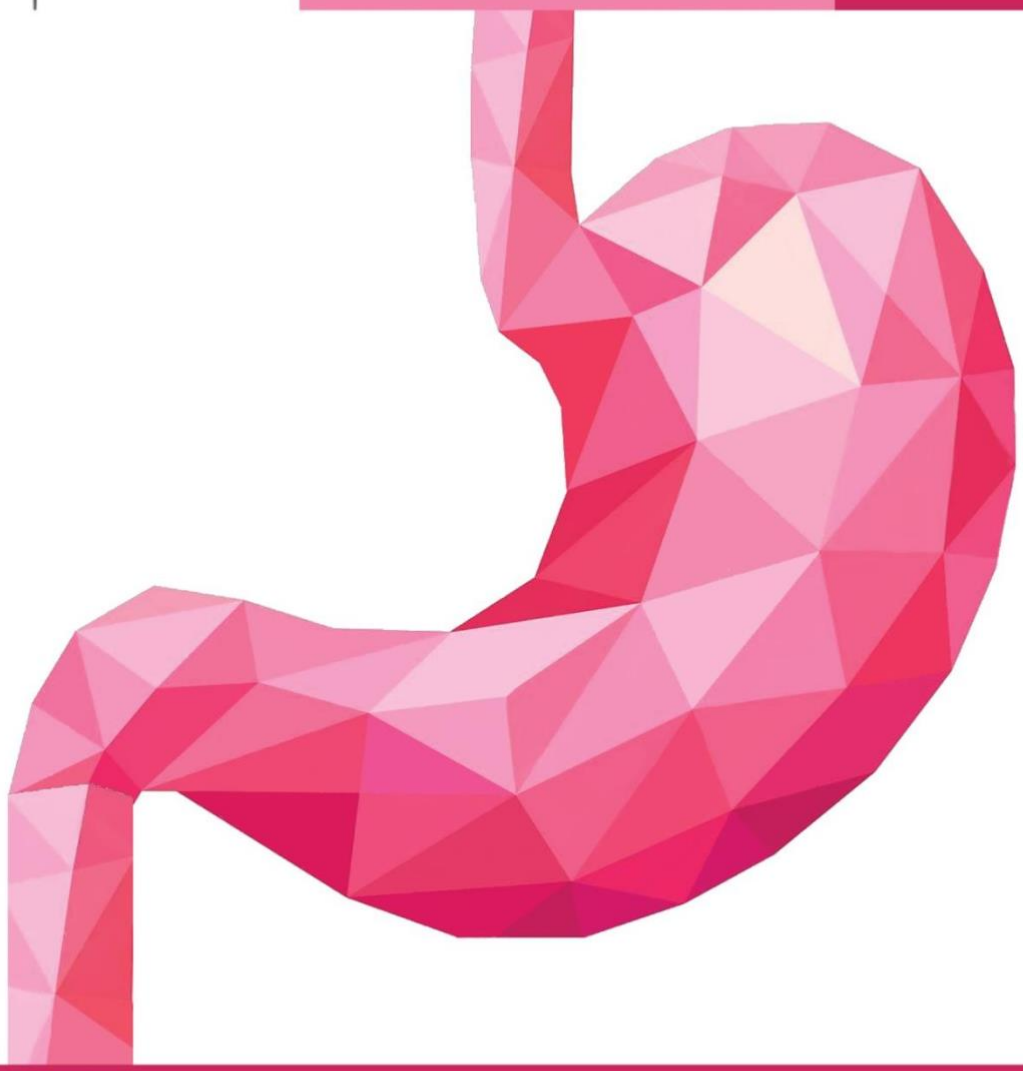
GIS 2

HISTOLOGY



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Scientific Correction:

Gramatical Correction:

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جعل الله حياتكم وردية جميلة ن ♥

In this sheet, we will talk about the histology of the esophagus and stomach.

The Esophagus:

-Is a muscular tube which is 25cm (thoracic part) that extends from the lower border of the cricoid cartilage at the level of the sixth cervical vertebra (C6) to the cardia of the stomach that becomes here 1.3cm (abdominal part) .
-It differs from the pharynx that it is a complete tube. (The pharynx has three anterior openings).
-It has an opening in the left of the diaphragm called: (**Esophageal Hiatus**). That passes the eso. from thoracic to the abdomen.

