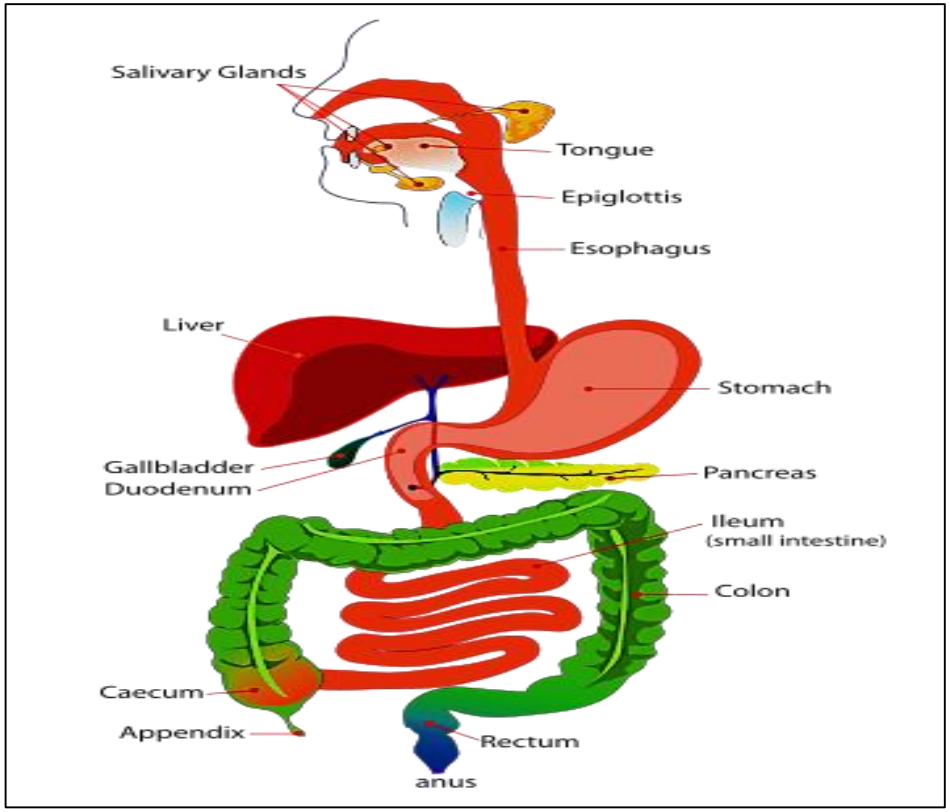
