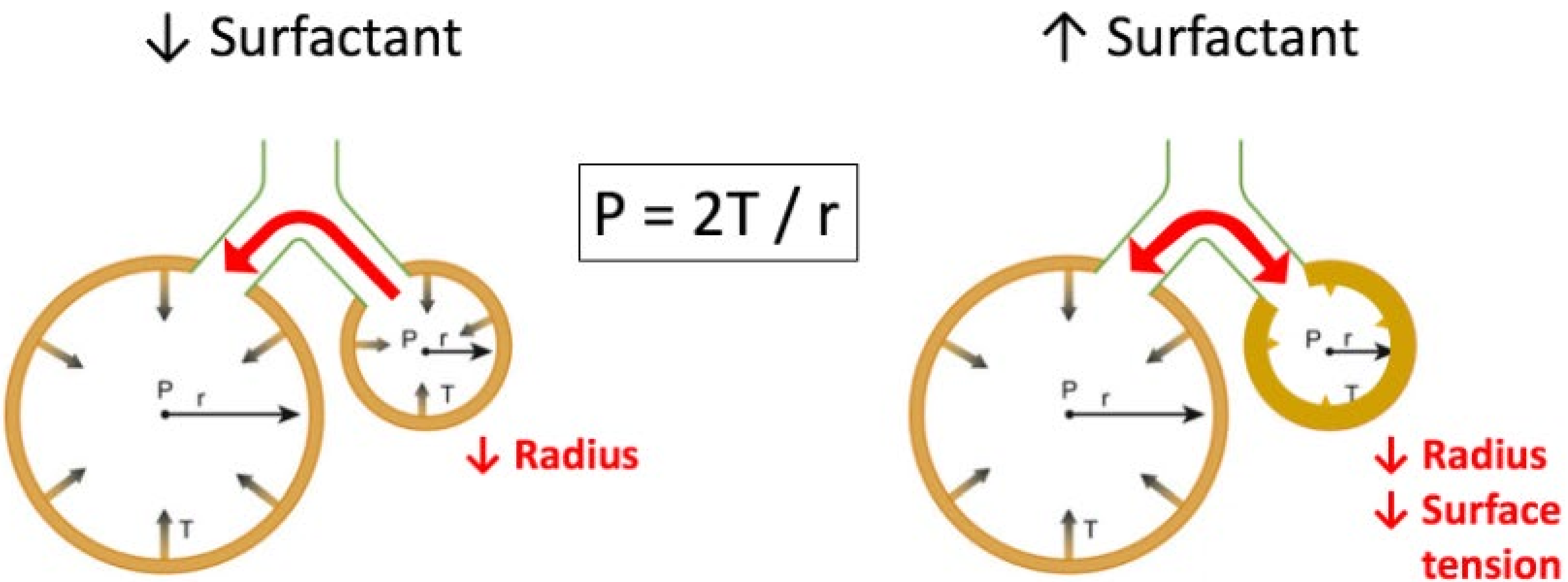
Ppulm artery = pulmonary artery pressure
PL atrium = left atrial pressure (pulmonary capillary wedge pressure)
CO= cardiac output

Ventilation-perfusion ratio (V/Q ratio): the volumetric ratio of air that reaches the alveoli (ventilation) to alveolar blood supply (perfusion) per minute

- **Ideal V/Q ratio= 1**
- **Average V/Q ratio = 0.8**
- **At the apex = 3 (V > Q)**
- **At the base = 0.6 (Q > V)**

In an upright position, the lung bases are better ventilated and perfused than the apices (apex of the lung)

Laplace law


↓ Surfactant
↑ Surfactant
P = 2T / r
P
r
T
↓ Radius
↓ Radius
↓ Surface tension

Flow = volume / time

Volume = flow × time

Pressure = flow × resistance

Resistance = change in pressure / flow

Compliance = volume / change in pressure

Work of breathing = pressure × volume

The FEV1/FVC ratio is the ratio of the forced expiratory volume in the first one second to the forced vital capacity of the lungs.

...

Formulas

1. FEV1 = Race x 1.08 x [(0.0395 x Height) - (0.025 x Age) - 2.6]
2. FVC = Race x 1.15 x [(0.0443 x Height) - (0.026 x Age) - 2.89]
3. FEV1/FVC Ratio = FEV1 / FEVC.

FEV1/FVC Ratios <70% are indicative of chronic obstructive pulmonary disease (COPD) or lower than 65% in patients older than 65 years.

Normal range FEV1 is between 3.0 and 5.0 L whilst normal range FEV1 is between 2.4 and 4.0 L.

Lower FEV1 values are indicative of obstructive lung disease, such as asthma or COPD.

if your FEV1 is 50%, **your lungs are able to handle only half as much air as they should**.
If your FEV1 is 33%, your lungs are able to handle even less—only a third as much.
The lower your FEV1 percentage, the less air your lungs are able to handle.

Pulmonary Vascular Resistance

$$PVR = \frac{80\,(MPAP - PAWP)}{CO}$$

Where:

MPAP: Mean Pulmonary Arterial Pressure
PCWP: Central Venous Pressure
CO: Cardiac Output

Questions and MCQ Respiratory part 3

1. What is Tidal Volume?
2. What is Total Lung Capacity (TLC)?
3. What is Vital Capacity (VC)?

1. What is Tidal Volume?
The volume of gas breathed with each normal breath (in L or ml).
2. What is Total Lung Capacity (TLC)?
The volume of gas in the lungs at the end of a maximal inspiration (in liters, L).
3. What is Vital Capacity (VC)?
The volume of gas exhaled from maximal inspiration to maximal exhalation, this may be forced (FVC) or relaxed (in liters, L).

4. What is Residual Volume (RV)?
5. What is Functional Residual Capacity (FRC)?

4. What is Residual Volume (RV)?
The gas remaining in the lungs after a maximal expiration (in liters, L). This volume of gas cannot be expelled, regardless of the maneuver performed.
5. What is Functional Residual Capacity (FRC)?
The total volume of gas remaining in the lungs at the end of a tidal exhalation, equaling the sum of the RV and ERV (in L).

6. What is Inspiratory Reserve Volume (IRV)?
7. What is Expiratory Reserve Volume (ERV)?
8. What is normally recorded in either liters (L) or milliliters (ml), and reported at body temperature, pressure, and saturation (BTPS)?
9. When does the spirometer not need to produce a graphic display?
10. Two acceptable vital capacity maneuvers should be obtained within what parameters?

6. What is Inspiratory Reserve Volume (IRV)?
The volume of gas that must be inhaled at the end of a tidal inspiration to reach total lung capacity (in L).
7. What is Expiratory Reserve Volume (ERV)?
The volume of gas within the lungs that could still be exhaled after the end of a tidal exhalation (in L).
8. What is normally recorded in either liters (L) or milliliters (ml), and reported at body temperature, pressure, and saturation (BTPS)?
Vital Capacity (VC).
9. When does the spirometer not need to produce a graphic display?
If only the vital capacity is to be measured.
10. Two acceptable vital capacity maneuvers should be obtained within what parameters?
The volumes should be within 150 ml.

11. What is the maximum volume of gas that can be expired when the patient exhales as forcefully and rapidly as possible after a maximal inspiration?
12. What are the three distinct phases to the FVC maneuver?
.
13. What two ways can the FVC be displayed?
14. Can spirometry measure gas exchange?
15. What does it mean when we say that spirometry is effort-dependent?

11. What is the maximum volume of gas that can be expired when the patient exhales as forcefully and rapidly as possible after a maximal inspiration?
FVC.
12. What are the three distinct phases to the FVC maneuver?
Maximal inspiration, a ”blast” of exhalation, and continued complete exhalation to the end of the test.
13. What two ways can the FVC be displayed?
Volume-time recording and flow-volume recording.
14. Can spirometry measure gas exchange?
No, we can infer gas exchange from spirometry but not directly measure it. Spirometry only measures gas volumes and time (flow = volume/time) – no direct assessment of gas exchange (as does a diffusion capacity measurement).
15. What does it mean when we say that spirometry is effort-dependent?
Spirometry is highly effort-dependent. Poor effort leads to poor quality data and poor effort spirometry will result in an underestimation of true values (e.g. FEV1, FVC).

Is the spirometry test more focused on inspiration or expiration?

What values cannot be measured from a spirogram?

What is the difference between TLC and RV?

Is the spirometry test more focused on inspiration or expiration?
Expiration, because of airflow diseases. Especially ones that cause obstruction, somewhat disproportionately affect expiration.

What values cannot be measured from a spirogram?
Residual Volume and Total Lung Capacity.
What is the difference between TLC and RV?
Vital Capacity.

What is FEV1?

What does normal spirometry mean?

What is the amount of air that the patient expelled if she/he inhales as deeply as possible and then blows the air out until he/she cannot exhale anymore?

What is FEV1?
Forced expiratory volume in 1 second.

What does normal spirometry mean?
FVC > 80% predicted and (80% to 120% is the normal range); FEV1/FVC ratio ≥ 0.75.

What is the amount of air that the patient expelled if she/he inhales as deeply as possible and then blows the air out until he/she cannot exhale anymore?

Vital capacity.

What is the resting tidal volume?

What is the Expiratory reserve volume (ERV)?

What is the Residual Volume?

What is the inspiratory reserve volume (IRV)?

What is the Inspiratory capacity?

What is the Functional Residual Capacity (FRC)?

What is the resting tidal volume?
It is the amount of air inhaled or exhaled with each breath under resting conditions. The normal value is 500 mL in both males and females.

What is the Expiratory reserve volume (ERV)?
The amount of air that you can voluntarily expel AFTER you have completed a normal, quiet respiratory cycle. The normal value is 1000-1200 ml. You use your accessory expiratory muscles.

What is the Residual Volume?
It is the amount of air remaining in the lungs even after a maximal exhalation. The normal value for males is 1200 ml while 1100 ml in females.

What is the inspiratory reserve volume (IRV)?
It is the amount of air that can be taken in over and above the tidal volume. IRV in males is about 3300 ml and for females is about 1900 ml.

What is the Inspiratory capacity?
The amount of air that can be drawn into the lungs after a quiet respiratory cycle has been completed. IC = TV + IRV.

What is the Functional Residual Capacity (FRC)?
The amount of air remaining in the lungs after a quiet respiratory cycle has been completed. FRC = ERV + RV.

What is the Vital capacity?

What is the Total lung capacity?

How many breaths can you take each minute?

What is a Forced vital capacity?
Measures the amount of gas expelled when the subject takes the deepest possible breath and then exhales forcefully and rapidly. The FVC is reduced in patients with a restrictive pulmonary disease.

What is a Forced Expiratory Volume?
It examines the percentage of the vital capacity that is exhaled during specific time intervals of the FVC test (amount of air exhaled during the first second). Healthy people can exhale 75-85% of their FVC in the first second.

All the lung volumes can be measured by spirometry *except*

A) tidal volumes.
B) inspiratory reserve volume.
C) expiratory reserve volume.
D) residual volume

The sum of the four primary lung volumes (tidal volume, inspiratory reserve volume, expiratory reserve volume, and residual volume) equals

A) the functional residual capacity (FRC).
B) the vital capacity (VC).
C) the total lung capacity (TLC).
D) the maximum ventilatory volume (MVV

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A person normally passively inhales and exhales 500 mL of air. This is the _________.

A. tidal volume
B. expiratory capacity
C. residual volume

The amount of air that a person normally cannot exhale at all is about 1200 mL. This is the _________.

A. vital capacity
B. residual volume
C. expiratory reserve volume

After a person inhales normally and then forces himself to inhale some more, this is called the _________ volume.

A. tidal
B. residual
C. inspiratory reserve

If a container consists of three different gases, such as oxygen, carbon dioxide, and nitrogen, which of the following would contribute to the overall pressure within the container?

A. the gas being inhaled
B. the gas being exhaled
C. all three gases

- It is important in the medical world that the partial pressure of oxygen is a specific value in order to get oxygen to diffuse from the lungs into the bloodstream. Which of the following statements is correct in that regard?

A. Oxygen has to have a high partial pressure.
B. Oxygen has to have a low partial pressure.
C. Oxygen has to have the same partial pressure as carbon dioxide.

A person normally passively inhales and exhales 500 mL of air. This is the _________.

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B. **expiratory capacity**
C. **residual volume**

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C. **Oxygen has to have the same partial pressure as carbon dioxide.**

- 4/ Given the following, calculate the tidal volume.
  - Vital capacity = 5000 mL
  - Inspiratory reserve volume = 3 L
  - Expiratory reserve volume = 1500 mL

5/Bjorn is a 37yo Swedish male who stands 6’6” and weighs in at 307lbs. He is a cigarette smoker, a movie fan, an alcoholic,

- and enjoys quiet sunset walks on the beach. As he grows older,
  1. What will happen to his vital capacity?
  2. What will happen to his residual volume?

6/Define expiratory reserve volume

- 4/ Given the following, calculate the tidal volume.
    - Vital capacity = 5000 mL
    - Inspiratory reserve volume = 3 L
    - Expiratory reserve volume = 1500 mL
- ***Tidal volume=500mL***

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• and enjoys quiet sunset walks on the beach. As he grows older,

1. What will happen to his vital capacity?
2. What will happen to his residual volume?

•a. Decrease b. Increase

6/Define expiratory reserve volume

The volume of air that can be exhaled after a normal tidal expiration

- Tasha’s tidal volume is half her expiratory reserve volume. Her inspiratory reserve volume is twice as big as her expiratory reserve volume. Her vital capacity is 5250mL. Calculate her

- 7/TV
- 8/ IRV
- 9/ERV.

- Tasha’s tidal volume is half her expiratory reserve volume. Her inspiratory reserve volume is twice as big as her expiratory reserve volume. Her vital capacity is 5250mL. Calculate her

- 7/TV
- 8/ IRV
- 9/ERV.

- TV = 750 mL ERV = 1500 mL IRV = 3000 mL

A patient has the following bedside spirometry results:

- Respiratory Rate = 12
- Tidal volume = 450 mL
- Dead Space = 147 mL
- Vital Capacity = 1.2 L

Based on this data, what is the patient's minute ventilation?

A patient has the following bedside spirometry results: • Respiratory Rate = 12 • Tidal volume = 450 mL • Dead Space = 147 mL • Vital Capacity = 1.2 L Based on this data, what is the patient's minute ventilation?

VE= RESPIRATORY RATE X Tidal volume

VE = 12 x 450 VE = 5,400 mL/min Divide by 1,000 to convert mL to L. VE = 5.4 L/min

A patient has the following bedside spirometry results: • Rate = 12 • Tidal Volume = 450 mL • Dead Space = 147 mL • Vital Capacity = 1.2 L Based on this data, what is the patient's minute ventilation?

VA = (Tidal Volume – Deadspace) x Respiratory Rate

A patient has the following bedside spirometry results: • Rate = 12 • Tidal Volume = 450 mL • Dead Space = 147 mL • Vital Capacity = 1.2 L Based on this data, what is the patient’s minute ventilation?

VA = (Tidal Volume – Deadspace) x Respiratory Rate
VA = (450 – 147) x 12 VA = 3,636 mL/min Divide by 1,000 to convert mL to L. VA = 3.6 L/min

Describe the functions of the respiratory system

Upper respiratory tract location

Upper respiratory tract divisions

Describe the functions of the respiratory system
•Supply oxygen to blood
•remove carbon dioxide from the blood
•maintain homeostasis of pH in the body
•warms, moistens, and filters the air
•produces sound for communication
•aids in olfaction

Upper respiratory tract location
- located outside thorax

Upper respiratory tract divisions
•Nose
•Nasal cavity
•Nasopharynx
•laryngopharynk
•larynx

Respiration – four distinct processes must happen?

WHAT ARE THE THREE TYPE OF EPITHELIUM FOUND IN THE PHARYNX?

The pharynx or throat has two functions what are these two function :

.

1/Respiration – four distinct processes must happen

- **Pulmonary ventilation** – moving air into and out of the lungs
- **External respiration** – gas exchange between the lungs and the blood
- **Transport** – transport of oxygen and carbon dioxide between the lungs and tissues
- **Internal respiration** – gas exchange between systemic blood vessels and tissues

4/WHAT ARE THE THREE TYPE OF EPITHELIUM FOUND IN THE PHARYNX

1. Stratified squamous (moist). This type, as in other sites in the body, is found where there is considerable friction, such as from air, food or contact with other surfaces. It lines most of the epiglottis (except part of the lower, posterior surface), the aryepiglottic folds, and the true vocal folds.

2. Ciliated pseudostratified columnar. This type of epithelium, which contains goblet cells begins near the base of the posterior surface of the epiglottis and lines most of the remainder of the larynx. It lines the false vocal folds, but not the true vocal folds. The cilia are 3.5-5 μm long and beat toward the mouth, moving foreign particles and mucus from the air passages toward the exterior of the body.

3. Ciliated stratified columnar

5/The pharynx or throat has two functions what are these two function :

. It is a
passageway for both food and air, and it forms
a resonating chamber for speech sounds.

Cells of the Olfactory mucosa.

Cells of the Olfactory mucosa.

1. **supporting cells**
2. **Basal cells**
3. **Olfactory cells**

1/ Define residual volume.

2/ Name a factor that could cause someone's actual vital capacity to be less than their predicted vital capacity.

3/ Put the following in correct chronological order during **EXPIRATION**:

A. Air rushes out of the lungs
B. Diaphragm relaxes
C. Lung pressure increases
D. Lung volume decreases

- 1/ Define residual volume.
- *The vol. of air remaining in the lungs after a maximal exhalation.*
- 2/ Name a factor that could cause someone's actual vital capacity to be less than their predicted vital capacity.
- *Asthma, emphysema, sedentary lifestyle, etc.*
- 3/ Put the following in correct chronological order during **EXPIRATION**:
  a) Air rushes out of the lungs
  b) Diaphragm relaxes
  c) Lung pressure increases
  d) Lung volume decreases
- *b-d-c-a*

Premature children do not produce adequate amounts of pulmonary surfactant. Name two cells that are involved and explain why this greatly increases the risk of death. What would you expect to see on a histological preparation of lung tissue from such an infant?

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Type II pneumocytes and Club (Clara) cells are both involved in surfactant production. The lung tissue histology of such an infant would appear with collapsed alveoli.

1. Briefly describe the structural and functional differences between the following:

- Respiratory Bronchiole and Terminal Bronchiole
- Alveolar Sac and Alveolus
- Type I and Type II Pneumocyte

Respiratory Bronchiole and Terminal Bronchiole: Terminal bronchioles transition from ciliated to cuboidal epithelia and are conducting passages.

Respiratory bronchioles also have cuboidal epithelia, but contain some alveoli.

Alveolar Sac and Alveolus: An alveolar sac contains many alveoli.

Type I and Type II Pneumocyte: Type I pneumocytes are squamous cells that support gas exchange; type II pneumocytes are cuboidal and create pulmonary surfactant

Trace the path of a molecule of oxygen from the nose to the bloodstream. Make sure to include all major airways, as well as each layer of tissue that must be traversed.

Describe the changes in the type of epithelia encountered as the molecule of oxygen in the question above moves from the nose to the alveolus.

Name two adaptations that ensure that the airways will remain open under the normal conditions of inhalation and exhalation. How do these work?

Trace the path of a molecule of oxygen from the nose to the bloodstream. Make sure to include all major airways, as well as each layer of tissue that must be traversed.

Nose to pharynx to trachea to bronchi to intralobar bronchioles to terminal bronchioles to respiratory bronchioles to alveolar duct to alveolar sac to alveolus to type I pneumocyte to basement membrane to endothelial cell to blood to RBC membrane to hemoglobin

Describe the changes in the type of epithelia encountered as the molecule of oxygen in the question above moves from the nose to the alveolus.

Pseudostratified columnar ciliated epithelium (nose to terminal bronchus) to cuboidal epithelium (terminal bronchus to alveolar sac) to simple squamous epithelium (alveolus)

Name two adaptations that ensure that the airways will remain open under the normal conditions of inhalation and exhalation. How do these work?

Cartilage mechanically holds the airway open. Surfactant works by decreasing surface tension

An infant born prematurely in gestational week 25 has neonatal respiratory distress syndrome.
Which of the following would be expected in this infant?
(A) Arterial P02 of 100 mm Hg
(B) Collapse of the small alveoli
(C) Increased lung compliance
(D) Normal breathing rate
(E) Lecithin:sphingomyelin ratio of greater than 2:1 in amniotic fluid

Which of the following lung volumes or capacities can be measured by spirometry?
(A) Functional residual capacity (FRC)
(B) Physiologic dead space
(C) Residual volume (RV)
(D) Total lung capacity (TLC)
(E) Vital capacity (VC)

Which volume remains in the lungs after a tidal volume (TV) is expired?
(A) Tidal volume (TV)
B) Vital capacity (VC)
(C) Expiratory reserve volume (ERV)
(D) Residual volume (RV)
(E) Functional residual capacity (FRC)
(1) Inspiratory capacity
(G) Total lung capacity

person has a vital capacity (VC) of 5 L, a tidal volume (TV) of 0.5 L, an inspiratory capacity of 3.5 L, and a functional residual capacity (FRC) of 2.5 L. What is his expiratory reserve volume (ERV)?
(A) 4.5 L
(B) 3.9 L
(C) 3.6 L
(D) 3.0 L
(E) 2.5 L
(F) 2.0 L
G)1.5L

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(D) Residual volume (RV)
(E) Functional residual capacity (FRC)
(1) Inspiratory capacity
(G) Total lung capacity

Residual volume (RV) cannot be measured by spirometry.
Therefore, any lung volume or capacity that includes the RV cannot be measured by spirometry.
Measurements that include RV are functional residual capacity (FRC) and total *lung capacity* (TLC). Vital capacity (VC) does not include RV and is, therefore, measurable by spirometry.
Physiologic dead space is not measurable by spirometry and requires sampling of arterial Pco2 and expired CO2.

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(B) 3.9 L
(C) 3.6 L
(D) 3.0 L
(E) 2.5 L
(F) 2.0 L
G)1.5L

ERV=VC-IC
IC= TV +IRV

When a person is standing, blood flow in the lungs is
(A) equal at the apex and the base
B) highest at the apex owing to the effects of gravity on arterial pressure
(C) highest at the base because that is where the difference between arterial and venous pressure is greatest
(D) lowest at the base because that is where alveolar pressure is greater than arterial pressure

In the hemoglobin-02 dissociation curves shown above, the shift from curve A to curve B could be caused by
(A) increased pH
(B) decreased 2,3-diphosphoglycerate (DPG) concentration
(C) strenuous exercise
(D) fetal hemoglobin (HbF)
(E) carbon monoxide (CO) poisoning

Which of the following is the site of highest airway resistance?
(A) Trachea
(B) Largest bronchi
(C) Medium-sized bronchi
(D) Smallest bronchi
(E) Alveoli

When a person is standing, blood flow in the lungs is
(A) equal at the apex and the base
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The distribution of blood flow in the lungs is affected by gravitational
effects on arterial hydrostatic pressure. Thus, blood flow is highest at the base, where arterial hydrostatic pressure is greatest and the difference between arterial and venous pressure
is also greatest. This pressure difference drives the blood flow.

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The medium-sized bronchi actually constitute the site of highest resistance along the bronchial tree.
Although the small radius of the alveoli might predict that they would have the highest resistance, they do not because of their parallel arrangement. In fact,early changes in resistance in the small airways may be "silent" and go undetected because of their small overall contribution to resistance.

Which is *not* part of the conducting portion of the respiratory system?
A. Alveoli
B. Trachea
C. Larynx
D. Nasal cavity
E. Bronchi

The terms "upper respiratory system" and "lower respiratory system" are ___________ categorizations of the respiratory system.
A. structural
B. functional
C. outdated

Which region(s) of the pharynx is lined by pseudostratified ciliated columnar epithelium?
A. Oropharynx
B. Nasopharynx
C. Laryngopharynx
D. Oropharynx and nasopharynx
E. Oropharynx, nasopharynx, and laryngopharynx

Terminal bronchioles of the lower respiratory system are lined with

A. keratinized stratified squamous epithelium.
B. simple cuboidal epithelium.
C. pseudostratified ciliated columnar epithelium.
D. stratified columnar epithelium.
E. nonkeratinized stratified squamous.

Several things happen to inhaled air in a process called conditioning. Select the exception.
A. The air is cooled.
B. The air is humidified.
C. The air is cleansed.
D. The air is moistened.
E. The air becomes turbulent.

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The region of the nasal cavity immediately internal to the nostrils is the _________; it contains coarse guard hairs.

A. choanae
B. olfactory region
C. vestibule
D. respiratory region
E. nasopharynx

An air passage (valley) beneath a turbinate within the nasal cavity is referred to as a

A. vestibule.
B. concha.
C. vibrissa.
D. meatus.

Which bone does *not* contain a paranasal sinus?

A. Sphenoid bone
B. Frontal bone
C. Ethmoid bone
D. Mandible
E. Maxilla

What structures are used by both the respiratory and digestive systems?

A. Oropharynx and laryngopharynx
B. Laryngopharynx and larynx
C. Nasal cavity and nasopharynx
D. Paranasal sinuses
E. Laryngopharynx and esophagus

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A 43-year-old female patient has been lying down on the hospital bed for more than 4 months. Her normal, quiet expiration is achieved by contraction of which of the following structures?

A. Elastic tissue in the lungs and thoracic wall

B. Serratus posterior superior muscles

C. Pectoralis minor muscles

D. Serratus anterior muscles

E. Diaphragm

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(B) Serratus posterior superior muscles
(C) Pectoralis minor muscles
(D) Serratus anterior muscles
(E) Diaphragm

Normal, quiet expiration is achieved by contraction of extensible tissue in
the lungs and the thoracic wall. The serratus posterior superior muscles, diaphragm, pectoralis
major, and serratus anterior are muscles of inspiration

Inspiration PROCESS?

Inspiration

- Occurs when the ribs and sternum (or thoracic cage) are elevated by the following **muscles**: the **diaphragm**; external, internal (interchondral part), and innermost intercostal; sternocleidomastoid; levator costarum; serratus anterior; scalenus; pectoralis major and minor; and serratus posterior superior muscles.
- Involves the following processes:

1. Contraction of the Diaphragm

- Pulls the dome inferiorly into the abdomen, thereby **increasing the vertical diameter** of the thorax.

2. Enlargement of the Pleural Cavities and Lungs

- **Reduces** the intrapulmonary **pressure** (creates a **negative pressure**), thus allowing air to rush into the lungs passively because of atmospheric pressure.

3. Forced Inspiration

- Involves contraction of the **intercostal muscles and elevation of the ribs** (superolateral movement), with the sternum moving anteriorly like a **bucket handle**. (When the handle is raised, the convexity moves laterally.)
- Results in **increased transverse and anteroposterior diameters** of the thoracic cavity. The abdominal volume is decreased with an increased abdominal pressure.

Expiration PROCESS?

Expiration

- Involves the following muscles: the **muscles of the anterior abdominal wall**, **internal intercostal** (costal part) **muscles**, and serratus posterior inferior muscles.
- Involves the following processes:

1. Overall Process

- Involves relaxation of the diaphragm, the internal intercostal muscles (costal part), and other muscles; decrease in thoracic volume; and increase in the intrathoracic pressure. The **abdominal pressure is decreased**, and the **ribs are depressed**.

2. Elastic Recoil of the Lungs

- Produces a **subatmospheric pressure** in the pleural cavities. Thus, much of the air is expelled. (**Quiet expiration** is a passive process caused by the elastic recoil of the lungs, whereas **quiet inspiration** results from contraction of the **diaphragm**.)

3. Forced Expiration

- Requires contraction of the anterior abdominal muscles and the internal intercostals (costal part).

Which volume remains in the lungs after a maximal expiration?
(A) Tidal volume (TV)
(B) Vital capacity (VC)
(C) Expiratory reserve volume (ERV)
(D) Residual volume (RV)
(E) Functional residual capacity (FItC)
(F) Inspiratory capacity
(G) Total lung capacity

A person with a tidal volume (TV) of 0.45 L has a breathing frequency of 16 breaths/min. His arterial PCO2 is 41 mm Hg, and the Pco 2 of his expired air is 35 mm Hg. What is his alveolar ventilation?
(A) 0.066 L/min
(B) 0.38 L/min
(C) 5.0 L/min
(D) 6.14 L/min
(E) 8.25 L/min

Compared with the apex of the lung, the base of the lung has
(A) a higher pulmonary capillary P02
(B) a higher pulmonary capillary Pco2
(C) a higher ventilation/perfusion (V/Q) ratio
(D) the same V/Q ratio

Which of the following changes occurs during
strenuous exercise?
(A) Ventilation rate and 02 consumption increase to the same extent
(B) Systemic arterial Poe decreases to about 70 mm Hg
(C) Systemic arterial PCO2 increases to about 60 mm Hg
(D) Systemic venous PCO2 decreases to about 20 mm Hg
(E) Pulmonary blood flow decreases at the expense of systemic blood flow

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Alveolar ventilation is the difference between tidal volume (TV) and dead space multiplied by breathing frequency.
AVR= TV-DEAD SPACE
TV and breathing frequency are given, but **dead space must be calculated.**

Dead space is TV multiplied by the difference between arterial PCO_2 and expired PCO_2 divided by arterial PCO_2.
DS= TV X(aPCO2-PeCO2/aPCO2)

Thus: dead space = 0.45 x (41 - 35/41) = 0.066 L.

Alveolar ventilation is then calculated as: (0.45 L - 0.066 L) x 16 breaths/min = 6.14 L/min.

Which of the following will occur as a result of residing at high altitude?
(A) Hypoventilation
(B) Arterial P02 greater than 100 mm Hg
(C) Decreased 2,3-diphosphoglycerate (DPG) concentration
(D) Shift to the right of the hemoglobin-02 dissociation curve
(E) Pulmonary vasodilation
(F) Hypertrophy of the left ventricle
(G) Respiratory acidosis

Which volume is expired in a maximal expiration?
(A) Tidal volume (TV)
(B) Vital capacity (VC)
(C) Expiratory reserve volume (ERV)
(D) Residual volume (RV)
(E) Functional residual capacity (FRC)
(F) Inspiratory capacity
(G) Total lung capacity

The volume expired in a forced maximal expiration is forced vital capacity, or vital capacity (VC).

1. Characteristics of olfactory epithelium
include which one of the following?
(A) It is located in the inferior region of the nasal cavity.
(B) It is classified as simple columnar.
(C) It has an underlying lamina propria containing mucous glands.
(D) It has modified cilia, which act as receptors for odor.
(E) It is unable to regenerate.

2. Which of the following statements concerning Terminal bronchioles is true?
(A) They are part of the conducting portion of the respiratory system.
(B) They function in gas exchange.
(C) They do not contain ciliated cells.
(D) They have cartilage plates present in their walls.
(E) They do not contain secretory cells.

3. The trachea possesses which one of the following components?
(A) Irregular cartilage plates in its wall
(B) Skeletal muscle in its wall
(C) An epithelium containing only two cell types
(D) A thick basement membrane underlying its epithelium
(E) Bowman glands in its lamina propria

4. Which of the following statements concerning Respiratory bronchioles is true?
(A) No gas exchange occurs in them.
(B) They do not have alveoli forming part of their wall.
(C) They contain goblet cells in their lining epithelium.
(D) They are included in the conducting portion of the respiratory system.
(E) Ciliated cells comprise a portion of their lining epithelium.

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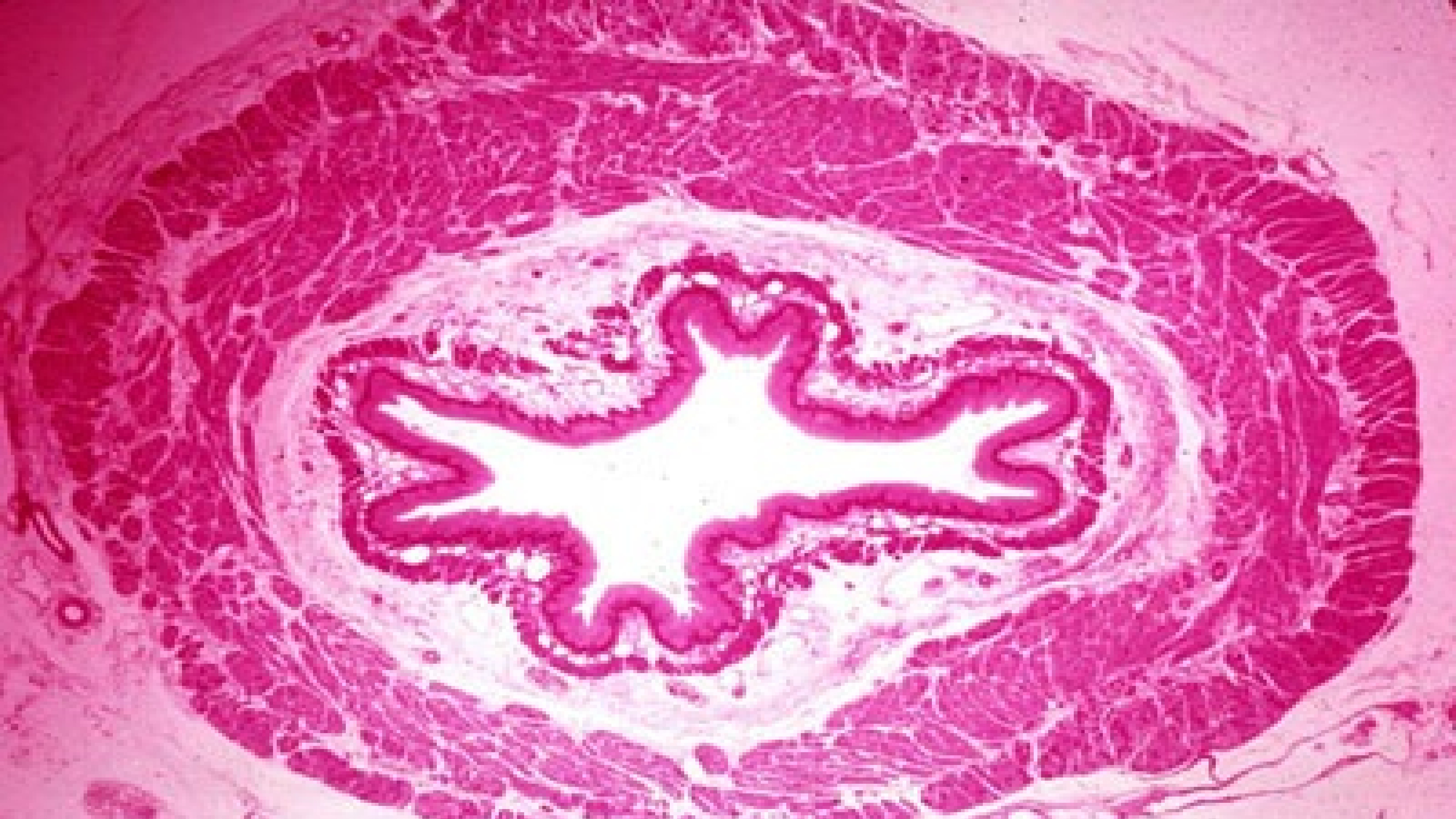
Digestive system



Esophagus

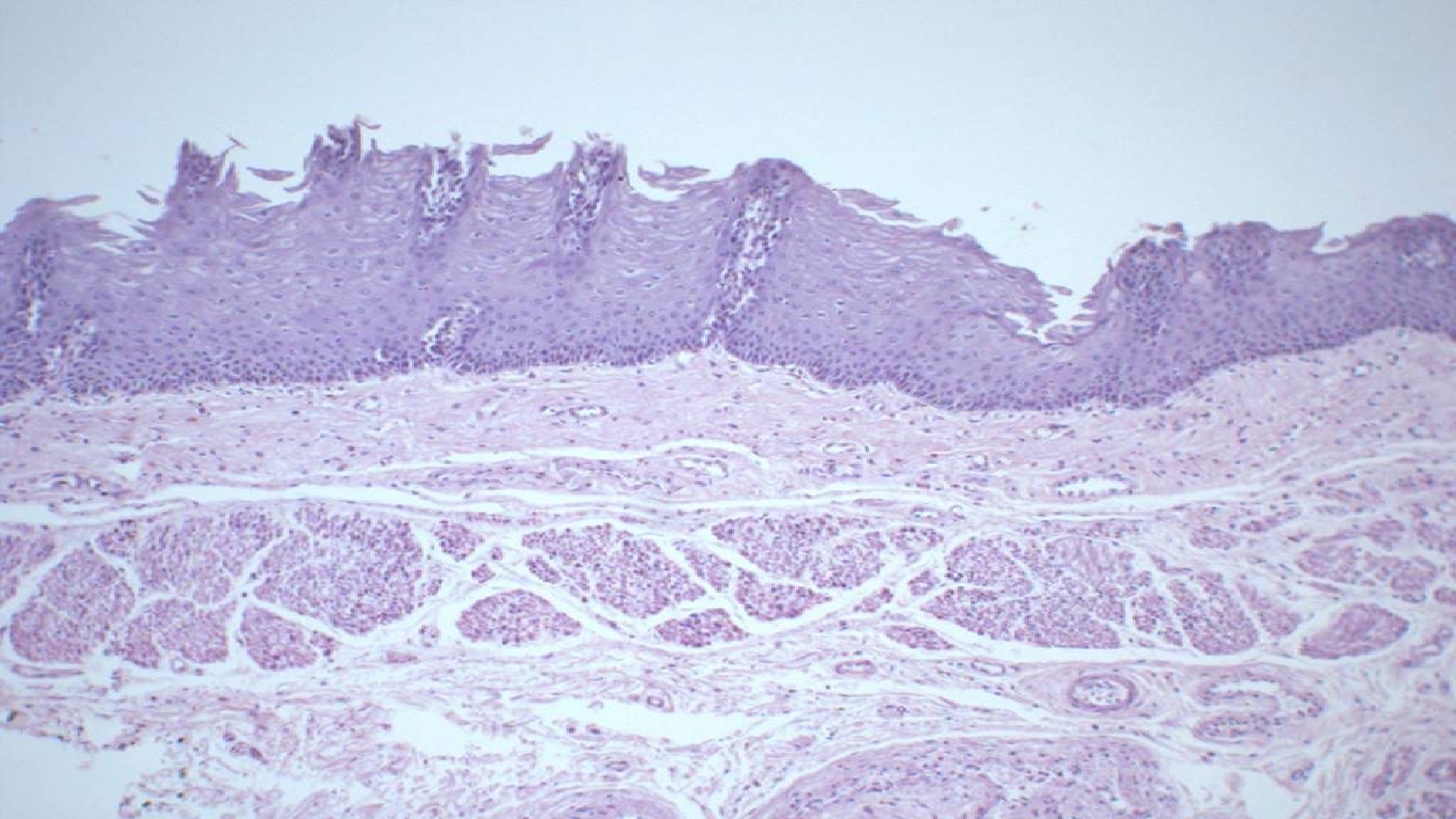
Esophageal-Gastric Junction


LUMEN

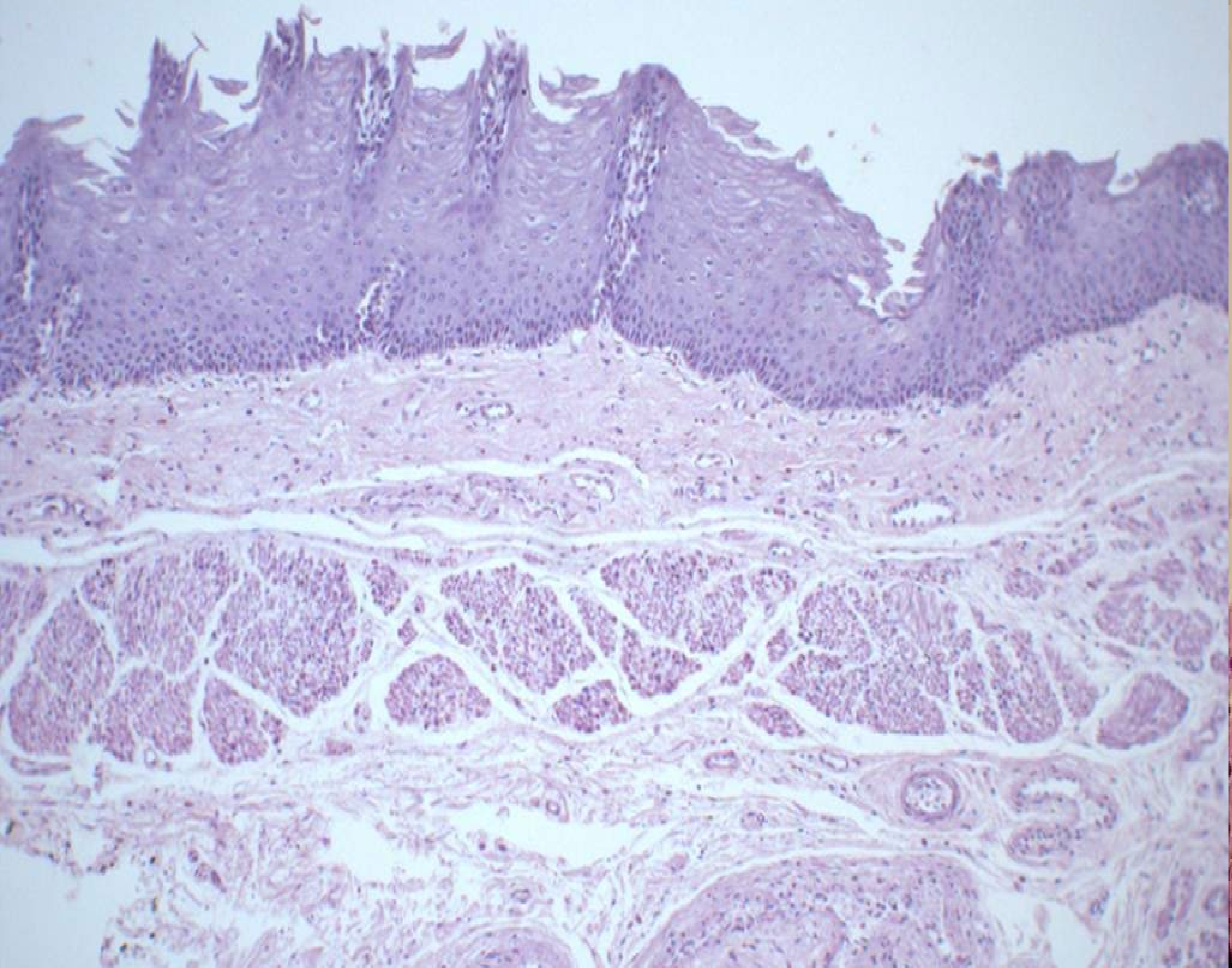
Esophagus

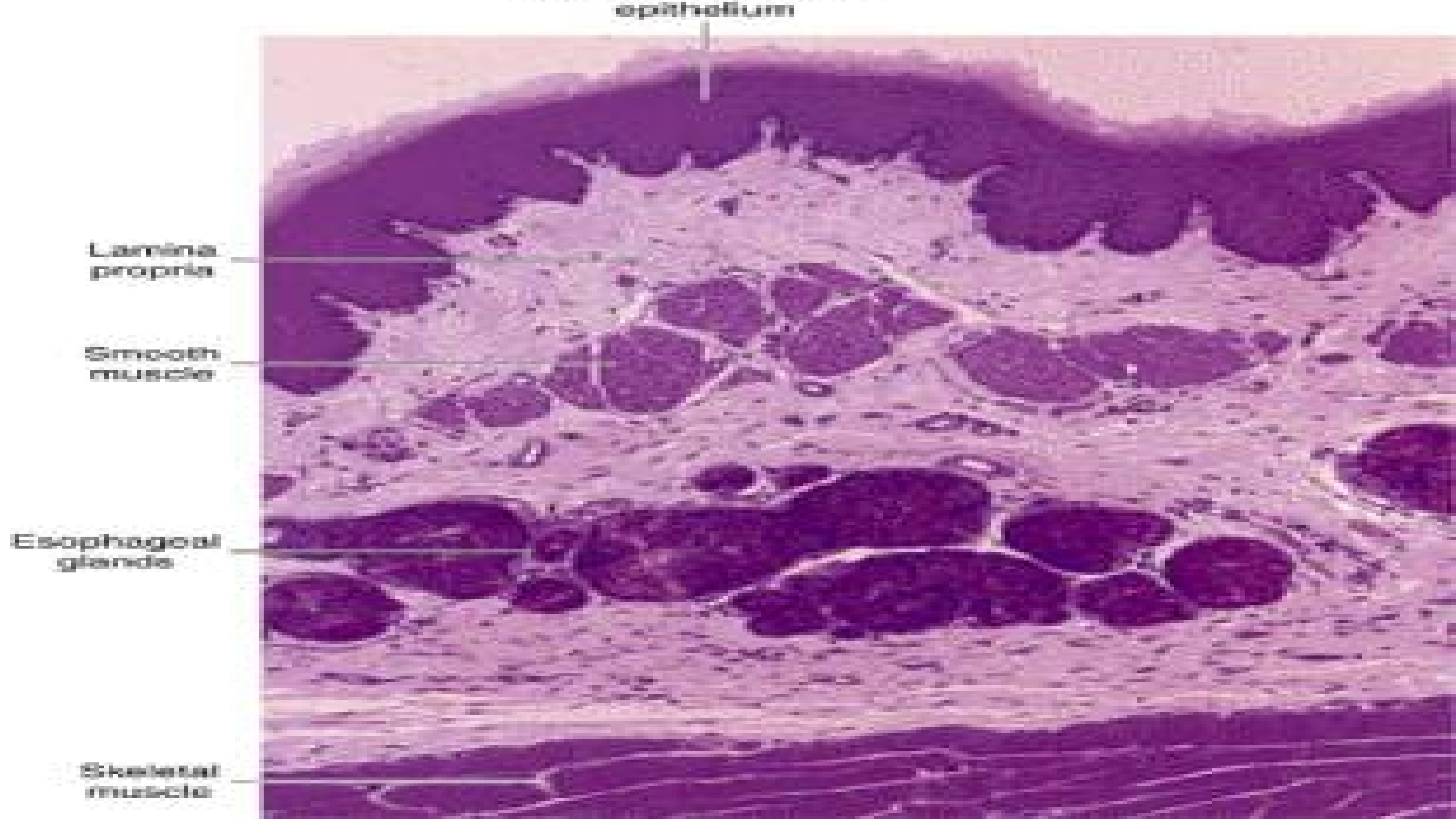
Esogastric junction

Stomach



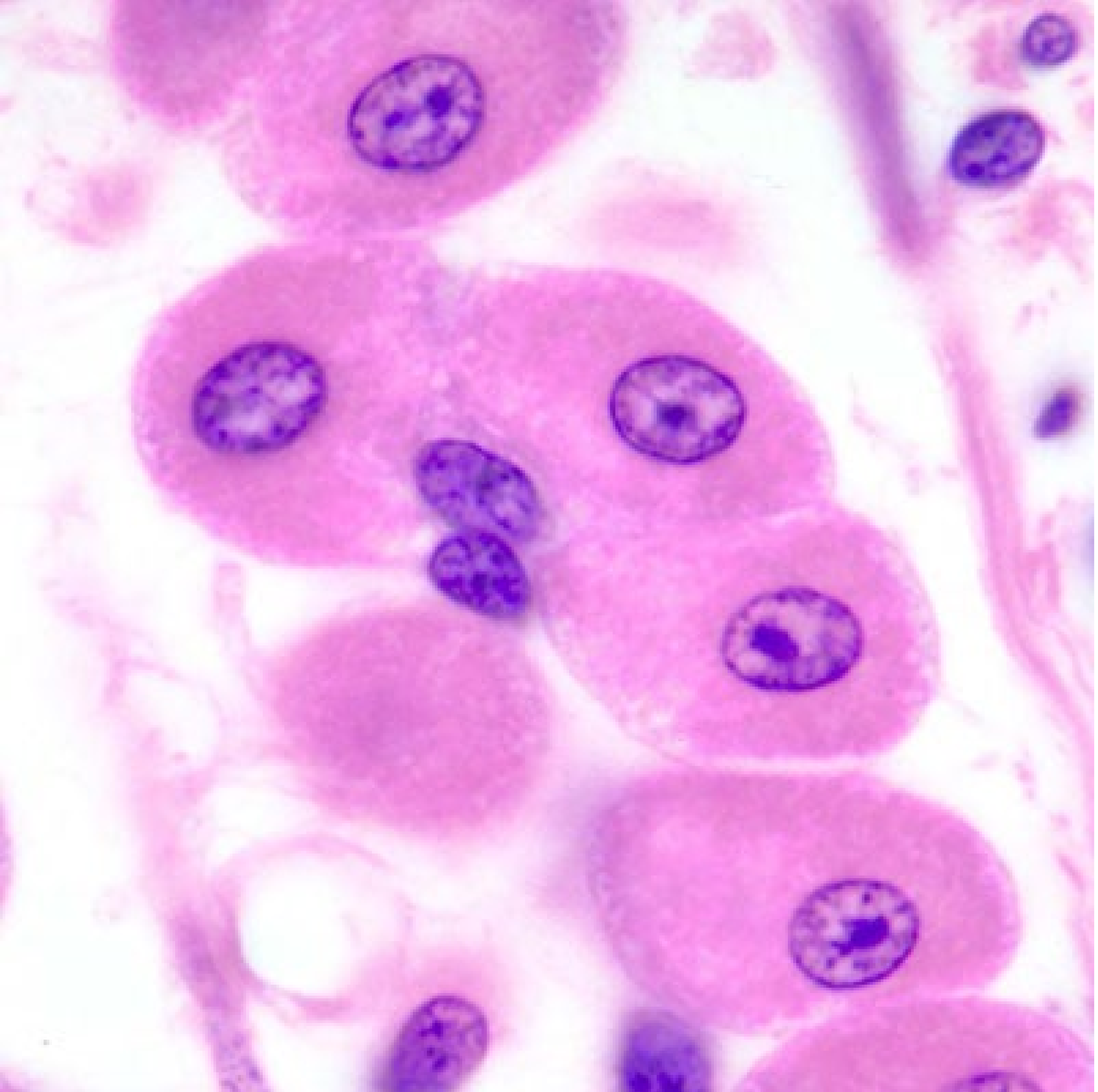
ESOPGAGUS

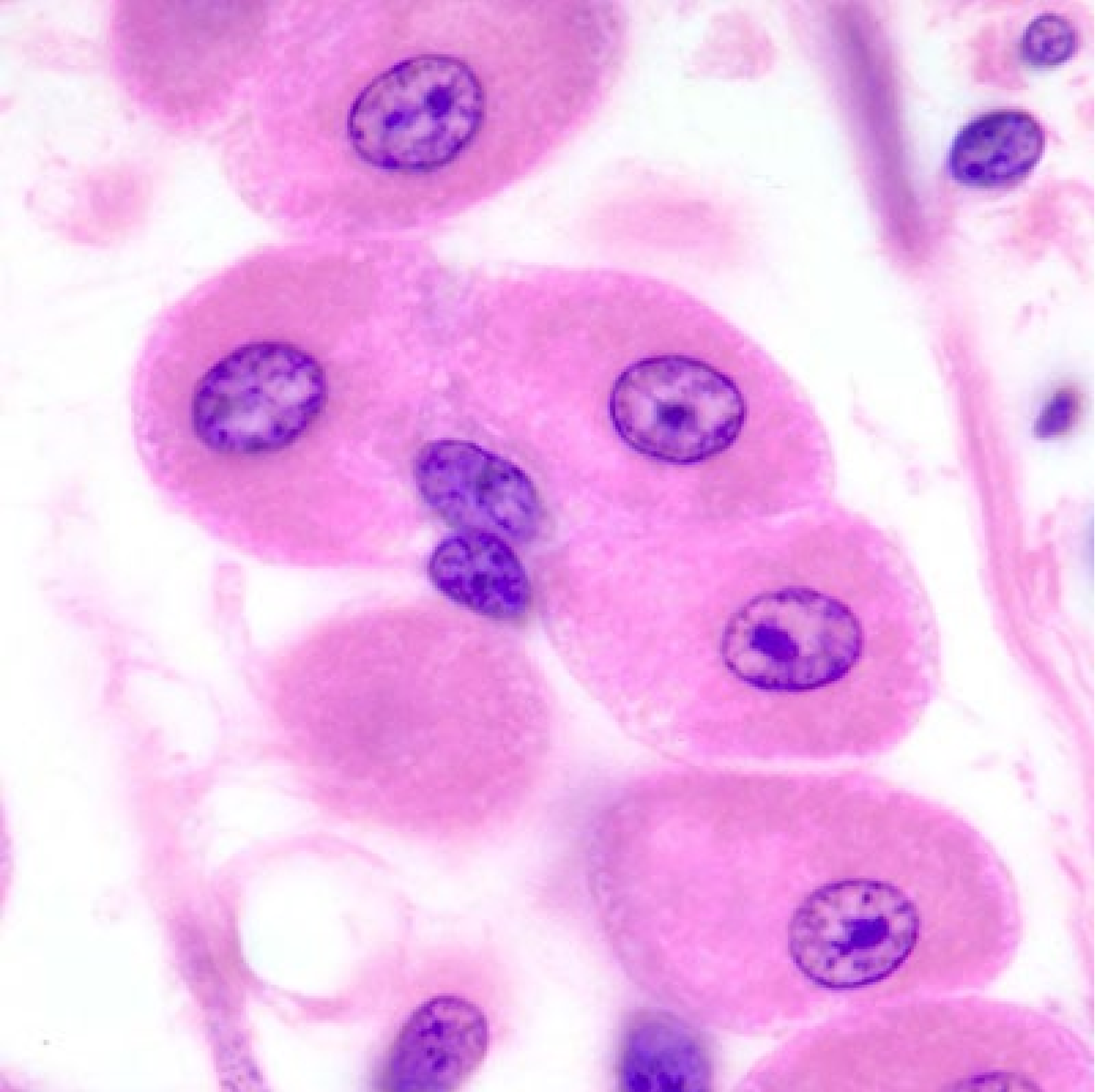



epithelium
Lamina propria
Smooth muscle
Esophageal glands
Skeletal muscle


1
3
2
2

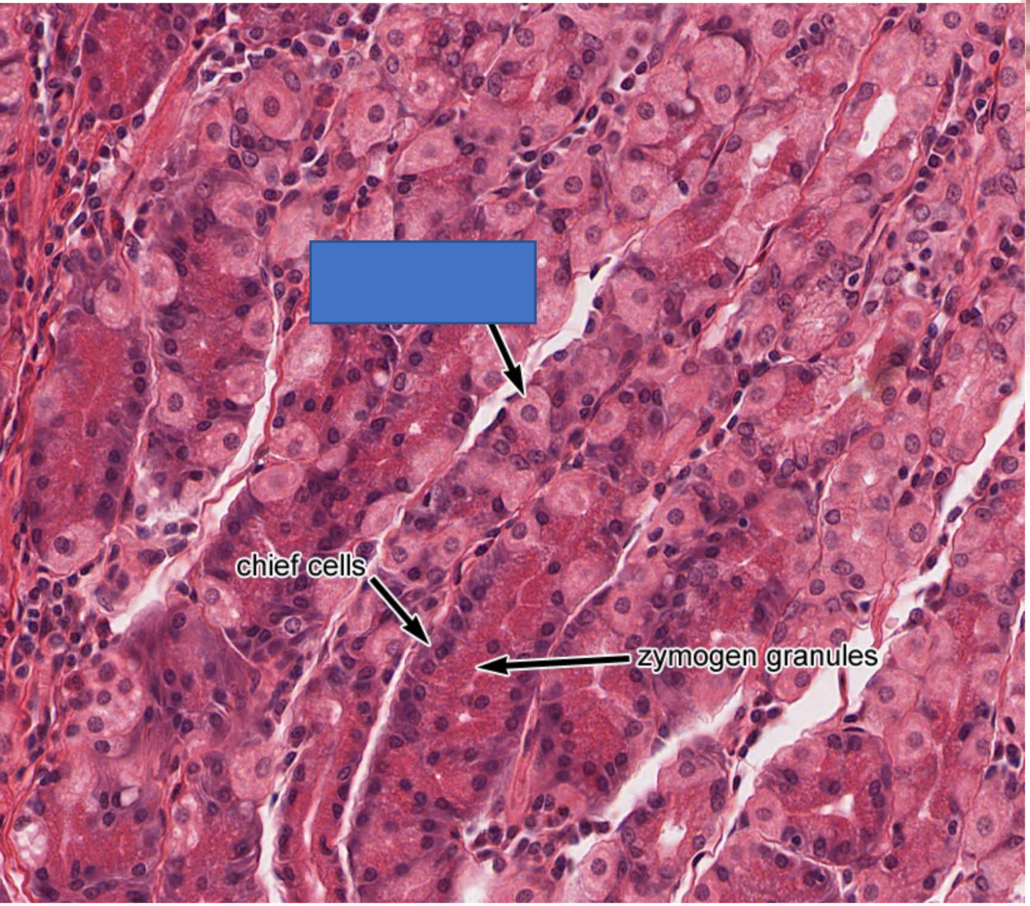
1. Stratified squamous epithelium
2. Mucous glands
3. Lamina propria

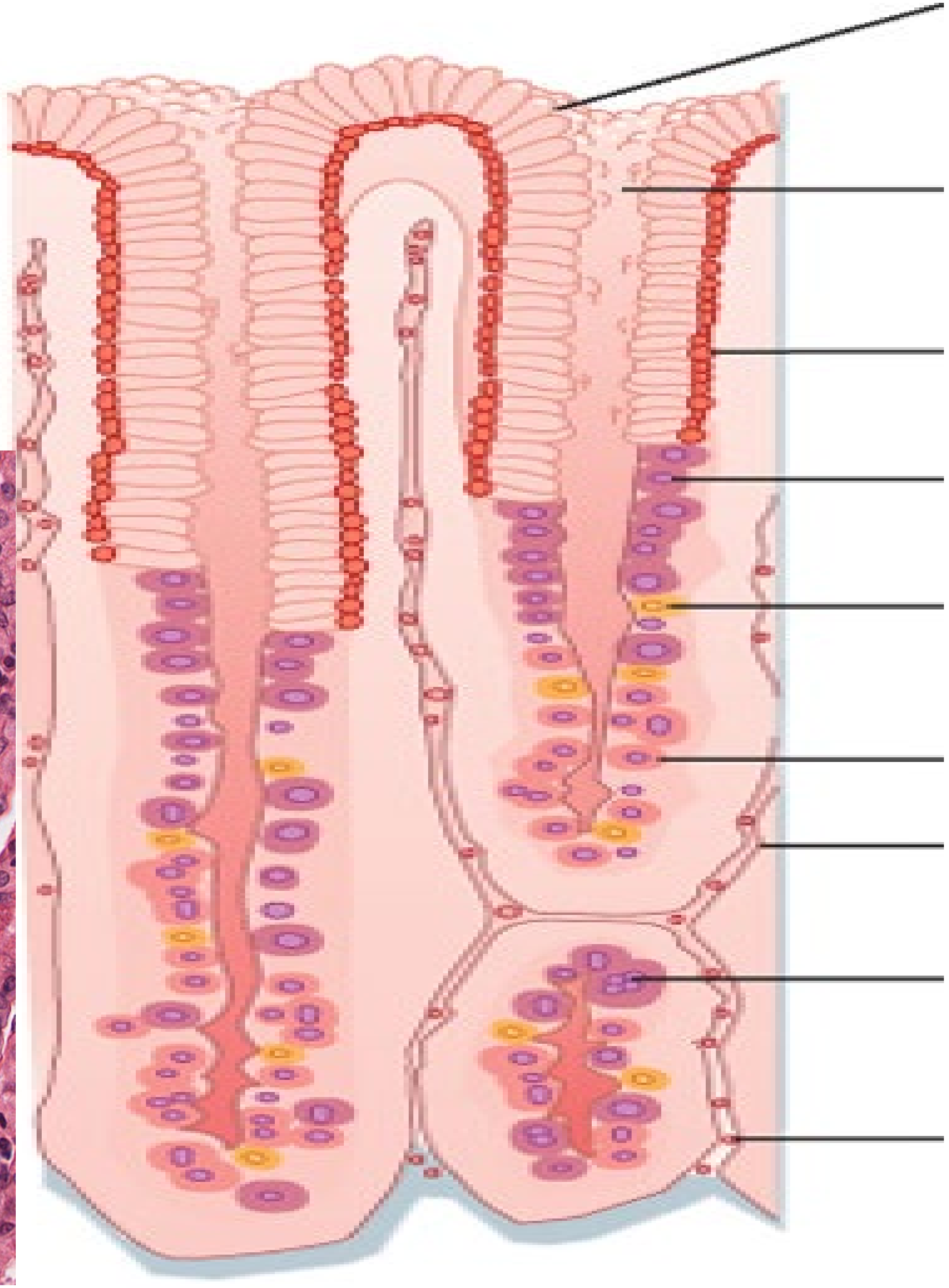


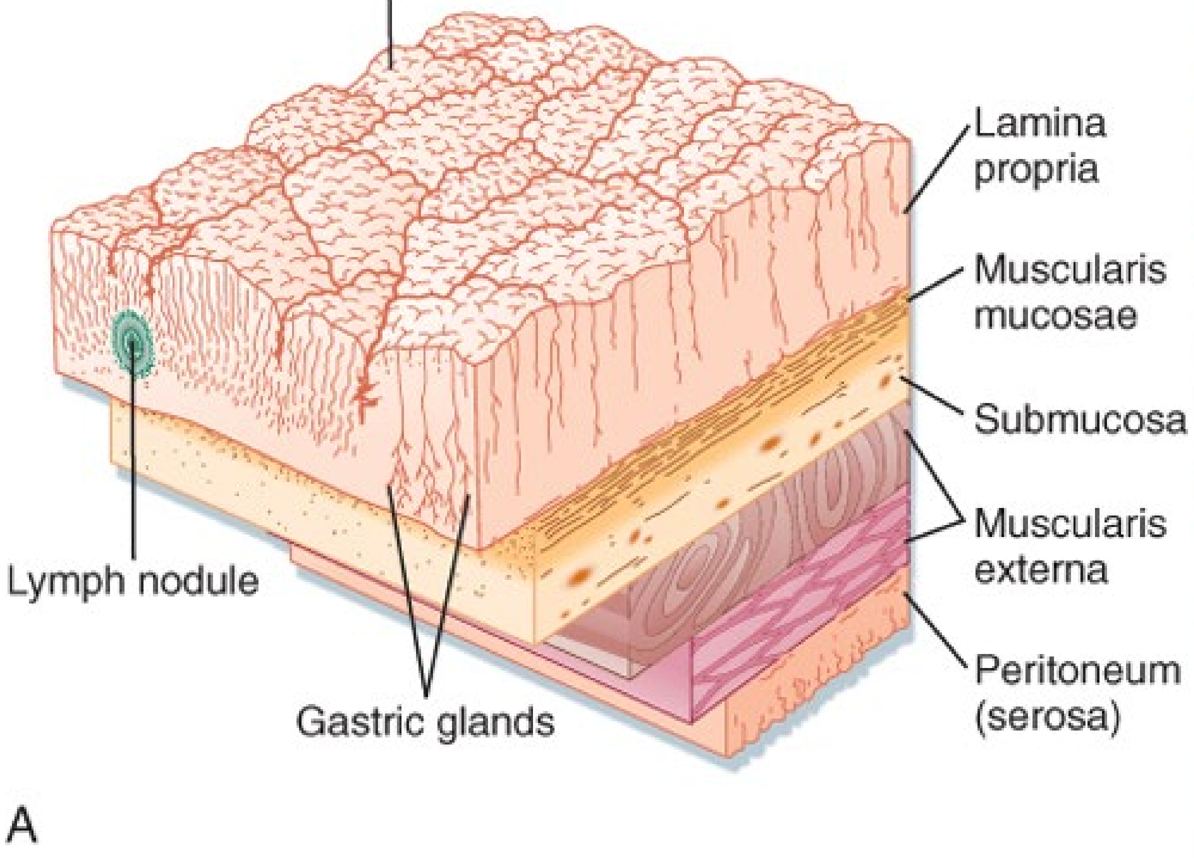


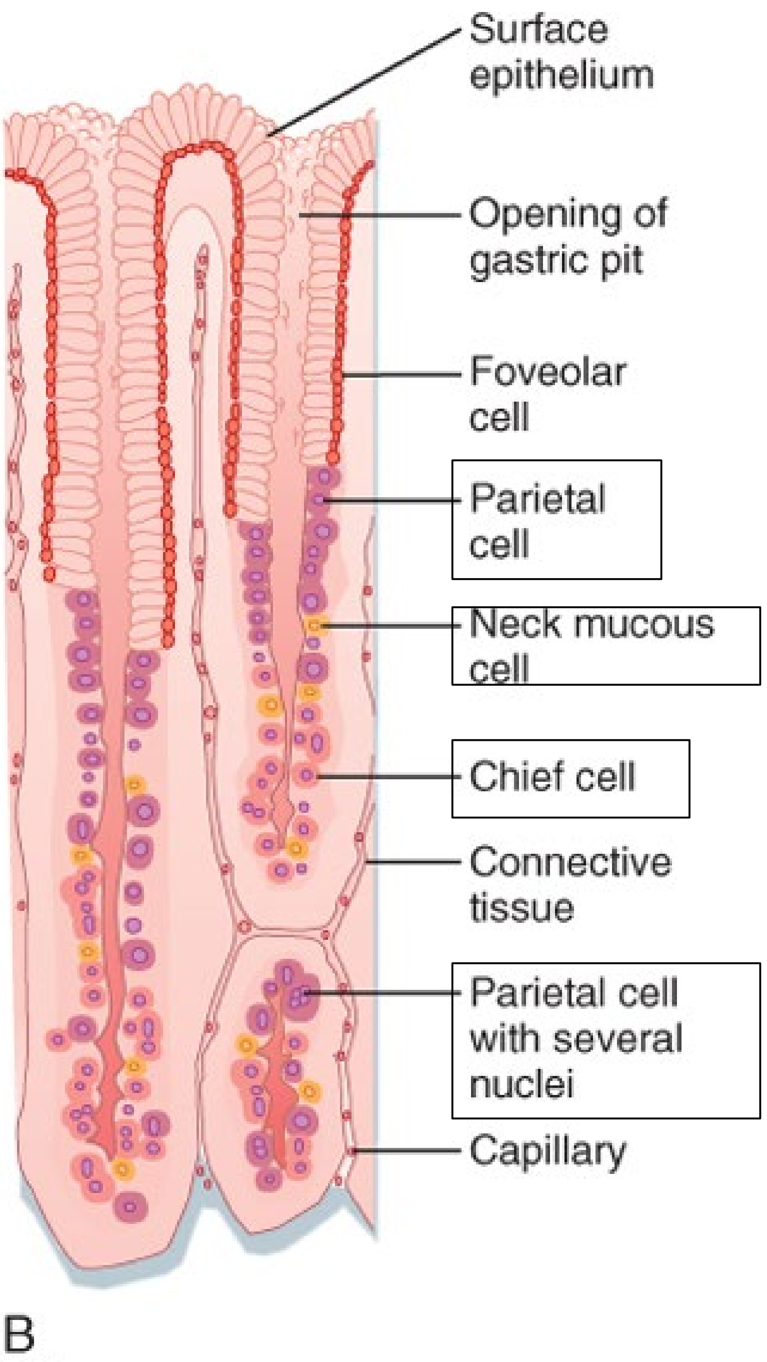
Parietal cell - HCl

Cells of the stomach pits?



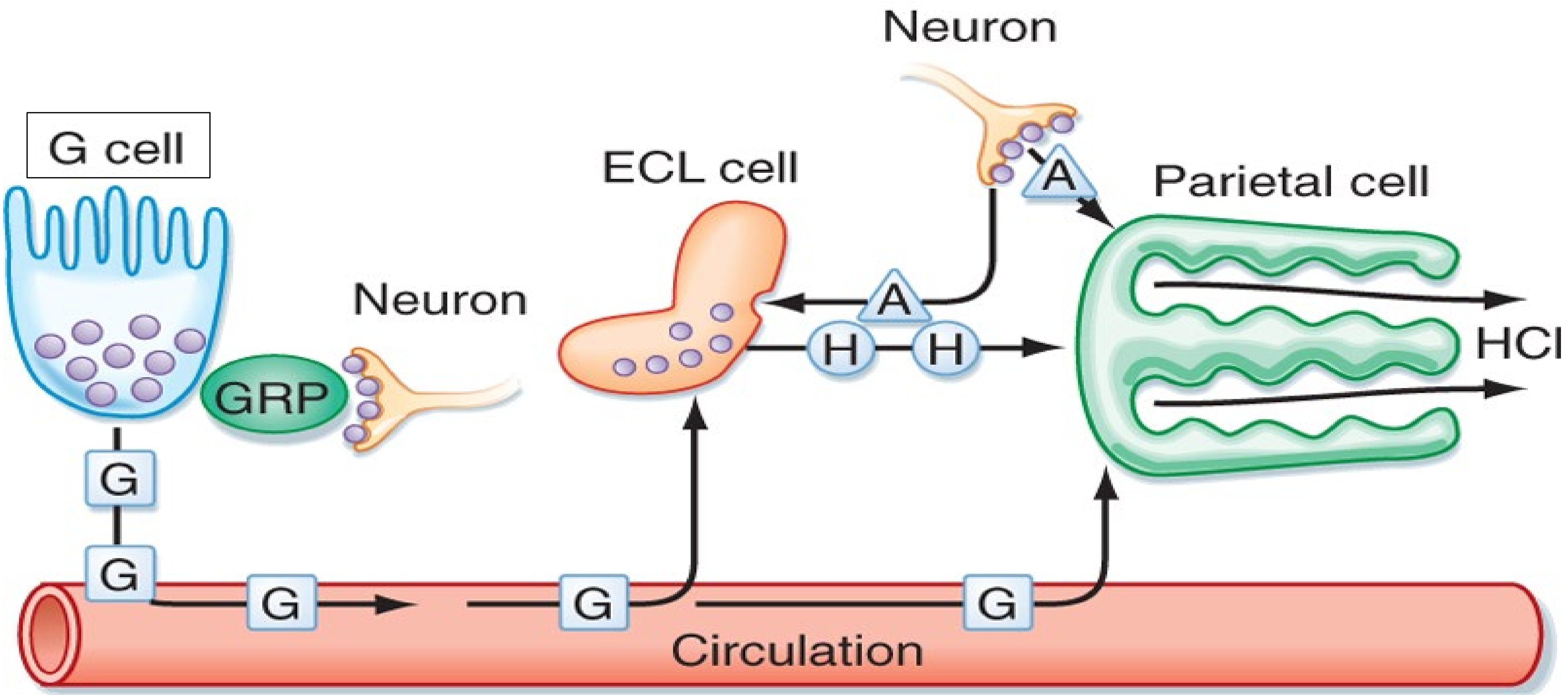






Koeppen & Stanton: Berne and Levy Physiology, 6th Edition.

ACETYLCHOLINE, GASTRIN, AND HISTAMINE STIMULATE THE PARIETAL CELL



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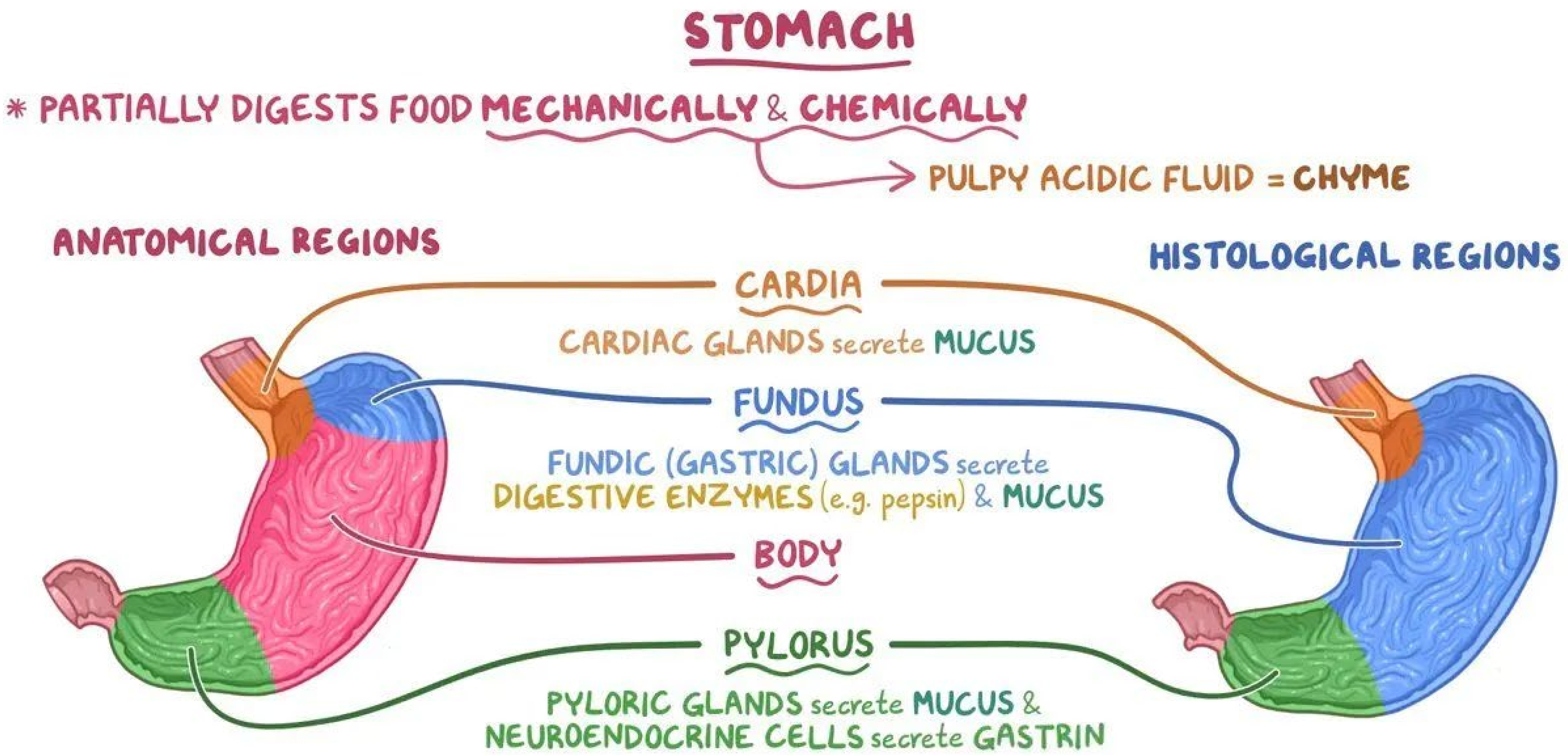
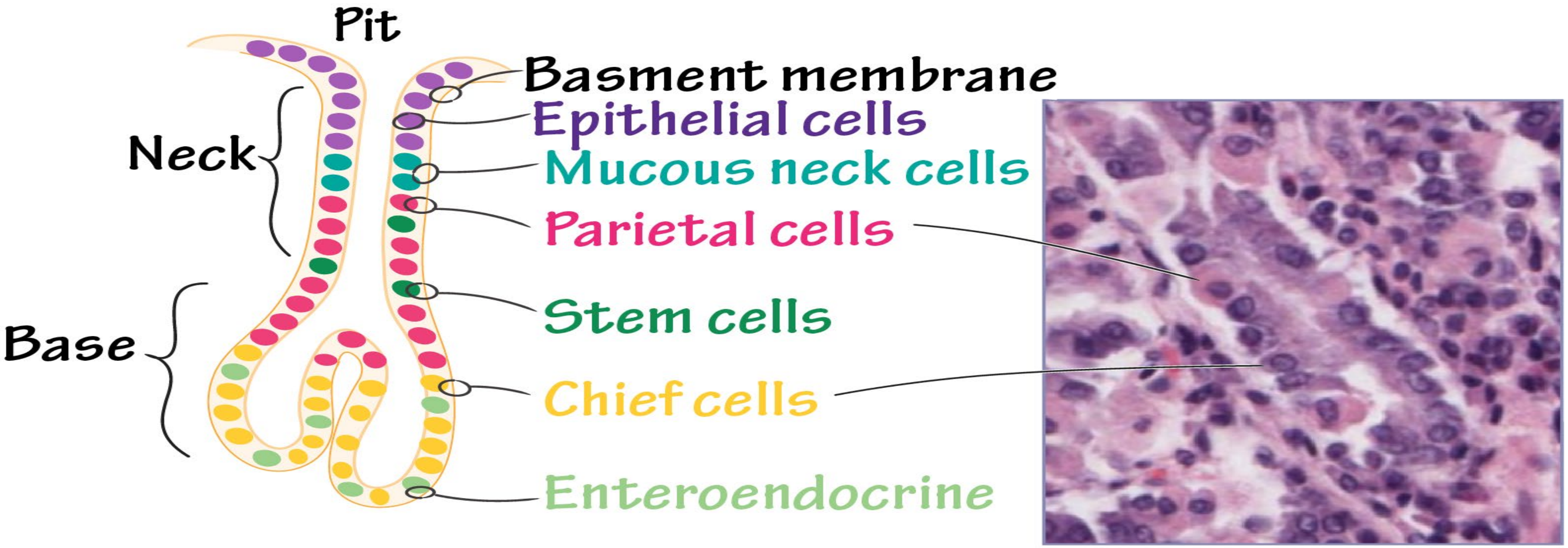
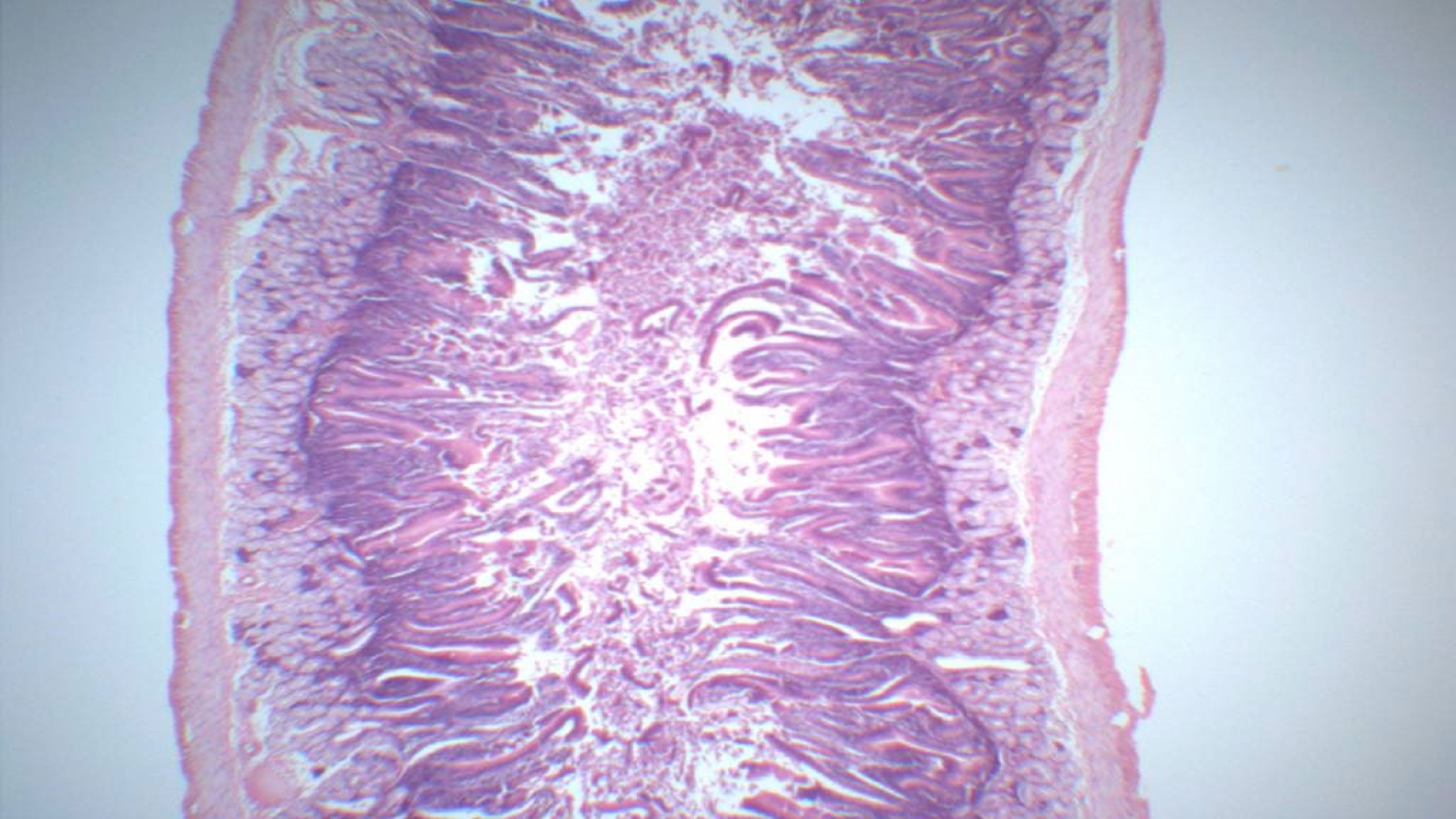
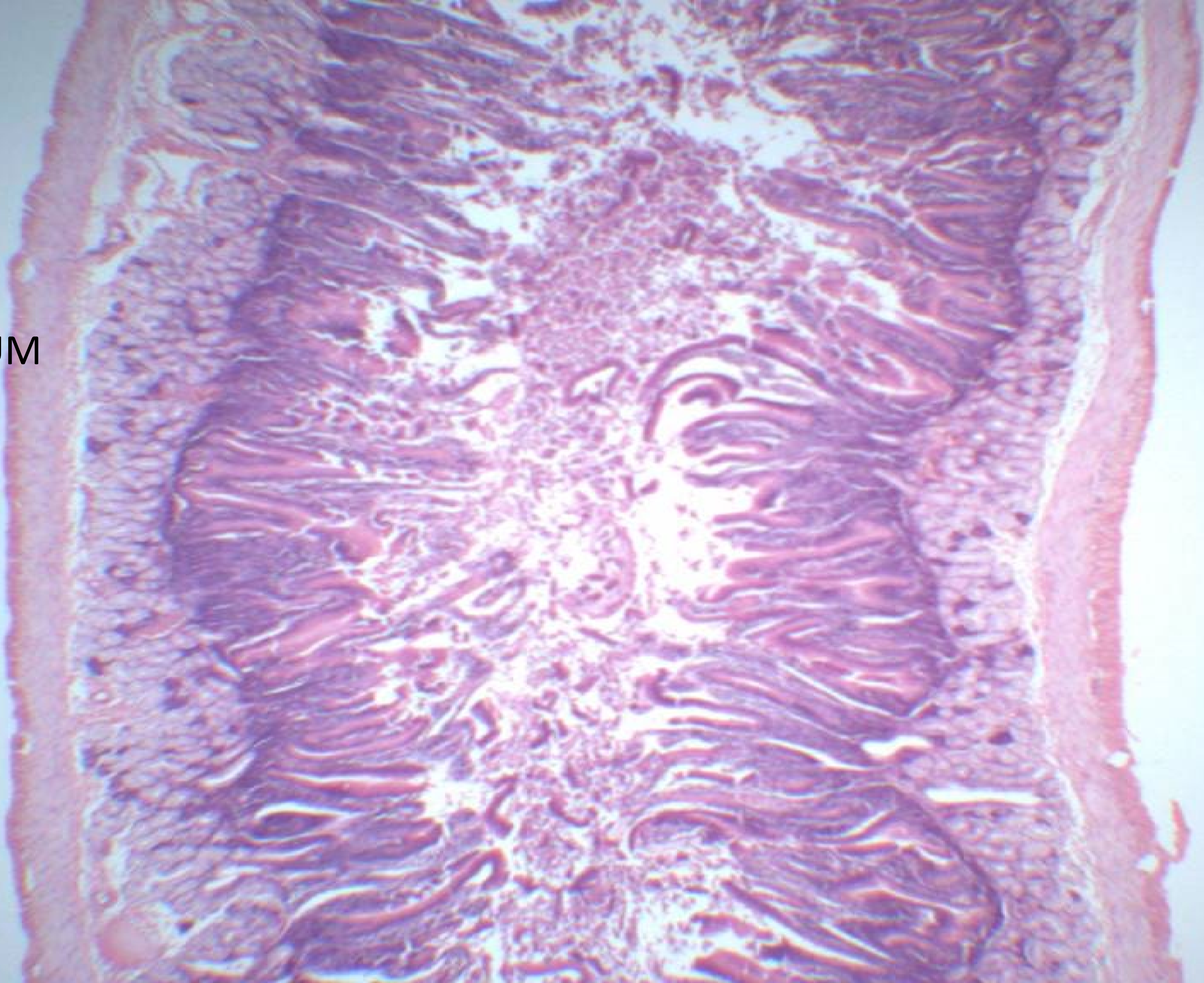

STOMACH
* PARTIALLY DIGESTS FOOD MECHANICALLY & CHEMICALLY
PULPY ACIDIC FLUID = CHYME
ANATOMICAL REGIONS
HISTOLOGICAL REGIONS
CARDIA
CARDIAC GLANDS secrete MUCUS
FUNDUS
FUNDIC (GASTRIC) GLANDS secrete
DIGESTIVE ENZYMES (e.g. pepsin) & MUCUS
BODY
PYLORUS
PYLORIC GLANDS secrete MUCUS &
NEUROENDOCRINE CELLS secrete GASTRIN

