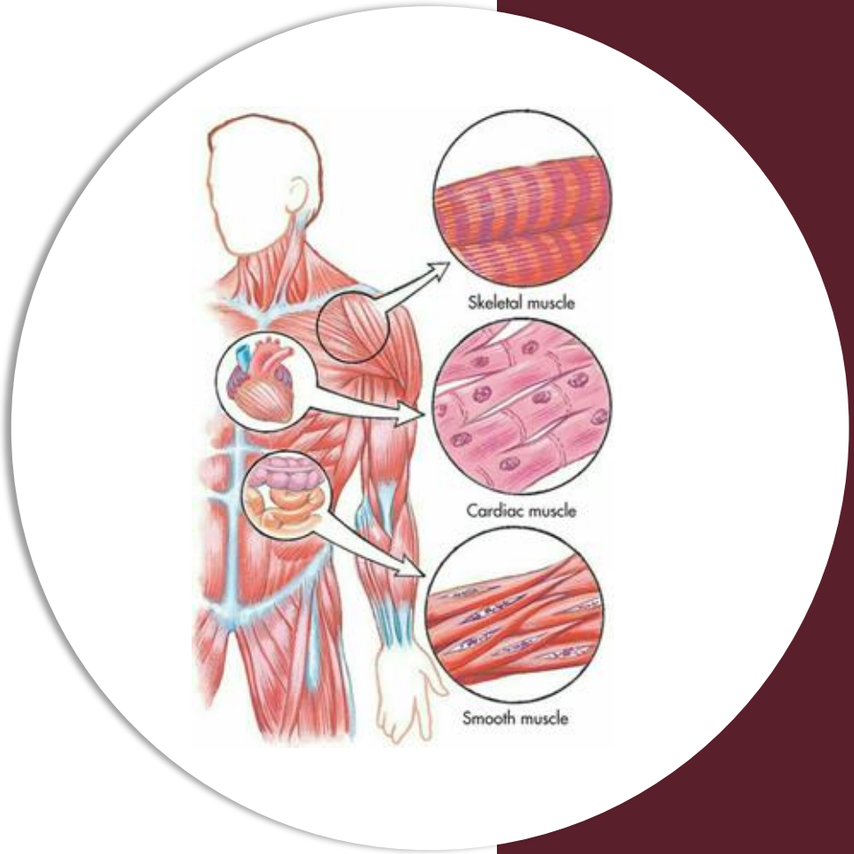
بسم الله الرحمـٰن الرحيم

(وَفَوْقَ كُلِّ ذِي عِلْمٍ عَلِيمٌ)

Histology | Lecture 2

Histology Of The GIT



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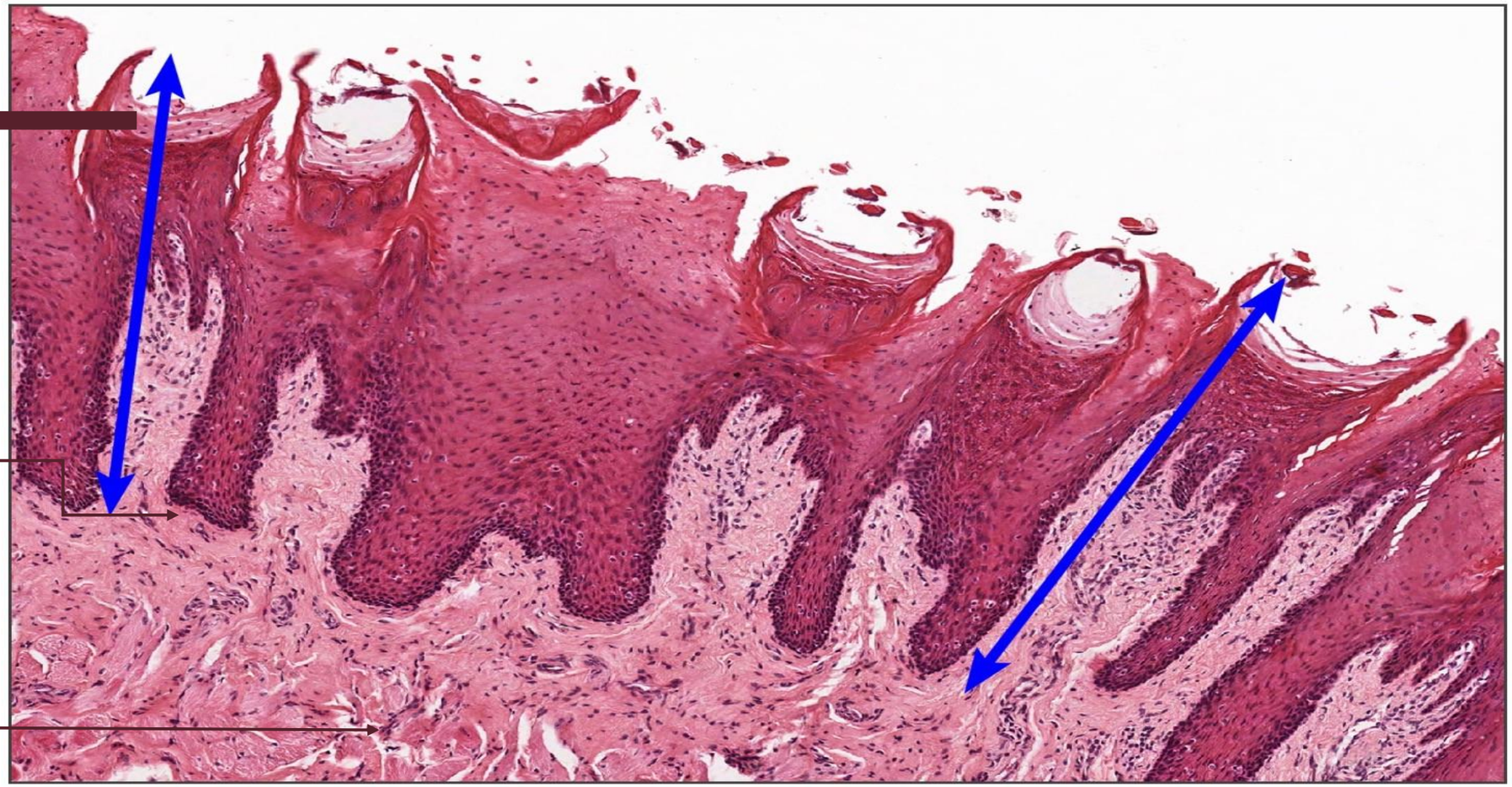
Filiform Papillae

Keratinized stratified squamous , however we might see some nucleated cells but the staining is totally different , they are extremely rich in keratin

Lamina propria

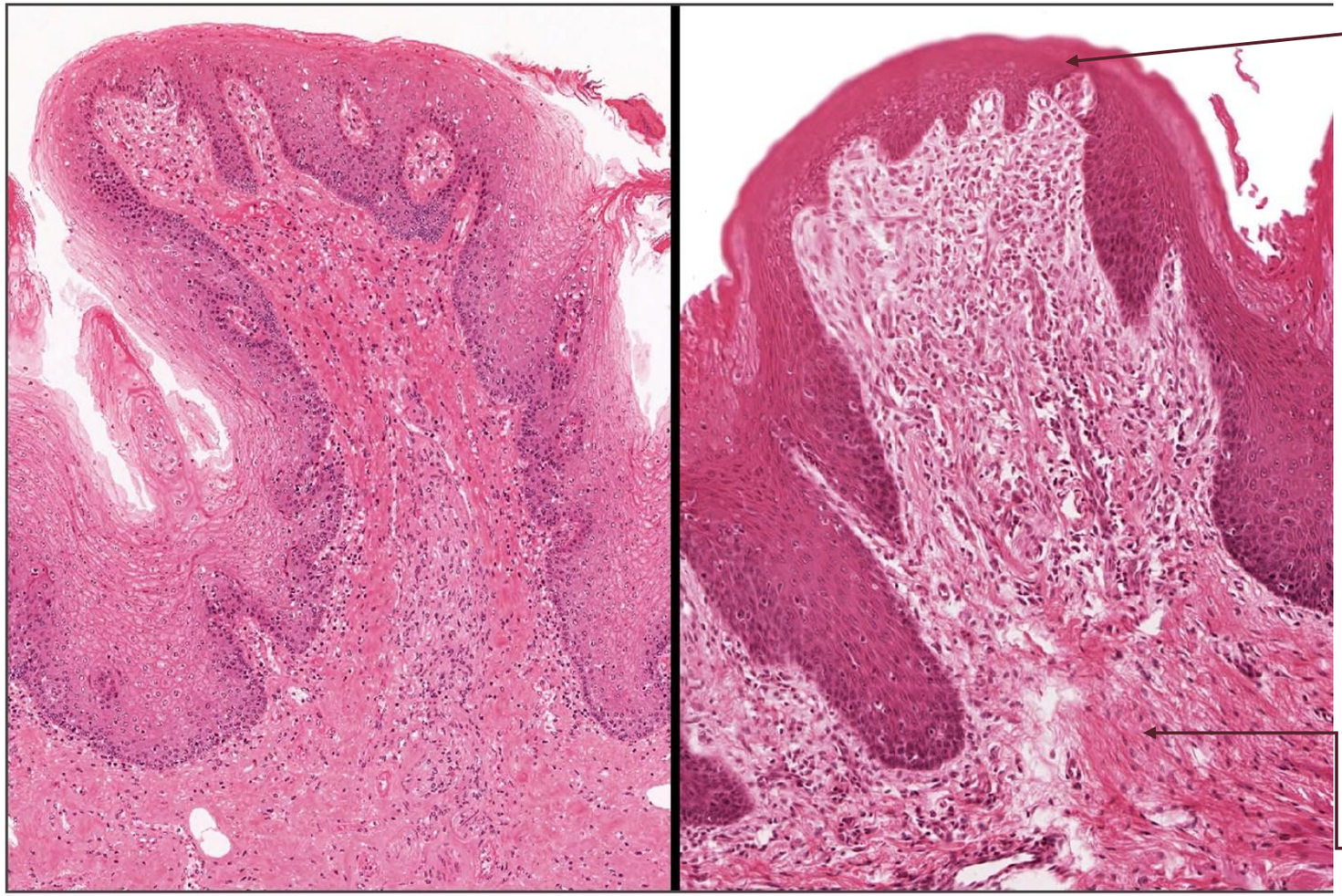
Muscles and connective tissue underneath



- The degree of keratinization is variable from one type of papillae to another

Fungiform Papillae

We were able to tell that this is a fungiform papillae from the amount of lamina propria and its size is totally bigger than the filiform

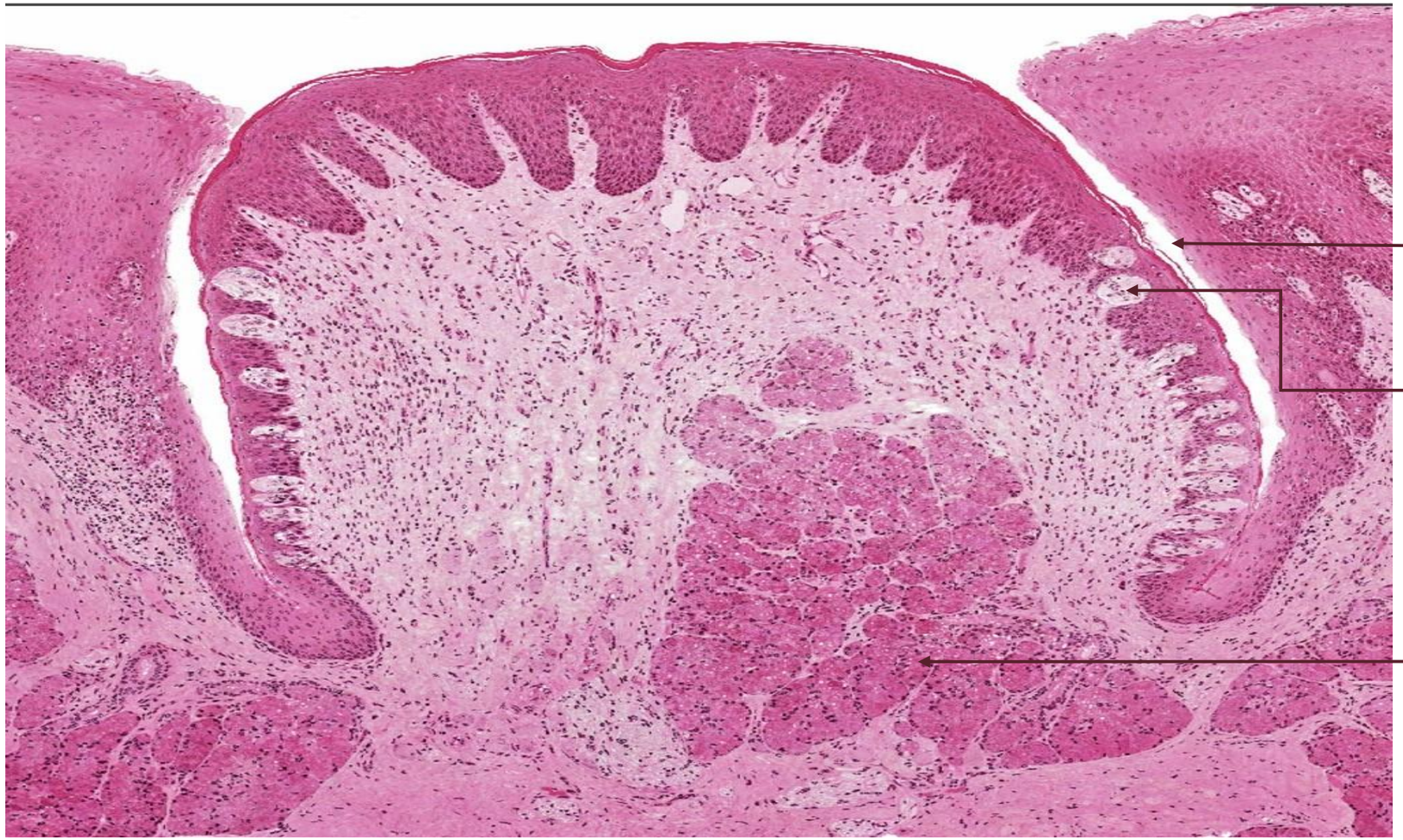


Lighter keratinization than filiform

Muscle

3 Unique things for Circumvallate :

Circumvallate Papillae



1-Sulcus

2-Taste Buds , each papilla contains about 250 taste buds

3-Lingual glands (Von Ebner's)

This is the perfect position for the taste buds , (this is how they are actually situated), reaching the surface in order to well dissolve the food (tasteness) and excite the gustatory cells

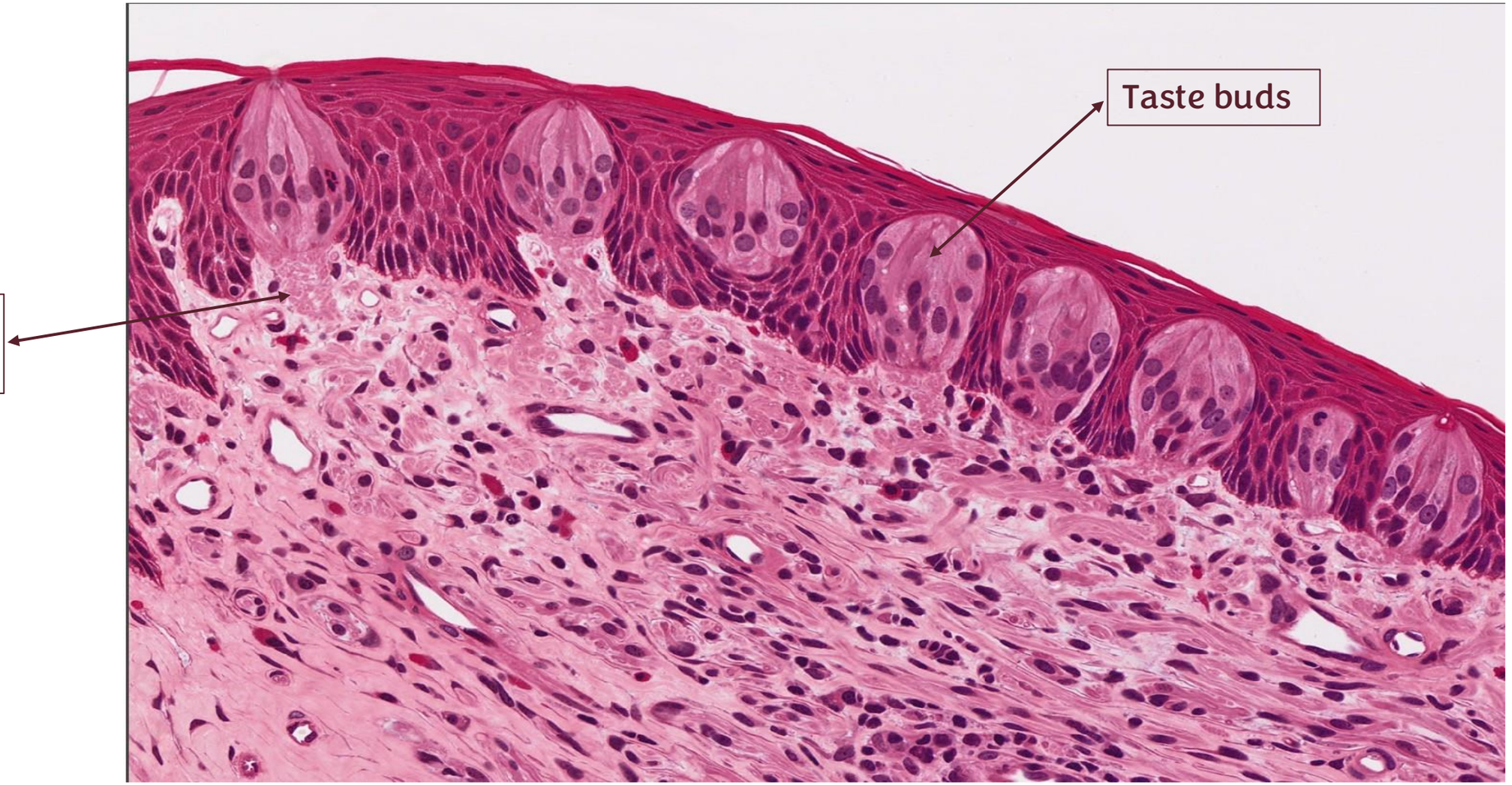
Not the correct anatomical representation

Serous glands

Is it logical to have mucous glands instead of serous cells?

No, it is **not logical** in this location, because **the structure is justified by the function**. Mucous secretion is thick and viscous, so it mainly functions in lubrication. It helps the food bolus move smoothly, but it would not be effective in rapidly washing material away from the taste buds.