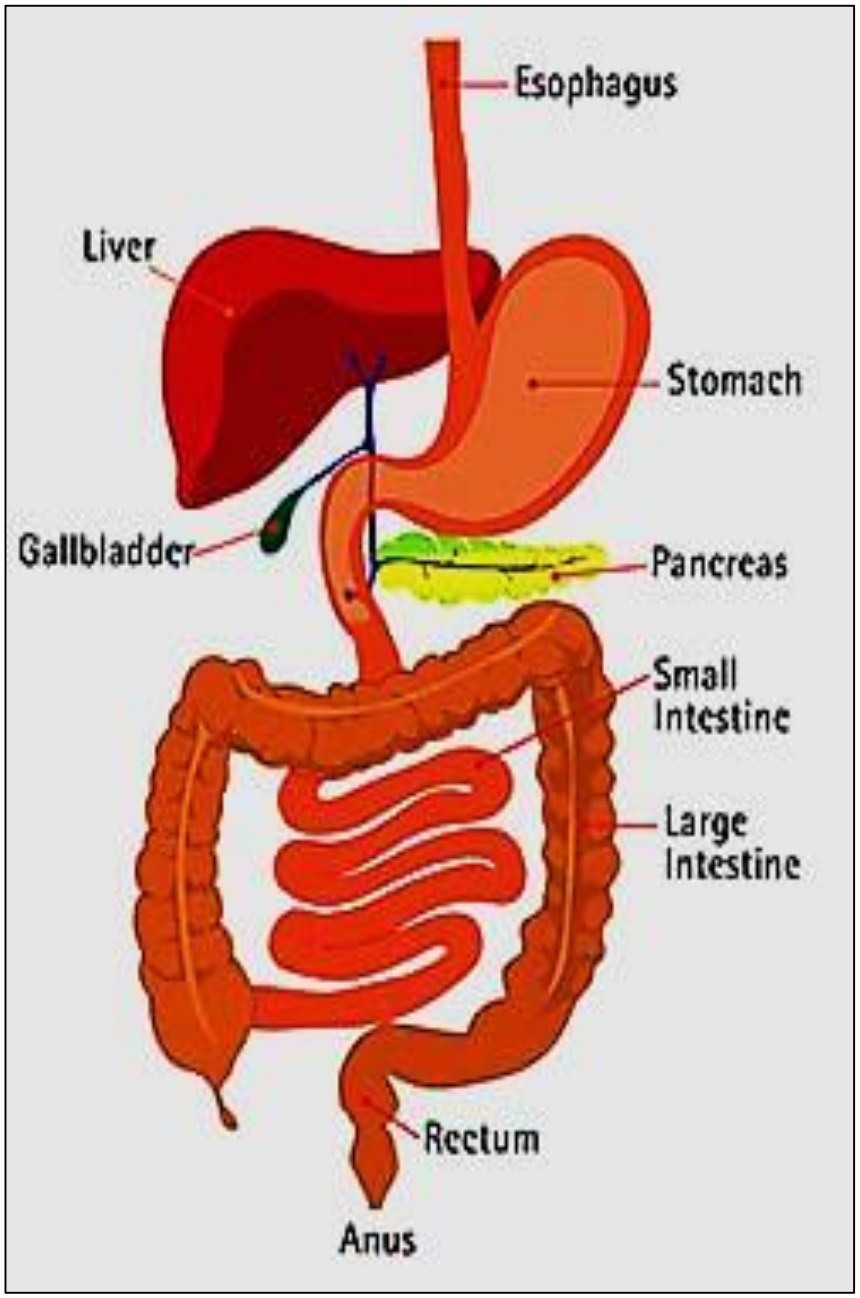
The digestive system II