Its functions:

1. **Transport foodstuffs** from the mouth to the stomach by peristalsis and sphincters' relaxation.
2. **Prevent the retrograde flow** of gastric contents.

-Usually controlled by reflexes and by the autonomic nervous system.

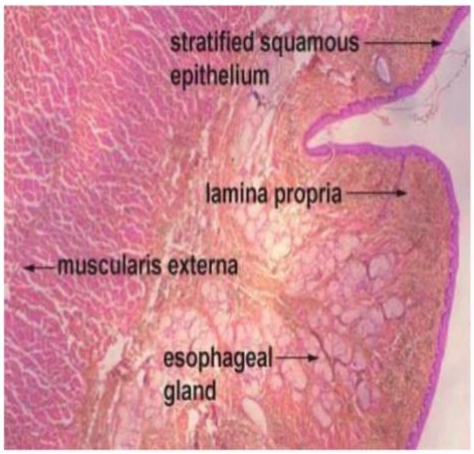
Layers of the esophagus: 4 layers:

(it has the same layers as the rest of the digestive tract)

1.Esophageal Mucosa:

-It is composed of three sublayers:

▪ **Lining epithelial**: which is stratified squamous nonkeratinized epithelium.
▪ **Lamina propria:** loose connective tissue, contains the esophageal cardiac glands, that secrete mucus especially at the distal end of the esophagus (near the stomach).
▪ **Muscular mucosa**: a layer of smooth muscle, separates the mucosa from the underlying submucosa.



2.Submucosa:

-Dense connective tissue contains lymphatic and blood vessels and also groups of small mucus-secreting glands, the esophageal glands, whose secretion facilitates the transport of foodstuffs and protects the mucosa.
NOTE: in the GIT there are only two organs that have glands in their submucosa; the esophagus and the duodenum, whose glands are knows as Brunner glands.

3.Muscularis Externa:

-Muscle fibers are oriented in two main directions: **Inner circular** and **outer longitudinal**.

-The type of muscles differes through the esophagus:

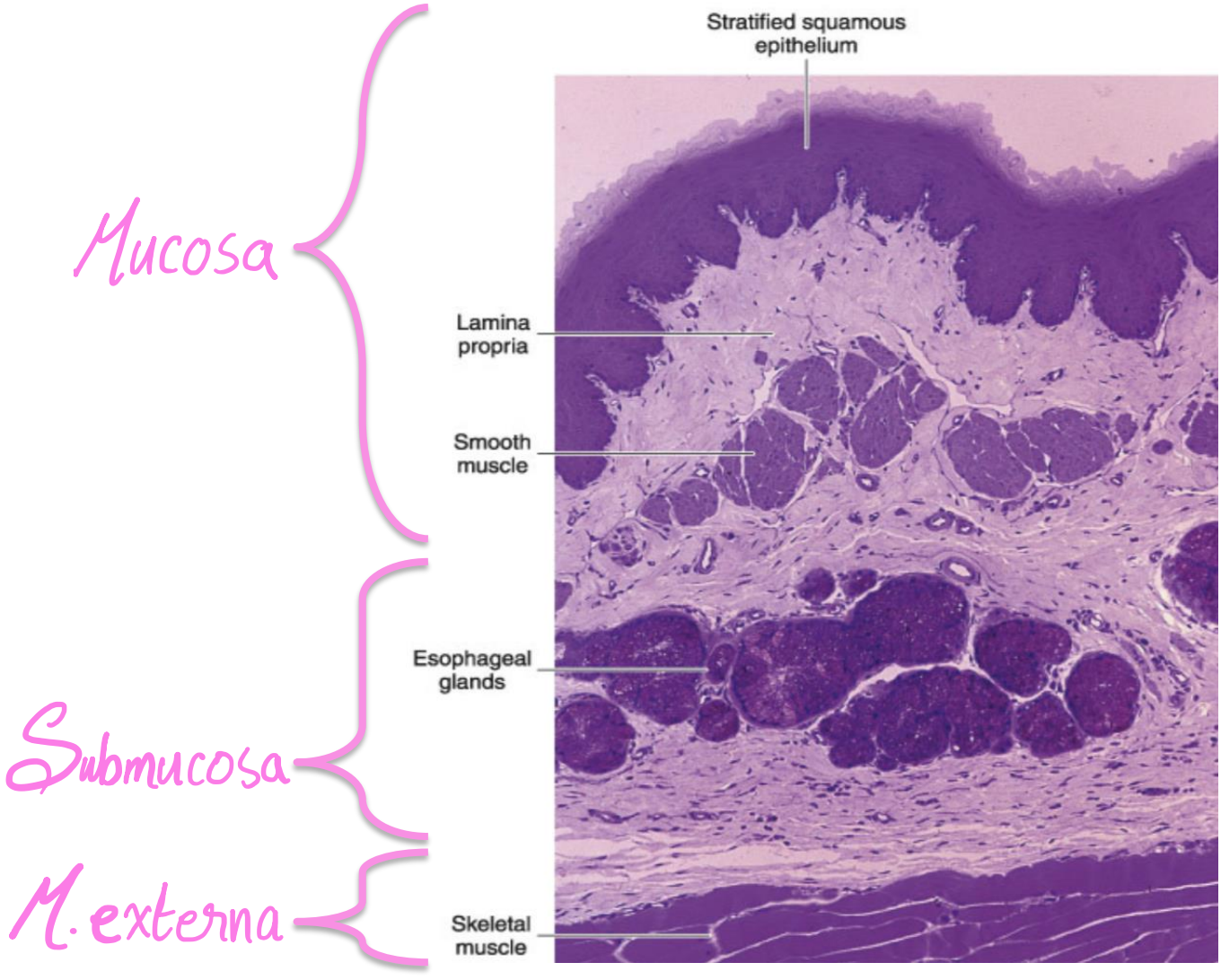
- Upper third → **striated** (skeletal) muscles only.
- Middle third → a **mixture** of striated (skeletal) and smooth muscle cells.
- Lower third → **smooth** muscles only.