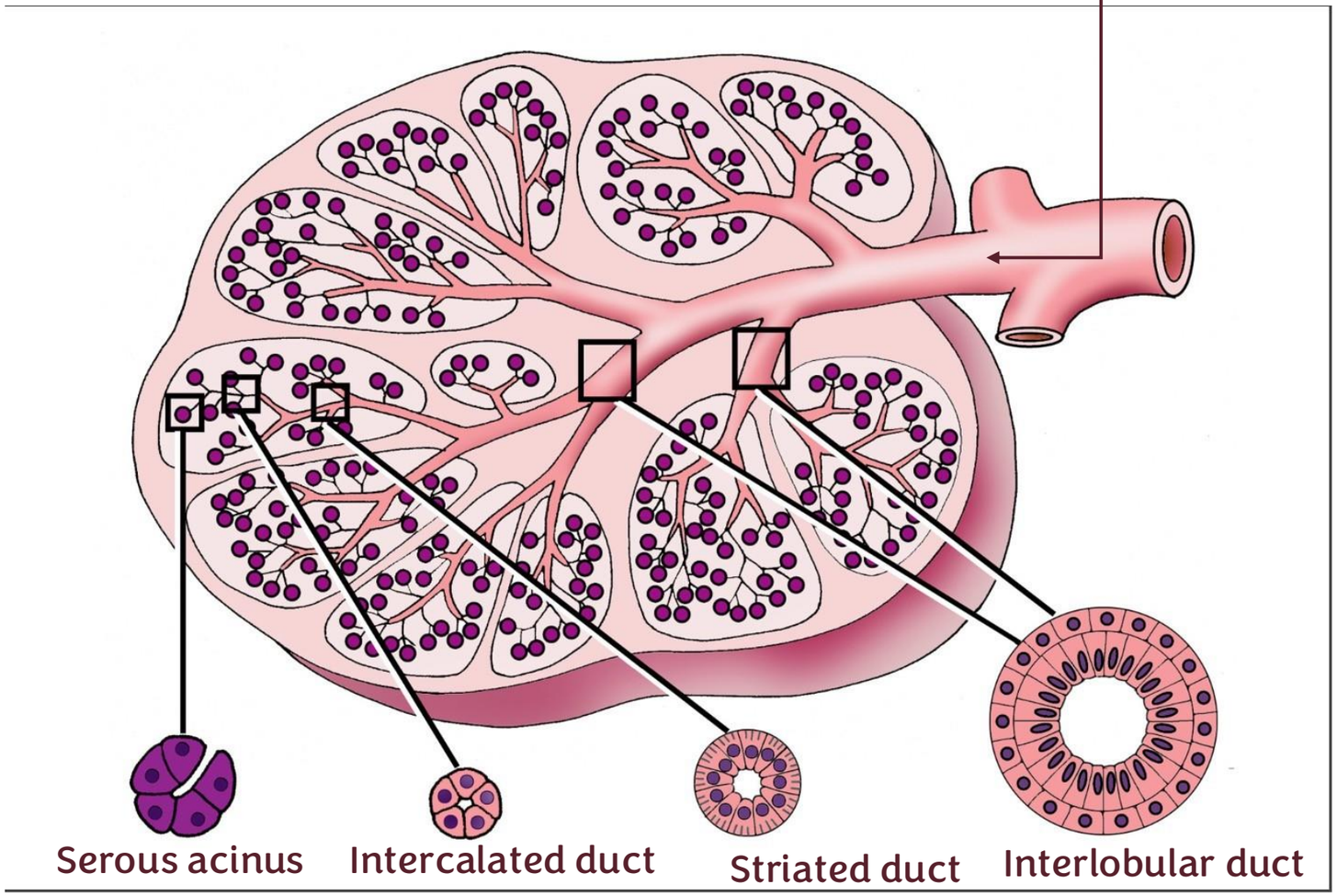
In contrast, serous secretion is watery and fluid. This makes it suitable for **flushing food particles and dissolved substances out of the grooves around the taste buds**, so that old taste stimuli are removed and new food can reach the taste receptors clearly.
So, having **serous cells** here makes sense because their watery secretion helps **clean the area and reset the taste buds for new taste sensations.**


Taste buds
Afferent fibers

It is an exocrine gland

Structure of the major gland

The interlobular join to form the excretory duct



- Each gland contains a group of lobes .
- Each lobe contains a group of lobules .
- Eventually , each lobule contains supporting , secretory and ductal cells .

- Secretory cells ---> produce saliva .
- Ductal cells ---> moves the saliva into the oral cavity .
- Connective tissue for sure everywhere for covering , protection and supporting .
- Stromal component ---> forming capsule , septum covering all the cells inside

- The amount of connective tissue covering becomes less and less by moving inside the gland , because technically there can't be large bundles of collagen type 1 inside .

Exocrine glands need a way to secrete their products, so they have a ductal system. The secretion is first produced by the **acinus**, then it passes into the smallest ducts, which are called **intercalated ducts**.

Intercalated ducts are lined by simple cuboidal epithelium. They are the smallest ducts and they collect secretion directly from the acini. Histologically, you can recognize them by their **very small lumen** and one row of nuclei.

Several intercalated ducts join together to form a **striated duct. Striated ducts** are lined by high cuboidal to simple columnar epithelium. They are larger than intercalated ducts. You can recognize them by their **taller cells, more cytoplasm,** and **a single layer of epithelium.**

Then, several striated ducts join together to form larger ducts called **interlobular ducts.**

Interlobular ducts are found between lobules, in the connective tissue septa. Their wall is thicker and their epithelium is usually more complex than the smaller ducts.

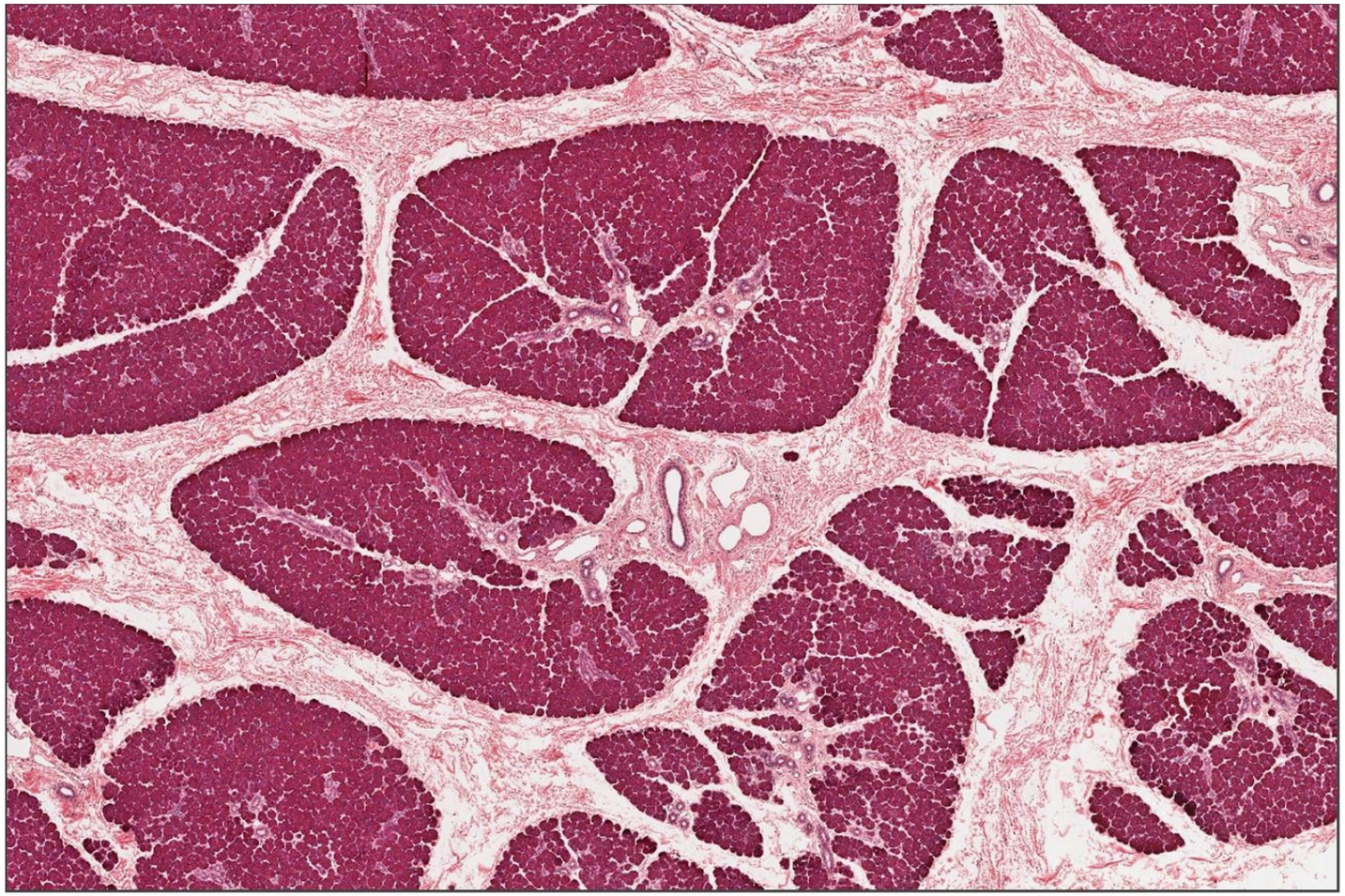
Acinus → Intercalated duct → Striated duct → stratified Interlobular duct → Main duct → Oral cavity.

Low magnification picture of a gland

- At this low magnification we can't decide if this is a totally serous gland or a seromucous one

Septa (stromal connective tissue)

- At this magnification it is indeed a serous gland



100% sure it is a serous gland

Excretory duct (stratified)

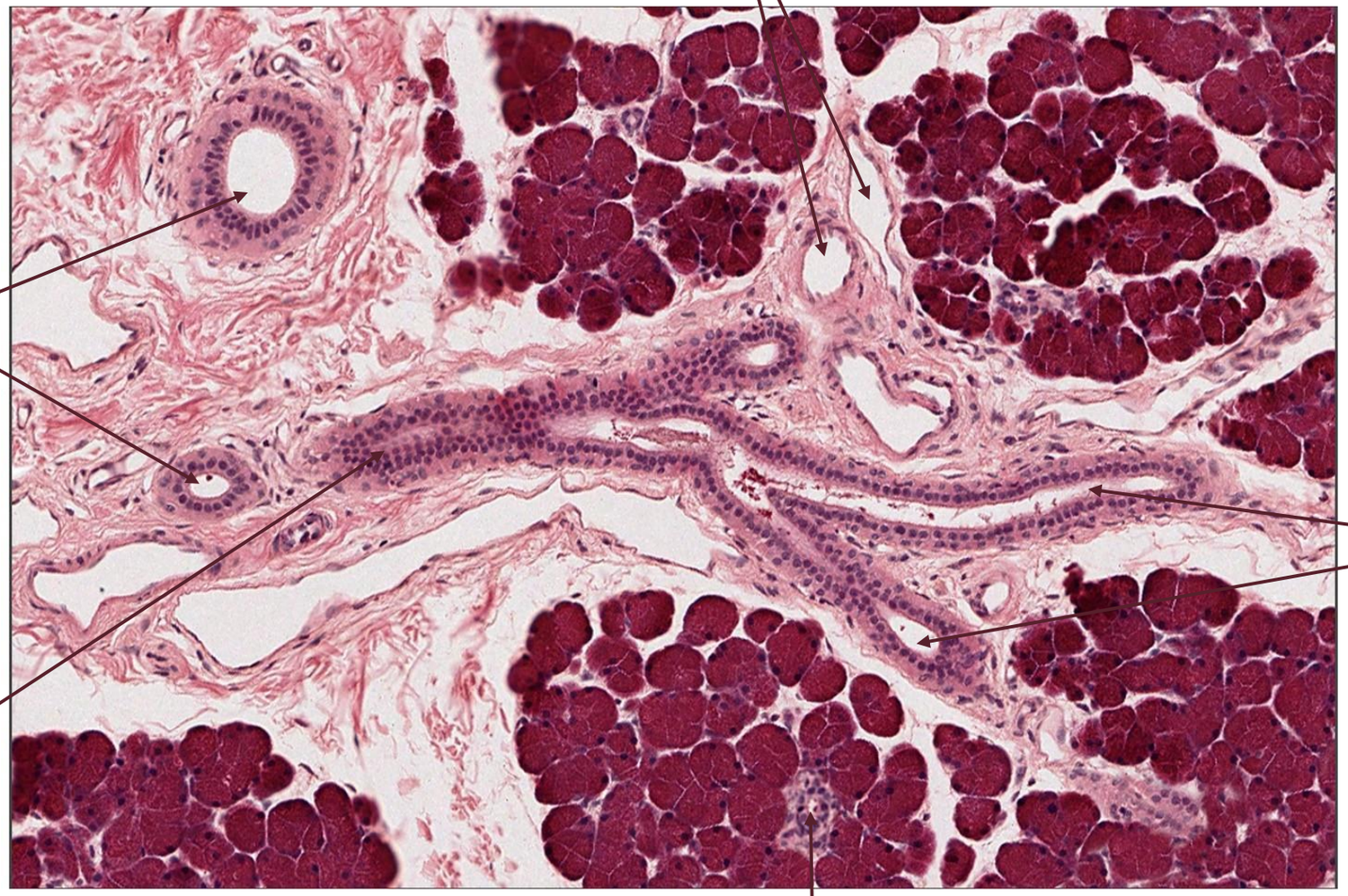
Interlobular duct

Intercalated duct (one raw of cells and a small lumen)

Striated duct (one raw of cells but with a larger lumen)

Blood vessels

** we differentiate blood vessels by the simple squamous lining



Striated ducts

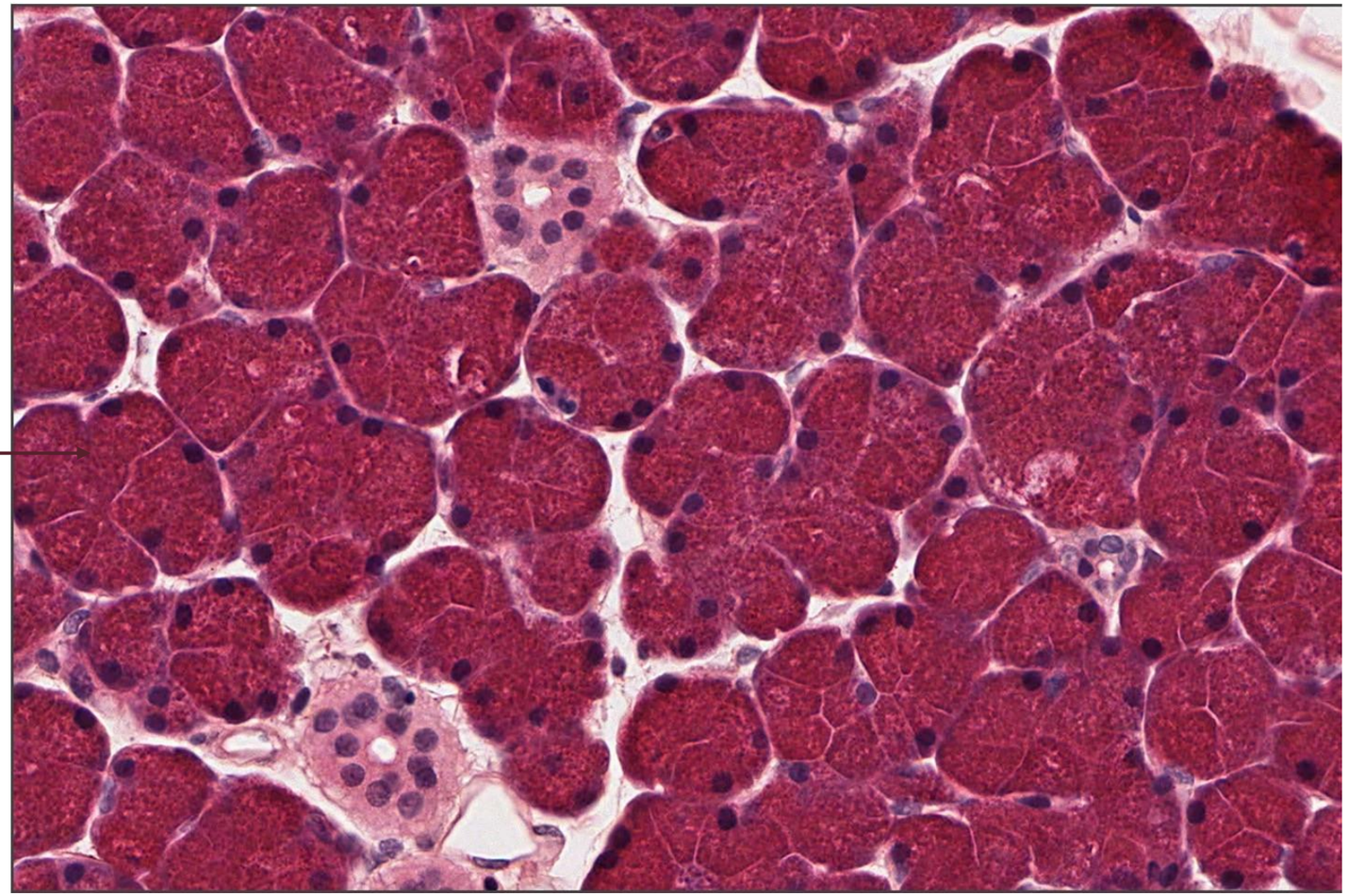
Excretory duct

Interlobular duct

Intercalated duct

- Intensely eosinophilic granulated cytoplasm with rounded basal located nuclei

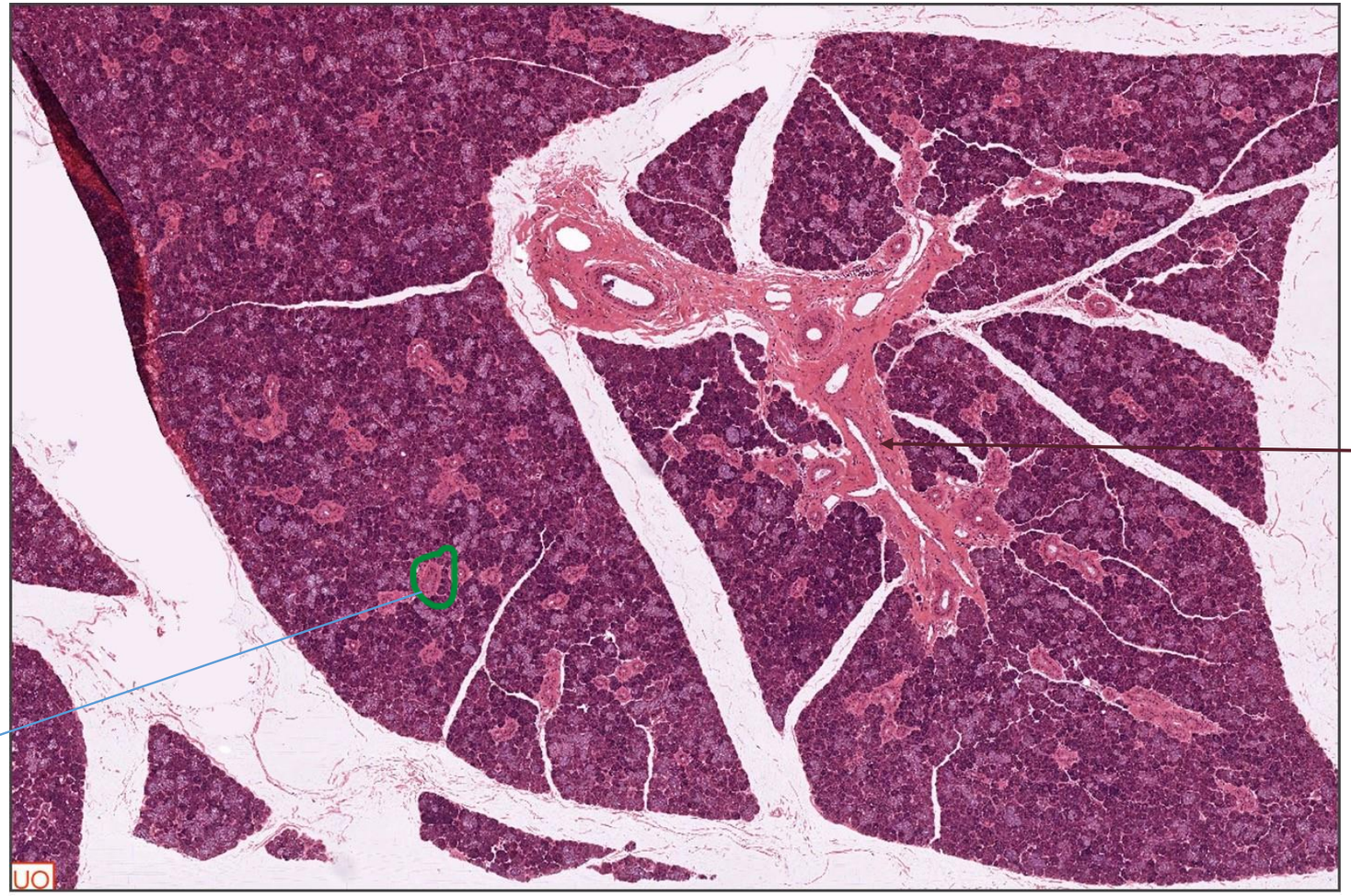
- Around the nucleus we can see RER , Golgi and mitochondria