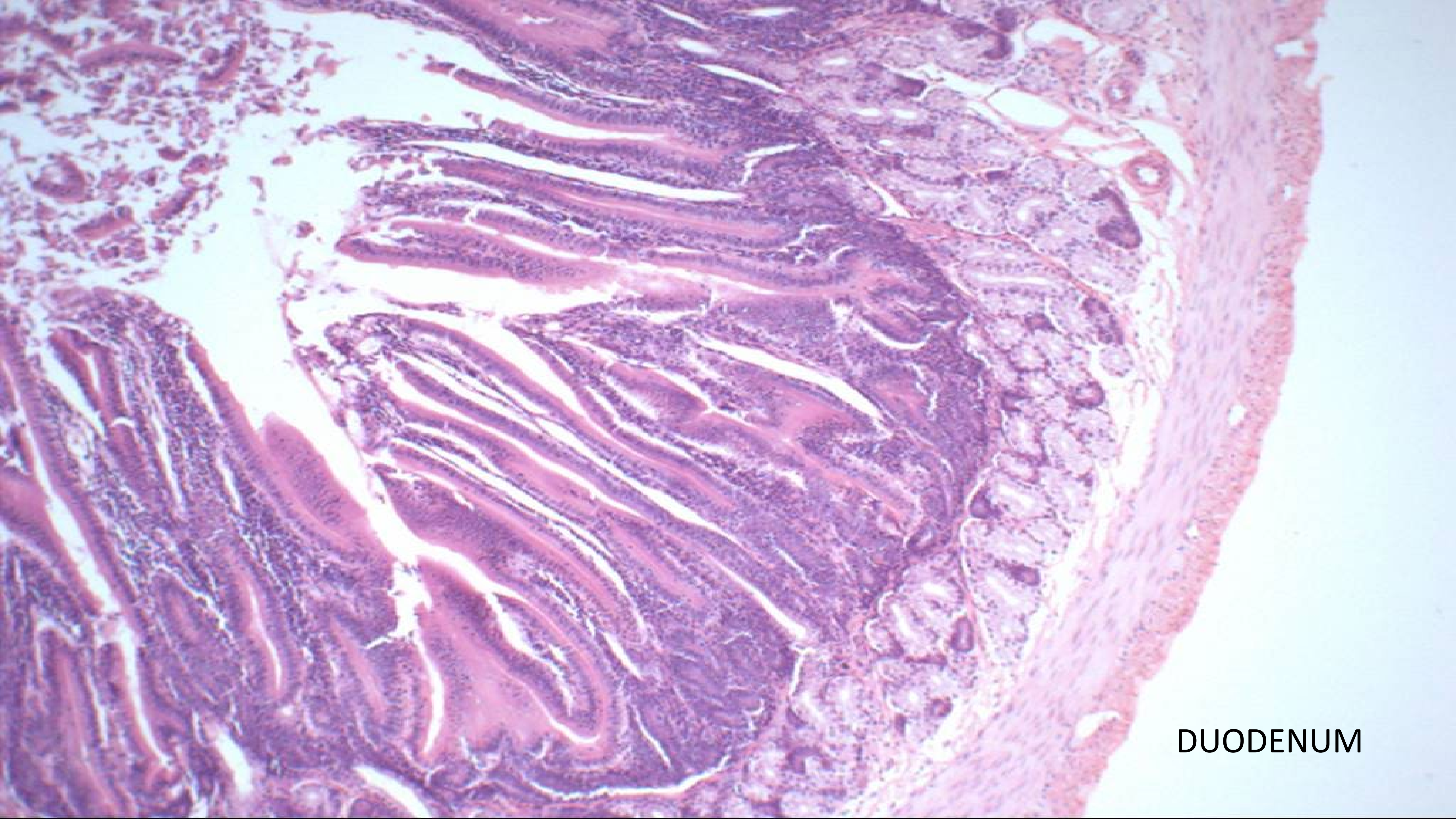
Typical Gastric Gland





DUODENUM





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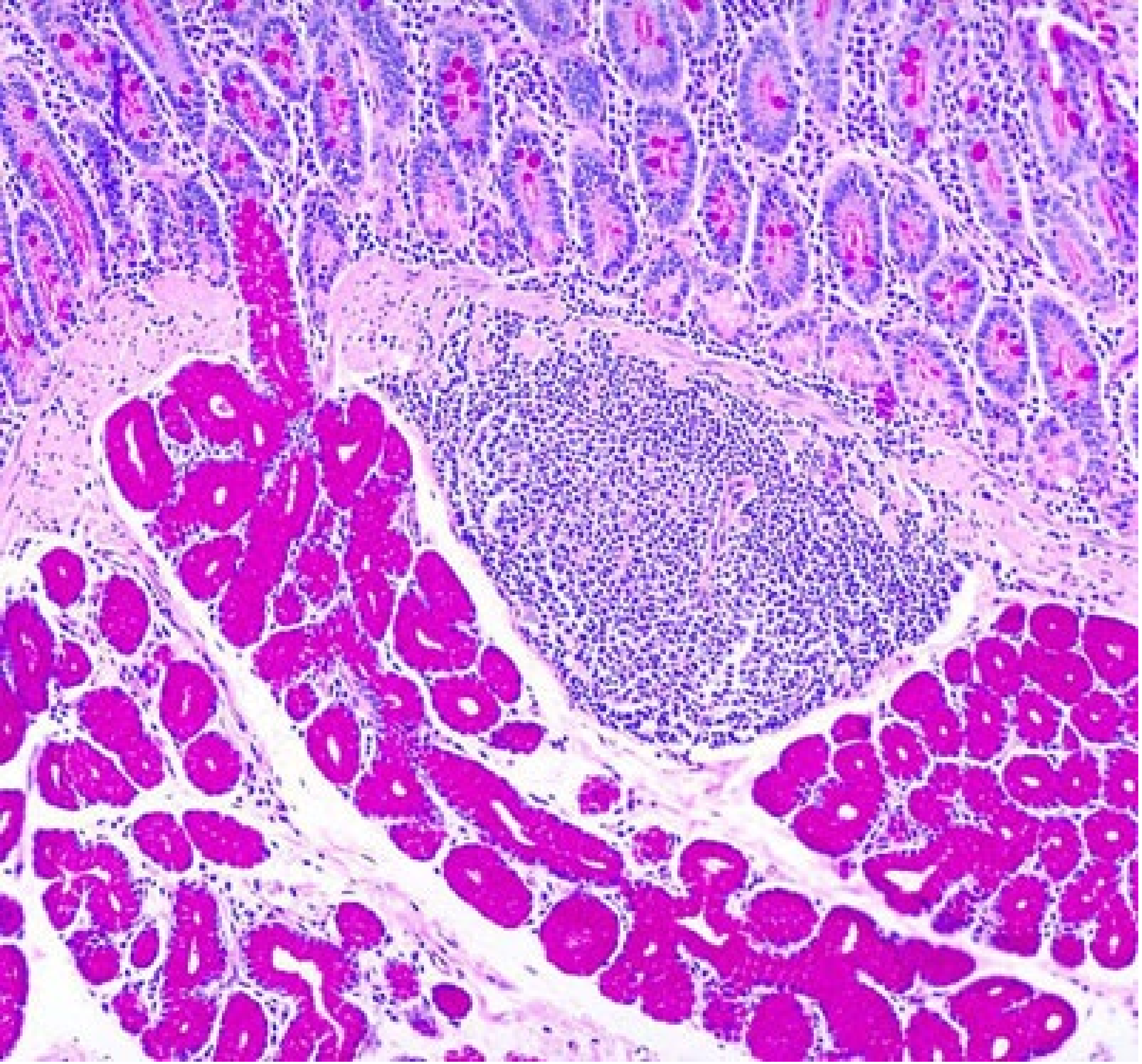
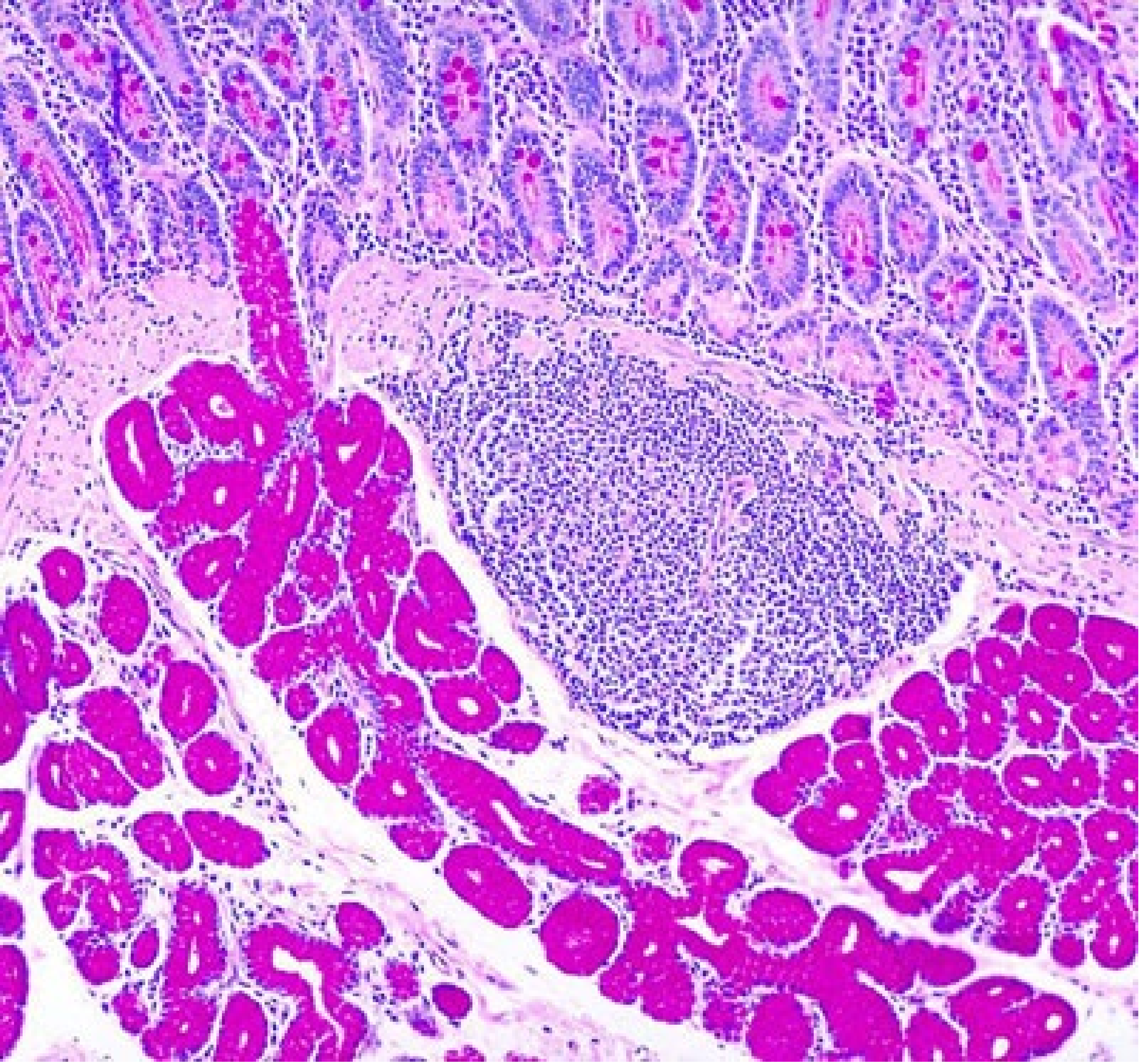
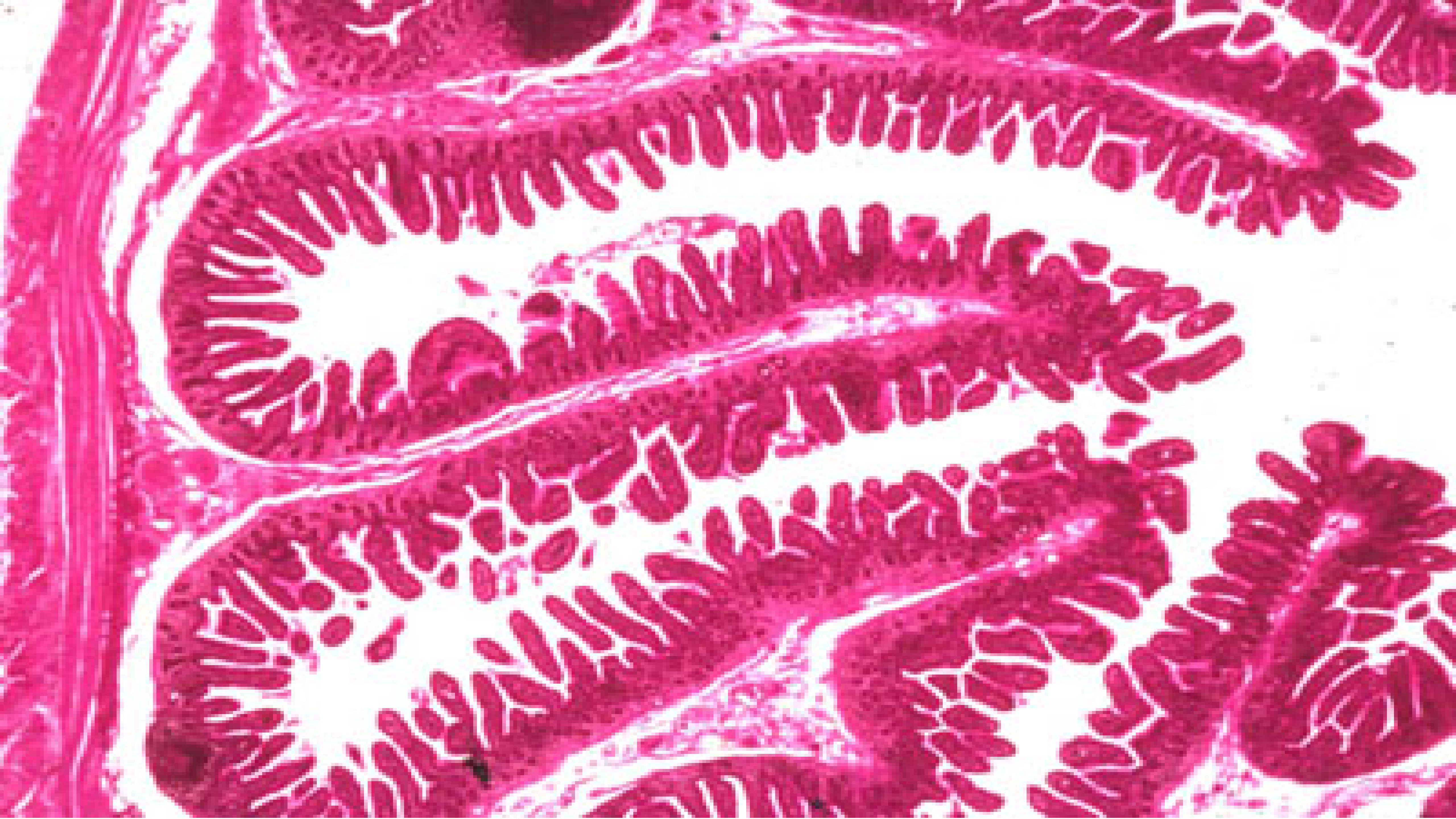
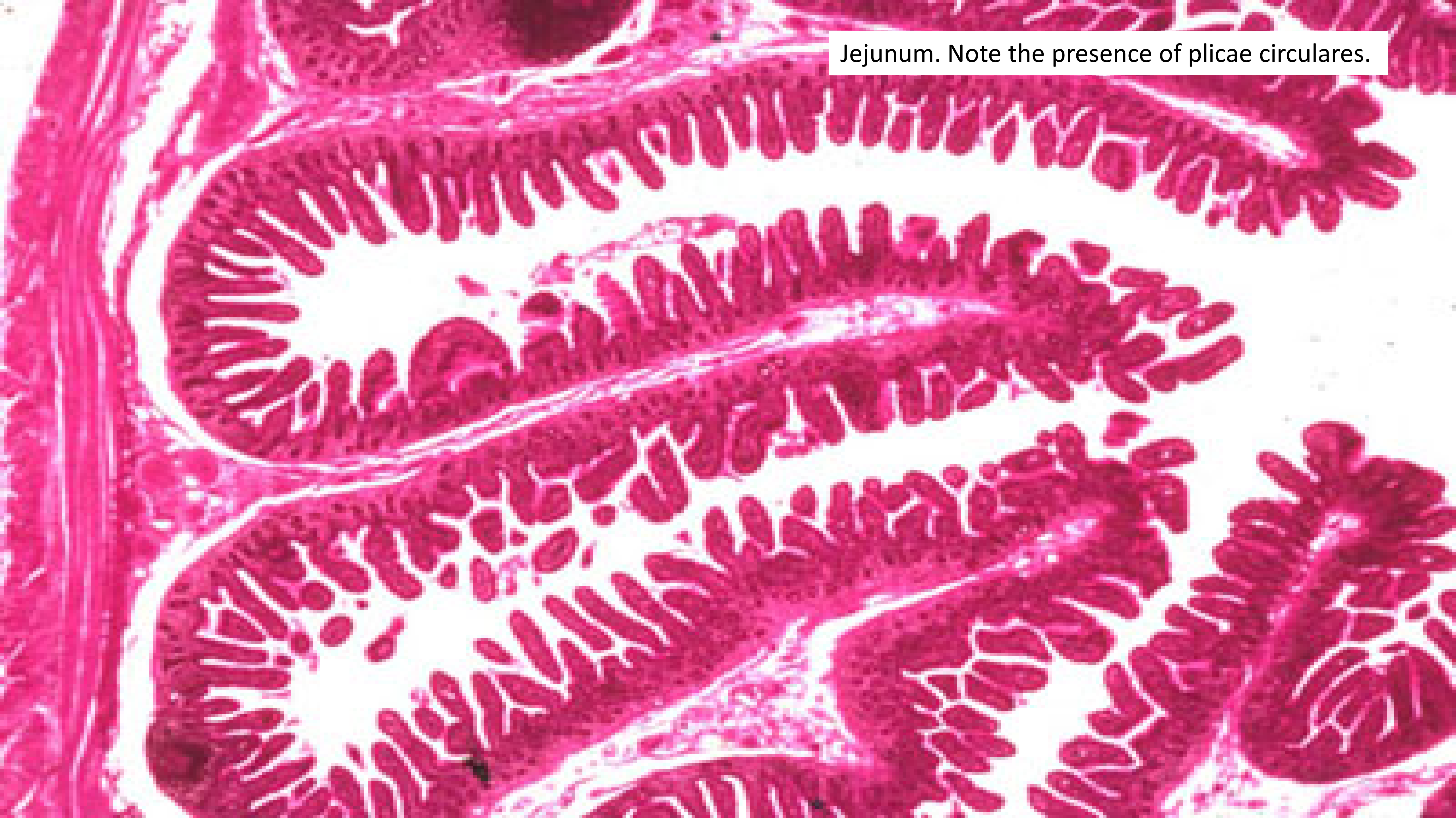


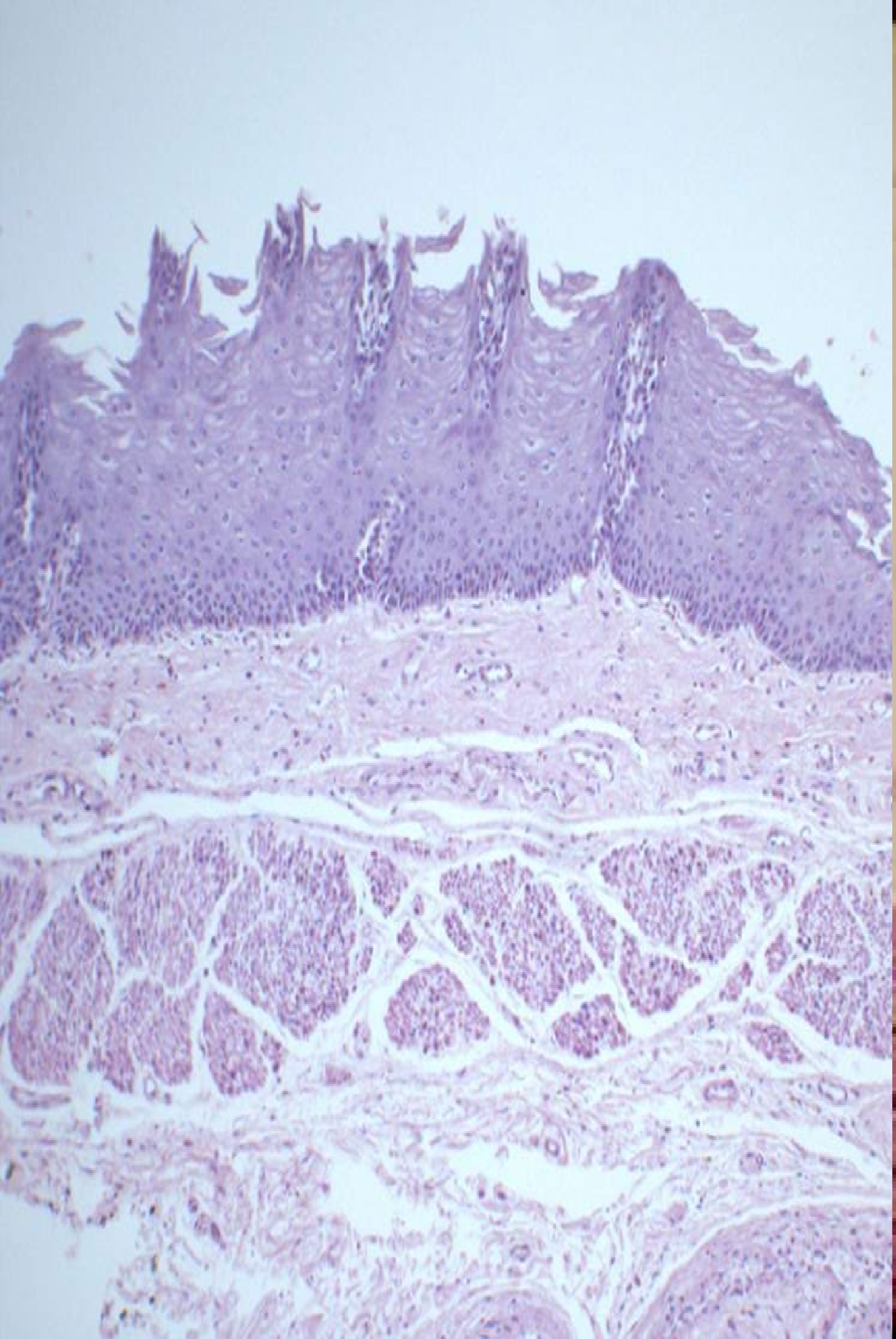
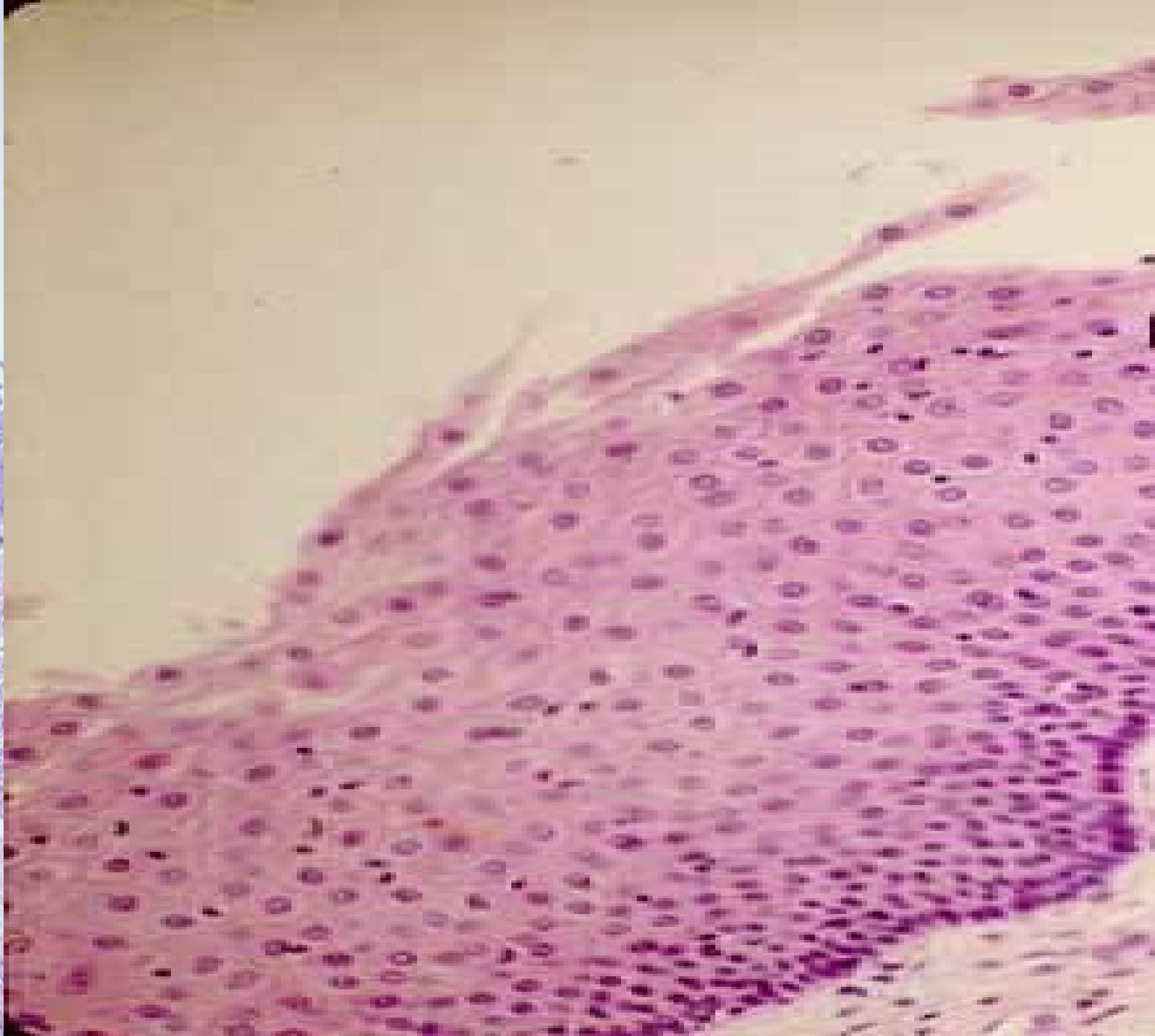


Small Intestine - Duodenum. Note the presence of Brunner's Glands in the submucosa.

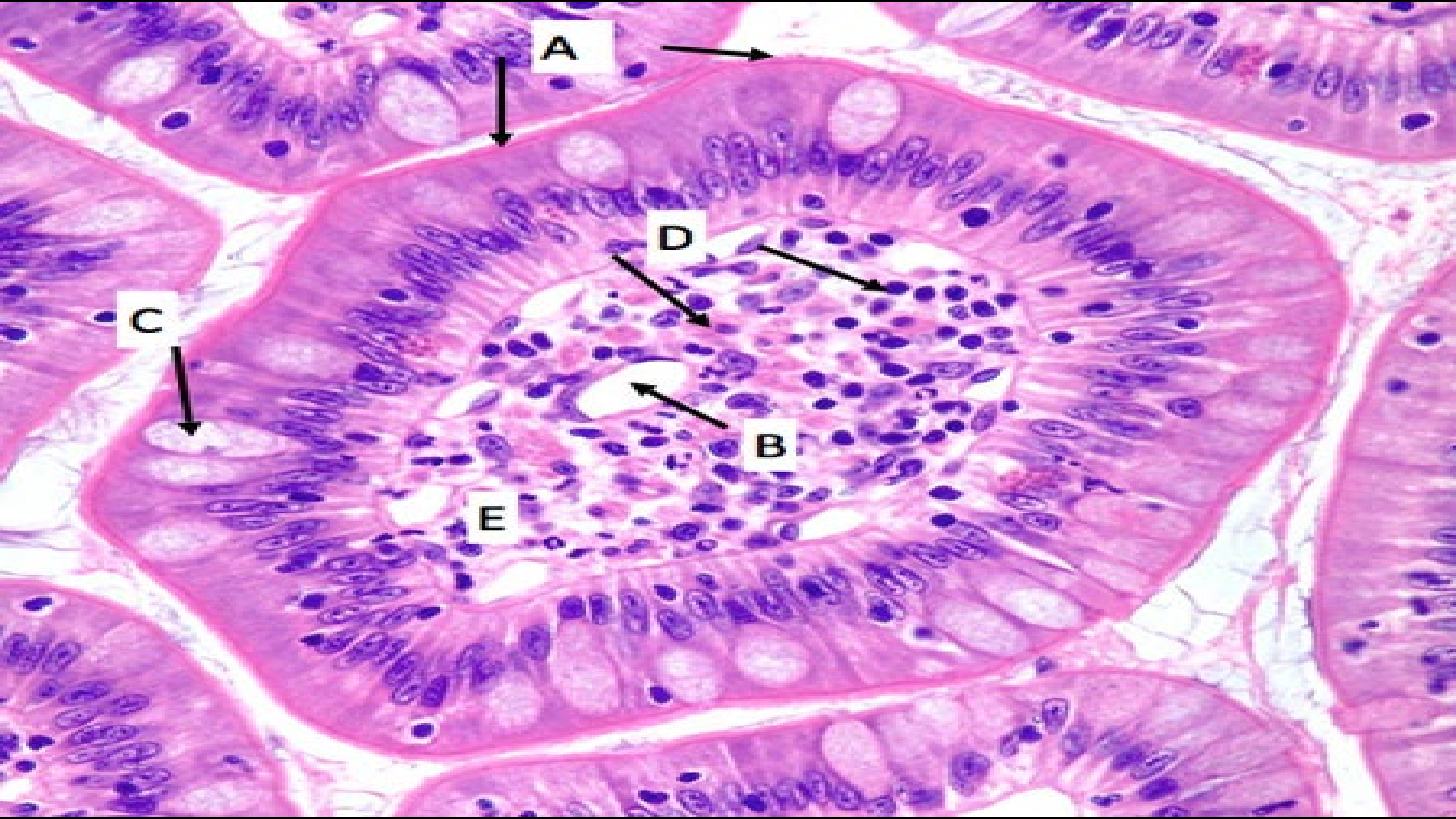


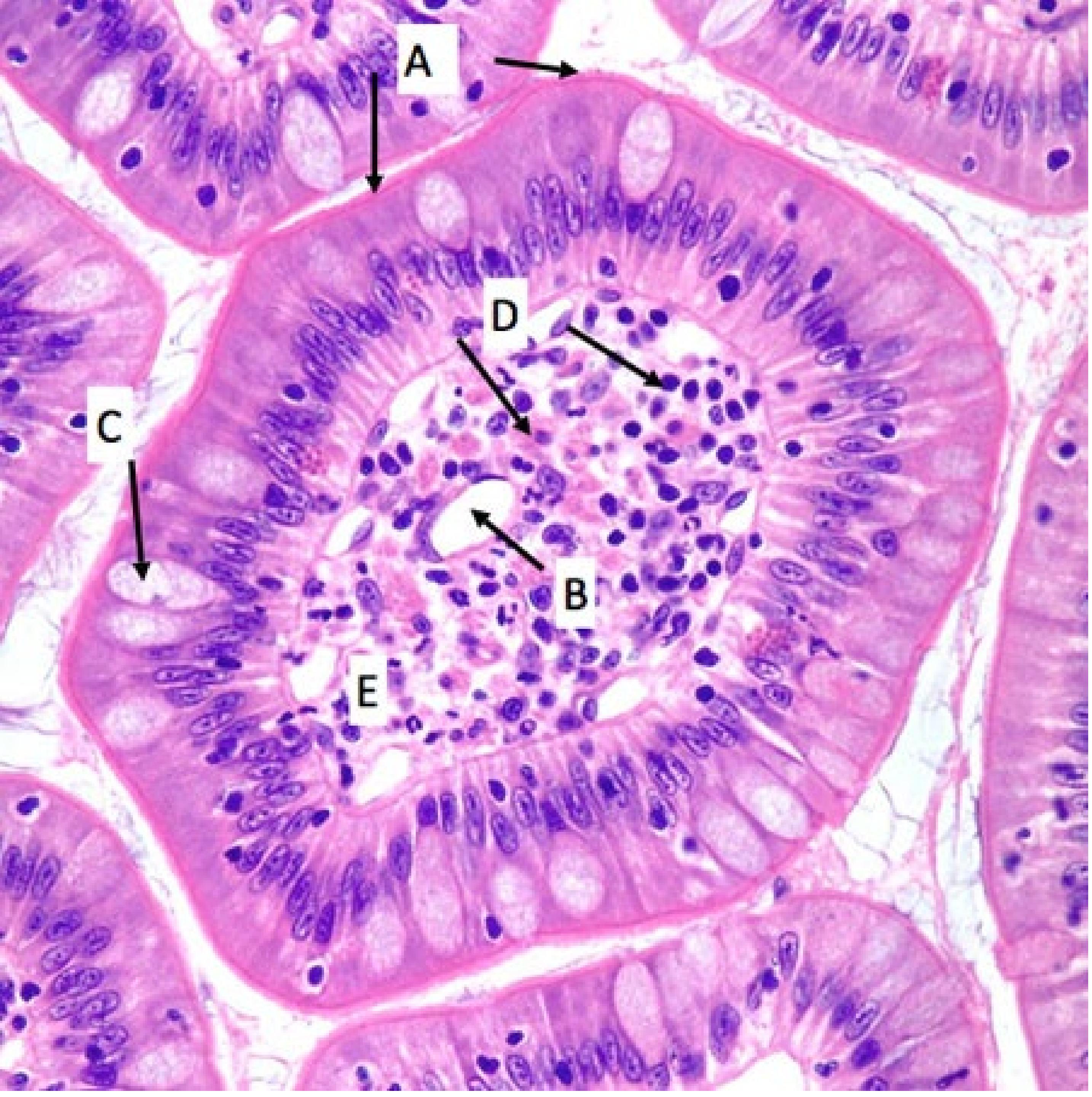


Jejunum. Note the presence of plicae circulares.

ESOPHAGUS


A
D
C
B
E



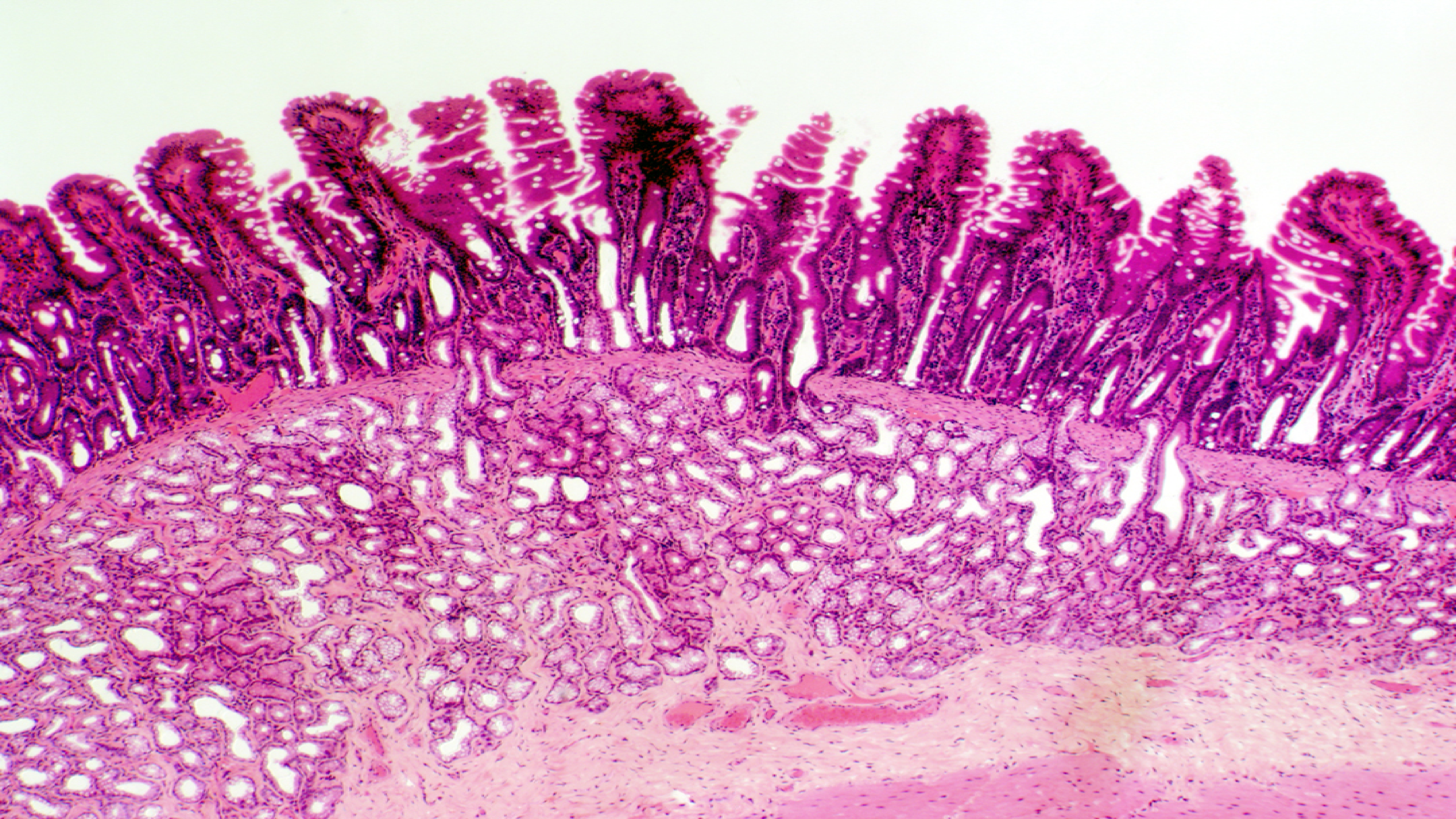
A = enterocyte brush border,

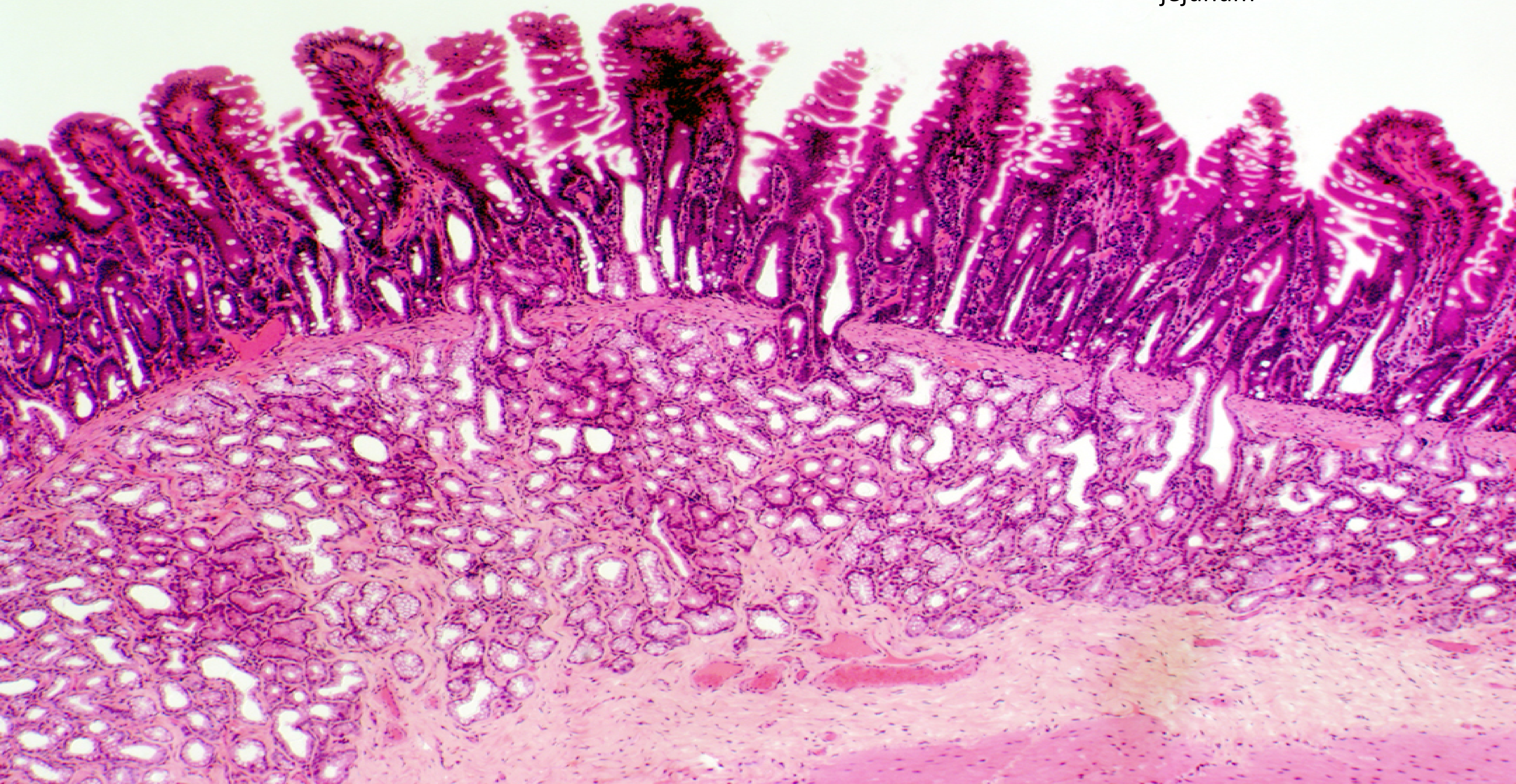
B = lacteal,

C = goblet cell,

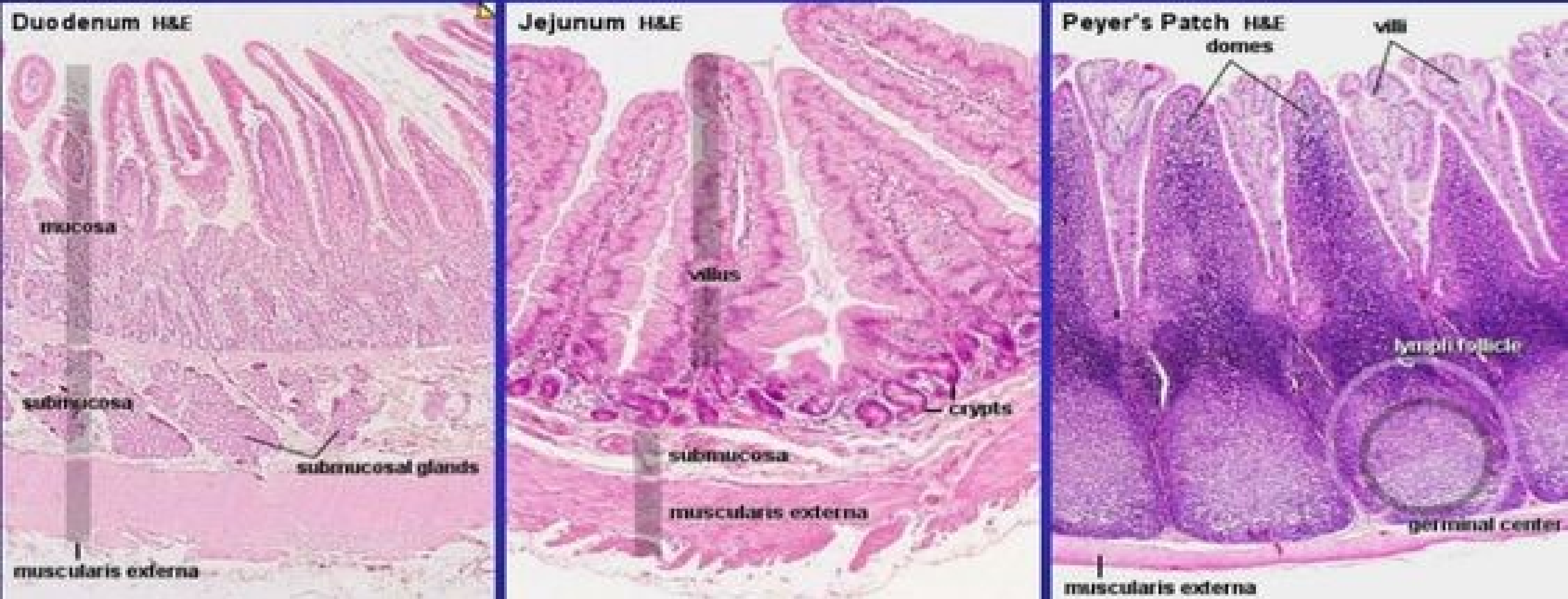
D = immune cells (lymphocytes),

E = lamina propria



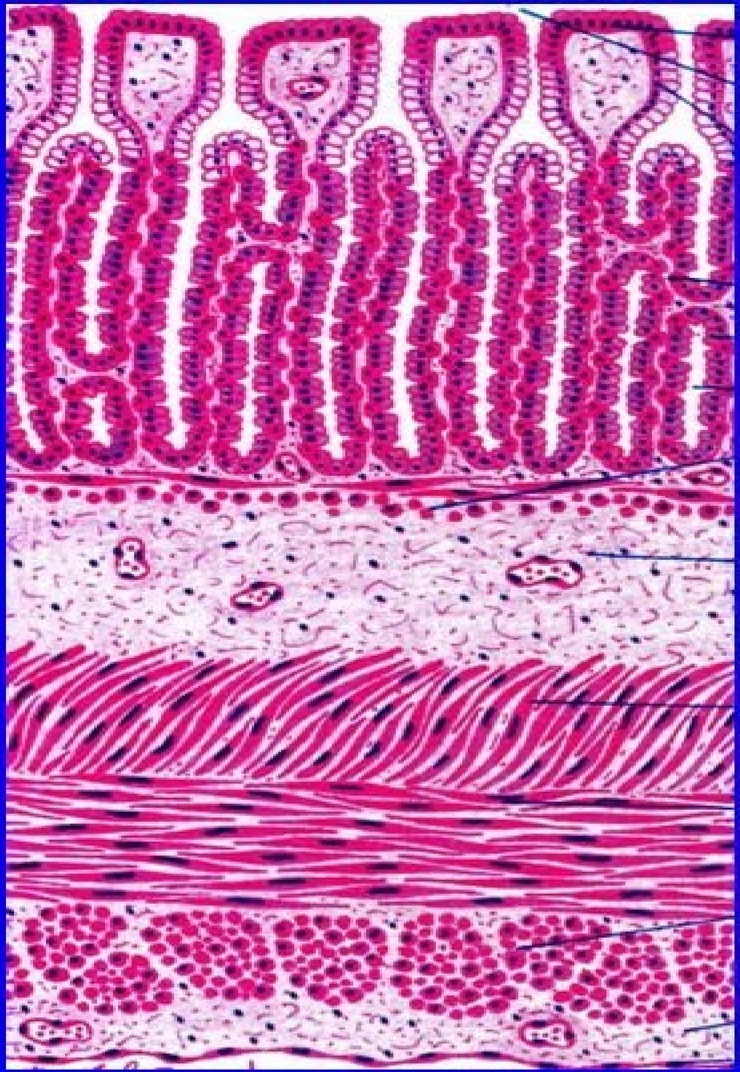

jejunum

COMPARISON



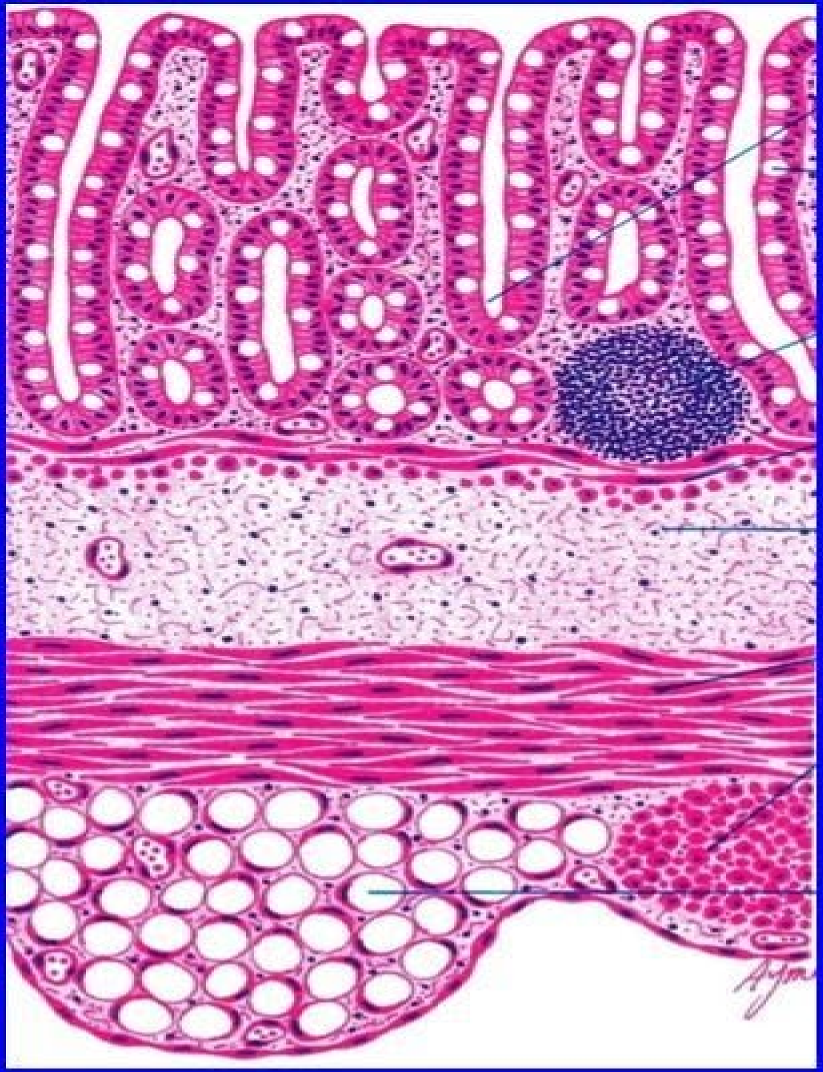
Duodenum H&E
mucosa
submucosa
submucosal glands
muscularis externa
Jejunum H&E
villus
crypts
submucosa
muscularis externa
Peyer's Patch H&E
villi
domes
lymph follicle
germinal center
muscularis externa

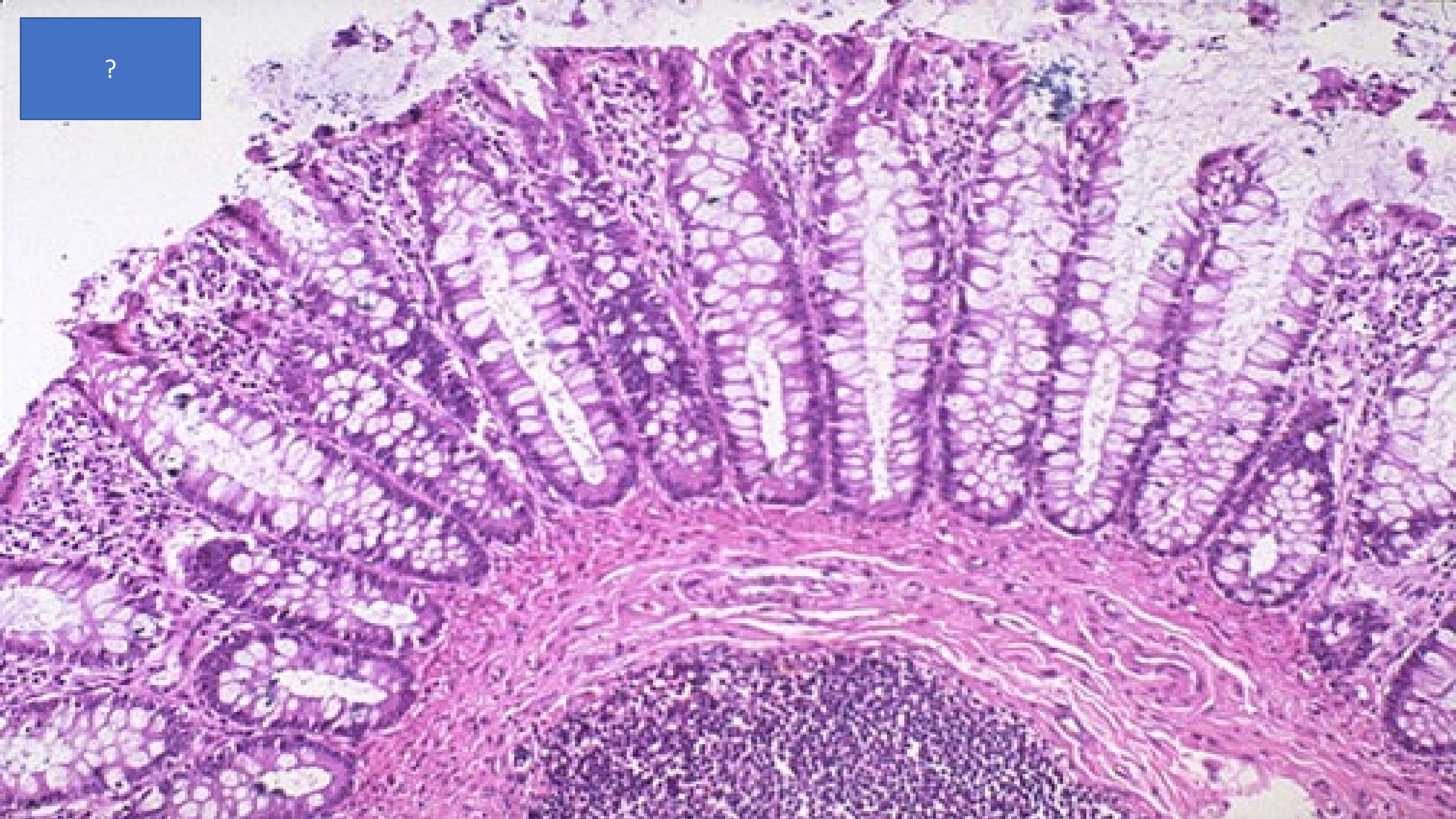
Fundus of Stomach



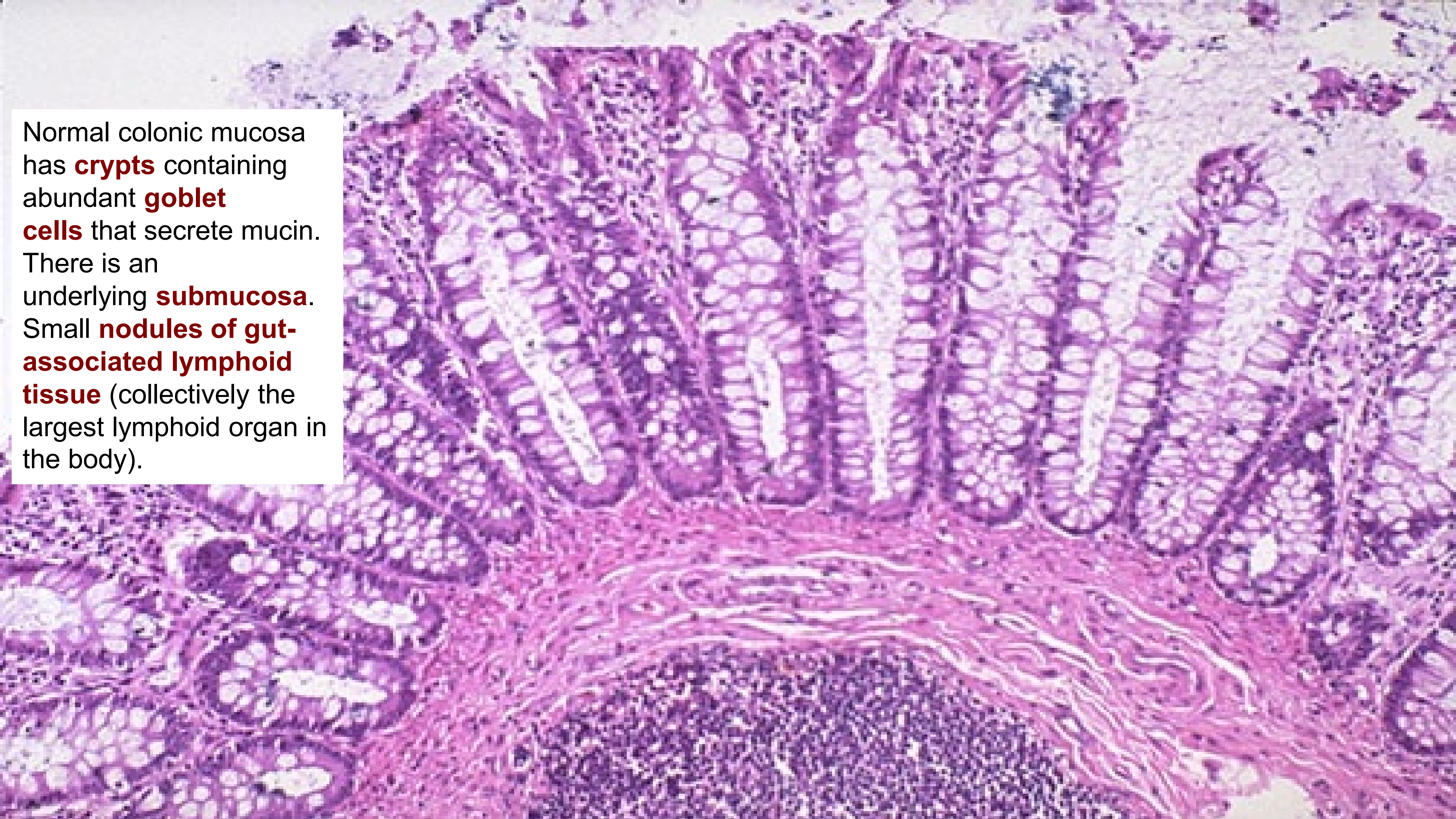
Duodenum

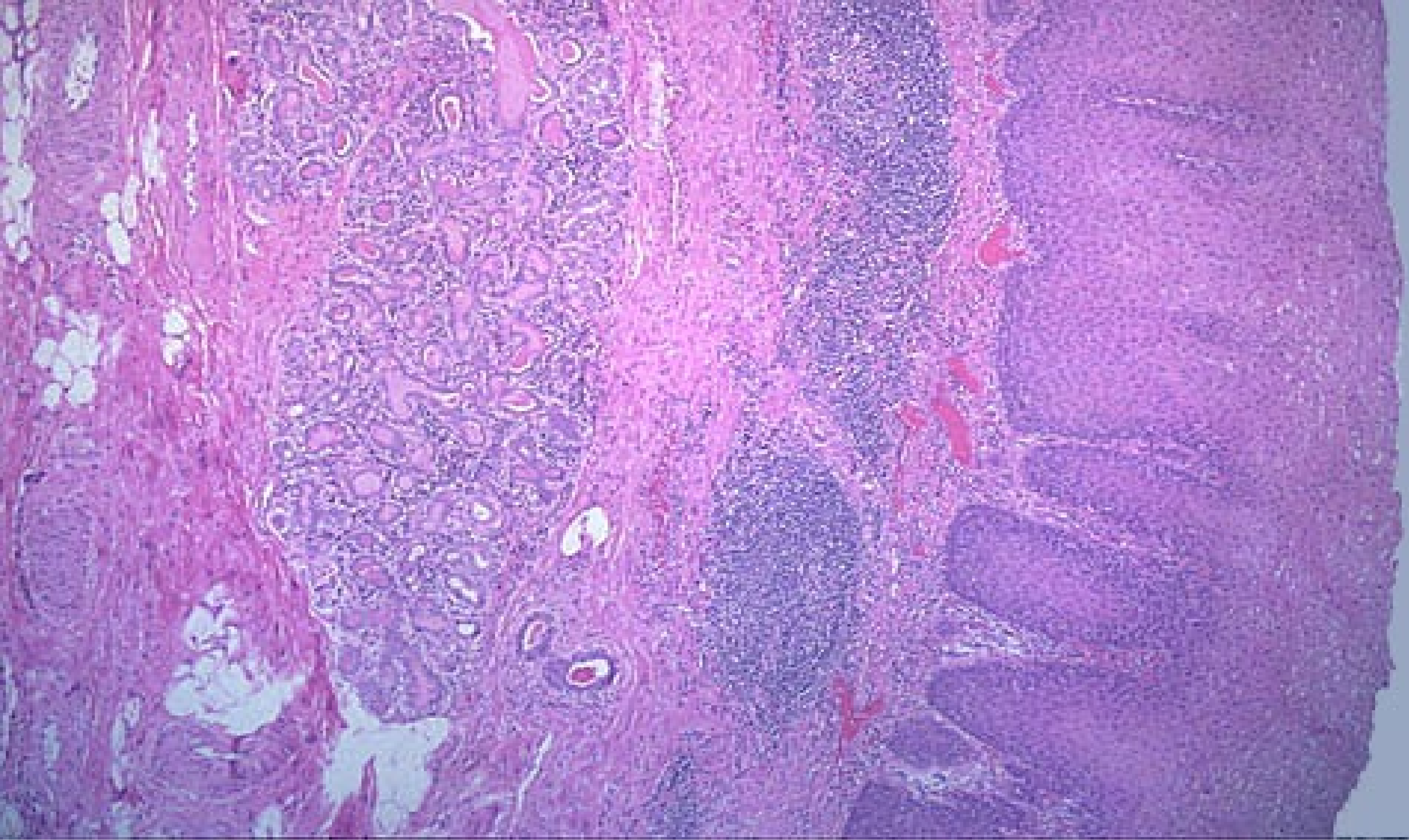
Colon

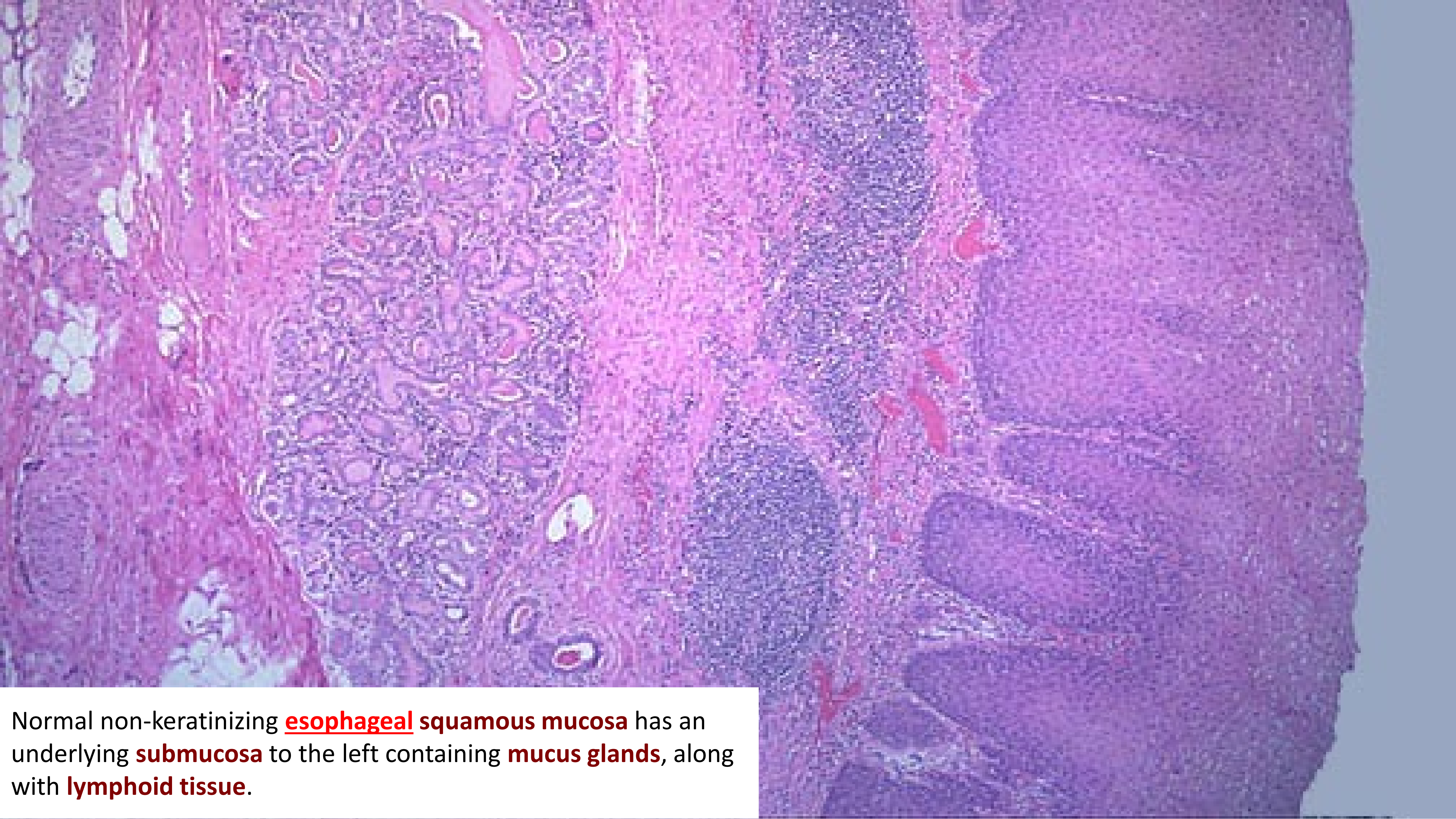




Normal colonic mucosa has **crypts** containing abundant **goblet cells** that secrete mucin. There is an underlying **submucosa**. Small **nodules of gut-associated lymphoid tissue** (collectively the largest lymphoid organ in the body).

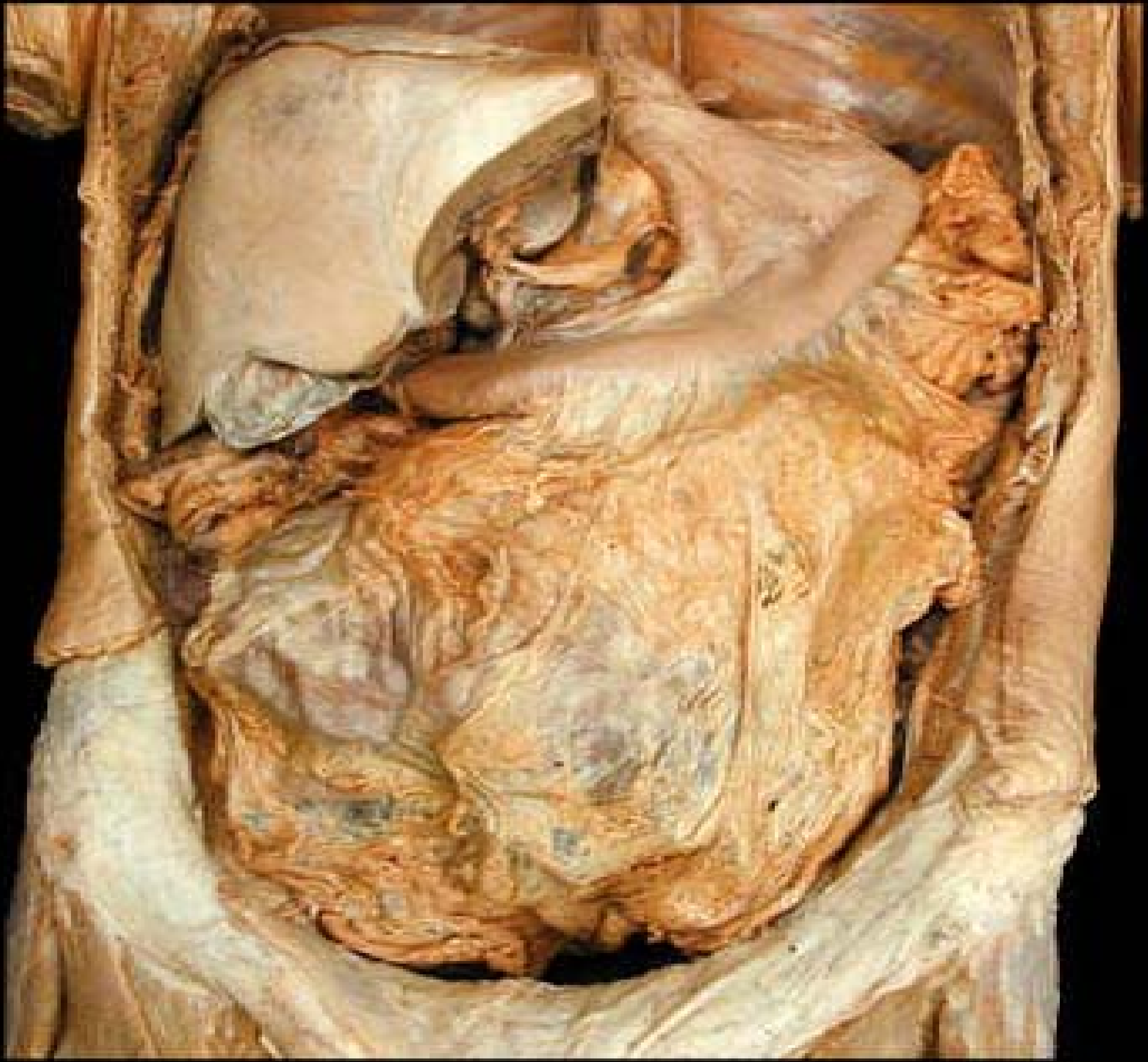




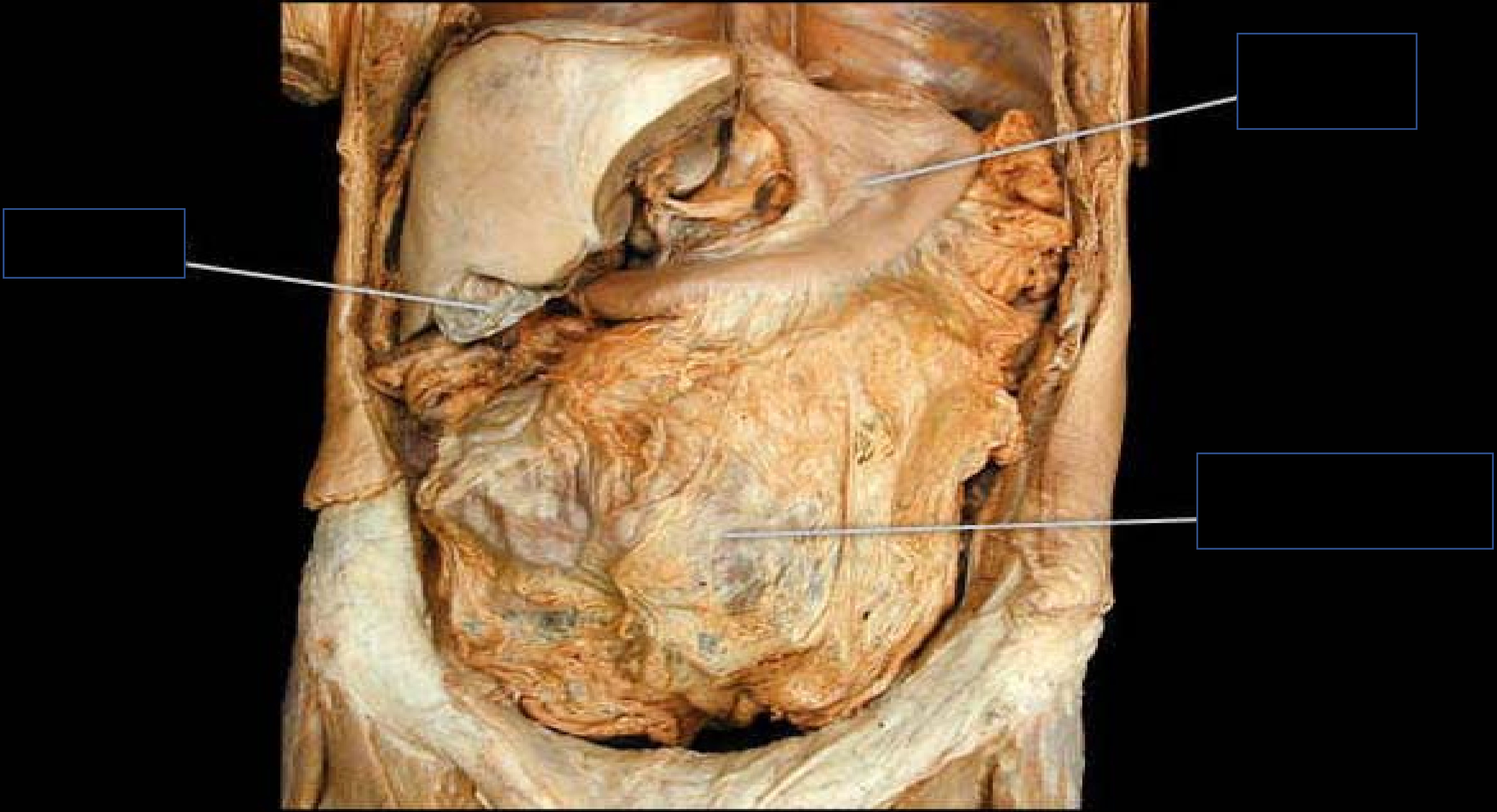


Normal non-keratinizing esophageal **squamous mucosa** has an underlying **submucosa** to the left containing **mucus glands**, along with **lymphoid tissue**.