It's important to know that because the skeletal muscles take voluntary innervation with peripheral and multiple nuclei though the smooth muscles are innervated from autonomic vagus nerve with mid located spindle nuclei.

4.Adventitia/ Serosa:

-**Adventitia** which is a layer of connective tissue that covers the larger part of the esophagus (neck and thoracic), it blends into the surrounding tissue.

-Serosa covers only that portion of the esophagus that is in the peritoneal cavity (abdomen).



The Stomach:

-It is a mixed exocrine–endocrine organ (like the small intestine) that digests food and secretes hormones, lies between the esophagus and the duodenum in the abdominal cavity in the epigastric rejoin.

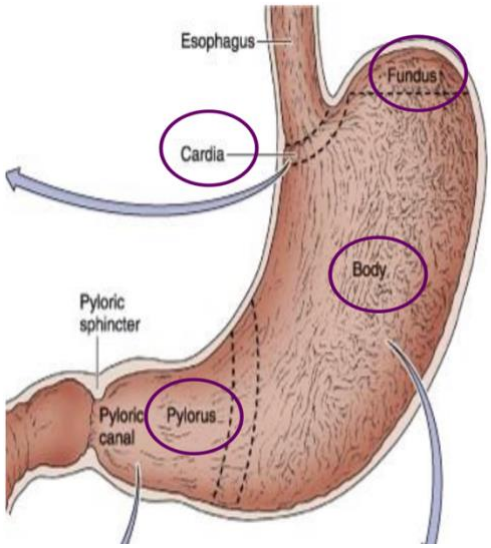
Its functions:

1. **Continues the digestion** of carbohydrates initiated in the mouth.
2. **Adds an acidic fluid** to the ingested food, **transform it by muscular activity** into a viscous mass called: **chyme.**

-The bolus spends 2-4 hours here then it's evacuated through the pyloric sphincter.

3. **Promotes the initial digestion of proteins with the enzyme pepsin.**
4. **Produces a gastric lipase** that digests triglycerides with the help of lingual lipase.

-The Stomach divided anatomically into four regions:



1. **Cardia**: a narrow circular band, 1.5–3 cm in width, at the transition between the esophagus and the stomach,
contains the cardiac sphincter which is a **physiological sphincter** controlled by the vagus nerve.
2. **Fundus.**
3. **Body**: the largest portion of the stomach, with the fundus responsible for the digestion. the fundus and body are identical in microscopic structure.