**Interlobular

Large stratified duct

Mixed gland

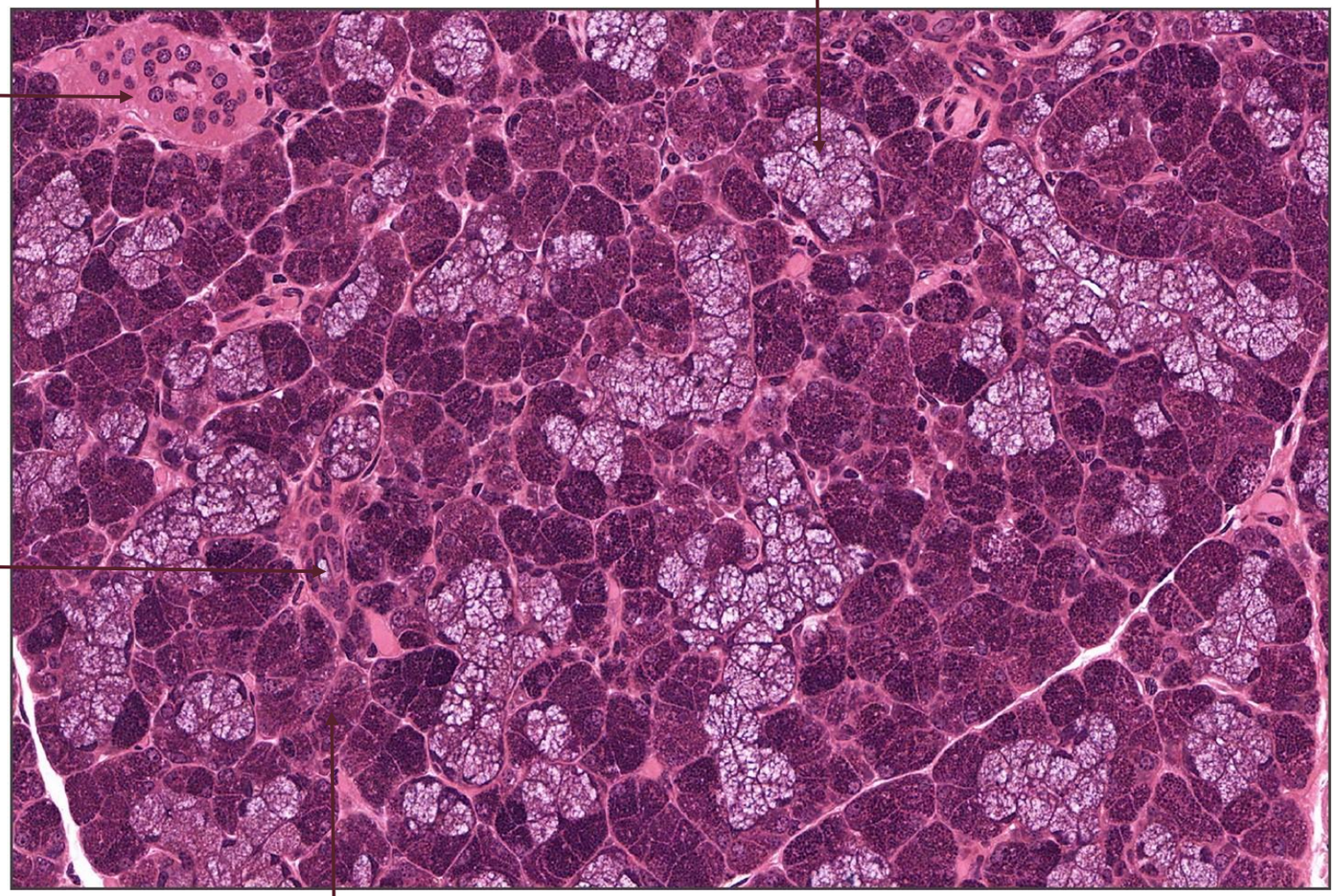


Connective tissue , part of the stroma

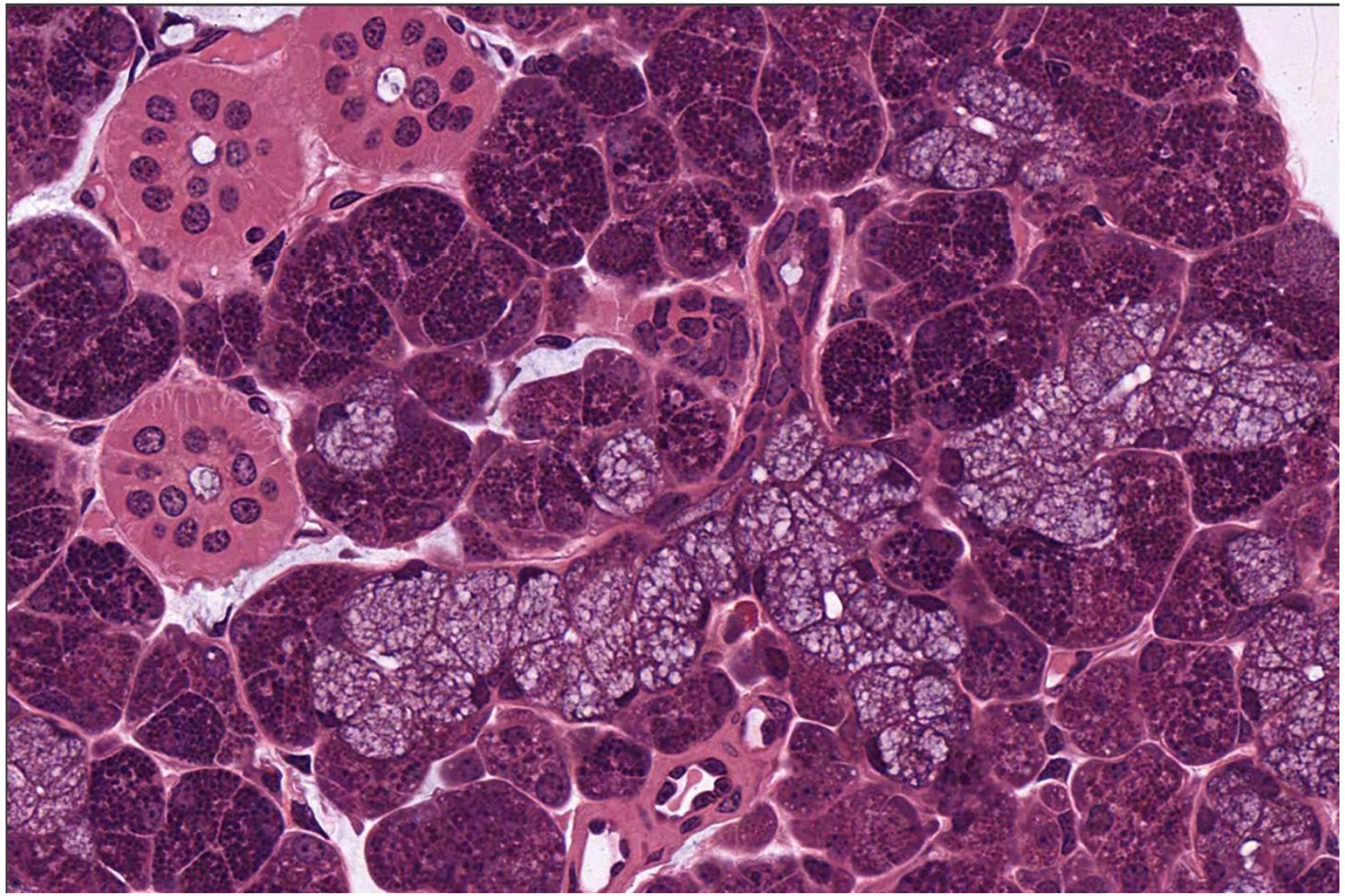
Mucus cell

Submandibular

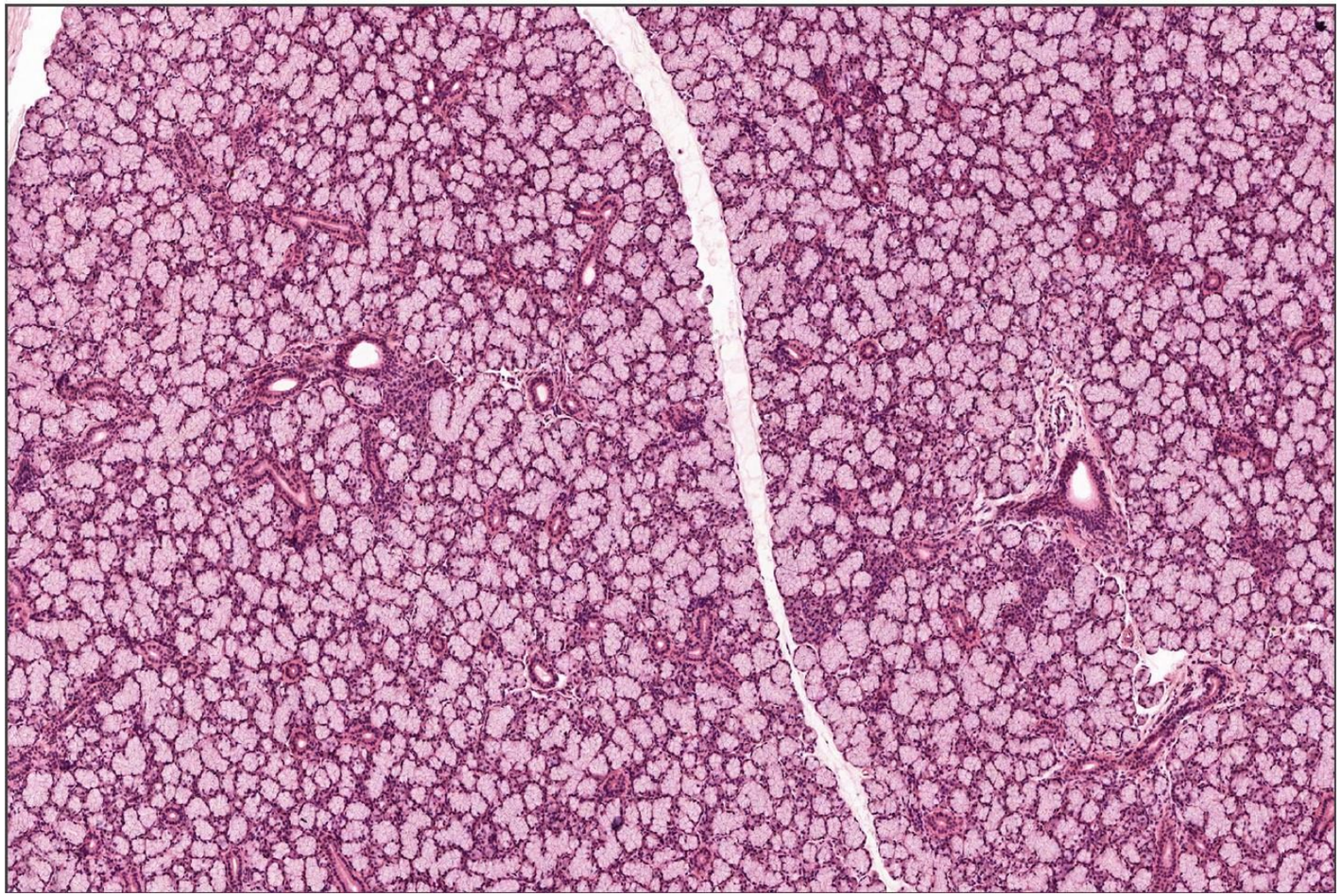
- It looks stratified due to the section taken , however it is definitely simple

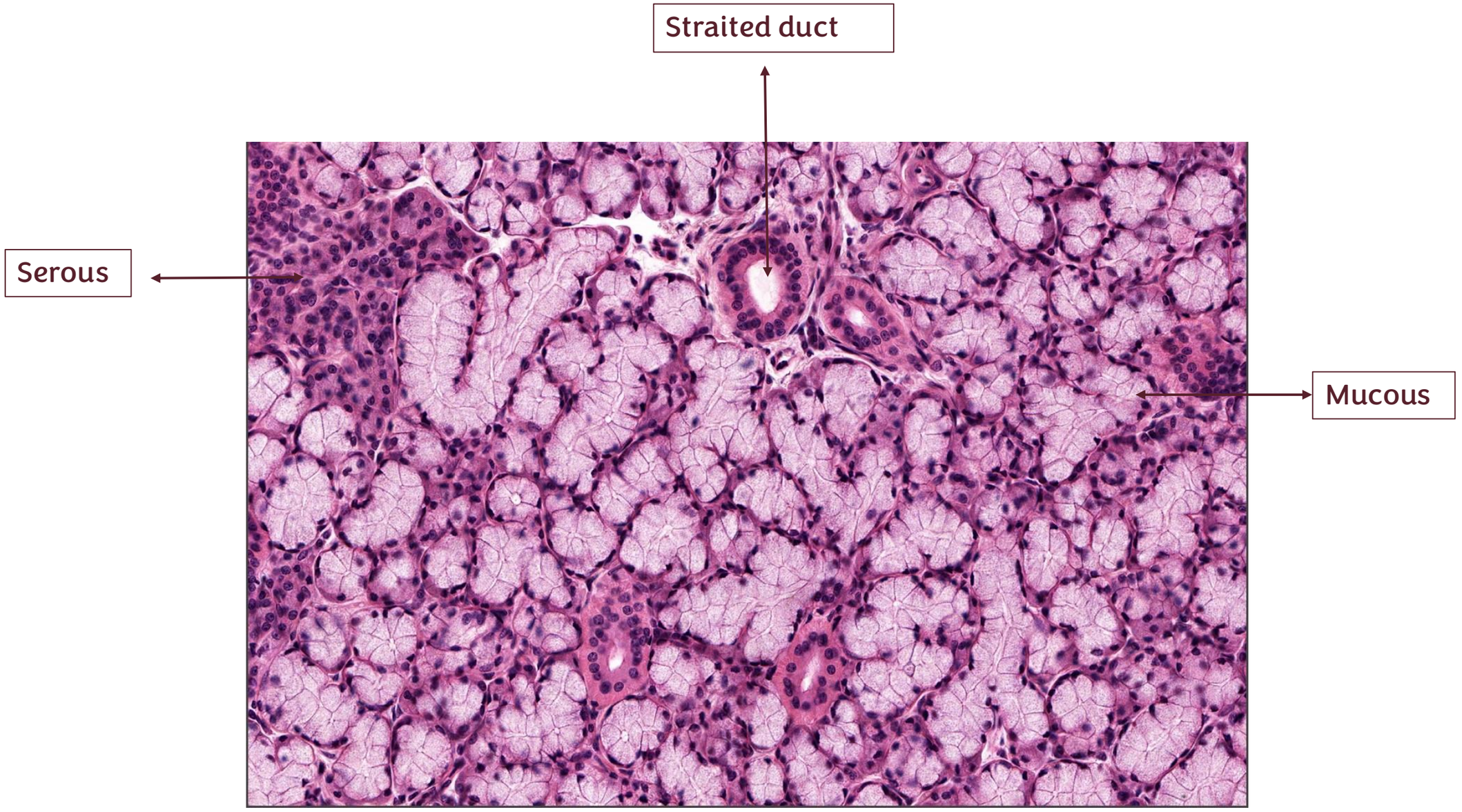


Same as previous one but at higher magnification



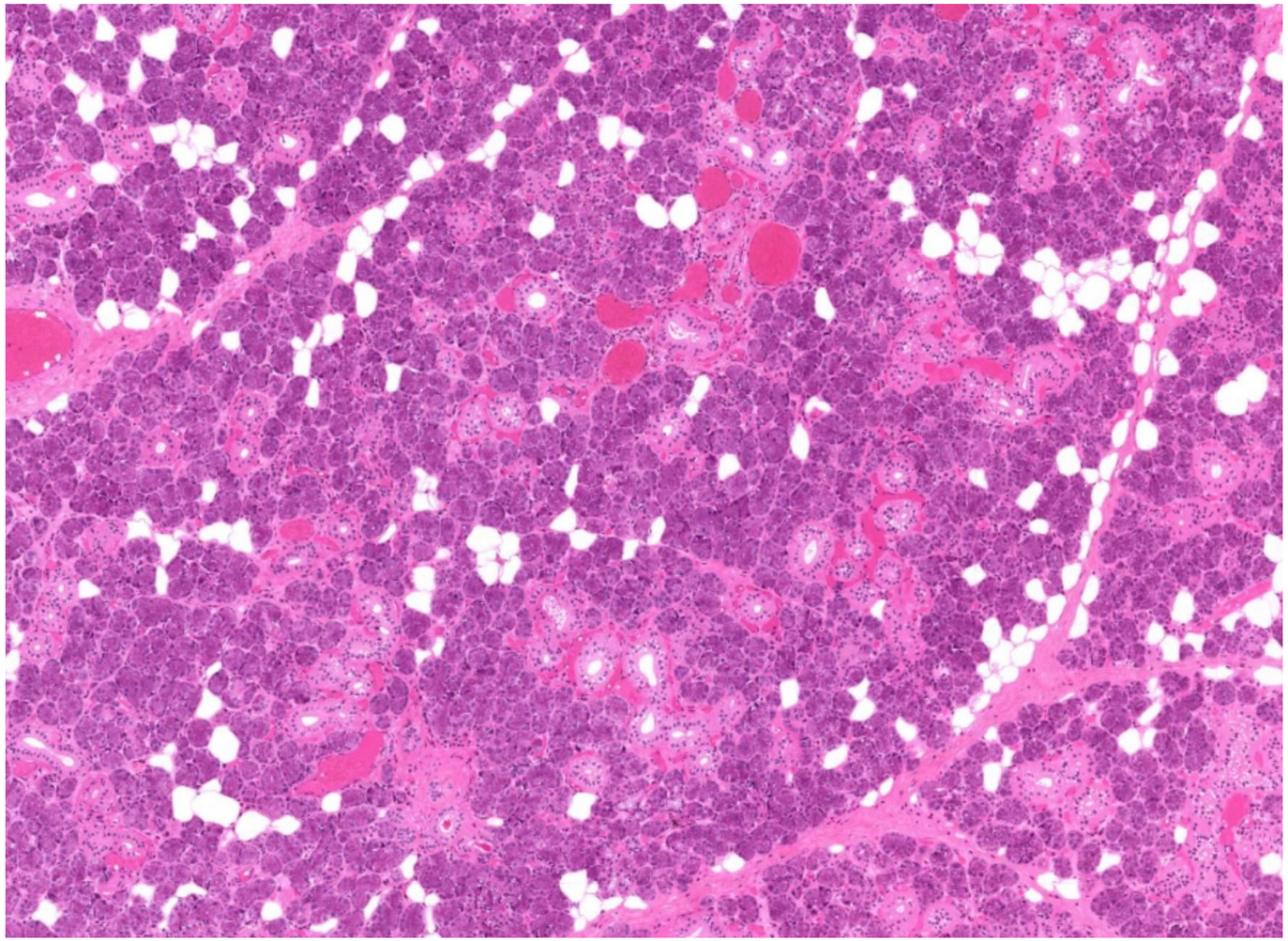
Mixed gland (mostly mucous)