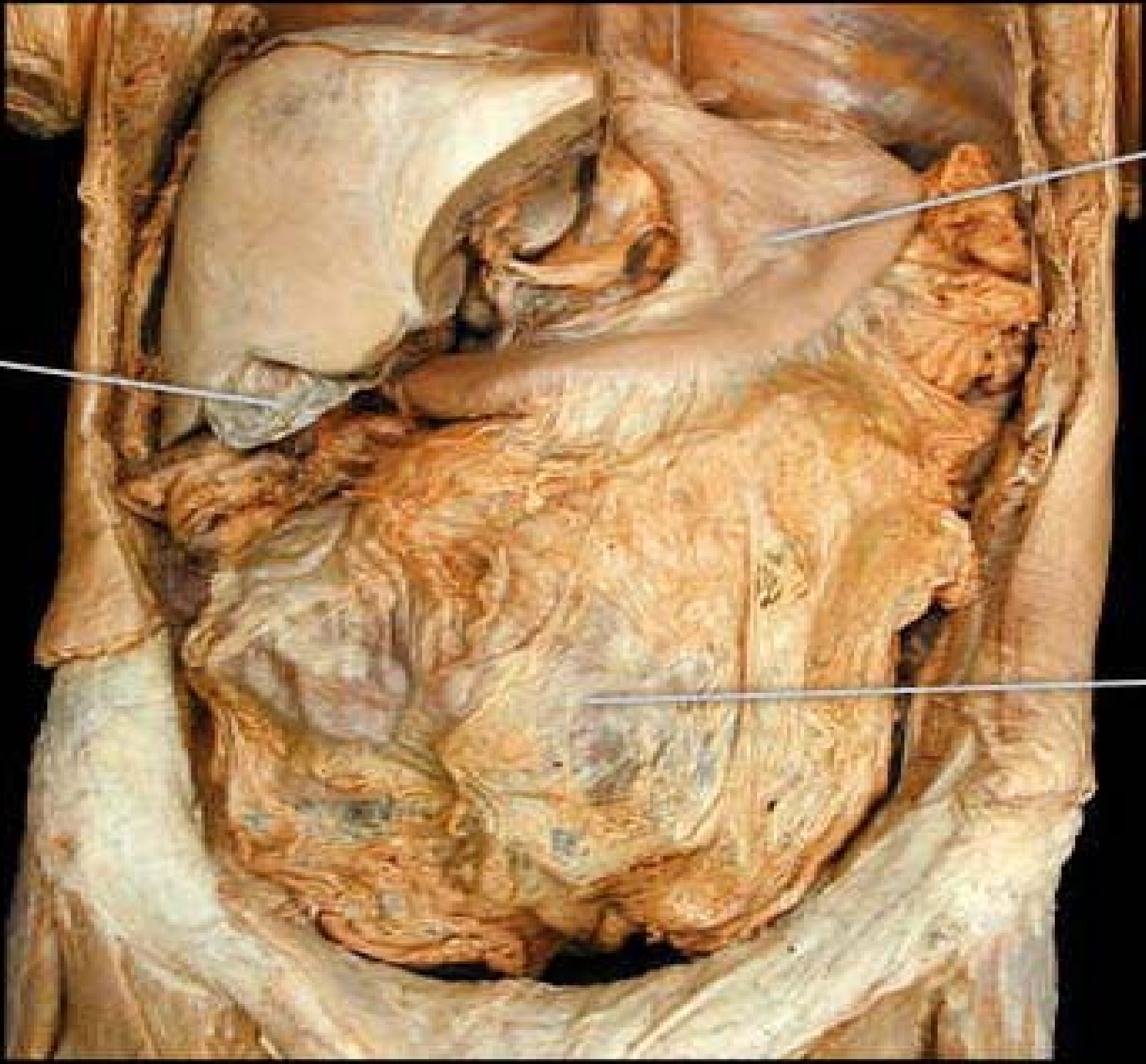
Stomach and greater omentum

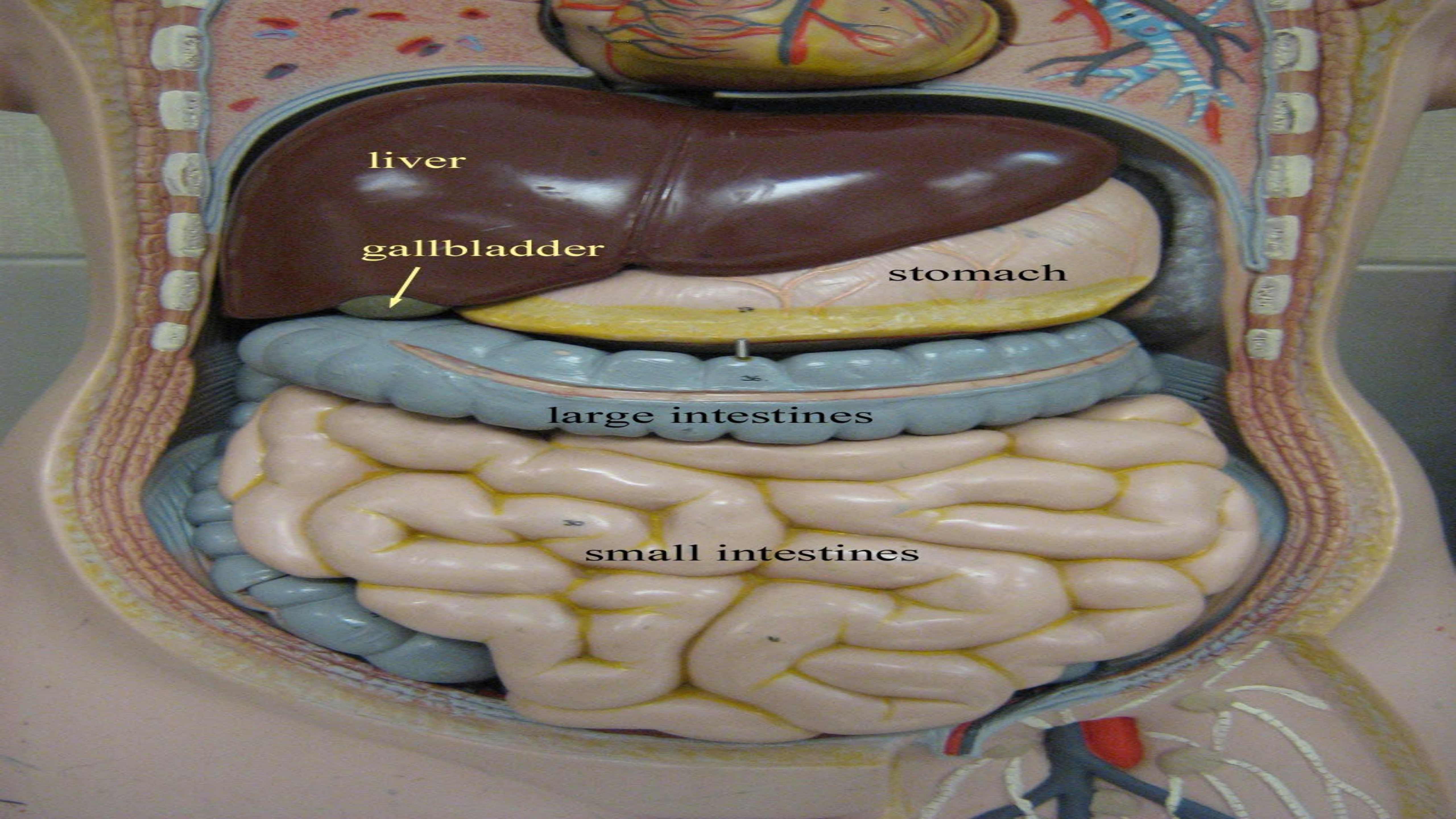


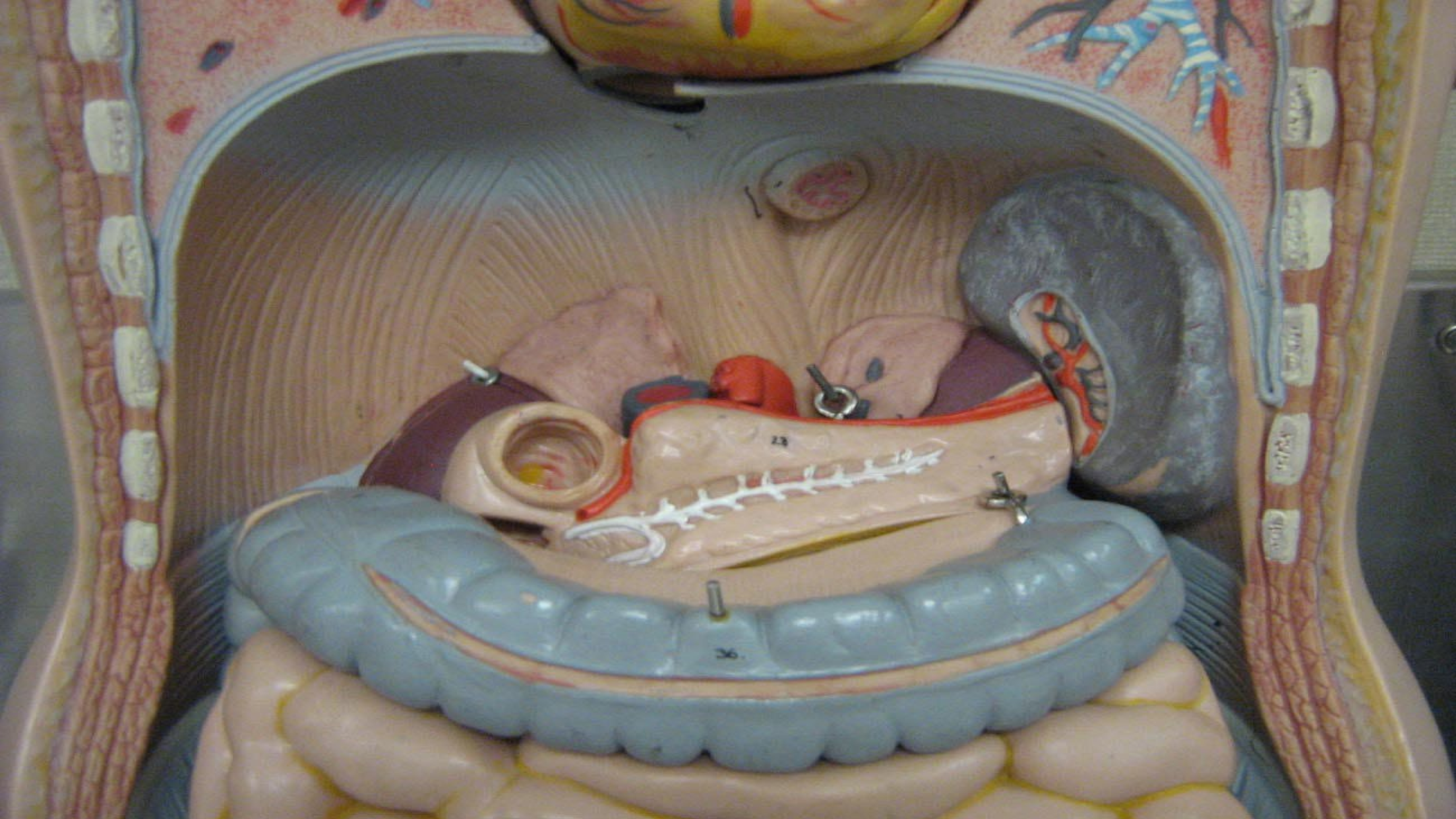
Stomach and greater omentum

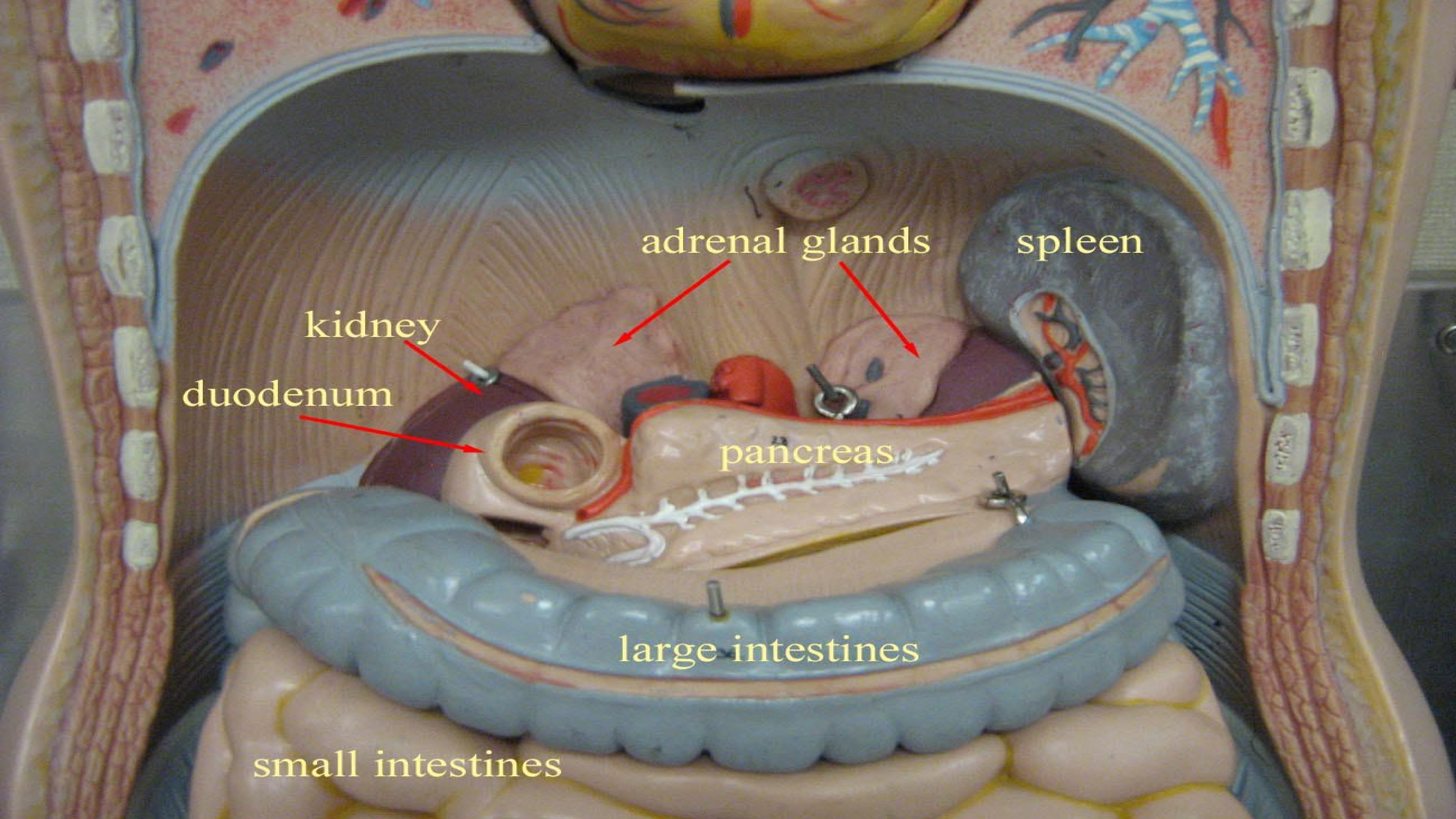


Stomach and greater omentum

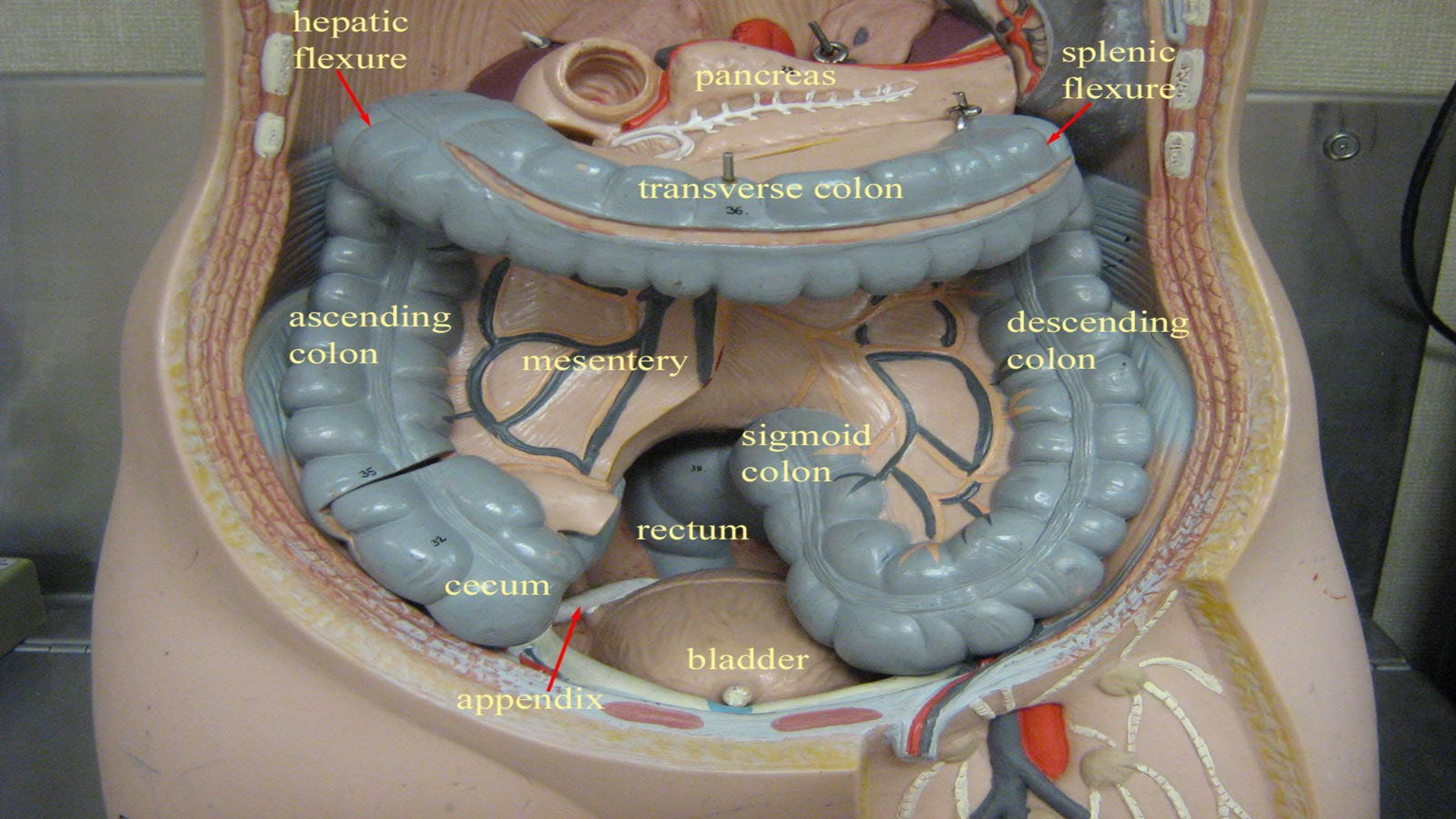



liver
gallbladder
stomach
large intestines
small intestines

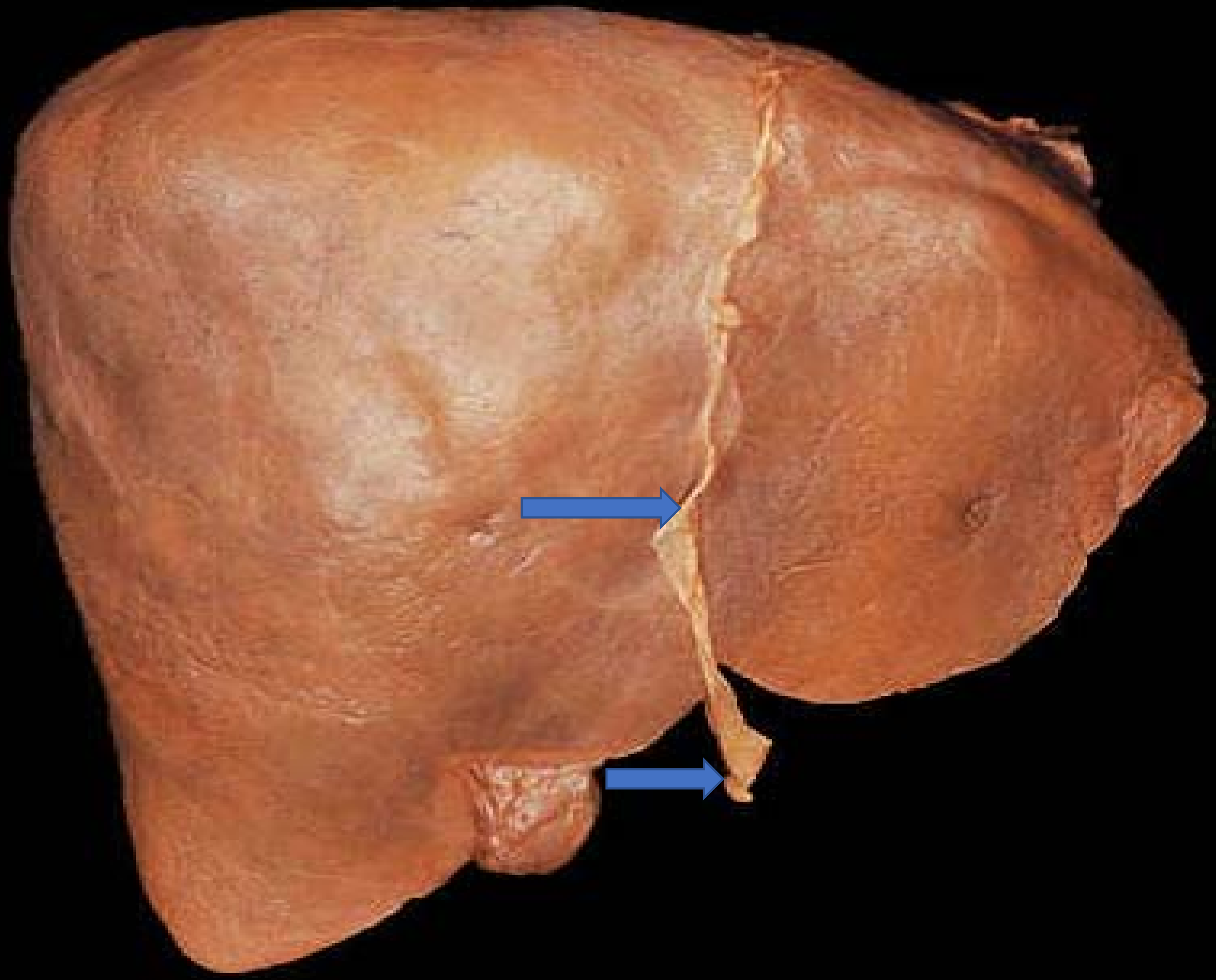



adrenal glands
spleen
kidney
duodenum
pancreas
large intestines
small intestines

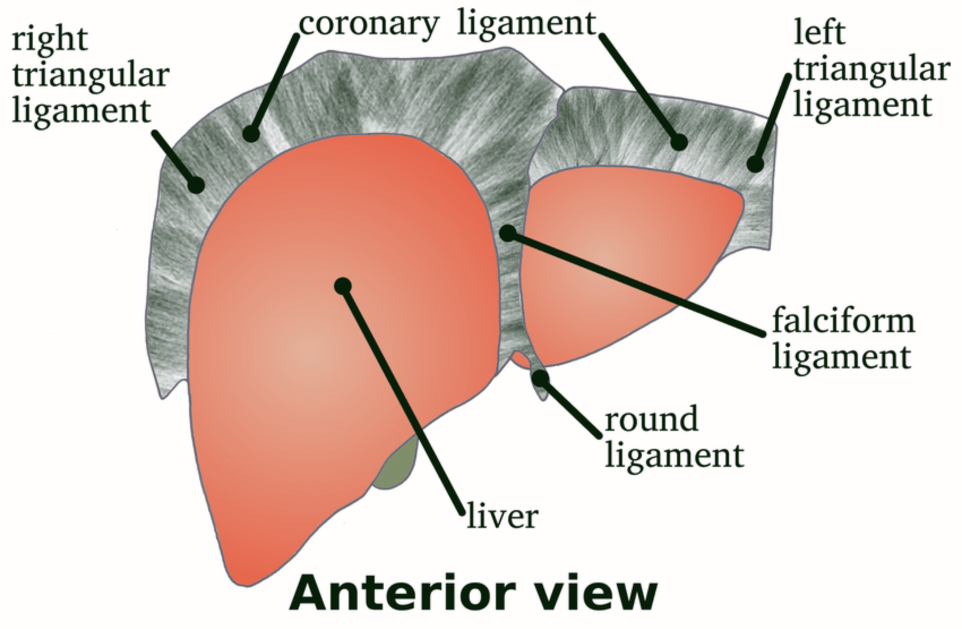

36.
35
32

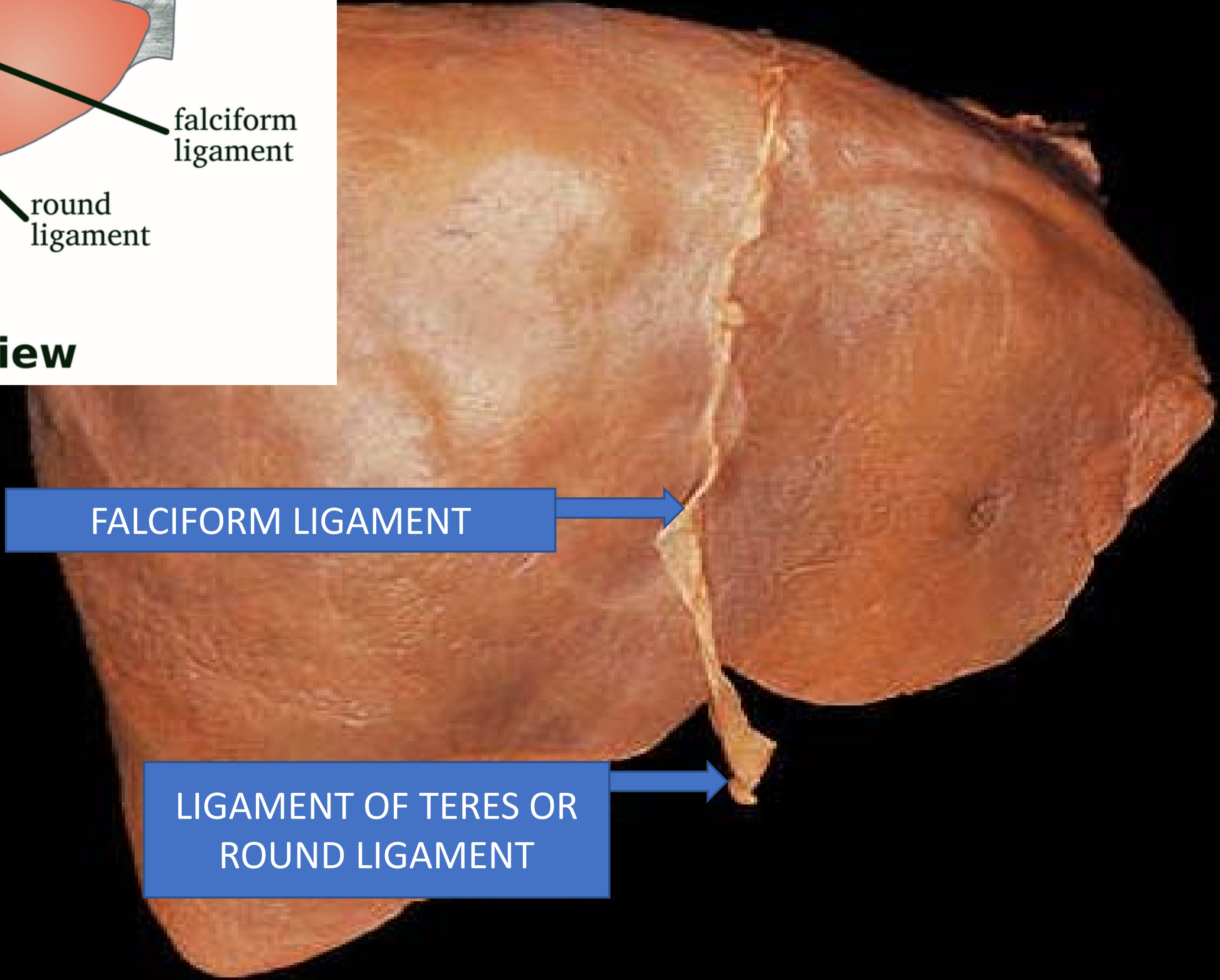

hepatic flexure
pancreas
splenic flexure
transverse colon
ascending colon
mesentery
descending colon
sigmoid colon
rectum
cecum
bladder
appendix

Liver

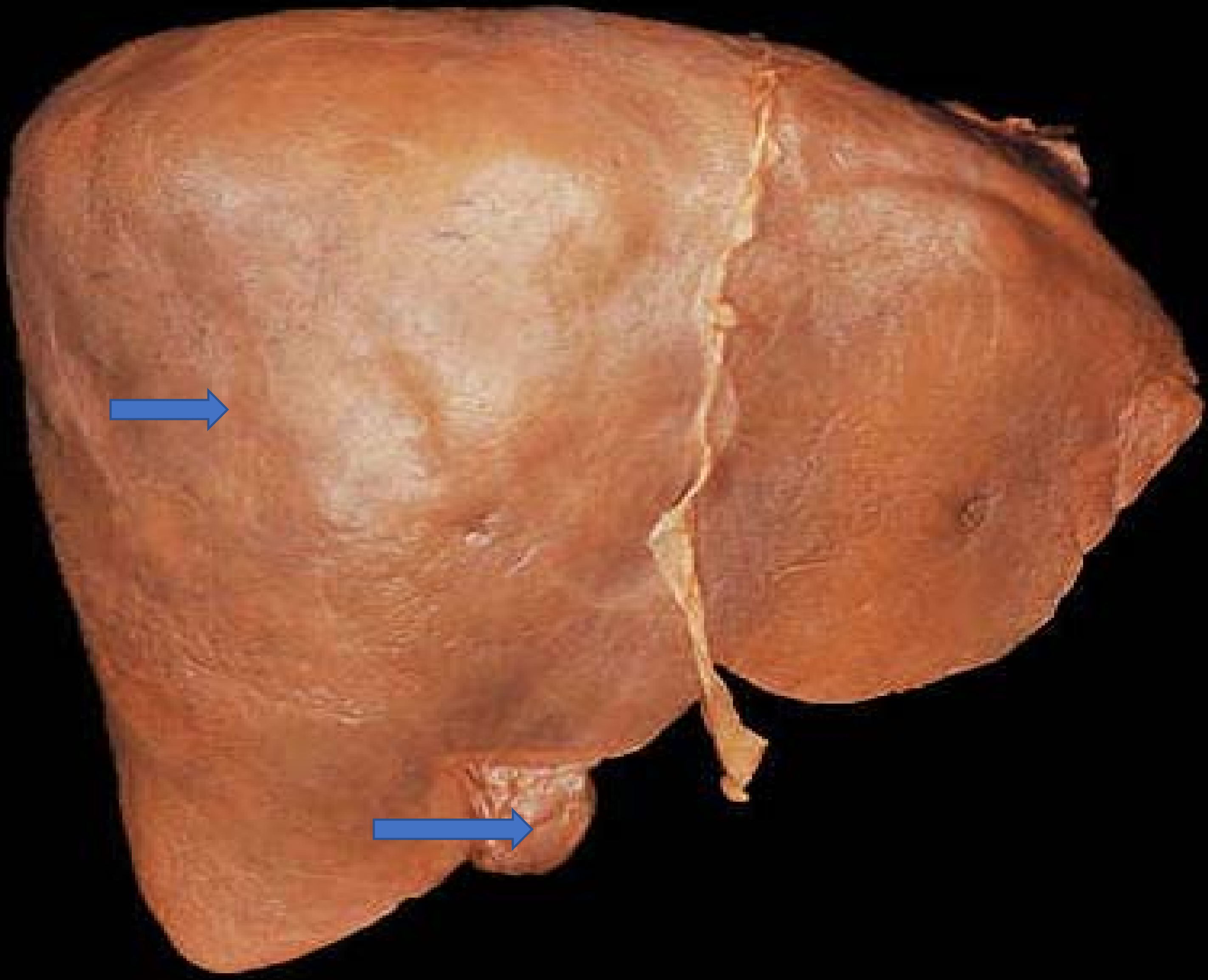


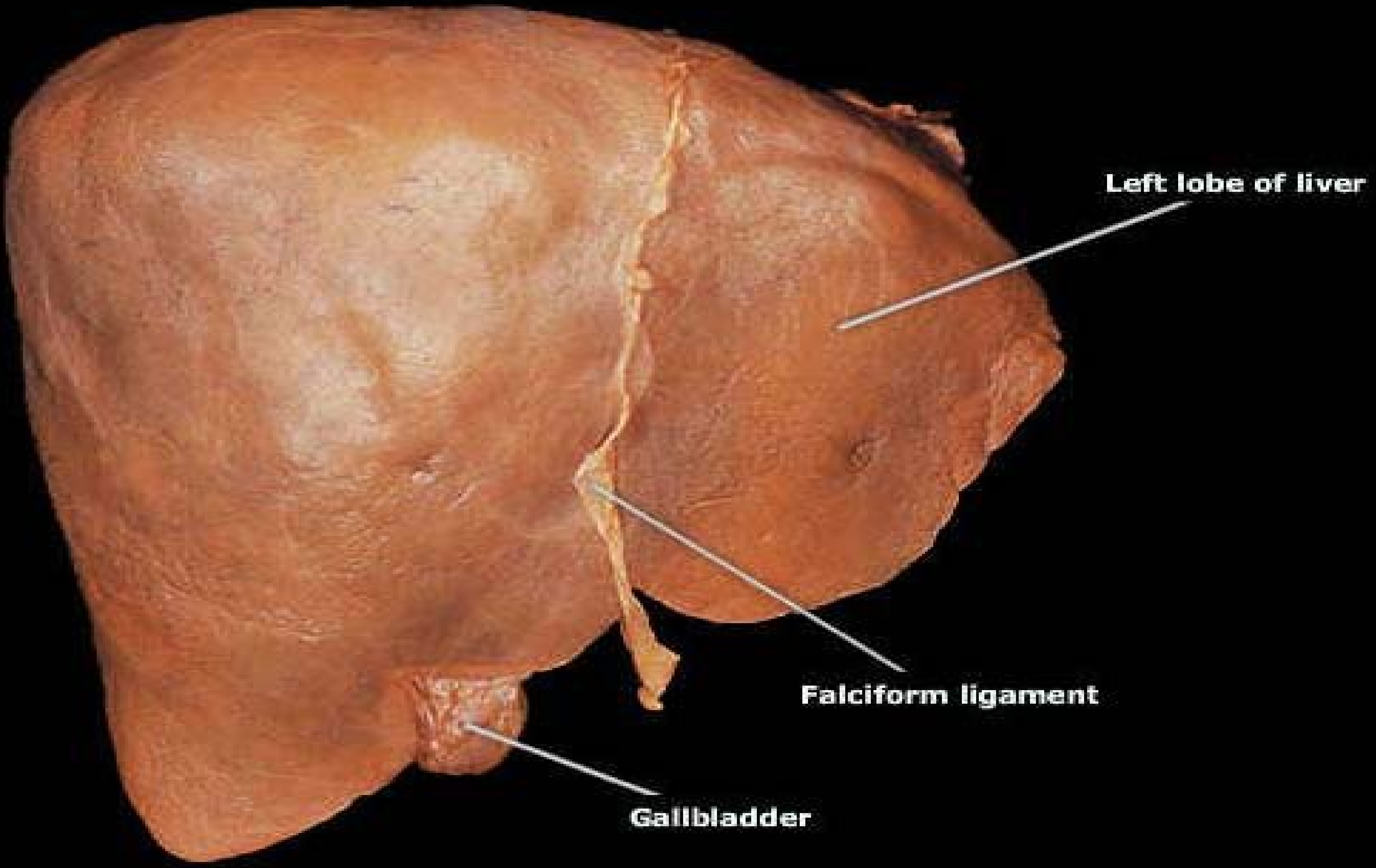
Liver

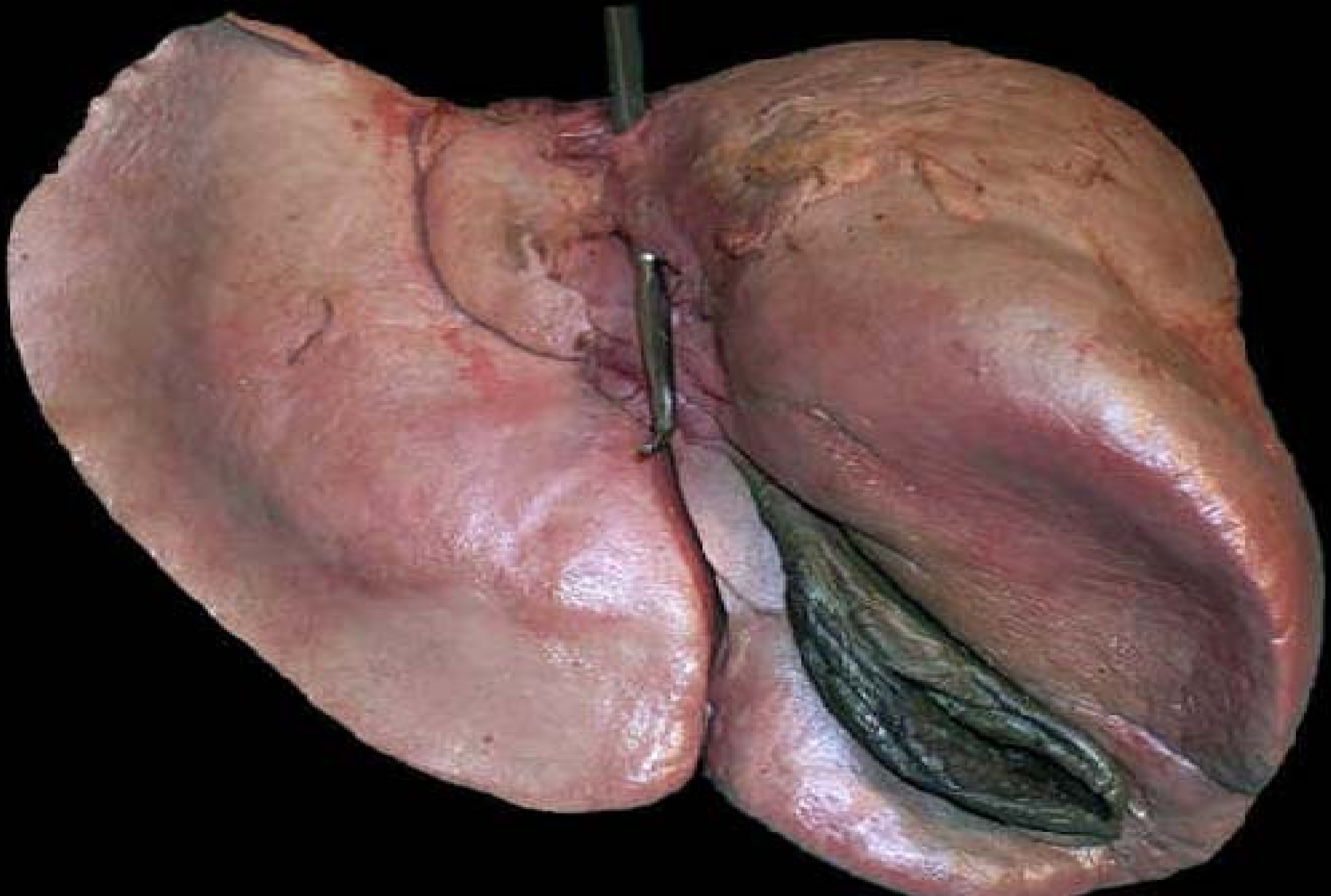

right triangular ligament
coronary ligament
left triangular ligament
falciform ligament
round ligament
liver
Anterior view

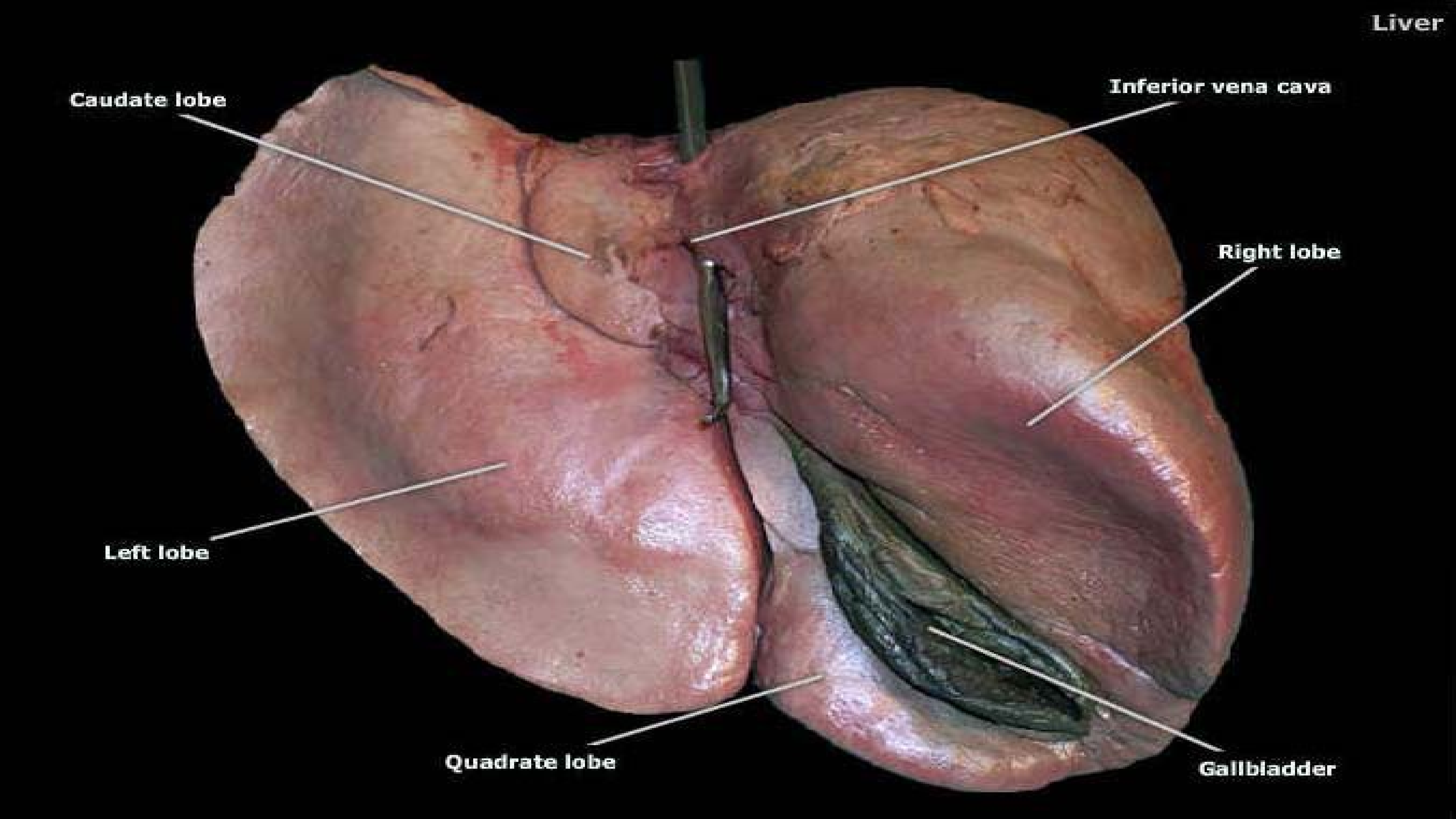

FALCIFORM LIGAMENT
LIGAMENT OF TERES OR ROUND LIGAMENT

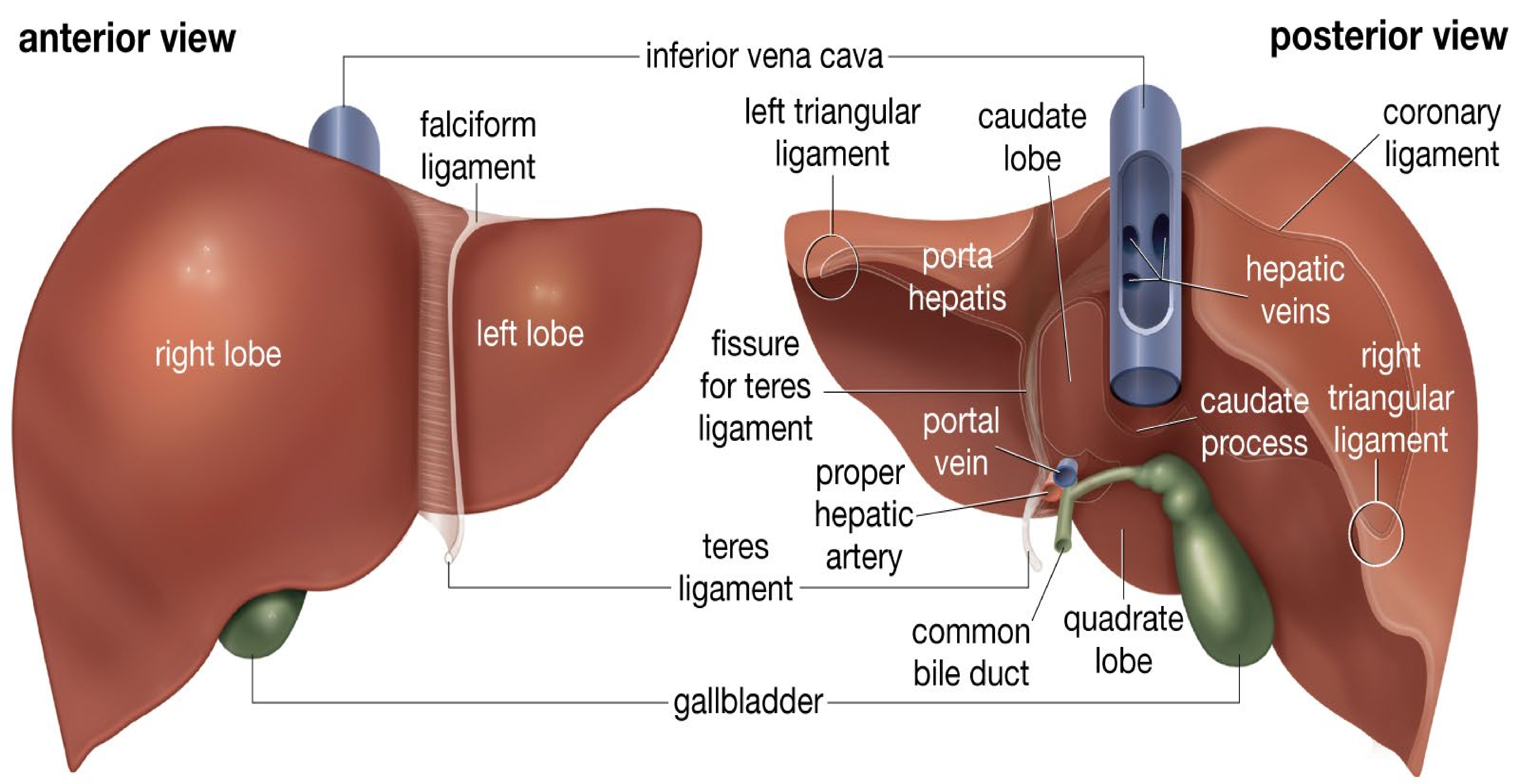
Liver

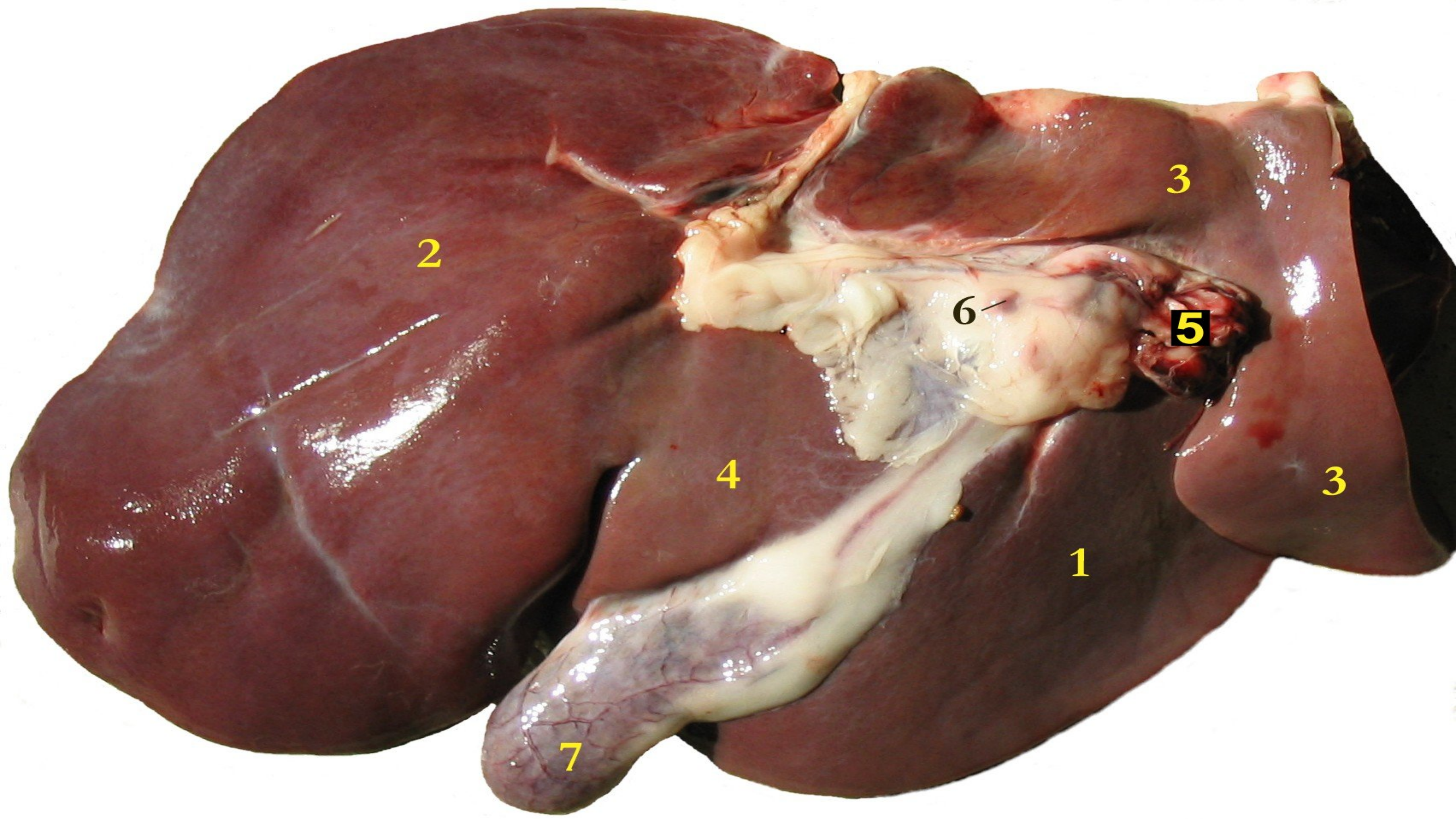


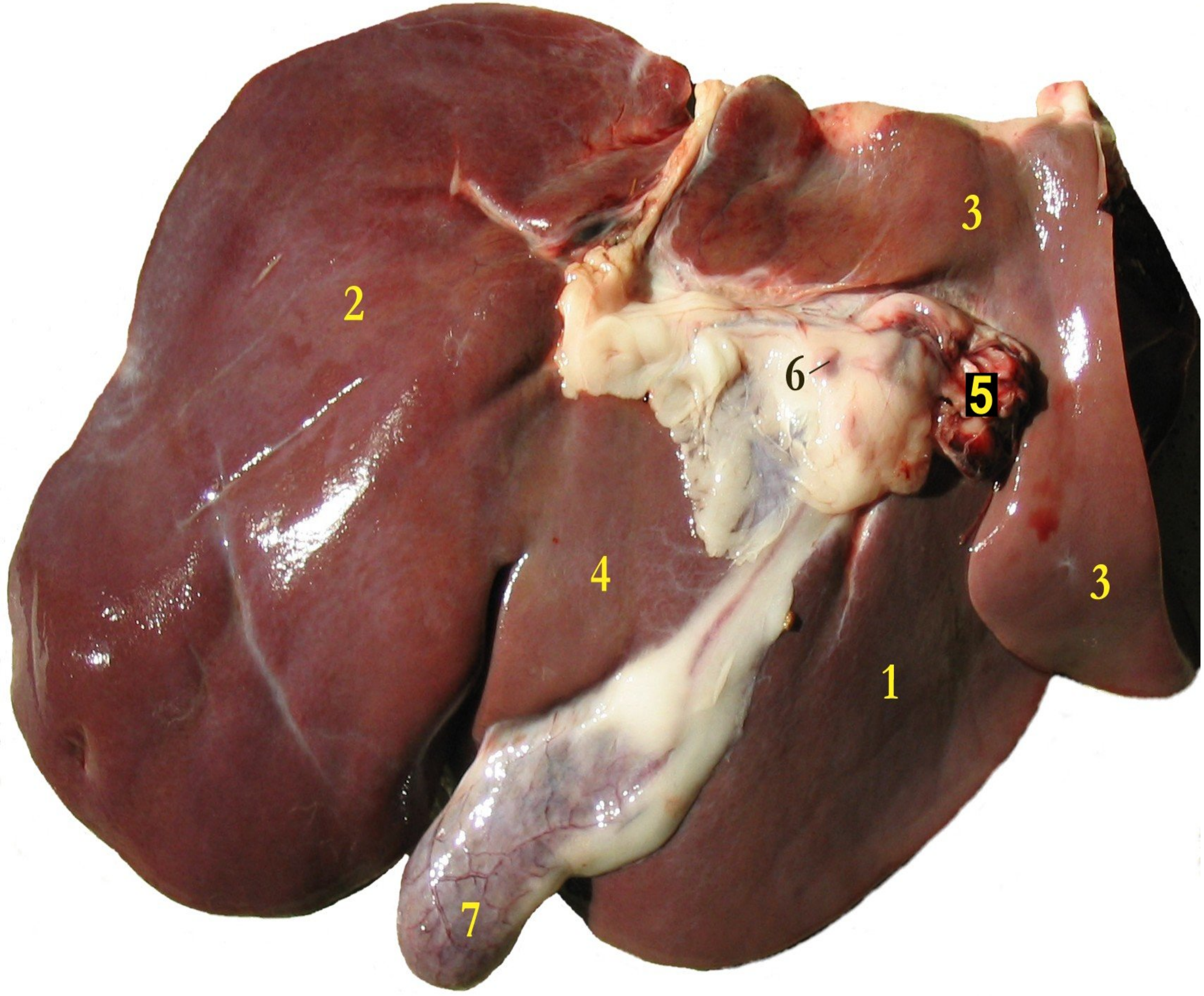

Left lobe of liver
Falciform ligament
Gallbladder




Liver
Caudate lobe
Inferior vena cava
Right lobe
Left lobe
Quadrate lobe
Gallbladder

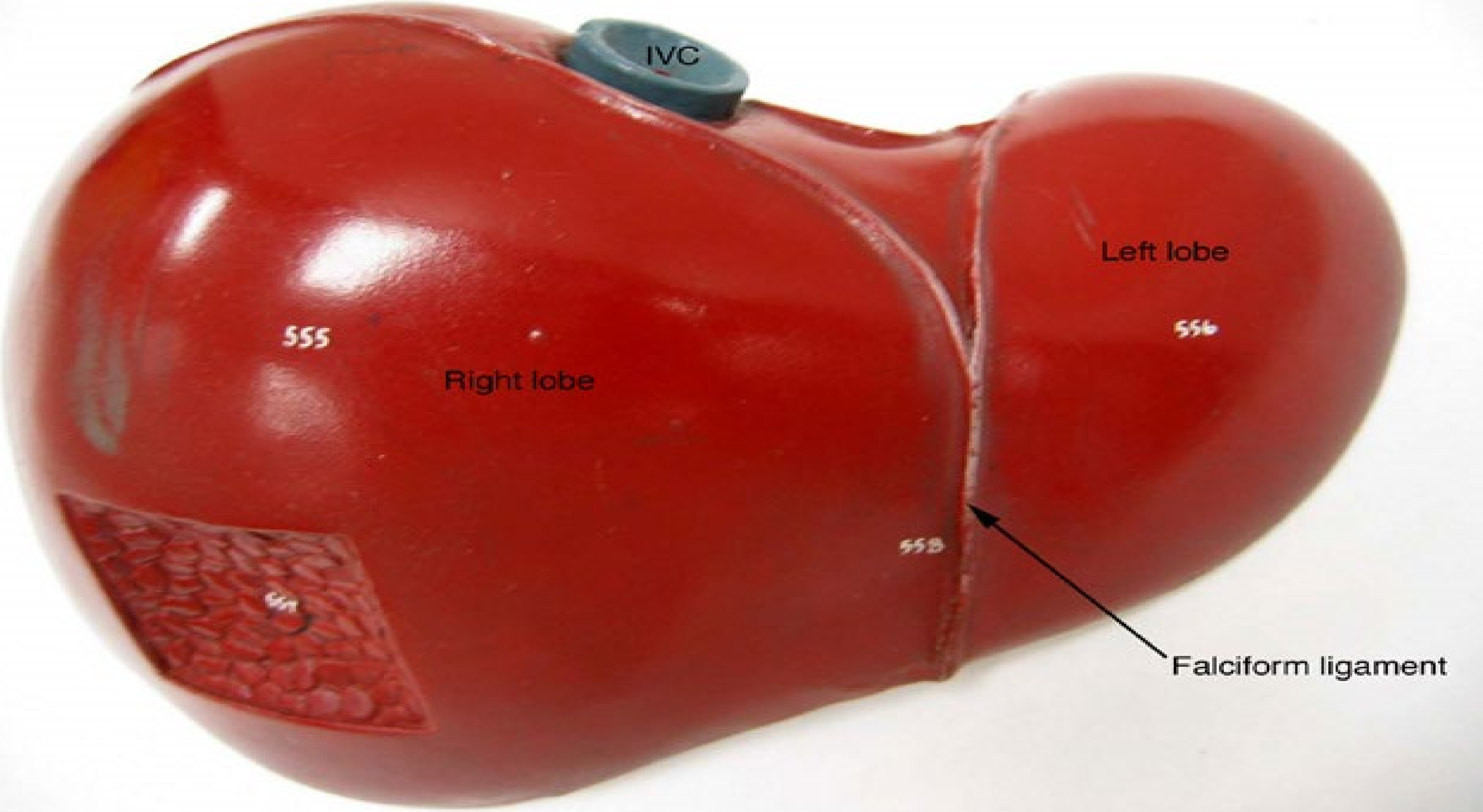

anterior view
posterior view
inferior vena cava
falciform ligament
left triangular ligament
caudate lobe
coronary ligament
porta hepatis
hepatic veins
right lobe
left lobe
fissure for teres ligament
right triangular ligament
caudate process
portal vein
proper hepatic artery
teres ligament
common bile duct
quadrate lobe
gallbladder

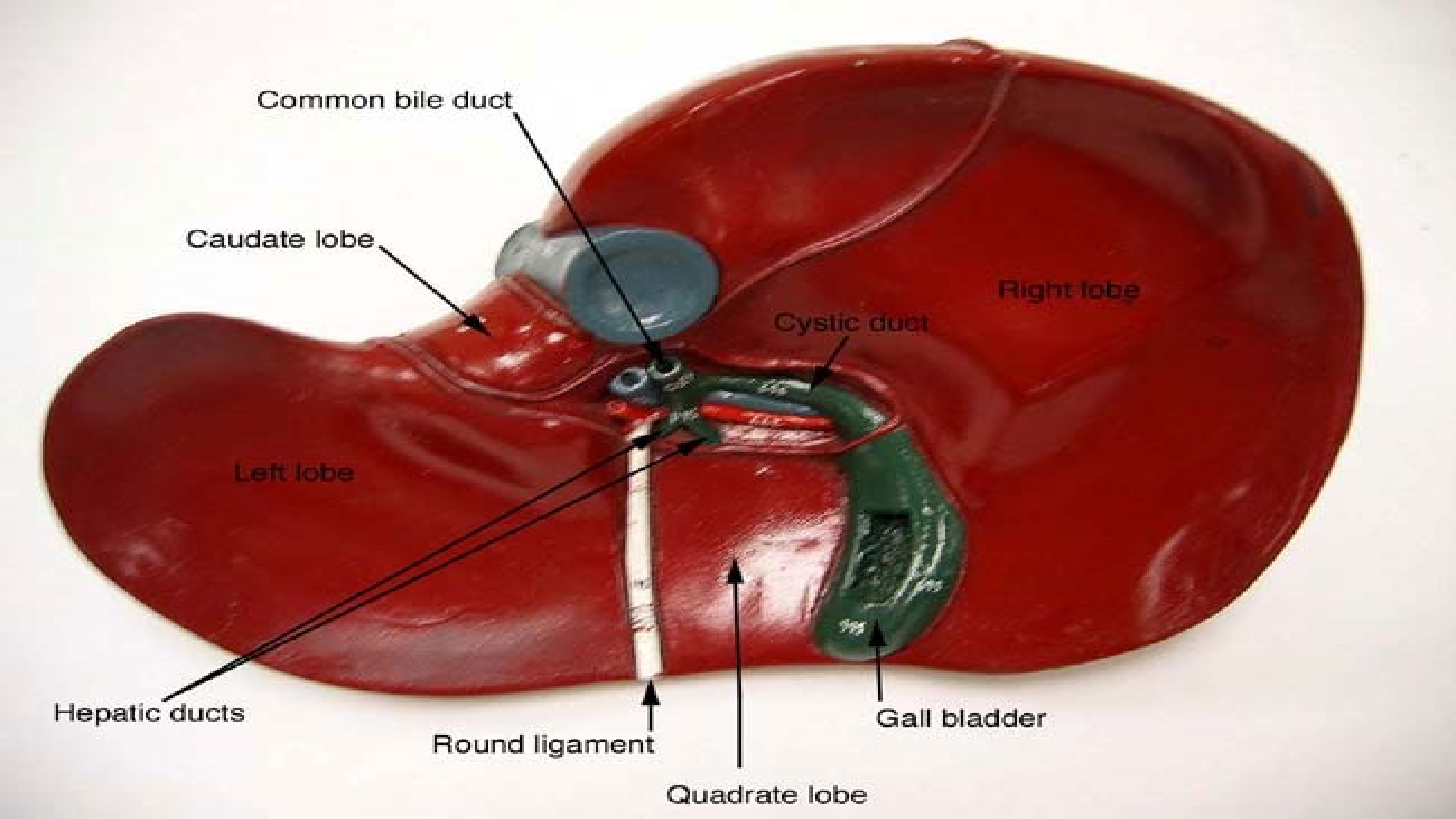

2
3
6
5
4
3
1
7

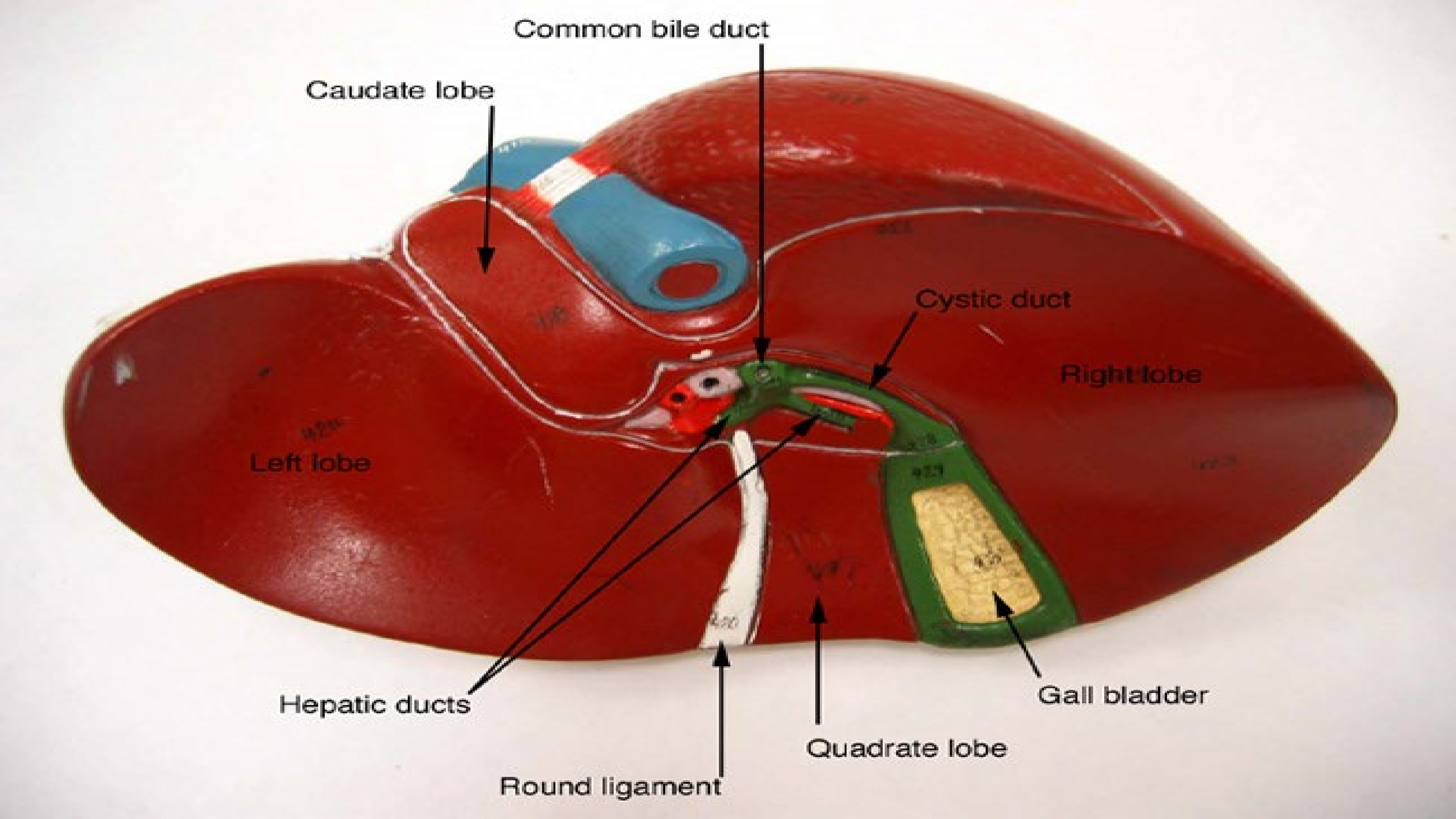


Liver of a sheep, visceral aspect
1 left lobe, 2 right lobe, 3 caudate lobe, 4 quadrate lobe, 5 hepatic artery and portal vein, 6 hepatic lymph nodes, 7 gall bladder

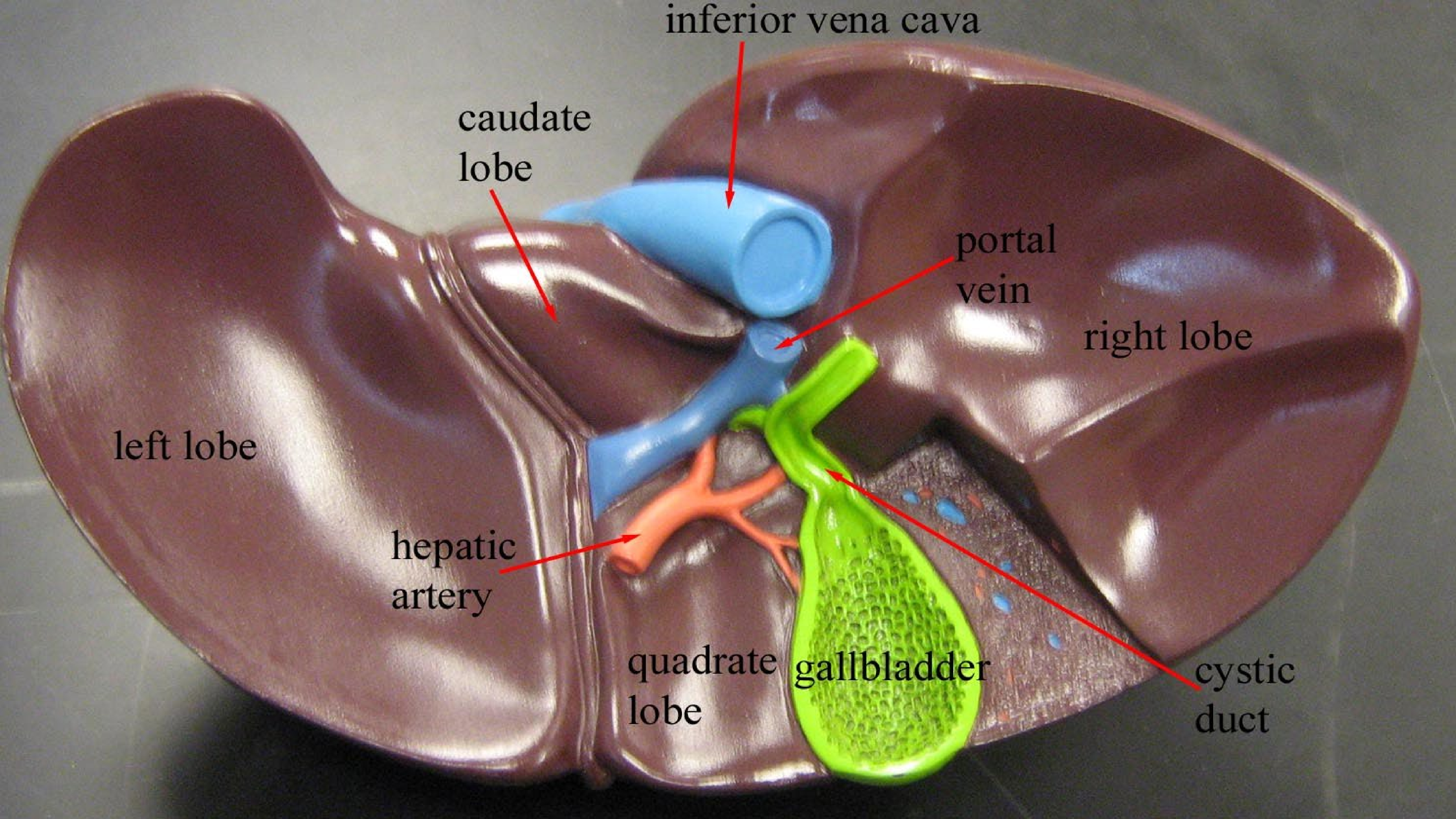
555
556

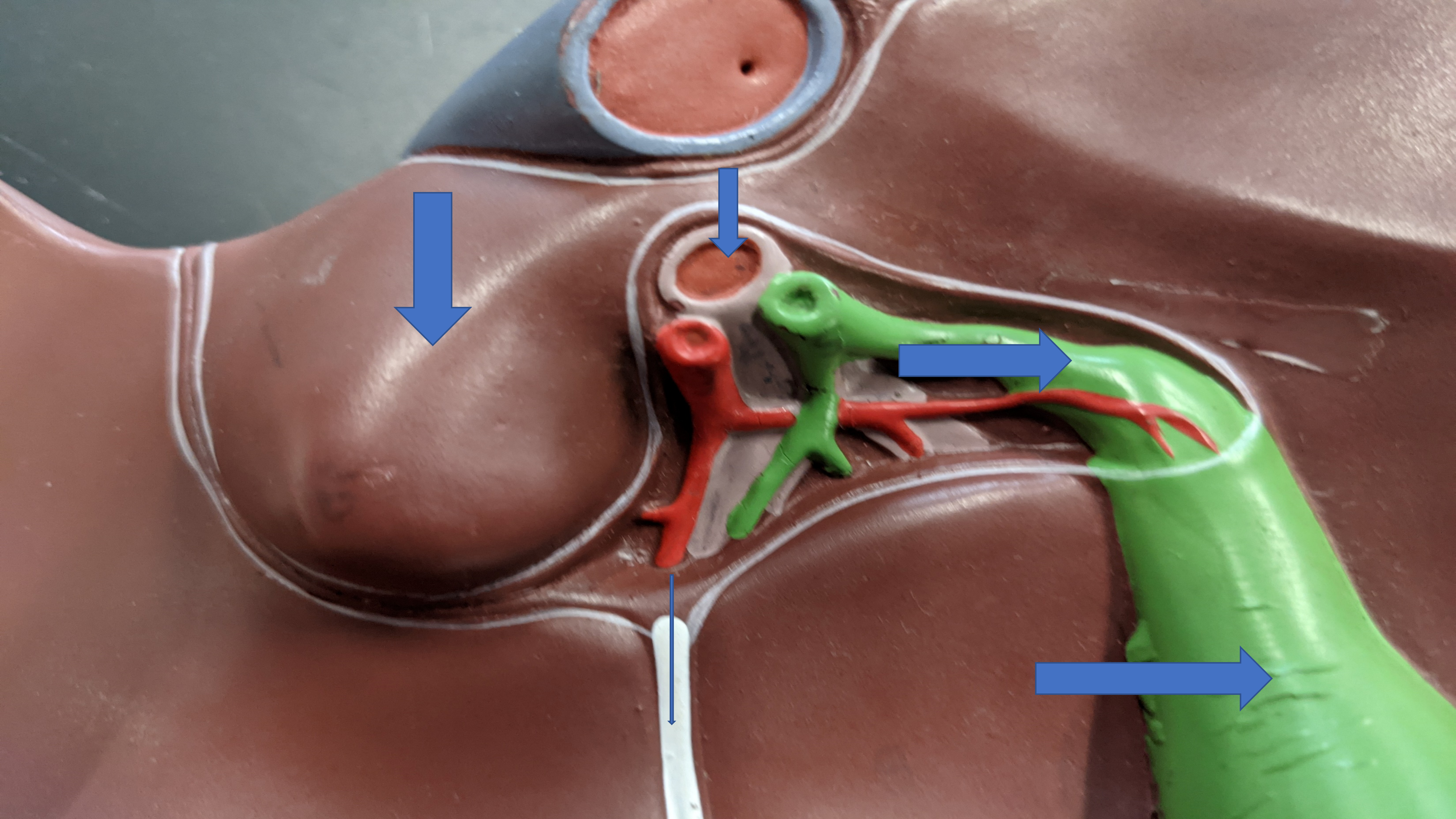

IVC
Left lobe
555
556
Right lobe
Falciform ligament

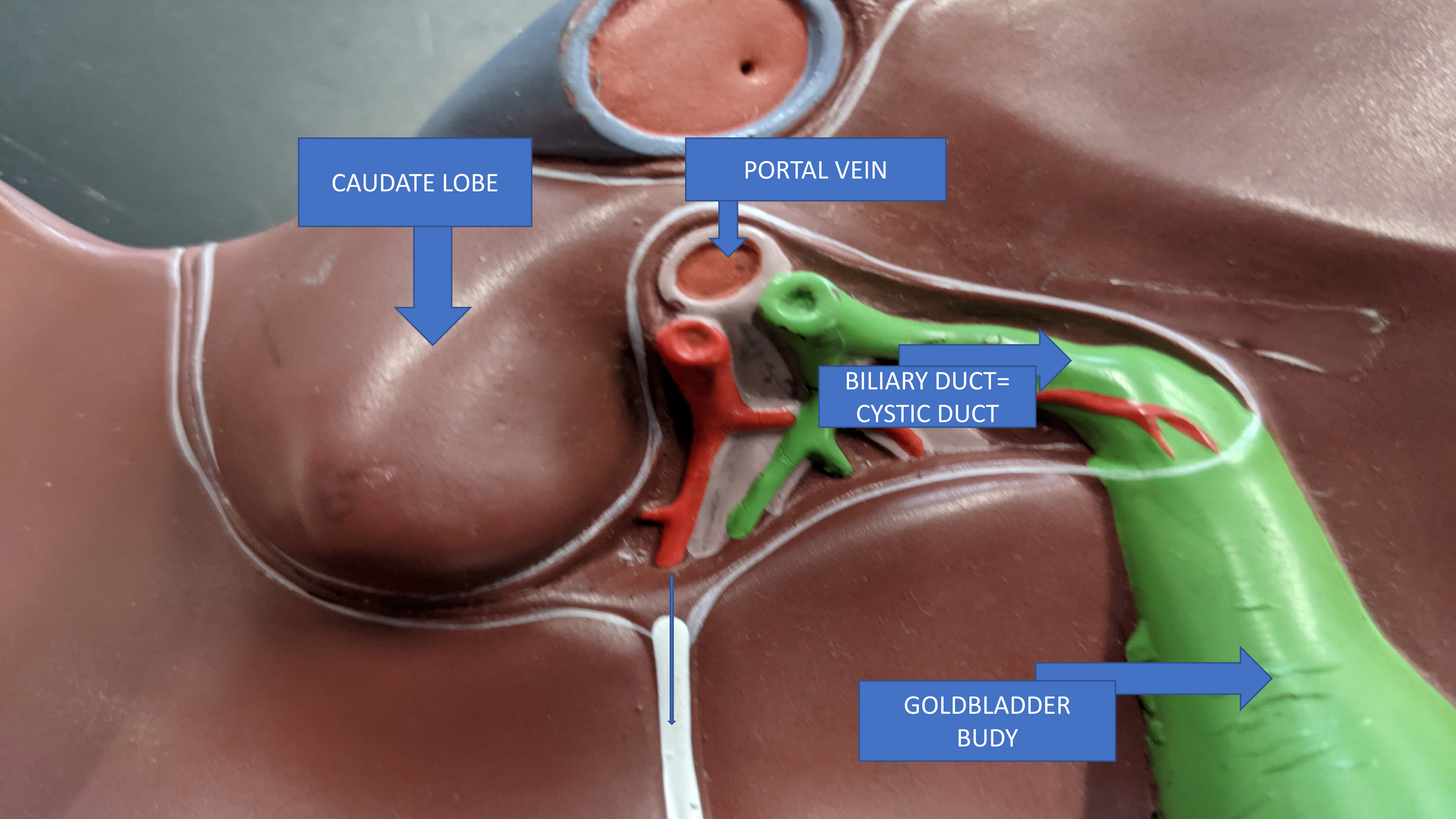

Common bile duct
Caudate lobe
Right lobe
Cystic duct
Left lobe
Hepatic ducts
Round ligament
Gall bladder
Quadrate lobe

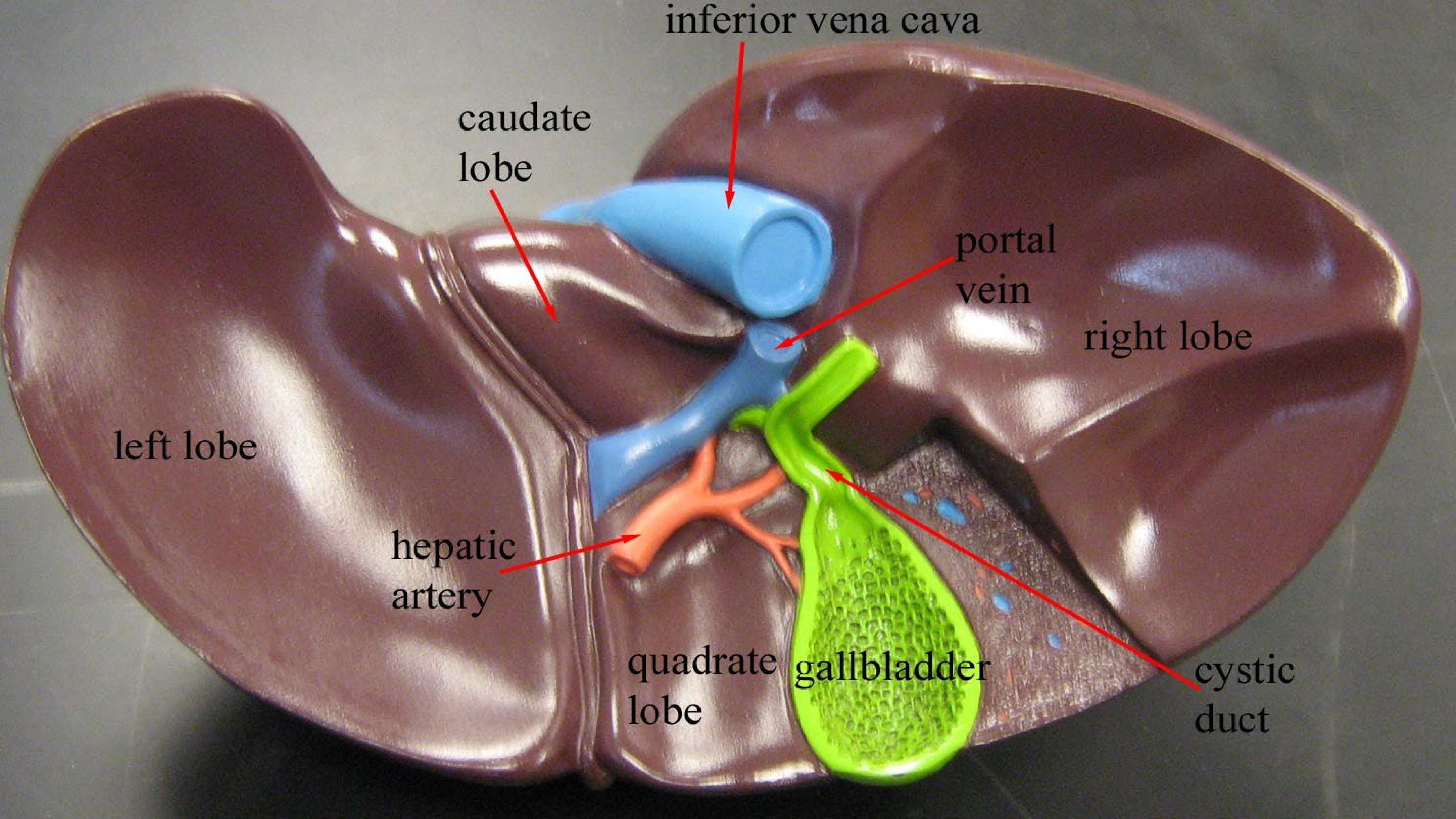

Common bile duct
Caudate lobe
Cystic duct
Right lobe
Left lobe
Hepatic ducts
Gall bladder
Quadrate lobe
Round ligament

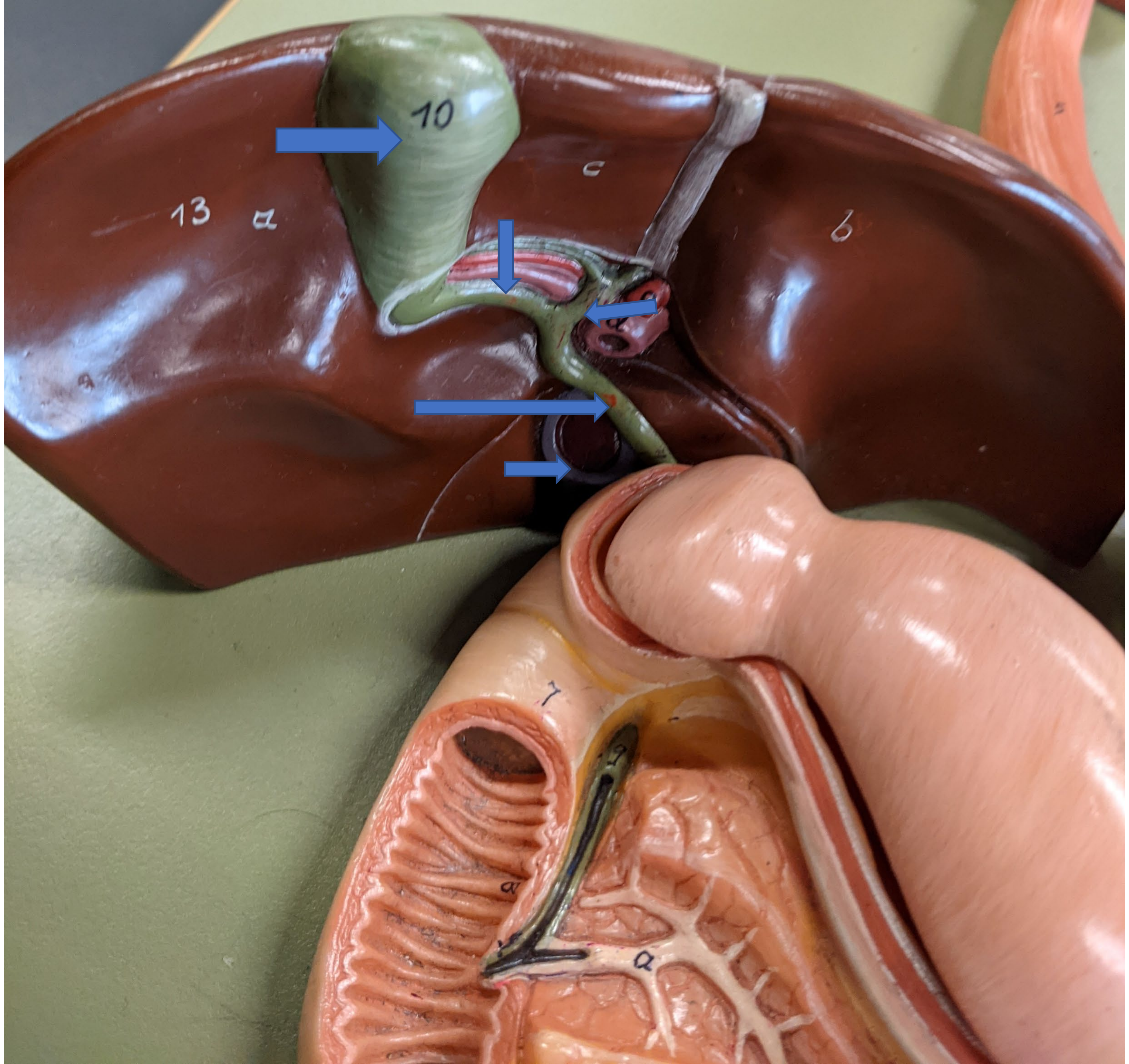

left lobe
inferior vena cava
common hepatic duct
cystic duct
right lobe
gallbladder
left hepatic duct
right hepatic duct

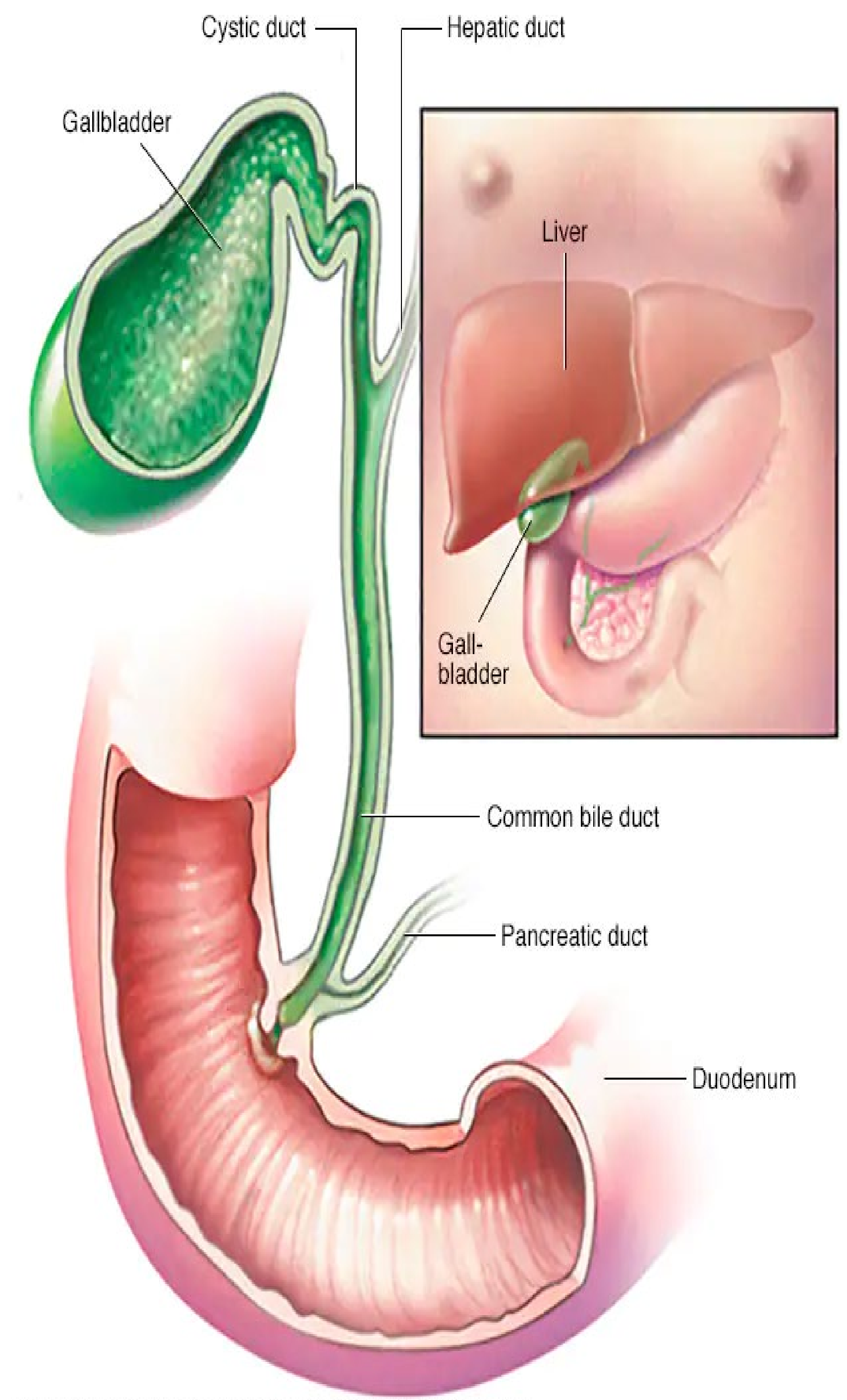

inferior vena cava
caudate
lobe
portal
vein
right lobe
left lobe
hepatic
artery
quadrate
lobe
gallbladder
cystic
duct

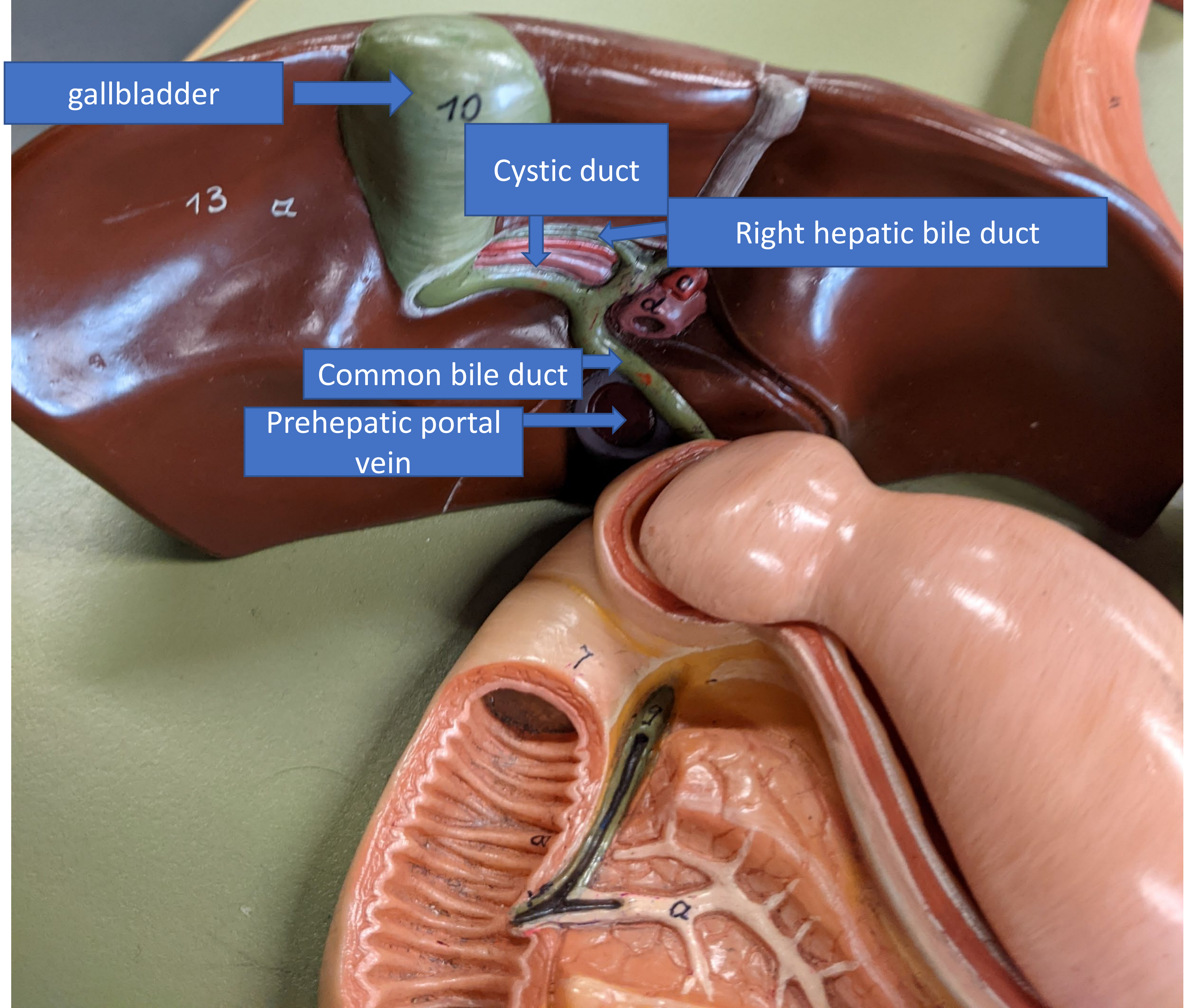


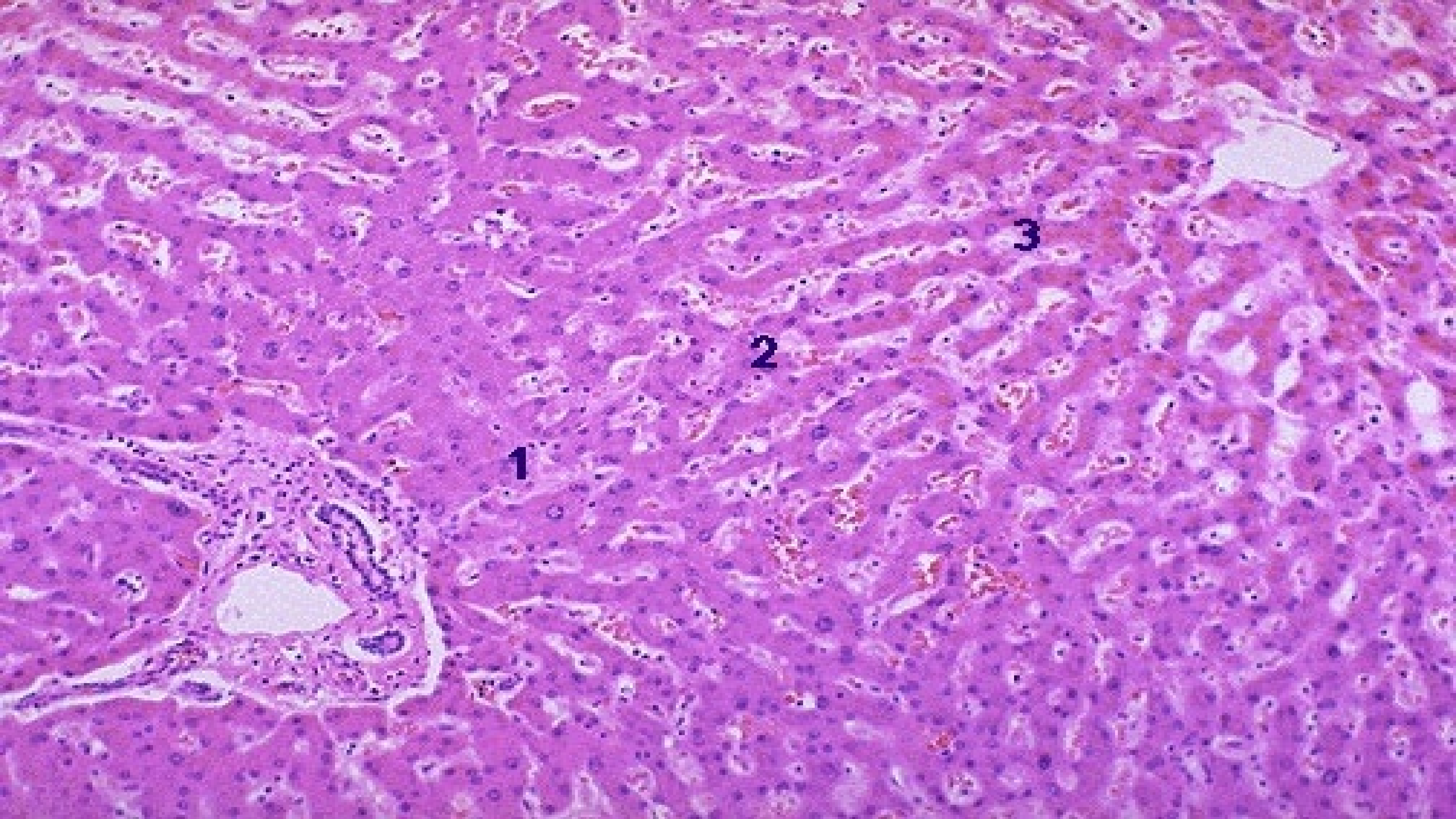

CAUDATE LOBE
PORTAL VEIN
BILIARY DUCT=
CYSTIC DUCT
GOLDBLADDER
BUDY

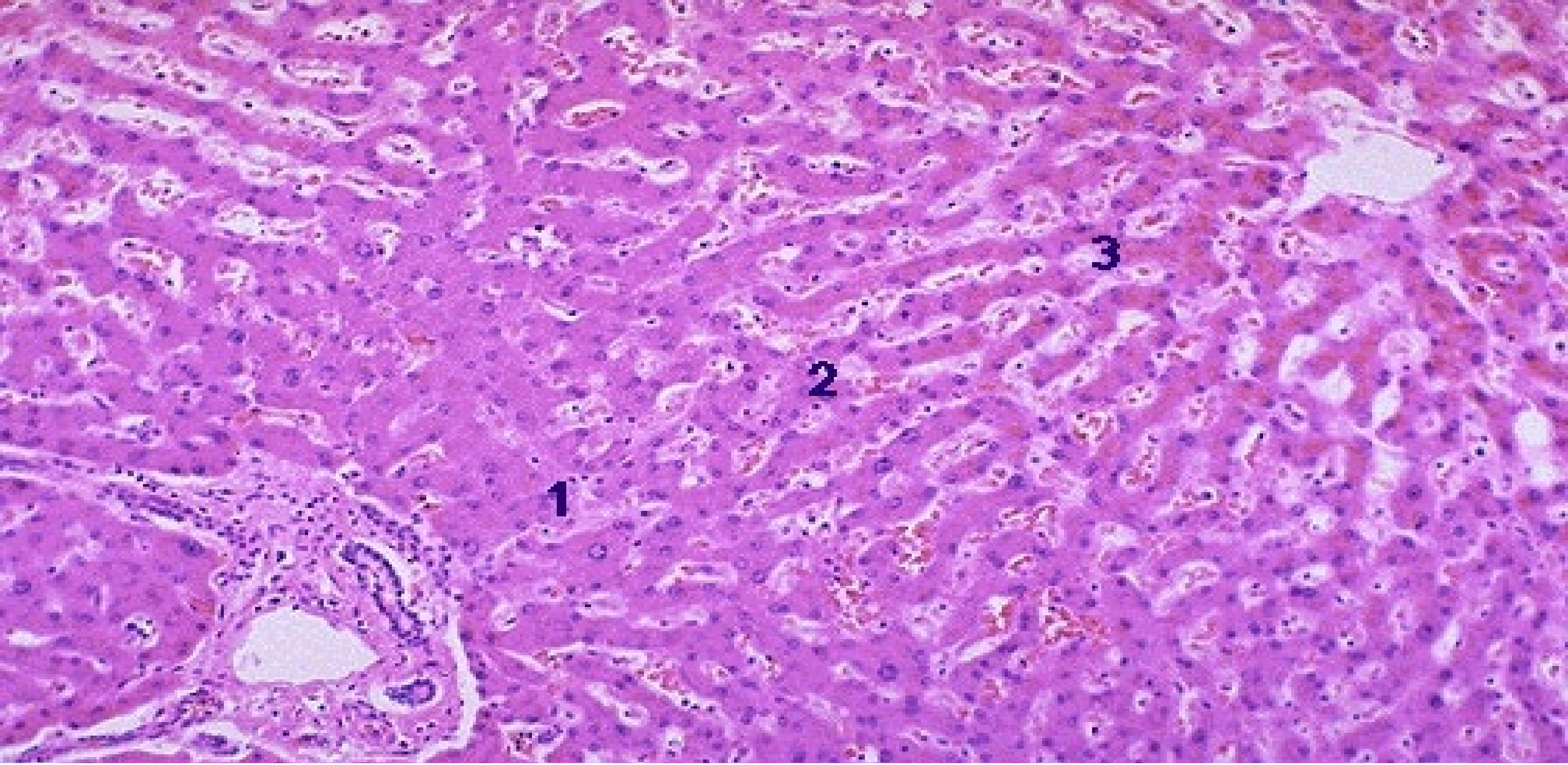

inferior vena cava
caudate lobe
portal vein
right lobe
left lobe
hepatic artery
quadrate lobe
gallbladder
cystic duct