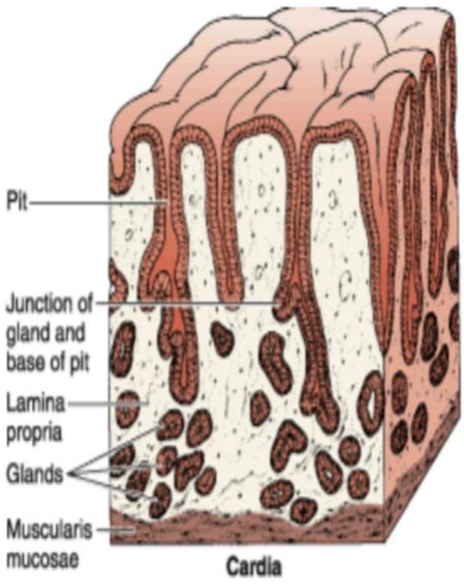
- The fundus and body are identical in microscopic structure.

4. **pylorus**: (3 parts)

- **pyloric antrum**
- **pyloric canal**
- **pyloric sphincter**: which is an **anatomical sphincter** formed by the thickening of the inner smooth muscles, controlled by the autonomic nervous system (sympathetic and parasympathetic).

An **anatomical sphincter** has a thickening in the inner smooth muscle whereas a physiologic one doesn't.
The **physiologic sphincter** is still capable of constricting and reducing its diameter and in so doing the same function as the anatomical one.

General histology of the stomach:



1.Gastric Mucosa:

-It is composed of three sublayers:

▪ Lining epithelium:

-simple columnar epithelial **without** goblet cells and **without** cilia.

-Contain **gastric pits**, which are numerous small circular or ovoid invaginations of the epithelial into the lamina propria (can be seen by the magnifying glass).

-**Gastric pits** act as if they are small ducts between **the gland** (lamina propria) and **the inner surface of the stomach** (mucosa) for the secretion to be there.

-The epithelium covering the surface and lining the pits secrete an **alkaline mucus.**

▪ Lamina propria:

-Composed of **loose connective tissue** interspersed with smooth muscle and lymphoid cells, contains branched, tubular glands (cardiac, gastric, and pyloric) characteristic of each region of the stomach which secretes mucus and empty into the **gastric pits**.

-This mucus consists primarily of water (95%), lipids, and glycoproteins which in combination, form a **hydrophobic protective gel.**

-**Bicarbonate**, secreted by the surface epithelial cells into the mucous gel, forms a pH gradient ranging from 1 at the gastric luminal surface to 7 along the epithelial cell surface (Ph increases from the lumen to the tissue due to the concentration of HCO_3^-).

- Surface epithelial cells also form an important line of defense due to their function in mucus production, intracellular tight junctions, and the ionic transporters that maintain intracellular pH and bicarbonate production, important for gel alkalinization.

-That's why the stomach doesn't digest itself!

▪ Muscular mucosa:

-A layer of smooth muscles, separates the mucosa from the underlying submucosa.

2.Submucosa:

-Composed of dense connective tissue containing blood and lymph vessels; it is infiltrated by lymphoid cells, macrophages, and mast cells.

- Folding of submucosa through the mucosa form **rugae**, when the stomach is filled with food, these folds flatten out to increase the surface area of the mucosa.

-In the side of lesser curvature → Longitudinal rugae.

-Other parts → oblique or horizontal rugae.

3.Muscularis Externa:

-Composed of smooth muscle fibers oriented in three main directions:

→ the external layer is longitudinal.

→ the middle layer is circular.

→ the internal layer is oblique.

-At the pylorus, the middle layer is greatly thickened to form the pyloric sphincter.

4.Serosa:

-The stomach is covered by a thin serosa.

-It is covered by a peritoneum.

Now, We will talk about the histological characteristics of the mucosa for each region of the stomach:

-It is divided histologically into three regions:

1. Cardia:

-Its Mucosa contains:

- Mainly **mucus cells, few parietal, steam, and enteroendocrine cells**, there are **no** chief cells.
- **Simple or branched tubular cardiac glands** which are similar in structure to the cardiac glands of the terminal portion of the esophagus. The terminal portions of these glands are frequently coiled, often with large lumens.
- Secretory cells produce **mucus** and **lysozyme** (an enzyme that attacks bacterial walls), but a **few parietal cells** secreting **H+ and Cl–** (which will form HCl in the lumen).