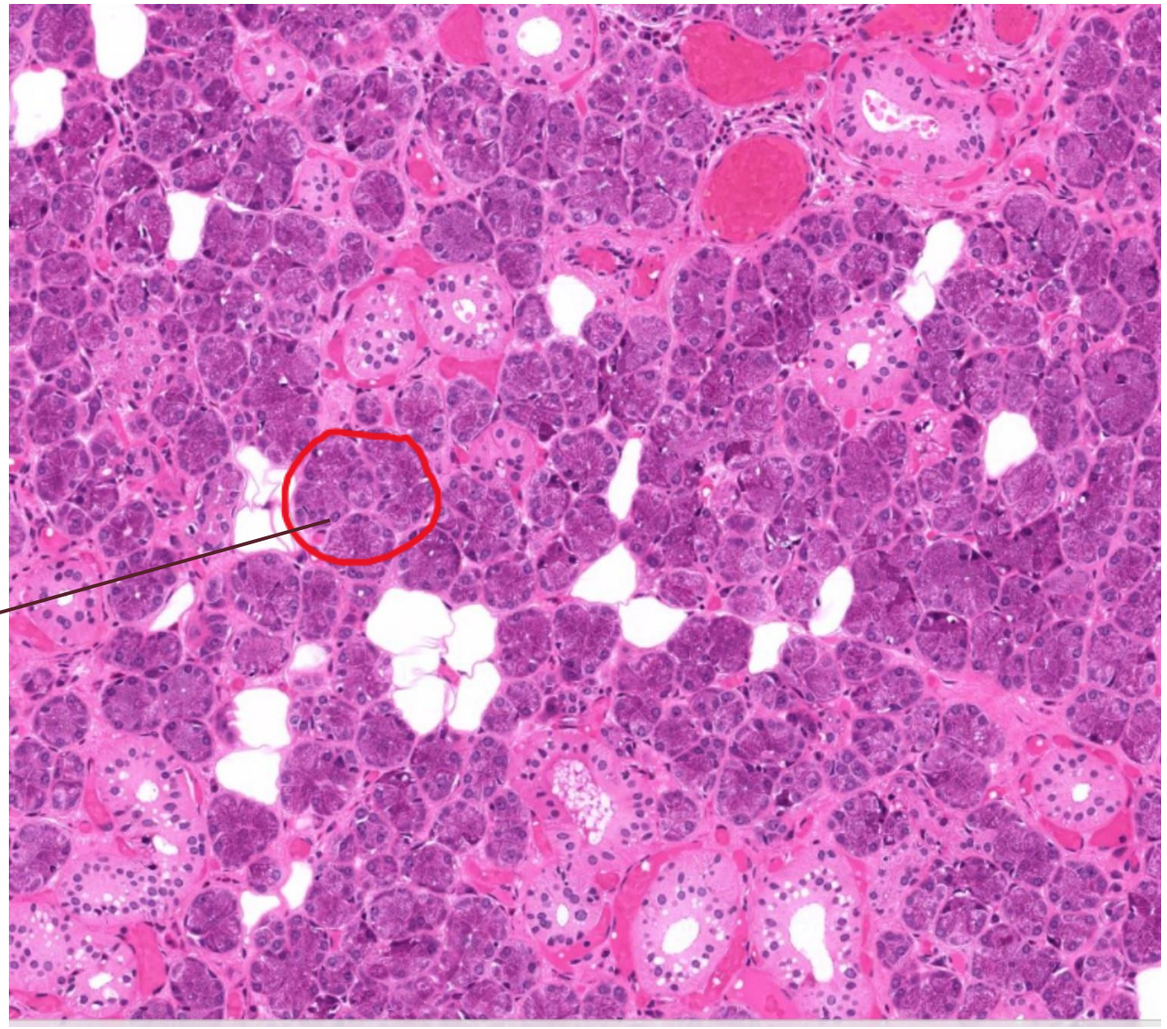



Straited duct
Serous
Mucous

** Serous and not mixed ,, be careful don't get confused by the whitish circles those are fat (which is a normal finding in glands in general and it occurs due to aging)

**There is no foamy gusty appearance , cells are clearly full

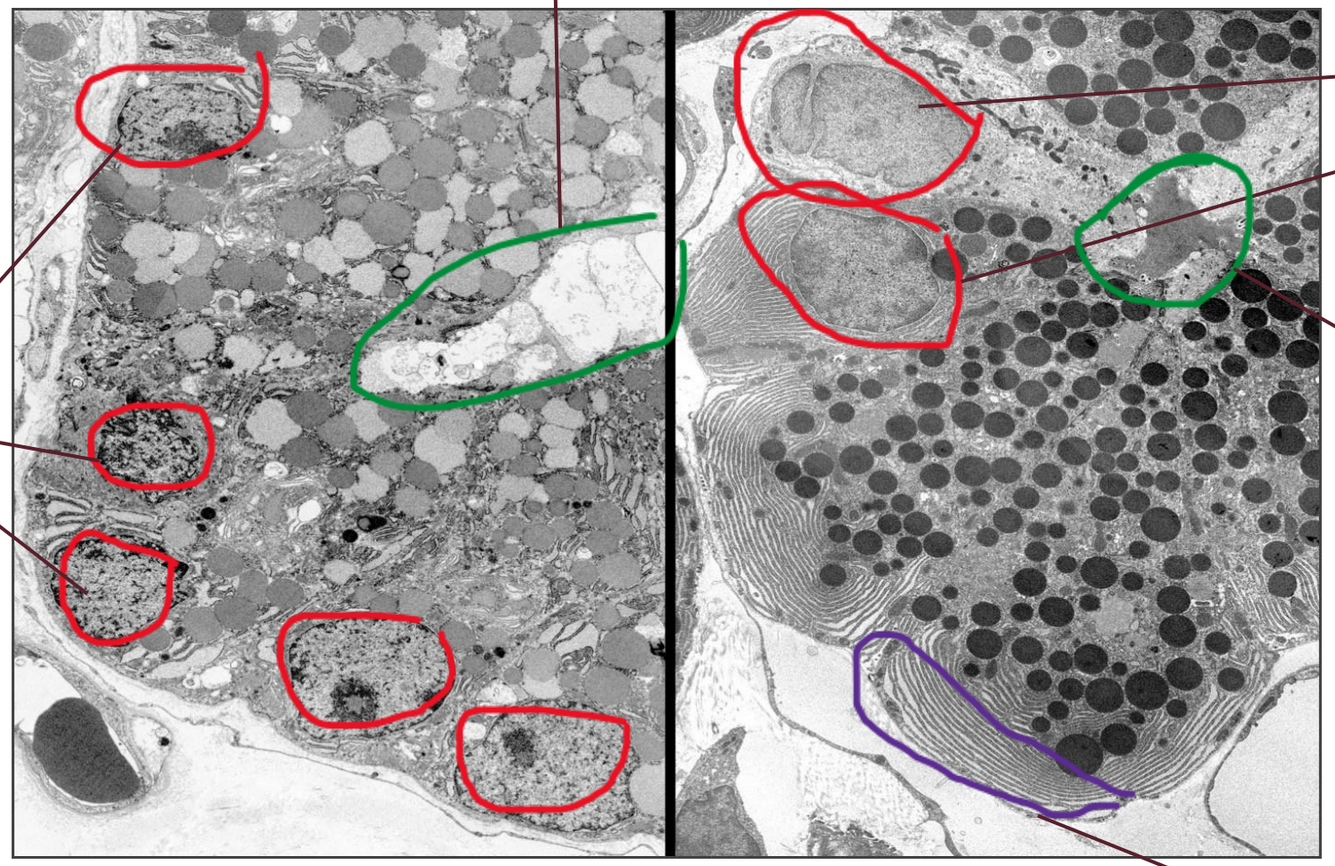



Ductal of serous

Lumen (wider for mucus secretion which needs a larger space as it is thicker)

TEM

TEM



Cells full with granules

Cells full with granules

Lumen

Mucus

Serous

RER (Responsible for granules production)

Gastrointestinal Tract (GIT)

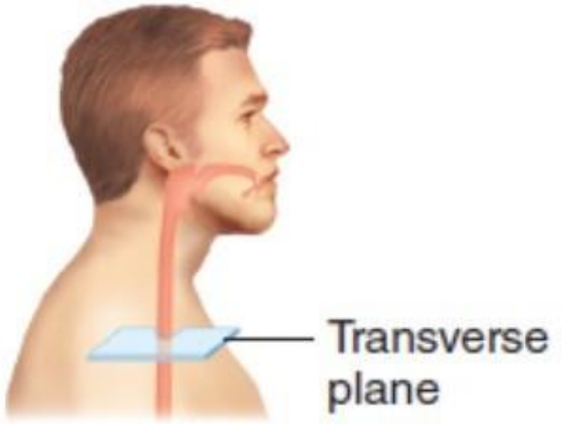
ESOPHAGUS AND

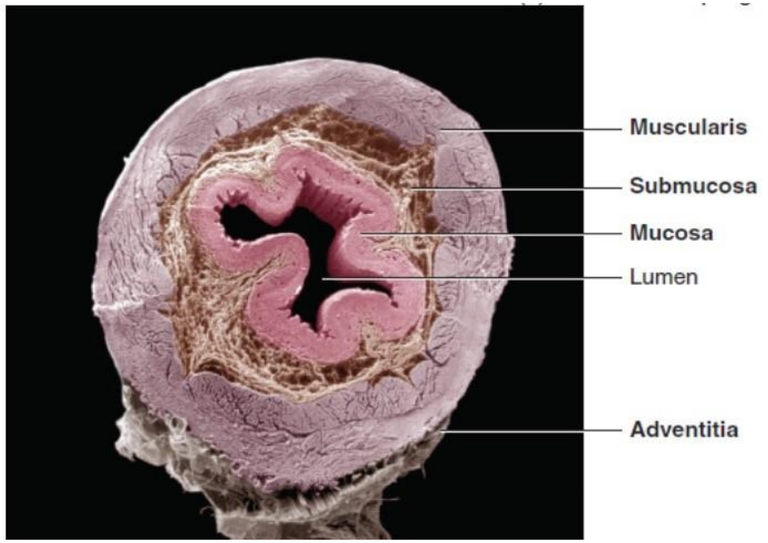
STOMACH

READ ONLY

The Esophagus

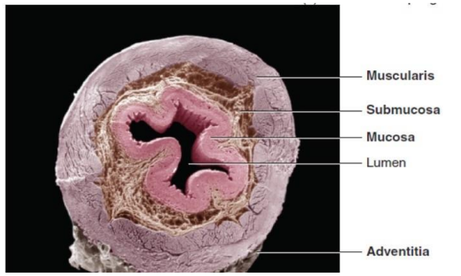
- Is a collapsible muscular tube, about 25 cm long
- Lies posterior to the trachea.
- Begins at the inferior end of the laryngopharynx, passes through the inferior aspect of the neck, and enters the mediastinum anterior to the vertebral column.
- It pierces the diaphragm through an opening called the **esophageal hiatus.**



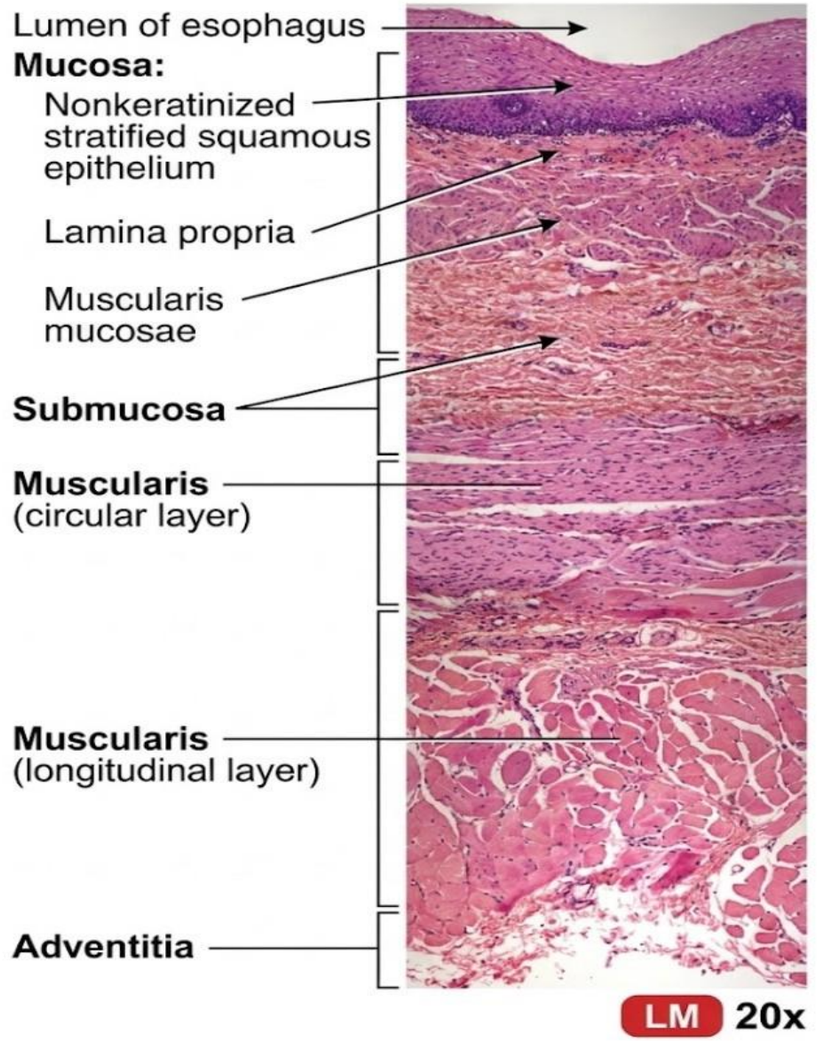


Histology Of The Esophagus

All the esophagus covered by adventitia except 1 or 2 cm at the junction with the stomach



- The **mucosa** of the esophagus consists of nonkeratinized stratified squamous epithelium, lamina propria, and a muscularis mucosae.
- The submucosa contains blood vessels, and mucous glands (esophageal glands, near the stomach it contains esophageal cardiac glands).
- The muscularis of the superior third is skeletal muscle, the intermediate third is skeletal and smooth muscle, and the inferior third is smooth muscle.
- The superficial layer of the esophagus is known as the **adventitia (**attaches the esophagus to surrounding structures), the distal 1-2 cm is covered by serosa.