The gastro- intestinal tract:

Composed of:

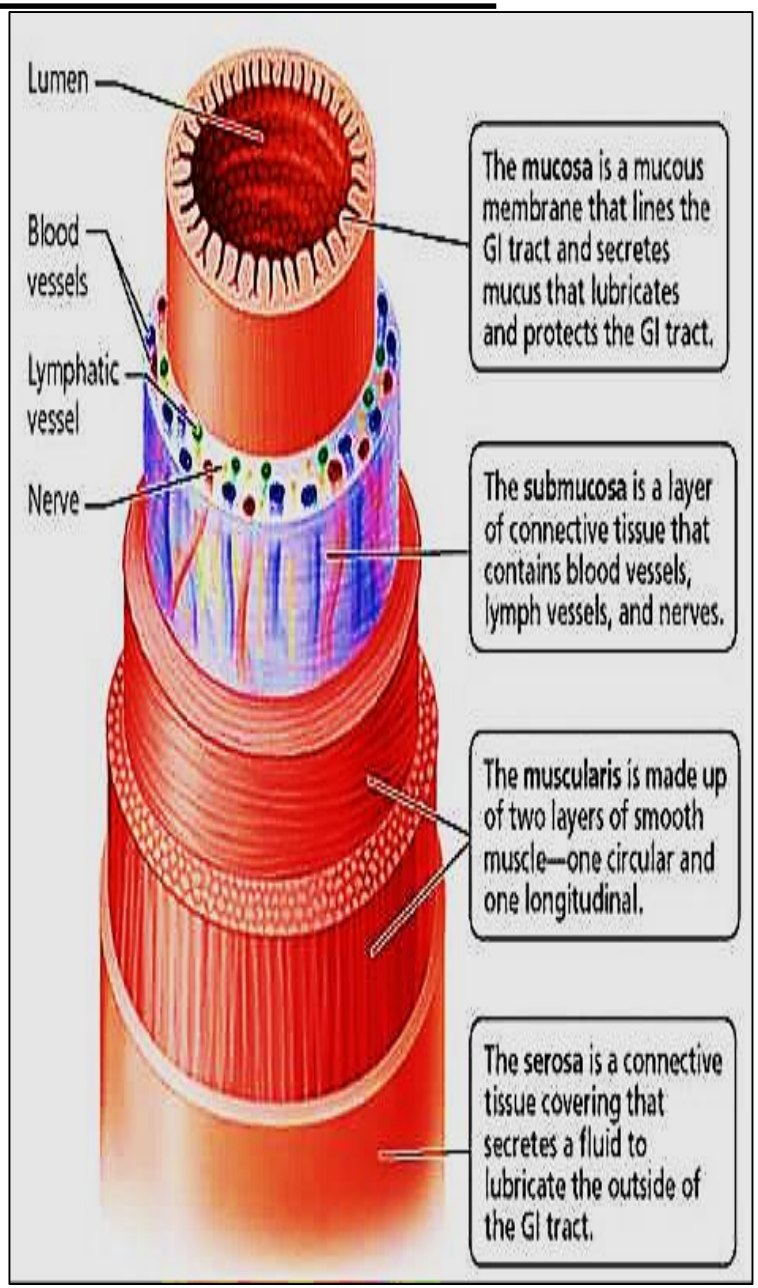
- Esophagus
- Stomach
- Small intestine
- Large intestine
- Anal canal



General features of the wall of the GIT

its wall is composed of **4 layers**:

- Mucosa:
  - Epithelium
  - CT (Lamina propria, corium)
  - Muscularis mucosa (s. ms.)
- Submucosa: C.T.
- Musculosa : 2 layers of smooth muscles (IC & OL)
- Adventitia or serosa



Adventitia vs. serosa

Serosa: double layer membrane made of epithelium

One layer is attached to the organ called visceral layer , the other layer will be close to the body cavity & called partial layer. In between these two epithelial layer is fluid called serous for lubrication (reduce friction)

Serosa will wrap organs that set in a body cavity i.e abdominal cavity like GIT organs within the peritoneum i.e intraperitoneal organs (liver, stomach, spleen, 1st part pf duodenum, ileum, jejunum, transverse & sigmoid colon)