-Gastric pits are the same length as the gastric gland.

2.Fundus & Body:

- ❖ The **lamina propria** of the fundus and body is filled with **branched**, **tubular gastric** (fundic) **glands**, three to seven of which open into the bottom of each gastric pit.
- ❖ The distribution of epithelial cells in gastric glands is **not** uniform.
- ❖ Gastric pits are wide and short, form about **2/5** of the thickness of the mucosa.
- ❖ Gastric gland are long, form about **3/5** of the thickness of mucosa, each gastric gland has three distinct regions:

1. Isthmus: close to the gastric pit, contains:

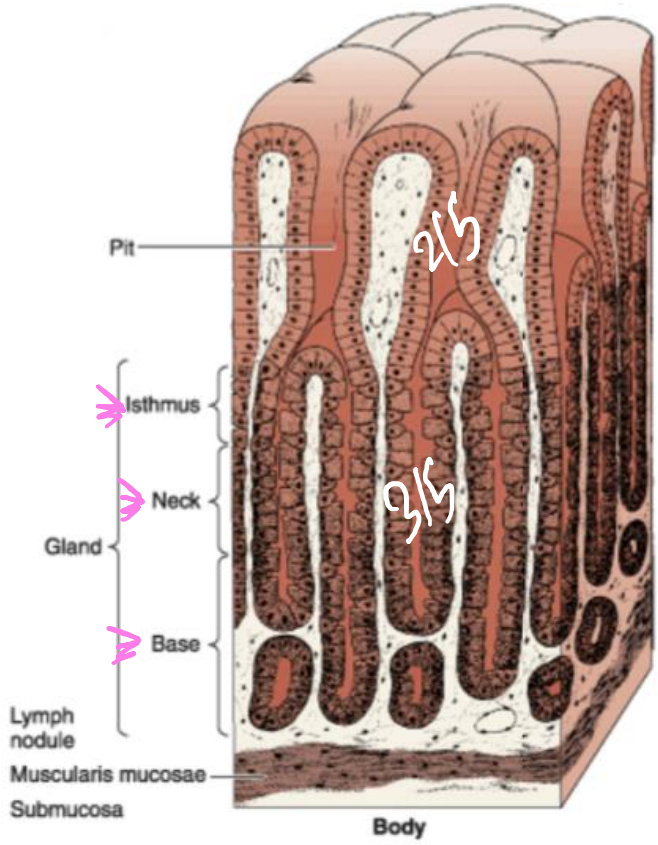
- ✓ differentiating mucous cells that will migrate and replace superficial mucous cells.
- ✓ some undifferentiated stem cells
- ✓ some parietal (oxyntic) cells.

2. Neck: consists of:

- ✓ stem cells.
- ✓ mucous neck cells (different. from the mucous cells in the isthmus).
- ✓ parietal cells.

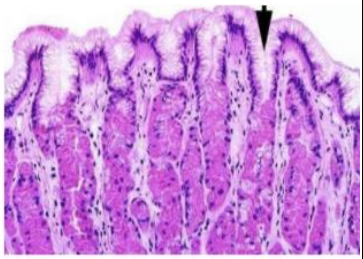
3. Base: primarily contains

- ✓ parietal cells.
- ✓ chief (zymogenic) cells.
- ✓ enteroendocrine cells.



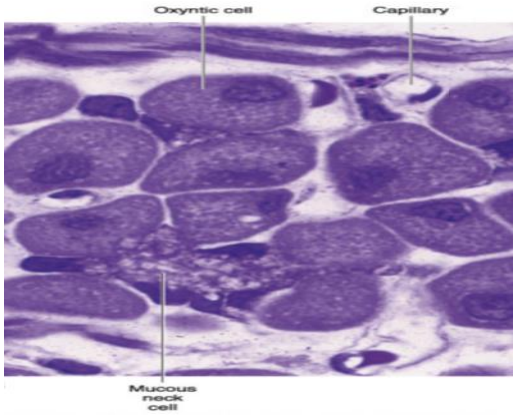
The cells of the Mucosa layer of the stomach:

1-Stem Cells:



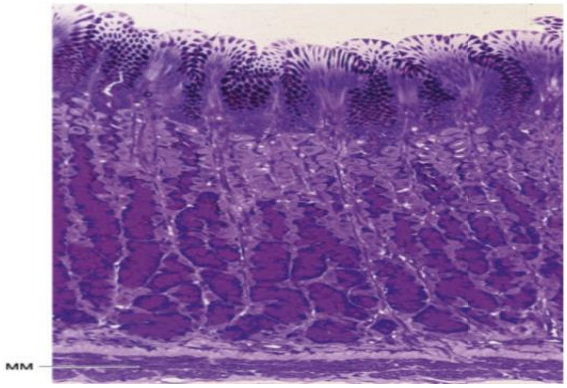
- ➢ Found in the **isthmus and neck** regions but few in number, stem cells are **low columnar cells** with **oval nuclei** near the bases of the cells.
- ➢ These cells have a **high rate of mitosis**; some of them move upward to replace the pit and surface mucous cells, which have a turnover time of 4–7 days.
- ➢ Other daughter cells migrate more deeply into the glands and differentiate into **mucous neck cells and parietal, chief, and enteroendocrine cells.**

2-Mucous Neck Cells:



- Present in **clusters** or as **single** cells between parietal cells in the **necks** of gastric glands.
- Their mucus secretion is quite **different** from that of the surface epithelial mucous cells.
- They are **irregular** in shape, with the **nucleus at the base** of the cell and the **secretory granules near the apical** surface.
- **Foamy** appearance under the microscope.

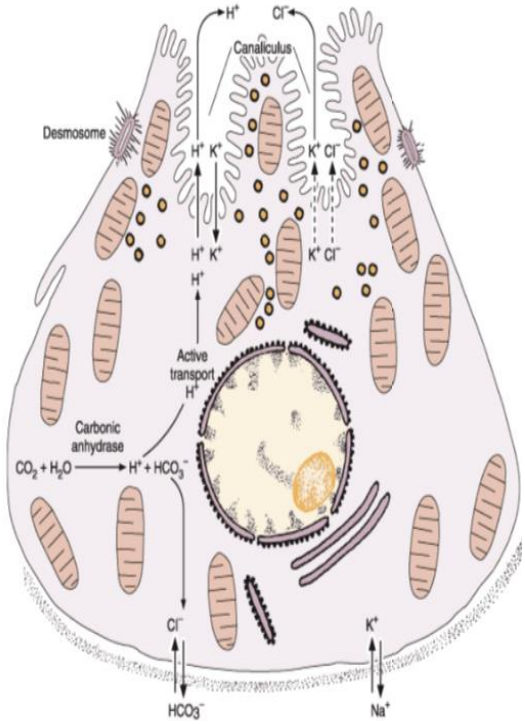
3-Oxyntic (Parietal) Cells:



- present mainly in the **upper half** of gastric glands; they are **scarce** in the base.
- They are **rounded** or **pyramidal** cells, with **one centrally placed spherical nucleus** and intensely **eosinophilic cytoplasm**.
- They present in two forms:***active and inactive:***
    - ***Active secreting cells***: in the electron microscope, are an abundance of mitochondria and a deep, circular invagination of the apical plasma membrane, forming the intracellular canaliculus which contains HCL.
    - ***Inactive cells (resting cells):*** their cytoplasm contains many tubulovesicular structures that can be seen in the apical region just below the plasmalemm, here the cell has few microvilli.
- When stimulated to **produce H+ and Cl–**, tubulovesicles **fuse** with the cell membrane to form the **canaliculus** and more microvilli thus, providing a generous increase in the surface of the cell membrane.
- Parietal cells secrete **hydrochloric acid** and intrinsic hormones.

Forming HCL inside the canaliculi of the active Parietal cells:

✓ The ion H+ originates from the dissociation of the H2CO3 produced by the action of carbonic anhydrase, an enzyme abundant in oxyntic cells.



✓ Once produced, H2CO3 dissociates in the cytoplasm into H+ and HCO3-.