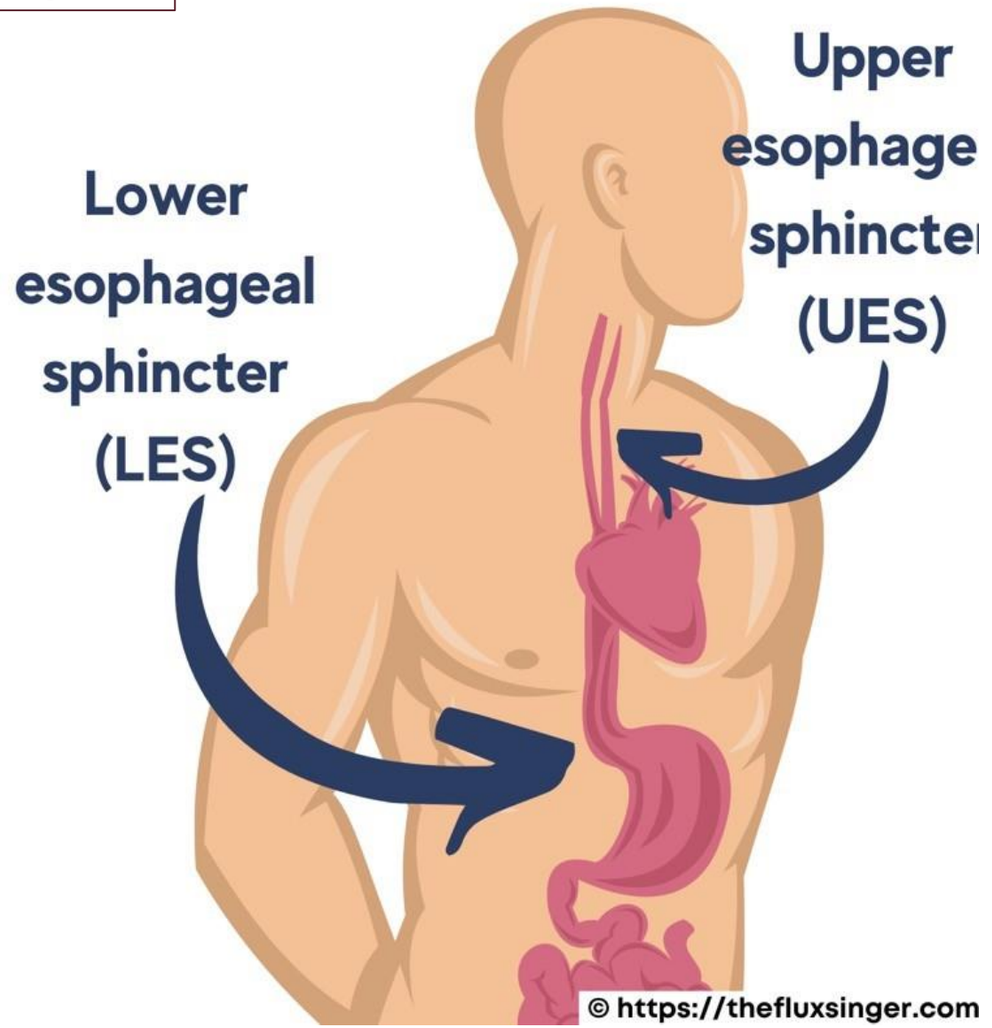


Sphincters

Sphincters are very important for checking on the things passing

- At each end of the esophagus, the muscularis forms two sphincters—

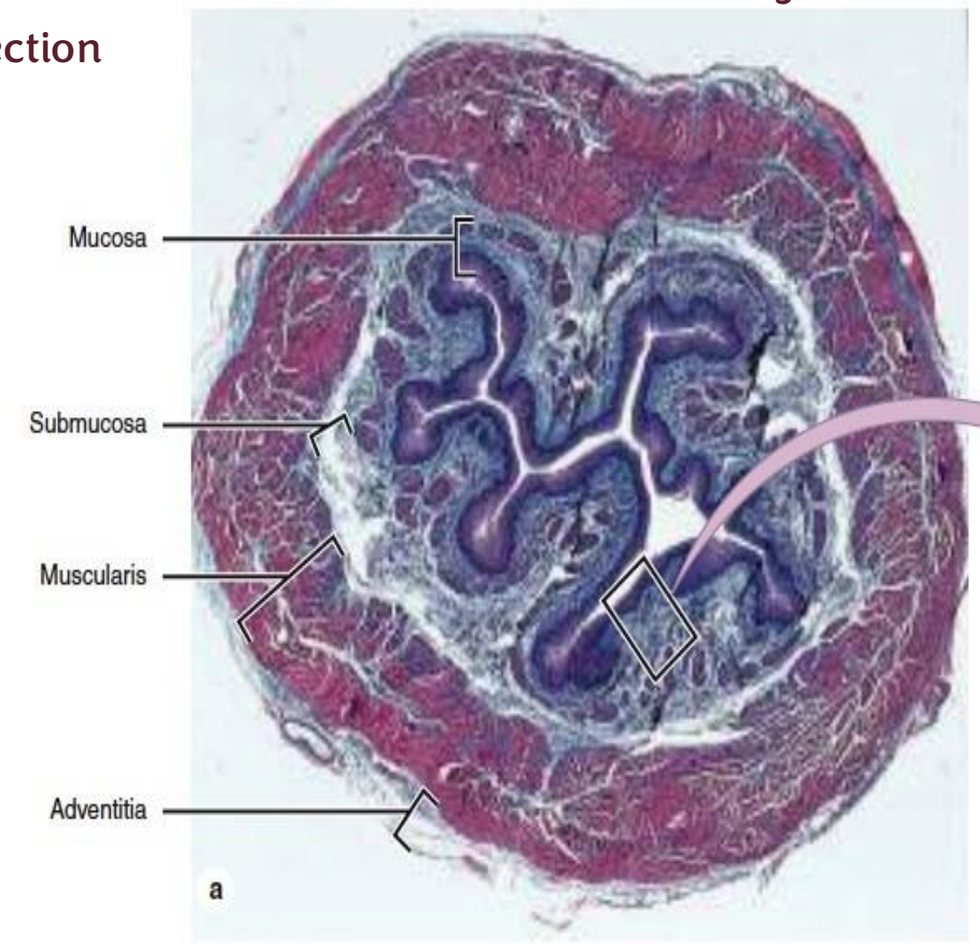
1. **Upper esophageal sphincter (UES) (**skeletal muscle): regulates the movement of food from the pharynx into the esophagus.
2. **Lower esophageal sphincter (LES) (**smooth muscle): regulates the movement of food from the esophagus into the stomach

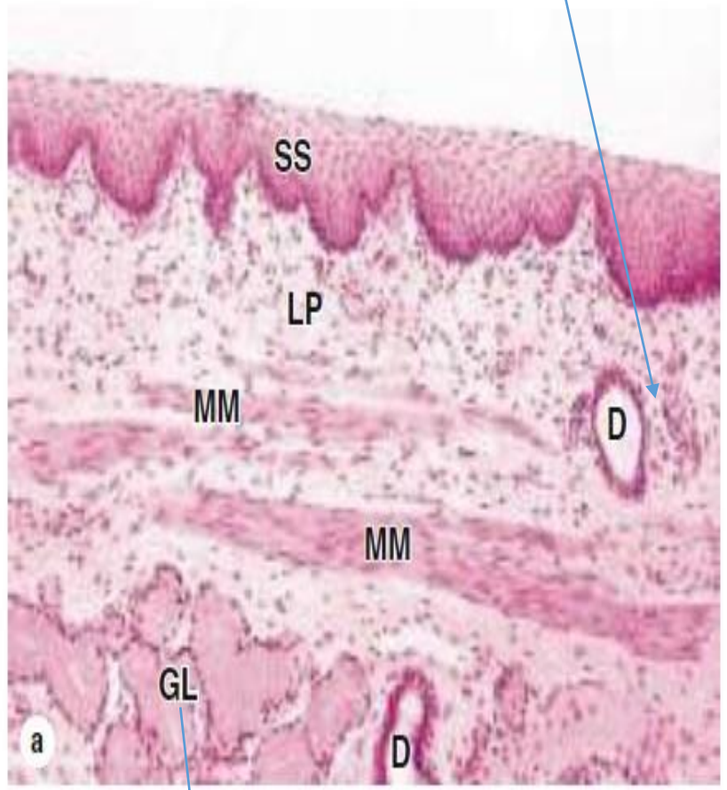


Esophagus

Trichrome staining

Cross-section





**Read only

MEDICAL APPLICATION

The lubricating mucus produced in the esophagus offers little protection against acid that may move there from the stomach. Such movement can produce heartburn or reflux esophagitis. An incompetent inferior esophageal sphincter may result in chronic heartburn, which can lead to erosion of the esophageal mucosa or gastroesophageal reflux disease (GERD). Untreated GERD can produce metaplastic changes
in the stratified squamous epithelium of the esophageal mucosa, a condition called Barrett esophagus.

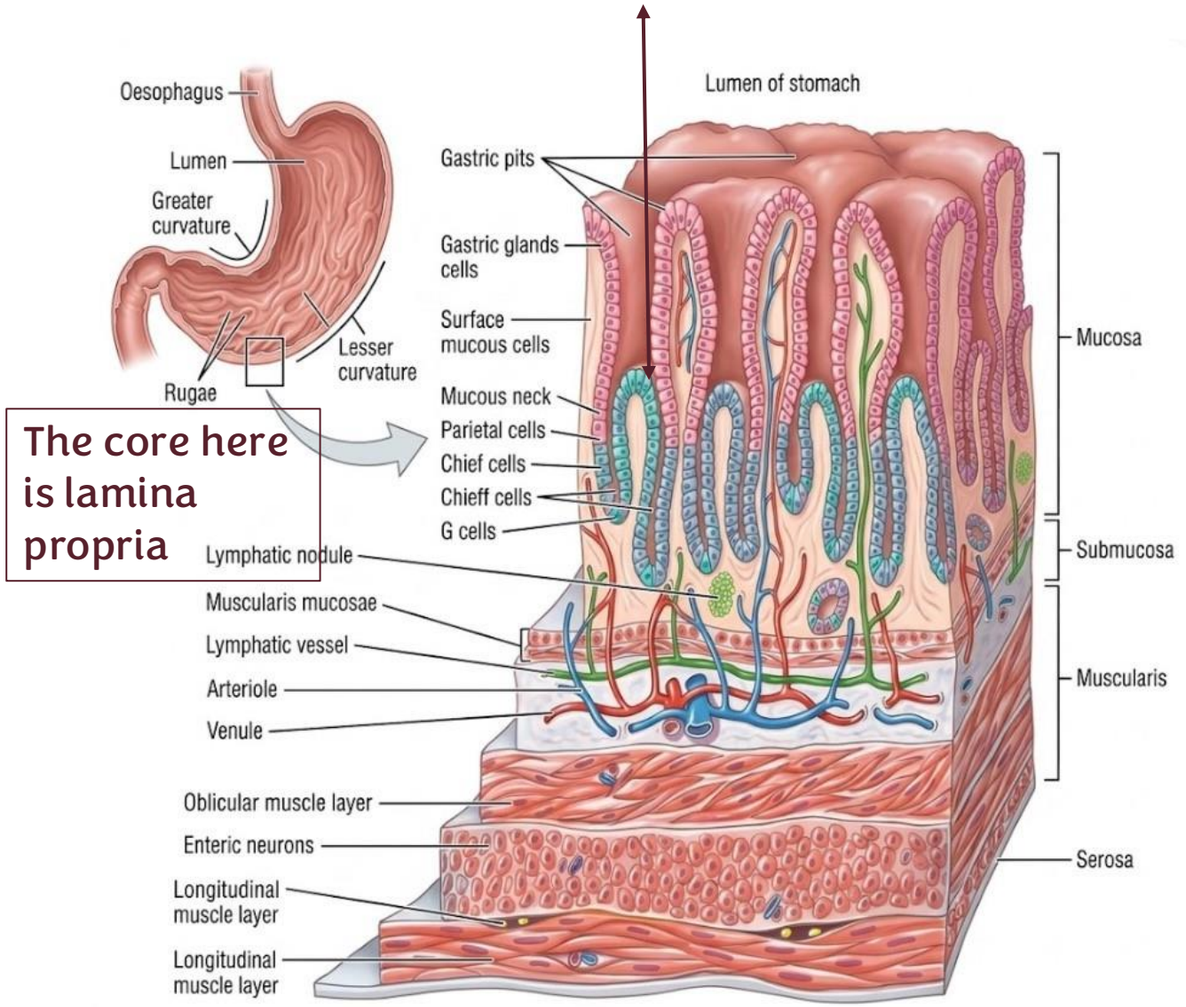
Histology Of The Stomach

Watching the lecture for this part is really helpful for more understanding;)

- Mucosa: epithelium + lamina propria + muscularis mucosae
- Epithelium: simple columnar cells--- **surface mucous cells.**
- **Gastric glands:** extension of epithelial cells down into the lamina propria and form columns of secretory cells.
- **Gastric pits:** bottom of narrow channels where several gastric glands open into then into the lumen of stomach.
- In the fundus and body the gastric glands themselves fill most of the mucosa

- In the duodenum we have something called sub mucosal glands

- Epithelium invades CT forming glands of the stomach



The core here is lamina propria

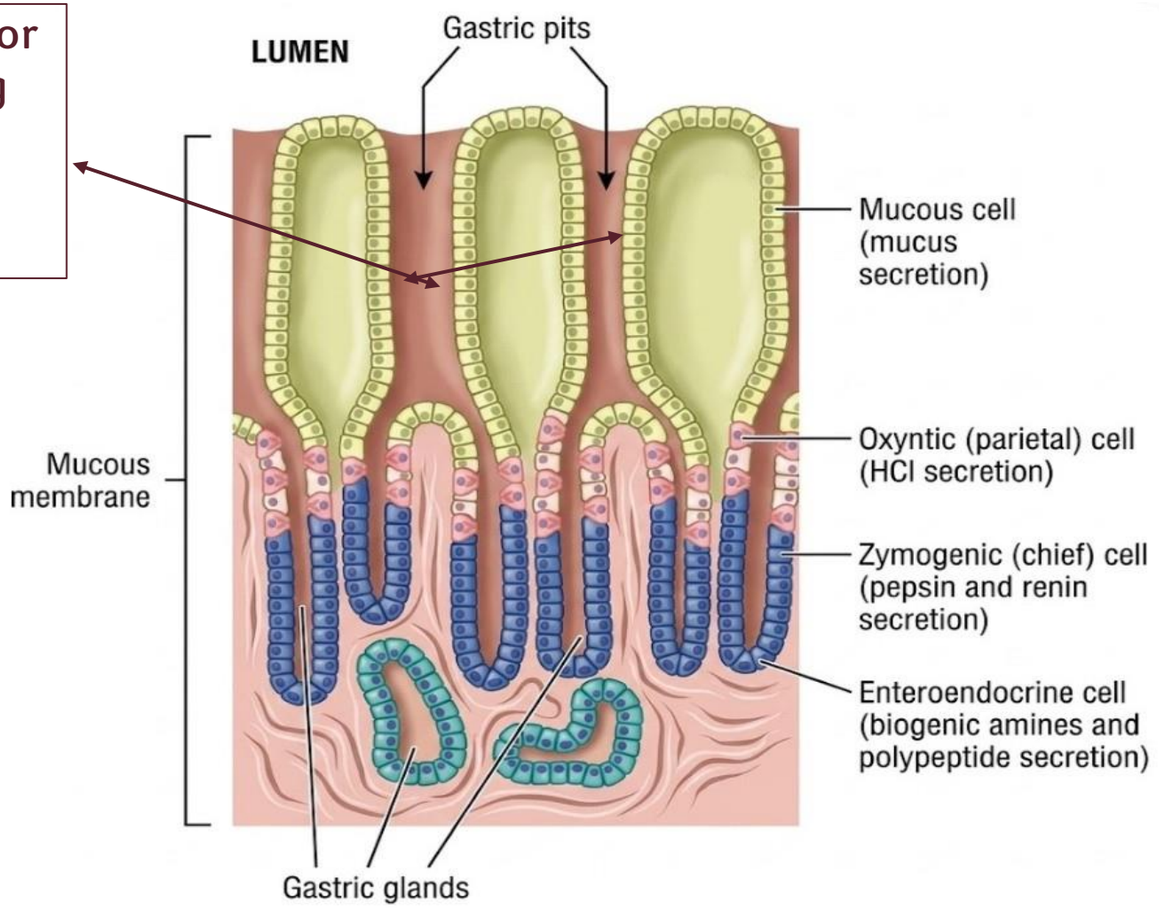
Mucosa

- Isthmus area which contains progenitor cells that are responsible for renewing gland cells regularly because they are under harsh conditions (around 4-7 days , could be shorter)

- The mucosal surface of the stomach is a simple columnar epithelium that invaginates deeply into the lamina propria. The invaginations form millions of gastric pits, each with an opening to the stomach lumen.

- The gastric pits lead to long, branched, tubular glands that extend through the full thickness of the lamina propria.

- We have also neck mucous cells that are deeper within the pit which secrete acidic mucous opposite to the ones on the surface



- The surface mucous cells that line the lumen and gastric pits secrete a thick, adherent, and highly viscous mucous layer that is rich in bicarbonate ions and protects the mucosa from both abrasive effects of intraluminal food and stomach acid. PH: 1-2

Histology Of The Stomach

Surface mucous cells are the cells directly line the stomach surface. They secrete an **alkaline** fluid containing mucin.

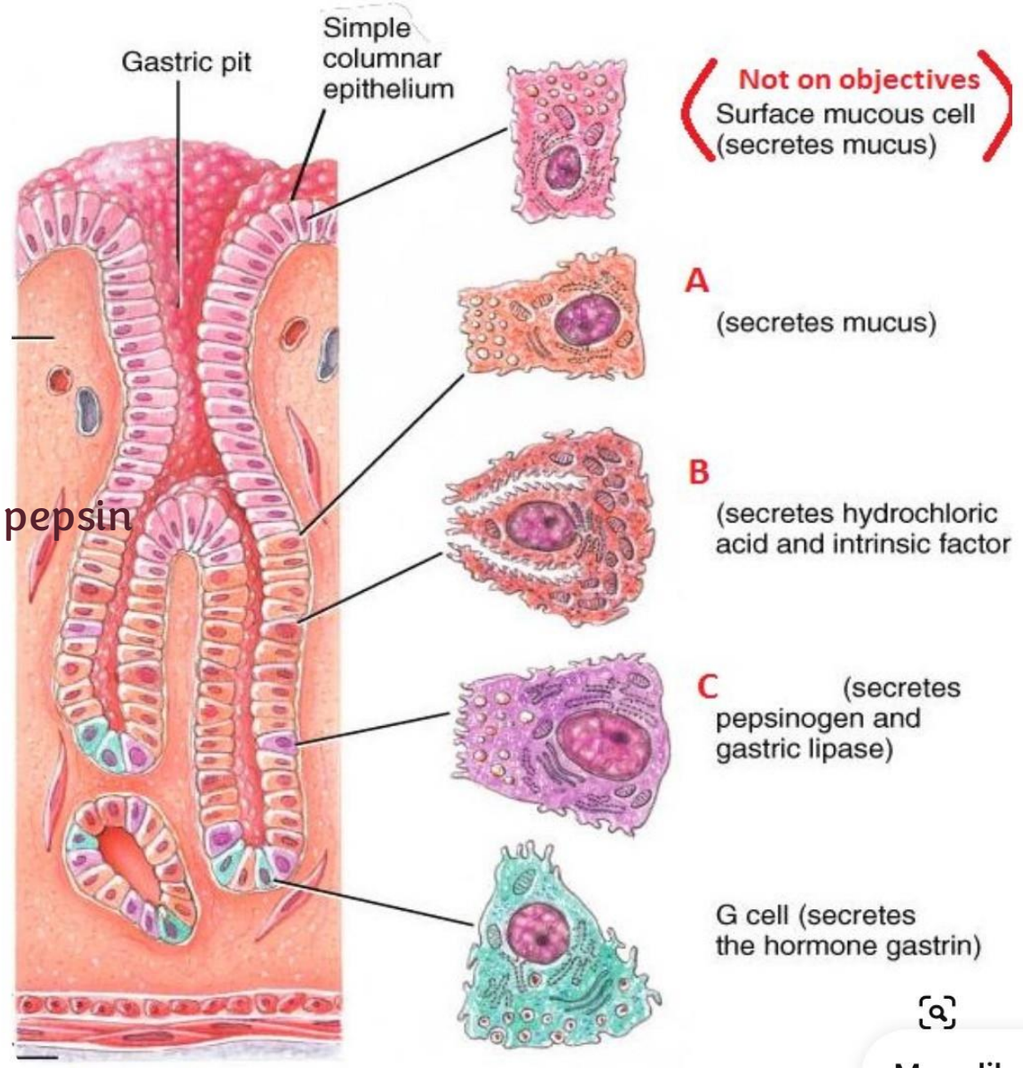
Exocrine gland cells **that secrete their products into the stomach lumen: mucous neck cells, chief cells, parietal cells, and enteroendocrine cells:**

1. mucous neck cells secrete mucus (**acidic** fluid).
2. Parietal (oxyntic) cells produce HCL and intrinsic factor (needed for absorption of vitamin b_{12}). Among mucous neck cells. Rounded or pyramidal. **Intensely eosinophilic (+++ mitochondria)**. its secretion is stimulated by parasympathetic innervation and by **gastrin**.