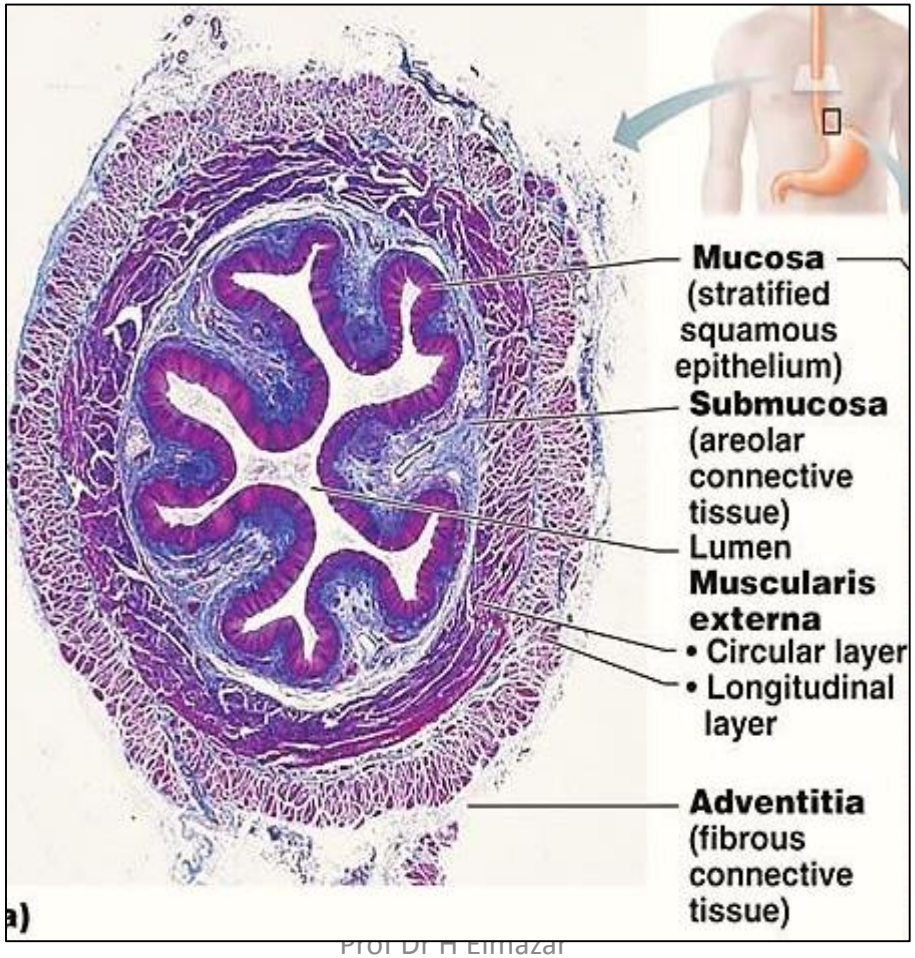
Adventitia: is not epithelial is loose CT that wraps organs that set outside the peritoneal cavity i.e. retroperitoneal and attach them to the abdominal cavity

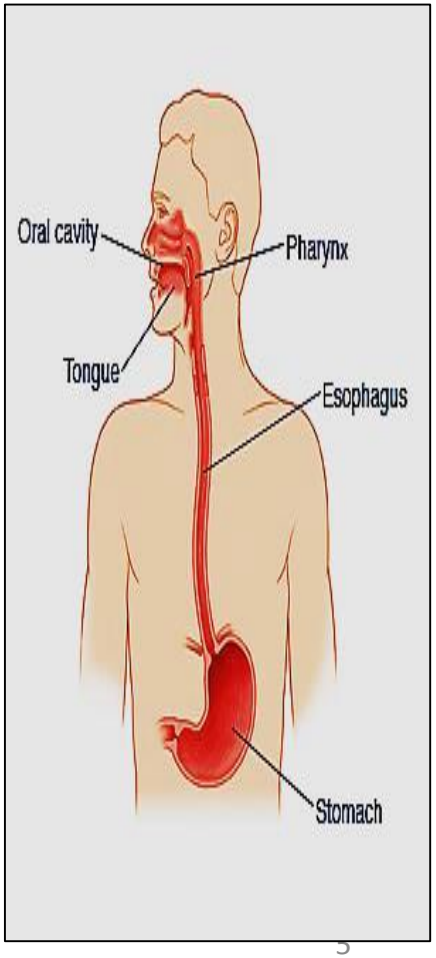
pancreas, rest of duodenum, cecum, ascending & descending Colcon

The esophagus

- **Muscular tube connects the pharynx with stomach, transport food**
- **Its wall consists of 4 layers:**

- **Mucosa**
- **Submucosa:**
- **Musculosa**
- **Adventitia**





- **Mucosa**

  Epithelium: Non-keratinized stratified squamous epith.