✓ The active cell also secretes K+ and Cl– in the canaliculus; the K+ is exchanged for H+ by the action of the H+/K+ pump, while the Cl– forms HCl. The presence of abundant mitochondria in the parietal cells indicates that their metabolic processes, particularly the pumping of H+/K+, are highly energy consuming.

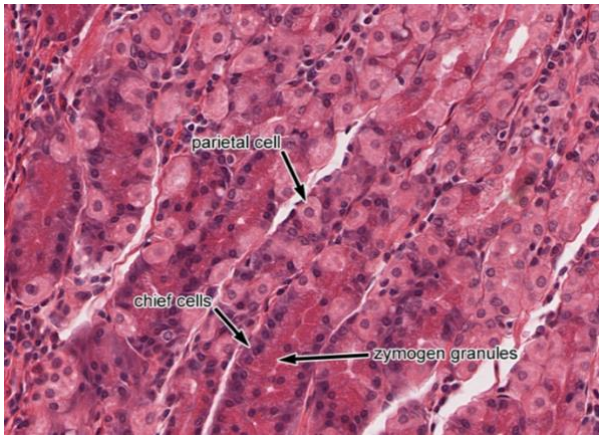
✓ The secretory activity of parietal cells is initiated by various mechanisms. One mechanism is through the cholinergic nerve endings (parasympathetic stimulation).

✓ Histamine and a polypeptide called gastrin, both secreted in the gastric mucosa, act strongly to stimulate the production of hydrochloric acid.

✓ Gastrin also has a trophic effect on the gastric mucosa stimulating growth.

4-Chief (Zymogenic) Cells:

- predominate in the lower region of the tubular glands.
- Characteristics of protein-synthesizing and -exporting cells.



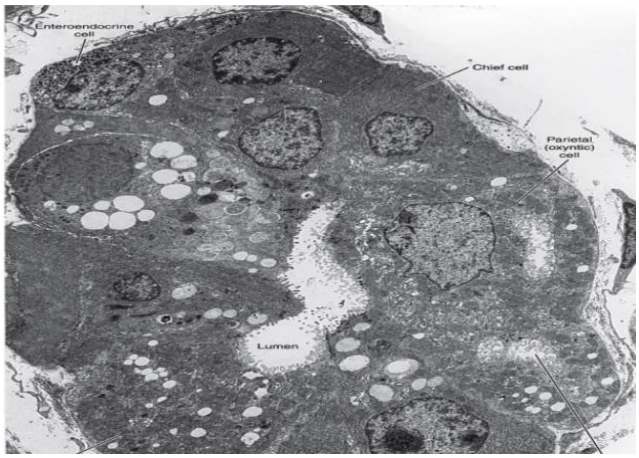
- Their basophilia is due to the abundant rough endoplasmic reticulum. The granules in their cytoplasm (zymogen granules) contain enzymes:

-**The inactive enzyme pepsinogen** which rapidly converted into the highly active proteolytic enzyme pepsin after being released into the acid environment of the stomach.

-Lipase enzyme.

- There are seven different pepsins in the human gastric juice, which are aspartate endoproteinases of relatively broad specificity active at pH<5.

5-Enteroendocrine Cells:



- Found in the neck and bases of gastric glands.
- G-pylorus cells are an example of enteroendocrine cells which produce Gastrin that leads to the Stimulation of gastric acid secretion and Gastric mucosal growth.
- In the fundus of the stomach, 5-hydroxytryptamine (serotonin) is one of the principal secretory products.