10
13
a
c
b
7
a


Cystic duct
Hepatic duct
Gallbladder
Liver
Gall-
bladder
Common bile duct
Pancreatic duct
Duodenum

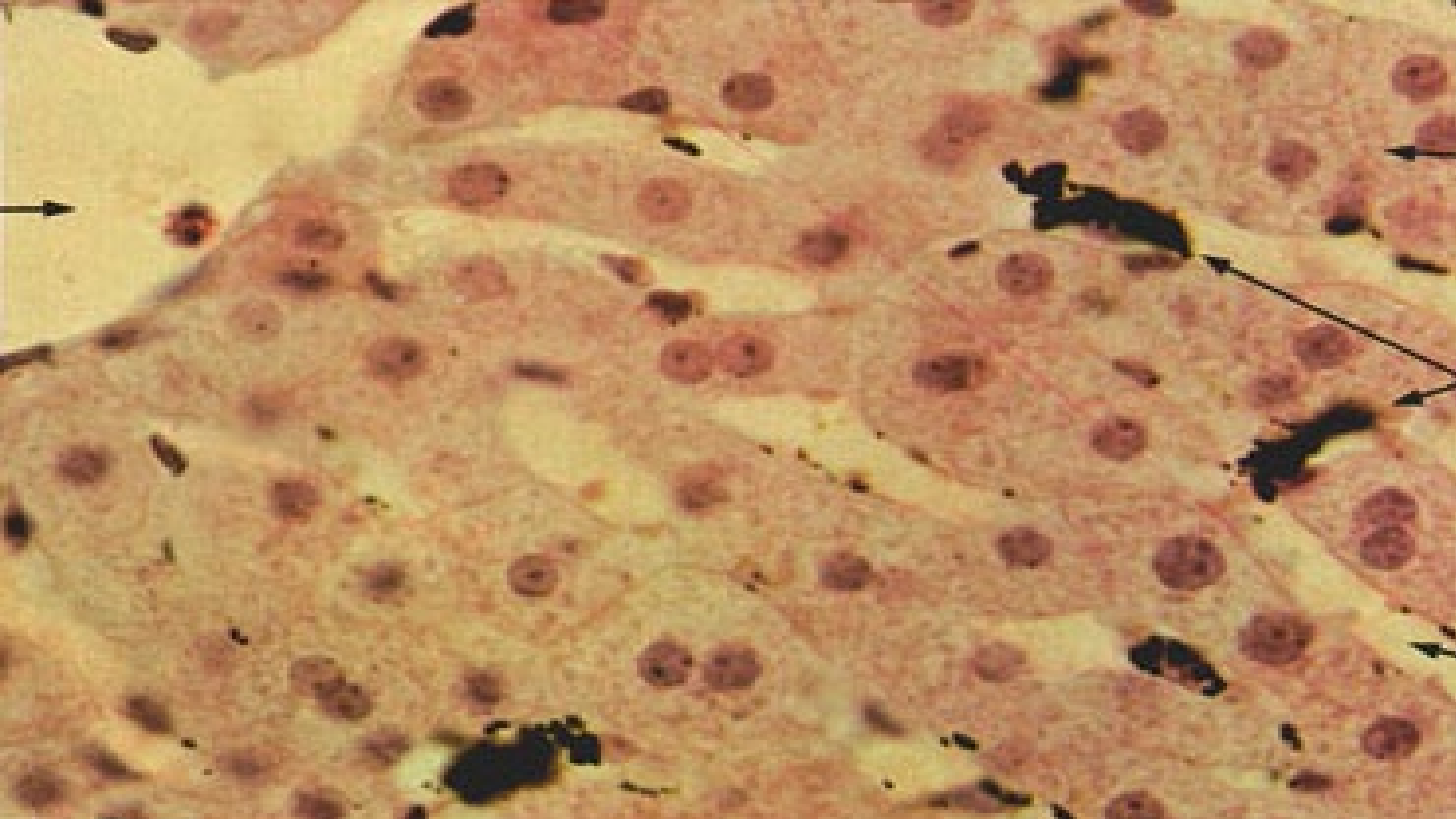

gallbladder
10
13
Cystic duct
Right hepatic bile duct
Common bile duct
Prehepatic portal
vein
7

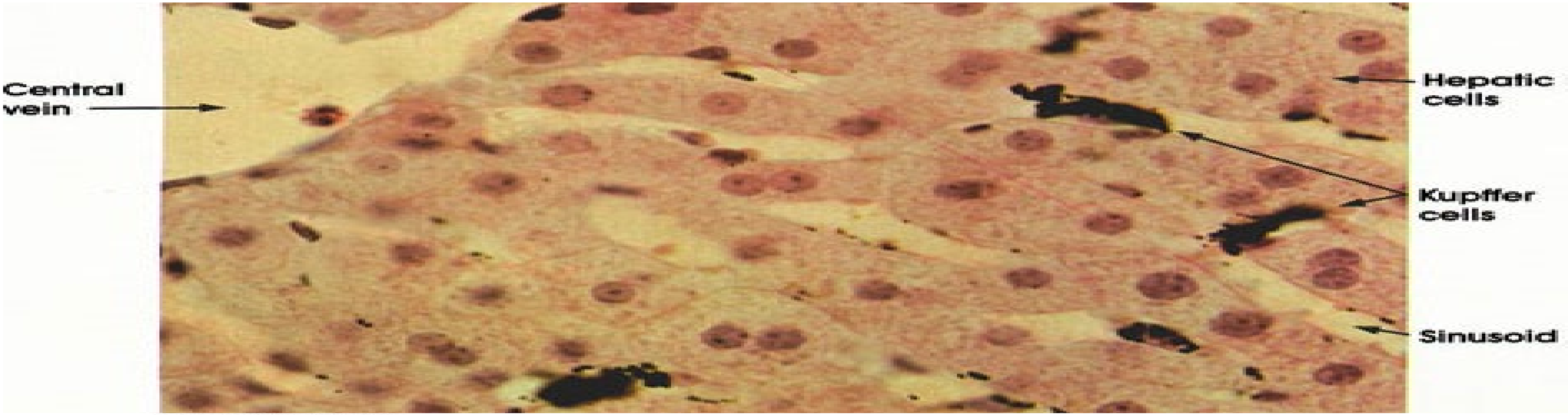

3
2
1

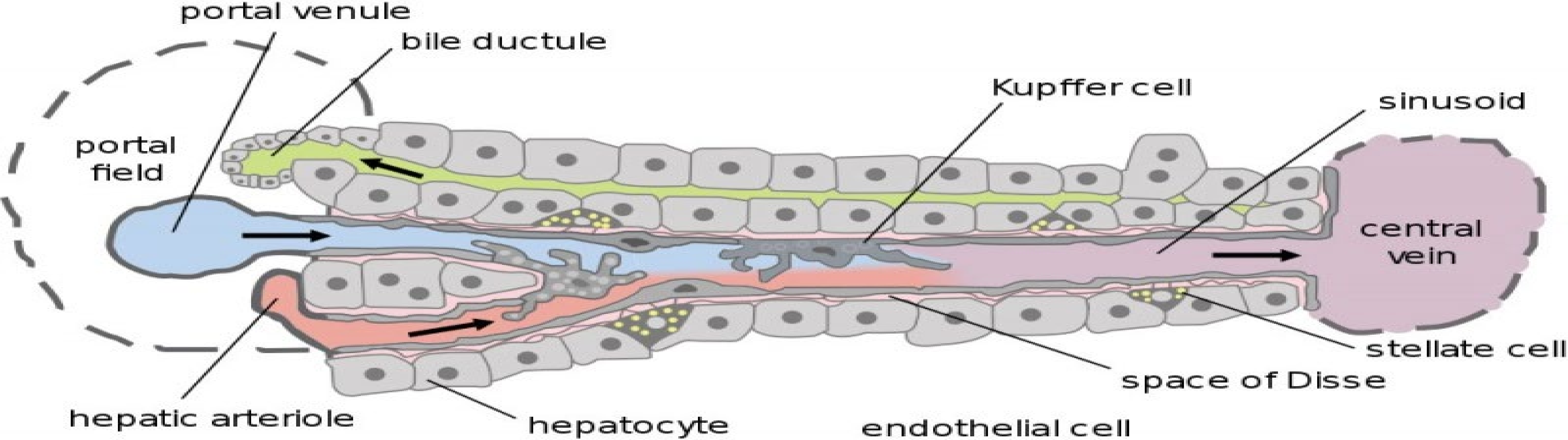


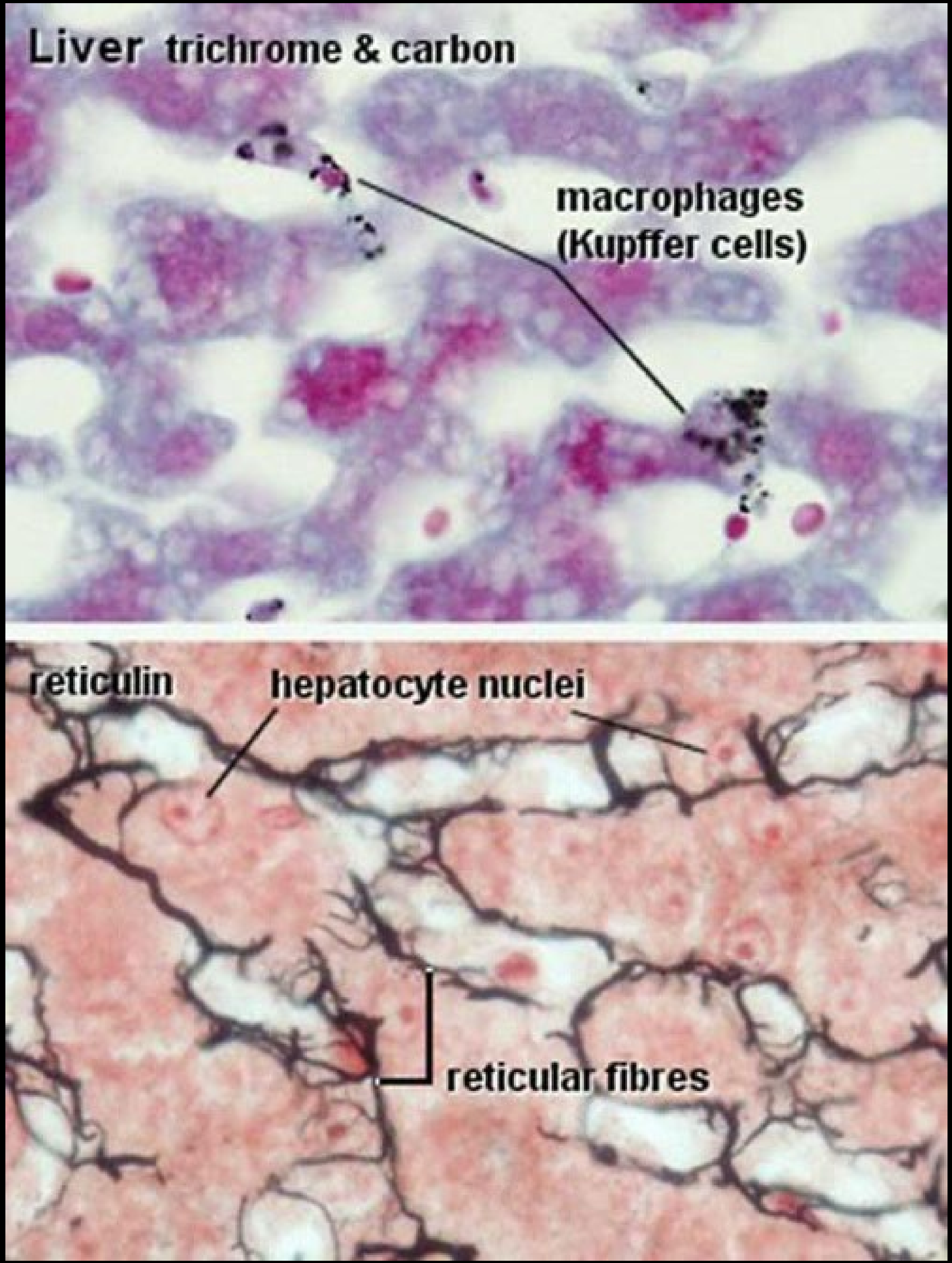
This is normal liver at medium power with zone 1 in periportal region, zone 2 in the middle of the lobule, and zone 3 in centrilobular region.

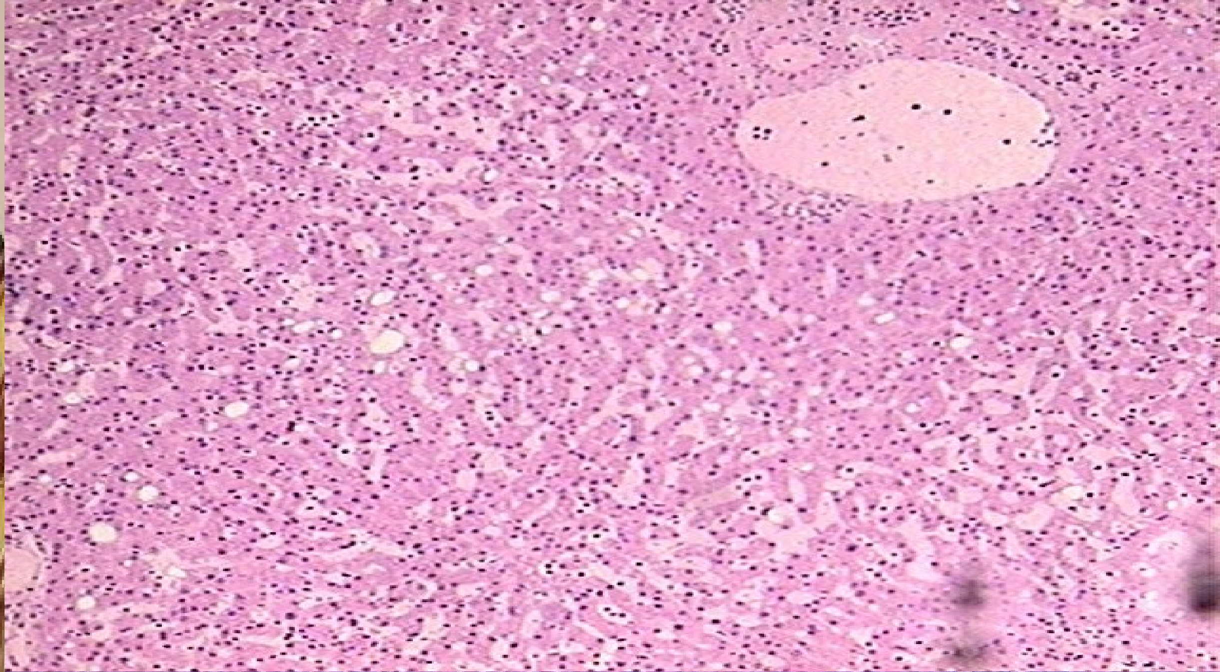
A **central vein** and a **portal triad** define the lobule.

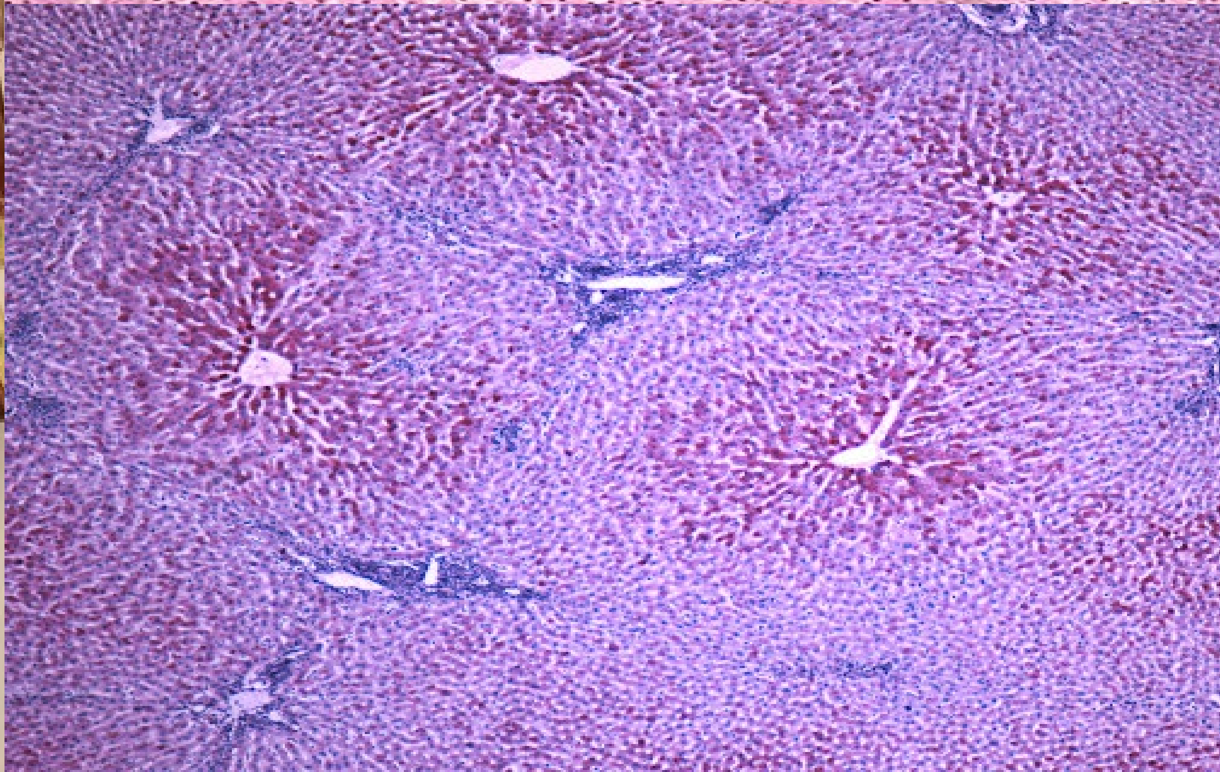



Central
vein
Hepatic
cells
Kupffer
cells
Sinusoid

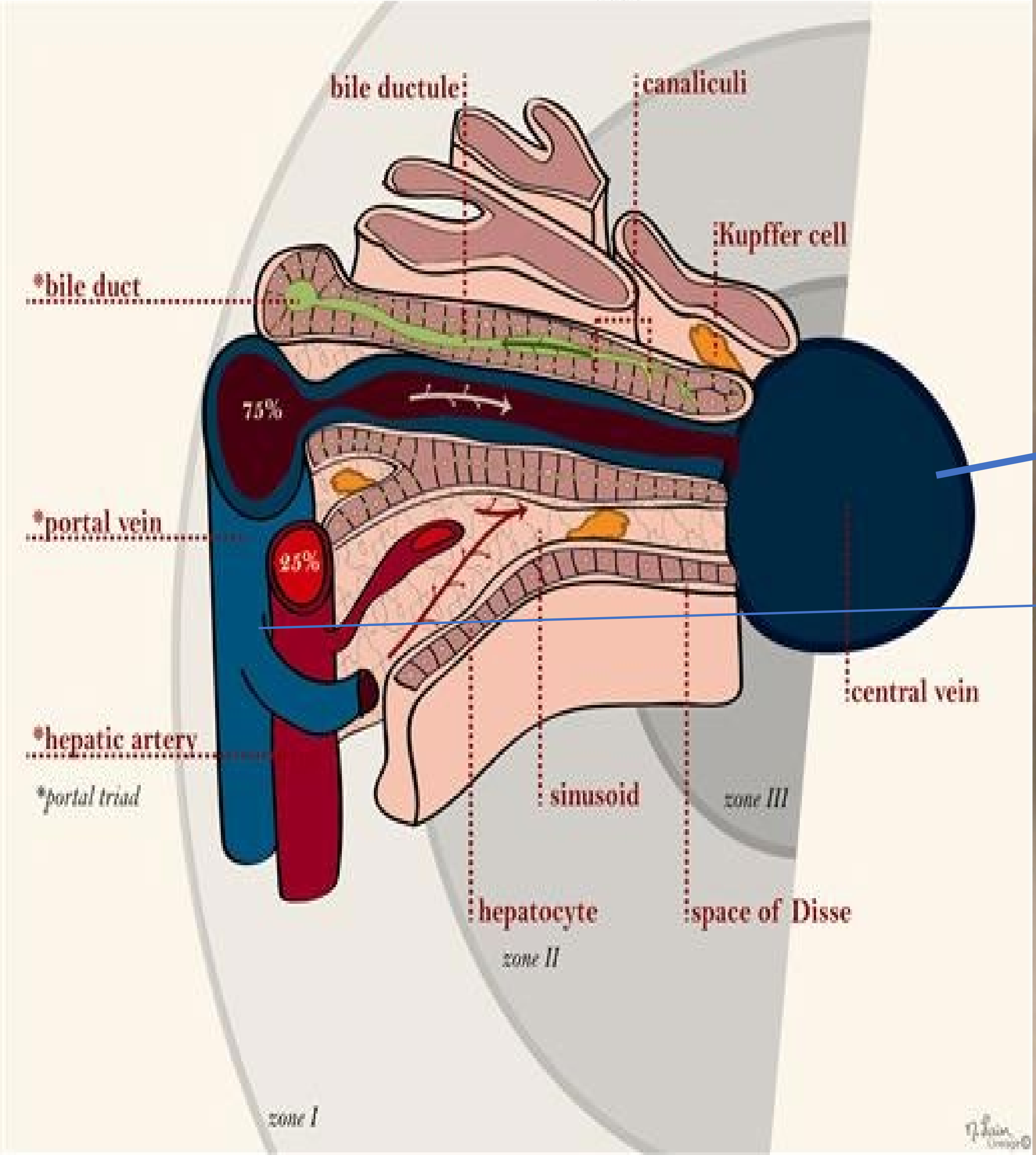

portal venule
bile ductule
Kupffer cell
sinusoid
portal
field
central
vein
stellate cell
space of Disse
hepatic arteriole
hepatocyte
endothelial cell

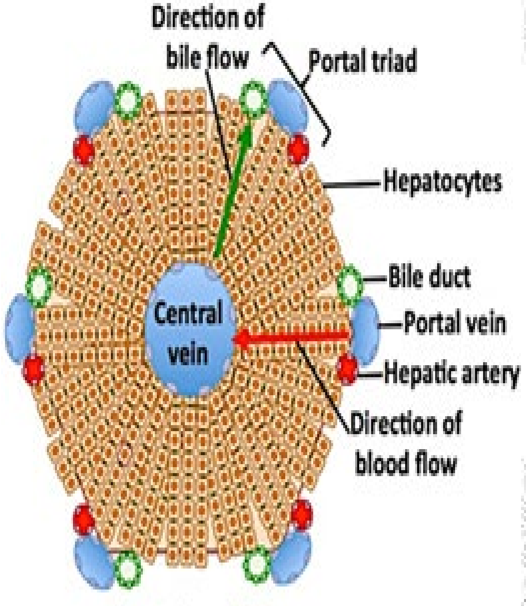

Liver trichrome & carbon
macrophages
(Kupffer cells)
reticulin
hepatocyte nuclei
reticular fibres



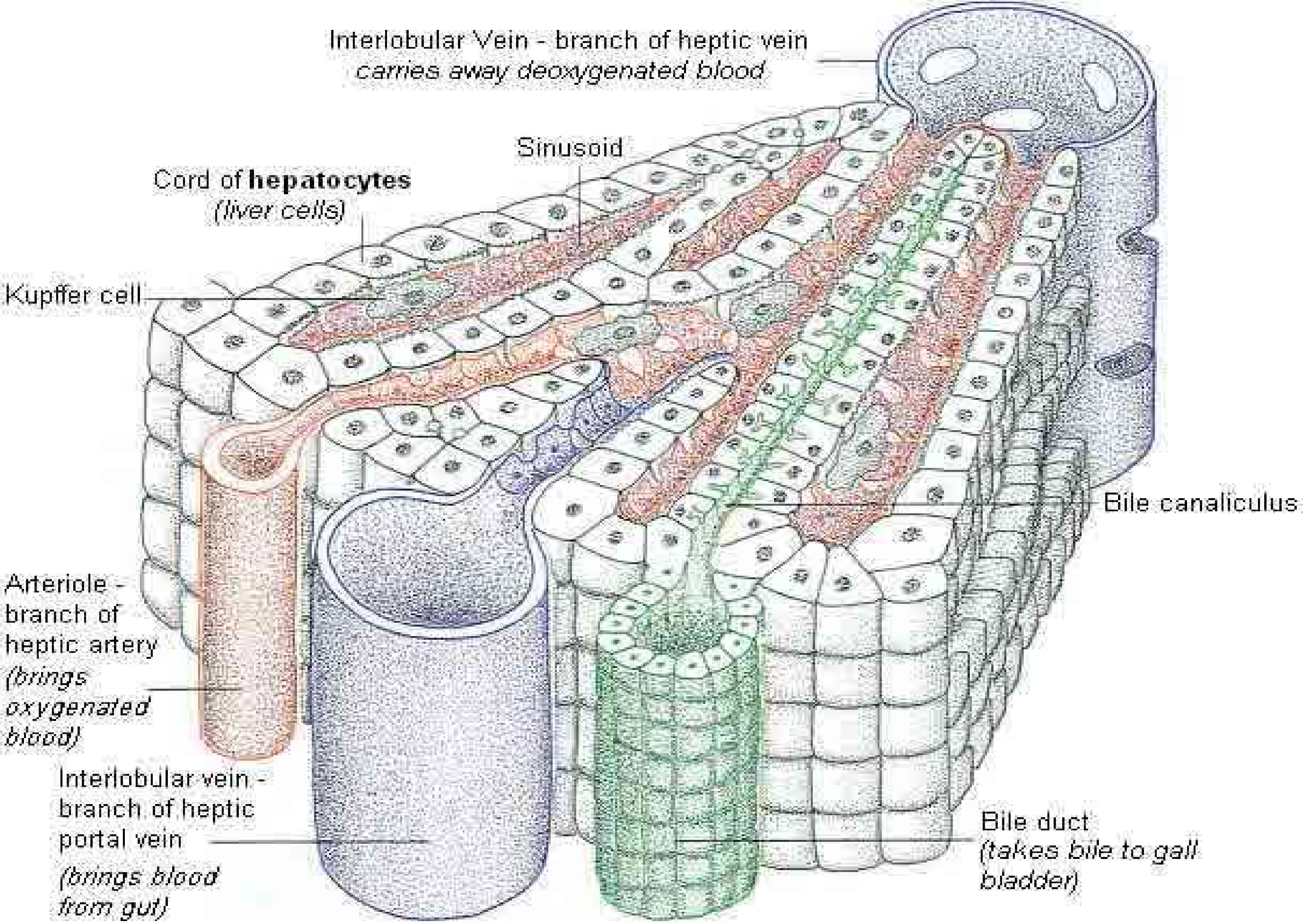


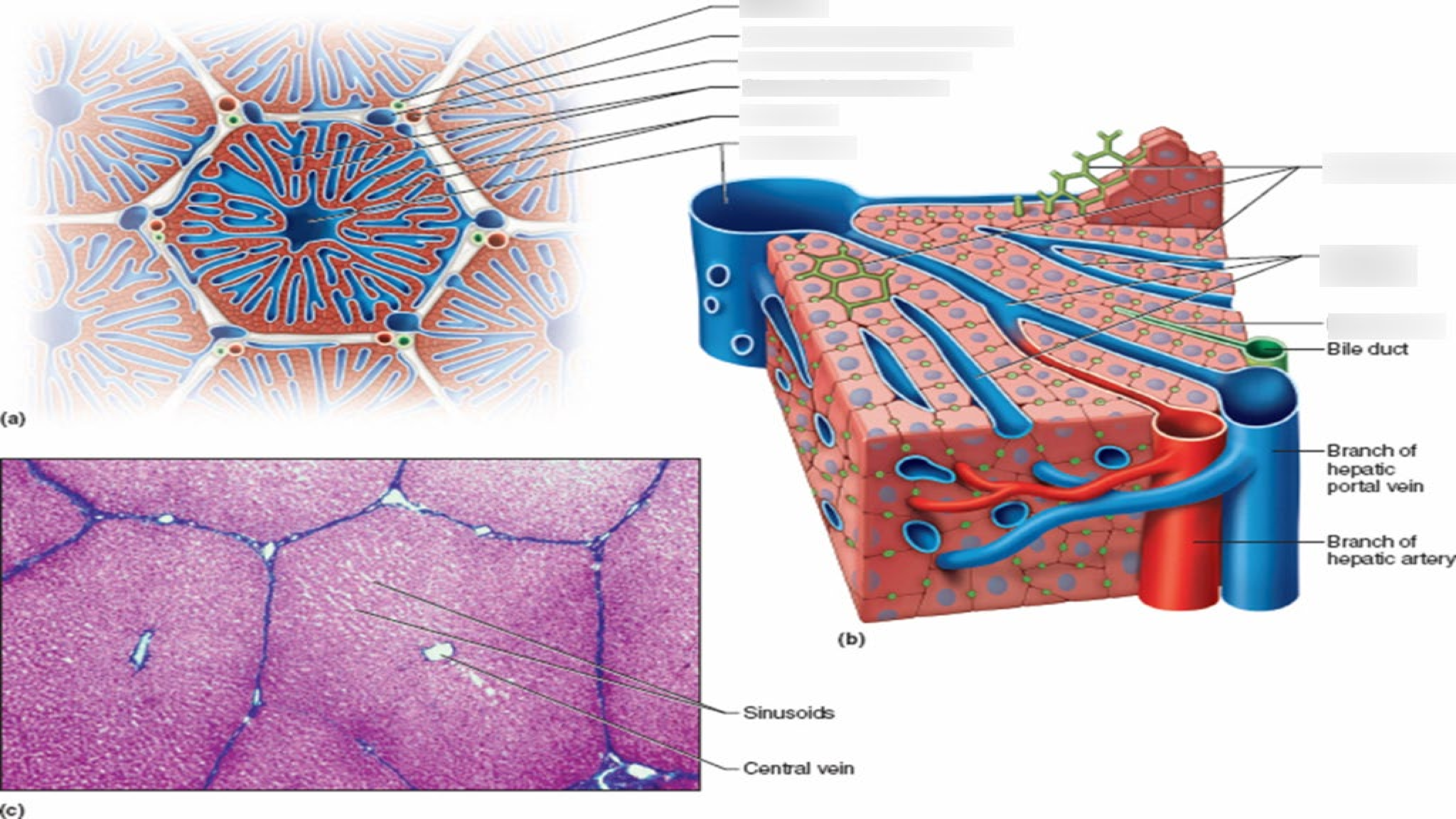
Liver Histology



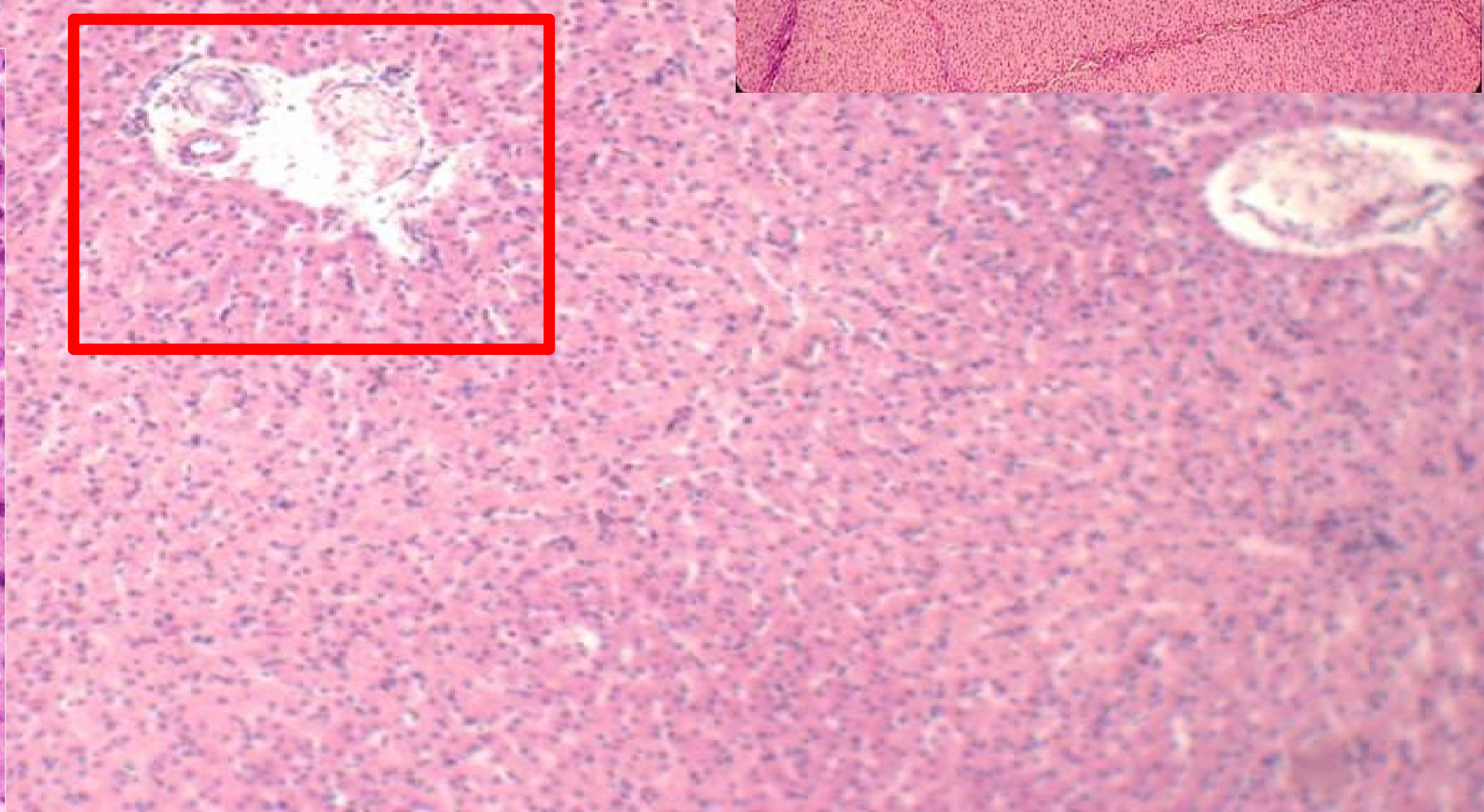


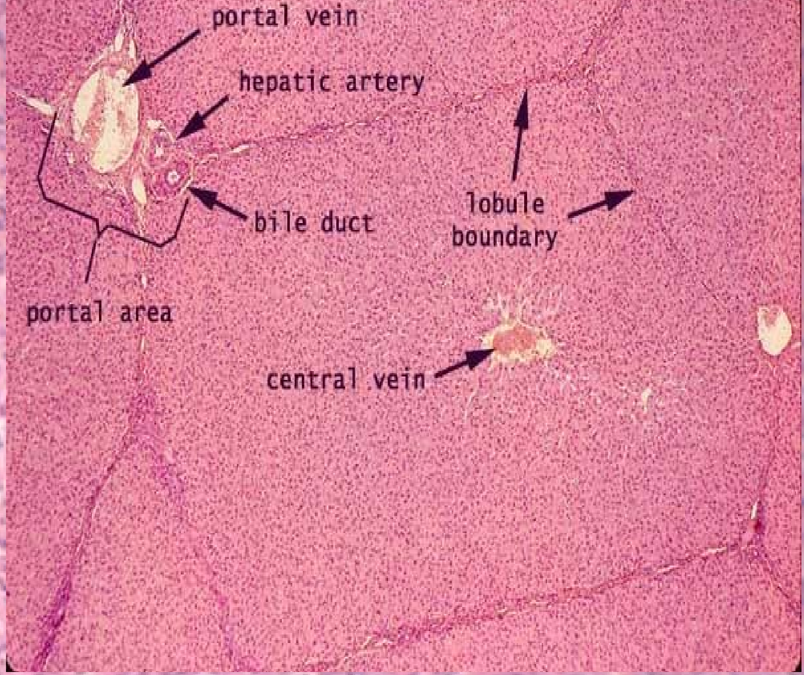
Classic liver lobule

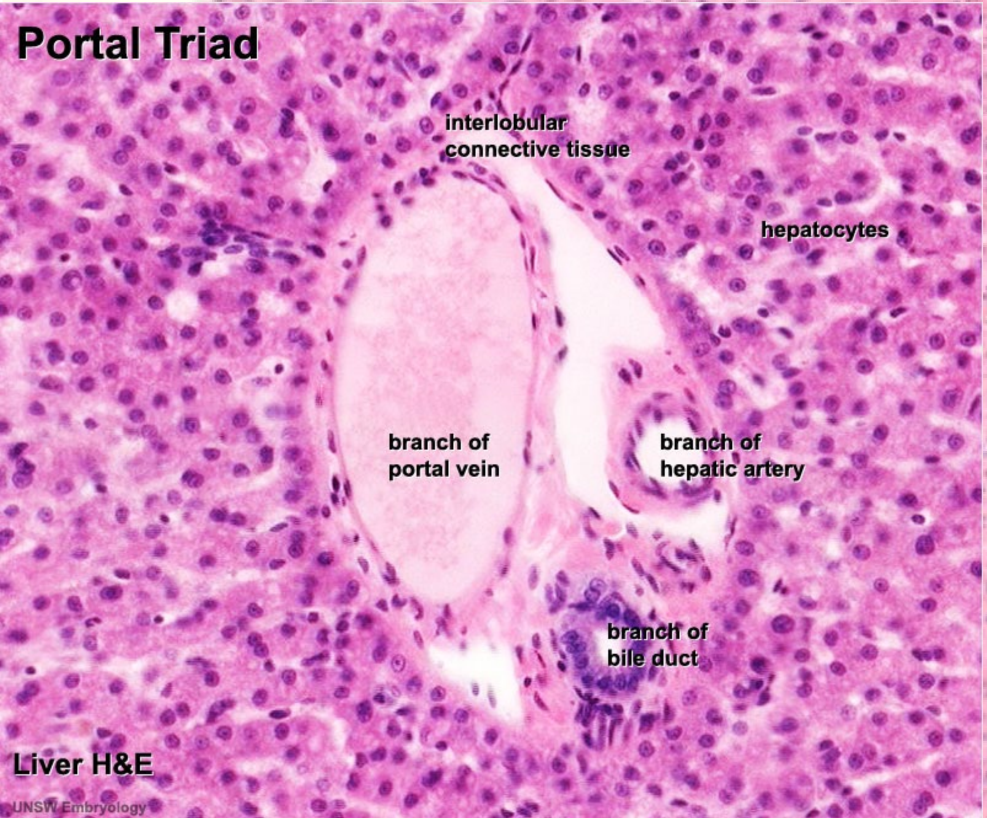


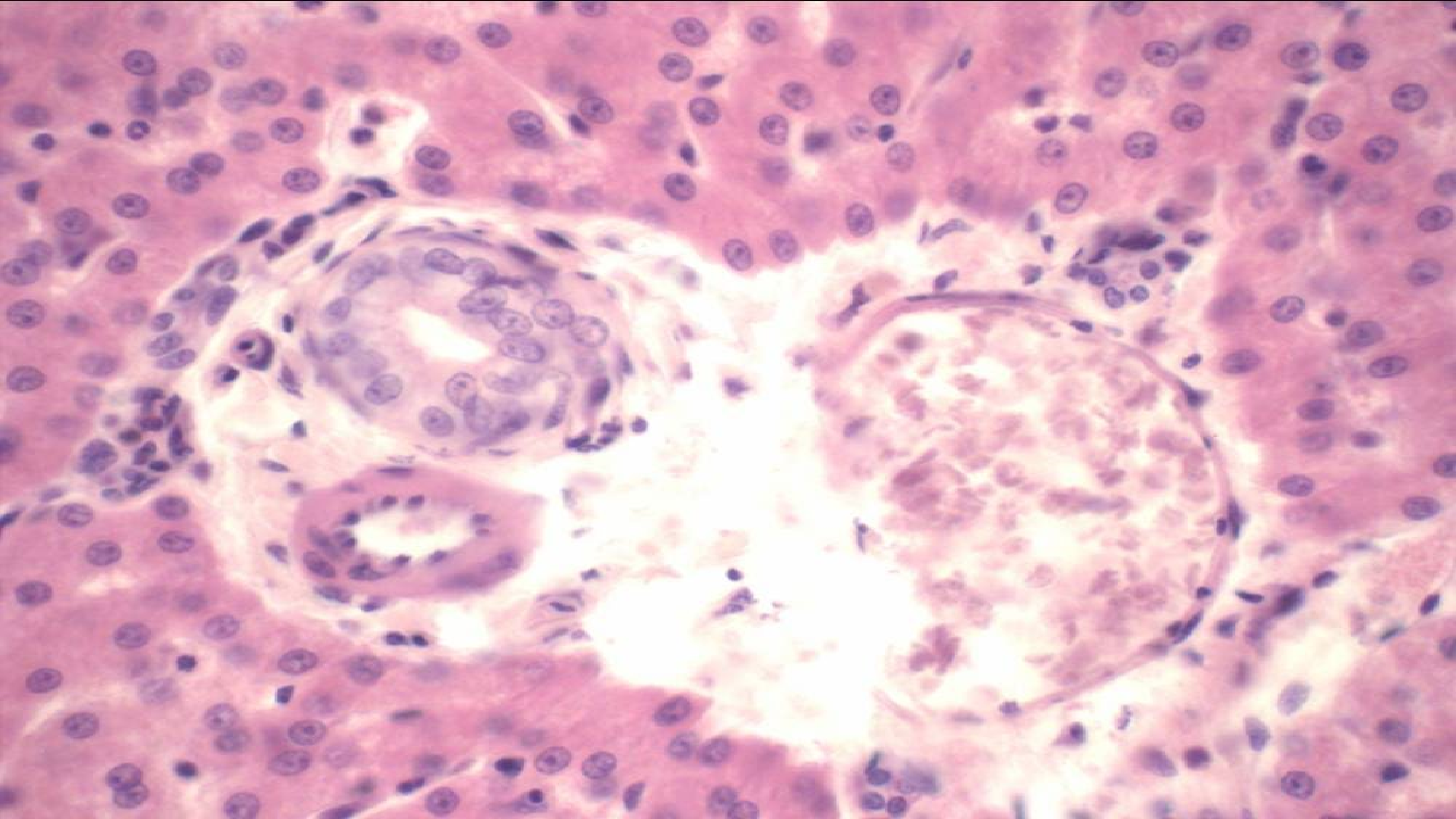

(a)
Bile duct
Branch of hepatic portal vein
Branch of hepatic artery
(b)
Sinusoids
Central vein
(c)

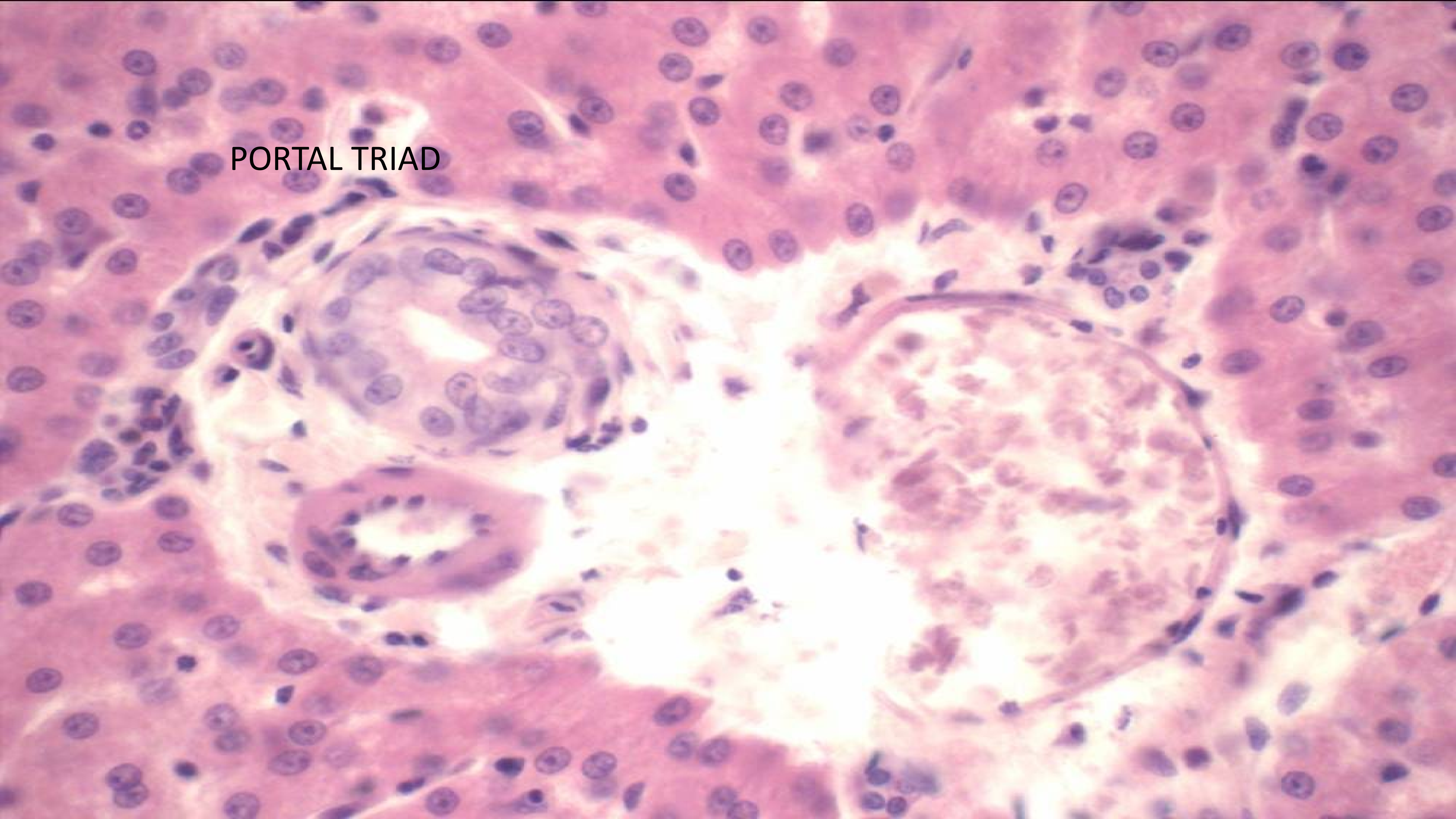
PORTAL TRIAD

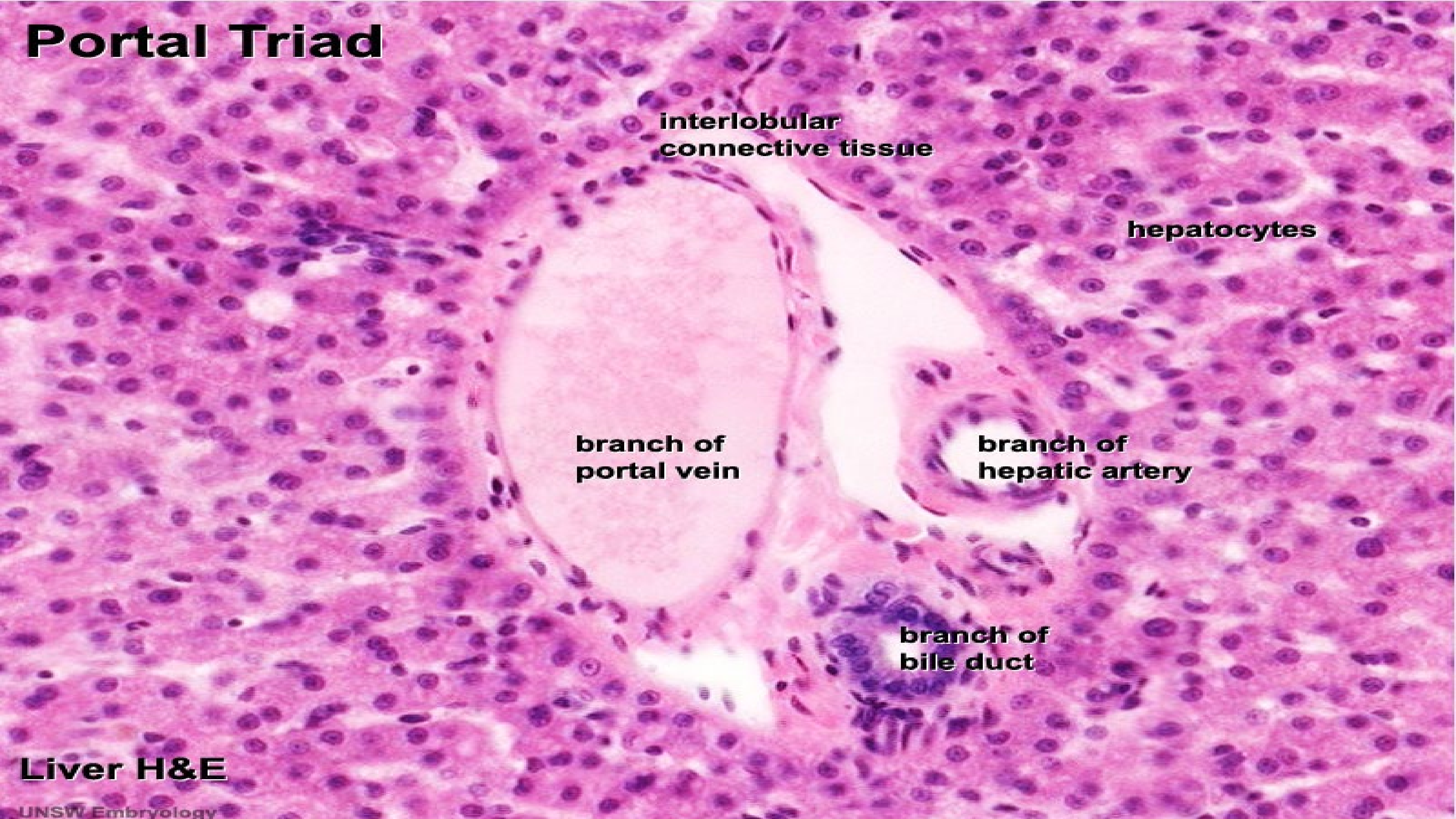


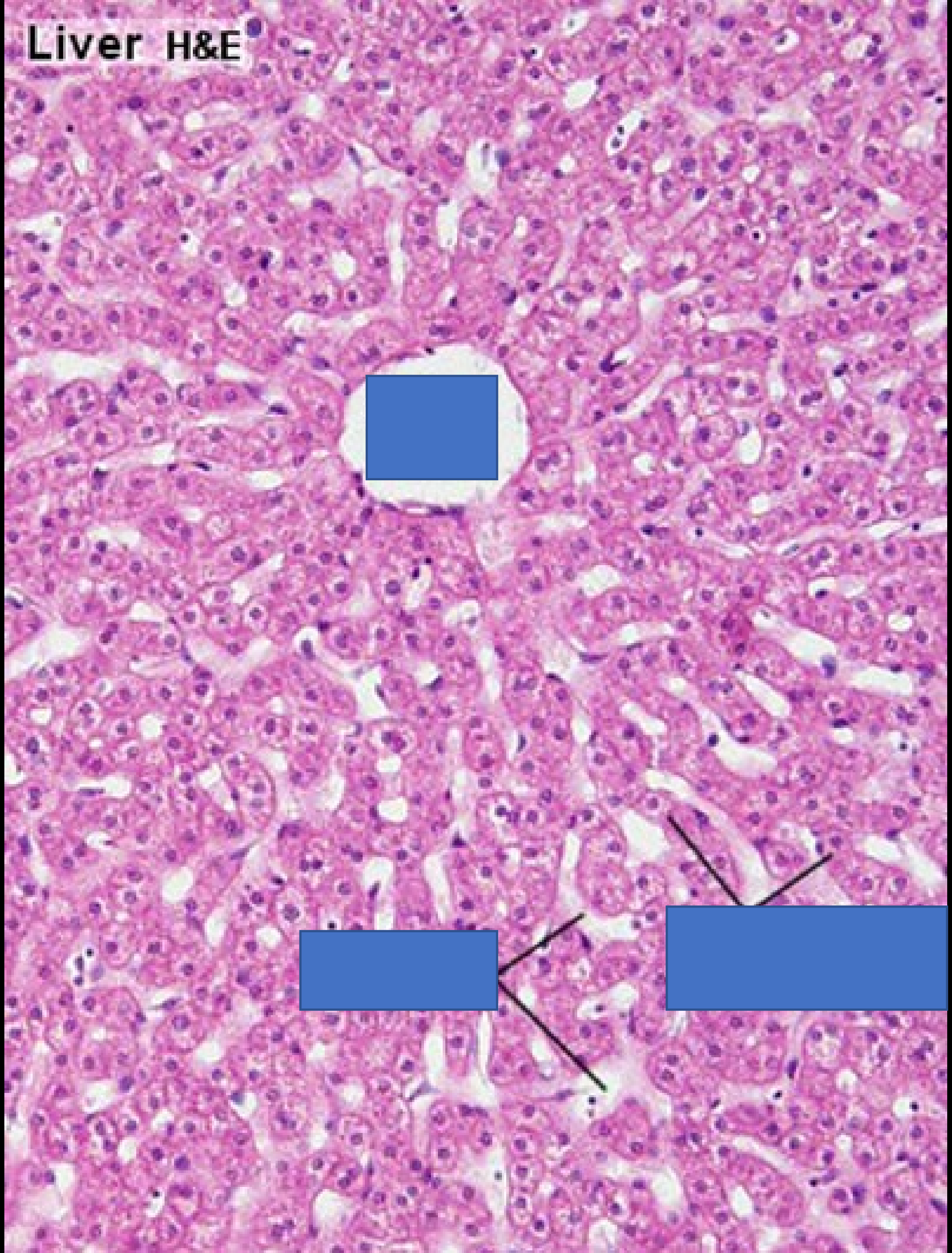


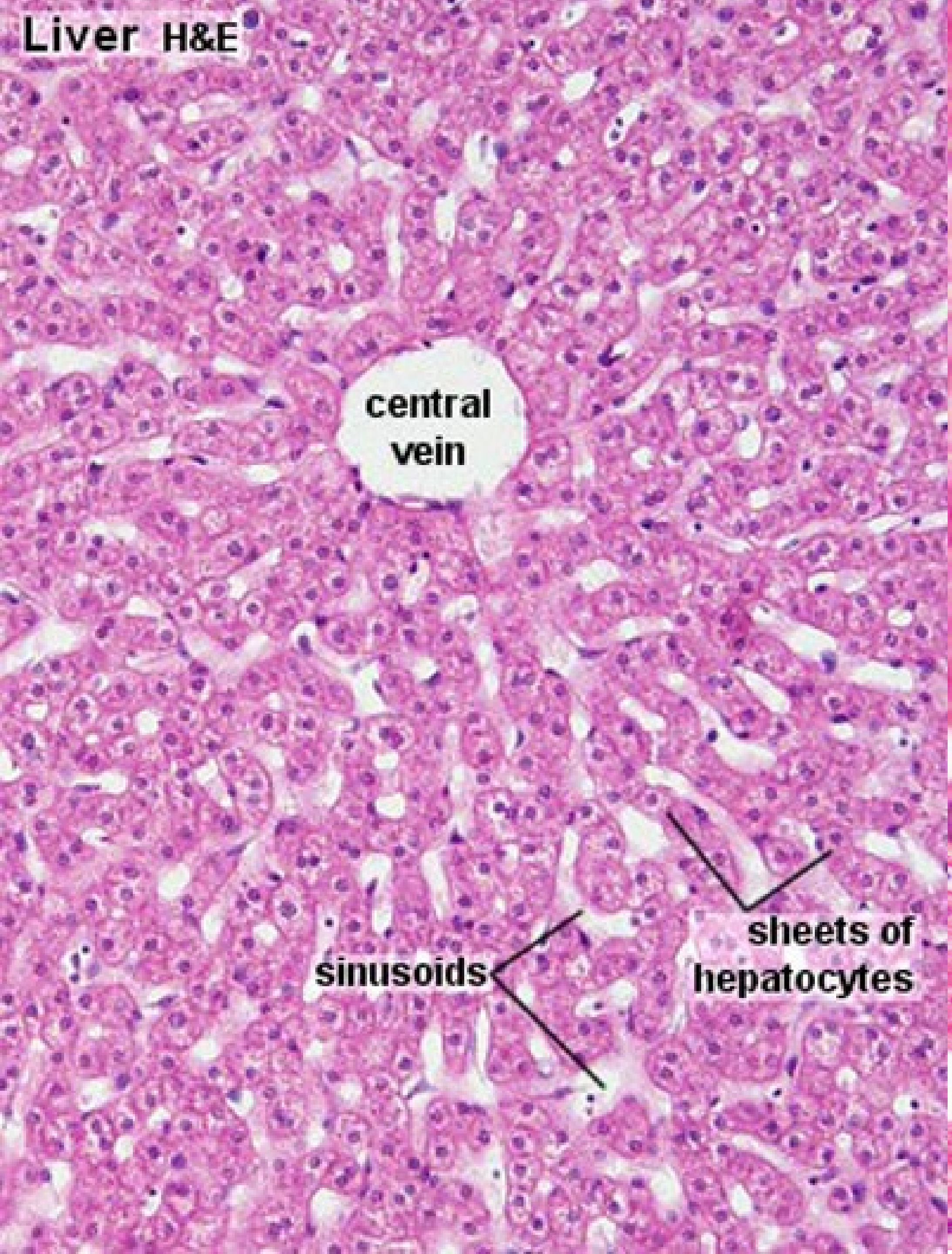


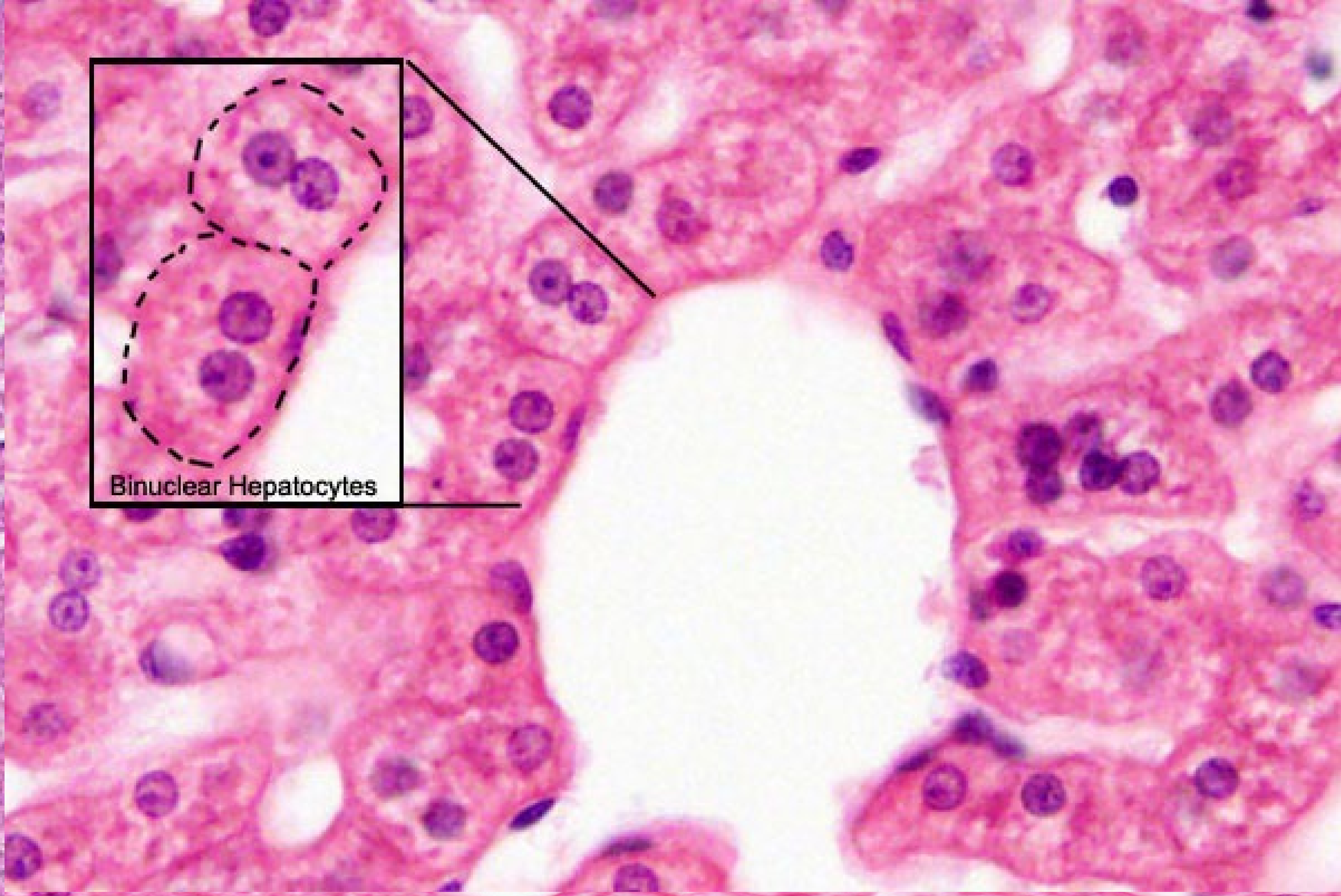


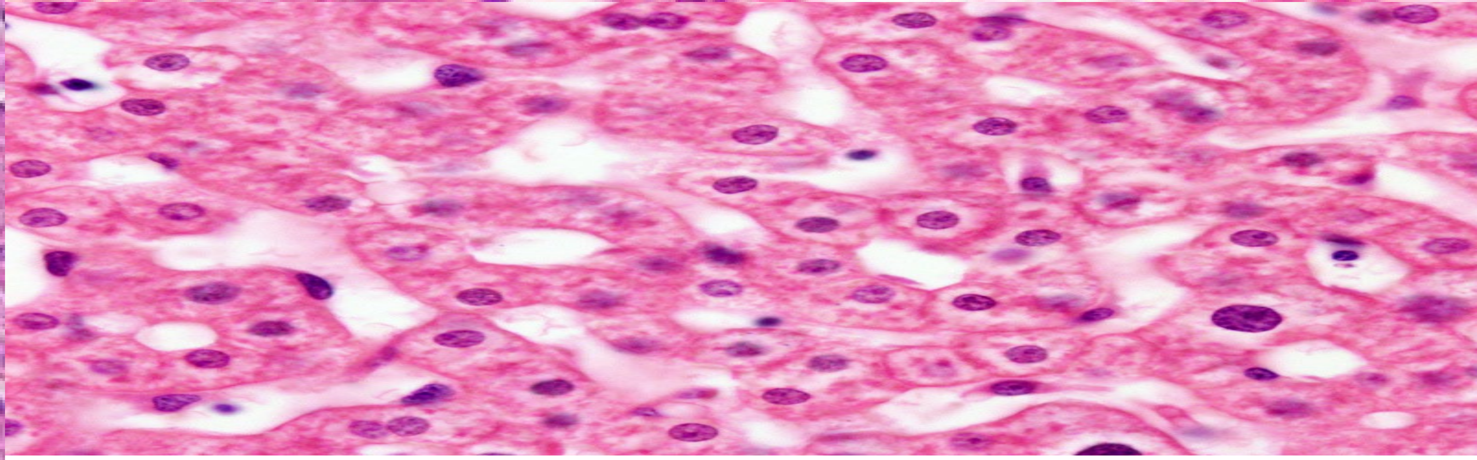

PORTAL TRIAD

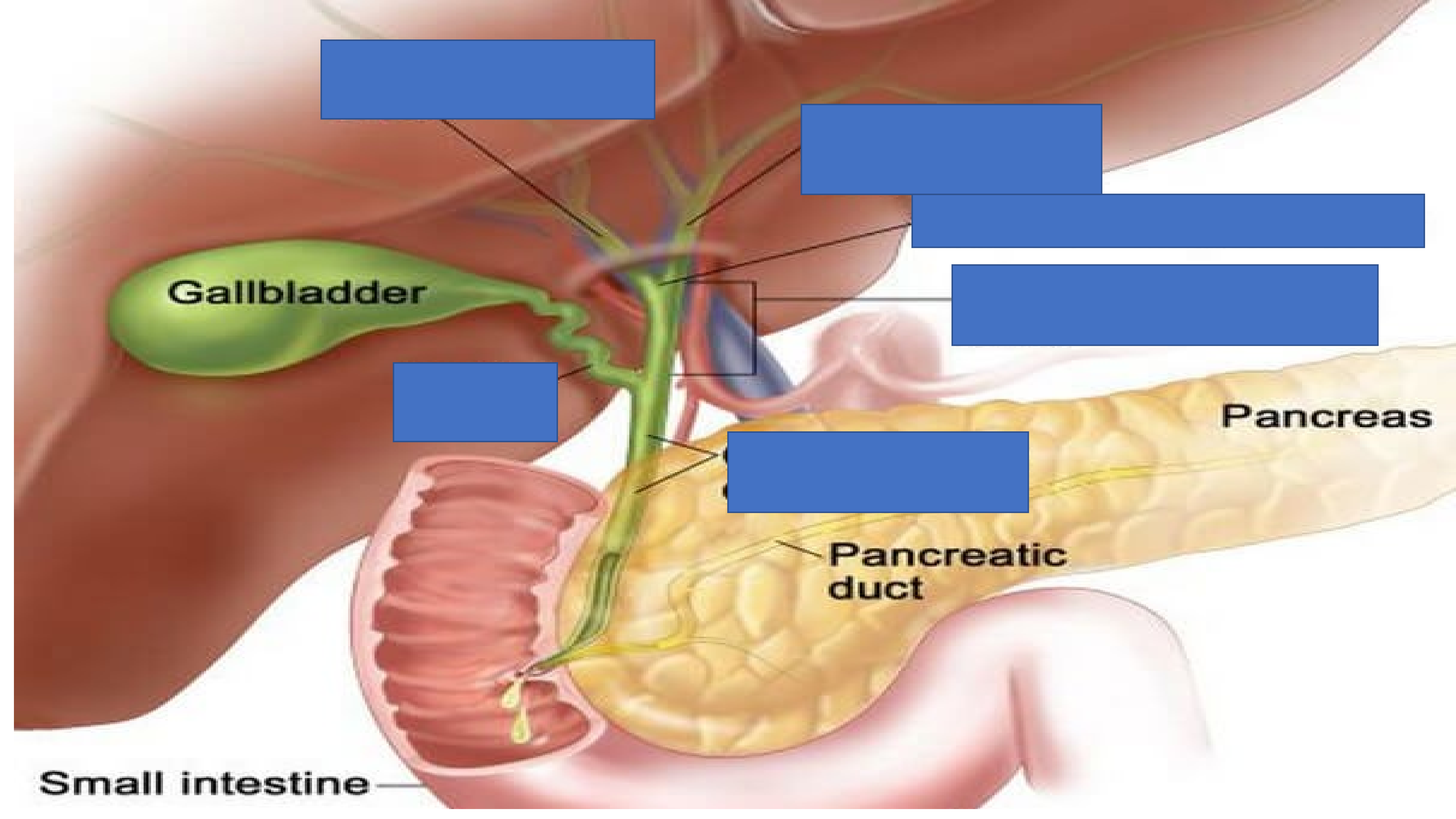

Portal Triad
interlobular
connective tissue
hepatocytes
branch of
portal vein
branch of
hepatic artery
branch of
bile duct
Liver H&E
UNSW Embryology

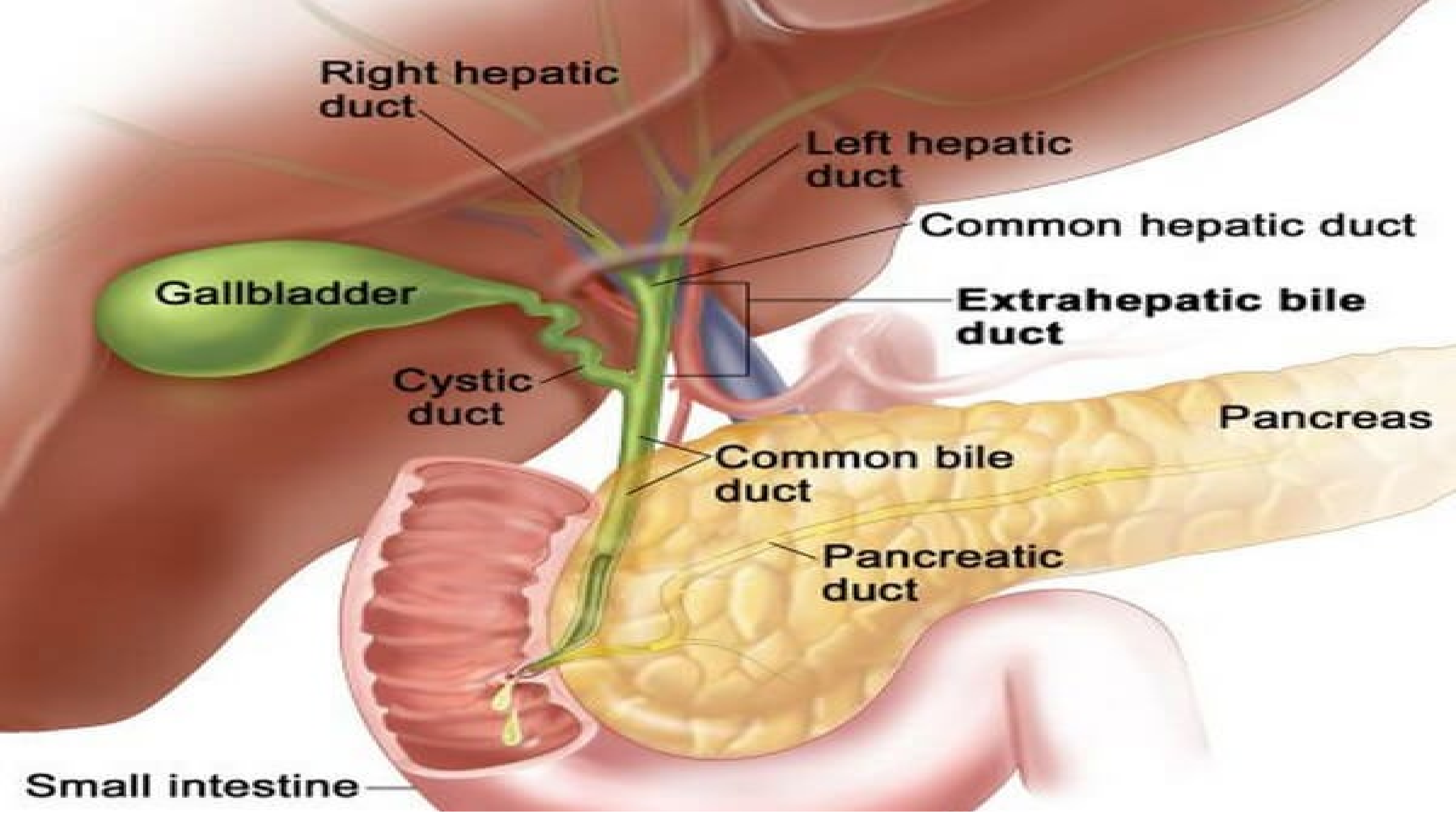

Liver H&E

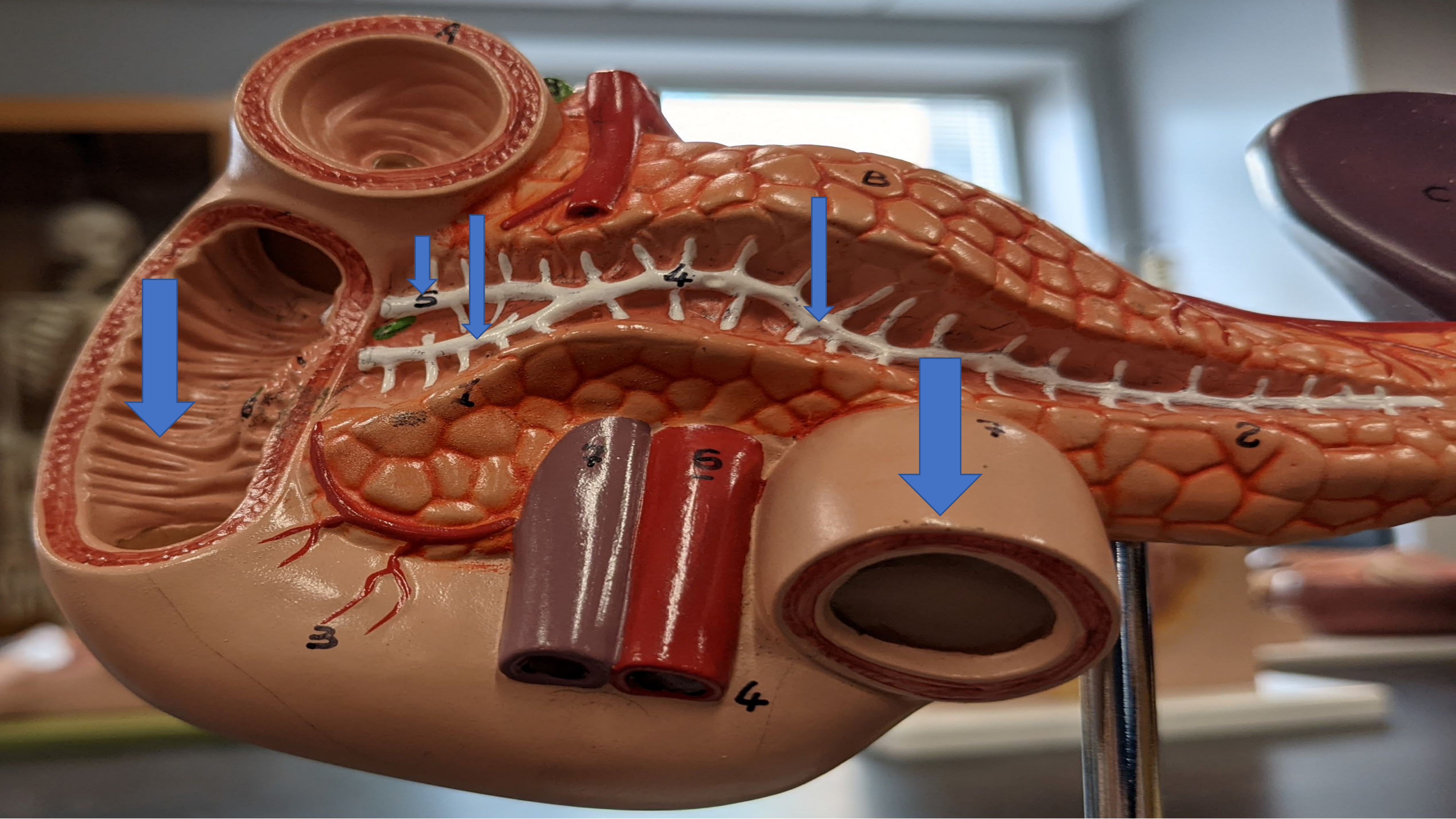

Liver H&E
central vein
sheets of hepatocytes
sinusoids

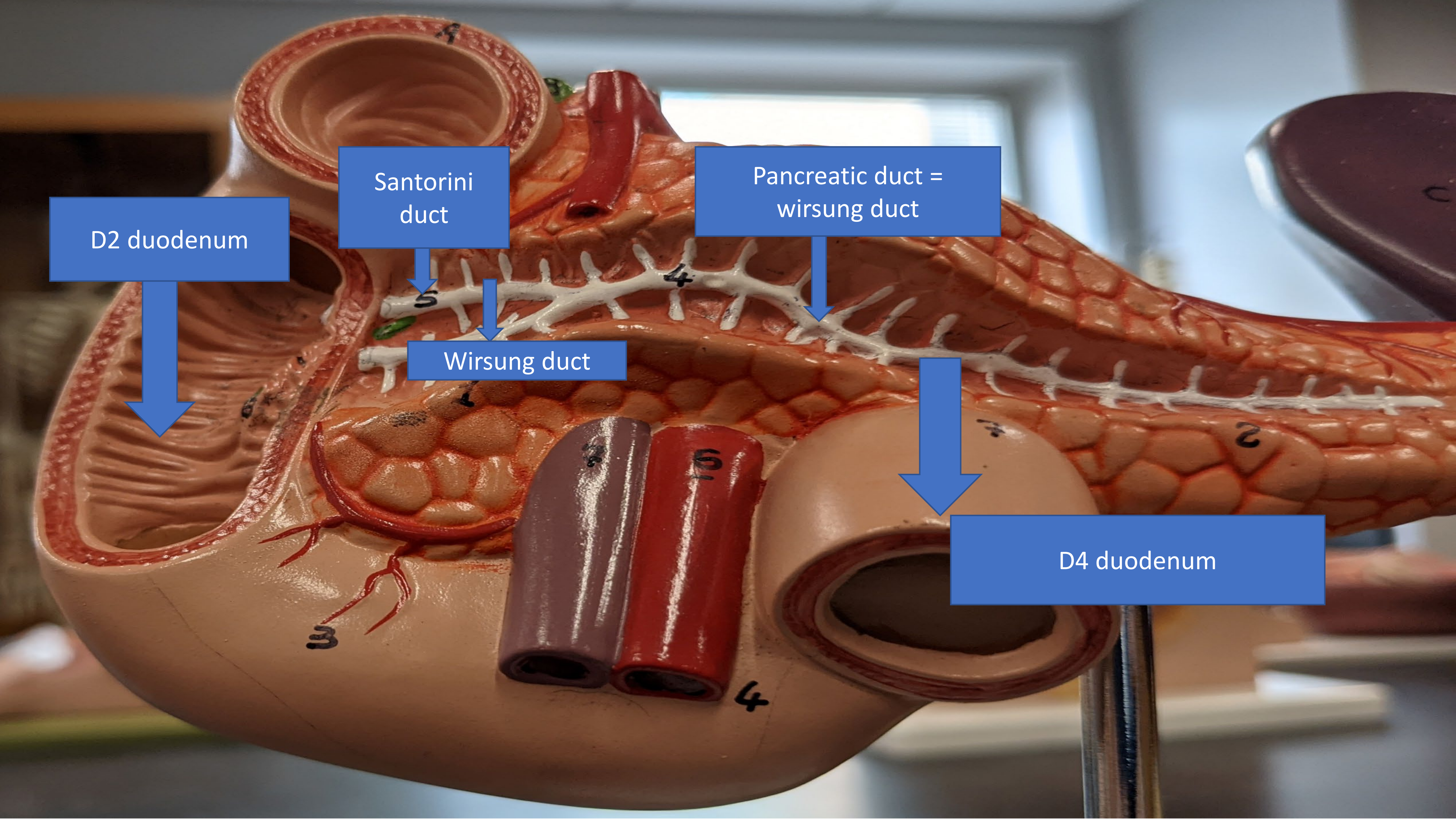

Binuclear Hepatocytes

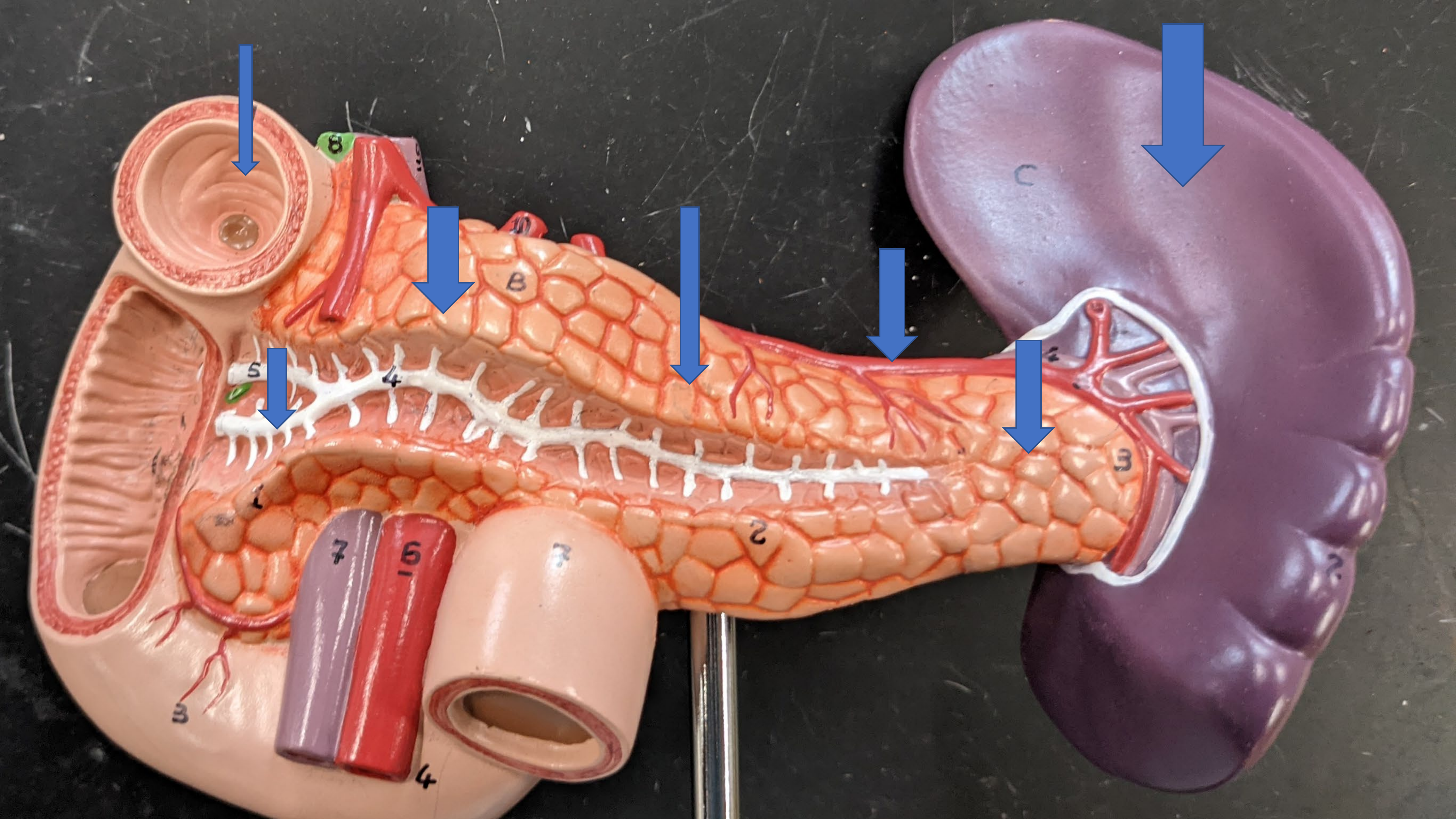


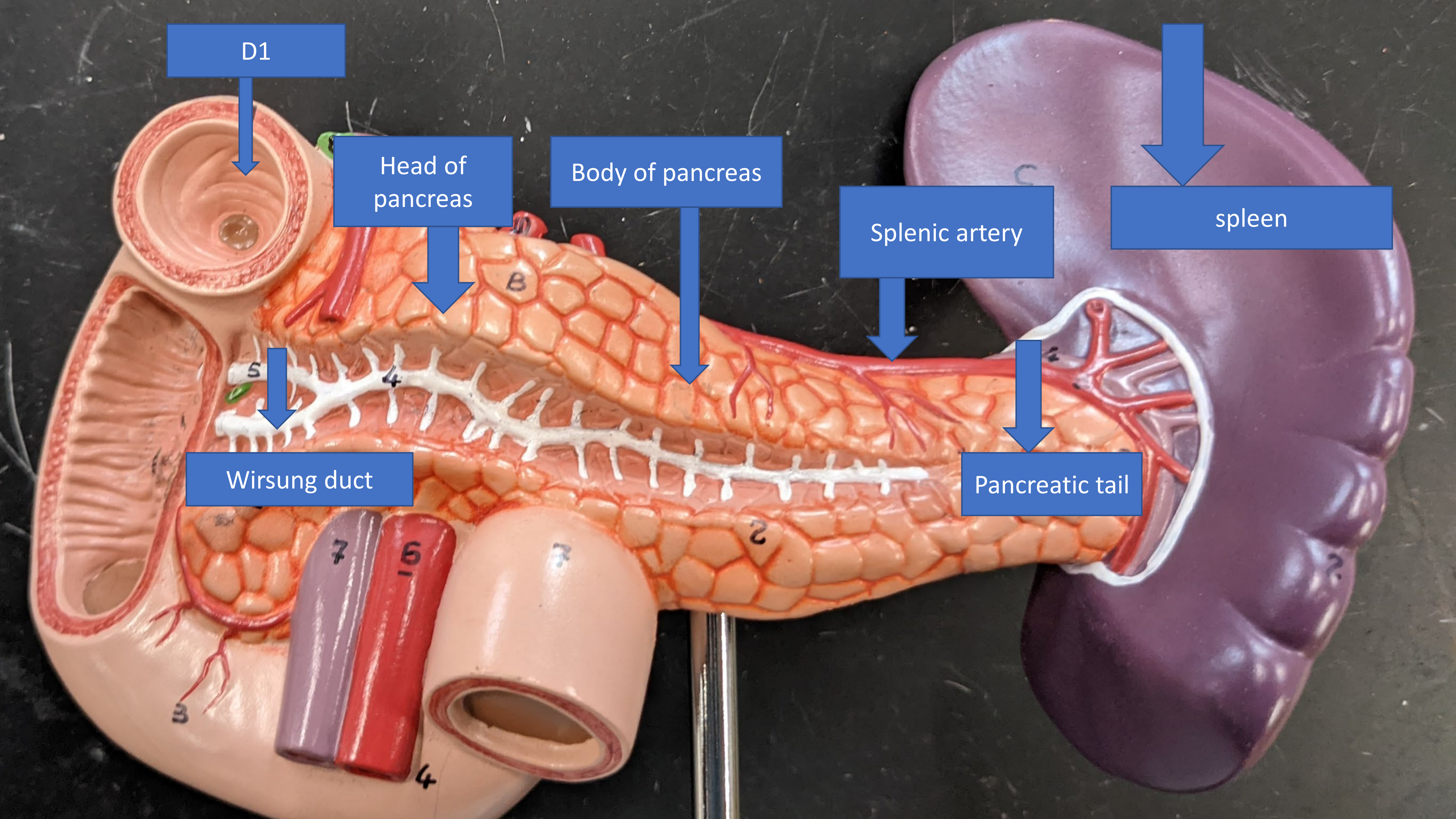

Gallbladder
Pancreas
Pancreatic duct
Small intestine

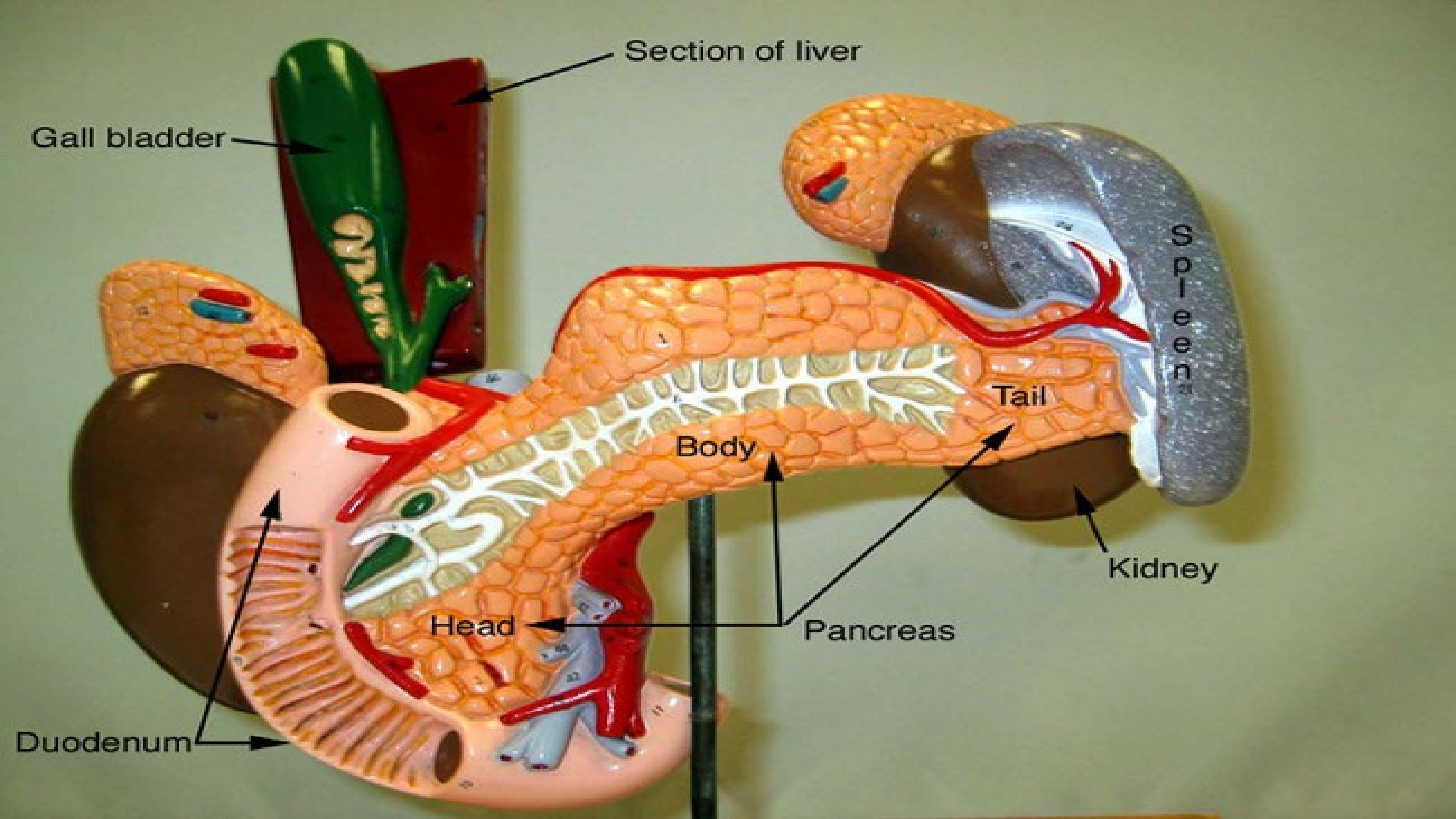

Right hepatic duct
Left hepatic duct
Common hepatic duct
Gallbladder
Extrahepatic bile duct
Cystic duct
Pancreas
Common bile duct
Pancreatic duct
Small intestine