  Lamina propria: B.V., nerves, lymphatics (!Cardiac orifice)

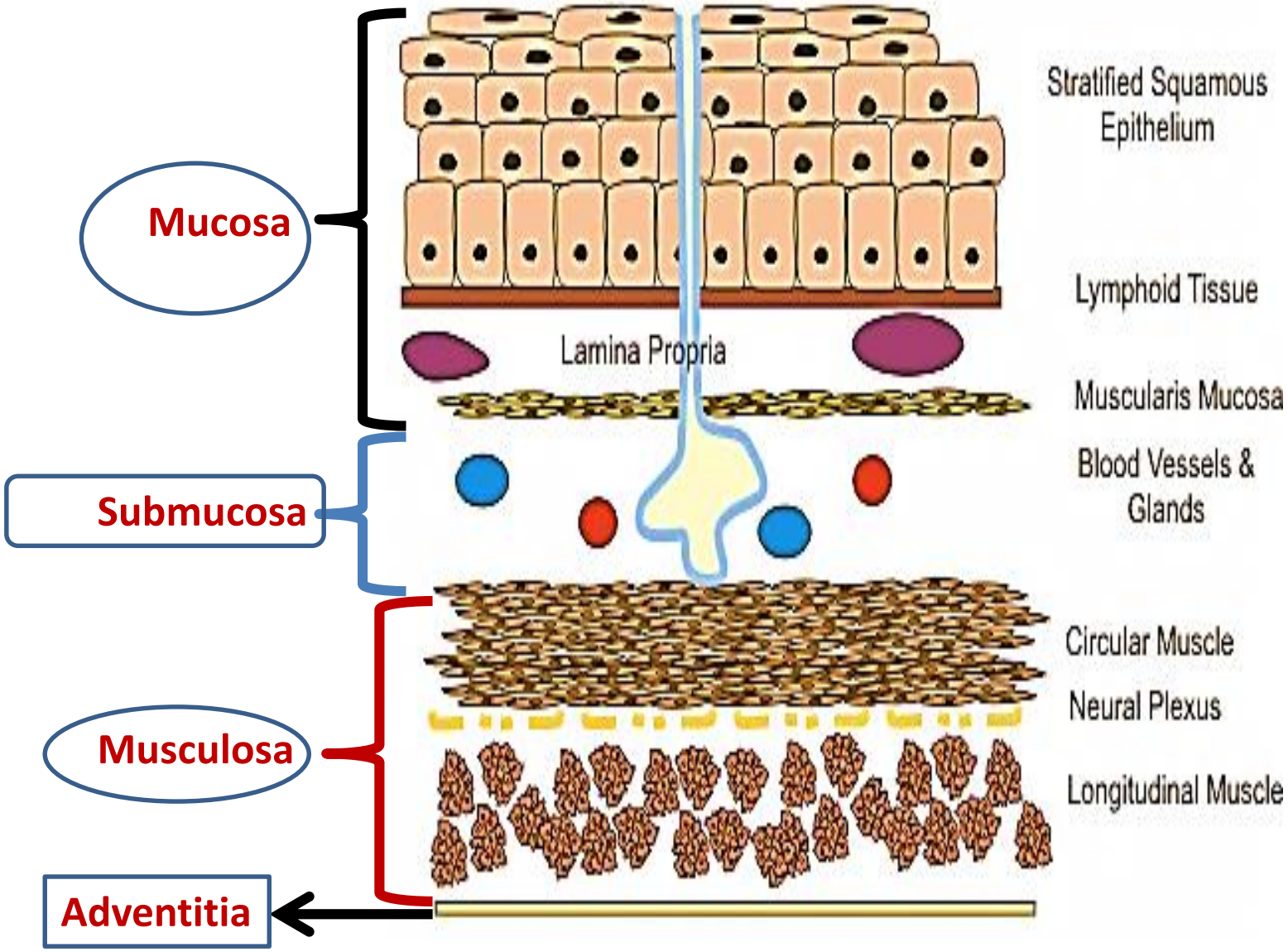
  Muscularis mucosa: smooth ms.