To sum up the cells of the mucosa: Ram019

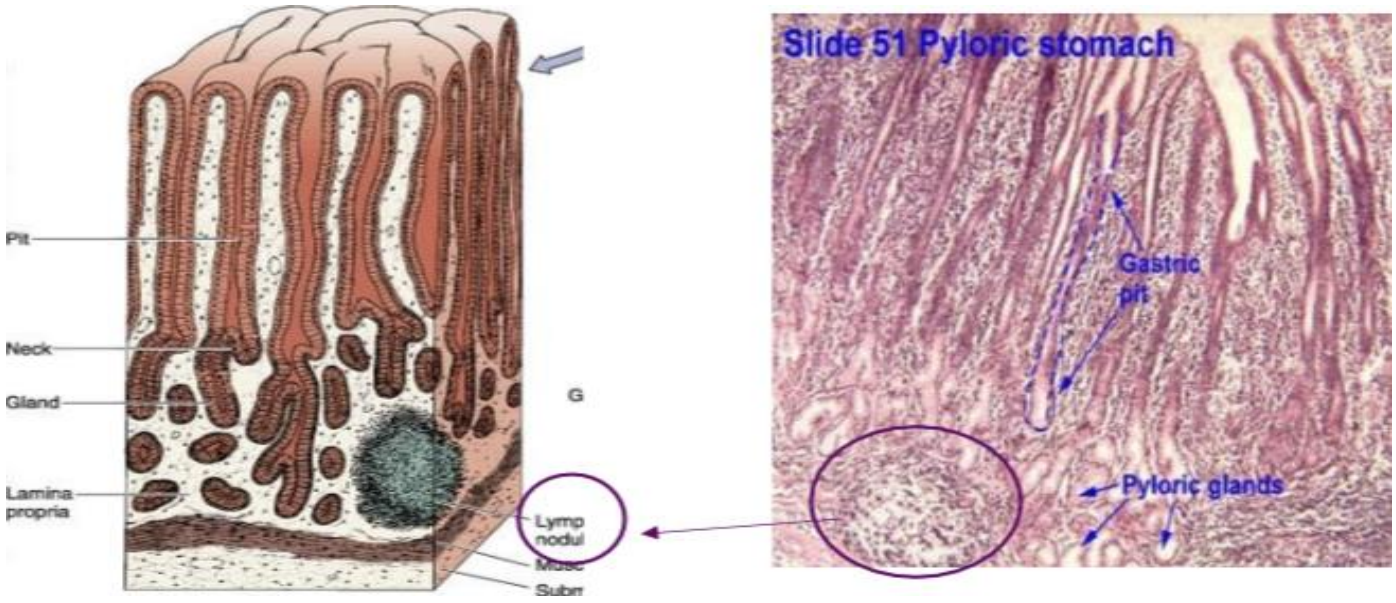
cell	Location in the Gastric gland	Main function	Microscopely appearance
Stem Cells	isthmus and neck	Replace the cells	
Mucous Neck Cells	neck	mucus secretion	• Foamy irregular • nucleus at the base of the cell • granules near the apex
Oxyntic (Parietal) Cells	Isthmus, neck, and base BUT most concentrated in the neck	Secrete HCL & intrinsic hormone	• rounded or pyramidal • centrally spherical nucleus • eosinophilic cytoplasm
Chief (Zymogenic) Cells	base	Secrete pepsinogen and enzyme lipase	• basophilic • basal nucleus • zymogen granules in the apex
Enteroendocrine Cells	neck and base	Secrete Gastrin and serotonin	

Cont. for the regions of the stomach ☹…

3.Pylorus:

- Has **deep gastric pits** into which the **branched, tubular pyloric glands open**.
- Compared with the glands in the cardiac region, pyloric glands have **longer pits** and **shorter coiled secretory portions** because this region of the stomach **hasn't** a role in digestion, rather it secretes mucus to neutralize the acidity of the chyme.
- These glands secrete **mucus** as well as appreciable amounts of the enzyme lysozyme (antibacterial enzyme).
- Gastrin (G) cells (which release gastrin) are enteroendocrine cells intercalated among the mucous cells of pyloric glands.
- The lamina propria contains lymphatic nodules.
- Parasympathetic stimulation, the presence of nutrients such as amino acids and amines in the stomach, and **distention of the stomach wall** directly **stimulate the G cell to release gastrin**, which in turn **activates** the **parietal cell**, **increasing acid secretion**.
- Other enteroendocrine cells (D cells) secrete **somatostatin**, which **inhibits the release of some other hormones,** including **gastrin.**

-Secretion of somatostatin is stimulated by HCl, counterbalancing the acid secretion.



NOTE: The epithelium of both the surface and the pits is simple columnar without goblet cells.

NOTE: unlike other parts of the stomach, the pylorus has no inner oblique muscle.

WE ARE GOING TO MAKE THIS SHEET AS TWO PARTS BECAUSE IT IS SO LONG!

So congrats you've finished part -1-

كل التوفيق، صبح يحب