A
B
C
4
5
1
2
3
5
4

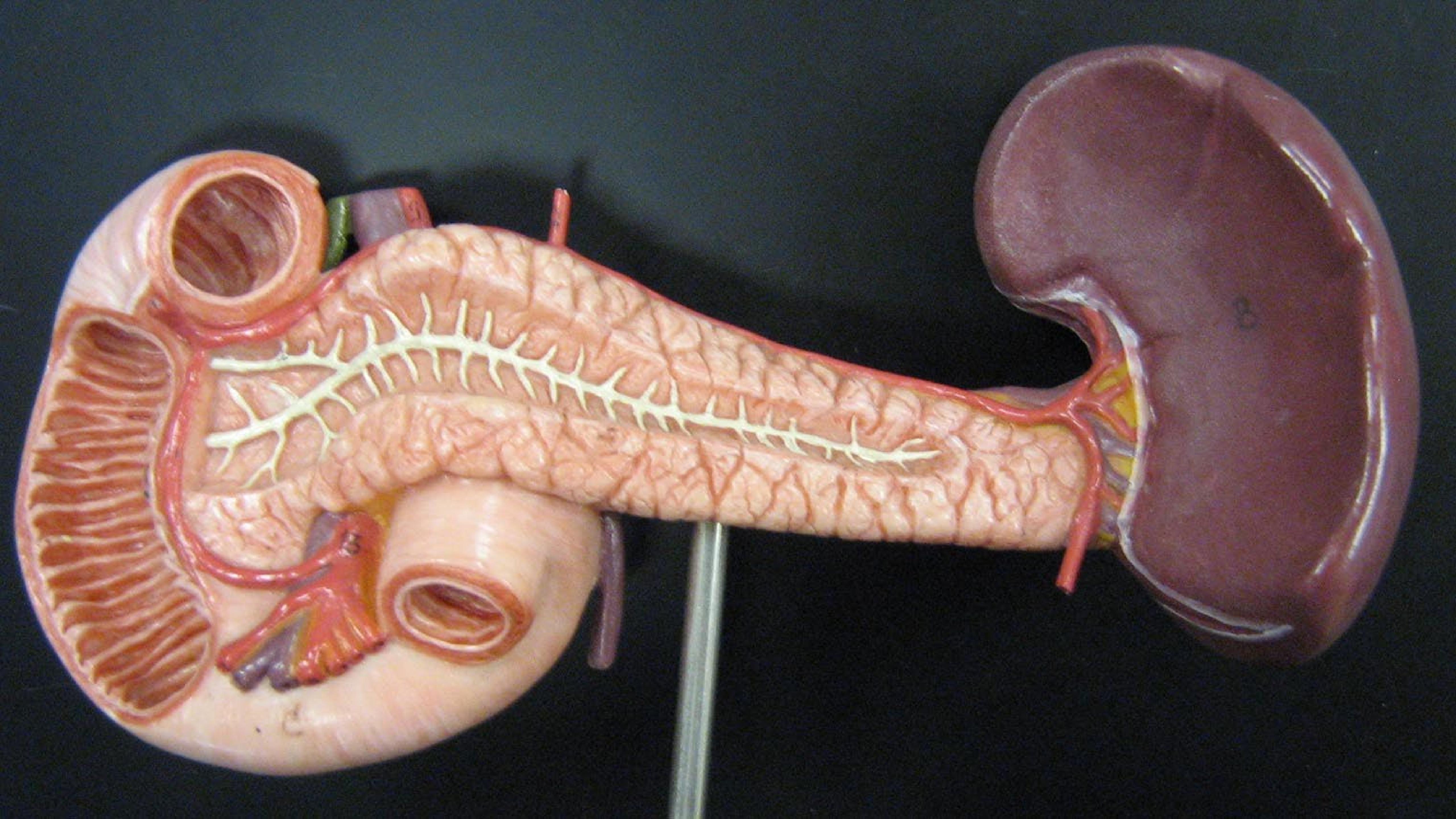

D2 duodenum
Santorini duct
Pancreatic duct = wirsung duct
Wirsung duct
D4 duodenum

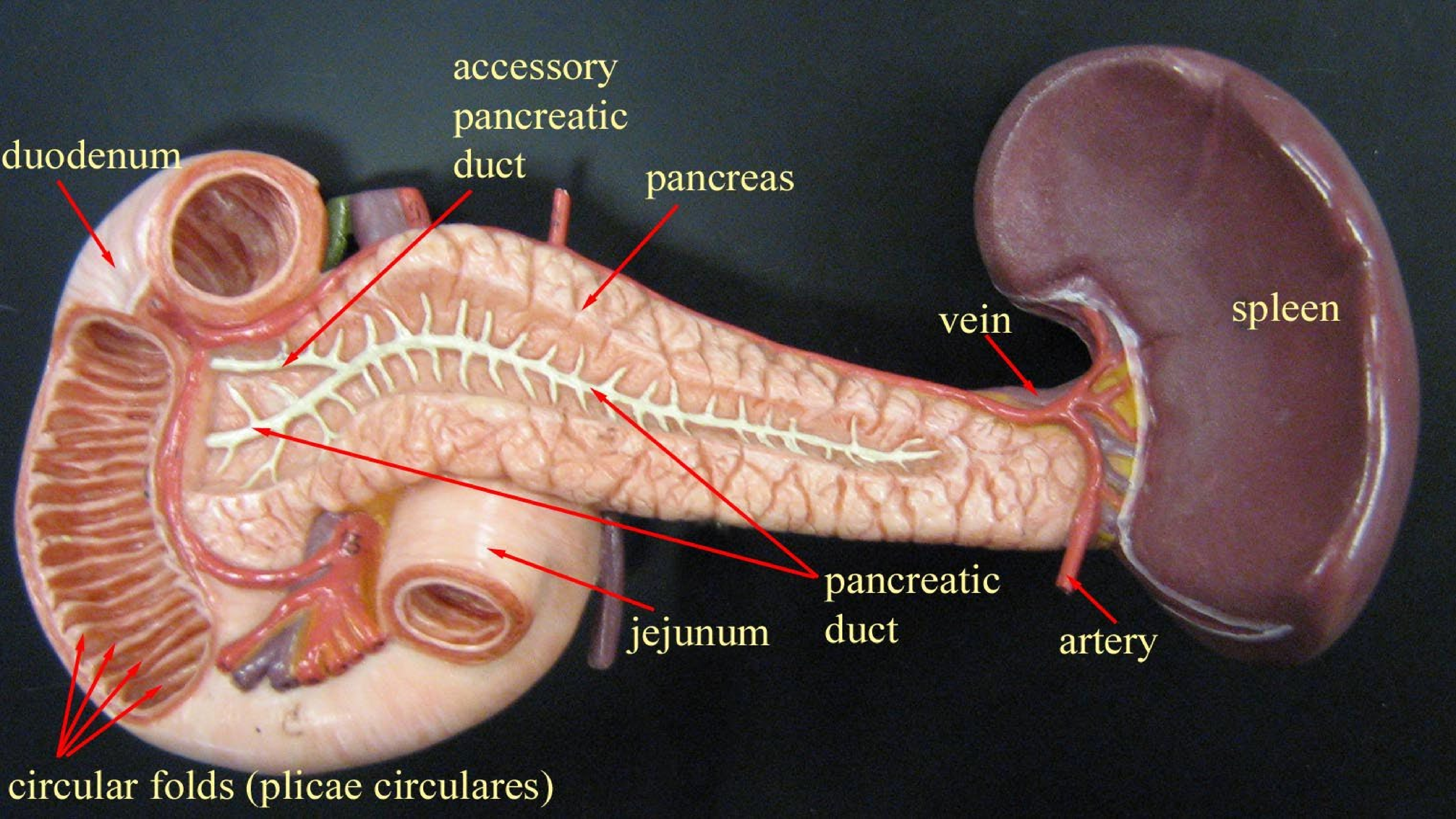

8
B
C
5
4
7
6
7
2
3
3
4

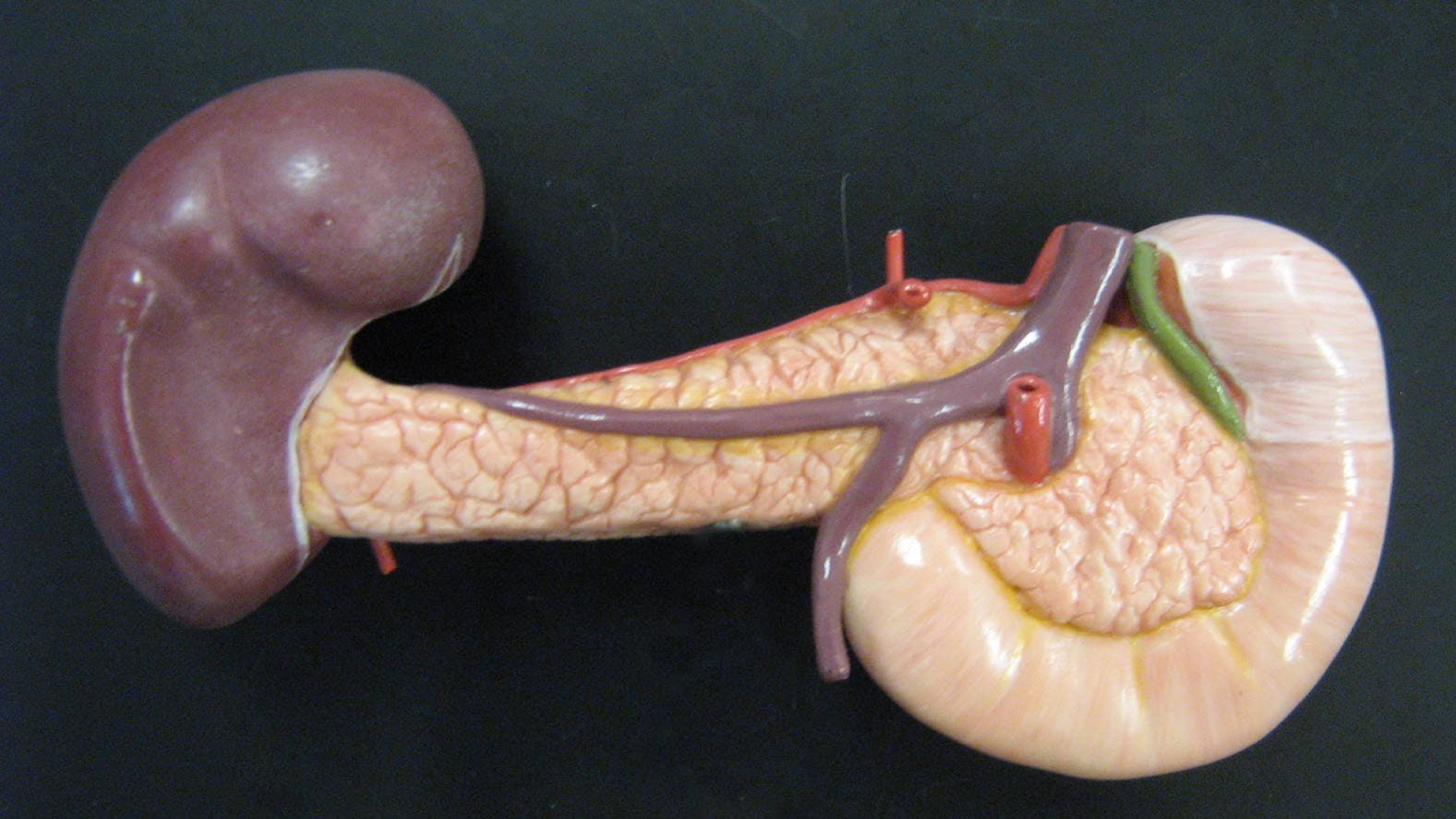

D1
Head of pancreas
Body of pancreas
Splenic artery
spleen
Wirsung duct
Pancreatic tail

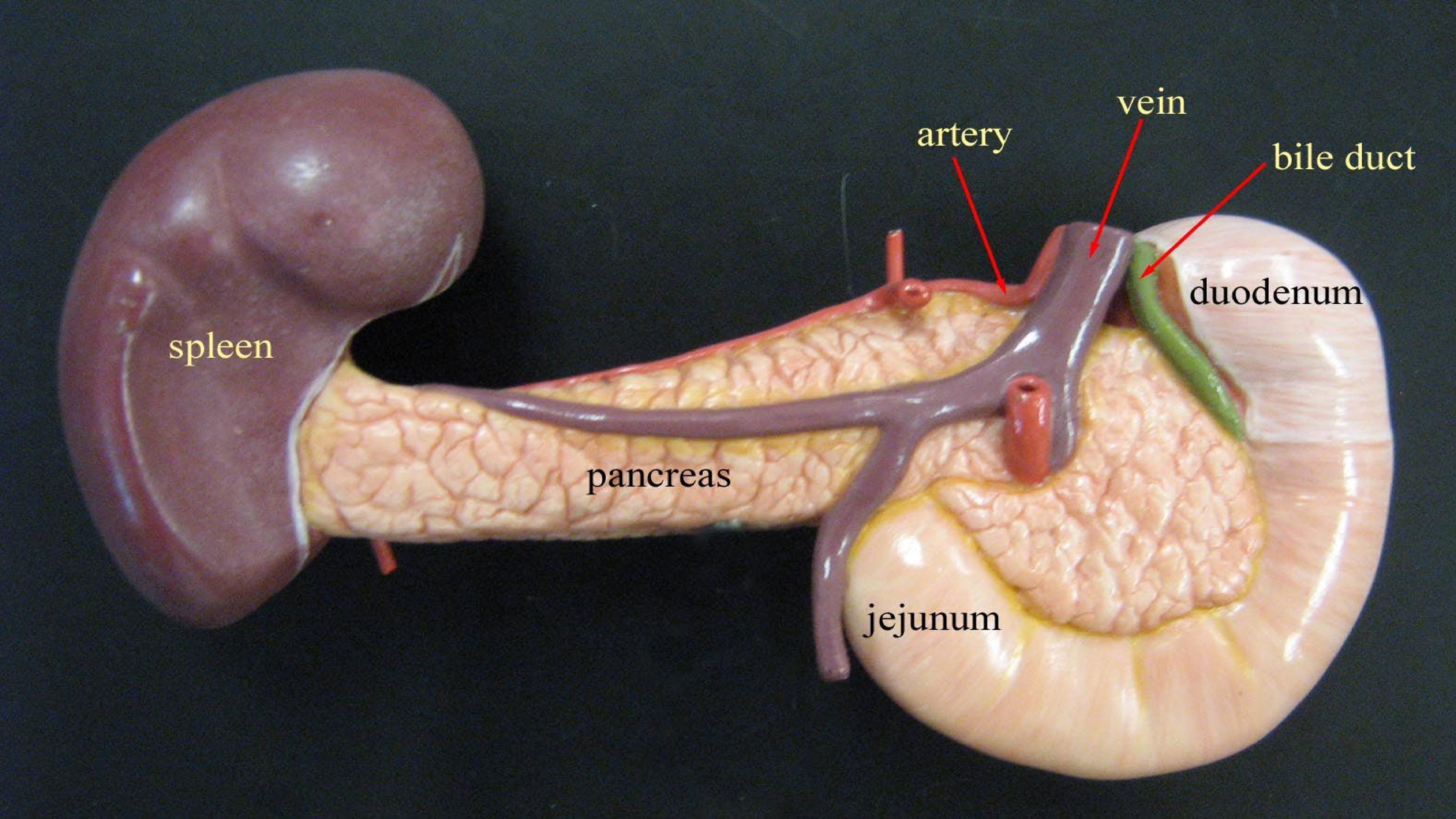


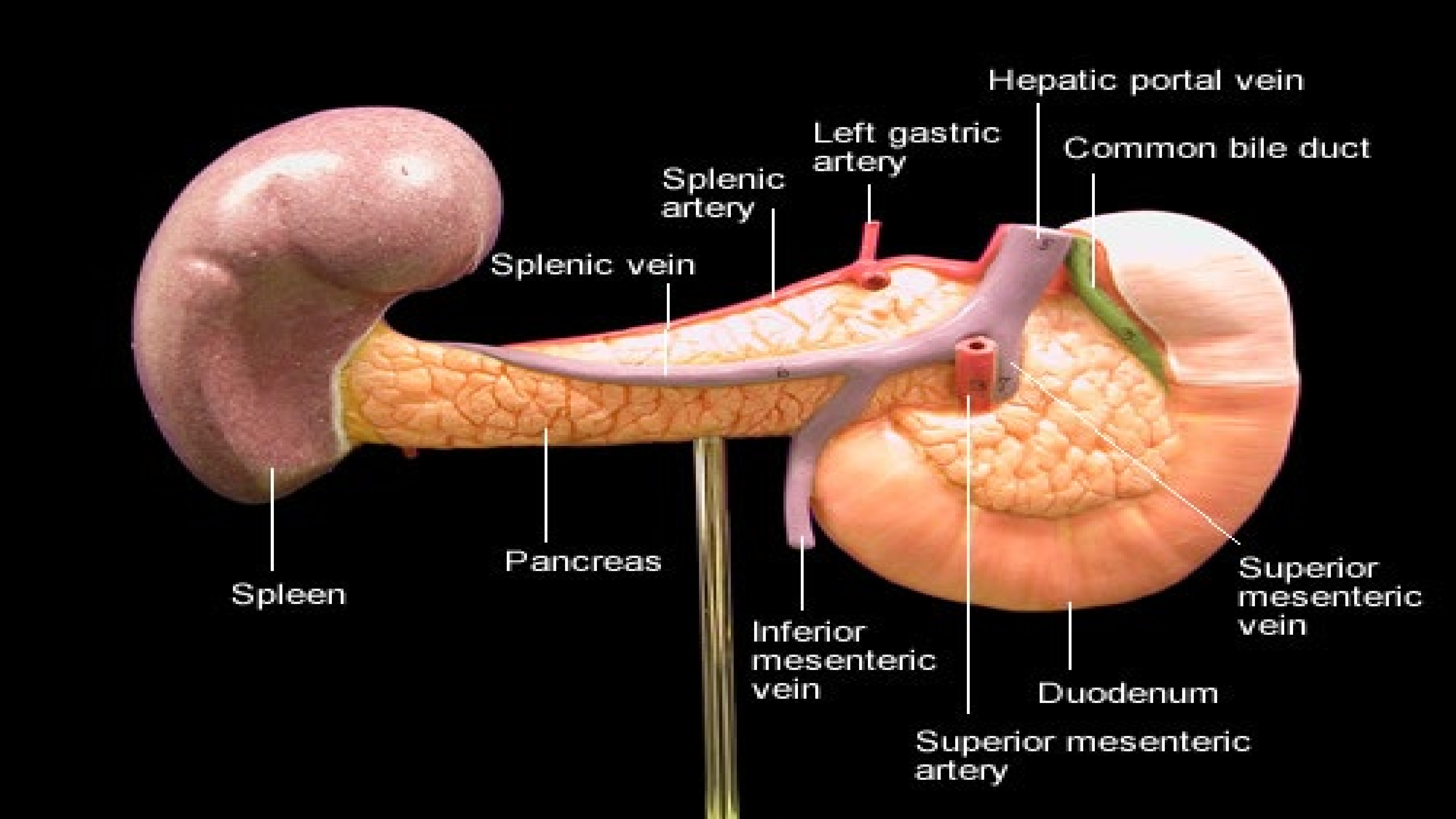
Section of liver
Gall bladder
Spleen
Tail
Body
Kidney
Head
Pancreas
Duodenum

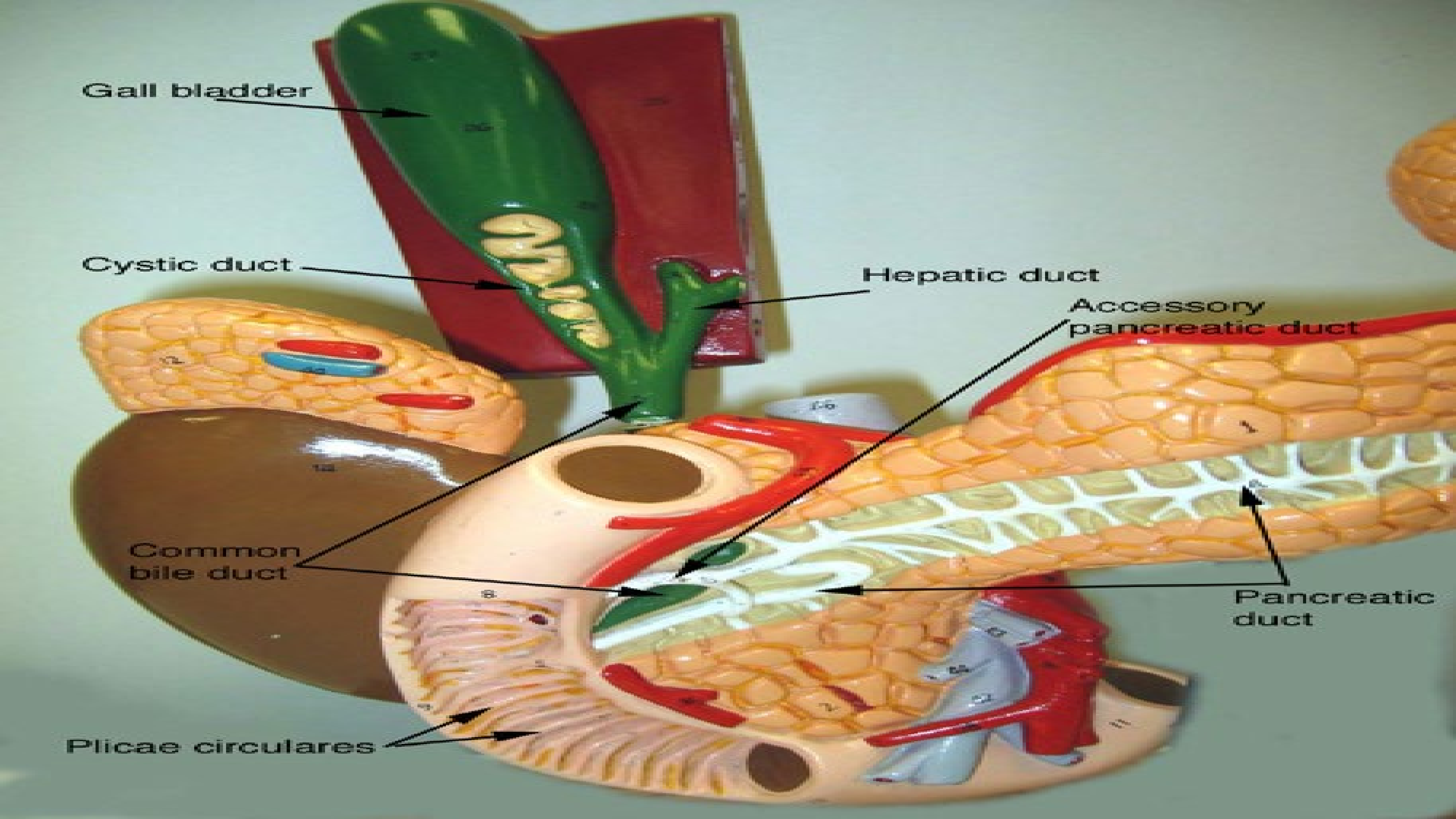



accessory pancreatic duct
duodenum
pancreas
spleen
vein
pancreatic duct
jejunum
artery
circular folds (plicae circulares)

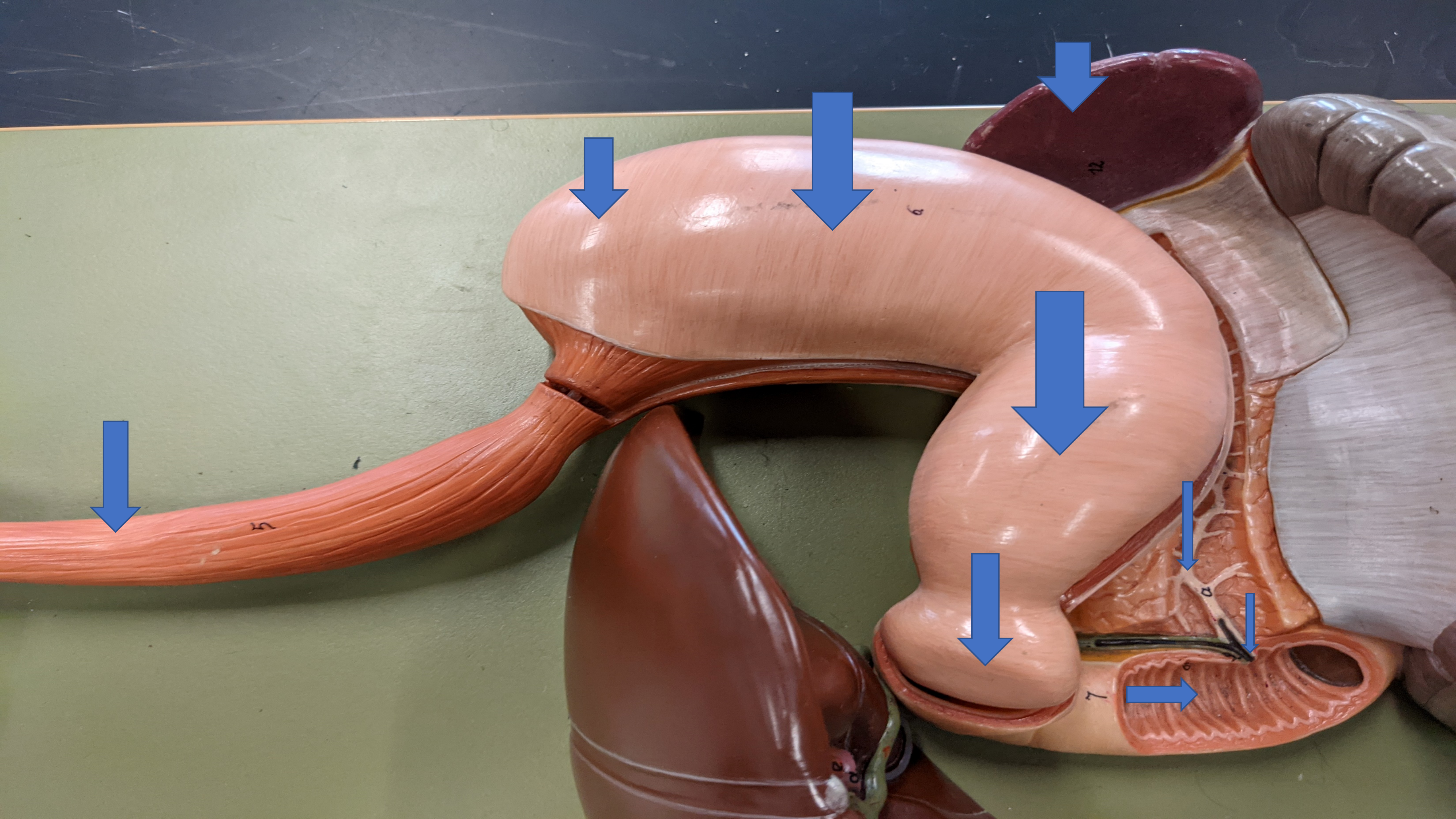


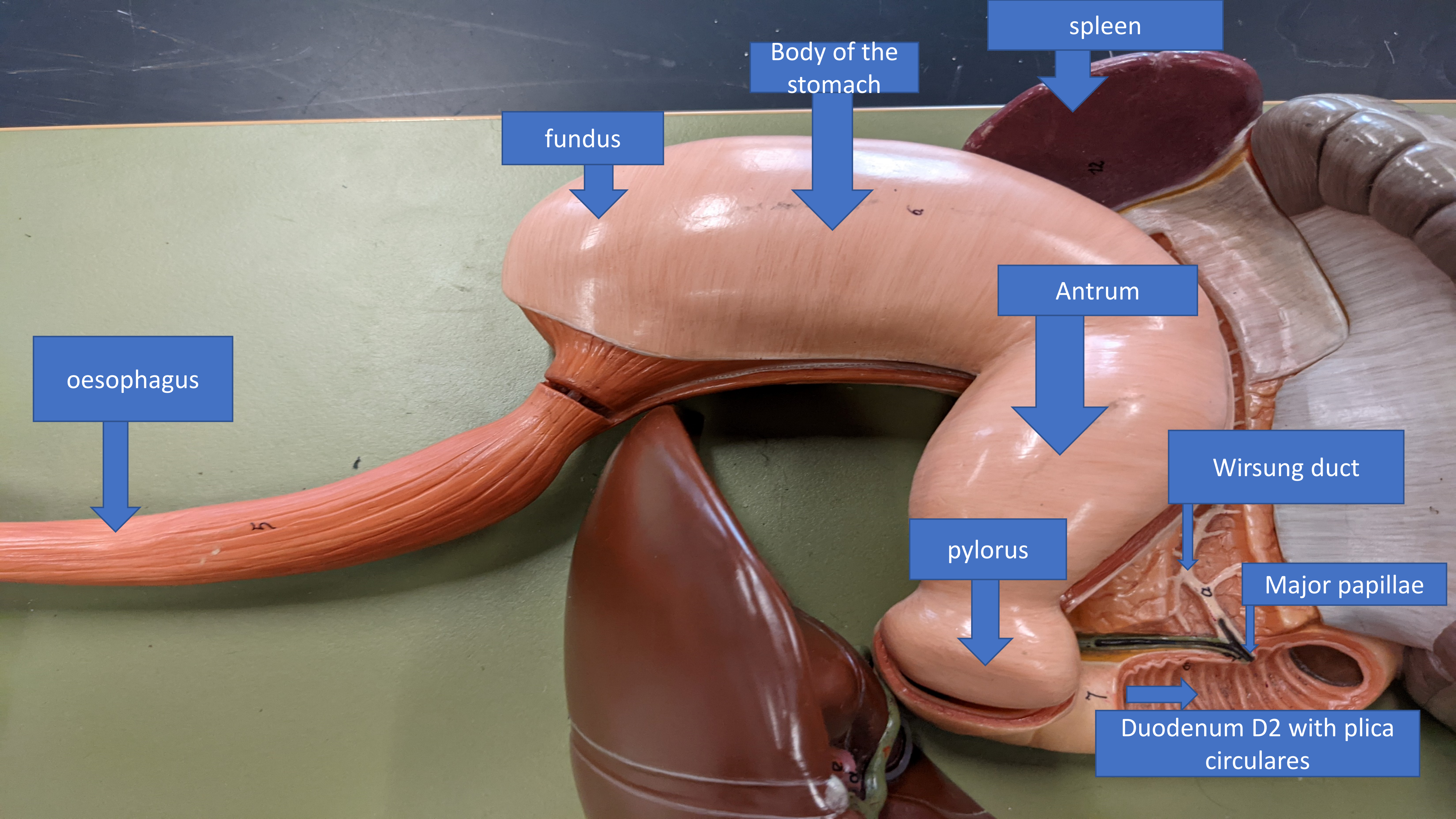

vein
artery
bile duct
duodenum
spleen
pancreas
jejunum

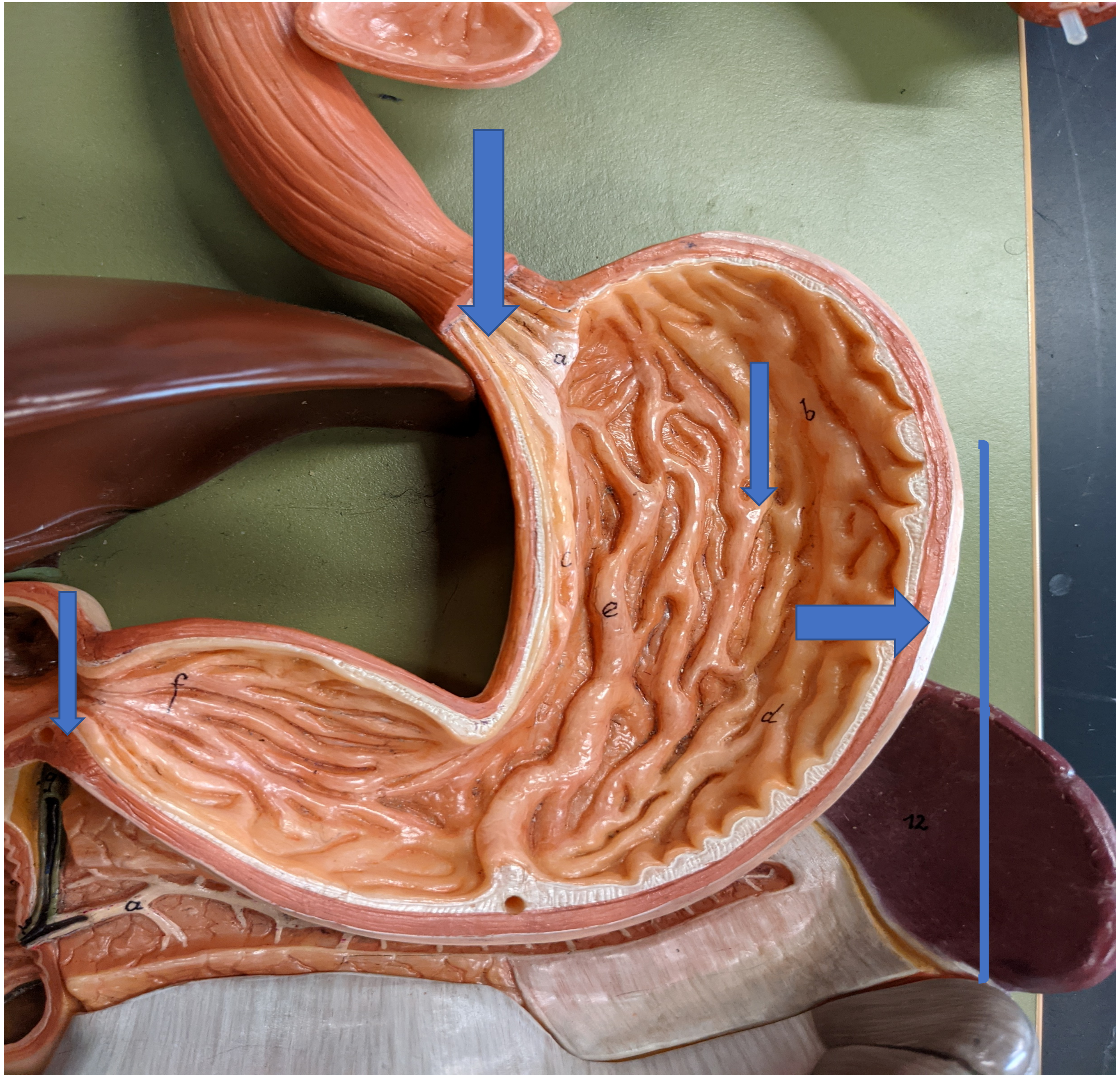

Hepatic portal vein
Left gastric
artery
Common bile duct
Splenic
artery
Splenic vein
Spleen
Pancreas
Inferior
mesenteric
vein
Superior mesenteric
artery
Duodenum
Superior
mesenteric
vein

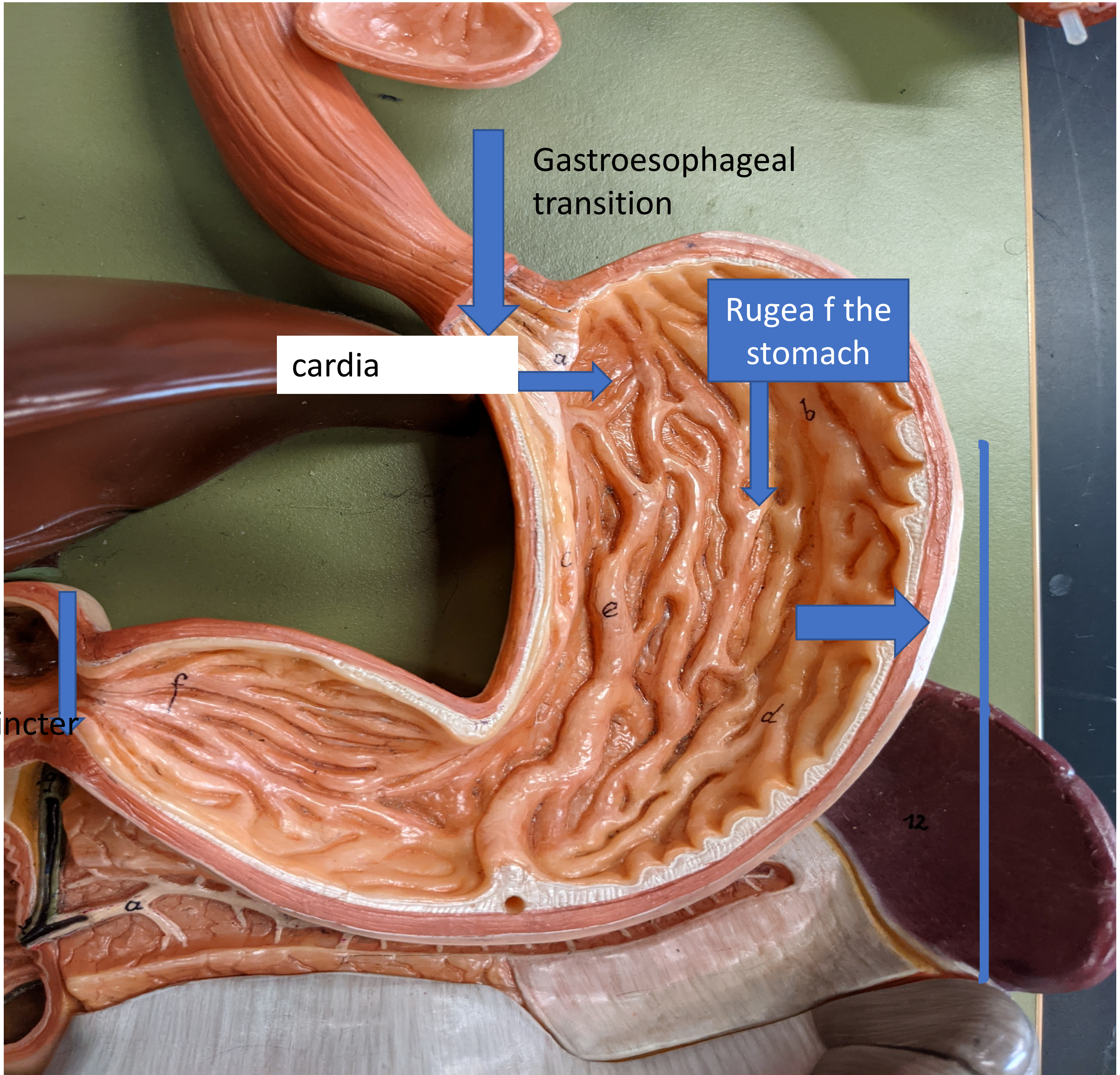


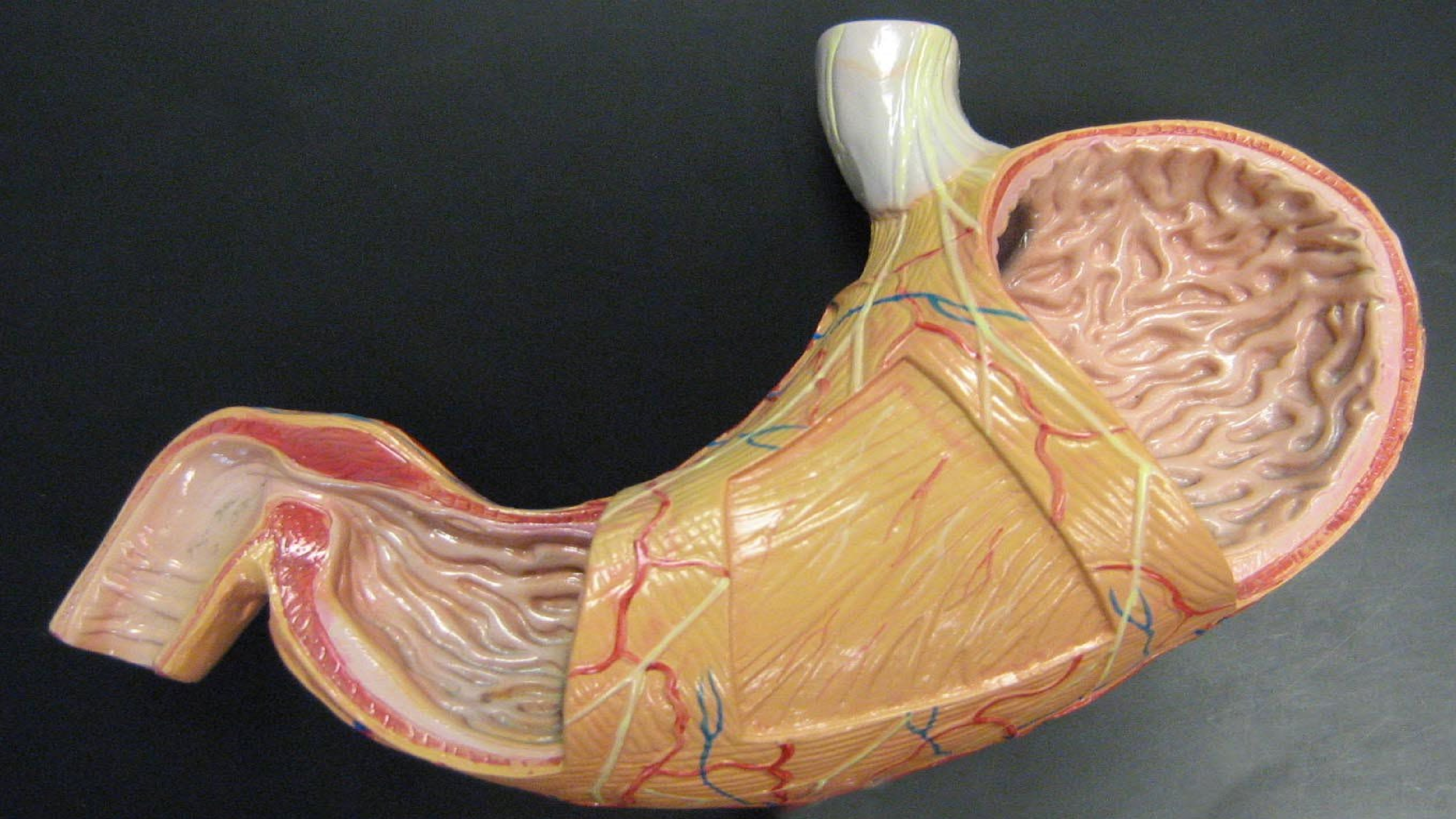
Gall bladder
Cystic duct
Hepatic duct
Accessory pancreatic duct
Common bile duct
Pancreatic duct
Plicae circulares

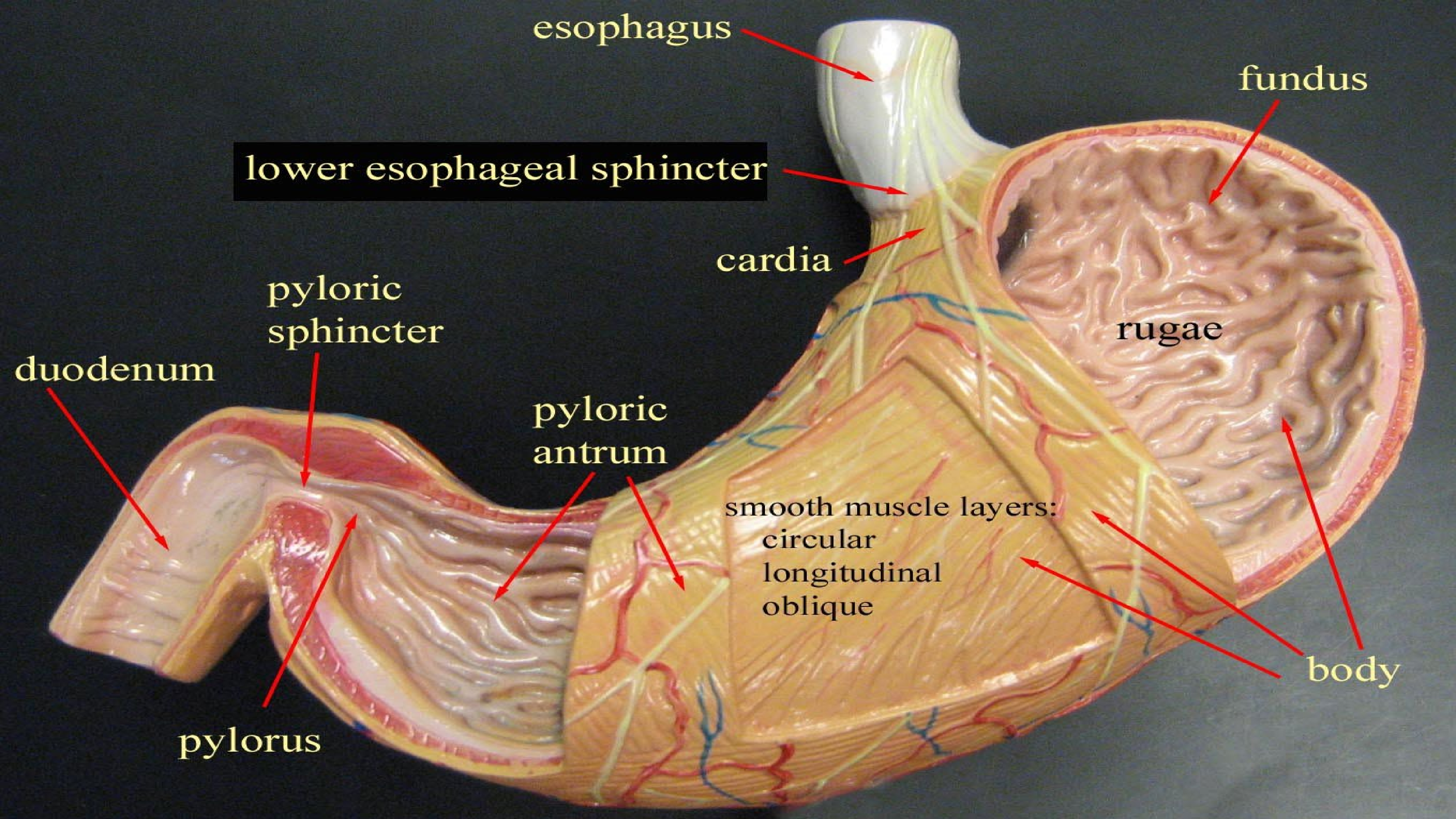



spleen
Body of the stomach
fundus
oesophagus
Antrum
Wirsung duct
pylorus
Major papillae
Duodenum D2 with plica circulares

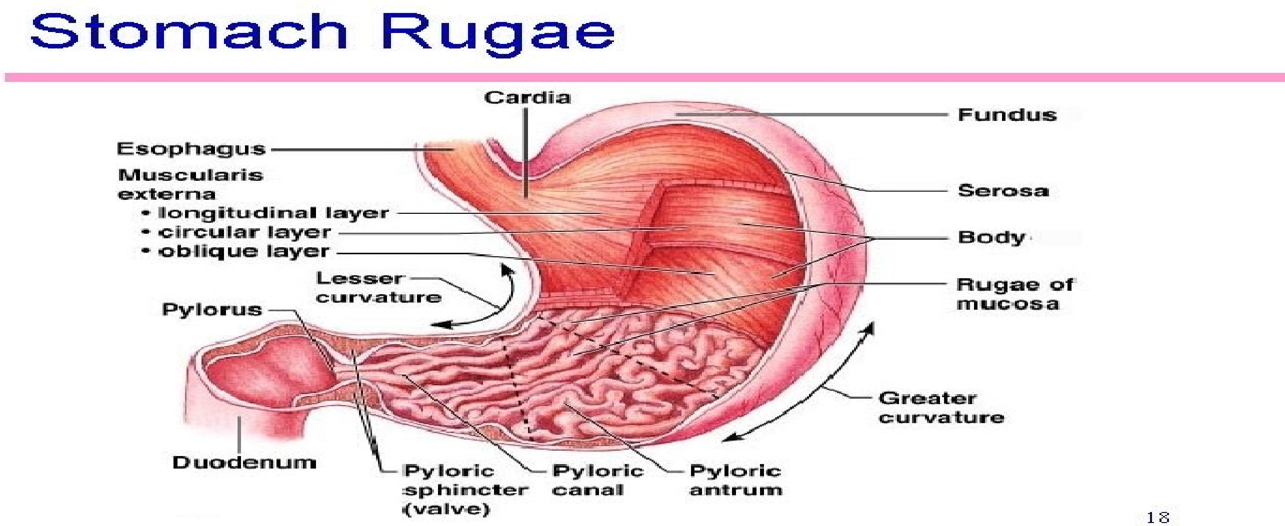

a
b
c
e
d
f
12
a

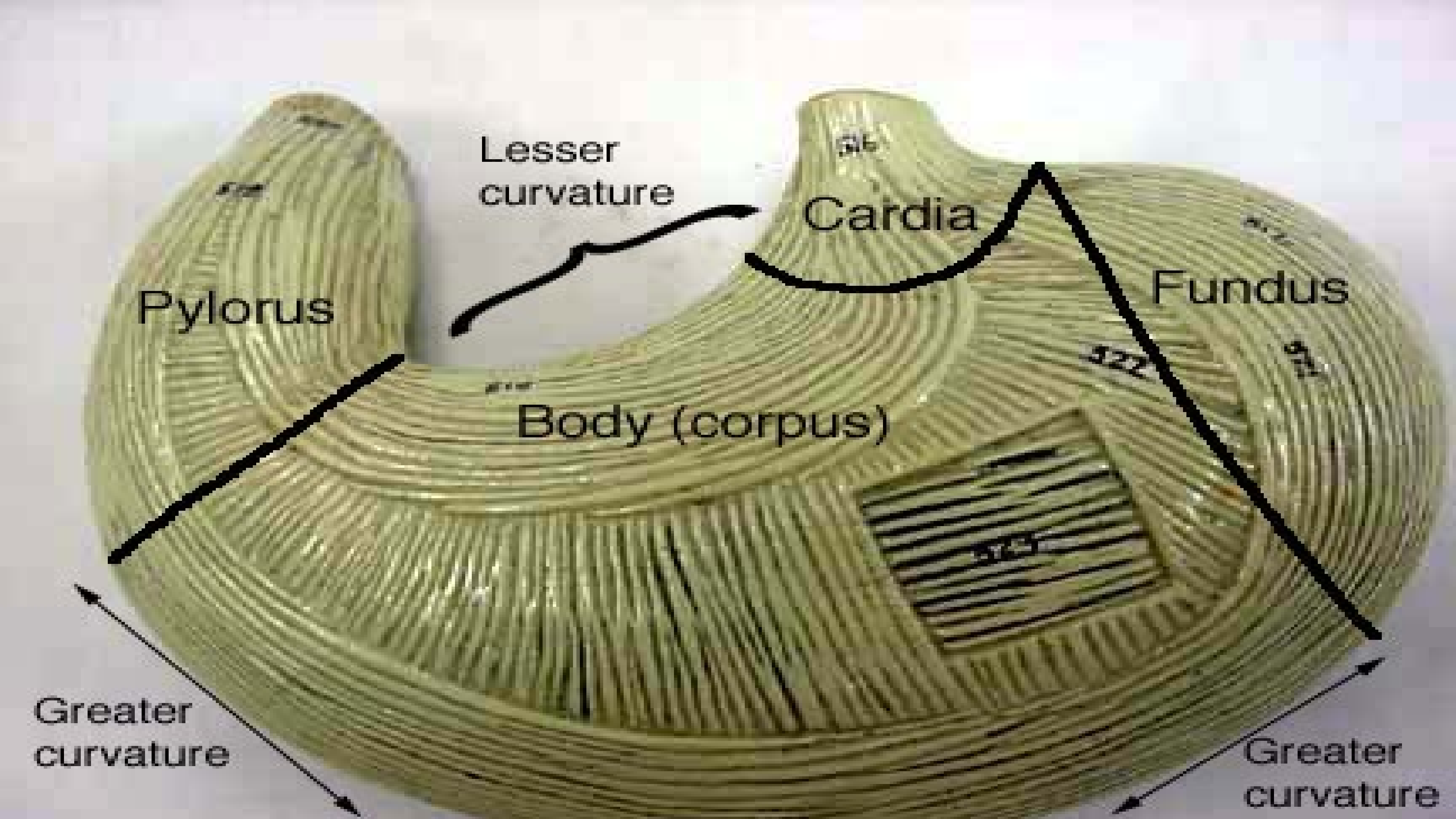

Gastroesophageal transition
cardia
Rugea f the stomach
Pylorus sphincter
Great curb of stomach



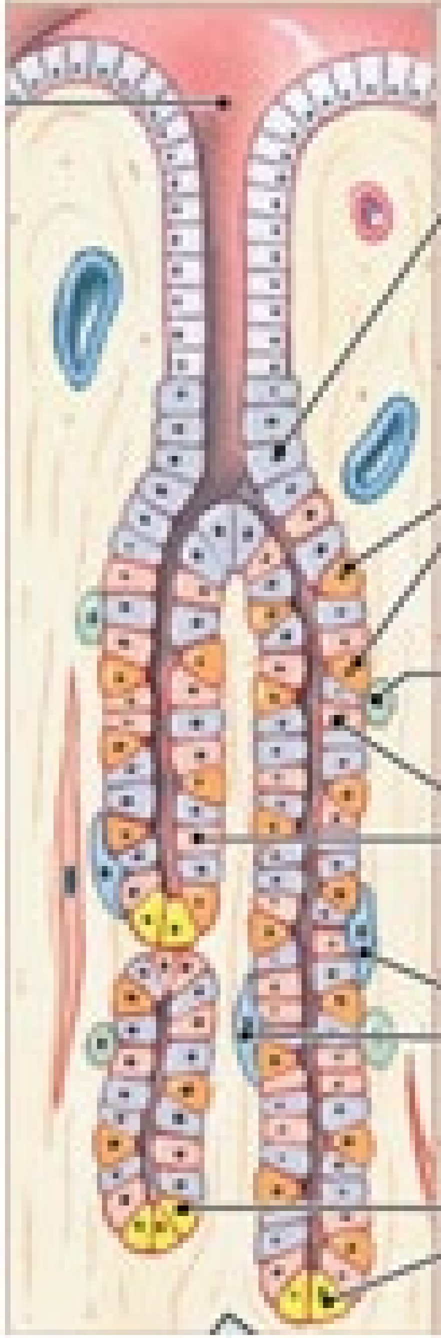

esophagus
fundus
lower esophageal sphincter
cardia
pyloric
sphincter
duodenum
rugae
pyloric
antrum
smooth muscle layers:
circular
longitudinal
oblique
body
pylorus

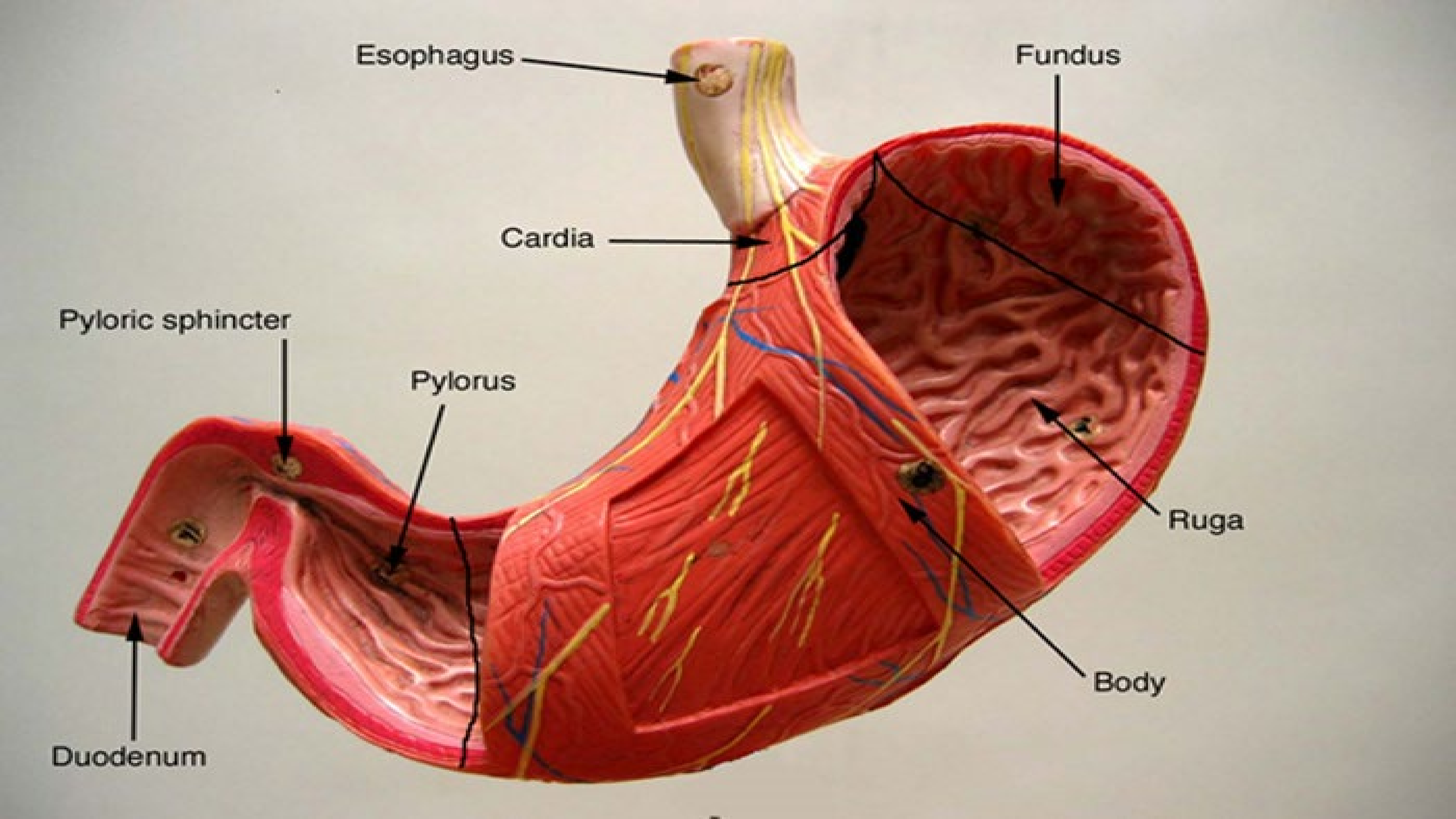
Stomach rugae

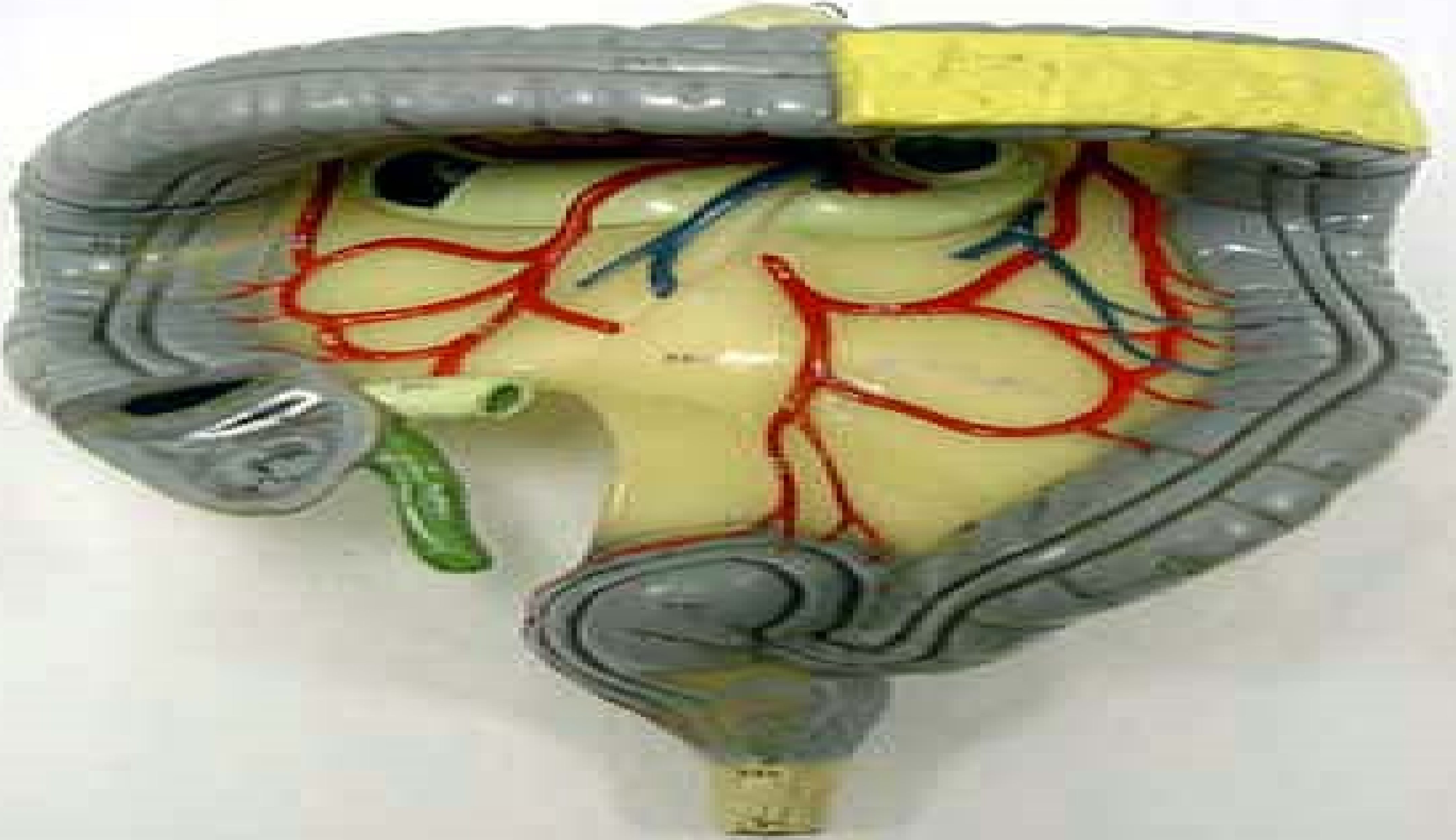


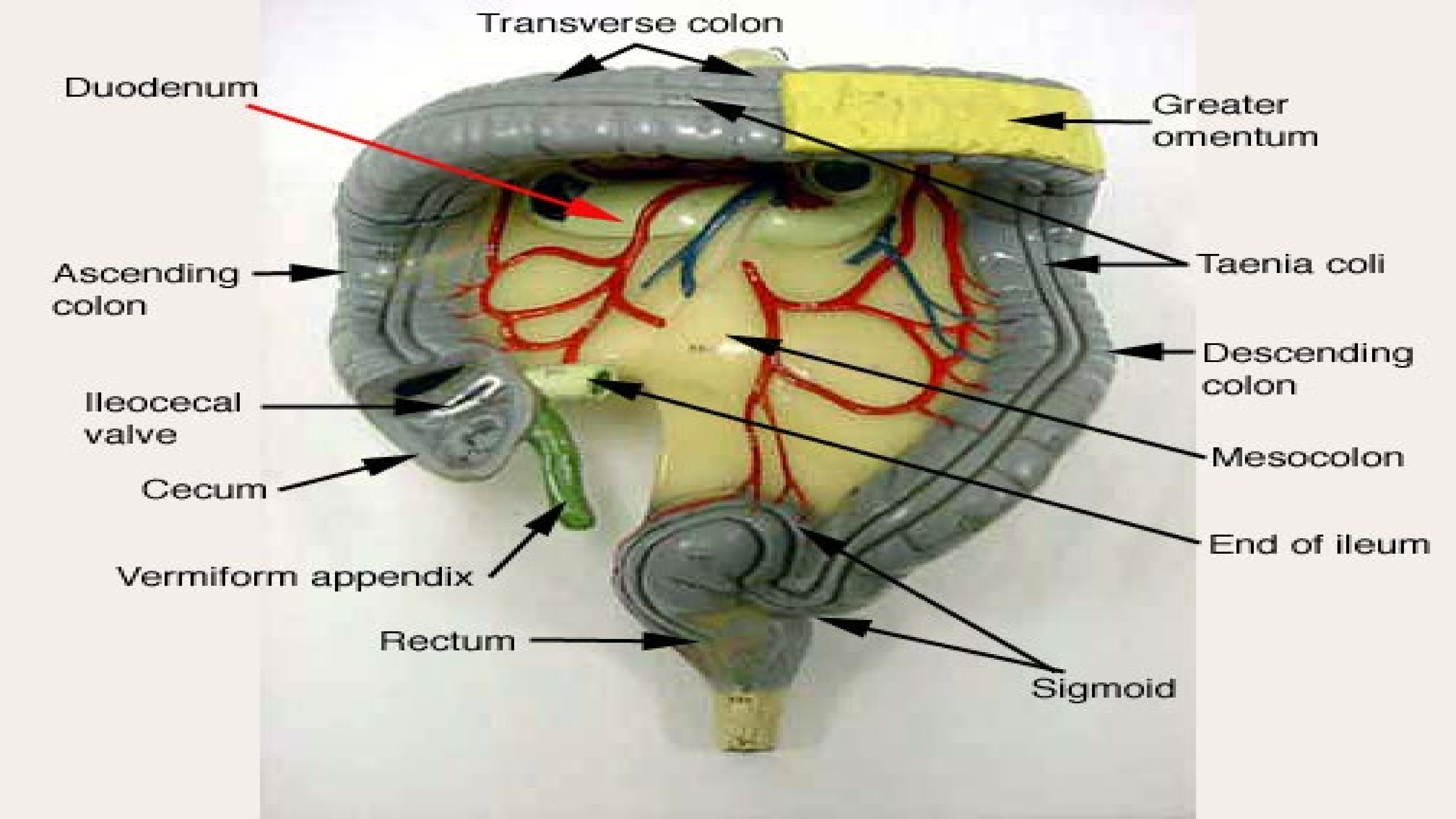


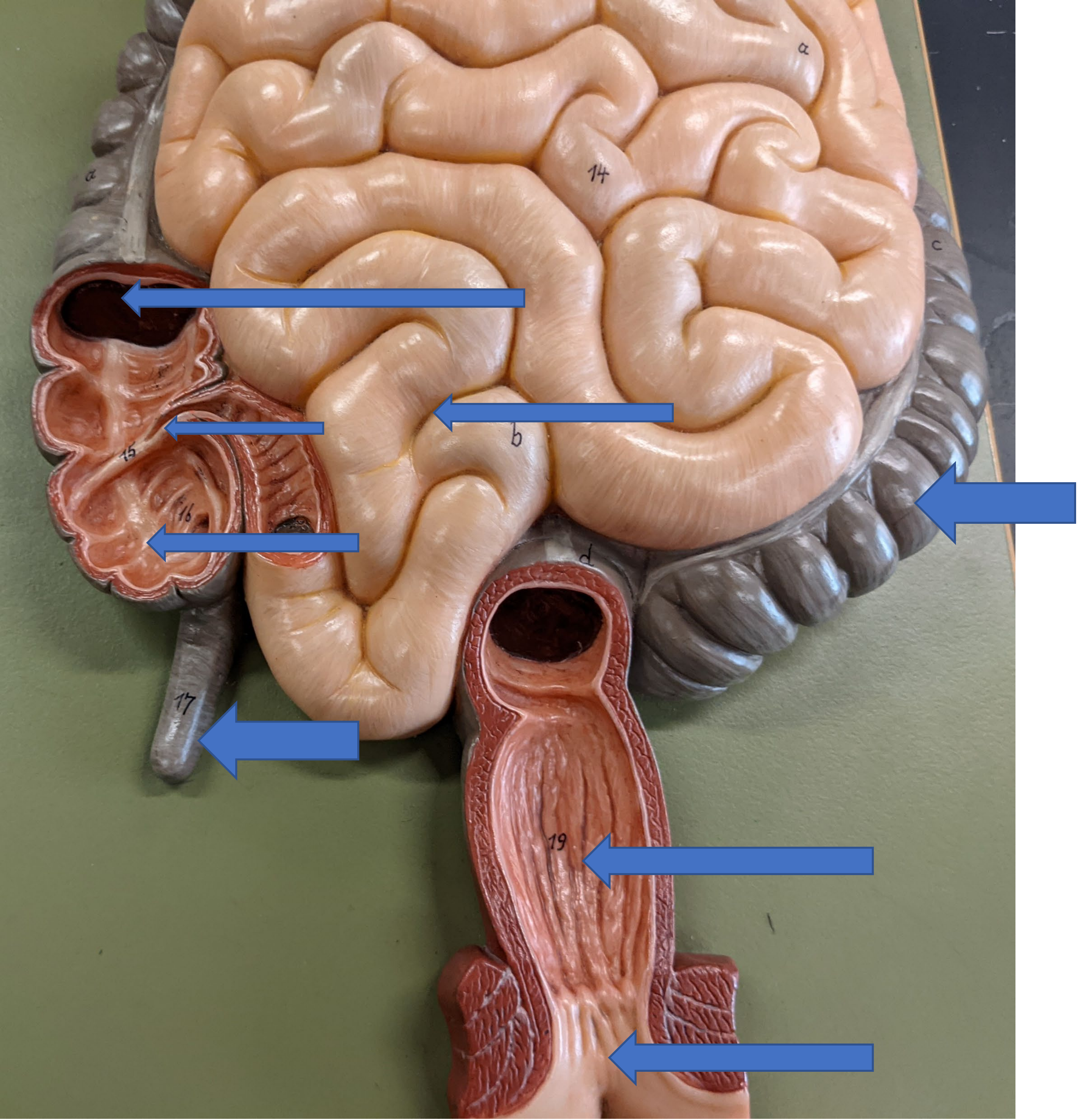
Lesser curvature
Cardia
Fundus
Pylorus
Body (corpus)
Greater curvature
Greater curvature

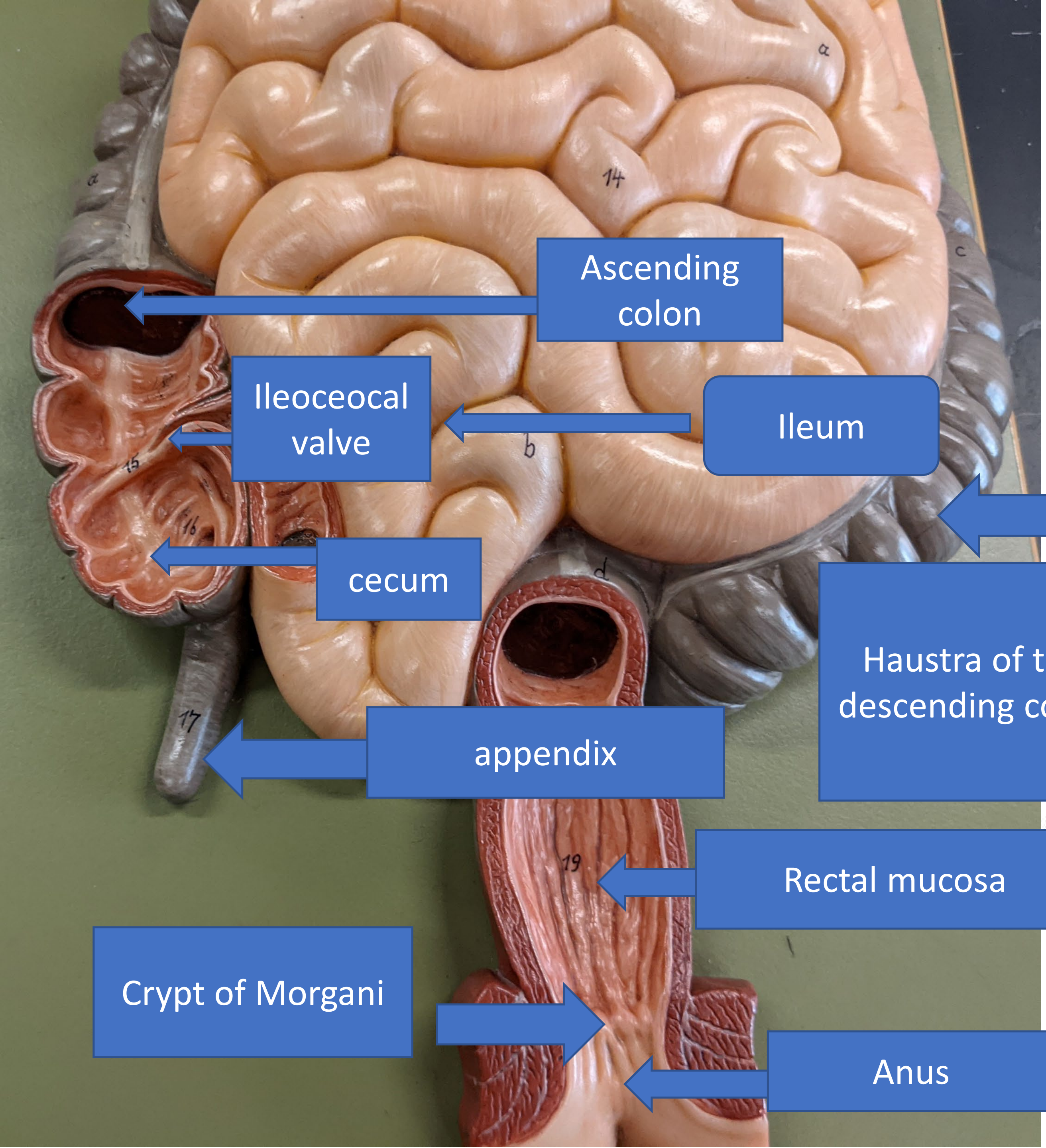
GASTRIC MUCOSA	CELL TYPES	SUBSTANCE SECRETED	STIMULUS FOR RELEASE	FUNCTION OF SECRETION
	Mucous neck cell	Mucus	Tonic secretion; with irritation of mucosa	Physical barrier between lumen and epithelium
		Bicarbonate	Secreted with mucus	Buffers gastric acid to prevent damage to epithelium
	Parietal cells	Gastric acid (HCl)	Acetylcholine, gastrin, histamine	Activates pepsin; kills bacteria
		Intrinsic factor		Complexes with vitamin B_{12} to permit absorption
	Enterochromaffin-like cell	Histamine	Acetylcholine, gastrin	Stimulates gastric acid secretion
	Chief cells	Pepsin(ogen)	Acetylcholine, acid secretion	Digests proteins
		Gastric lipase		Digests fats
	D cells	Somatostatin	Acid in the stomach	Inhibits gastric acid secretion
	G cells	Gastrin	Acetylcholine, peptides, and amino acids	Stimulates gastric acid secretion