Transforms pepsinogen into pepsin

They appear intensely eosinophilic because their machinery requires lots of mitochondria

A hormone produced by G cells



Additional notes

- Pepsinogen is secreted by chief cells
- If a person has any issues (inflammation/ has done gastric by pass / wants to lose weight) these cells (parietal cells) will be affected, so levels of b12 will be affected
- They are considered unicellular glands (remember glands can be unicellular or multicellular)

Histology Of The Stomach

Those cells usually accumulate the secretion in granules , so they appear basophilic which makes them easily differentiated than parietal

3. The chief (*zymogenic*) cells secrete pepsinogen and gastric lipase (protein and lipid digestion). Predominate the lower part of the gland. Protein-secreting cell---abundant RER and apical granules (inactive pepsinogens).

4. Enteroendocrine cells are scattered cells with endocrine and paracrine function. located mainly in the pyloric antrum and secretes the hormone **gastrin---G cells**.

Act on the neighboring cells , gives secretions to parietal and oxyntic cells

SEM showing surface mucous cells

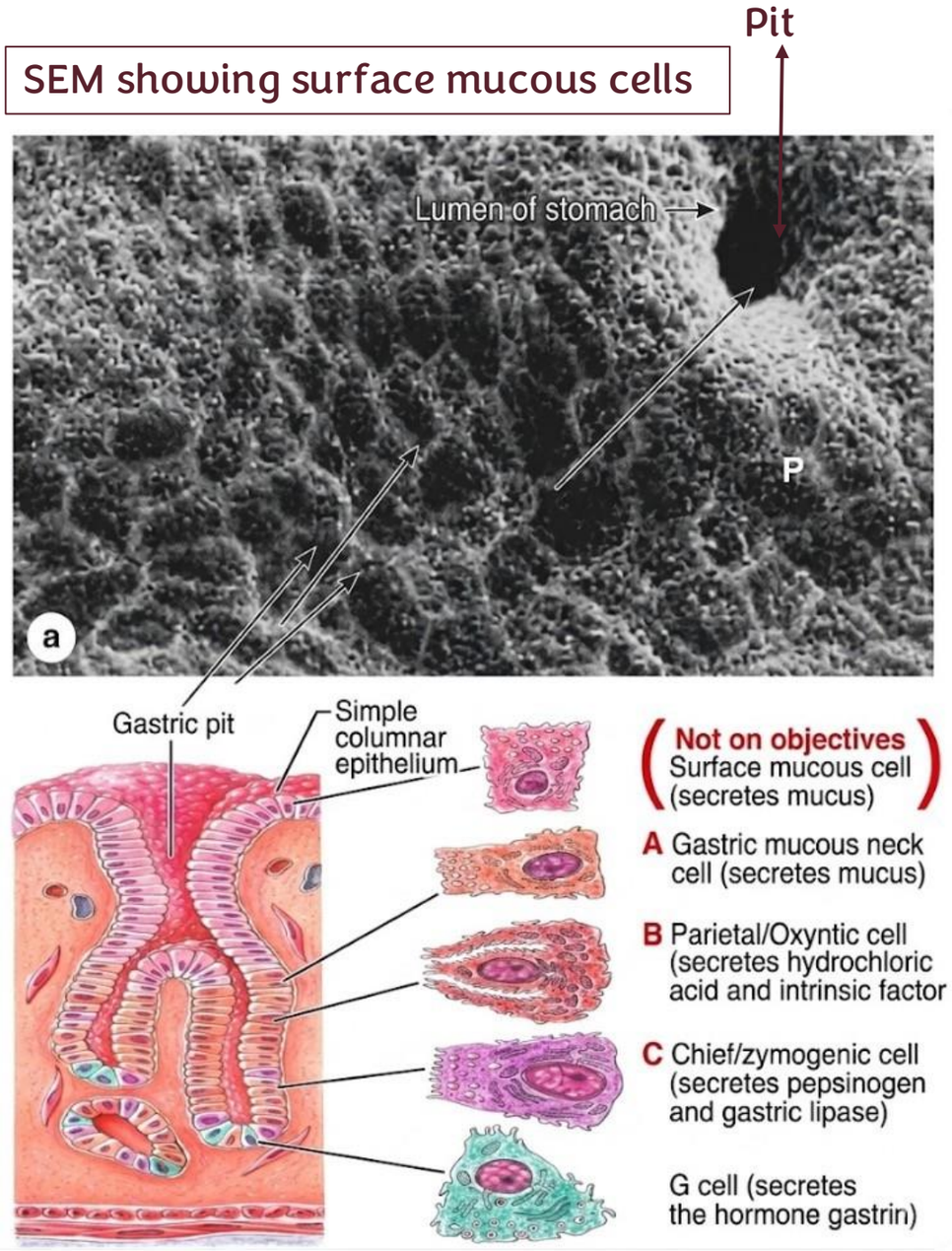


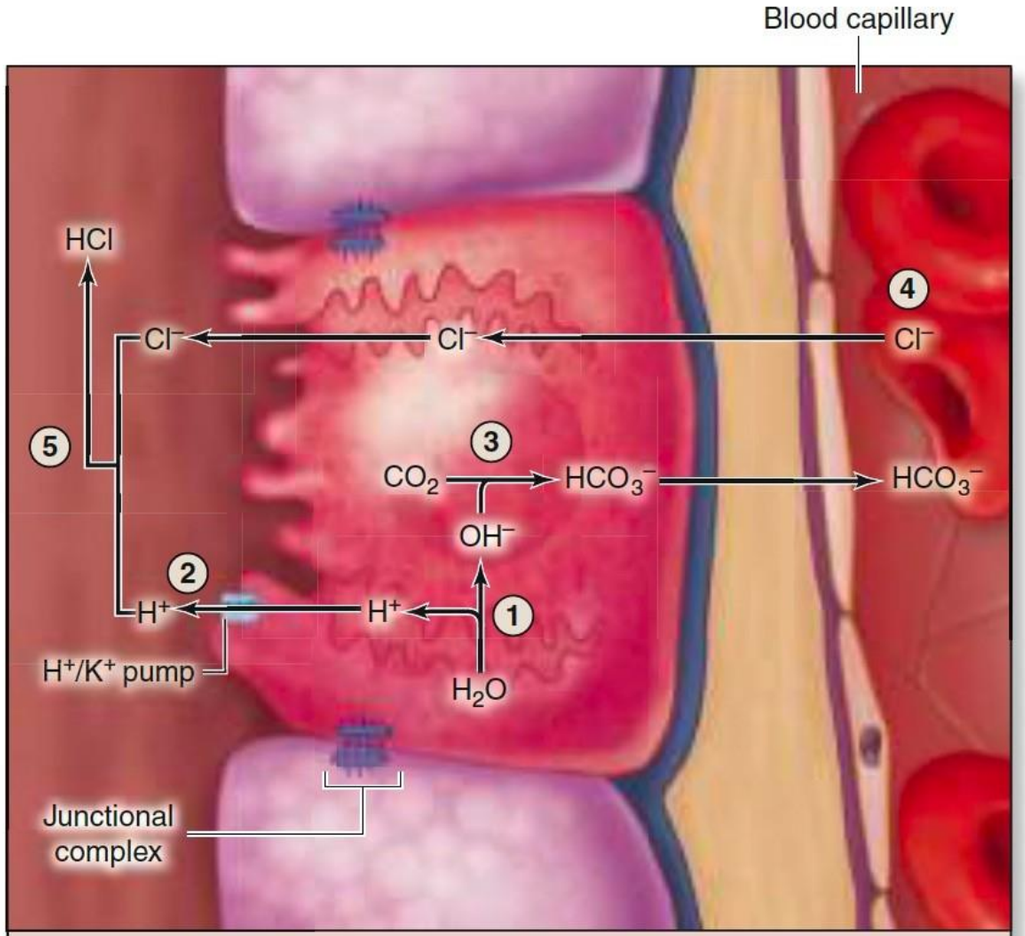
TABLE 15–1 Principal enteroendocrine cells in the gastrointestinal tract.

Study only the circled cell types , others will be discussed in the small intestines

Cell Type	Major Location	Hormone Produced	Major Action: Promotes	Major Action: Inhibits
D cells	Pylorus, duodenum, and pancreatic islets	Somatostatin		Secretion from other DNES cells nearby
EC cells	Stomach, small and large intestines	Serotonin and substance P	Increased gut motility	
G cells	Pylorus	Gastrin	Gastric acid secretion	
I cells	Small intestine	Cholecystokinin (CCK)	Pancreatic enzyme secretion, gallbladder contraction	Gastric acid secretion
K cells	Duodenum and jejunum	Gastric inhibitory polypeptide (GIP)		Gastric acid secretion
L cells	Ileum and colon	Glucagon-like peptide (GLP-1)	Insulin secretion	Gastric acid secretion Sense of hunger
L cells	Ileum and colon	Peptide YY	H_2O and electrolyte absorption in large intestine	Gastric acid secretion
Mo cells	Small intestine	Motilin	Increased gut motility	
N cells	Ileum	Neurotensin		Gastric acid secretion
S cells	Small intestine	Secretin	Pancreatic and biliary bicarbonate and water secretion	Gastric acid secretion Stomach emptying

HCL production

READ ONLY



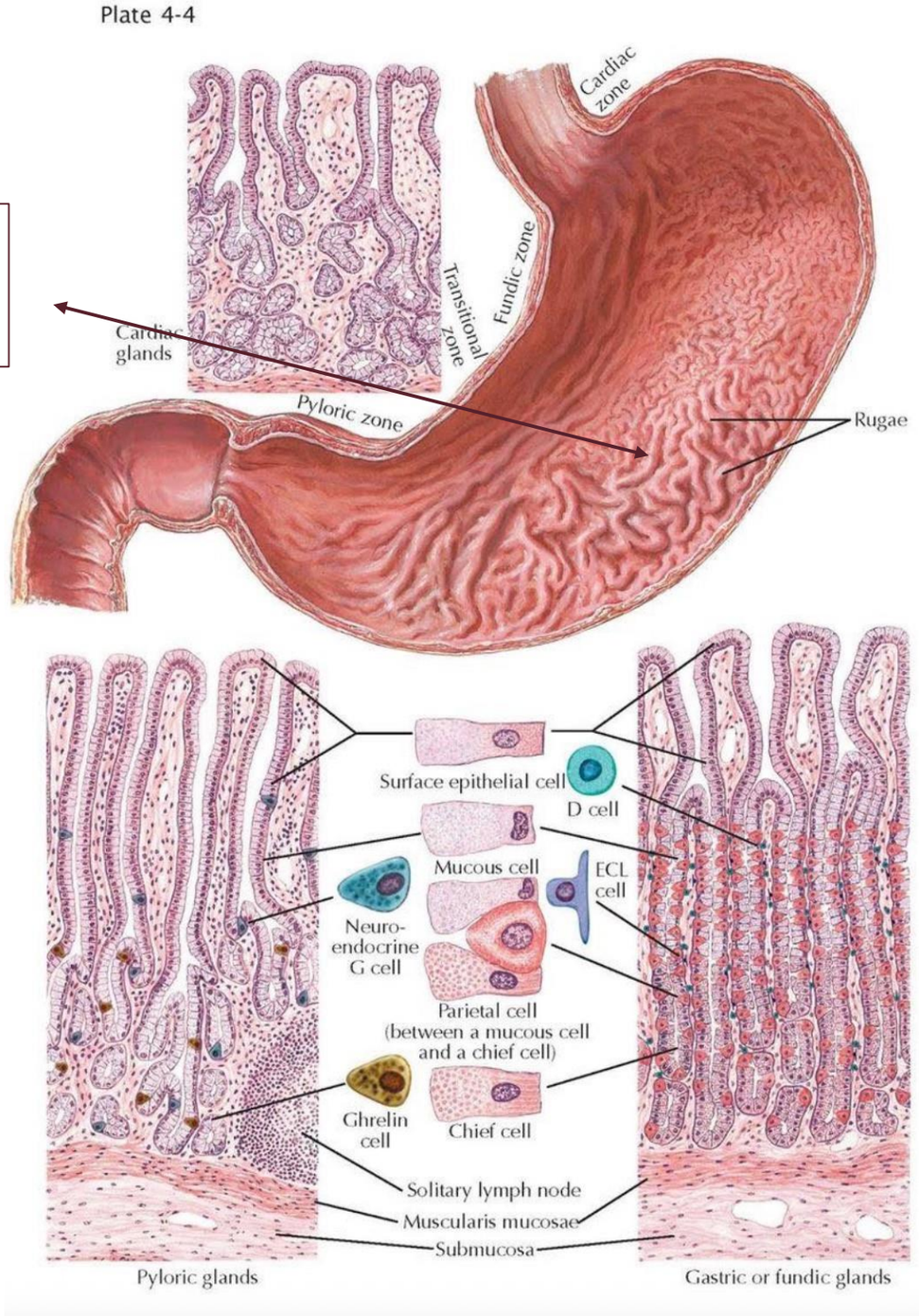
1. Water (H_2O) within the parietal cell is split into a hydrogen ion (H^+) and hydroxide ion (OH^-).
2. H^+ is pumped into the lumen of the gastric gland by an H^+/K^+ pump.
3. OH^- bonds with carbon dioxide (CO_2) to form bicarbonate ion (HCO_3^-).
4. An exchange occurs as HCO_3^- is transported out of the parietal cell (HCO_3^- then enters the blood), while chloride ion (Cl^-) is transported into the parietal cell; Cl^- then enters the lumen of the gastric gland.
5. Within the lumen of the gastric gland, Cl^- combines with H^+ to form hydrochloric acid (HCl).

Histology Of The Stomach

Mucosa of the beginning and end of stomach are similar and different than the mucosa in the body and fundus .

Food will spend most of the time in this area , so the most cells seen here are chief and parietal cells .

- In the cardia and pylorus regions of the stomach, the mucosa also contains tubular glands, with long pits, branching into coiled secretory portions, called cardiac glands and pyloric glands. These glands **lack** both parietal and chief cells, primarily secreting abundant mucus.



Gastric Gland Type	Zone	Anatomical Context & Role	Core Cell Population (Exocrine)	Primary Function(s)
Cardiac Glands	**Cardiac Zone**	Located at the gastroesophageal junction. Forms a transitional zone between esophageal and gastric tissue.	Mostly **Mucous cells**(high volume secretion to protect esophagus). Few parietal/chief cells.	Secretes alkaline mucus to protect the distal esophagus from acidic reflux and lubricate the cardia.
Gastric or Fundic Glands	**Fundic Zone**(Body & Fundus)	The primary secretory region of the stomach. Contains the most cell diversity. Glands are simple, branching, with deep pits.	Abundant **Parietal cells** (HCl) and **Chief cells** (Pepsinogen). Rich in **Mucous cells**(both surface and neck).	**Primary Acidification:** HCl secretion creates pH 1-2. Protein digestion via pepsin. Vit B12 absorption (Intrinsic Factor from parietal cells).
Pyloric Glands	**Pyloric Zone**(Antrum & Pylorus)	Forming the transitional zone leading to the duodenum. Glands are deeply branched, coiled, and contained in the Pyloric pits.	Predominantly **Mucous cells** and **Pyloric mucous neck cells**. Some Chief cells are present, but parietal cells are rare.	**Primary Hormone Regulation:** Secretes Gastrin to stimulate acid production and motility. Secretes Ghrelin to stimulate appetite. Provides heavy mucus protection near the duodenum.

Enjoy Studying it !

Histology Of The Stomach

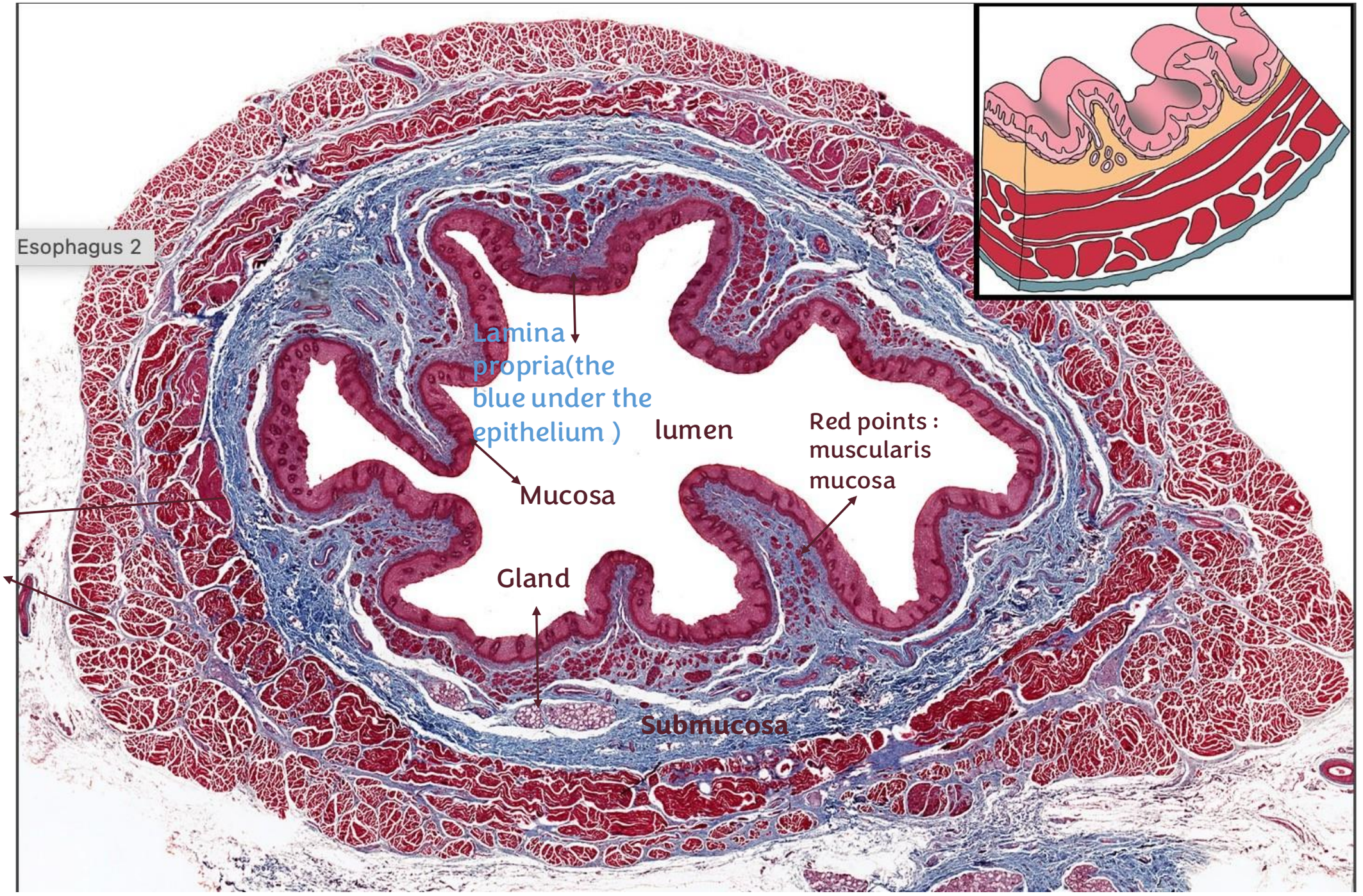
- The submucosa is composed of connective tissue: Large blood and lymph vessels and many lymphoid cells, macrophages, and mast cells
- The muscularis has three layers of smooth muscle (outer longitudinal, a middle circular, and an inner oblique). At the pylorus the middle layer is thickened to form the pyloric sphincter
- The serosa is composed of simple squamous epithelium (mesothelium) and areolar connective tissue;