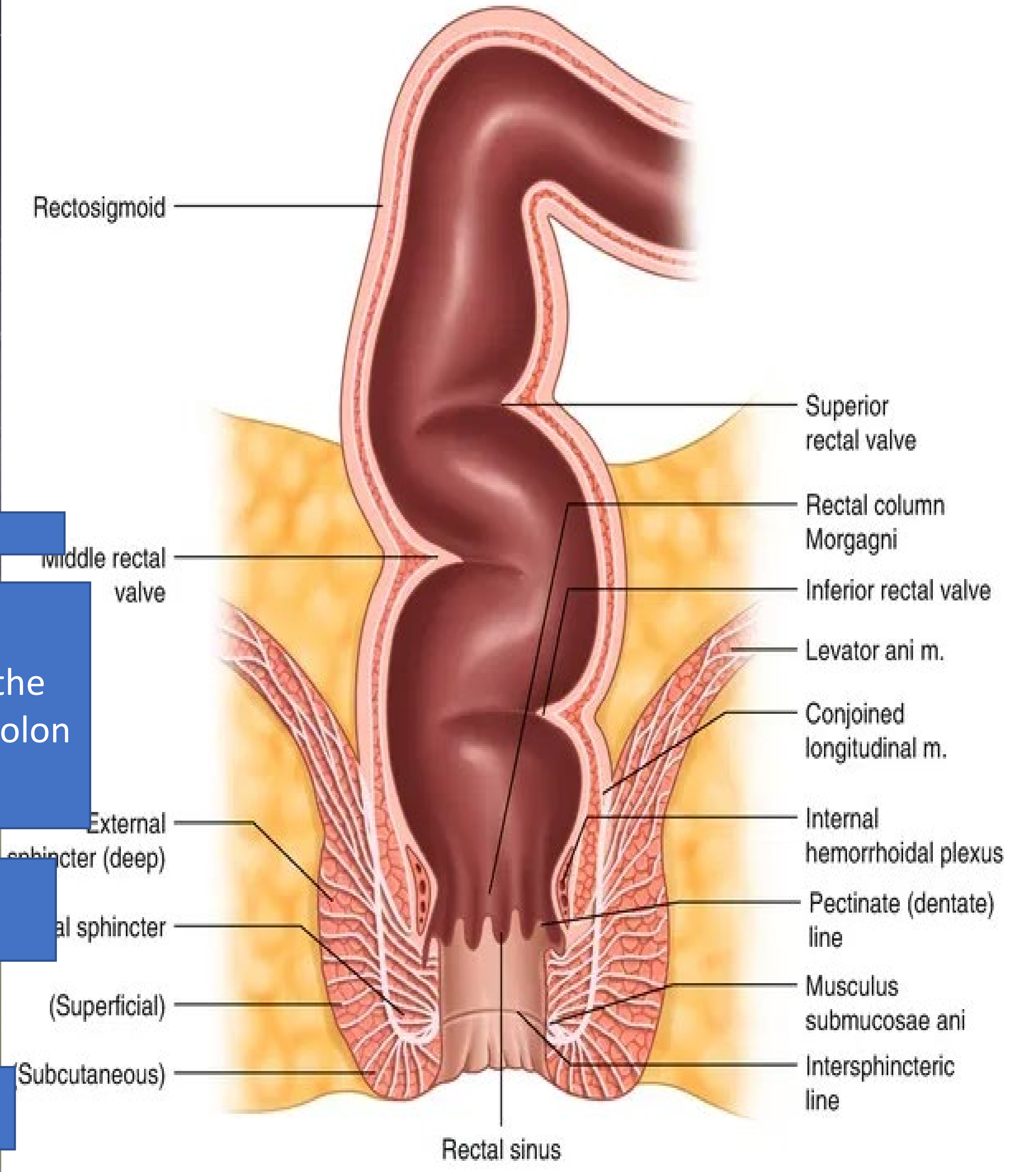

Esophagus
Fundus
Cardia
Pyloric sphincter
Pylorus
Ruga
Body
Duodenum

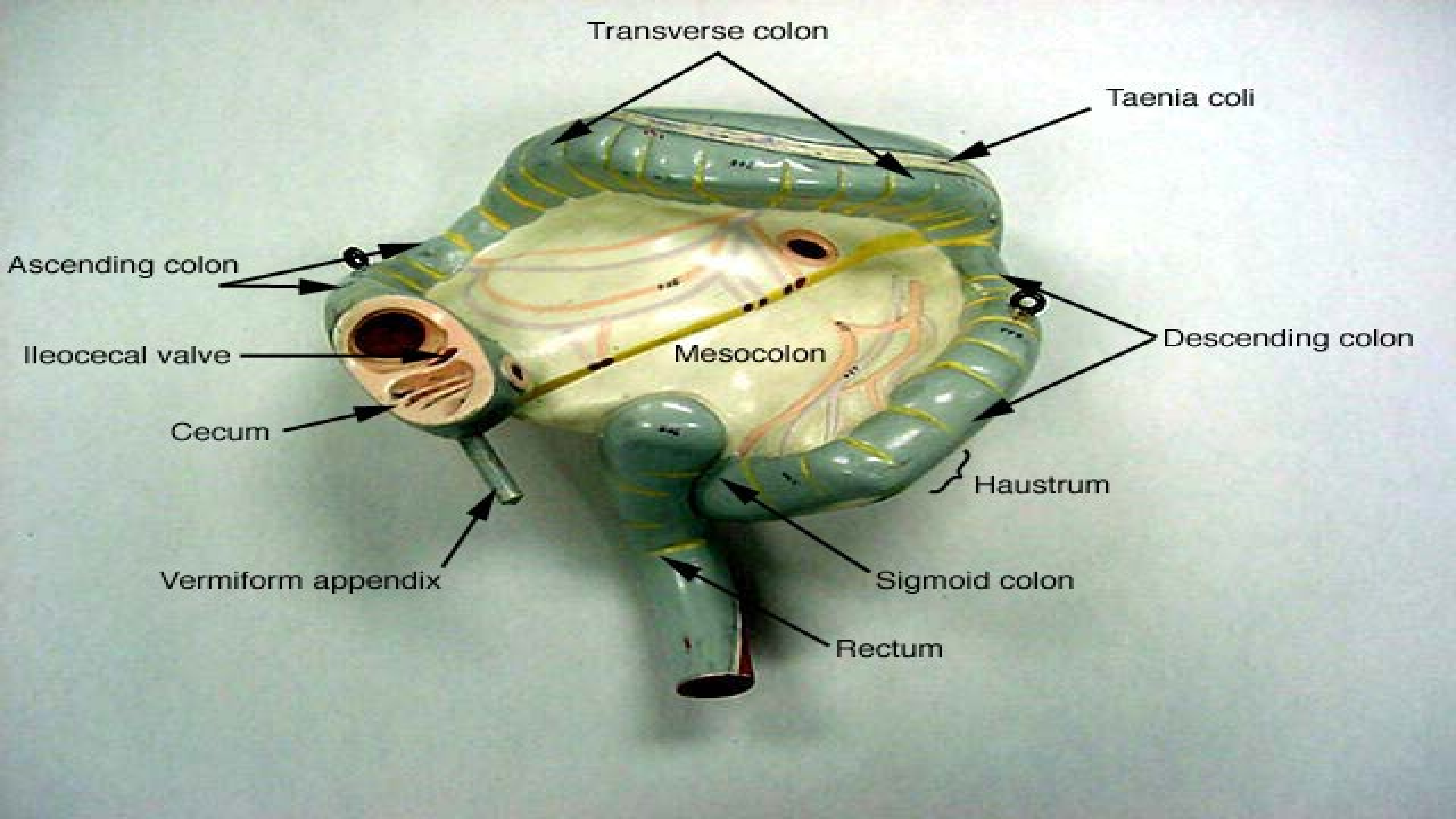



Transverse colon
Duodenum
Greater omentum
Ascending colon
Taenia coli
Descending colon
Ileocecal valve
Cecum
Mesocolon
End of ileum
Vermiform appendix
Rectum
Sigmoid

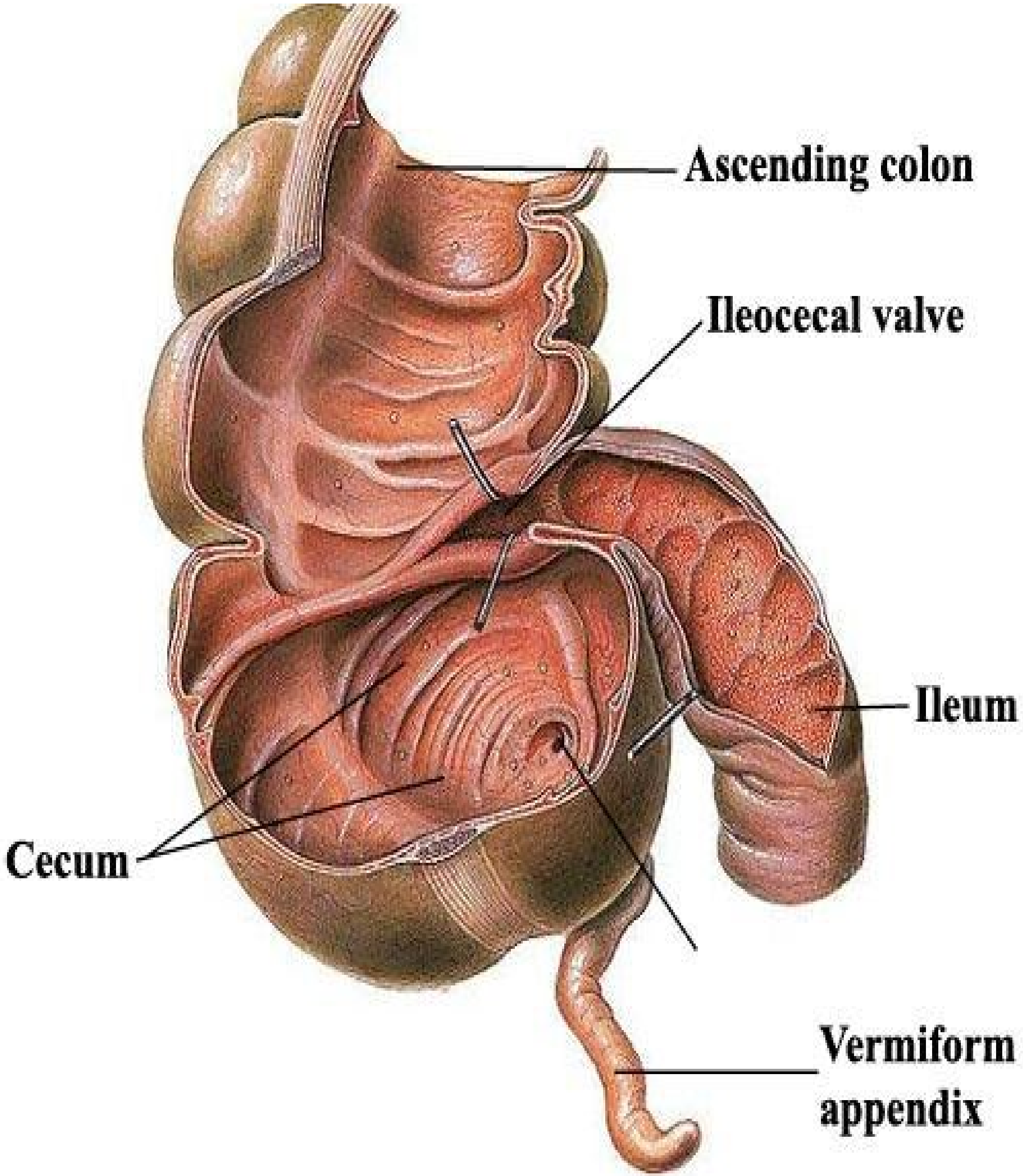

a
a
14
c
b
15
16
d
17
19

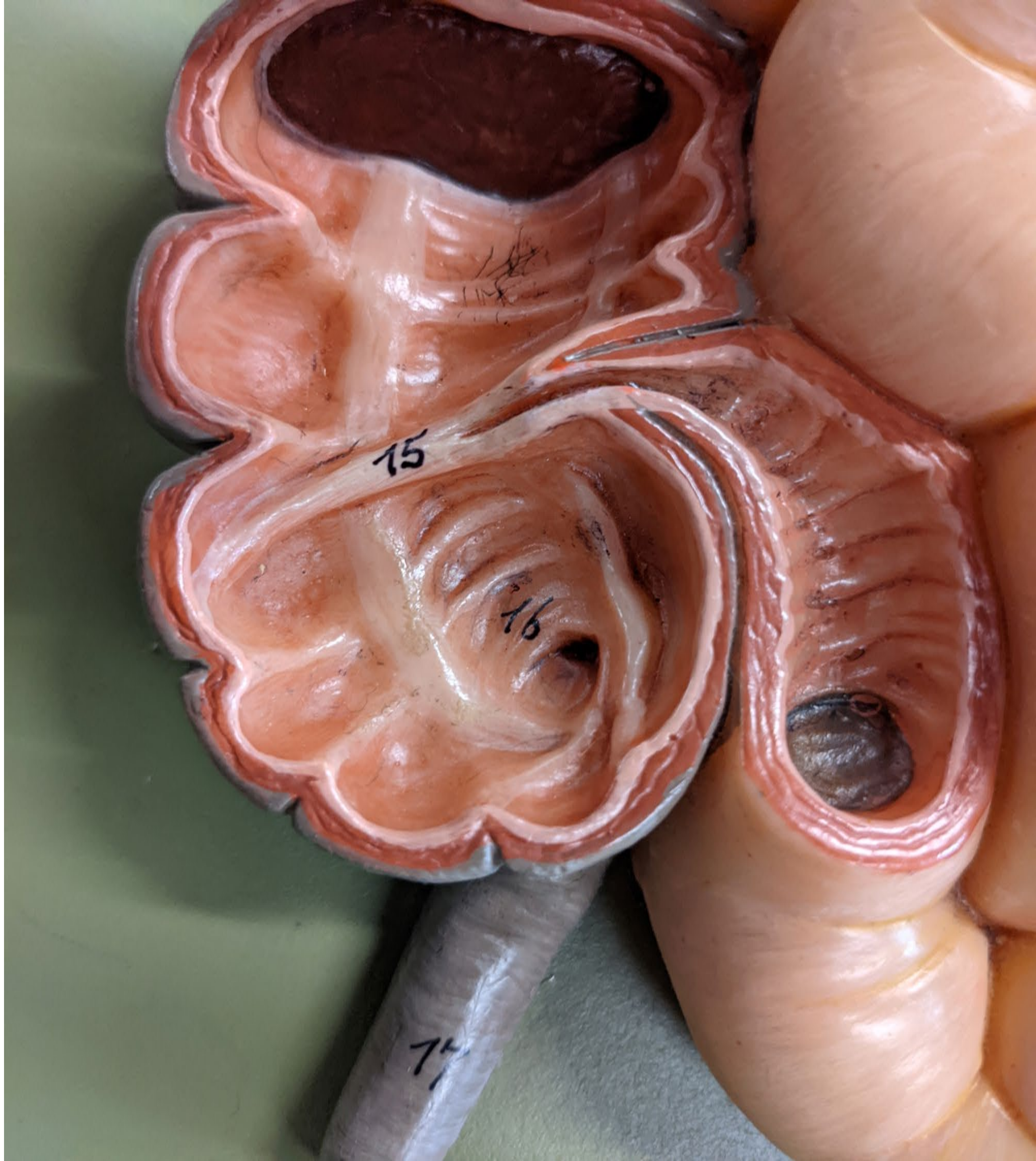

Ascending colon
Ileoceocal valve
Ileum
cecum
Haustra of the descending colon
appendix
Rectal mucosa
Crypt of Morgani
Anus

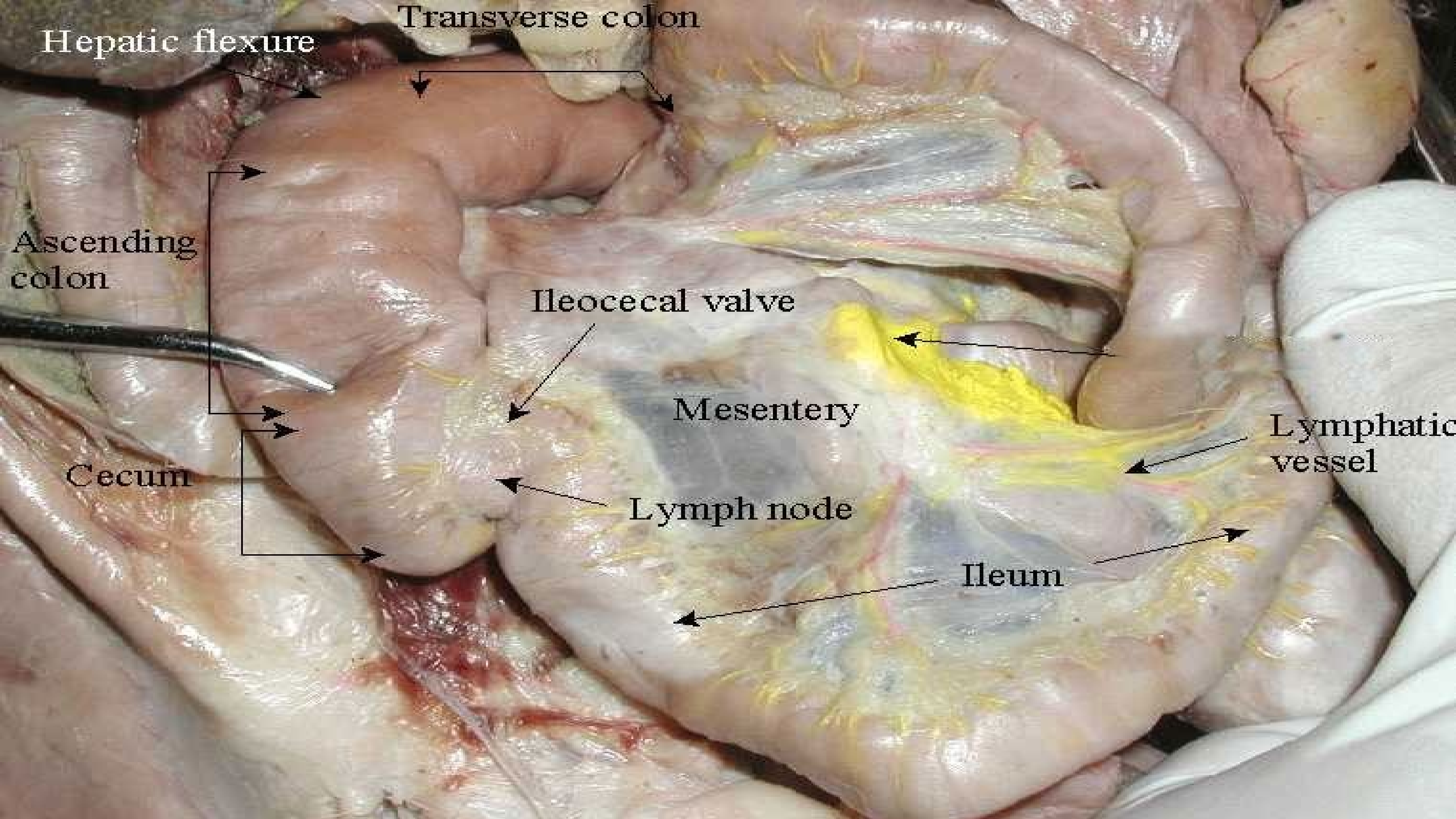

Rectosigmoid
Superior rectal valve
Rectal column Morgagni
Inferior rectal valve
Levator ani m.
Conjoined longitudinal m.
Internal hemorrhoidal plexus
Pectinate (dentate) line
Musculus submucosae ani
Intersphincteric line
Rectal sinus
(Subcutaneous)
(Superficial)
al sphincter
External
rectal valve

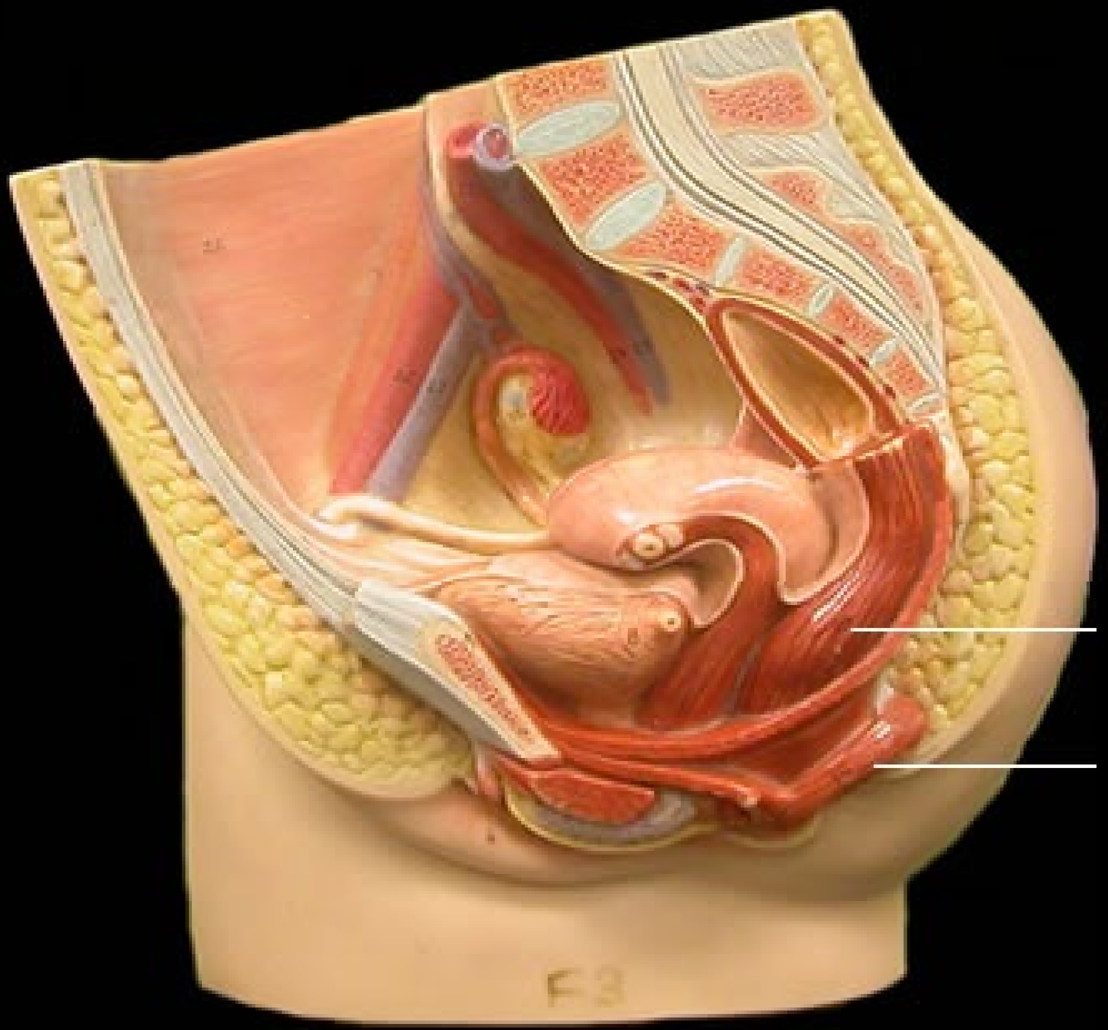

Transverse colon
Taenia coli
Ascending colon
Ileocecal valve
Mesocolon
Descending colon
Cecum
Haustrum
Vermiform appendix
Sigmoid colon
Rectum


15
16
17

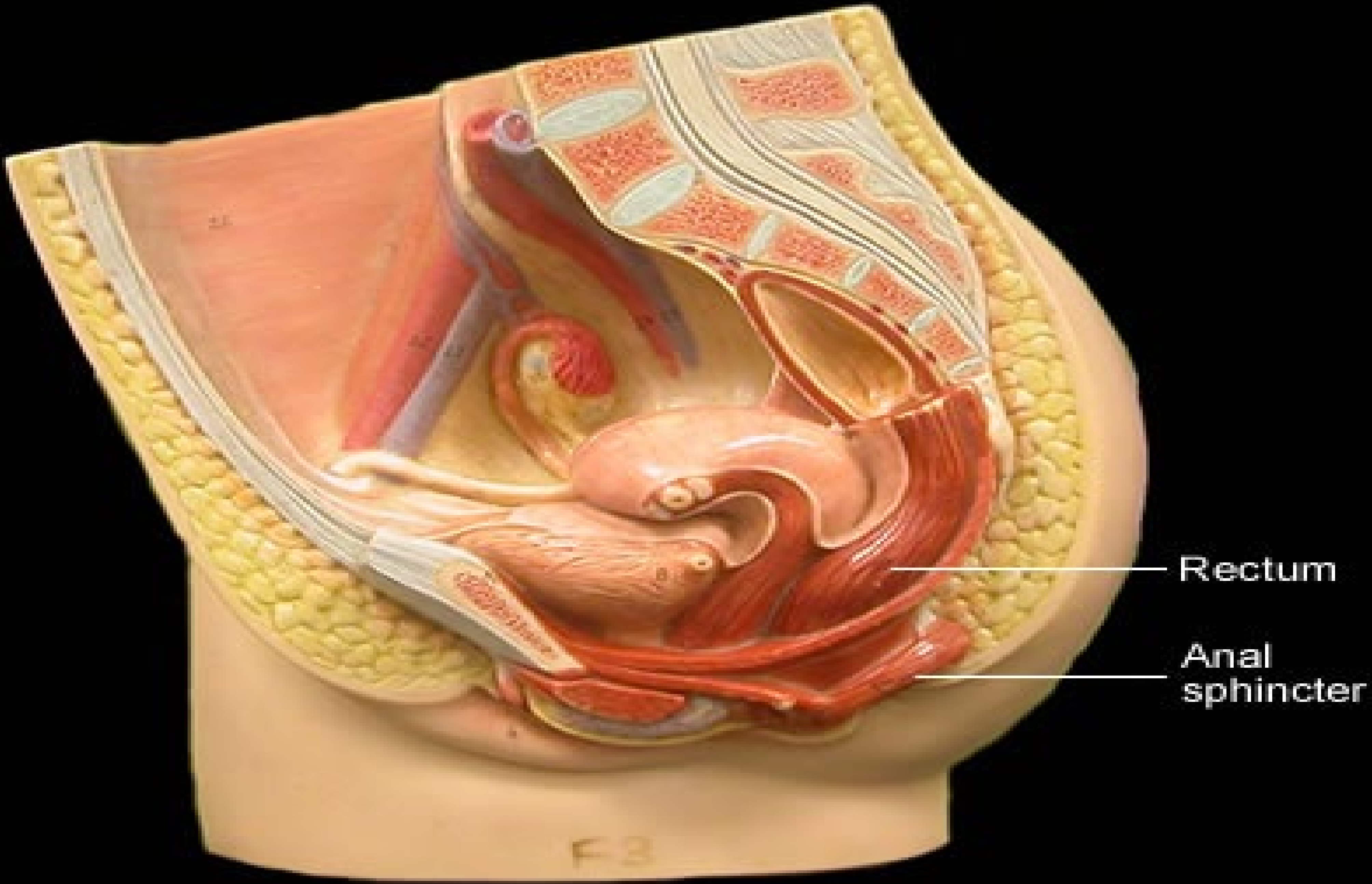

Ascending colon
Ileocecal valve
Ileum
Cecum
Vermiform
appendix

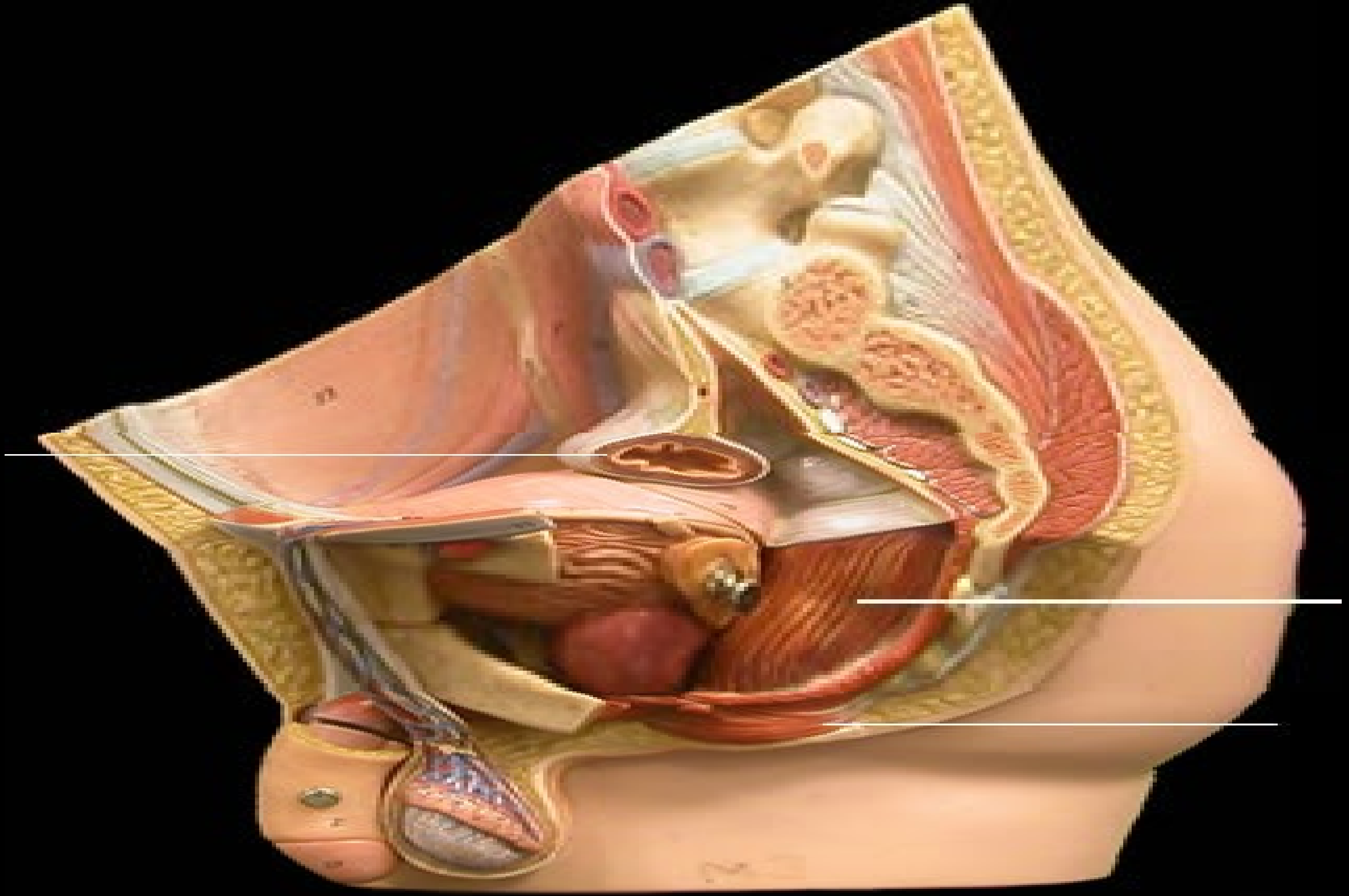

15
16

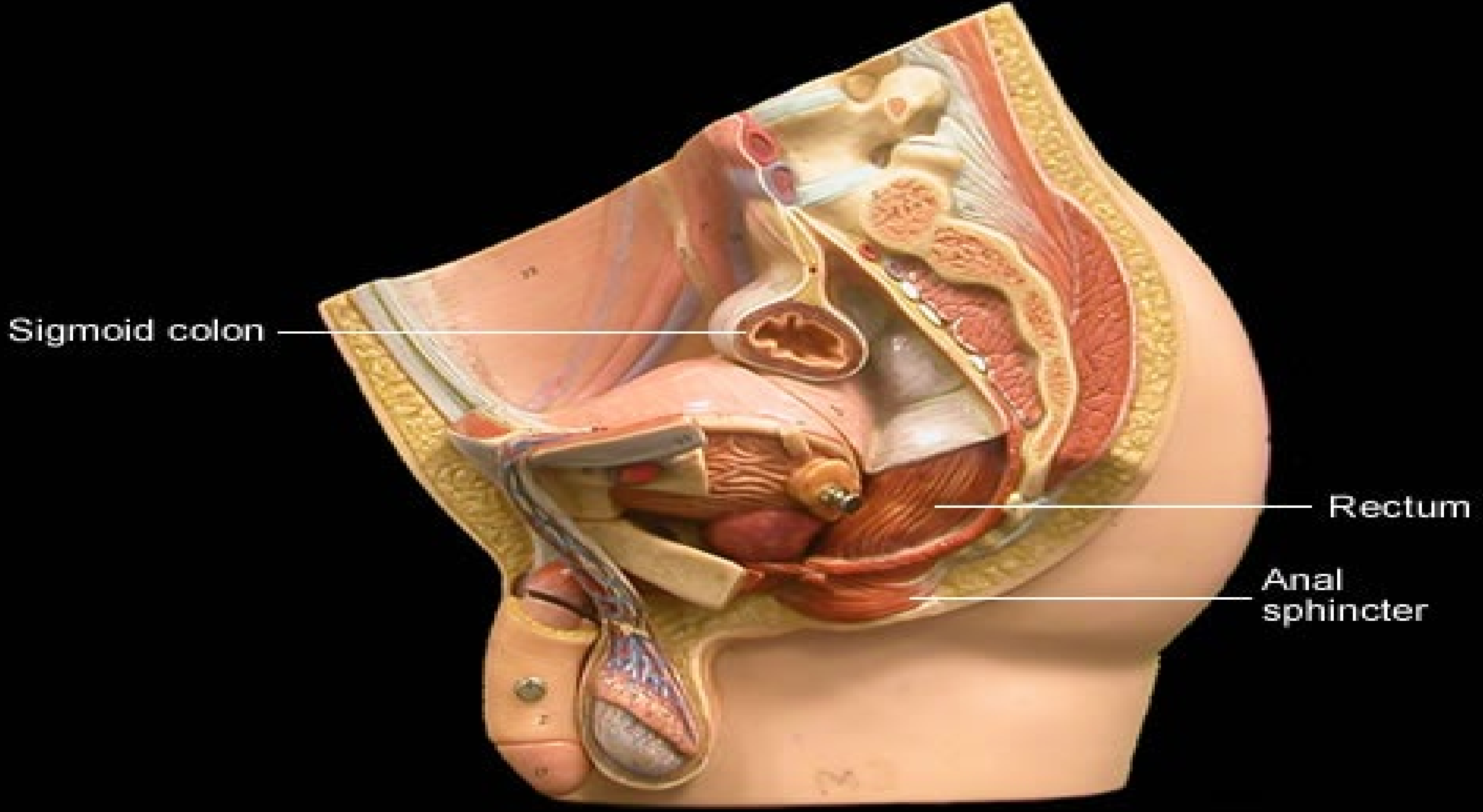

Transverse colon
Hepatic flexure
Ascending colon
Ileocecal valve
Mesentery
Lymphatic vessel
Cecum
Lymph node
Ileum

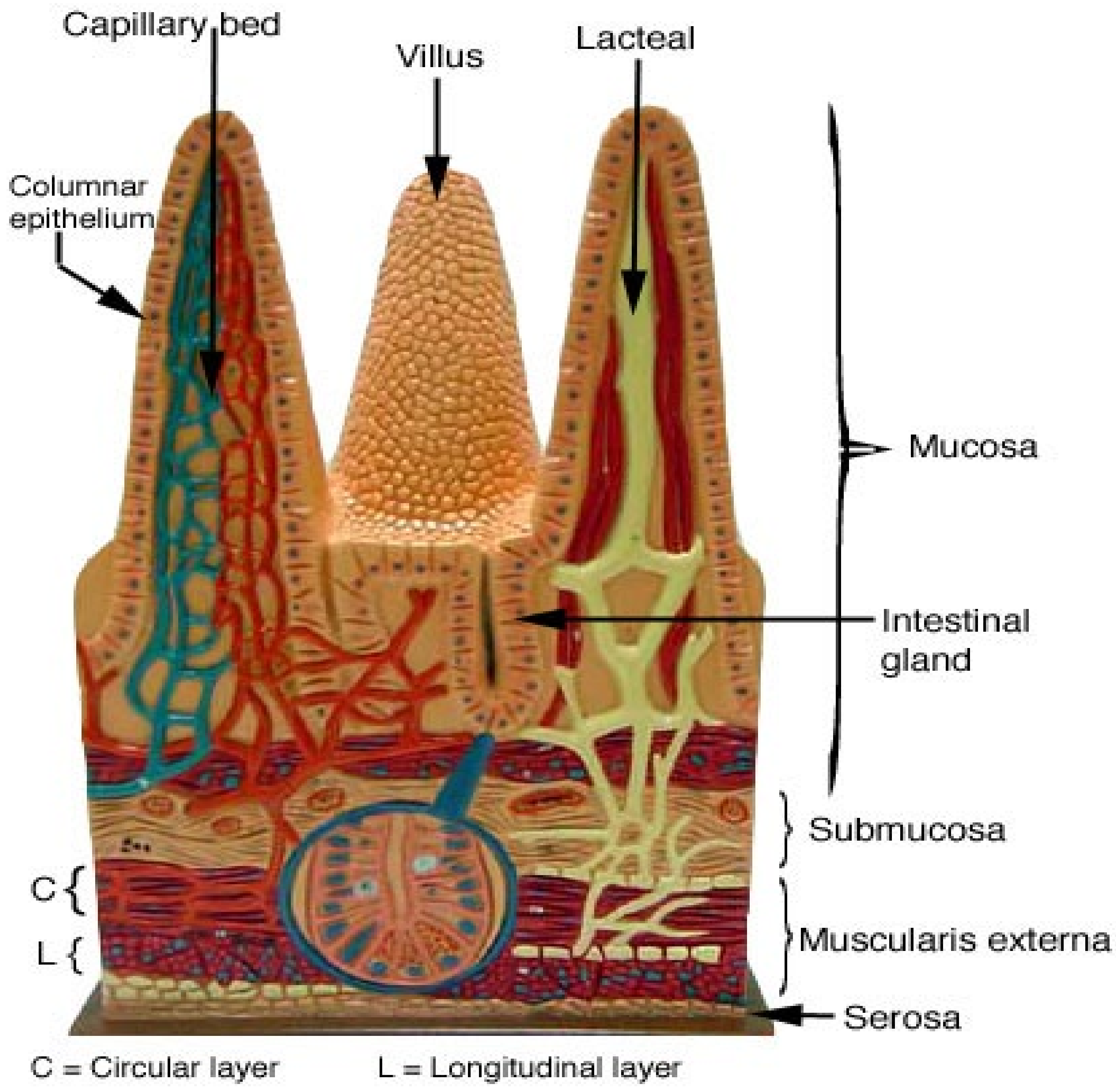

F3

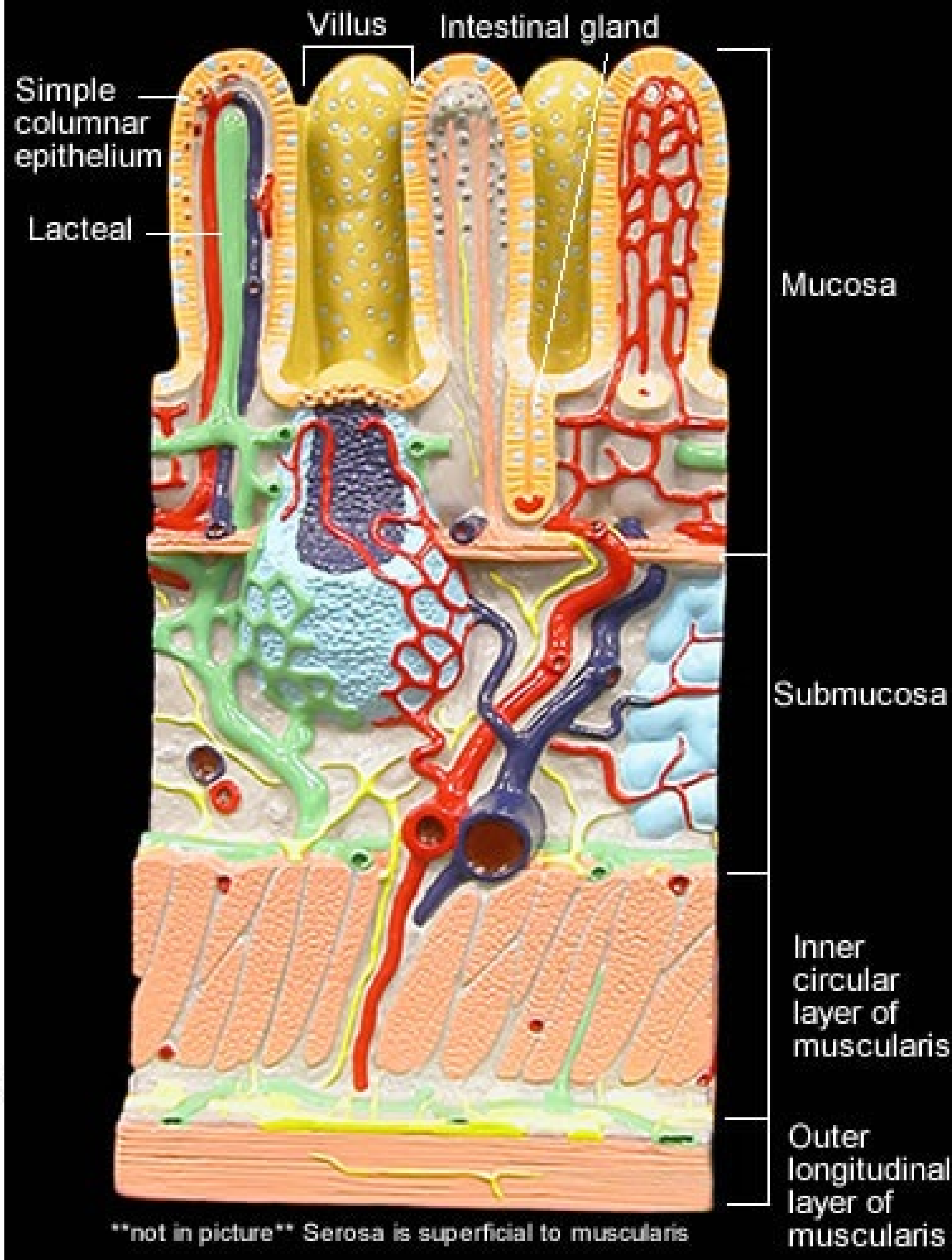
Go to:
Deep View



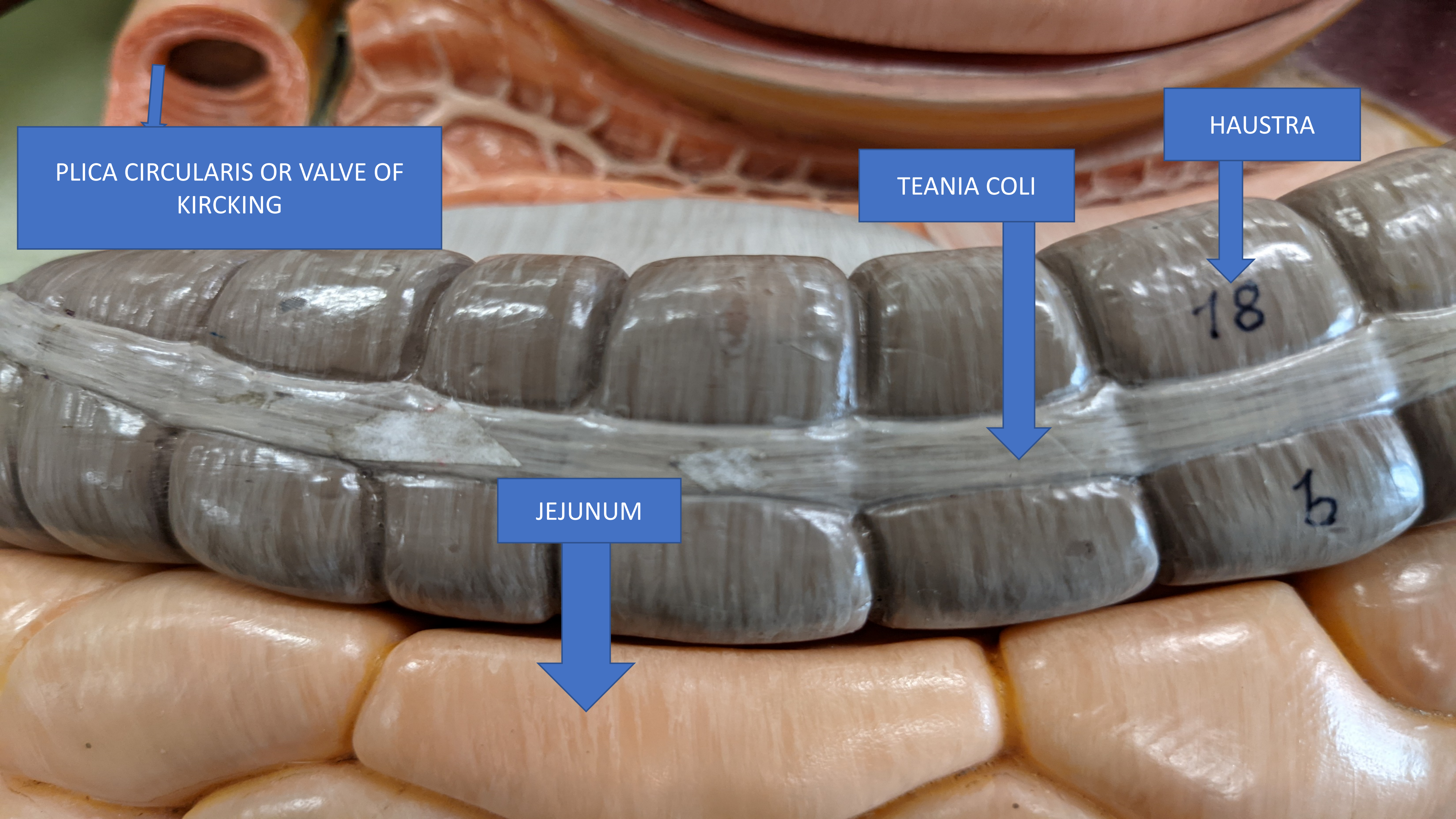



Sigmoid colon
Rectum
Anal
sphincter


Capillary bed
Villus
Lacteal
Columnar epithelium
Mucosa
Intestinal gland
Submucosa
C
L
Muscularis externa
Serosa
C = Circular layer
L = Longitudinal layer

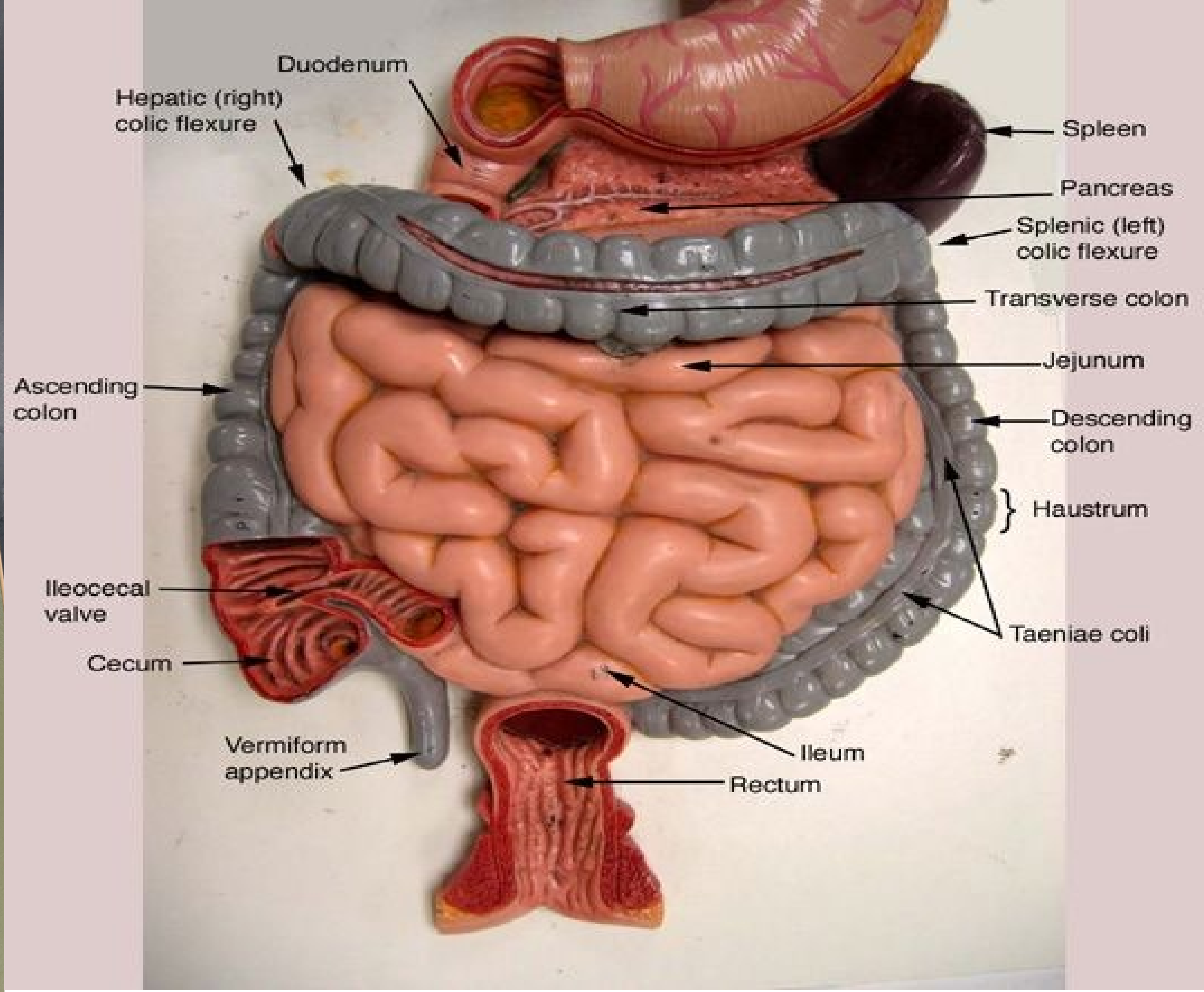

Villus
Intestinal gland
Simple columnar epithelium
Lacteal
Mucosa
Submucosa
Inner circular layer of muscularis
Outer longitudinal layer of muscularis
not in picture Serosa is superficial to muscularis


18
b

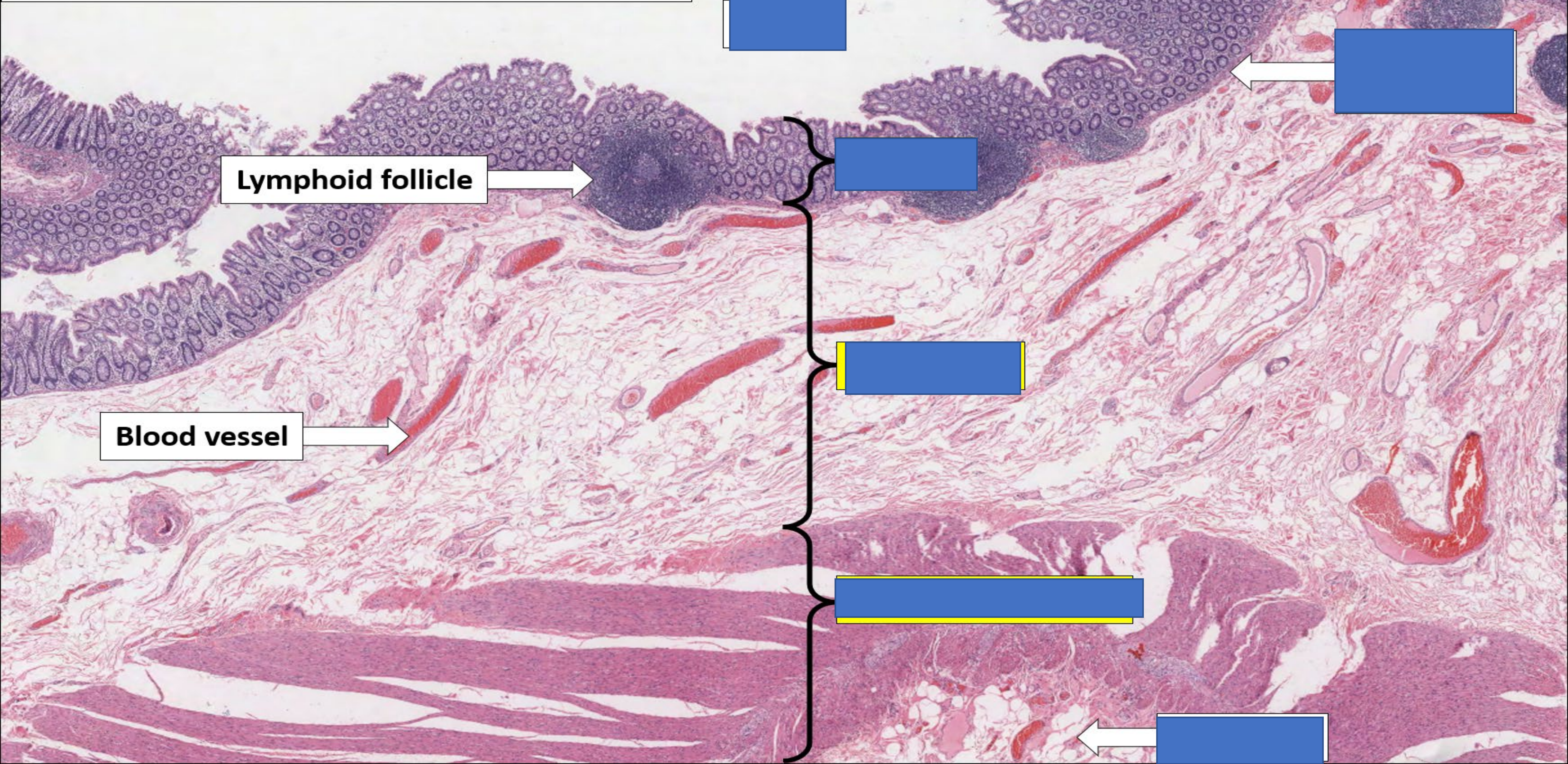

PLICA CIRCULARIS OR VALVE OF KIRCKING
TEANIA COLI
HAUSTRA
18
JEJUNUM


7
a
18
b
a
14
a
c
b
15
16
d
17
19


18
14
17
19

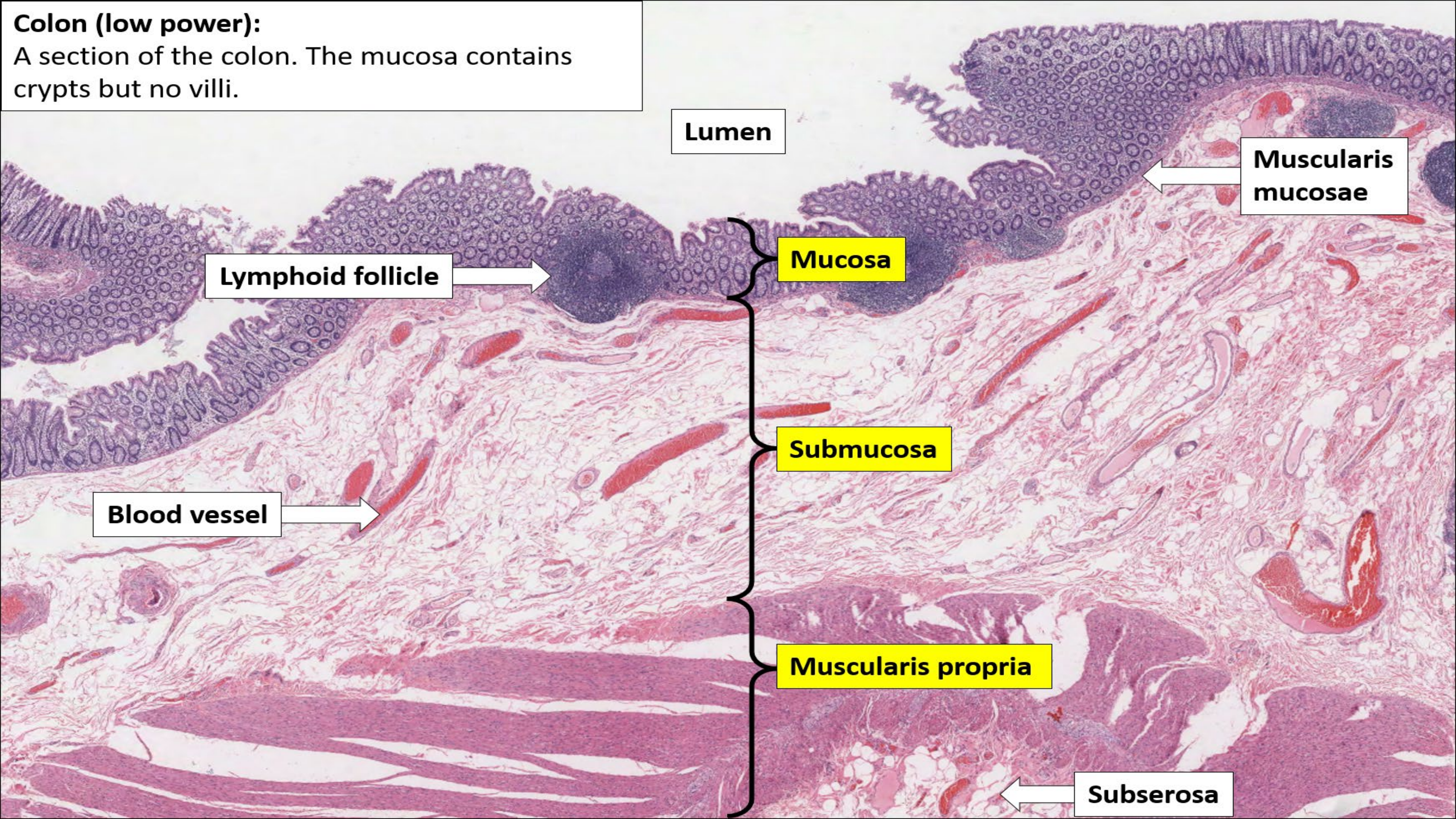

Duodenum
Hepatic (right)
colic flexure
Spleen
Pancreas
Splenic (left)
colic flexure
Transverse colon
Jejunum
Ascending
colon
Descending
colon
Haustrum
Ileocecal
valve
Taeniae coli
Cecum
Vermiform
appendix
Ileum
Rectum

Colon (low power):
A section of the colon. The mucosa contains crypts but no villi.

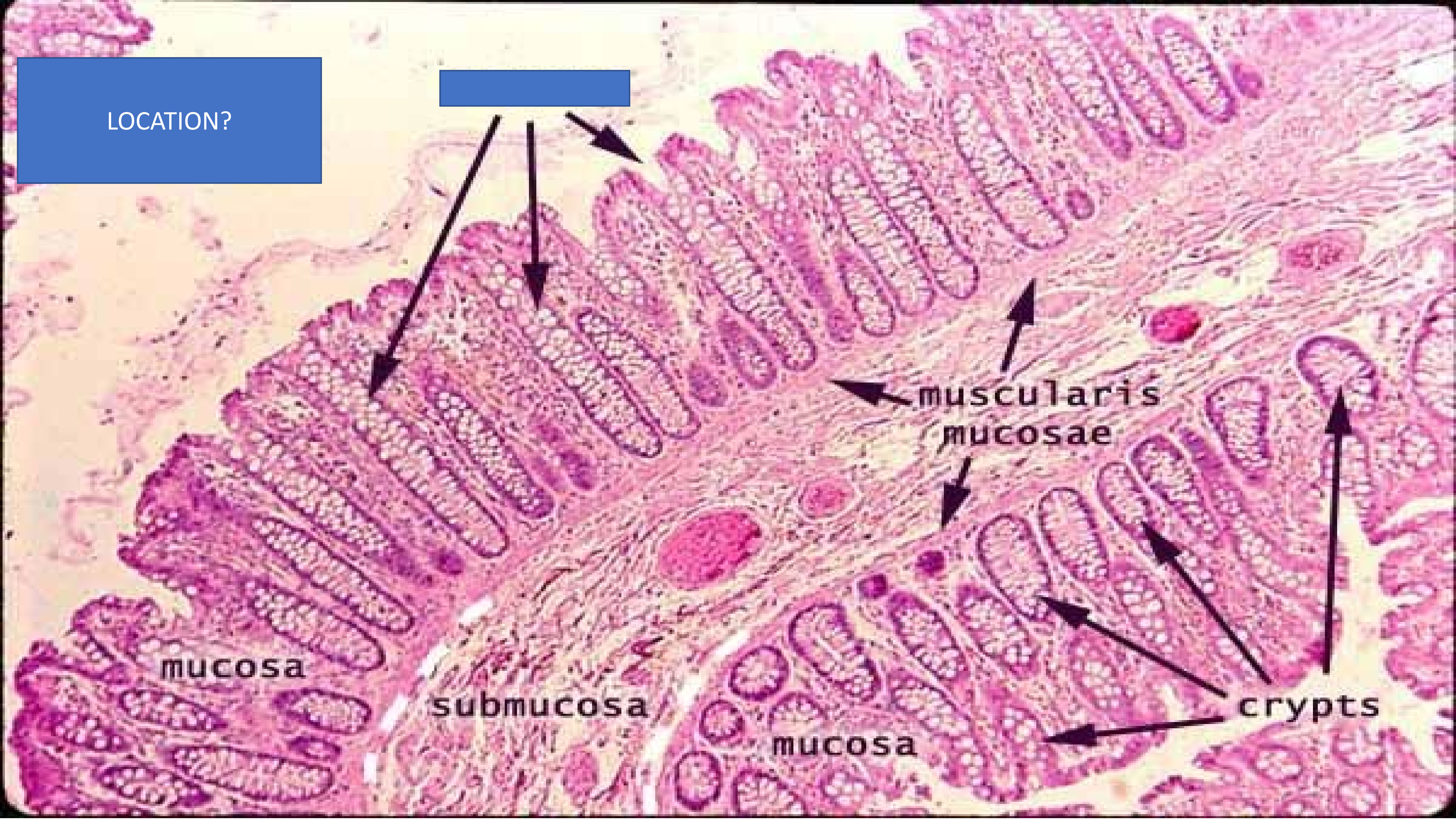


Colon (low power):

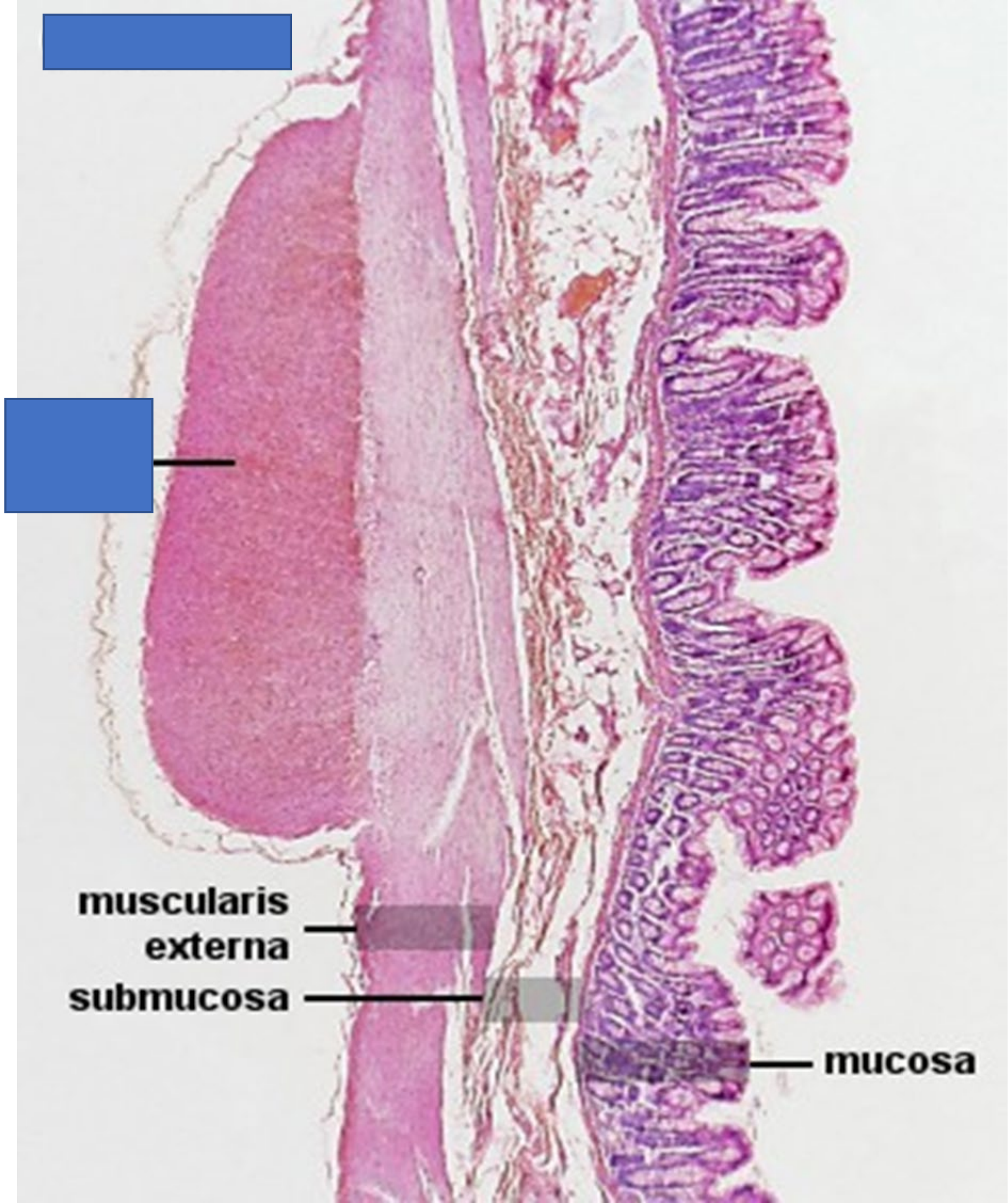
A section of the colon. The mucosa contains crypts but no villi.

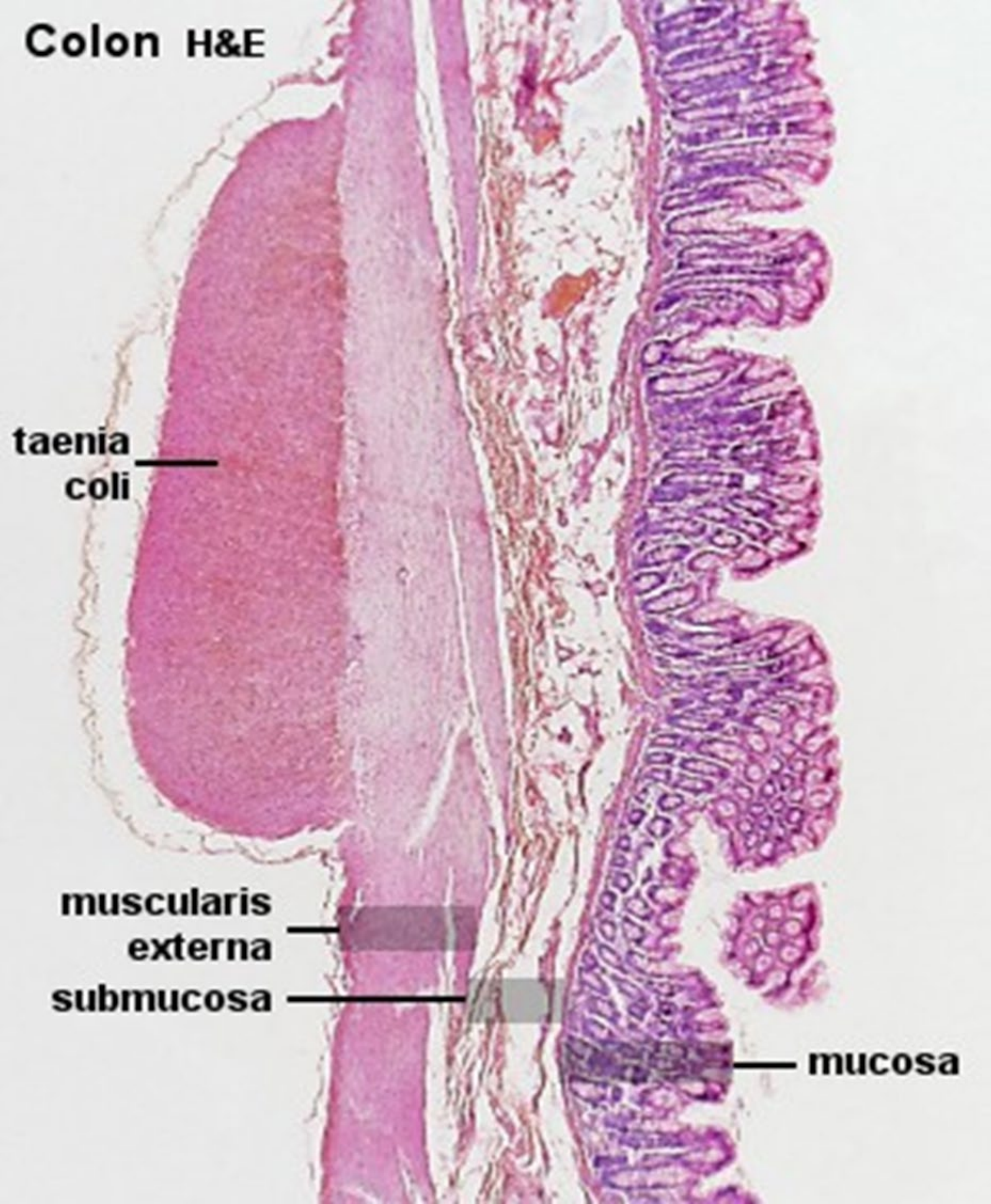


LOCATION?

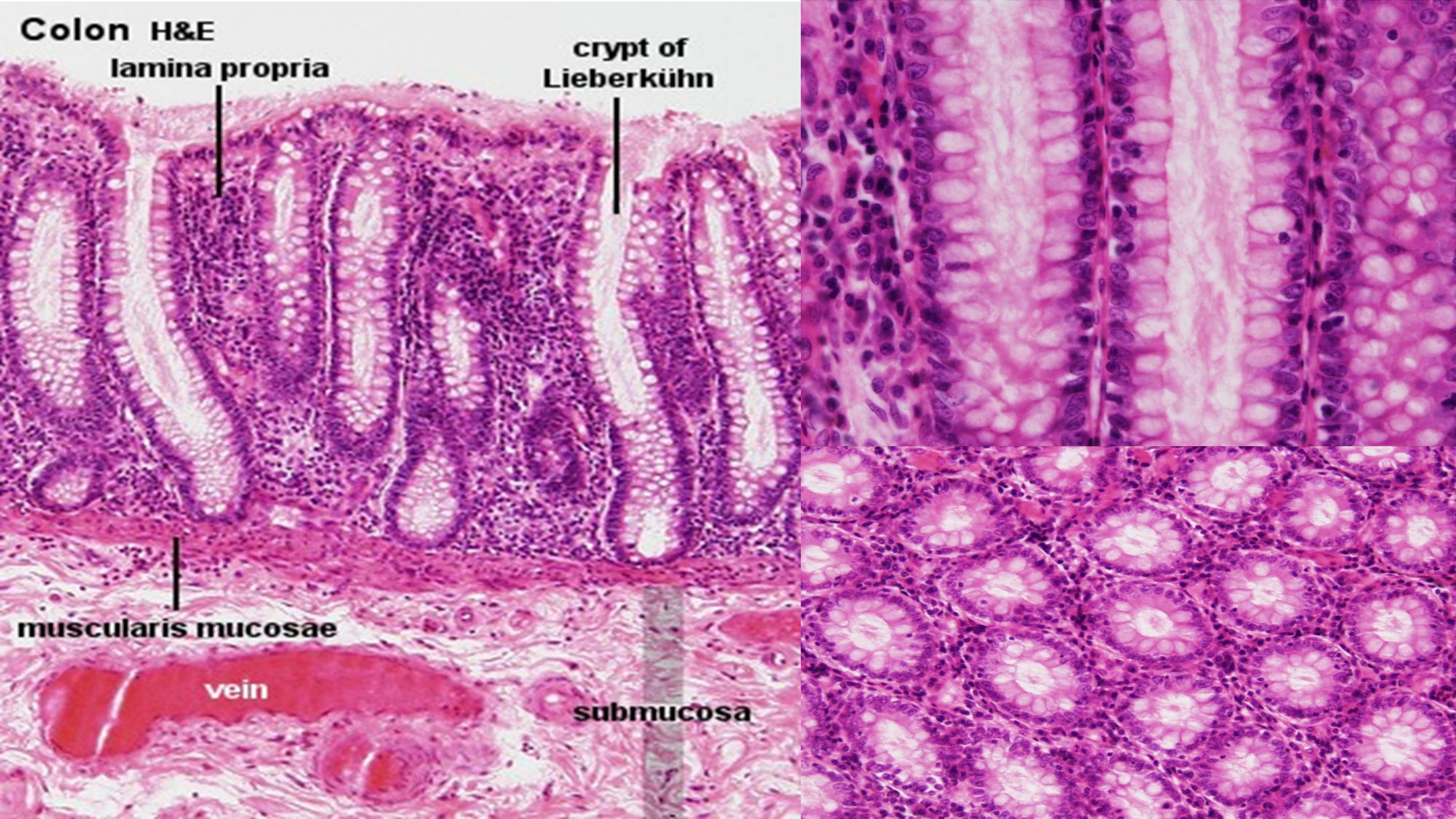


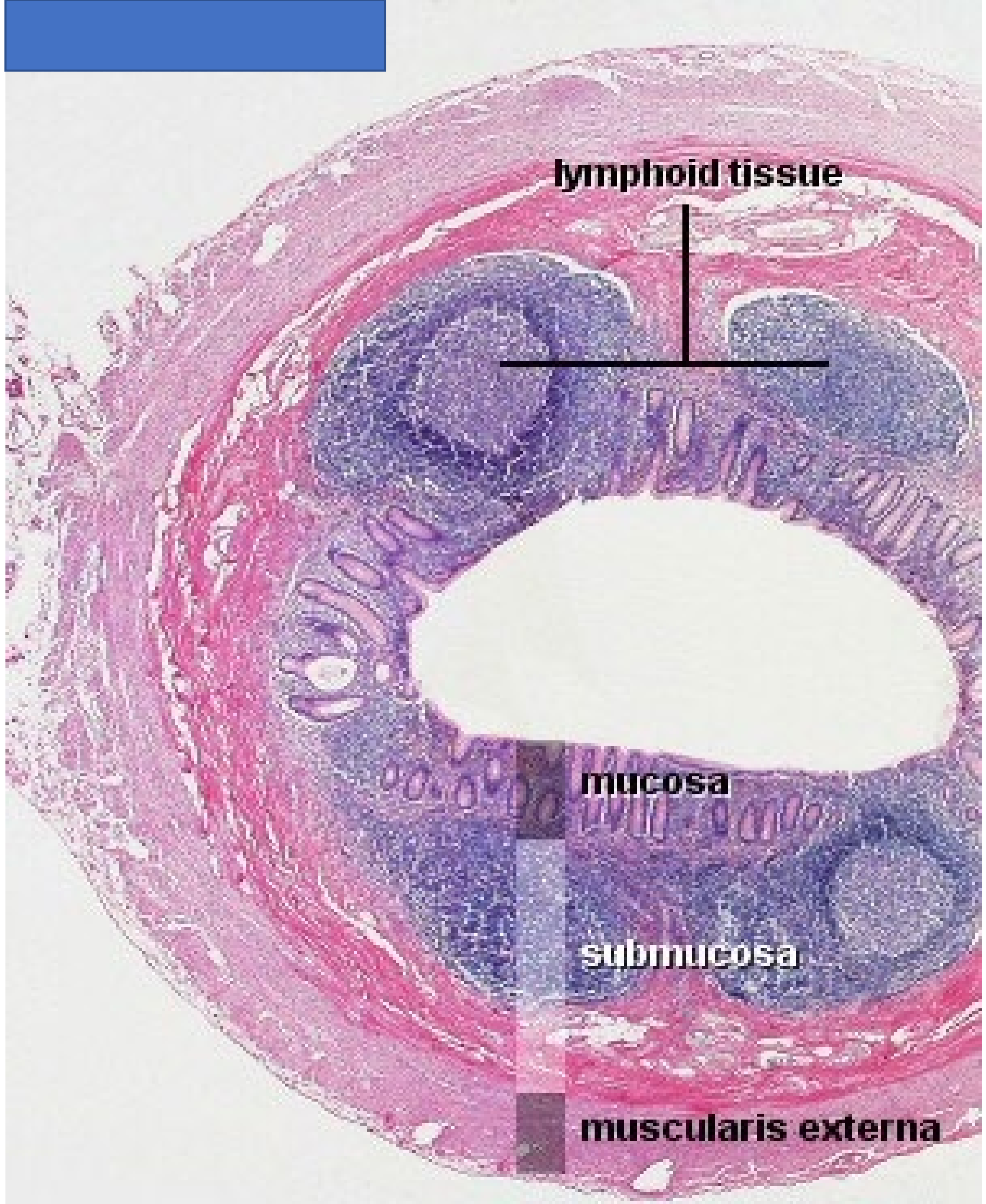
COLON

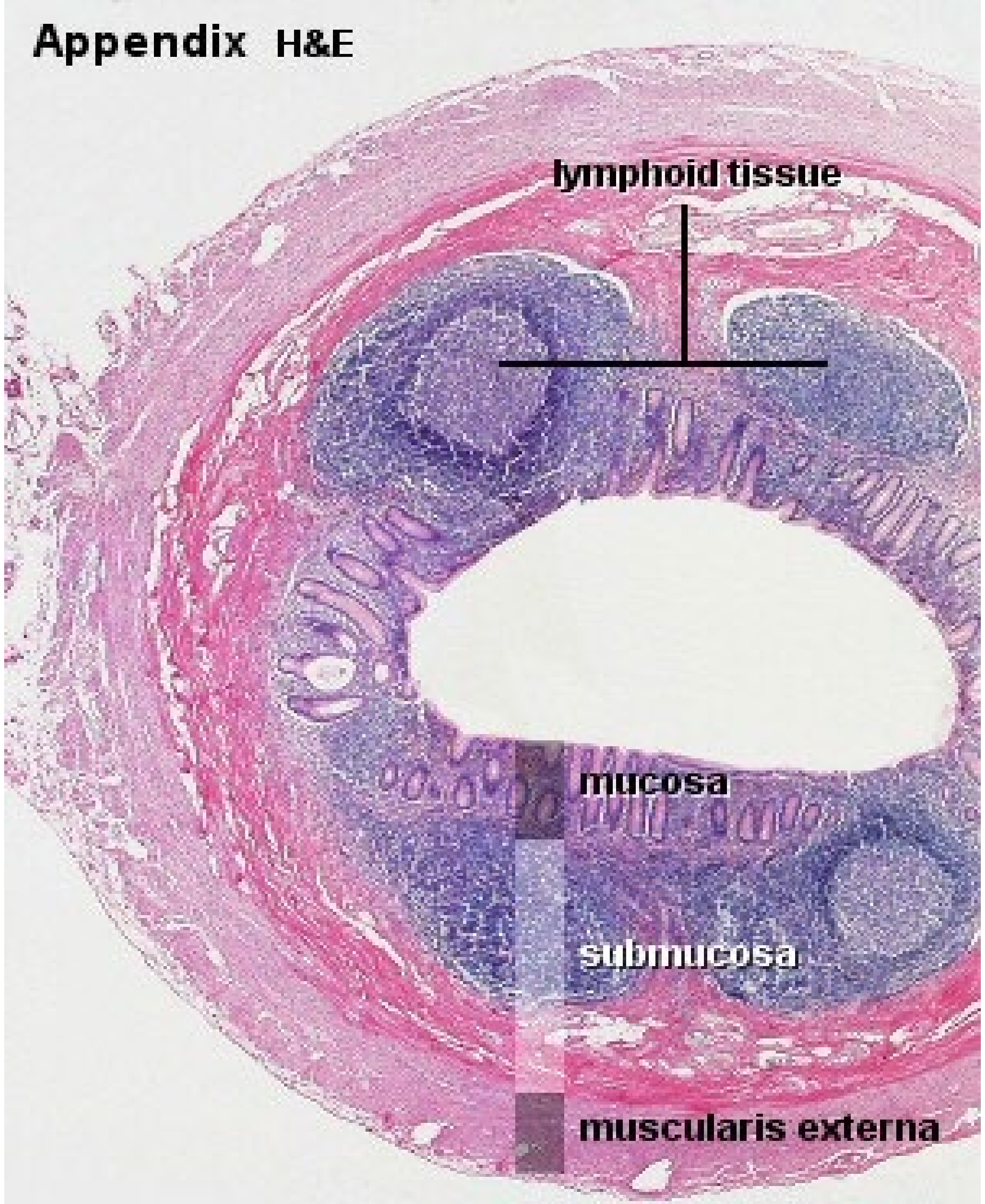

muscularis
externa
submucosa
mucosa

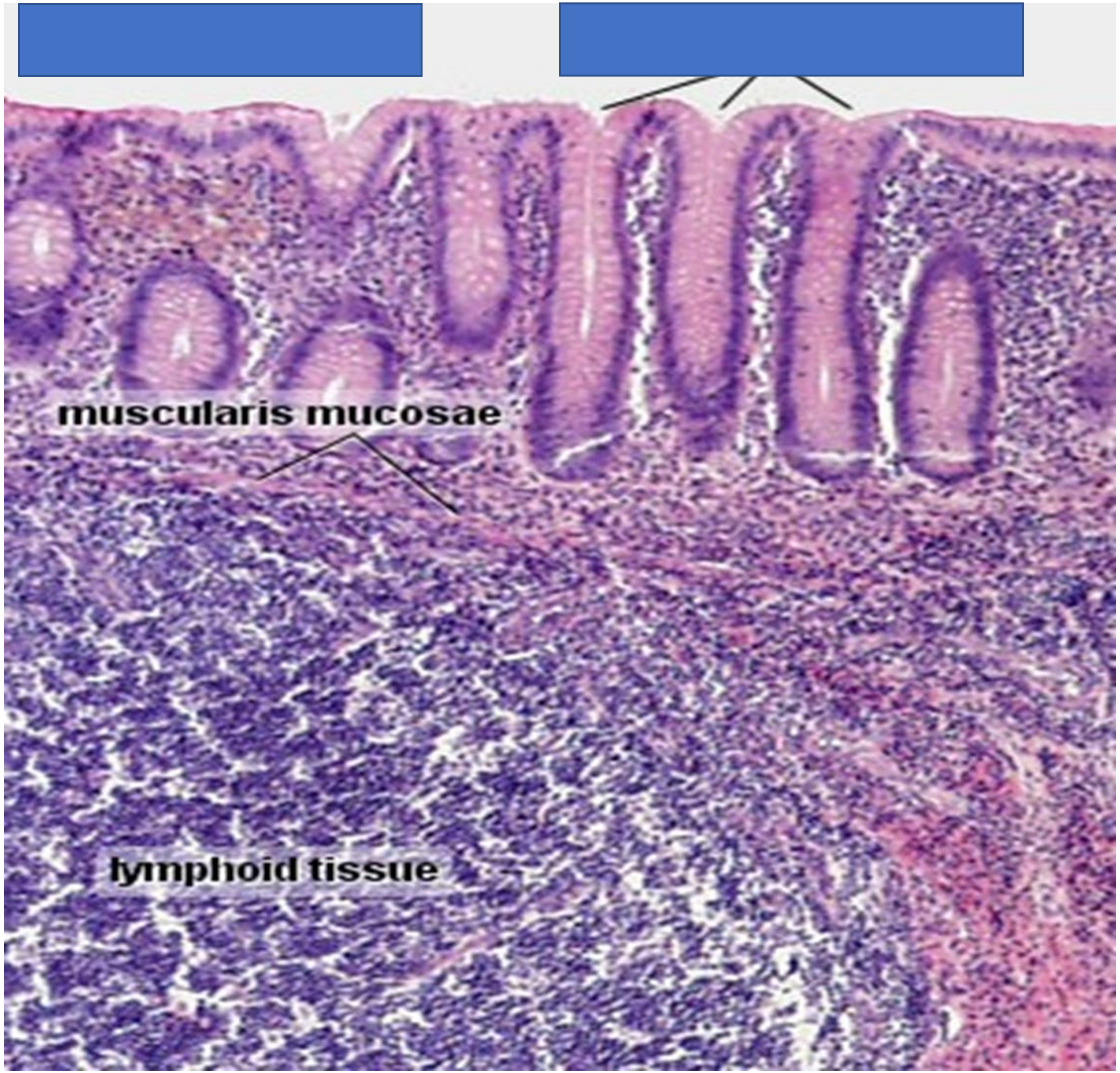

Colon H&E
taenia coli
muscularis externa
submucosa
mucosa

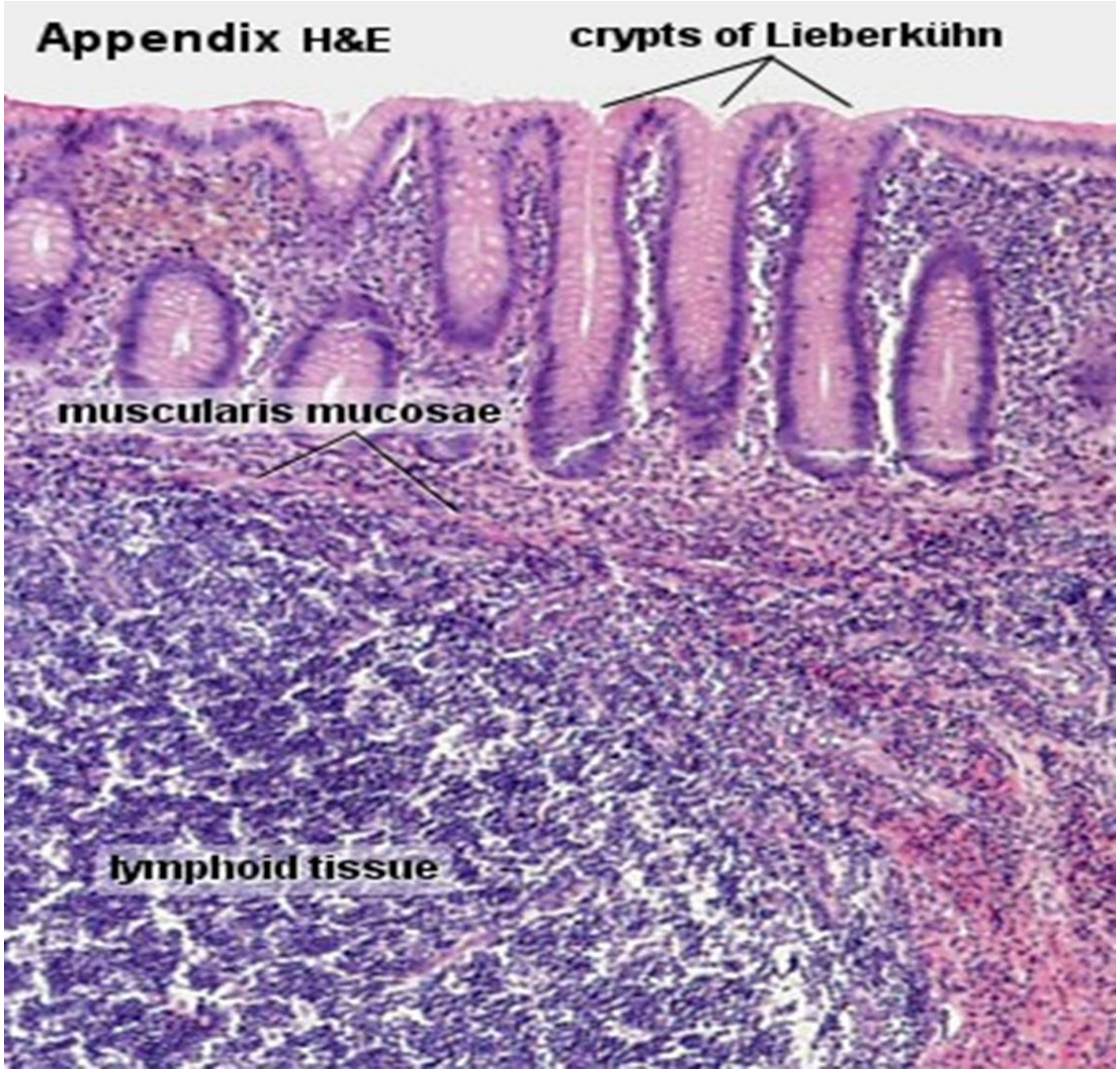

lamina propria
muscularis mucosae
vein
submucosa


Colon H&E
lamina propria
crypt of Lieberkühn
muscularis mucosae
vein
submucosa

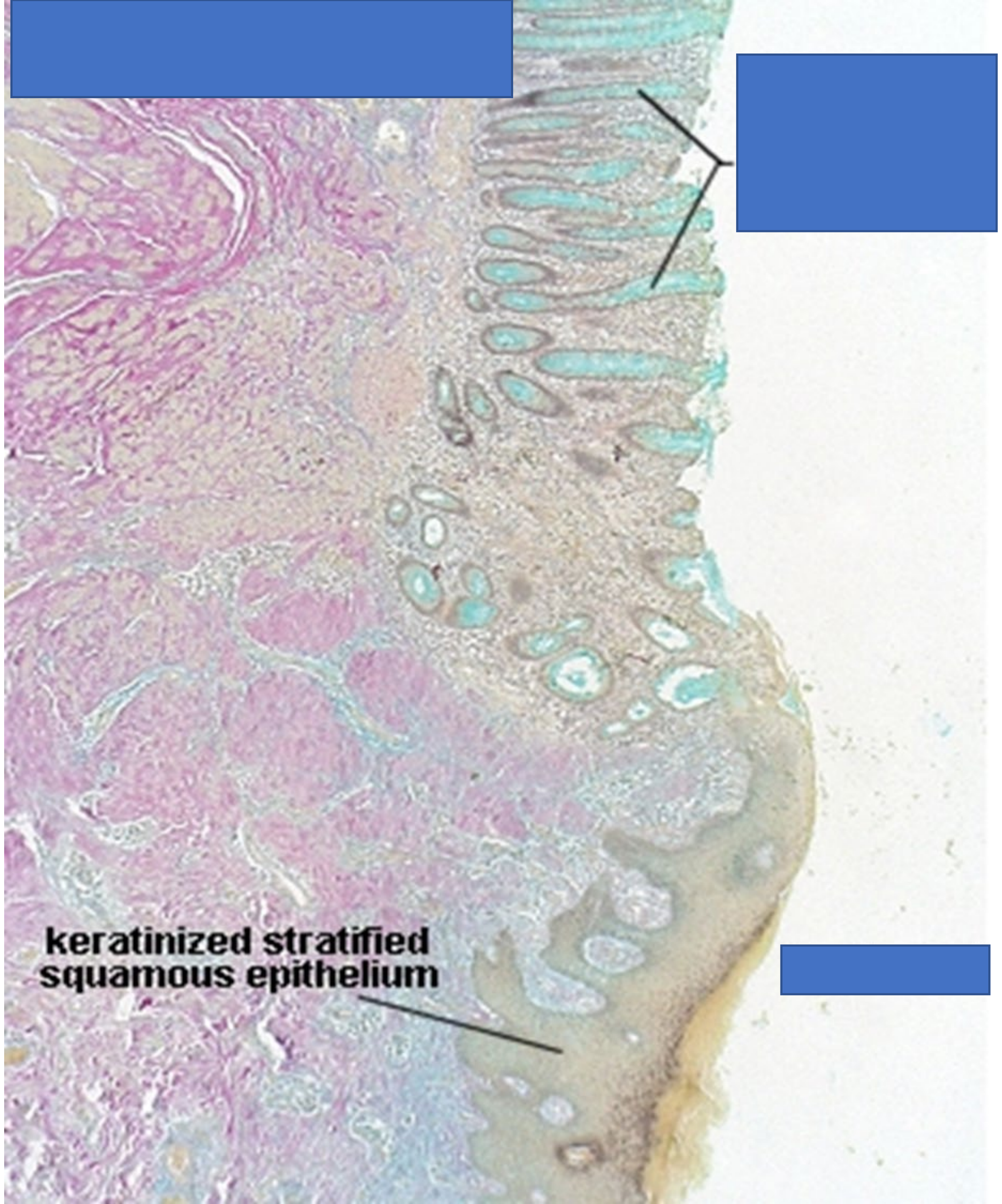

lymphoid tissue
mucosa
submucosa
muscularis externa

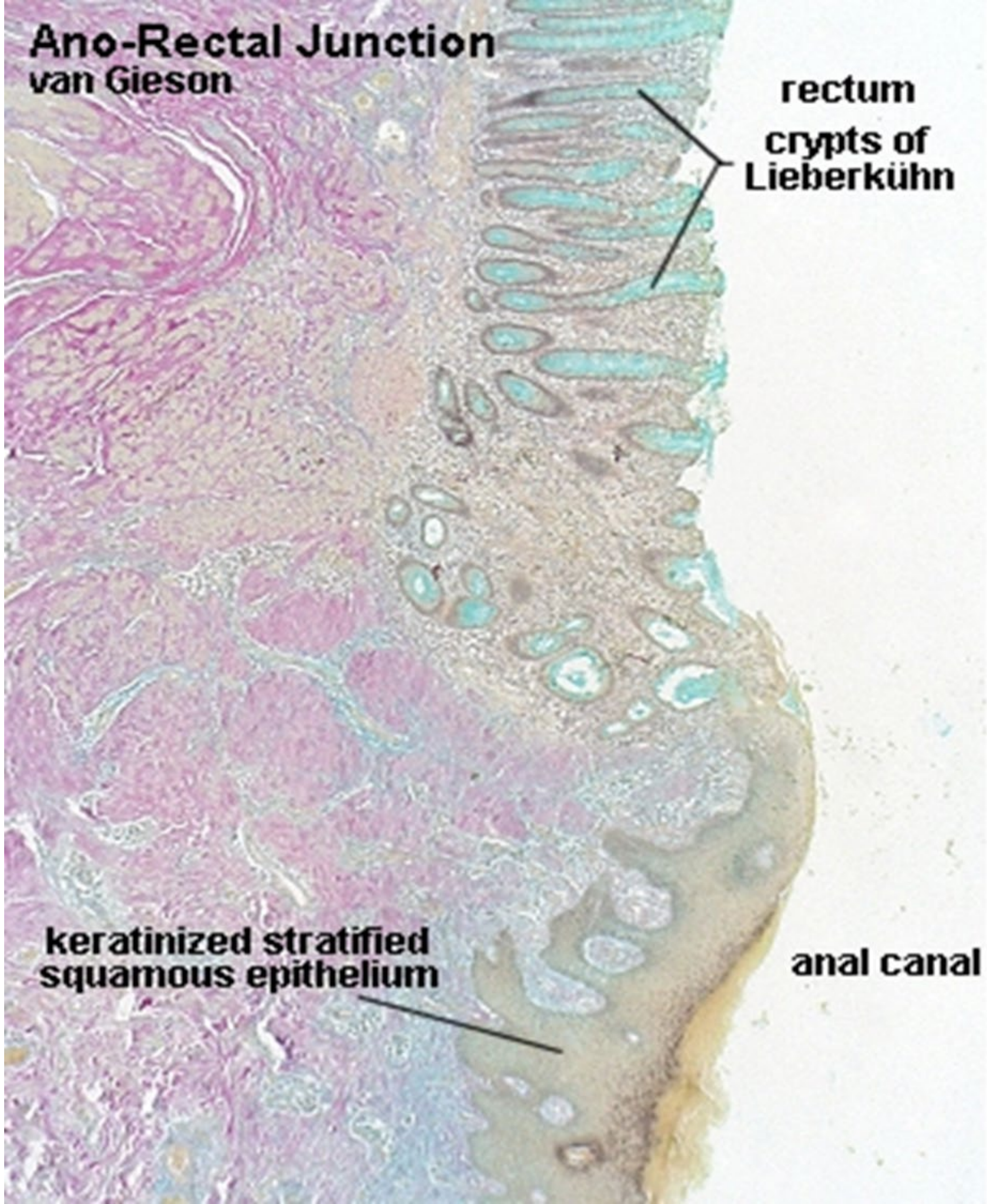

Appendix H&E
lymphoid tissue
mucosa
submucosa
muscularis externa

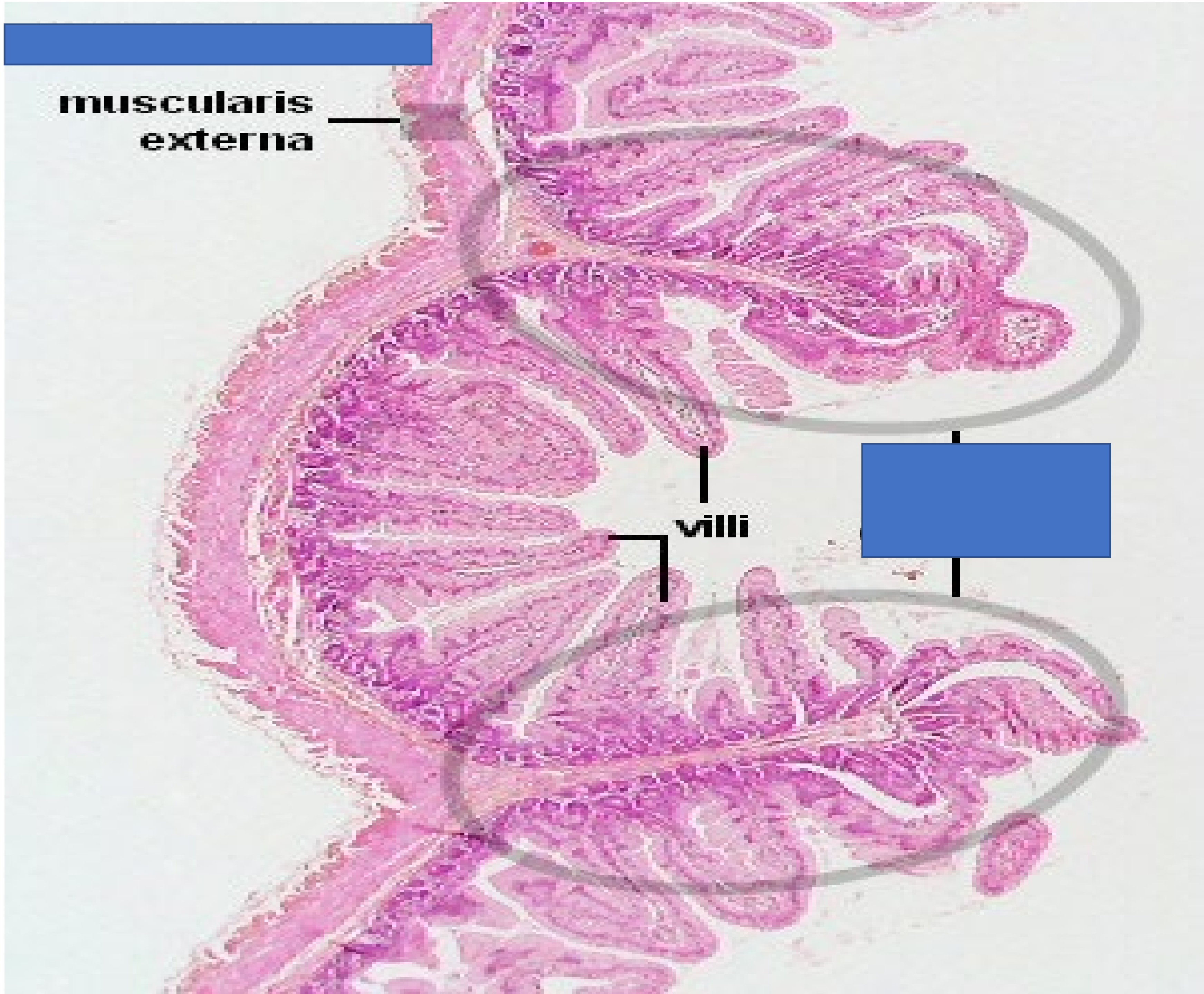

muscularis mucosae
lymphoid tissue

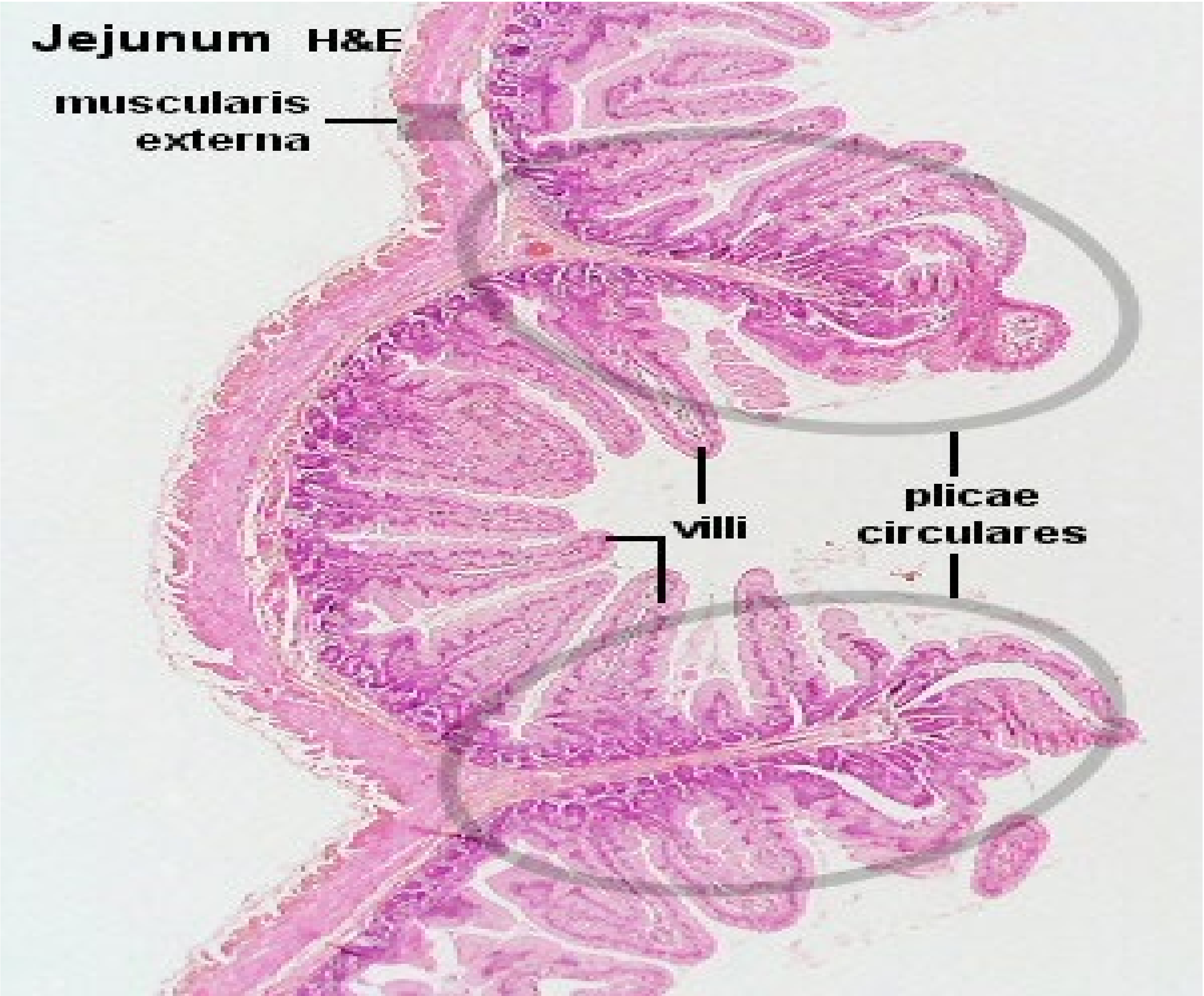

Appendix H&E
crypts of Lieberkühn
muscularis mucosae
lymphoid tissue

Location of this slide? (observe well)

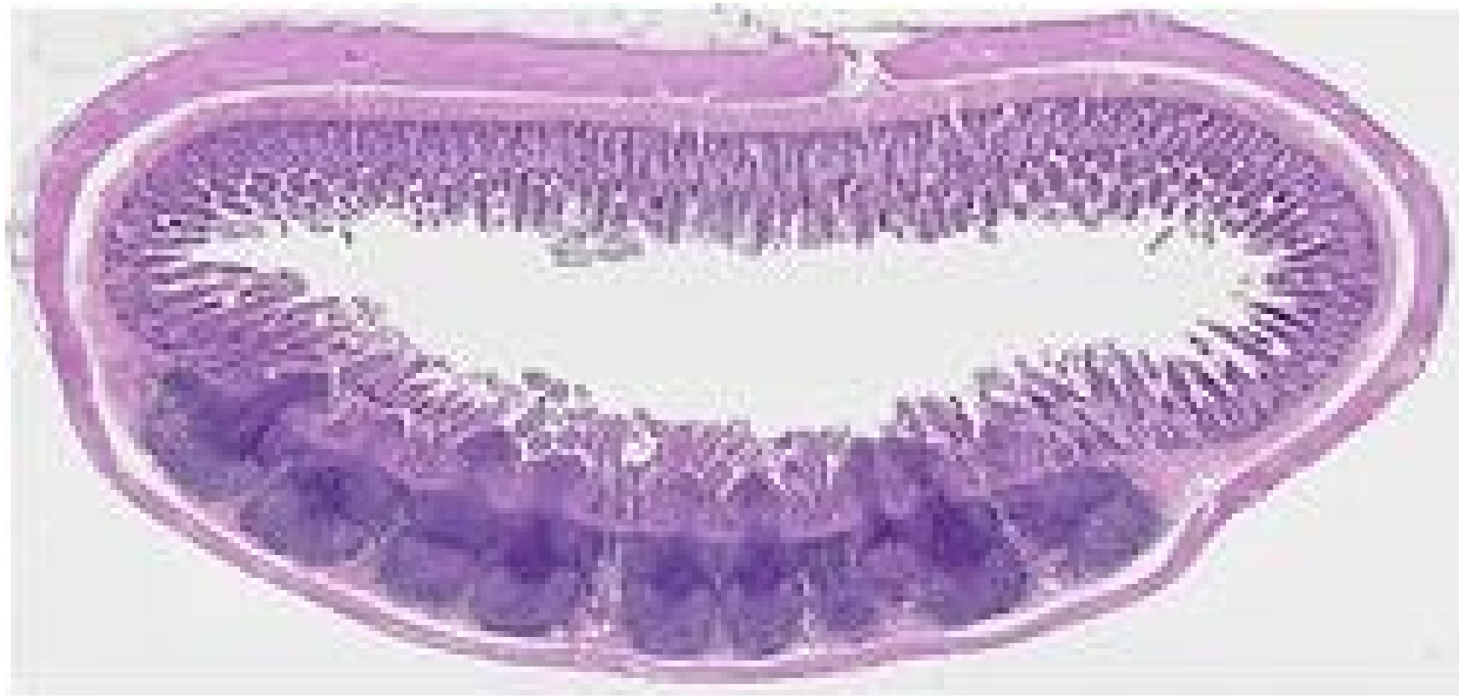


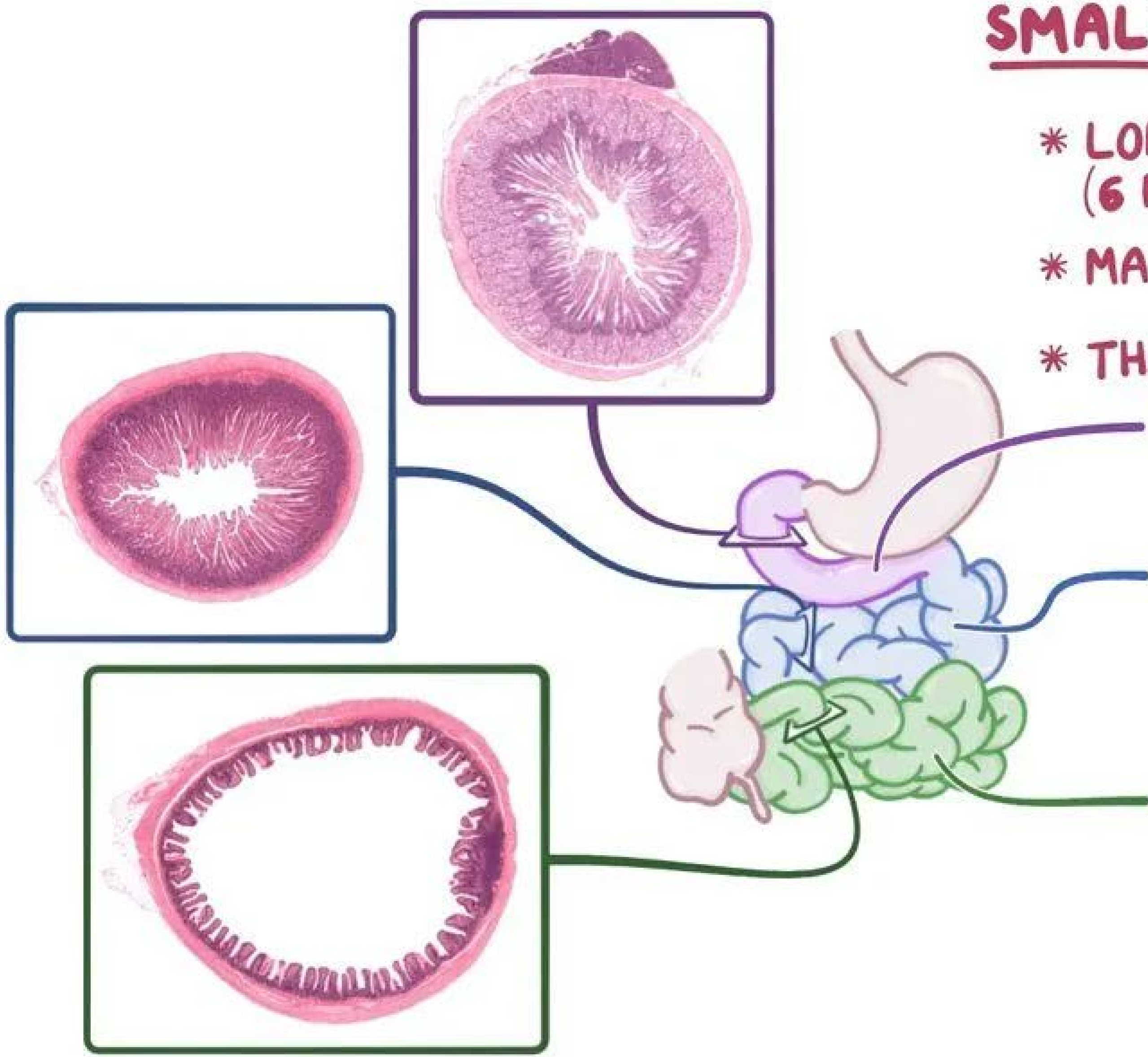

Ano-Rectal Junction
van Gieson
rectum
crypts of
Lieberkühn
keratinized stratified
squamous epithelium
anal canal


muscularis externa
villi


Jejunum H&E
muscularis
externa
villi
plicae
circulares

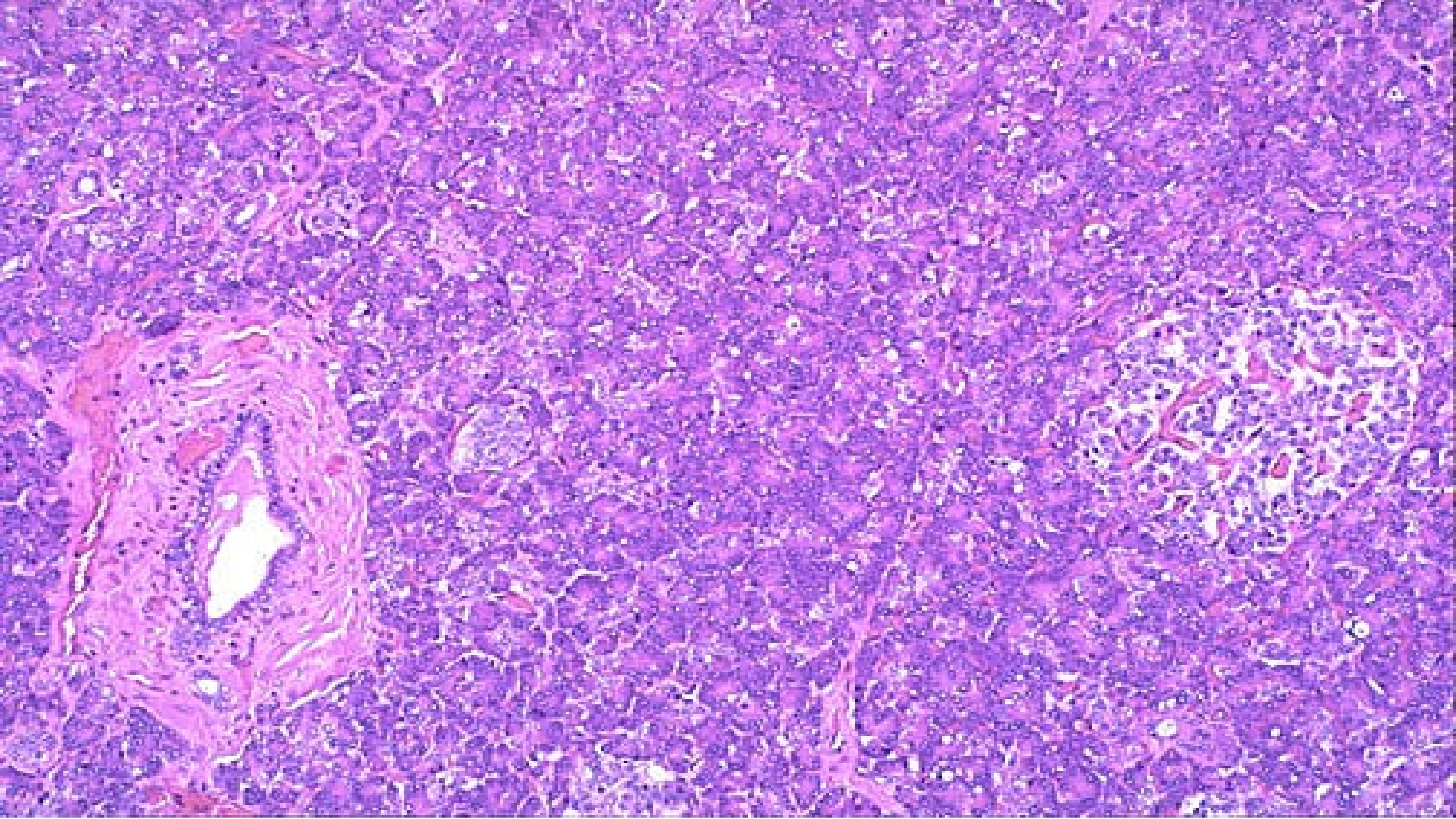
ILEUM

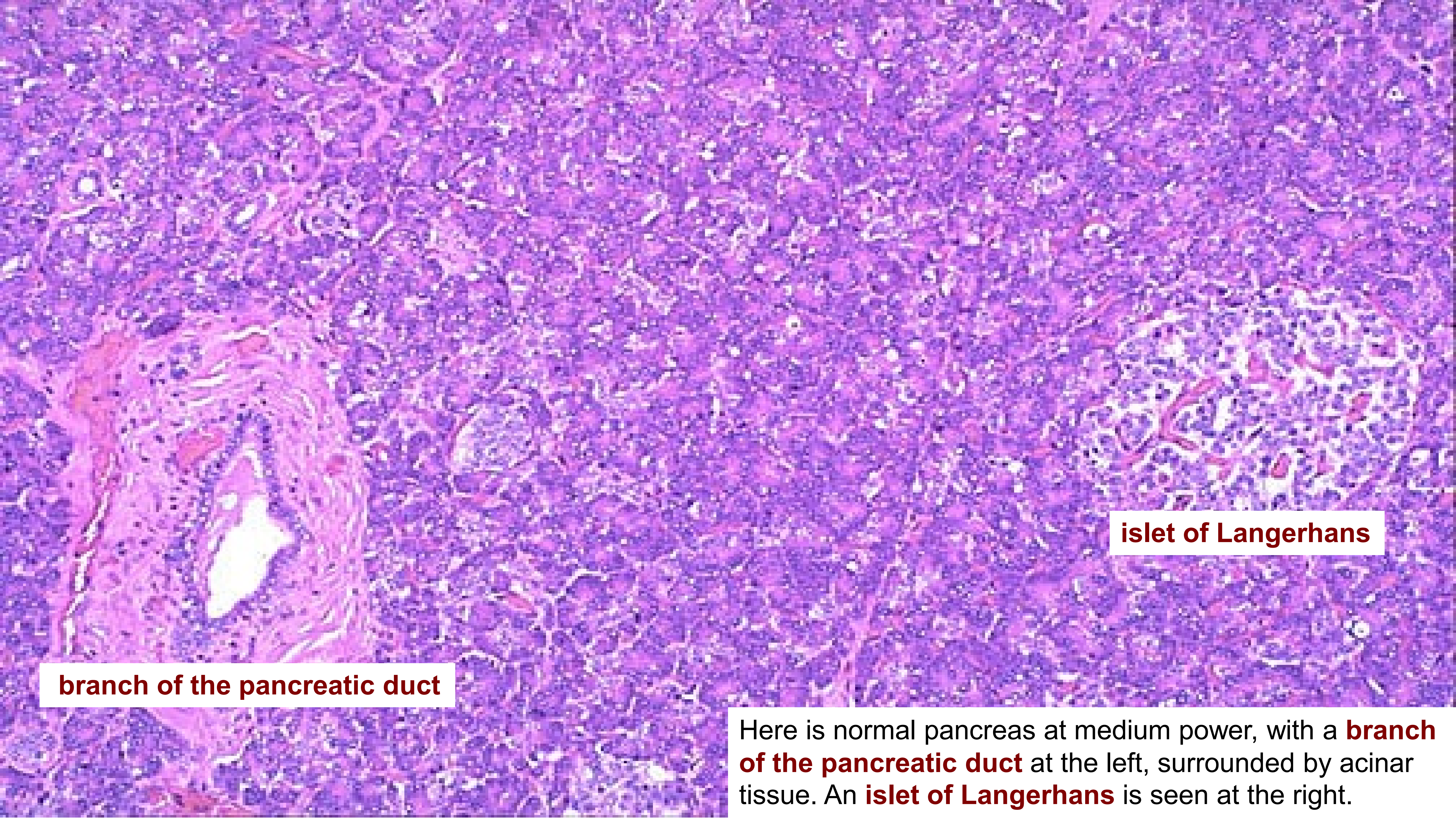




SMALL INTESTINE

- LONGEST PORTION of the GI TRACT (**6 METERS** in ADULTS)
- MAIN SITE for DIGESTION & ABSORPTION of FOOD
- THREE MAIN SEGMENTS:
  - DUODENUM
    - MOST PROXIMAL & SHORTEST SEGMENT
  - JEJUNUM
    - ~2.5 METERS LONG
    - GRADUALLY TRANSITIONS to the ILEUM
  - ILEUM
    - 3.5 METERS LONG
    - LEADS to the CECUM of the LARGE INTESTINE

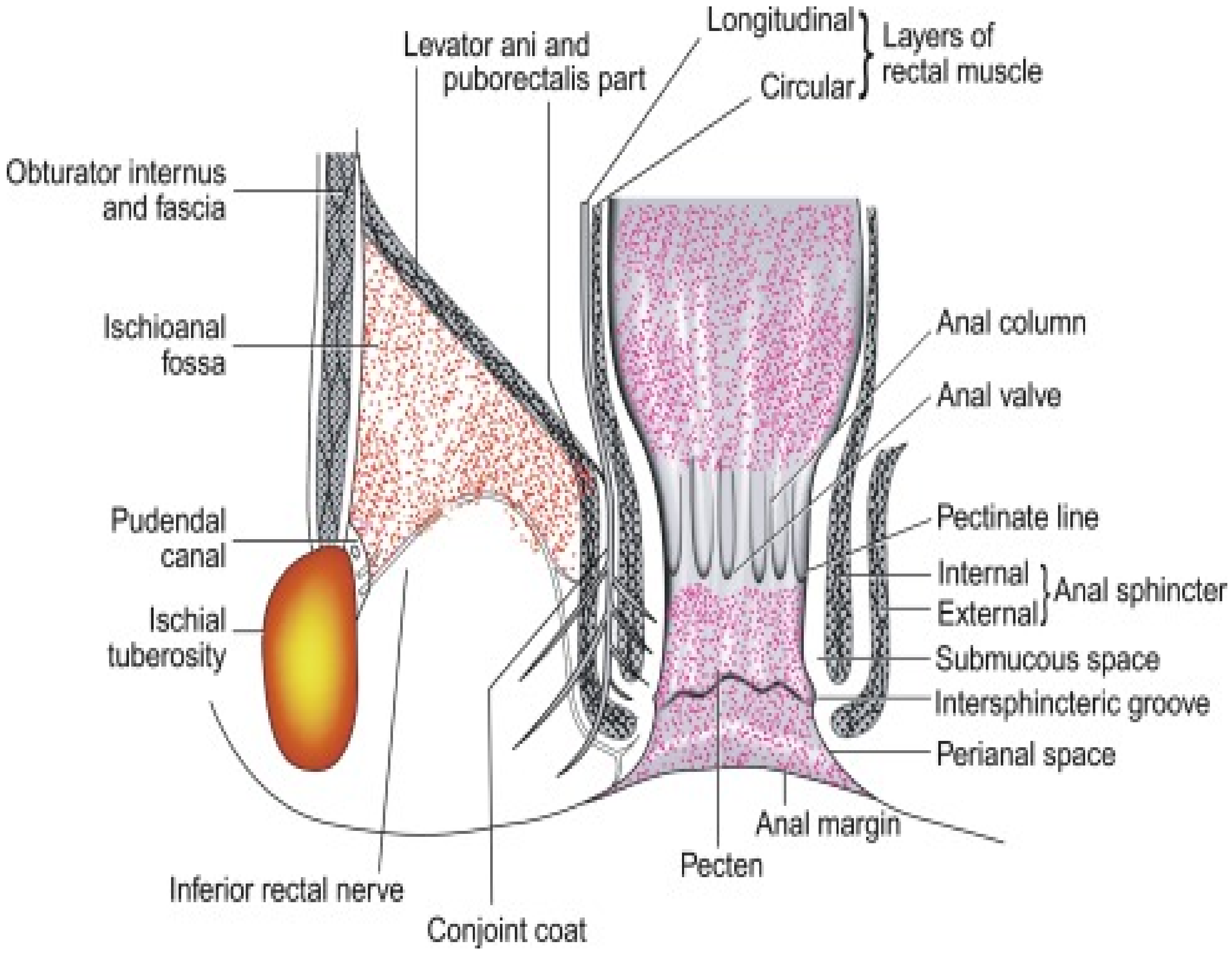


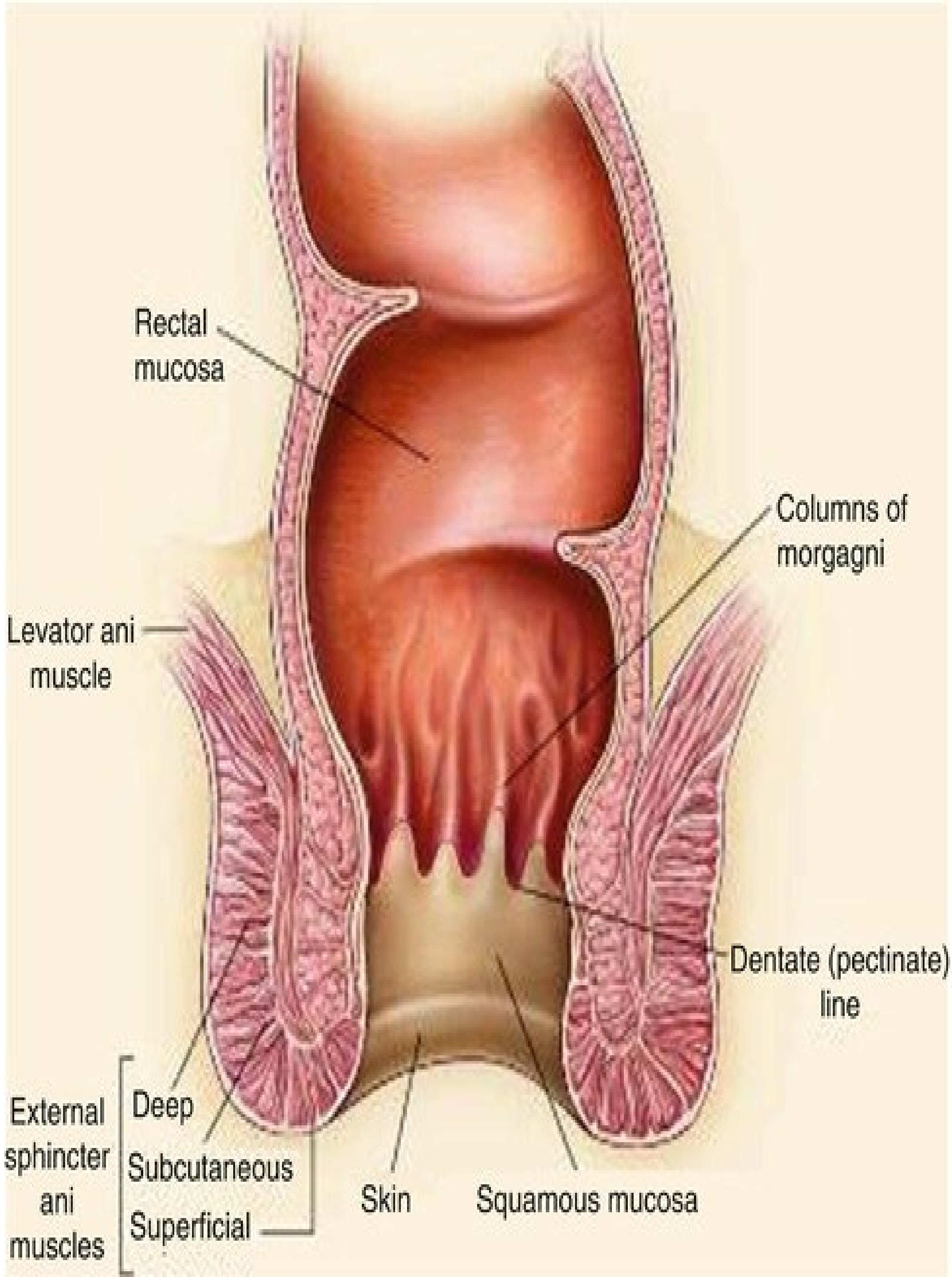


Here is normal pancreas at medium power, with a **branch of the pancreatic duct** at the left, surrounded by acinar tissue. An **islet of Langerhans** is seen at the right.

pectinate line -

•**pectinate line** - anal canal small mucosal folds between the anal columns (anal valves).

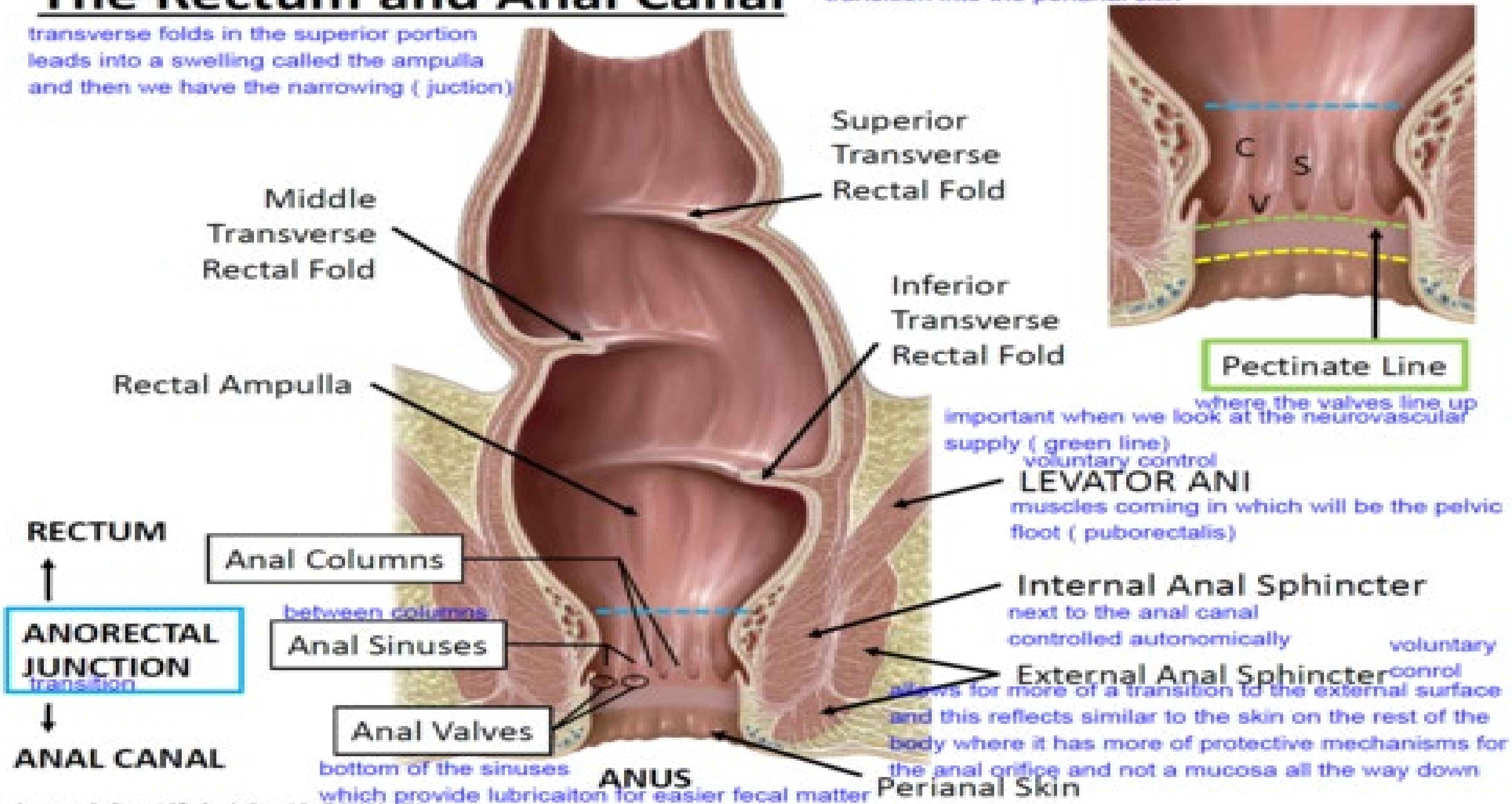




The Rectum and Anal Canal

yellow line is where the mucosal membranes end and we transition into the perianal skin

transverse folds in the superior portion leads into a swelling called the ampulla and then we have the narrowing (juction)



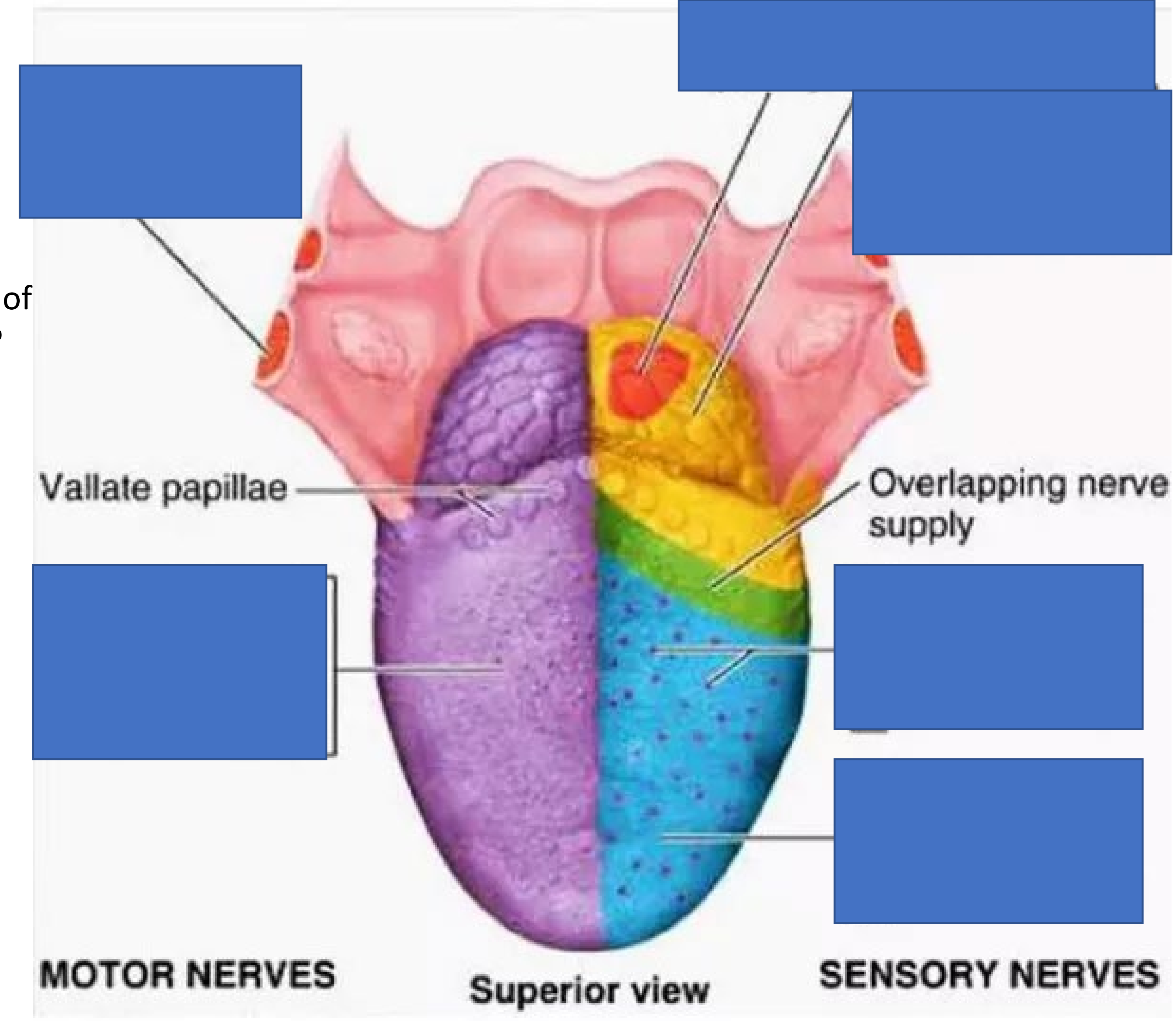
Abdominal quadrants

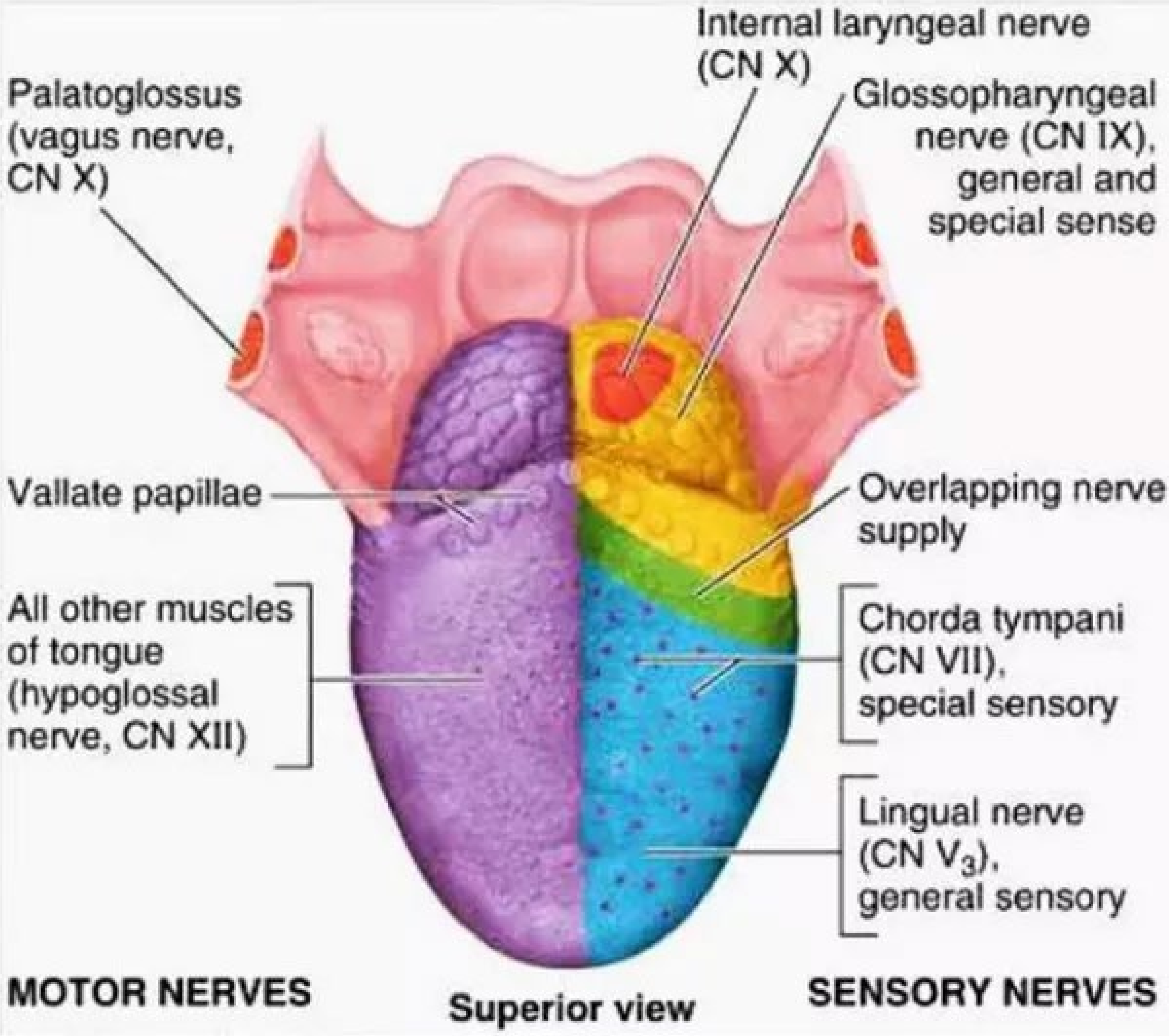
Right upper quadrant	Left upper quadrant
Right lower quadrant	**Left lower quadrant**

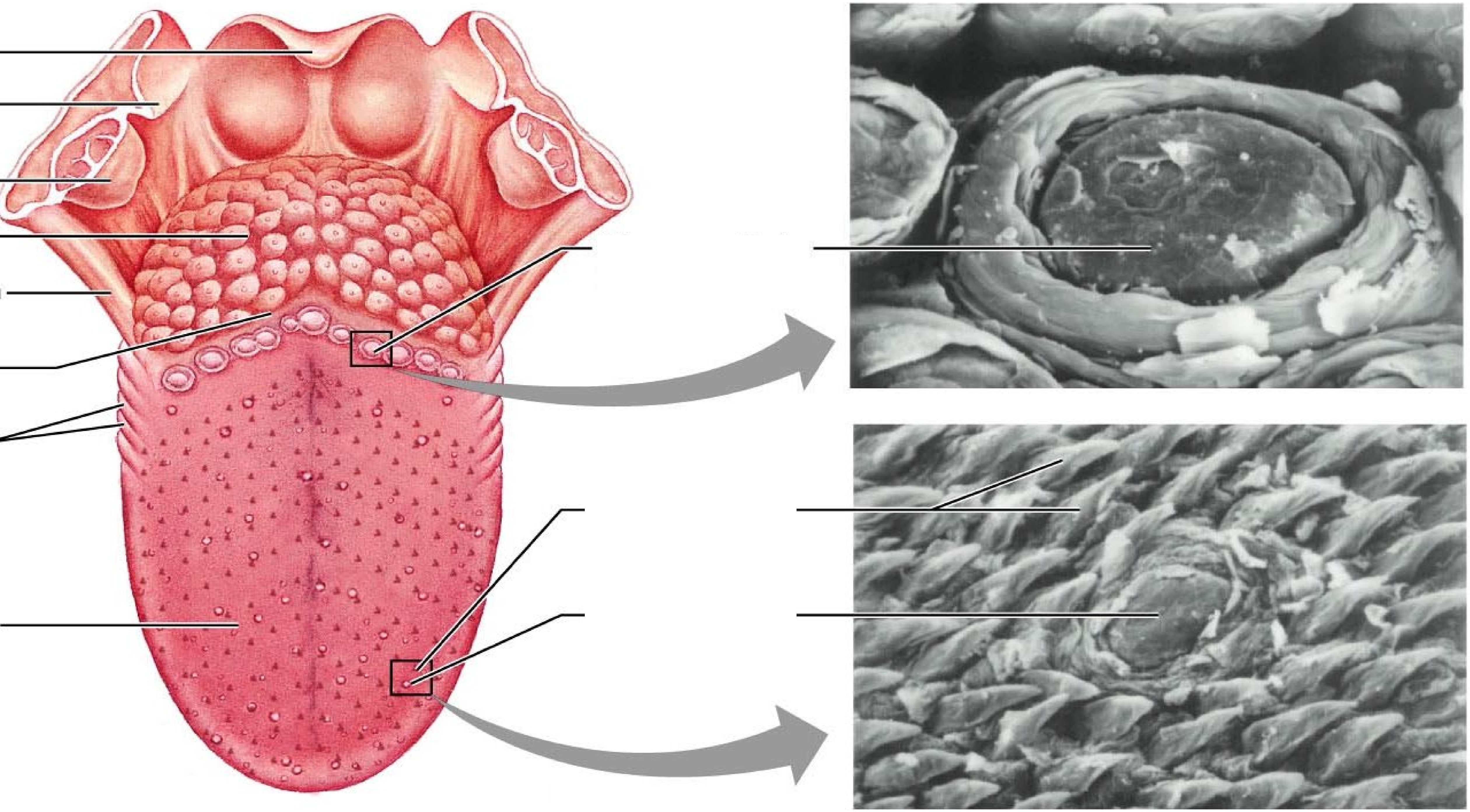
Abdominal quadrants

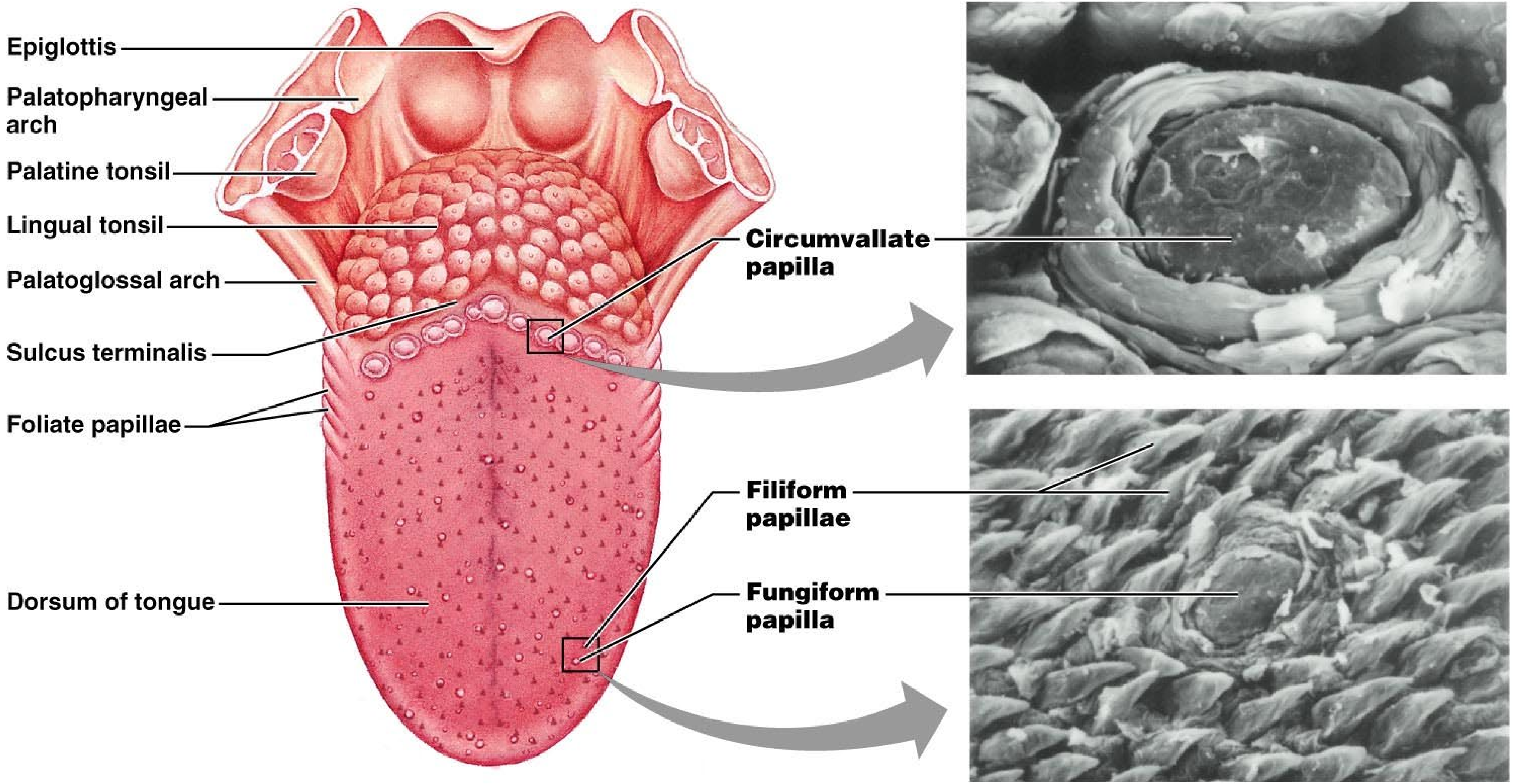
Right upper quadrant	Left upper quadrant
Liver right lobe Gallbladder, stomach, pylorus, doudenum, Pancreas head, R suprarenal gland, R kidney, R colic flexure, Ascending colon superior part, Transvrse colon R half.	Liver left lobe Spleen, stomach, jejunum, prox ileum, pancreas body and tail, left kidney, L suprarenal, left colic flexure, Transverse colon left part, descending colon superior part.
Right lower quadrant	**Left lower quadrant**
Cecum, Appendix, Ileum, Asc. Colon, R ovary, R uterine tube, R ureter, R spermatic cord, Uterus, Urinary bladder (full)	Sigmoid colon, Desc. Colon, L ovary, L uterine tube, L ureter, L spermatic cord, Uterus enlarge, Urinary bladder (full).

Innervation of the tongue?

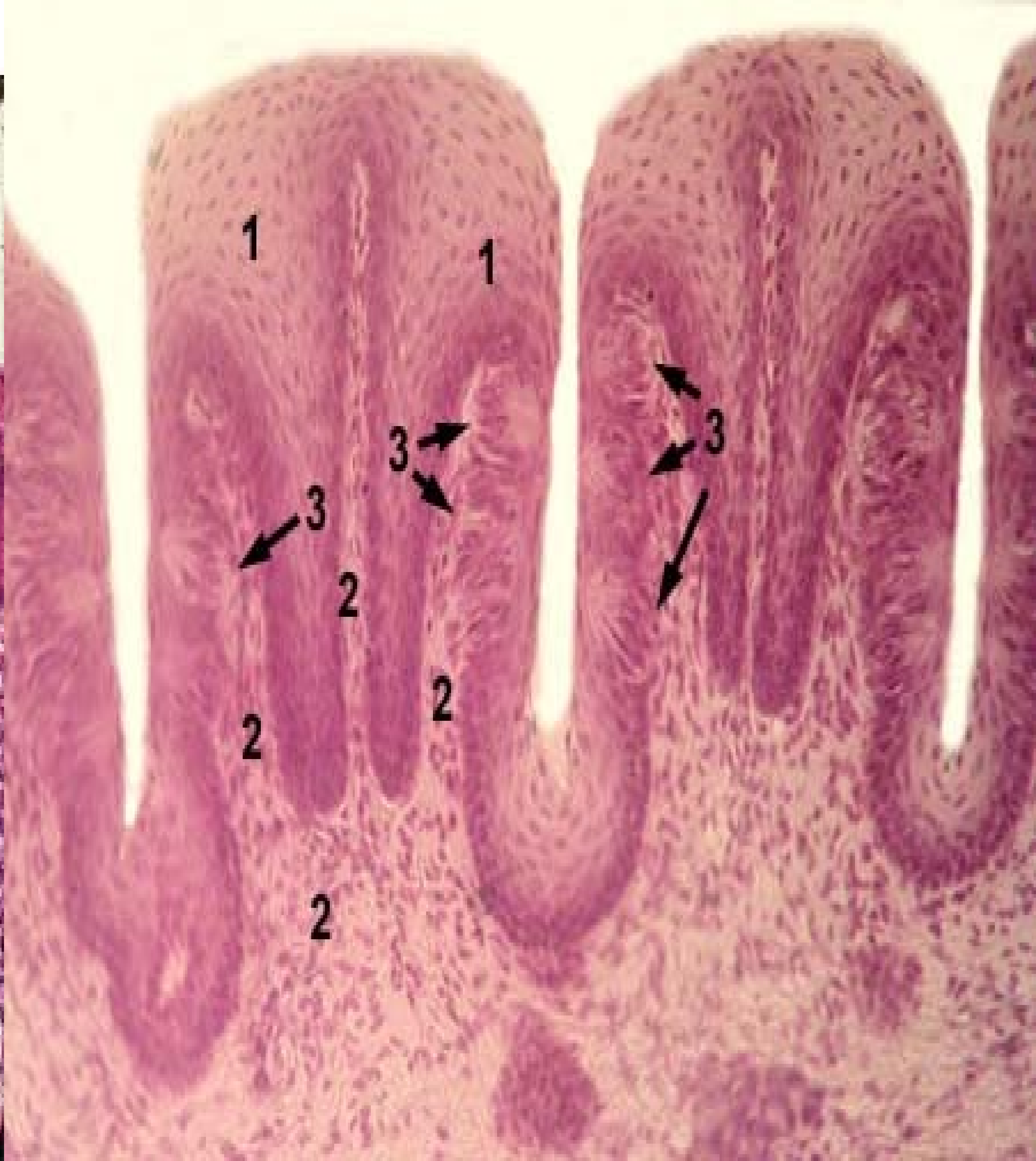



Internal laryngeal nerve (CN X)
Palatoglossus (vagus nerve, CN X)
Glossopharyngeal nerve (CN IX), general and special sense
Vallate papillae
Overlapping nerve supply
All other muscles of tongue (hypoglossal nerve, CN XII)
Chorda tympani (CN VII), special sensory
Lingual nerve (CN V_3), general sensory
MOTOR NERVES
Superior view
SENSORY NERVES




Epiglottis
Palatopharyngeal arch
Palatine tonsil
Lingual tonsil
Palatoglossal arch
Sulcus terminalis
Foliate papillae
Dorsum of tongue
Circumvallate papilla
Filiform papillae
Fungiform papilla

Histology Lab Part 13: Slide 36

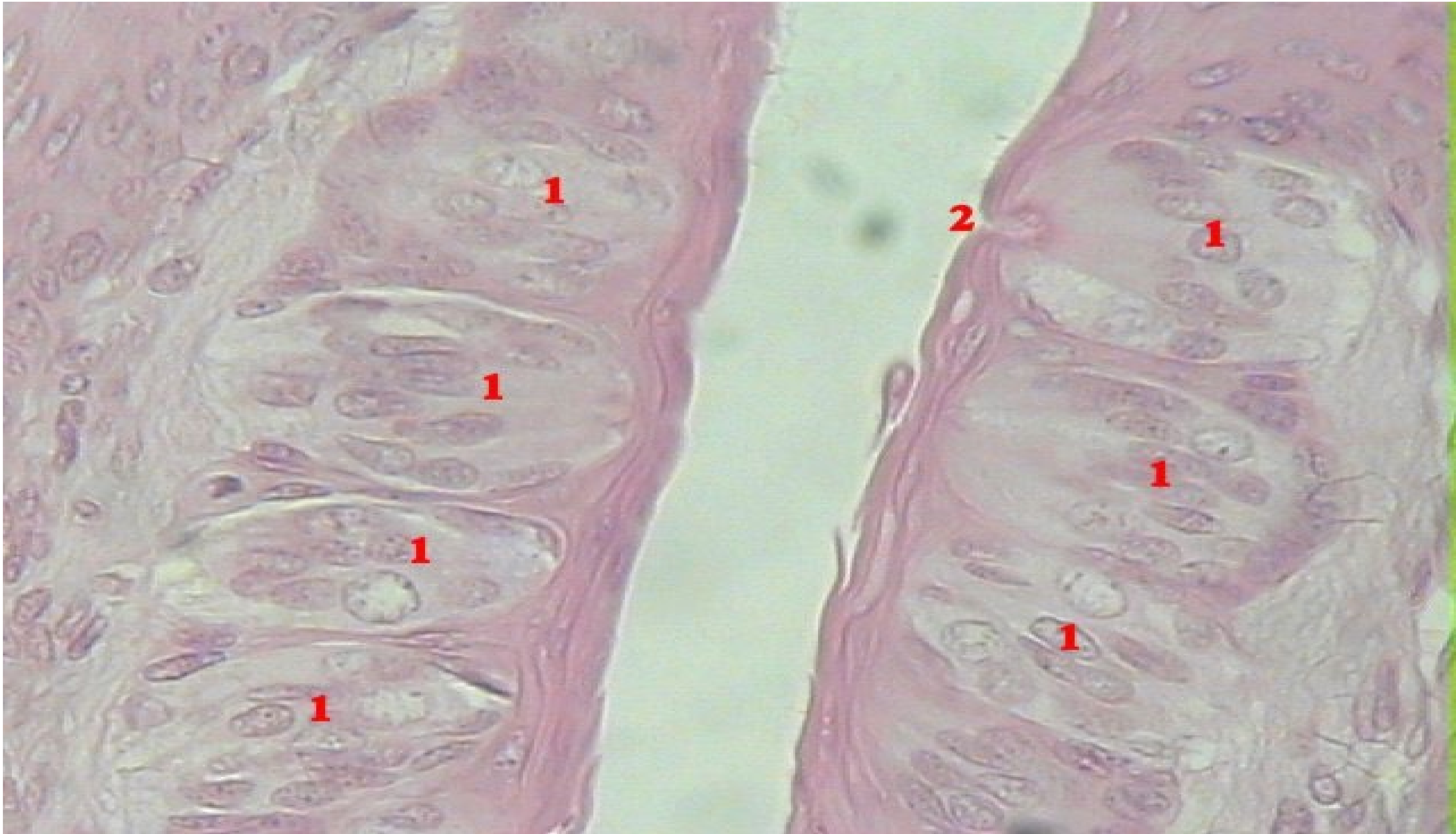


Histology Lab Part 13: Slide 36

Detail of circumvallate papilla, showing pale taste buds opening into the lumen of the furrow that surrounds the papilla.

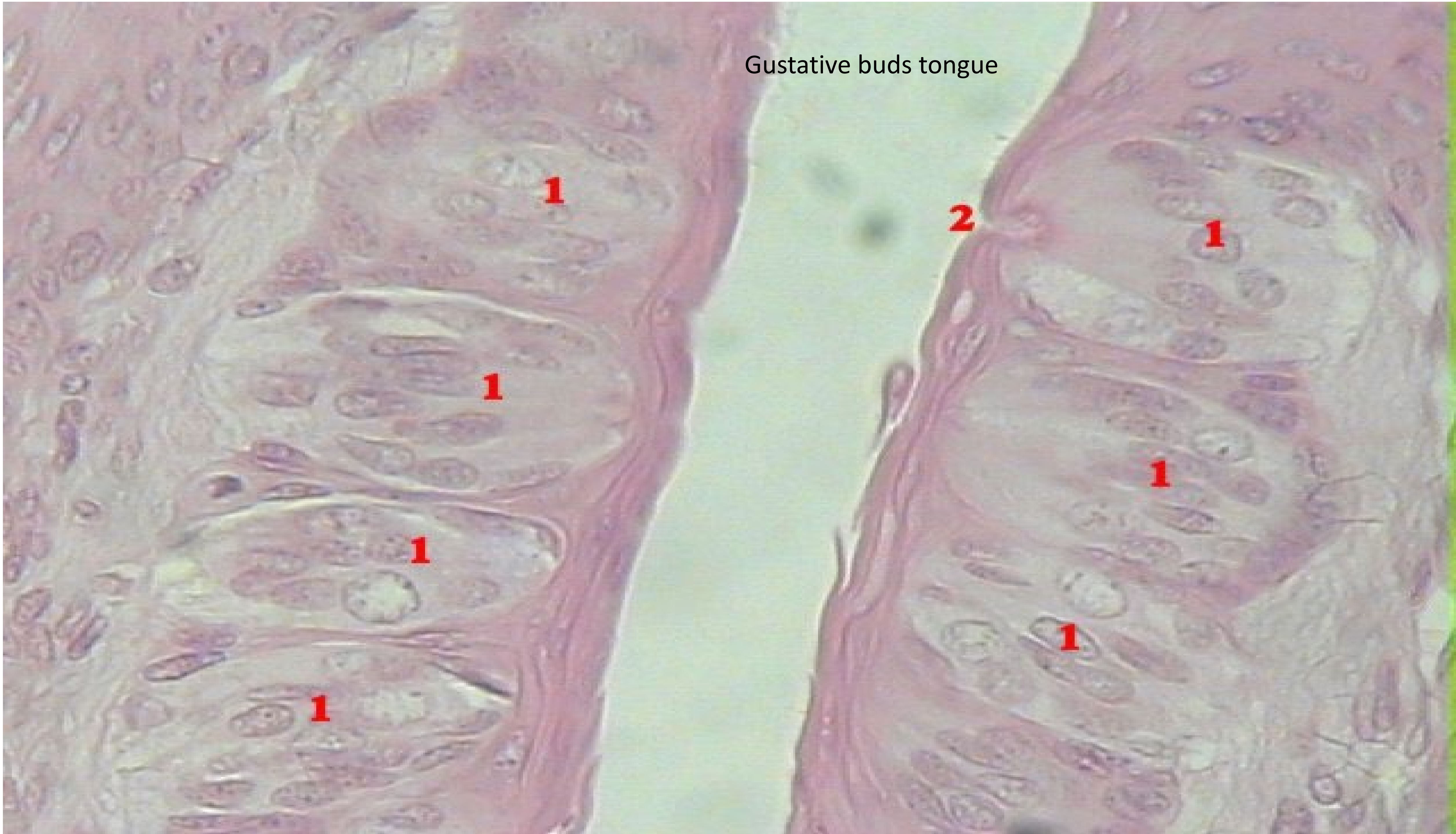
LEAF SHAPED PAPILLAE OF THE TONGUE

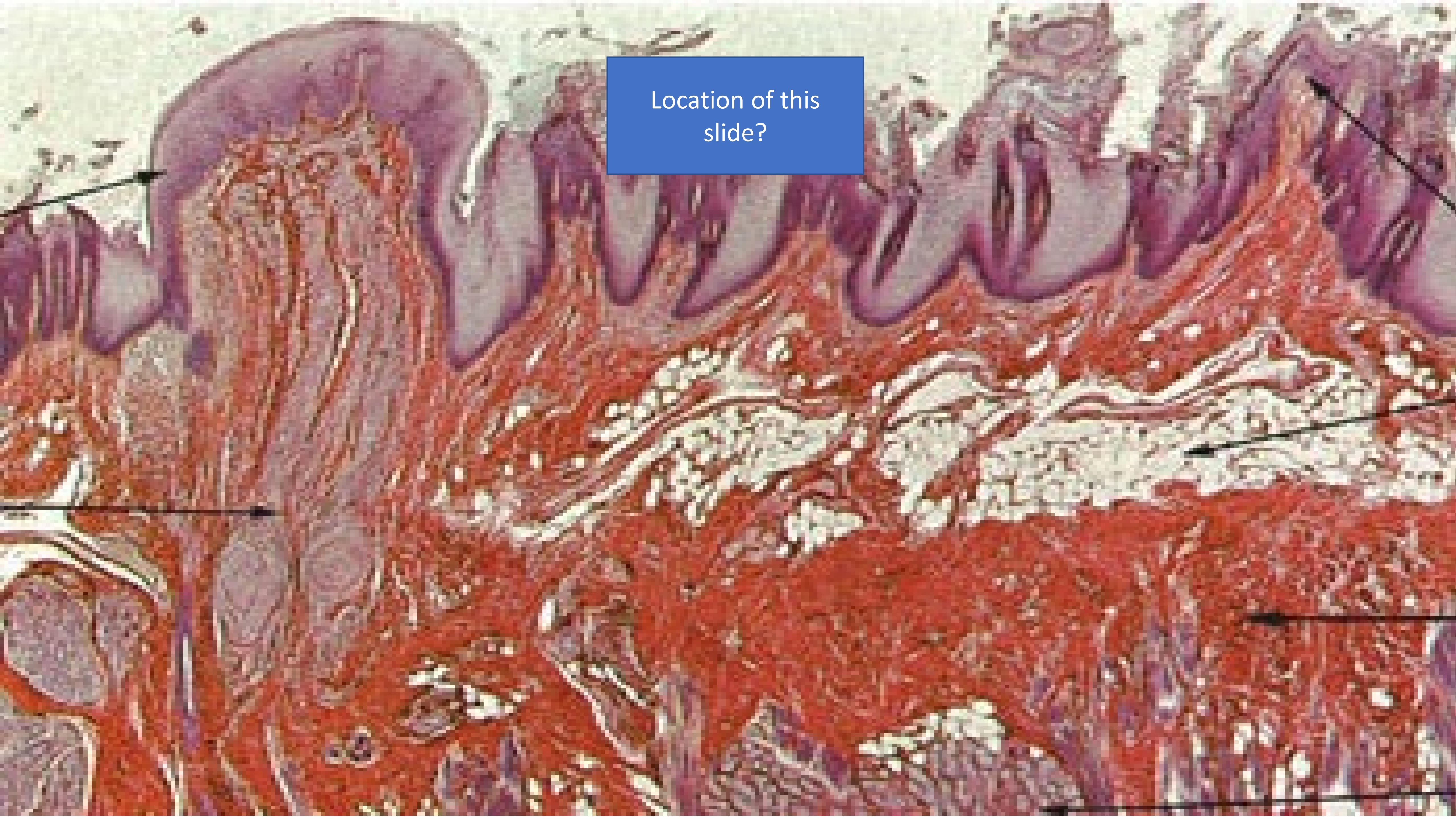
Stained with haematoxylin and eosin 1 - epithelium covering papilla
(stratified squamous nonkeratinizing)
2 - core of the papilla (lamina propria
of the mucosa of dorsal surface of the tongue)
3 - taste bud

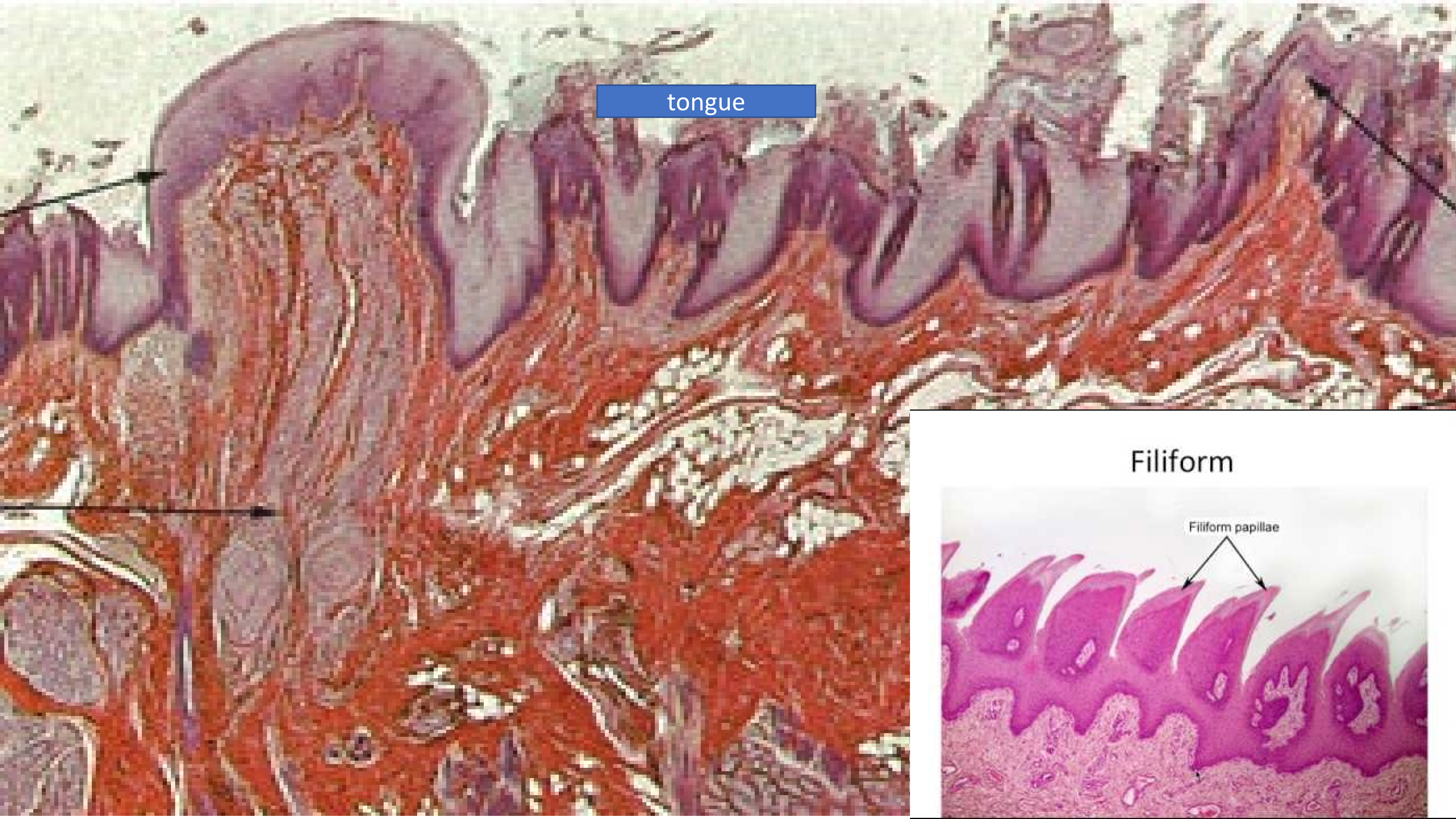


1
2
1
1
1
1
1
1

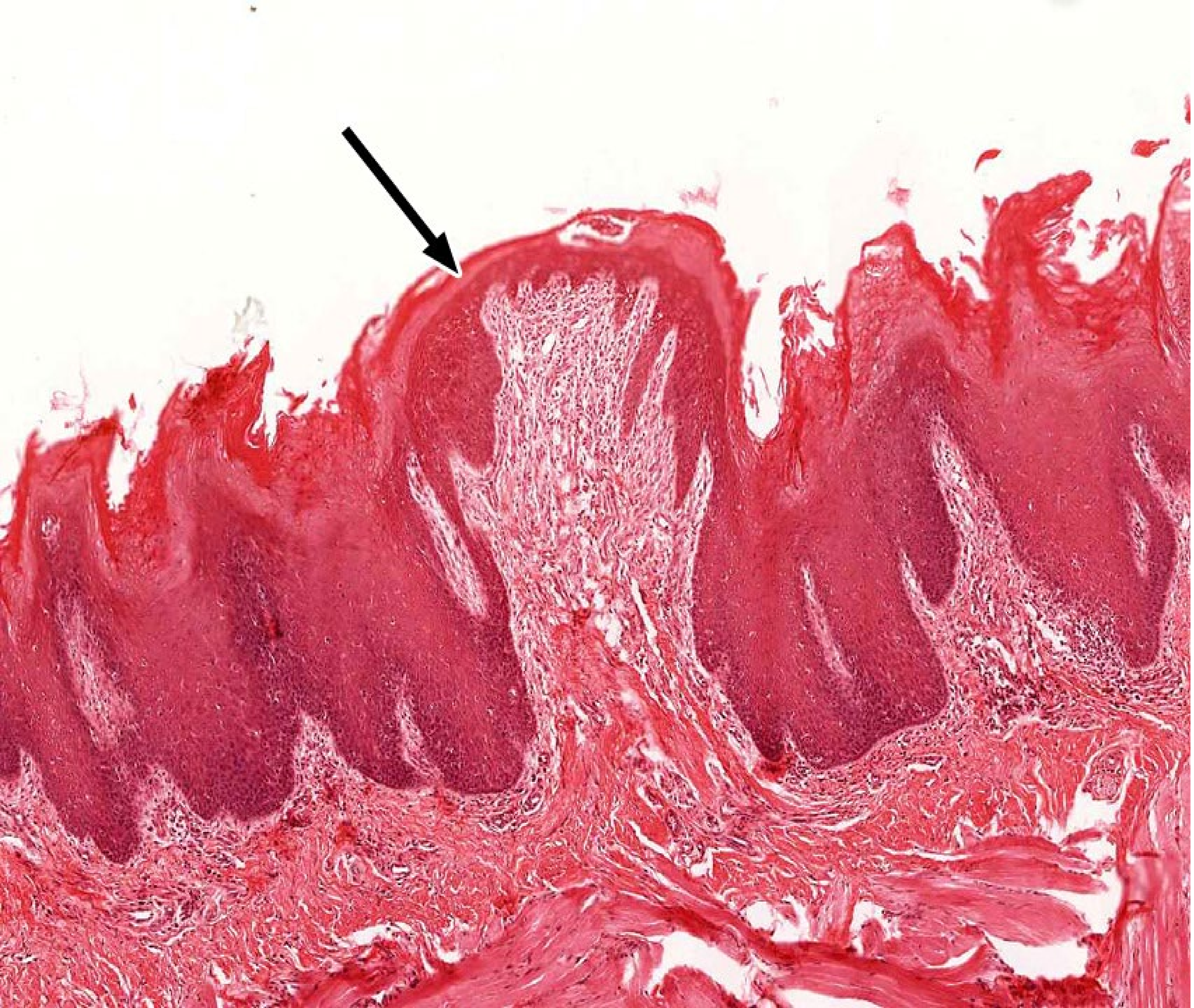
Gustative buds tongue




Location of this slide?

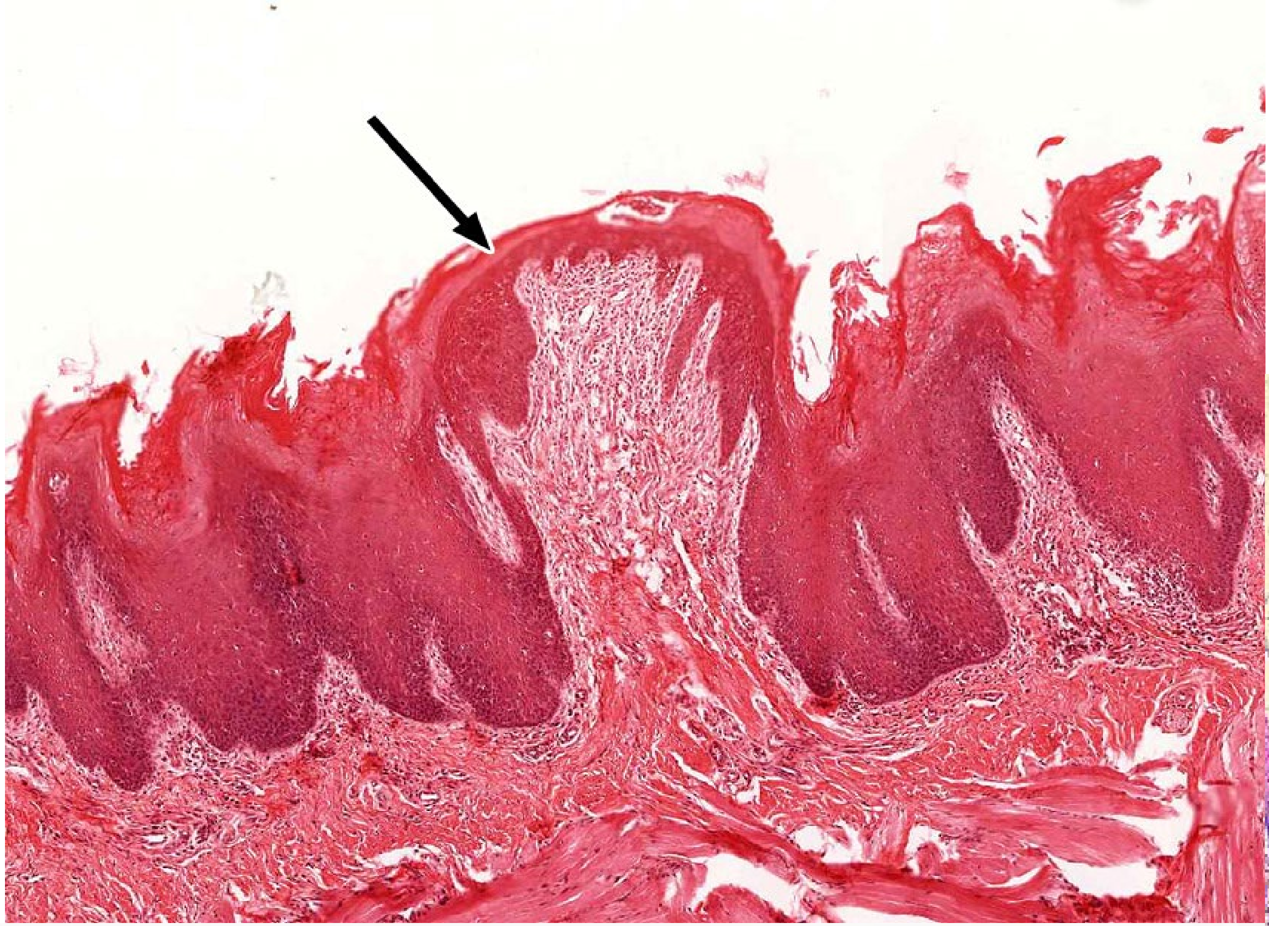

tongue

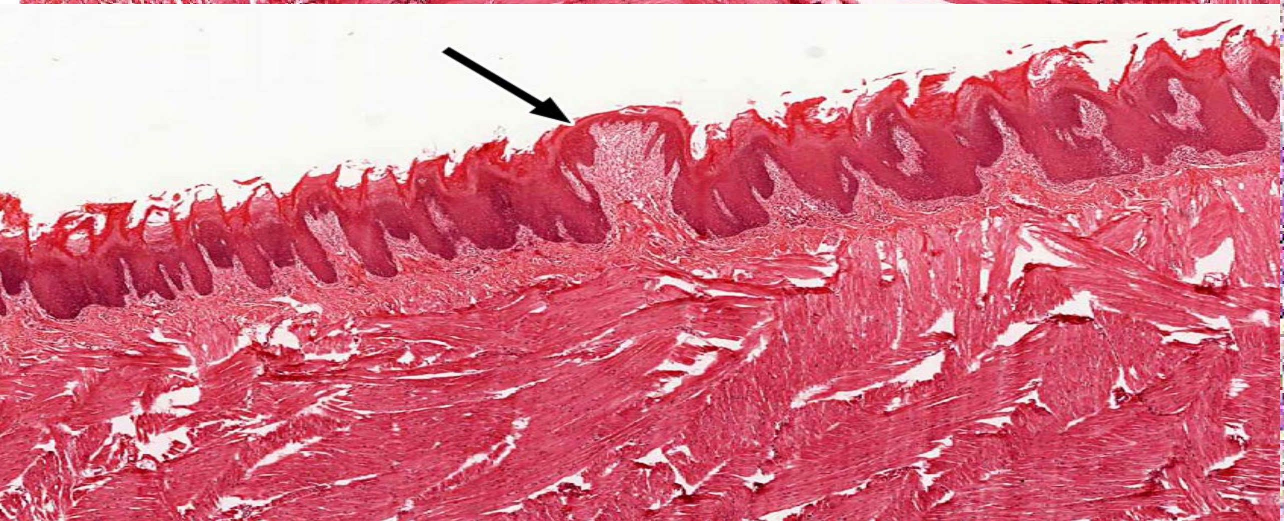
Filiform
Filiform papillae



Identify this structure?