MEDICAL APPLICATION

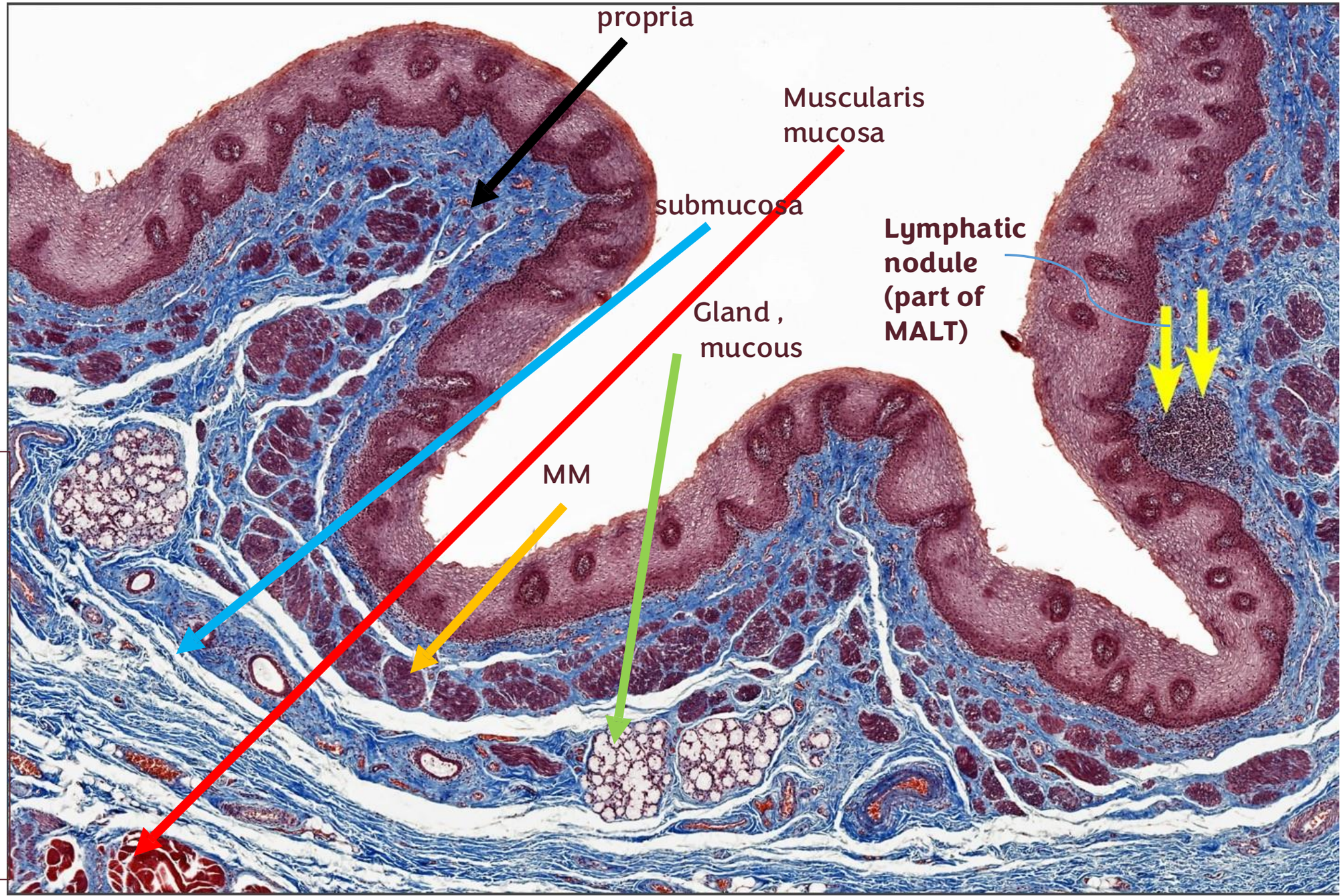
For various reasons, including autoimmunity, parietal cells may be damaged to the extent that insufficient quantities of intrinsic factor are secreted and **vitamin B12** is not absorbed adequately. This vitamin is a cofactor required for DNA synthesis; low levels of **vitamin B12** can reduce proliferation of erythroblasts, producing **pernicious anemia.**

MEDICAL APPLICATION

Gastric and duodenal ulcers are painful erosive lesions of the mucosa that may extend to deeper layers. Such ulcers can occur anywhere between the lower esophagus and the jejunum, and their causes include bacterial infections with *Helicobacter pylori*, effects of nonsteroidal anti-inflammatory drugs, overproduction of HCI or pepsin, and lowered production or secretion of mucus or bicarbonate.

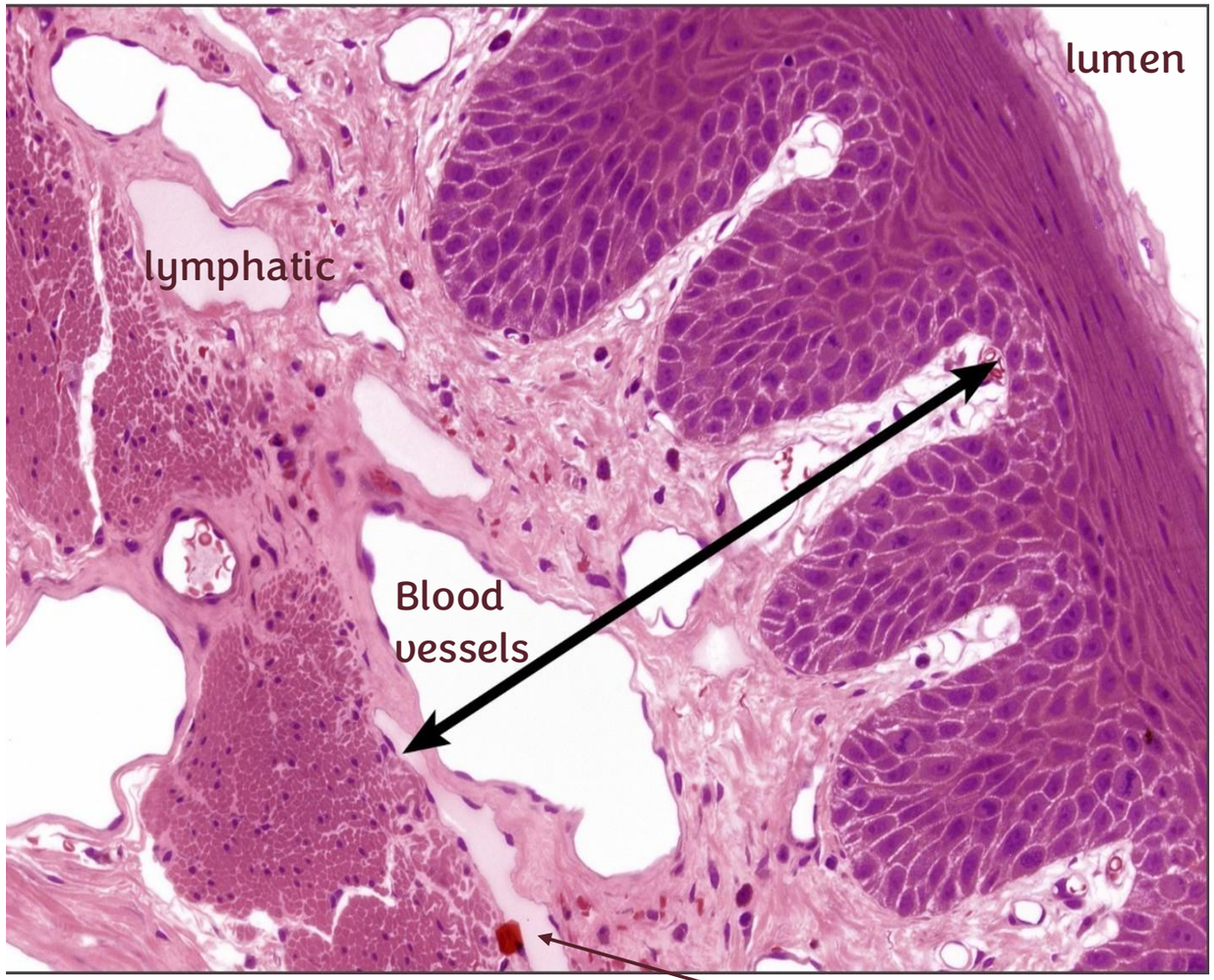

Esophagus 2
Lamina propria(the blue under the epithelium)
lumen
Red points : muscularis mucosa
Mucosa
Muscularis (note that the 2 muscular layers are well separated by connective tissue)
Gland
Submucosa

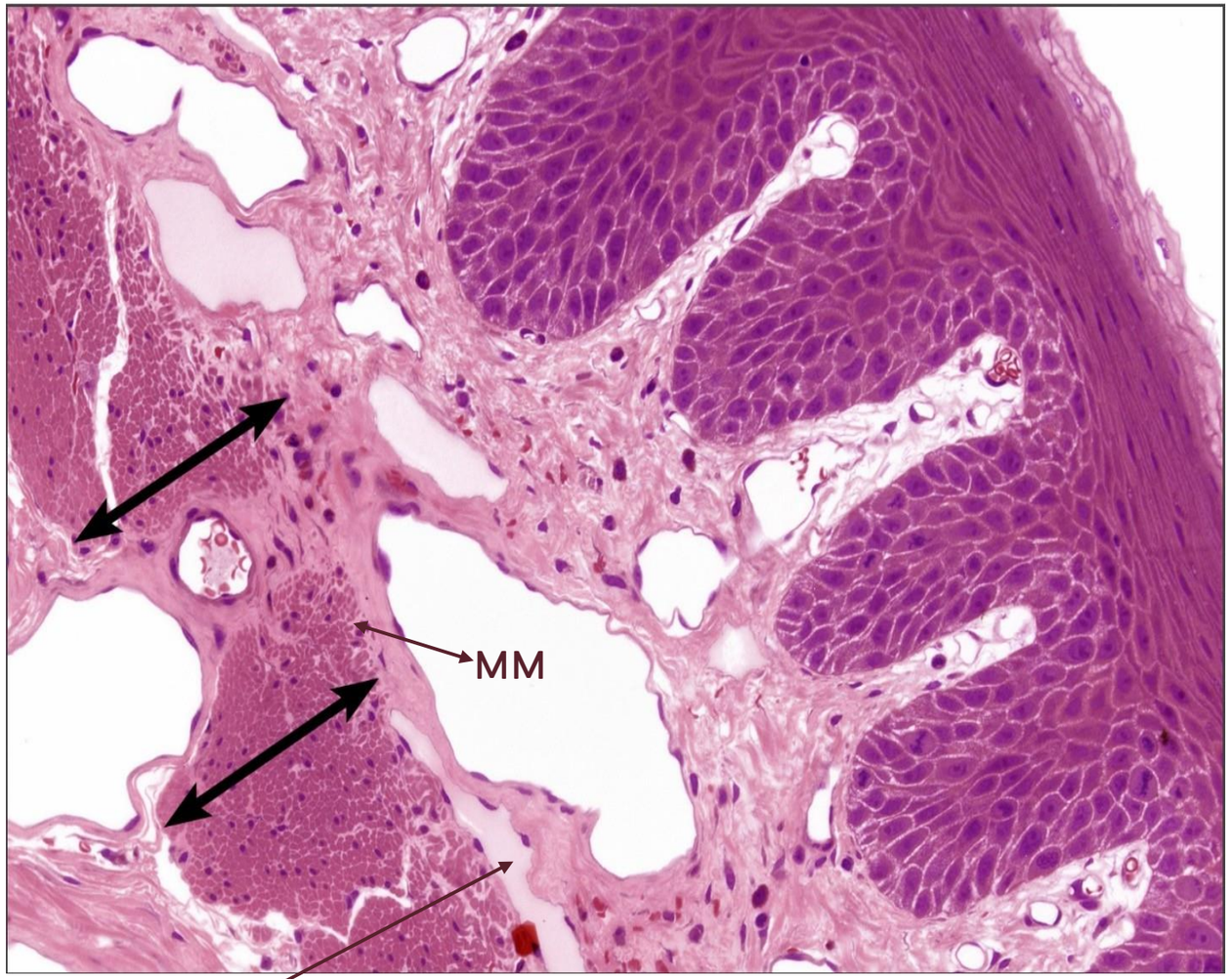
MM: Muscularis mucosa



**In addition to salivary contents, esophagus has its own mucus glands that function mainly in protection for the mucus surface of esophagus

Cross sections

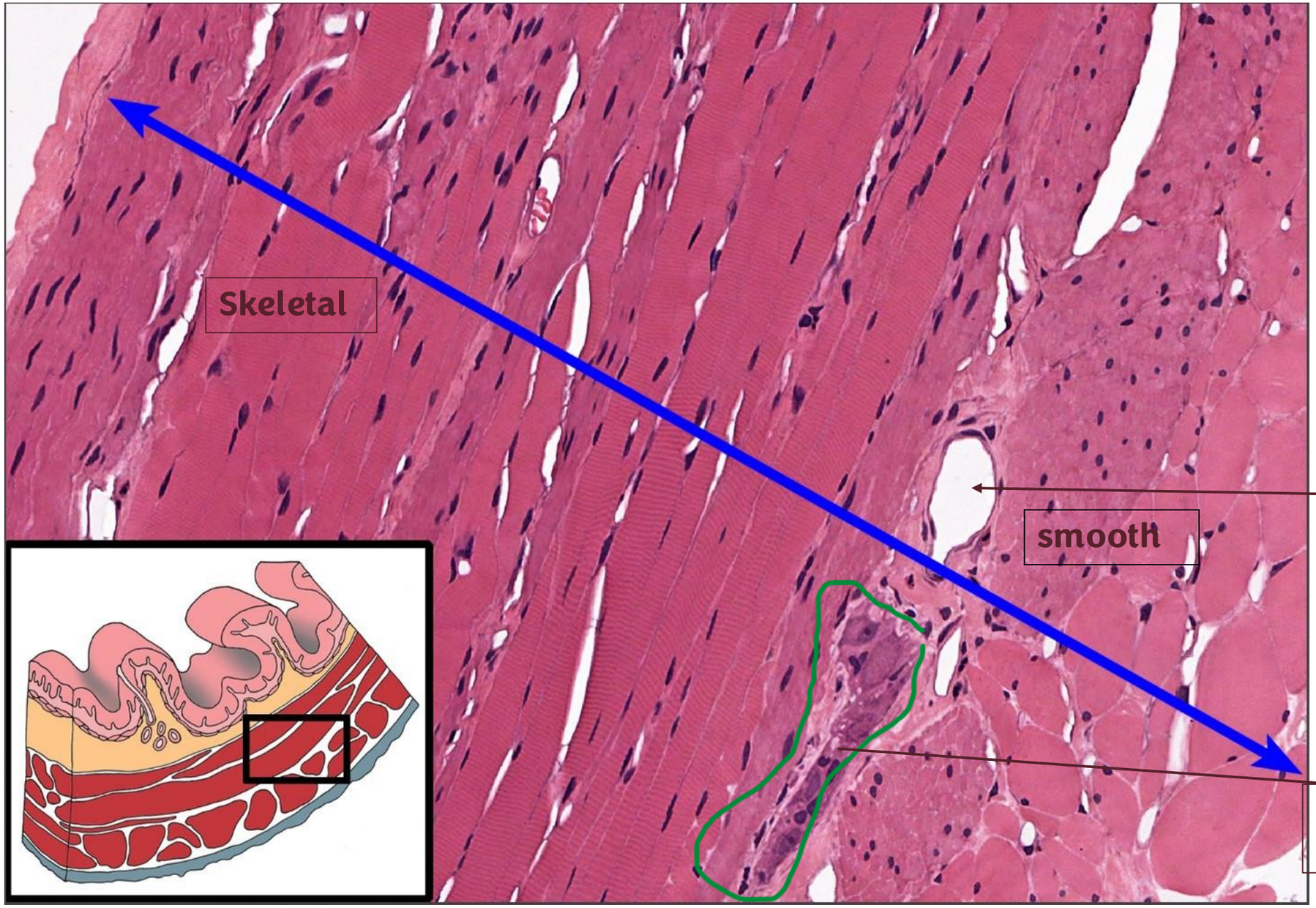




Lymphatic

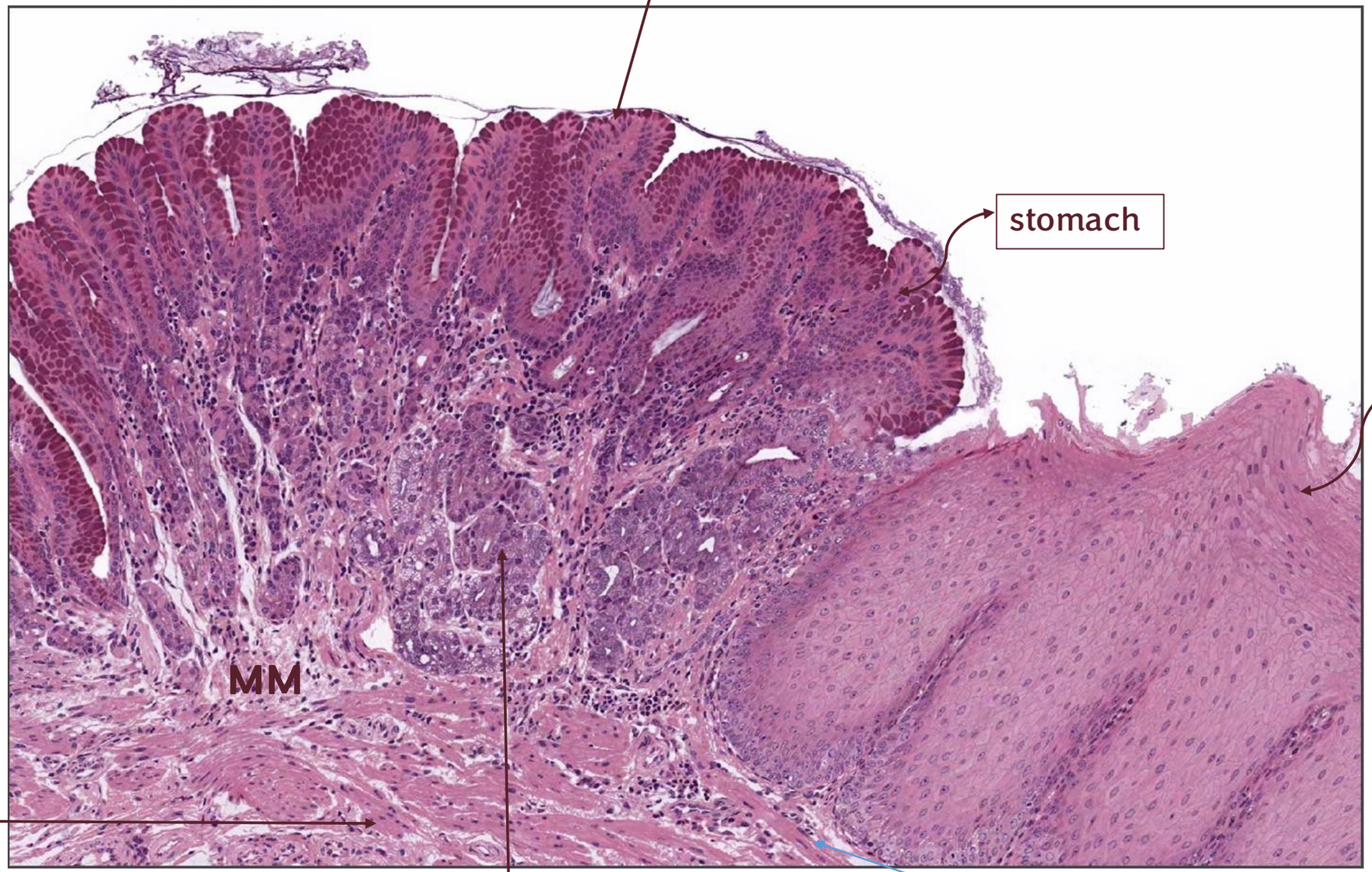
2 muscle tissue types

Longitudinal section



Gastroesophageal Junction

- No goblet cells because there is mucous cells
- This area is the cardia , so we don't expect chief and parietal cells



stomach

Esophagus (Stratified squamous non keratinized)

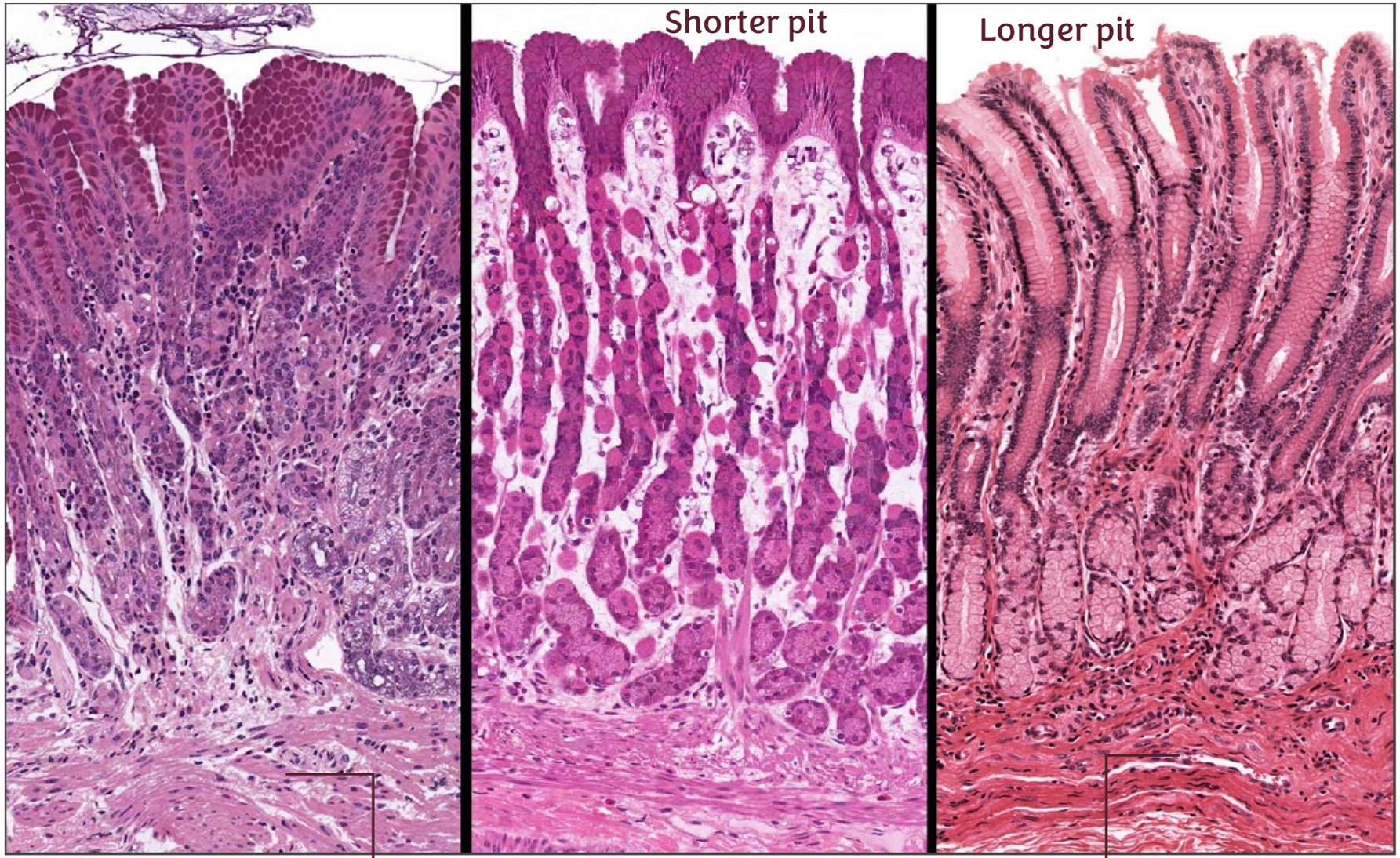
We find in it messiener and myenteric plexus also lymphoid and blood vessels

Submucosa

Glands secrete into the pits

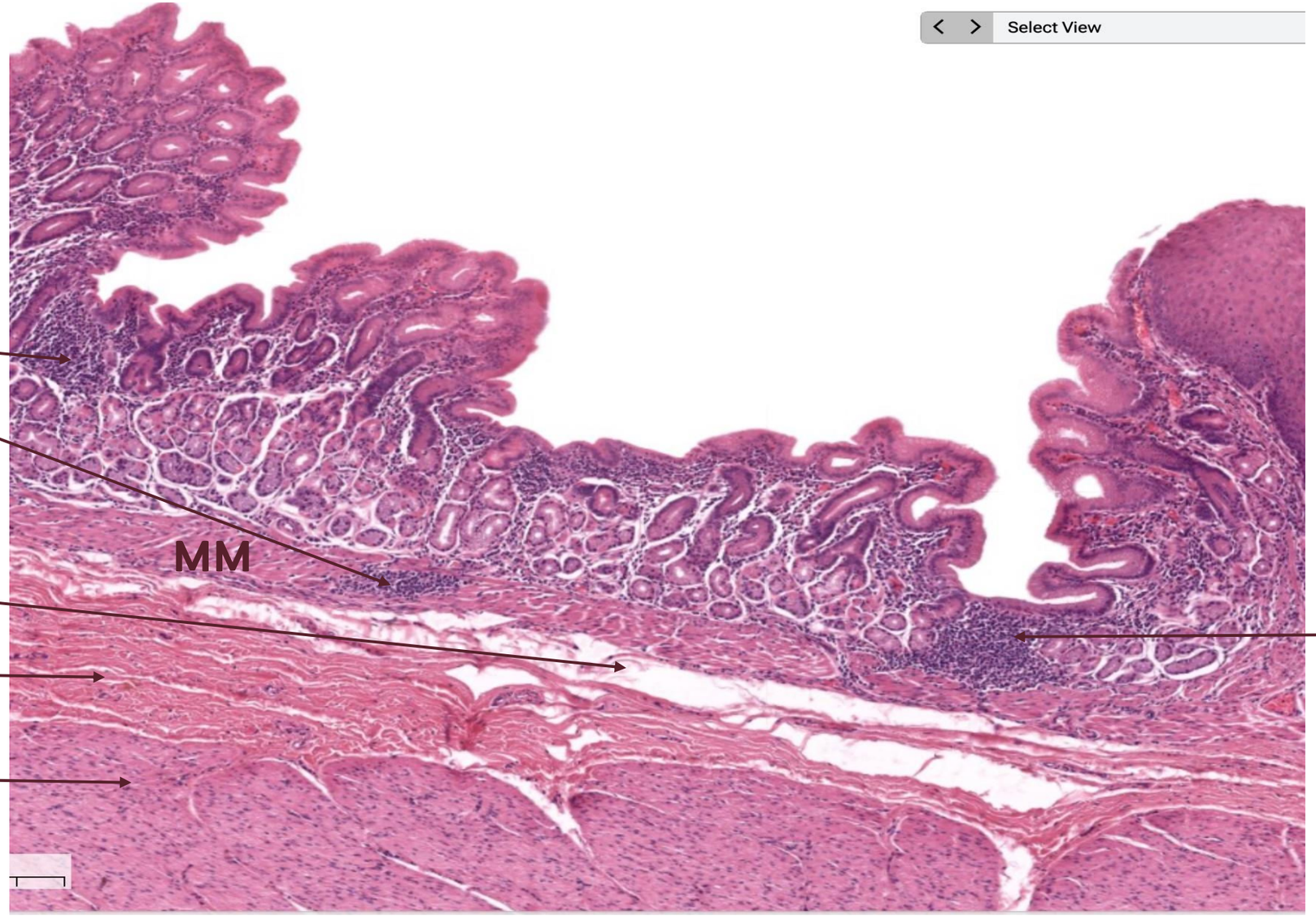
Muscularis mucousa

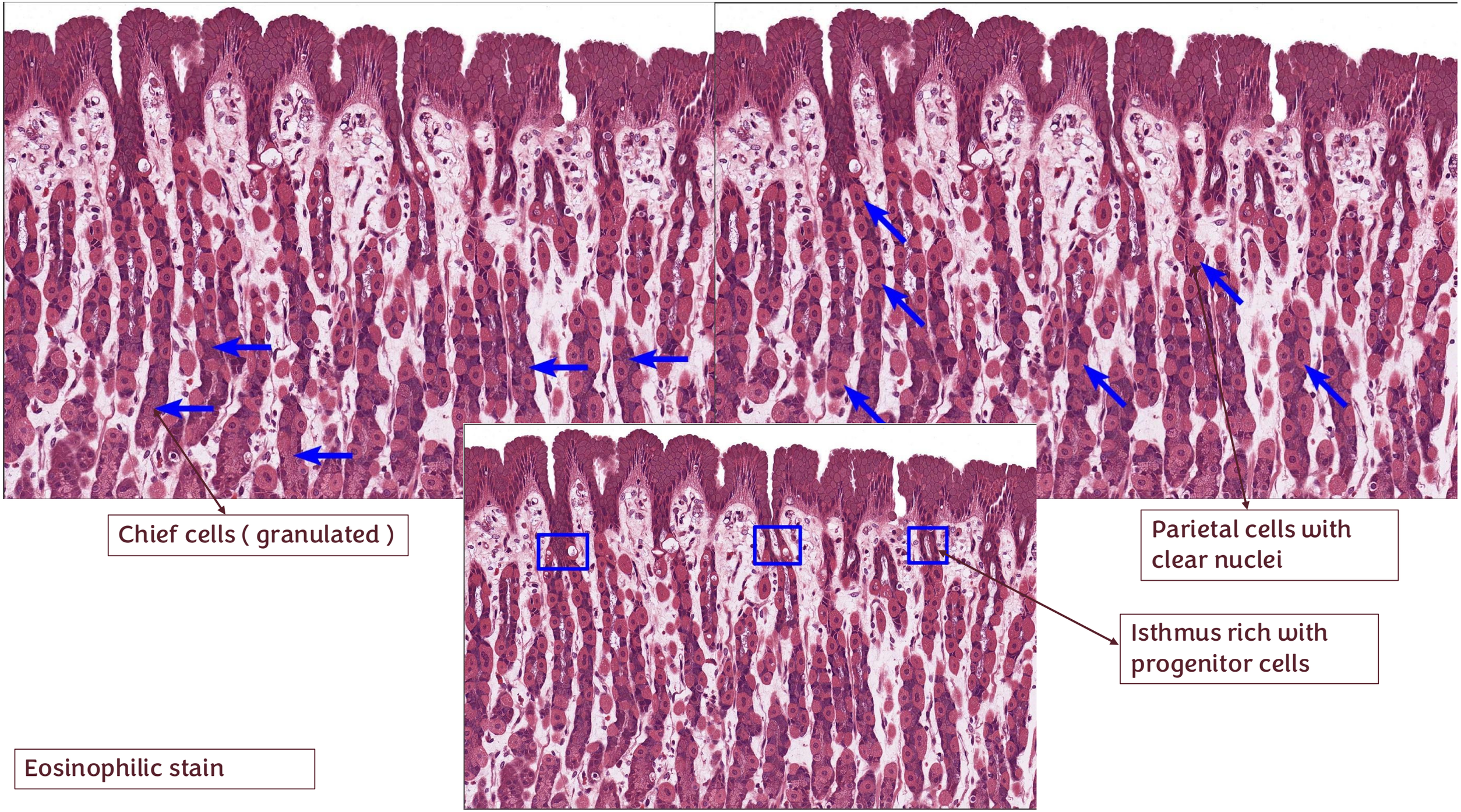
CARDIAC BODY/FUNDUS PYLORIC



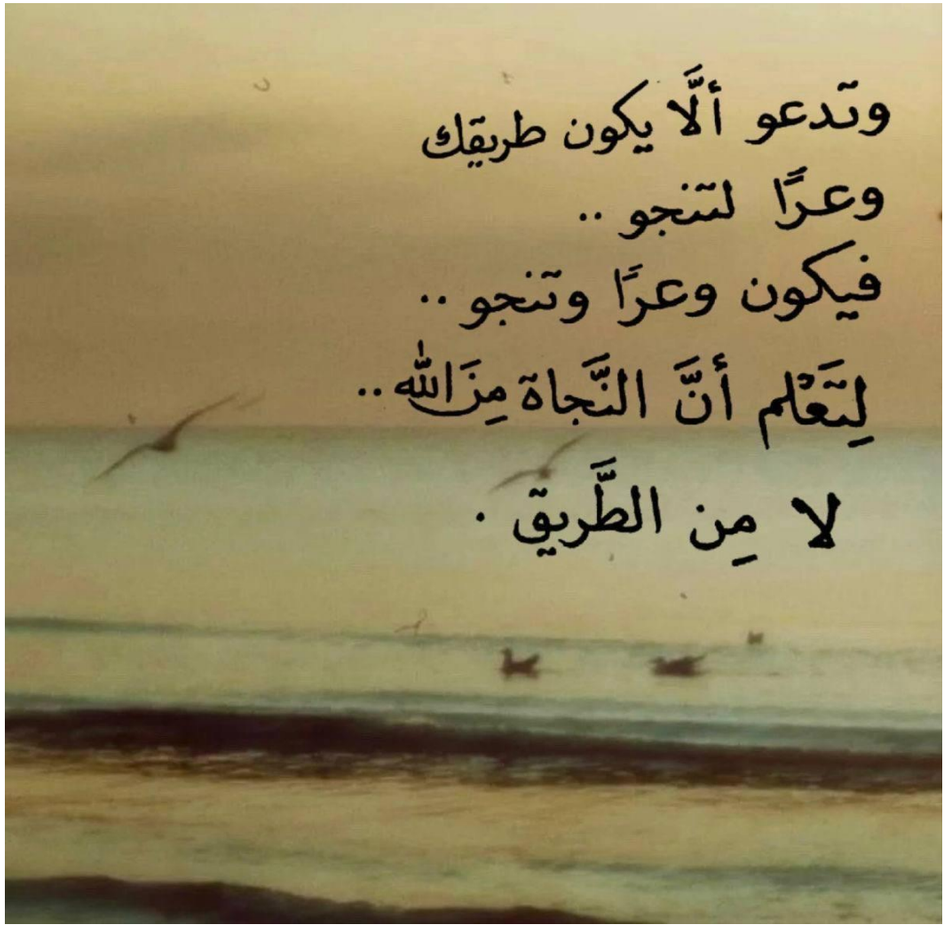
Similar , rich in mucous glands

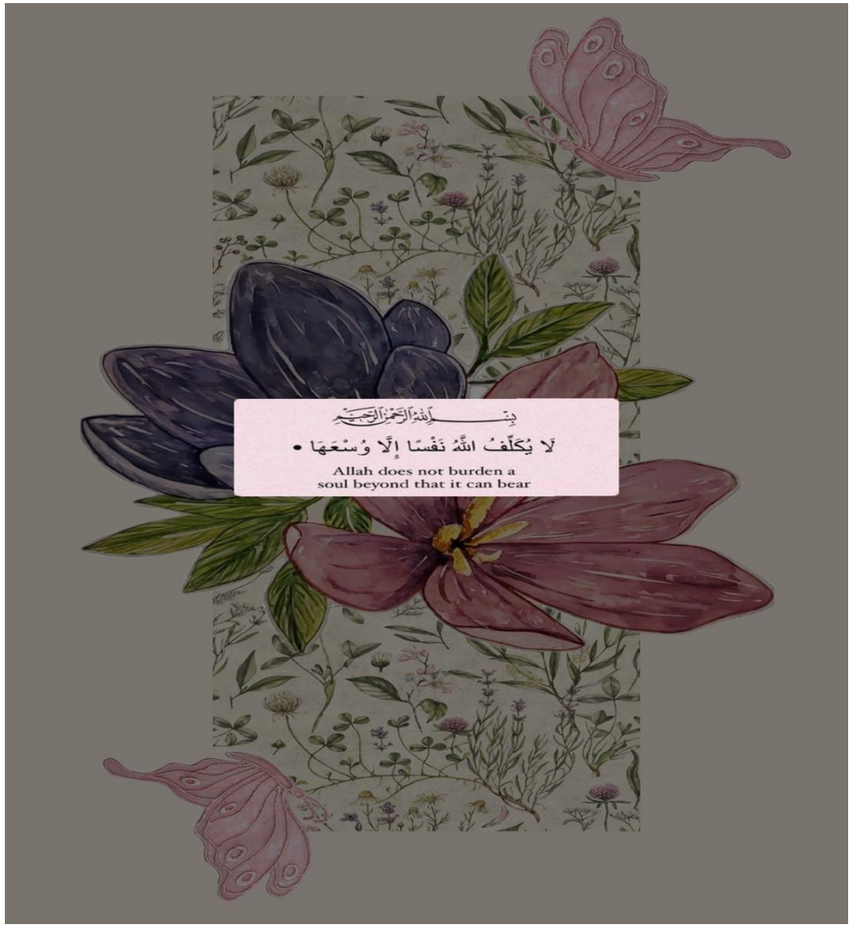
Junction also




Chief cells (granulated)
Parietal cells with clear nuclei
Isthmus rich with progenitor cells
Eosinophilic stain

رسالة من الفريق العلمي:





For any feedback, scan the code or click on it.

Corrections from previous versions:

Versions	Slide # and Place of Error	Before Correction	After Correction
V0 → V1			
V1 → V2			