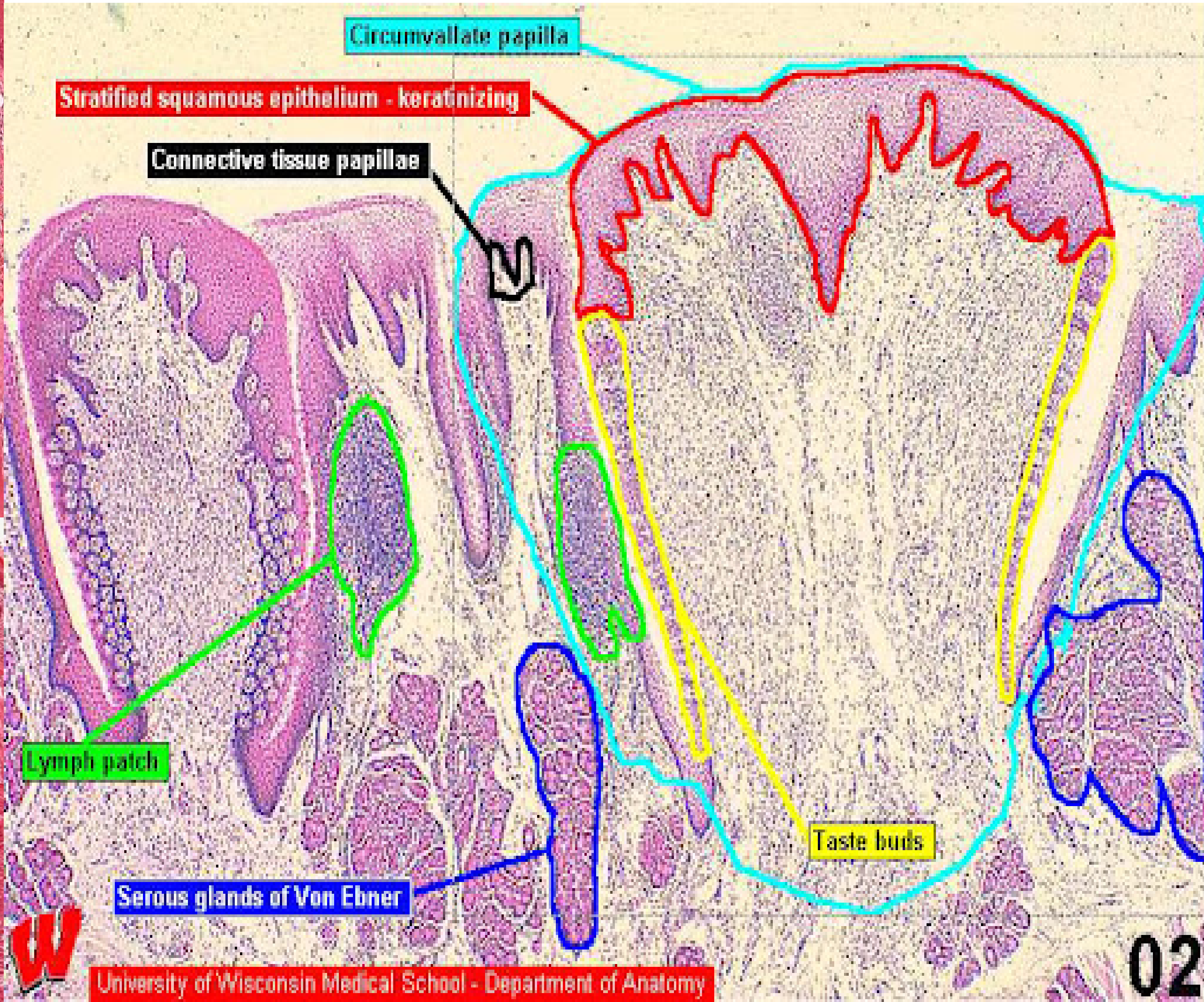
1.The vermillion zone of the lip
2.A filliform papilla of tongue
3.A fungiform papilla of tongue
4.A circumvallate papilla of tongue
5.The mucosa of pharynx

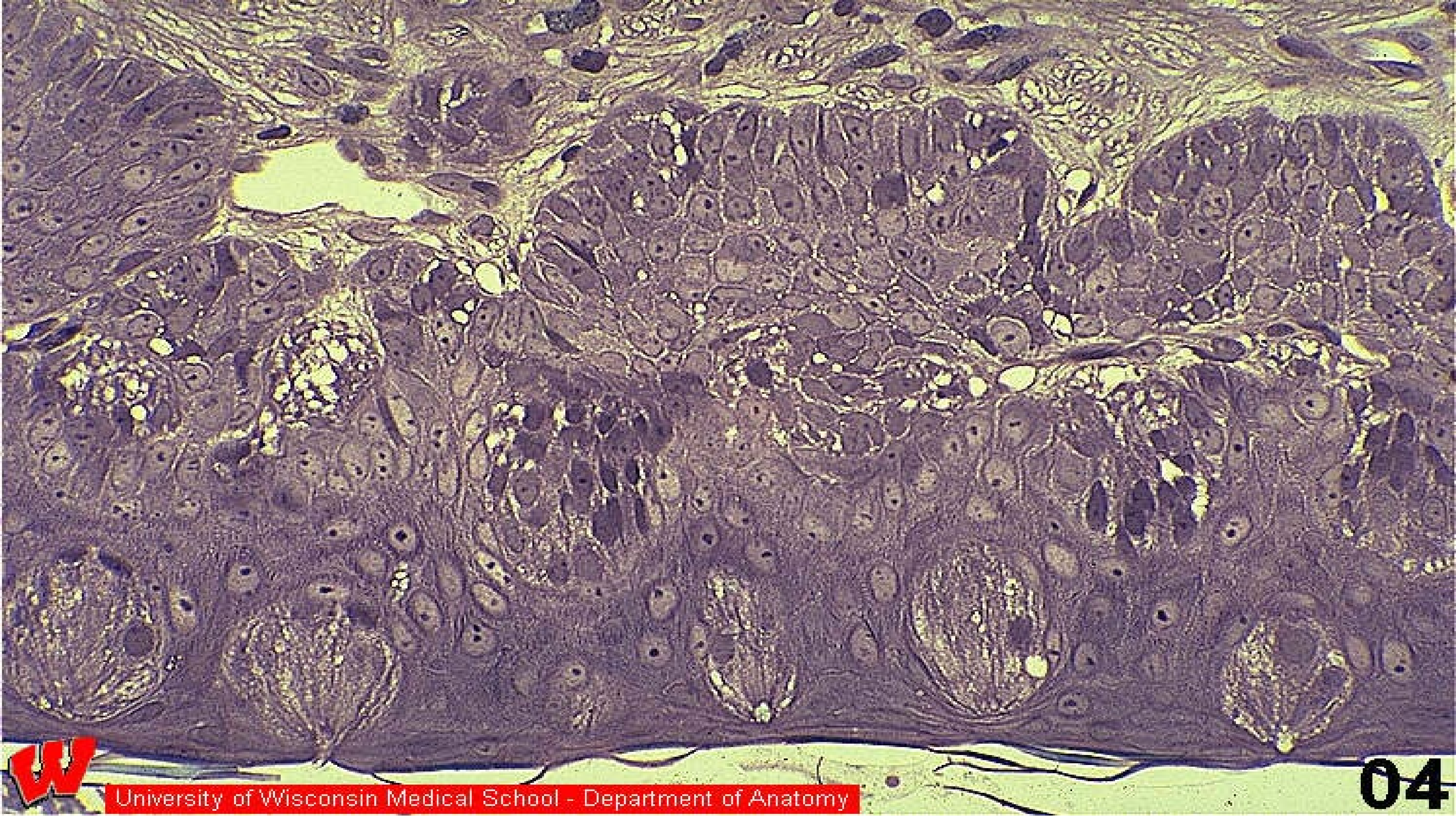


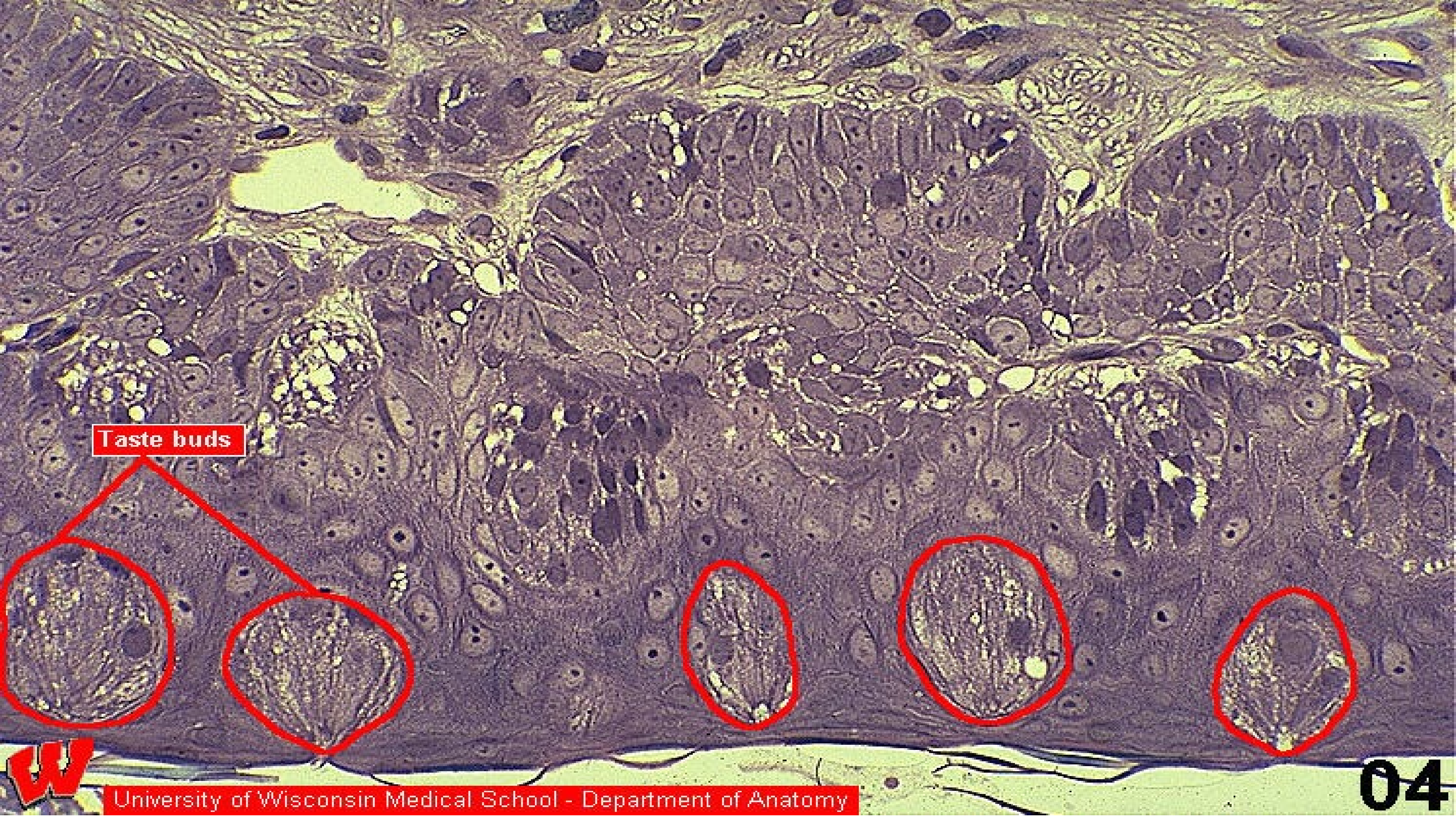


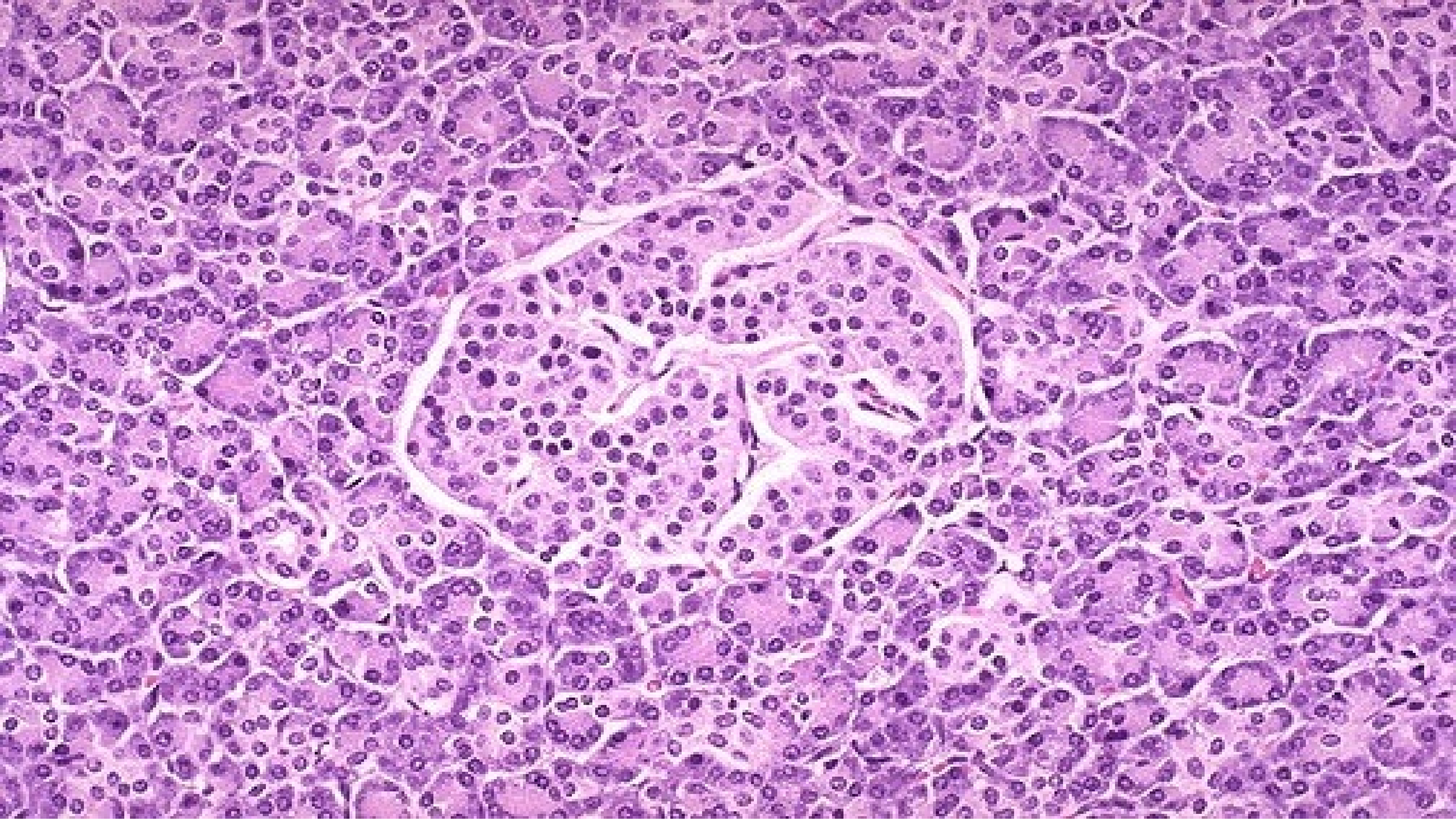
Identify this structure?

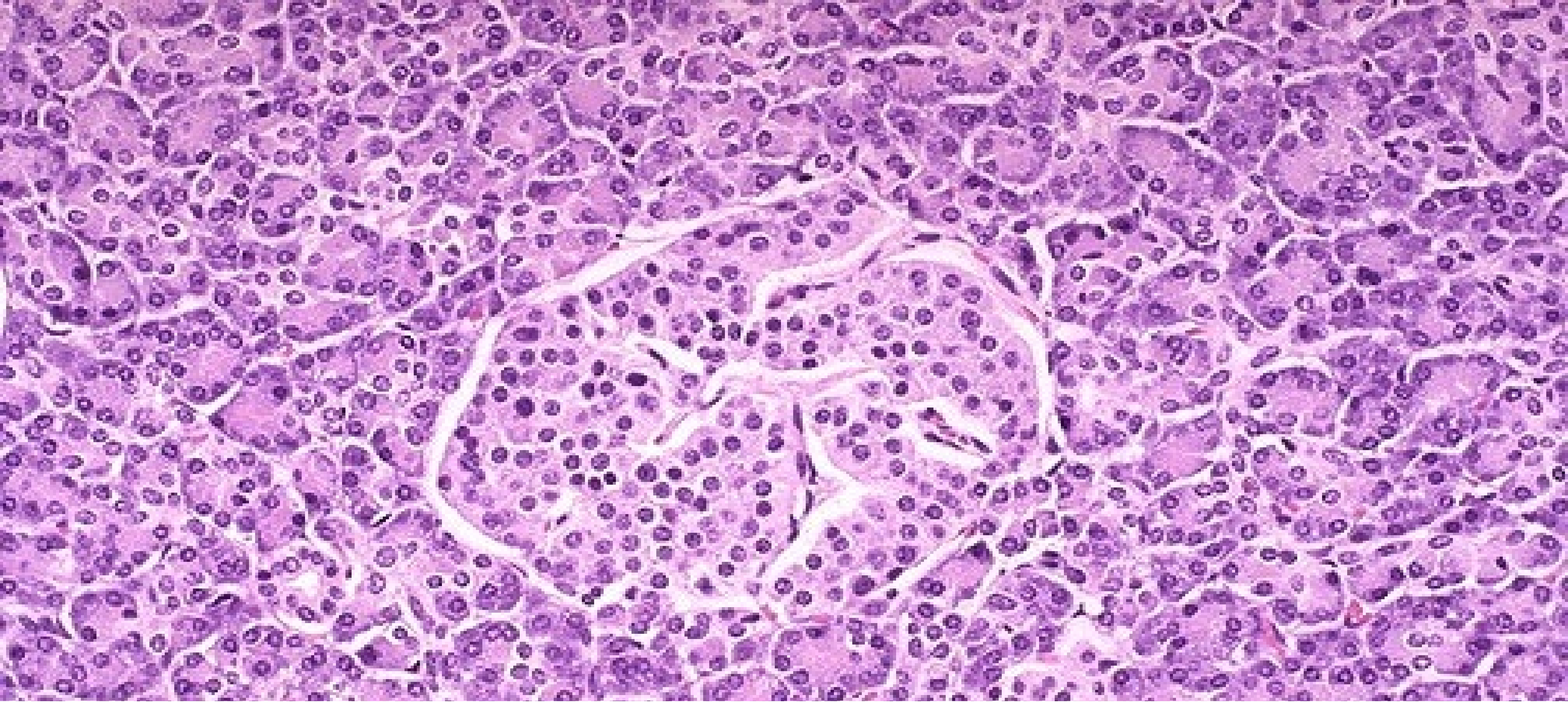
1.The vermillion zone of the lip
2.A filliform papilla of tongue
3.A fungiform papilla of tongue
4.A circumvallate papilla of tongue
5.The mucosa of pharynx



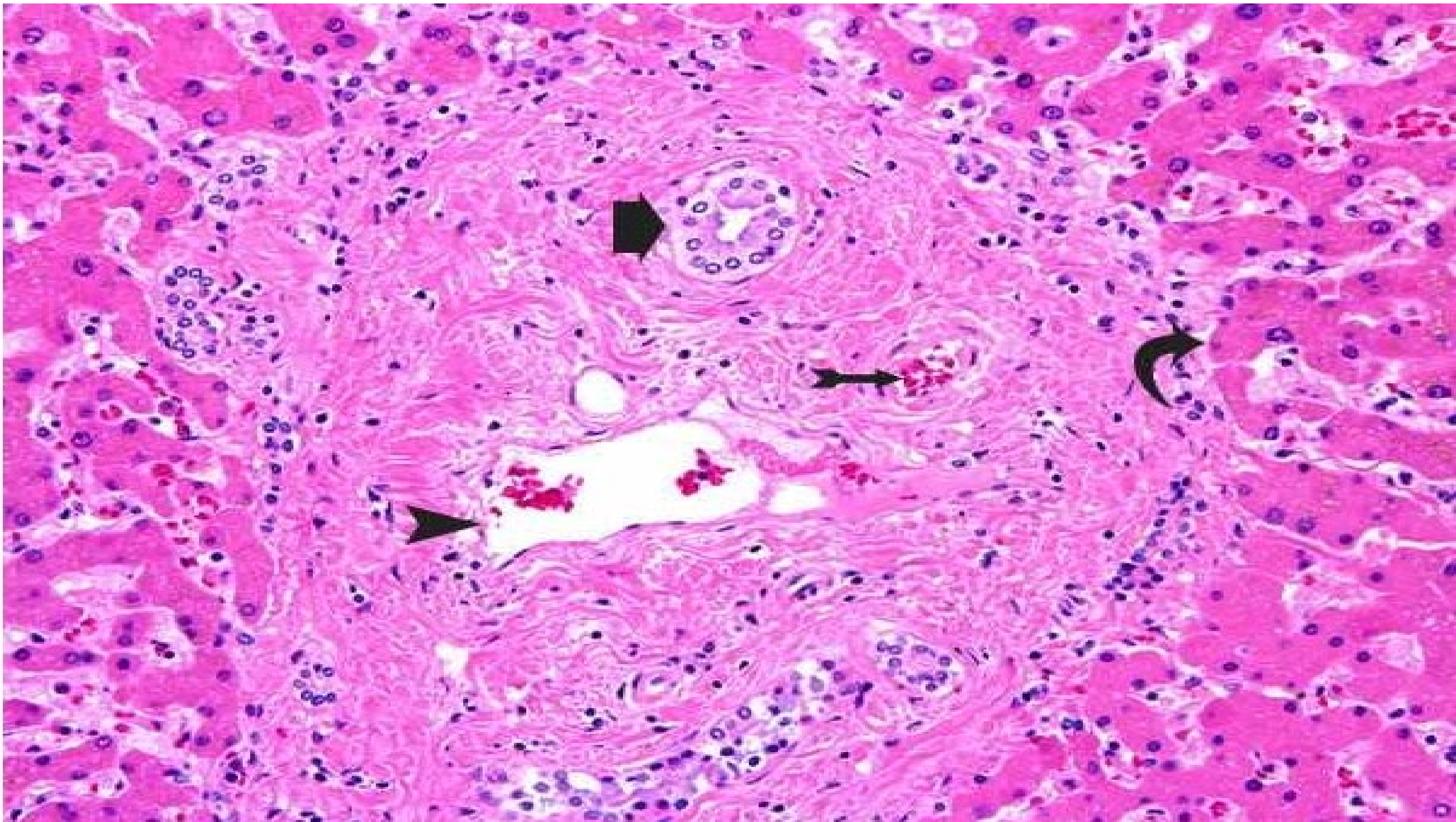

University of Wisconsin Medical School - Department of Anatomy
04

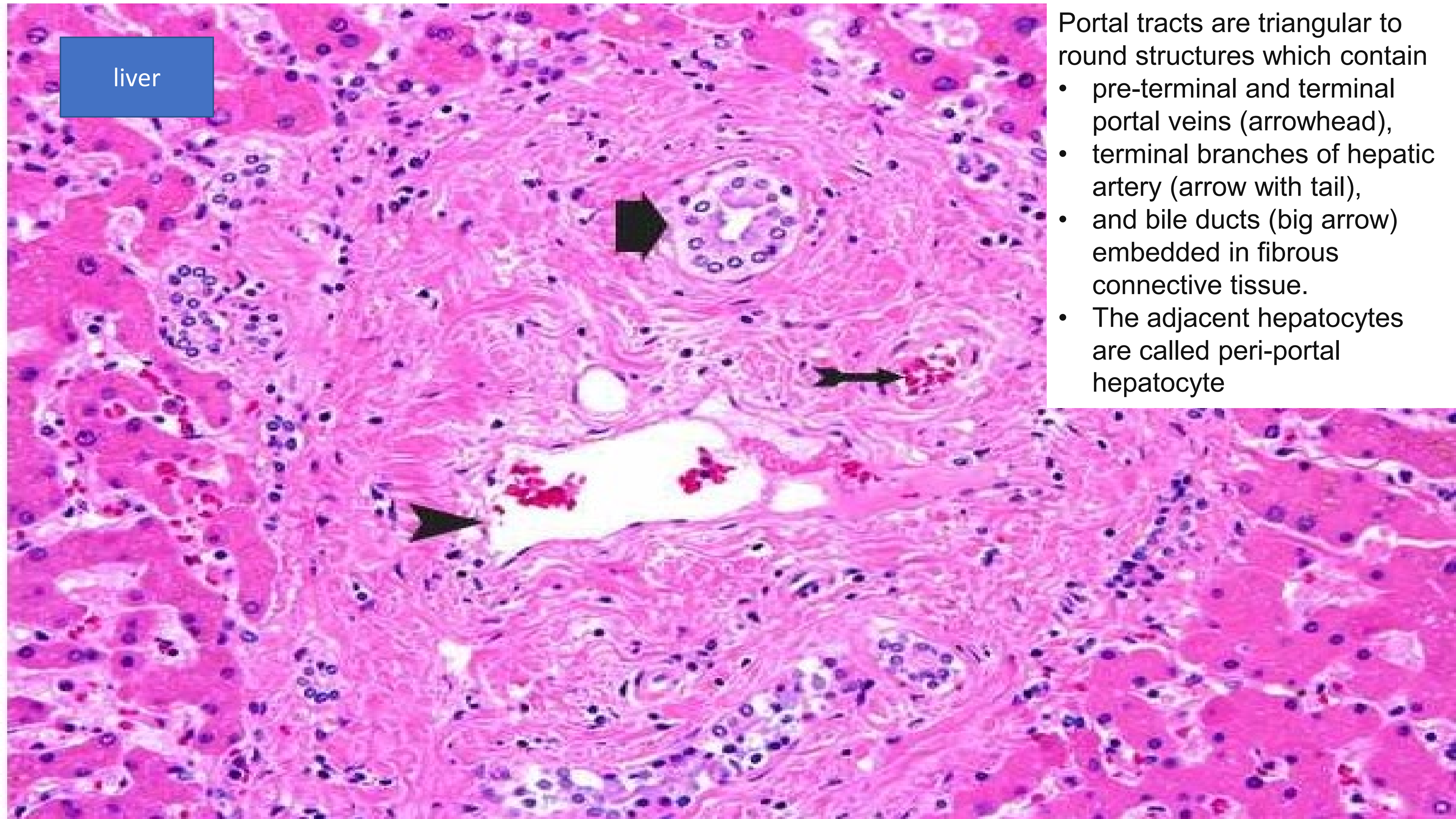

Taste buds
University of Wisconsin Medical School - Department of Anatomy
04





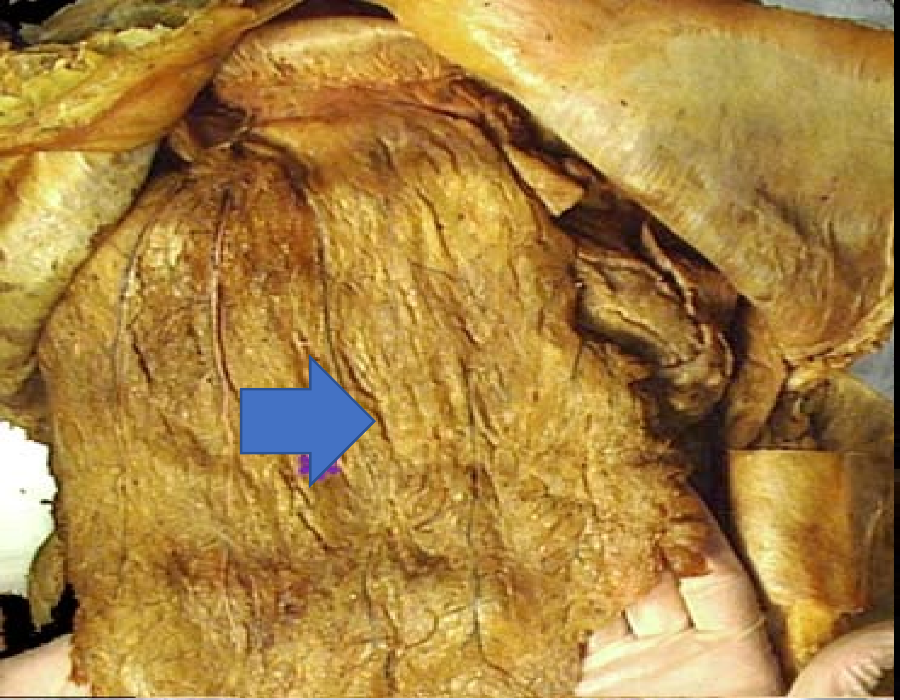
This is a normal **islet of Langerhans** seen at high power, surrounded by acinar pancreas.
The endocrine cells of the islet have a similar appearance with H&E staining.
Immunohistochemical staining can reveal which are alpha cells (secreting glucagon), beta cells (insulin), and delta cells (somatostatin).

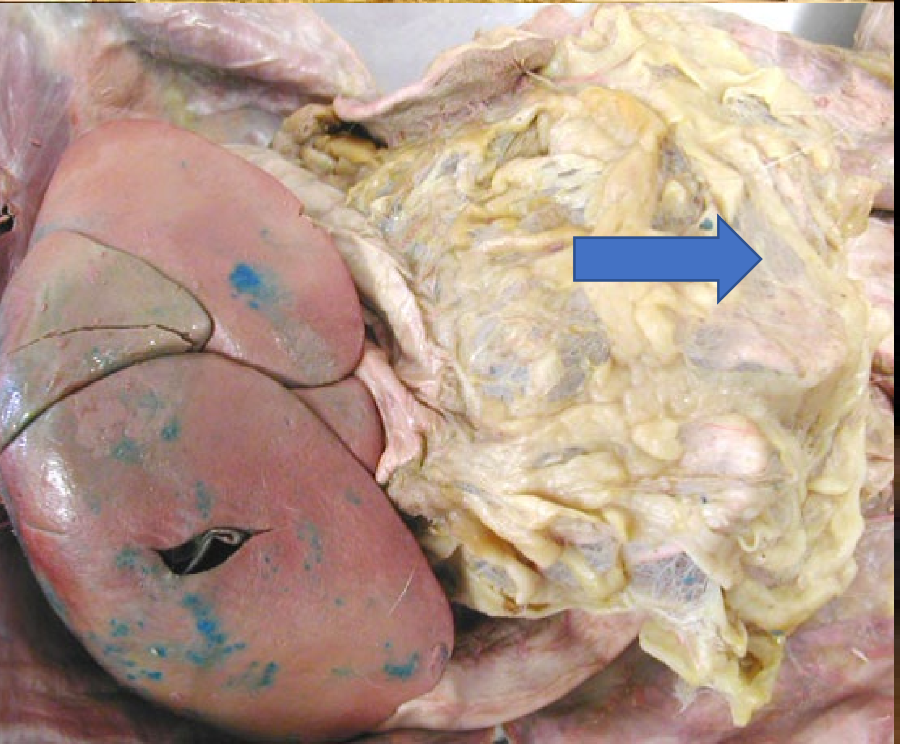




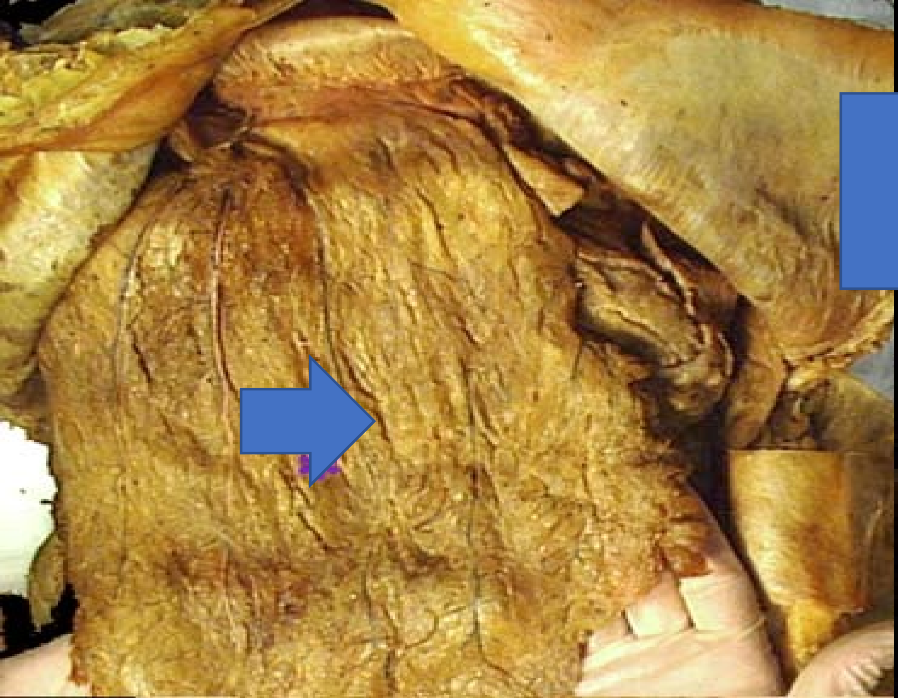
Portal tracts are triangular to round structures which contain

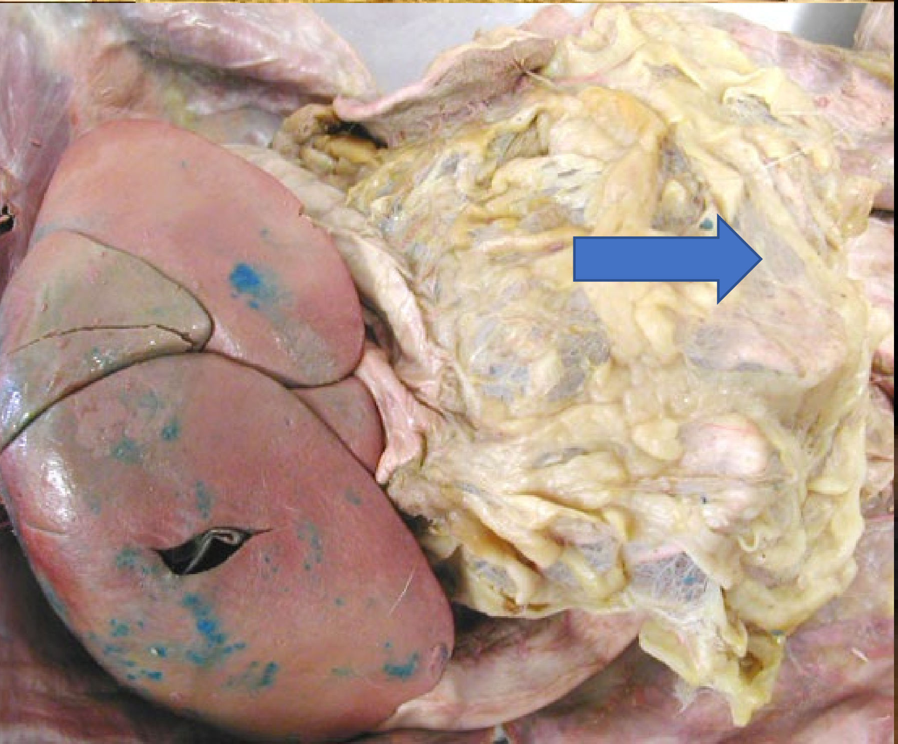
- pre-terminal and terminal portal veins (arrowhead),
- terminal branches of hepatic artery (arrow with tail),
- and bile ducts (big arrow) embedded in fibrous connective tissue.
- The adjacent hepatocytes are called peri-portal hepatocyte

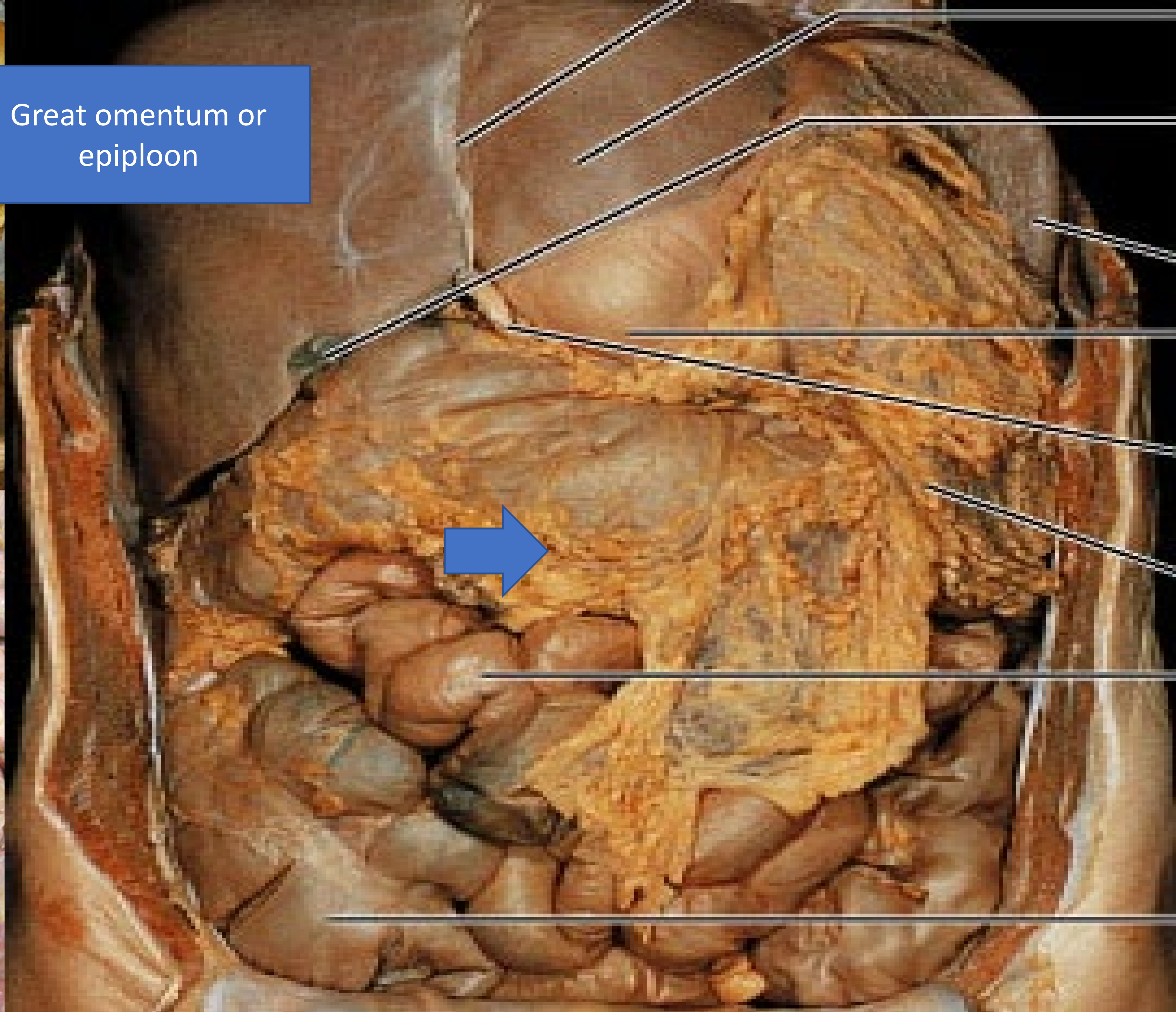




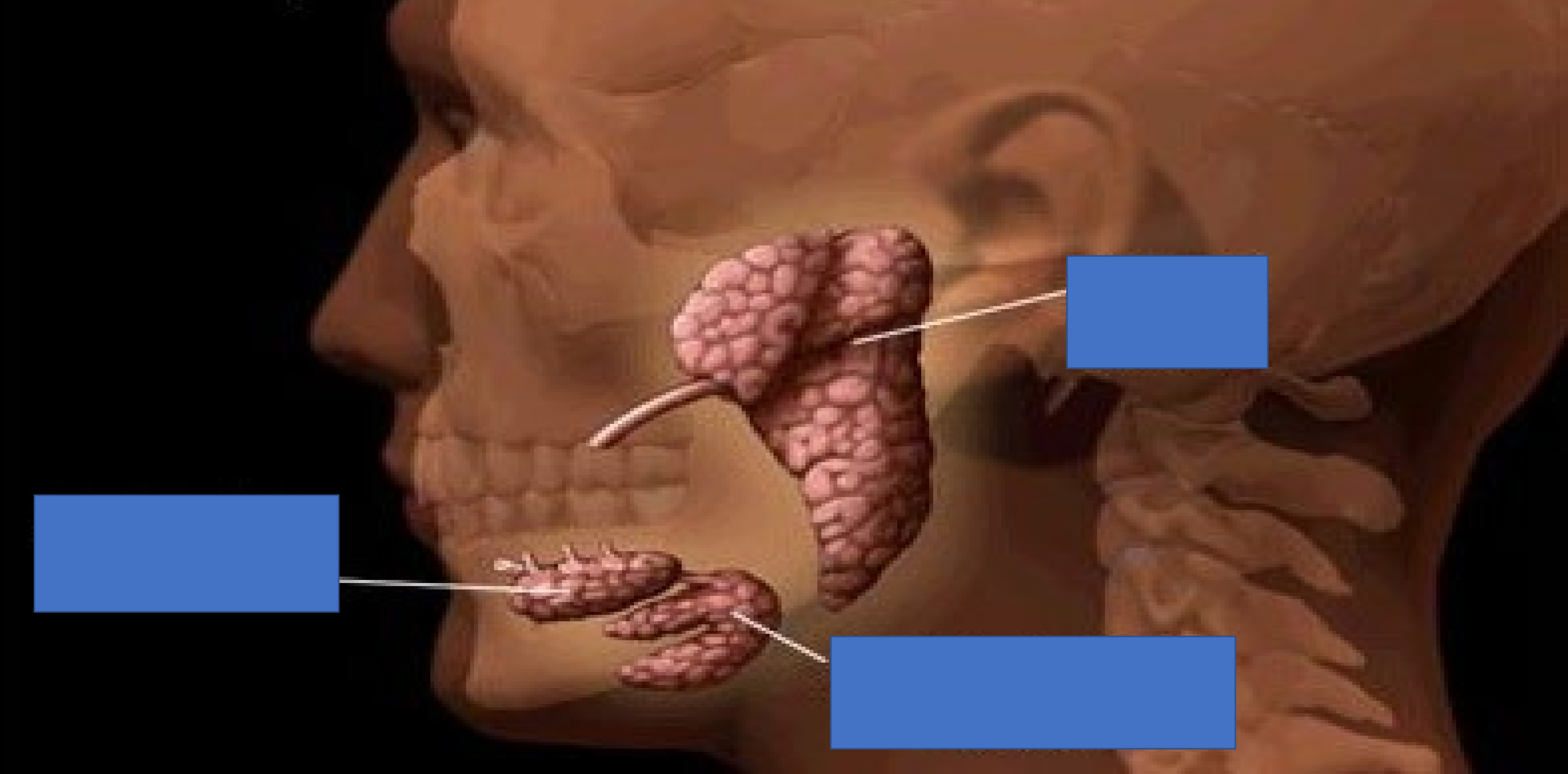
Great omentum or epiploon

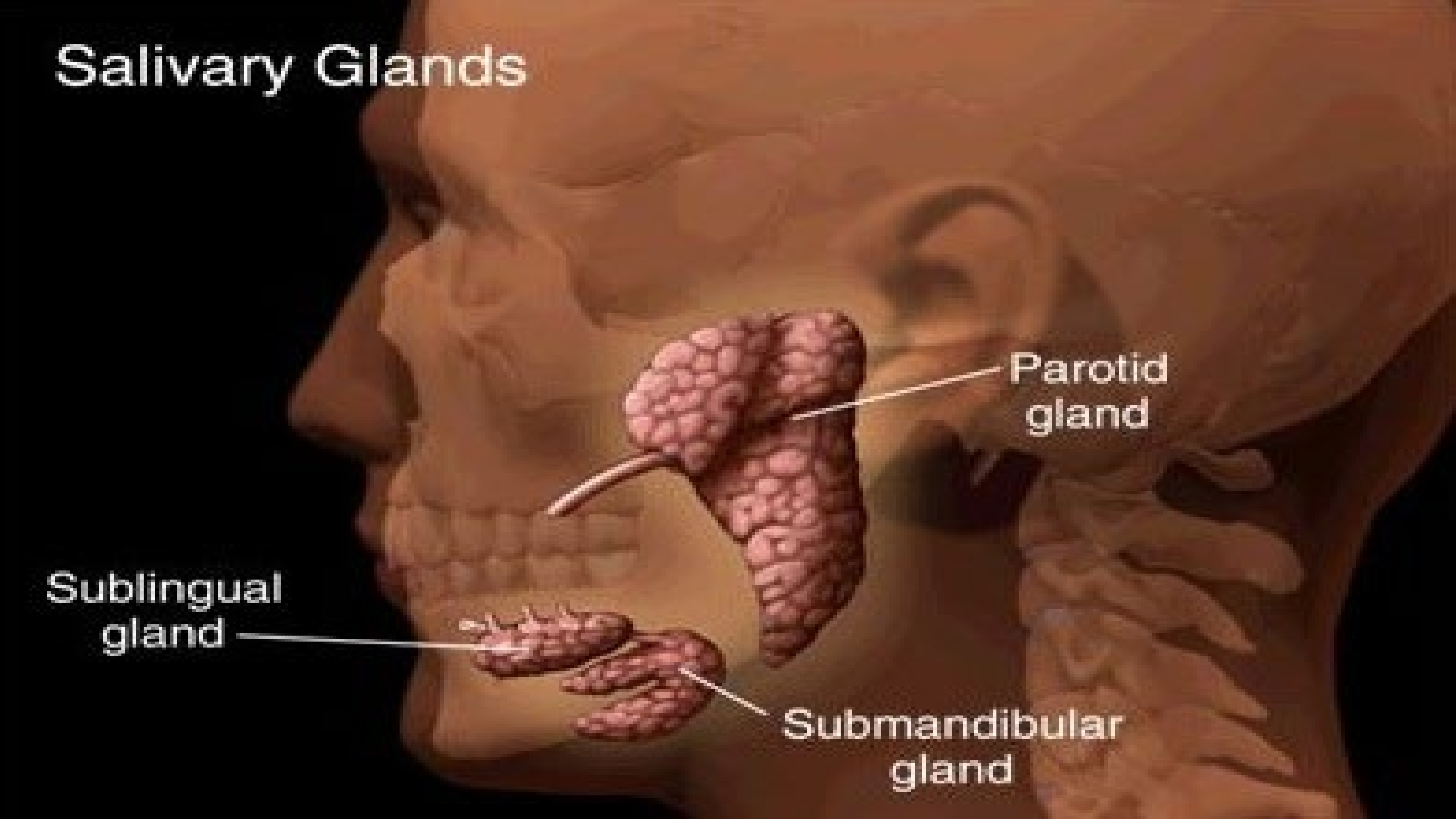


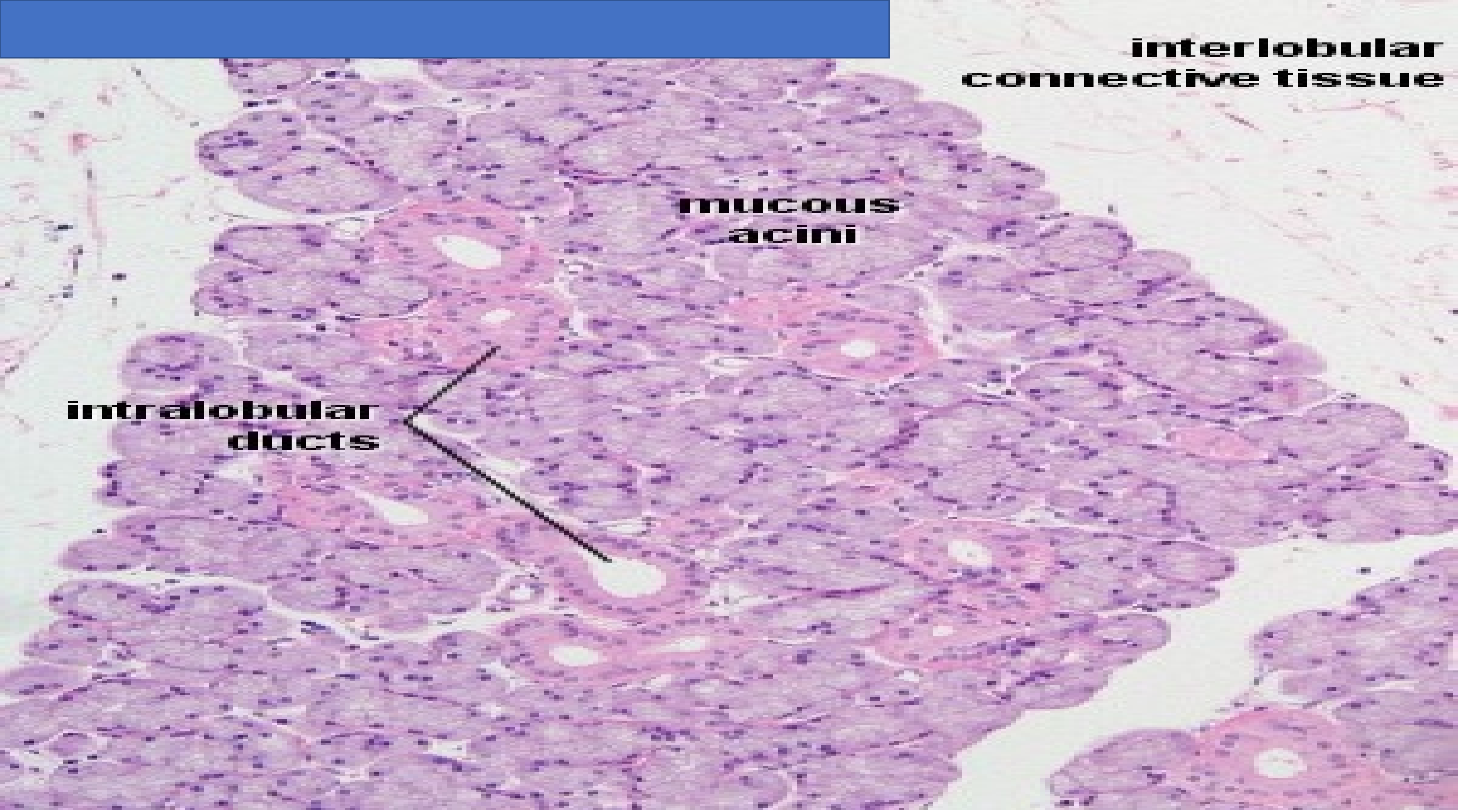


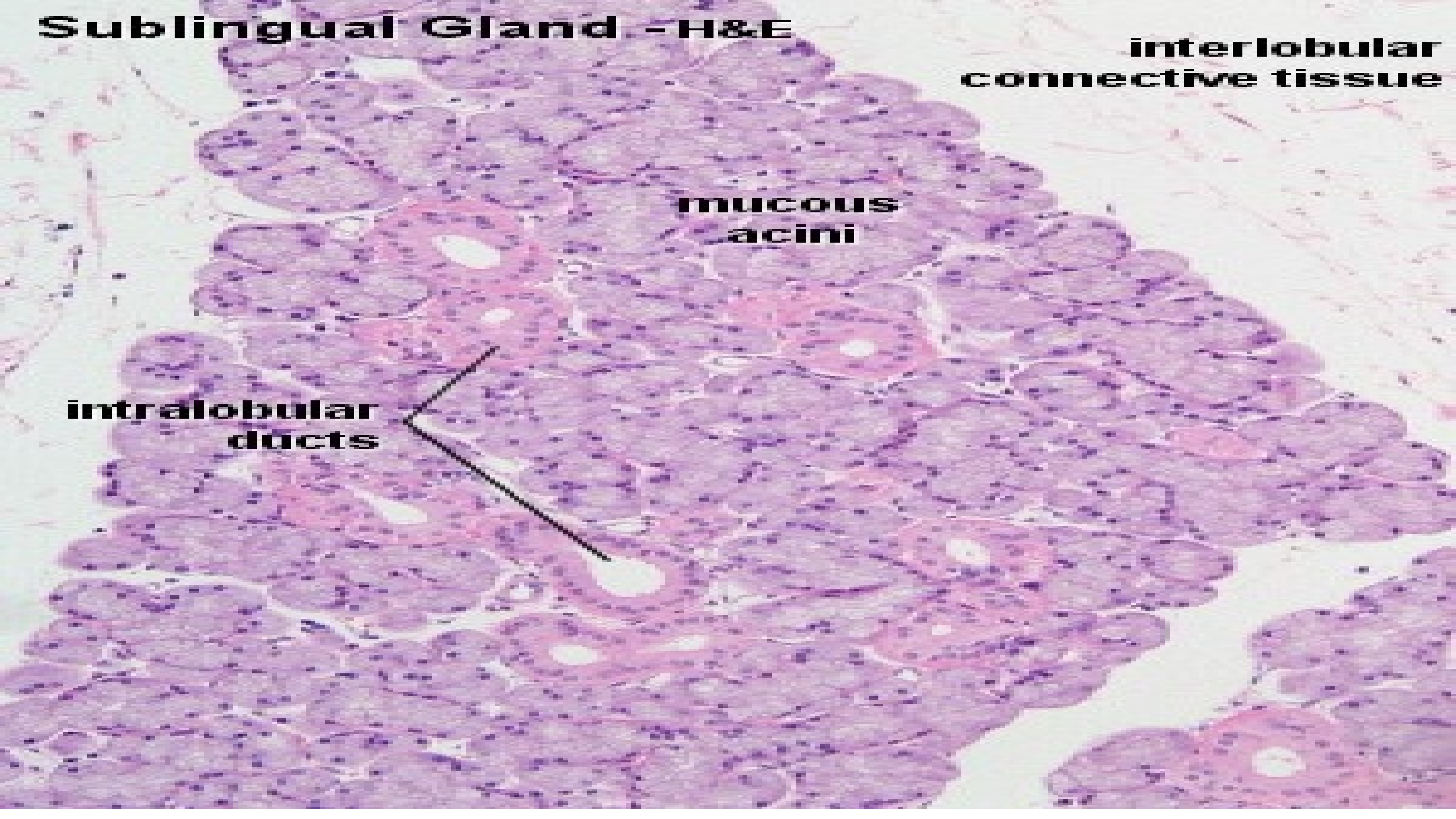


Salivary Glands




Salivary Glands
Parotid gland
Sublingual gland
Submandibular gland

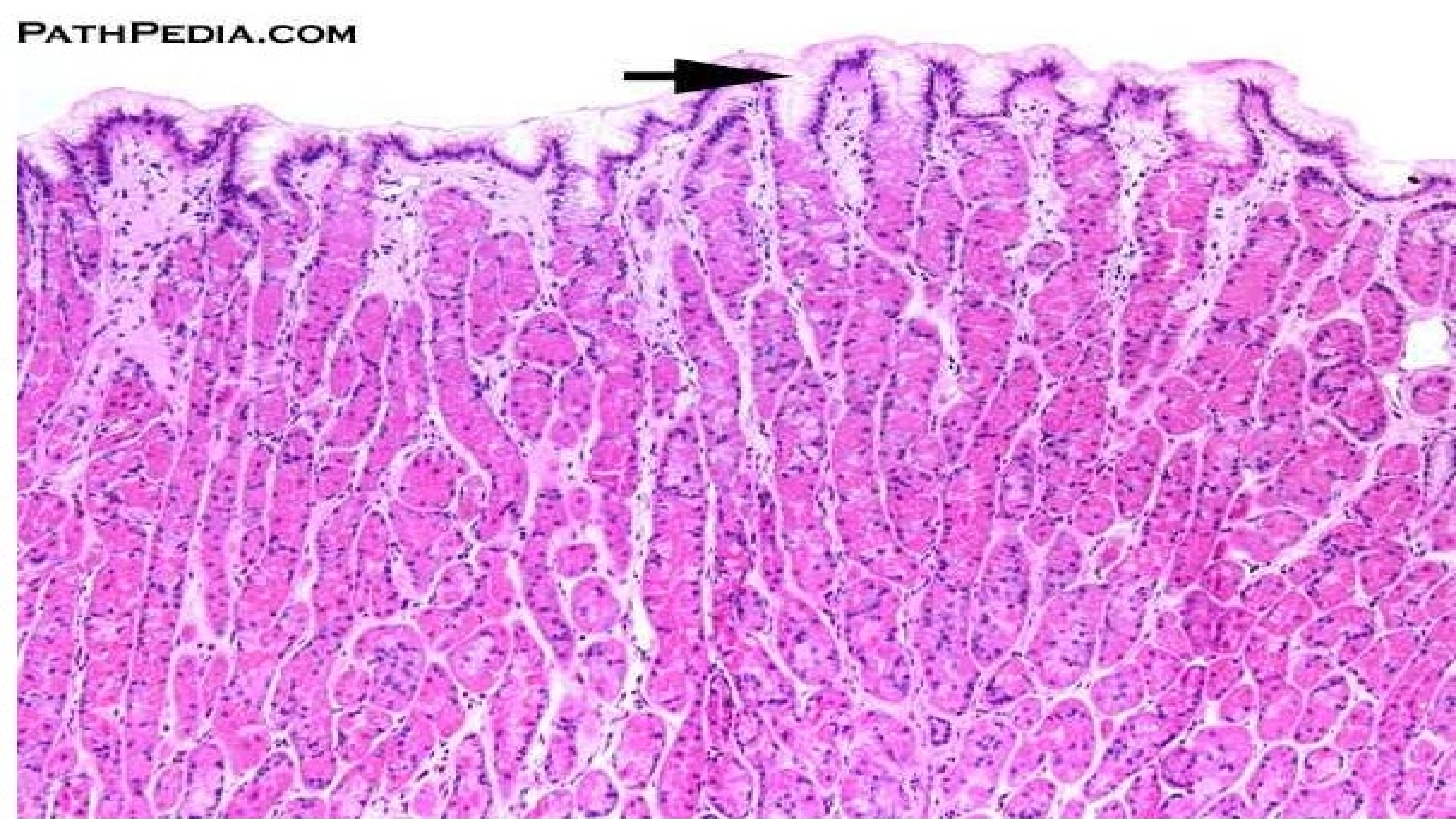

interlobular
connective tissue
mucous
acini
intralobular
ducts

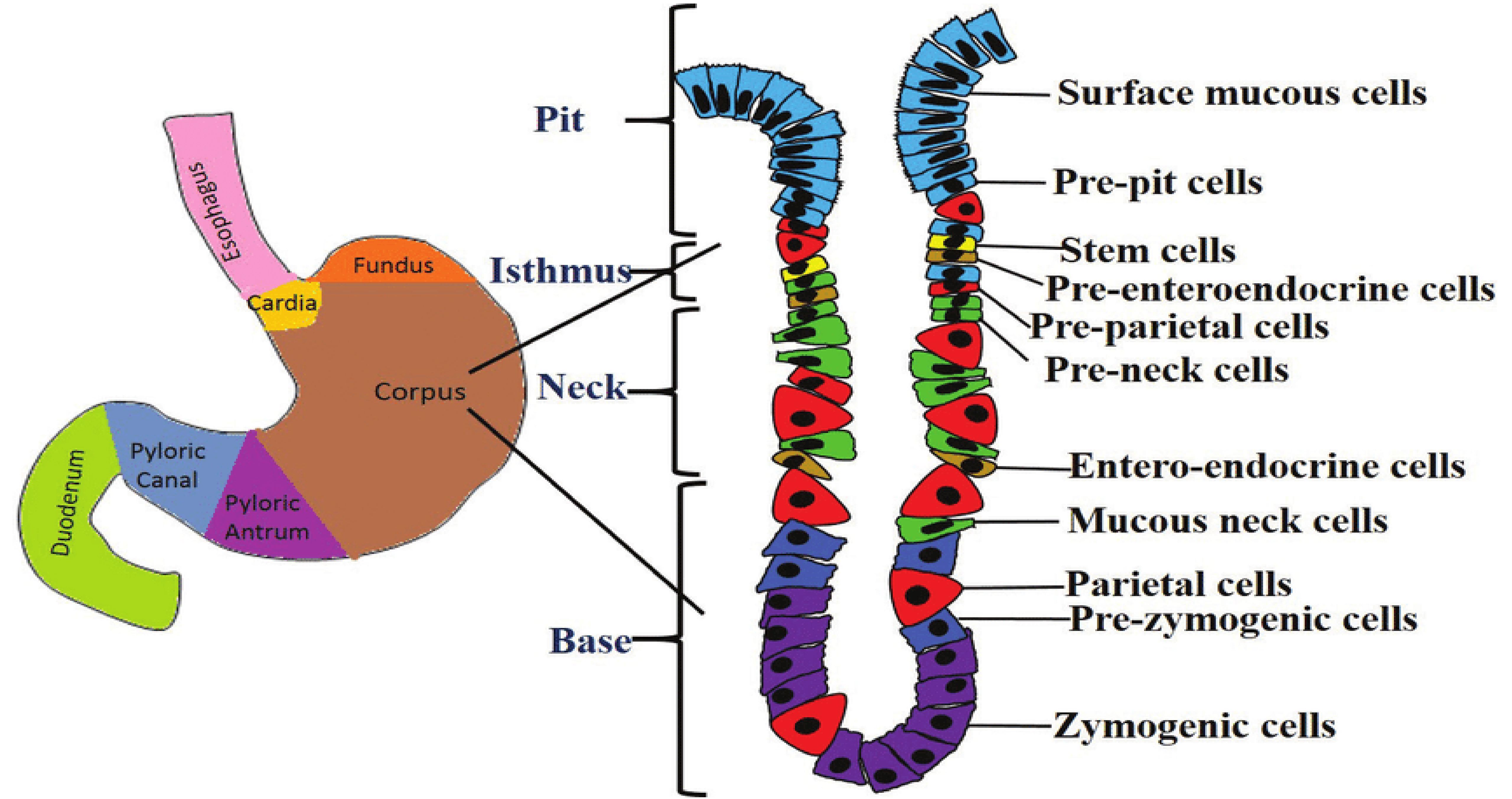

Sublingual Gland - H&E
interlobular
connective tissue
mucous
acini
intralobular
ducts

1
2
3
4
5
6
7

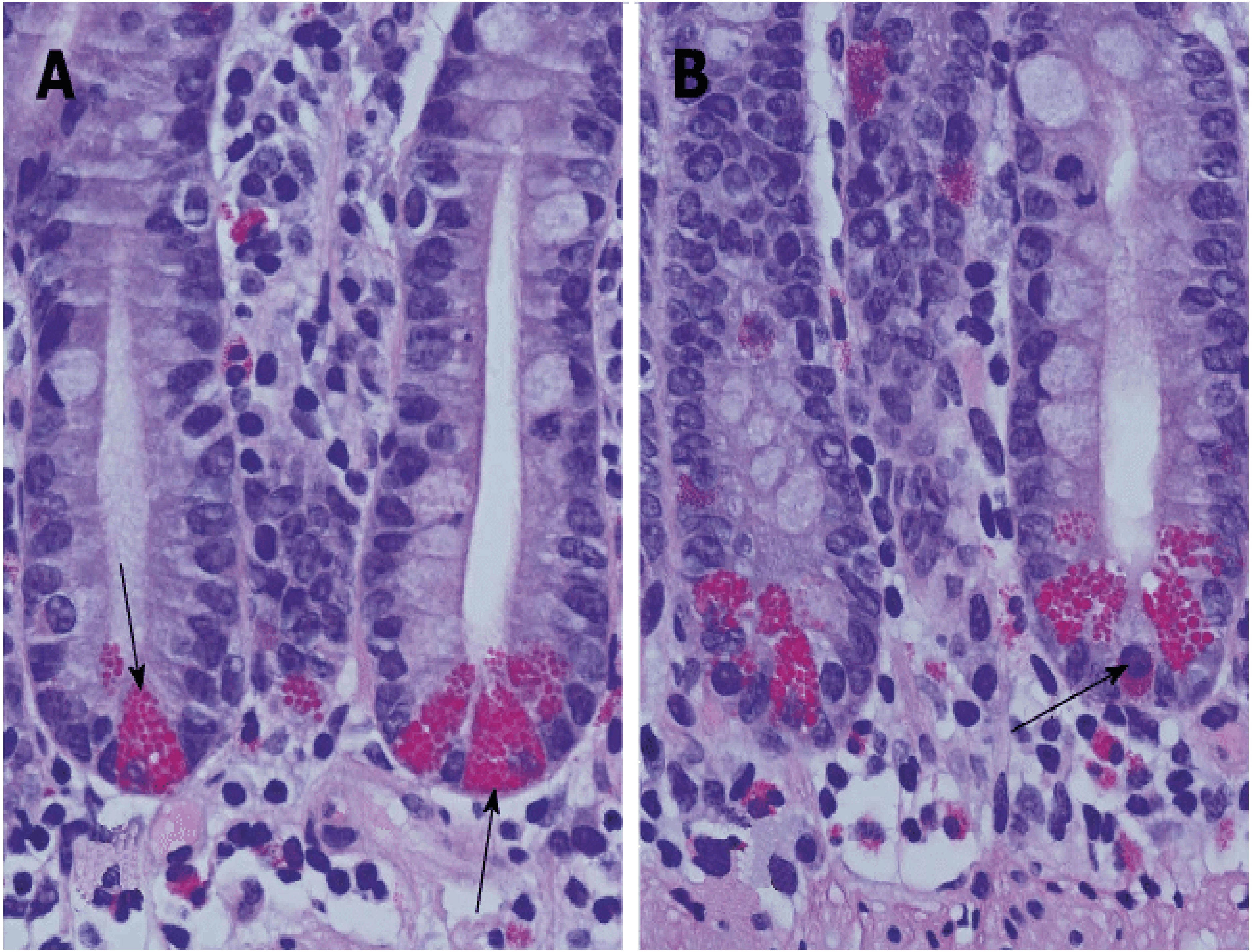
ILEUM

1. Villus
2. Lamina propria of a villus
3. Cluster of goblet cells
4. Intestinal gland
5. Submucosa
6. Peyer's patch


PathPedia.com

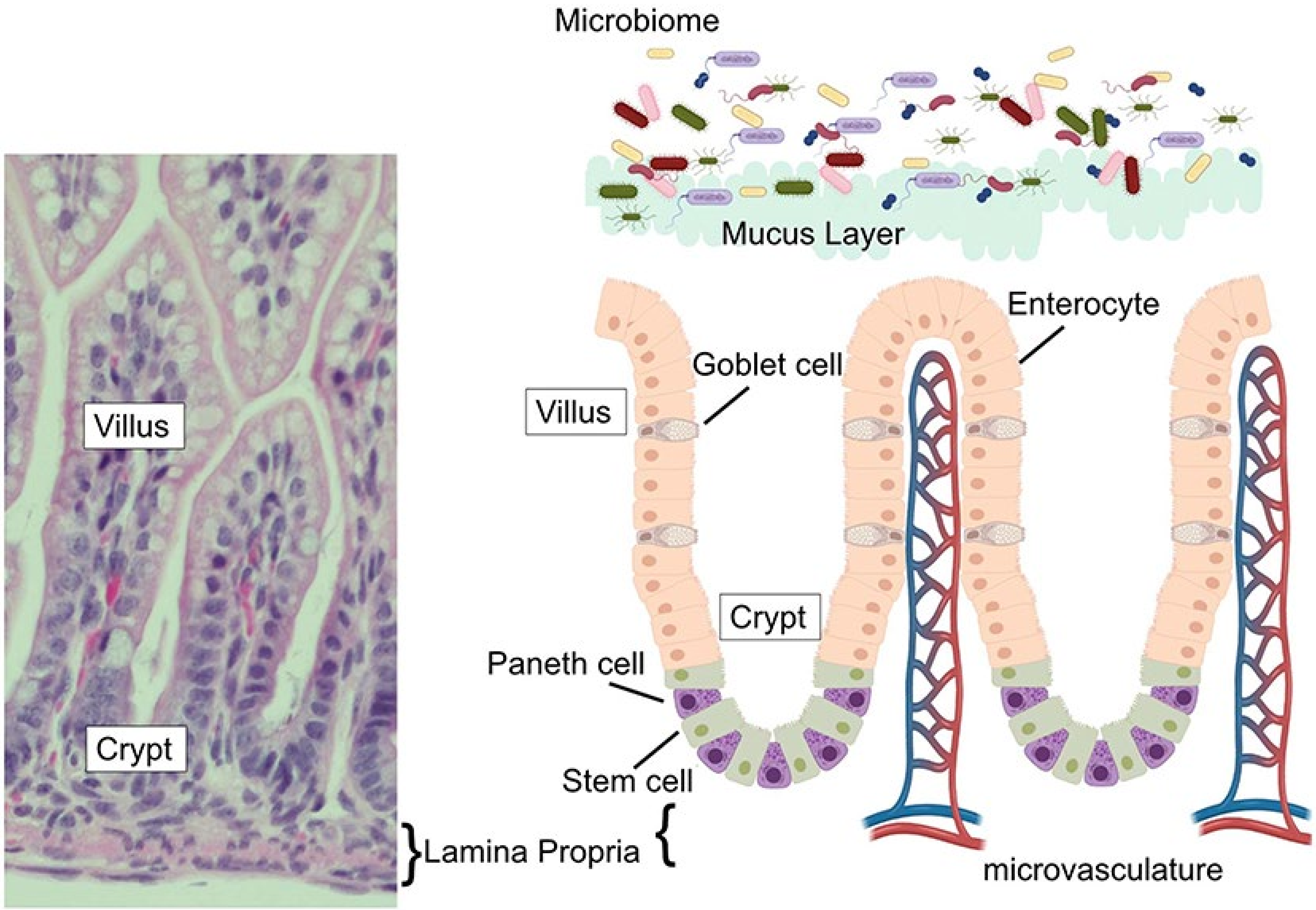

Esophagus
Fundus
Cardia
Corpus
Pyloric Canal
Pyloric Antrum
Duodenum
Pit
Isthmus
Neck
Base
Surface mucous cells
Pre-pit cells
Stem cells
Pre-enteroendocrine cells
Pre-parietal cells
Pre-neck cells
Entero-endocrine cells
Mucous neck cells
Parietal cells
Pre-zymogenic cells
Zymogenic cells

Paneth cells?



Paneth cells

- located at the base of the crypts of Lieberkühn
- are pyramidal cells that secrete the antibacterial enzyme lysozyme stored in large, apical, membrane bounded Secretory granules.
- These cells also release other antibacterial agents, defensins and tumor necrosis factor ` and display extensive RER (basally), a large supranuclear Golgi complex, and many mitochondria.
- These agents have the capability of killing bacteria as well as certain protozoa.



MCQ AND OPEN QUESTION

Function ?

- **Mucosa:**
- **Submucosa:**
- **Muscularis extena:**
- **Serosa:**

- **Mucosa:** Absorption.
- **Submucosa:** Vascular and lymphatic supply.
- **Muscularis extena:** Mechanical mixing, dissociation, and propulsion.
- **Serosa:** Protection

Structurally, the mucosa has four adaptations that increase the absorptive surface area, what are they?

Structurally, the mucosa has four adaptations that increase the absorptive surface area, what are they?

- **Plicae circulares (circular folds, or valves of Kerckring)**
- **Intatinal villi**
- **Intestinal glands**
- **Microvilli on the apical epithelium**

1.Describe the changes in epithelial structure at each of the following four junctions in the GI tract:

- gastro-esophageal
- gastro-duodenal
- ileo-cecal
- recto-anal

Gastro-esophageal: Simple columnar (Gastric) -> stratified squamous (esophagus).

Gastro-duodenal: Epithelial glands in mucosa (Gastric) -> Epithelial glands in sub-mucosa (Duodenum).

Ileo-cecal: Epithelium in villi (ileum) -> no villi (large intestine).

Recto-anal: Simple columnar (rectum) -> stratified squamous (anal)

What are the four types of gastrointestinal mucosa, and what are their key characteristics?

- Protective (stratified squamous epithelium),
- secretory (gastric glands),
- absorptive (villi and crypts),
- absorptive/protective (glands with many goblet cells).

What are the two plexuses of the enteric nervous system and which muscular layers do they control?

- Meissner’s (submucosal) plexus controls the muscularis mucosa;
- Auerbach’s plexus (myenteric) controls the muscularis propria.

Match the cell type with its secretion:

1. Goblet Cell	A. gastrin
2. Parietal Cell	B. histamine
3. Chief Cell	C. pepsinogen
4. G-cell	D. intrinsic factor
5. ECL Cell	E. mucous

- Goblet Cell: mucous,
- Parietal Cell: intrinsic factor,
- Chief Cell: pepsinogen,
- G-cell: gastrin,
- ECL cell: histamine.

A gastric biopsy is taken from a 42-year-old man. As the pathologist inspects the specimen, he observes numerous, normal cuboidal-to-columnar cells with apical membrane-bound secretion granules in the gastric glands. From which area of the stomach was the biopsy most likely taken?

A. Cardiac region
B. Columns of Morgagni
C. Fundic region
D. Greater omentum
E. Pyloric region

Explanation:

A 36-year-old Asian male complains of difficulty swallowing. Esophagoscopy reveals a polypoid mass that is subsequently biopsied. In addition to tumor cells, the esophageal biopsy show normal smooth muscle and striated muscle in the same section. Which portion of the esophagus was the source of this biopsy?

A. Lower esophageal sphincter
B. Lower third of the esophagus
C. Middle third of the esophagus
D. Upper esophageal sphincter
E. Upper third of the esophagus

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Explanation:

The correct answer is C

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The correct answer is C

In which test tube would protein digestion occur at the highest rate?

1. Tube containing pepsinogen and salivary amylase
2. Tube containing pepsinogen
3. Tube containing HCl
4. Tube containing HCl and intestinal amylase
5. Tube containing HCl and pepsinogen

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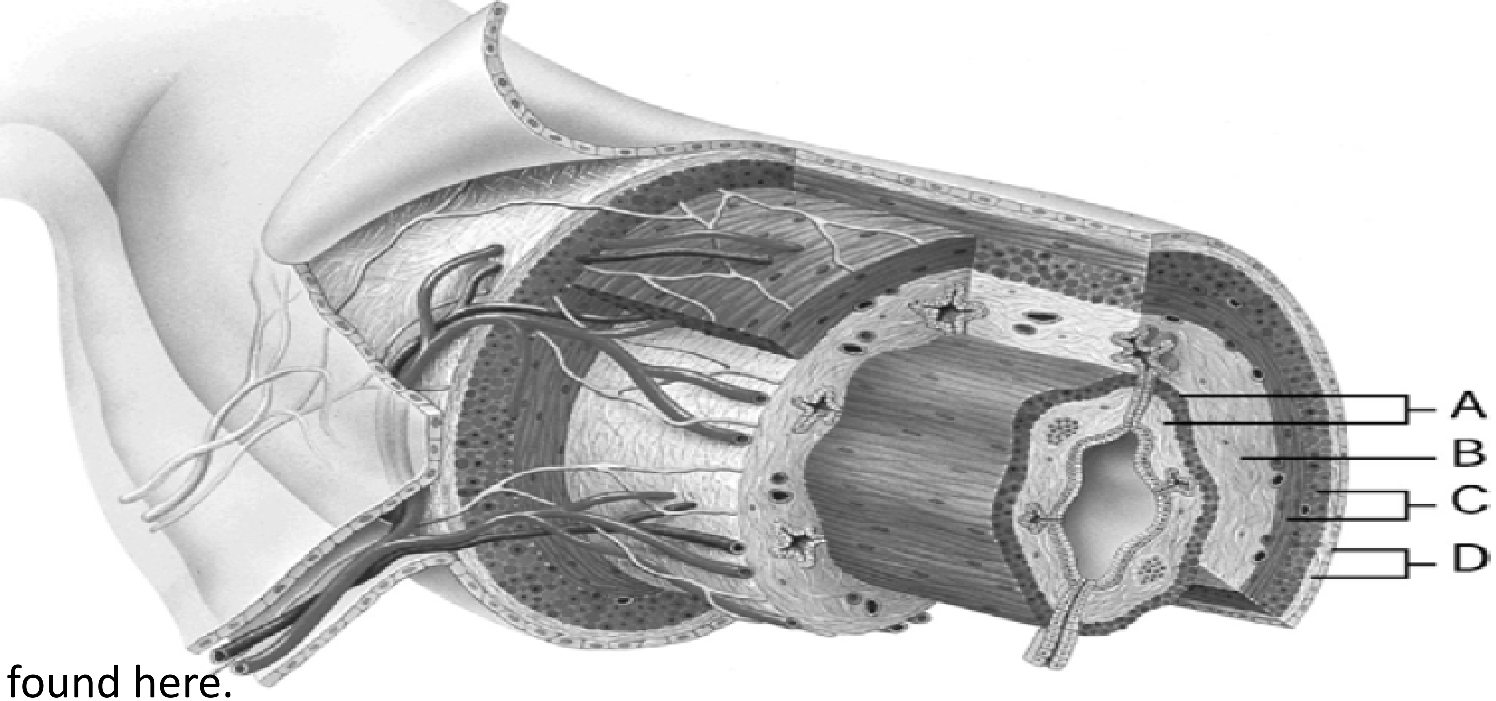
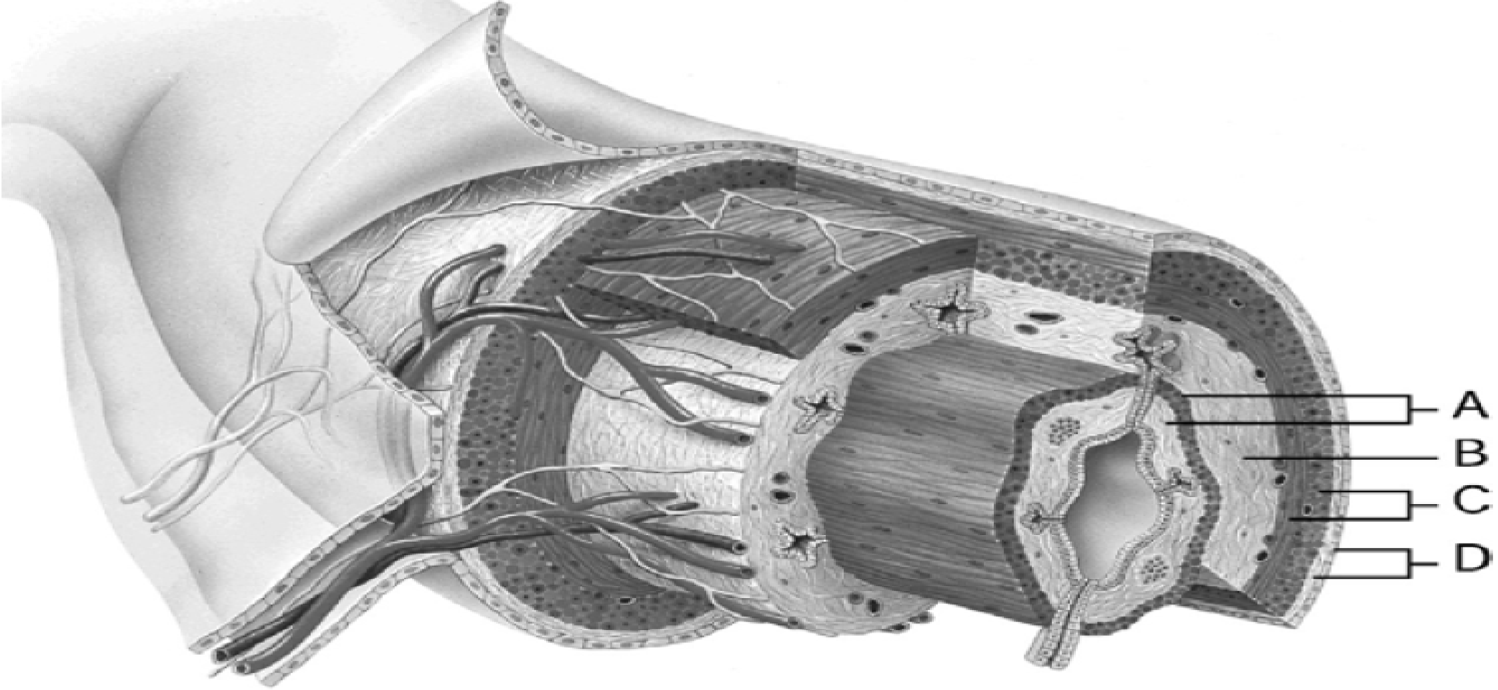


17/ Mucosa.
18/ Duodenal glands found here.
19/ Smooth muscle layer.
20/ MALT found here.
21/ Serosa.
22/ Area of the lamina propria.
23/ Continuation of the mesentery.



17/ Mucosa.
Answer: A
18/ Duodenal glands found here.
Answer: B
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Answer: C
20/ MALT found here.
Answer: B
21/ Serosa.
Answer: D
22/ Area of the lamina propria.
Answer: A
23/ Continuation of the mesentery.
Answer: D

Gastric mucosal cells ?production?

Cell Types of Gastric Mucosa??

Body of stomach contains?

Antrum

Gastric mucosal cells secrete **gastric juice**

- **HCl** and **pepsinogen** initiate protein digestion
- **Intrinsic factor** required for absorption of vitamin B_{12}
- **Mucus** protects gastric mucosa from HCl

Cell Types of Gastric Mucosa

- **Body** of stomach contains oxyntic glands
  - **Parietal cells** → HCl and Intrinsic Factor
  - **Chief cells** → Pepsinogen
- **Antrum** of stomach contains pyloric glands
  - **G cells** → Gastrin *into the circulation*
  - **Mucous neck cells** → Mucus, HCO_3-, and Pepsinogen

1 Which of the following cell types is present in the small bowel and ascending colon but not
in the descending colon?
a Endocrine cells
b Goblet cells
c Paneth cells
d Plasma cells
e Eosinophils

2 Which of the following organs lacks lymphatic vessels in the lamina propria?
a Esophagus
b Stomach
c Small bowel
d Colon
e All of the above

3 Which of the following choices correctly pairs the nerve plexi with their locations?
a Meissner’s plexus in lamina propria, Auerbach’s plexus in submucosa
b Meissner’s plexus in submucosa, Auerbach’s plexus in muscularis propria
c Meissner’s plexus in muscularis propria, Auerbach’s plexus in muscularis mucosae
d Meissner’s plexus in muscularis mucosae, Auerbach’s plexus in serosa
e Meissner’s plexus in serosa, Auerbach’s plexus in lamina propria

4 Which of the following layers would be present in a mucosal biopsy?
1) Lamina propria
2) Muscularis propria
3) Epithelium
4) Serosa
5) Submucosa
6) Muscularis mucosae

a 1, 3, 6
b 2, 3, 5
c 1, 2, 3, 5
d 2, 4, 5
e 3, 4, 5, 6

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e Meissner’s plexus in serosa, Auerbach’s plexus in lamina propria

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5 Which of the following cell types is not present in the body of the stomach?

a Parietal cells

b Chief cells

c Enterochromaffin-like cells

d Foveolar cells

e G cells

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Component	Source	Function
Hydrochloric acid (HCl)		Converts pepsinogen to pepsin; kills pathogens
Pepsinogen		Inactive form of pepsin
Pepsin		Protein-splitting enzyme
Mucus		Protects the mucosa
Intrinsic factor		Aids absorption of vitamin B12
Serotonin & his-tamine		Autocrine regulators
Gastrin		Stimulates secretion of HCl and pepsin

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Pepsinogen	Chief cells	Inactive form of pepsin
Pepsin	From pepsinogen in the presence of HCl	Protein-splitting enzyme
Mucus	Goblet cells	Protects the mucosa
Intrinsic factor	Parietal cells	Aids absorption of vitamin B12
Serotonin & histamine	Argentaffin cells	Autocrine regulators
Gastrin	G cells	Stimulates secretion of HCl and pepsin