- **Submucosa**: loose C.T. contains BV, lymphatics, Meissner's plexus of nerves & esophageal mucous glands

- **Musculosa:** IC &OL (**OL**: upper 1/3 Striated *, middle 1/3 mixed & lower 1/3 smooth ms.) NB: swallowing start with controllable motion but finishes with involuntary peristalsis

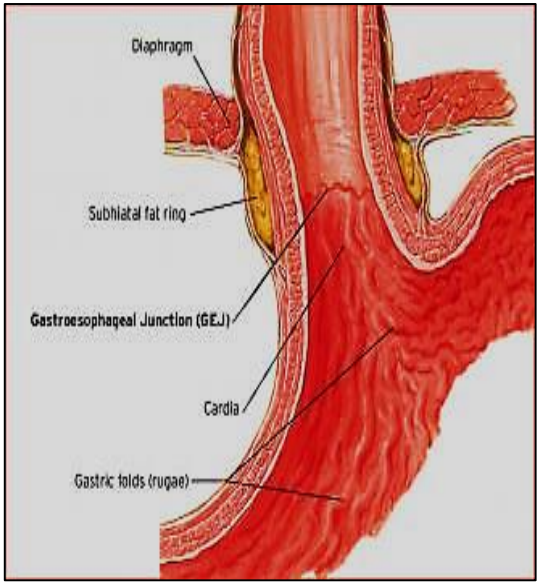
- **Adventitia**: covers most of the esophagus except the most distal portion which is located in the abdominal cavity is covered by serosa

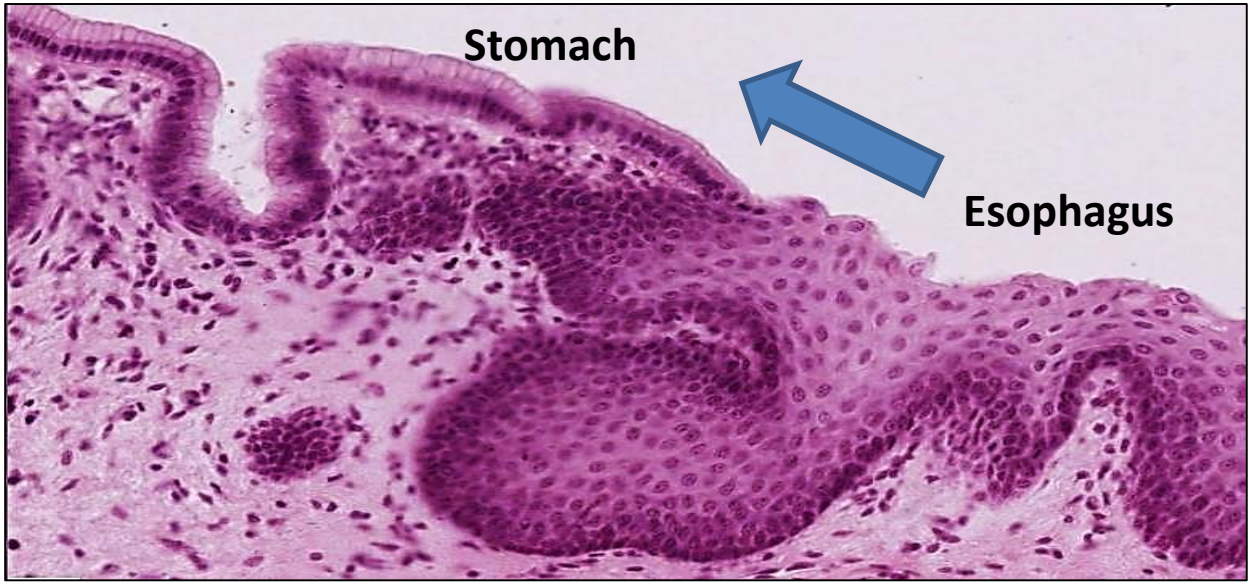
Layers of the wall of the esophagus



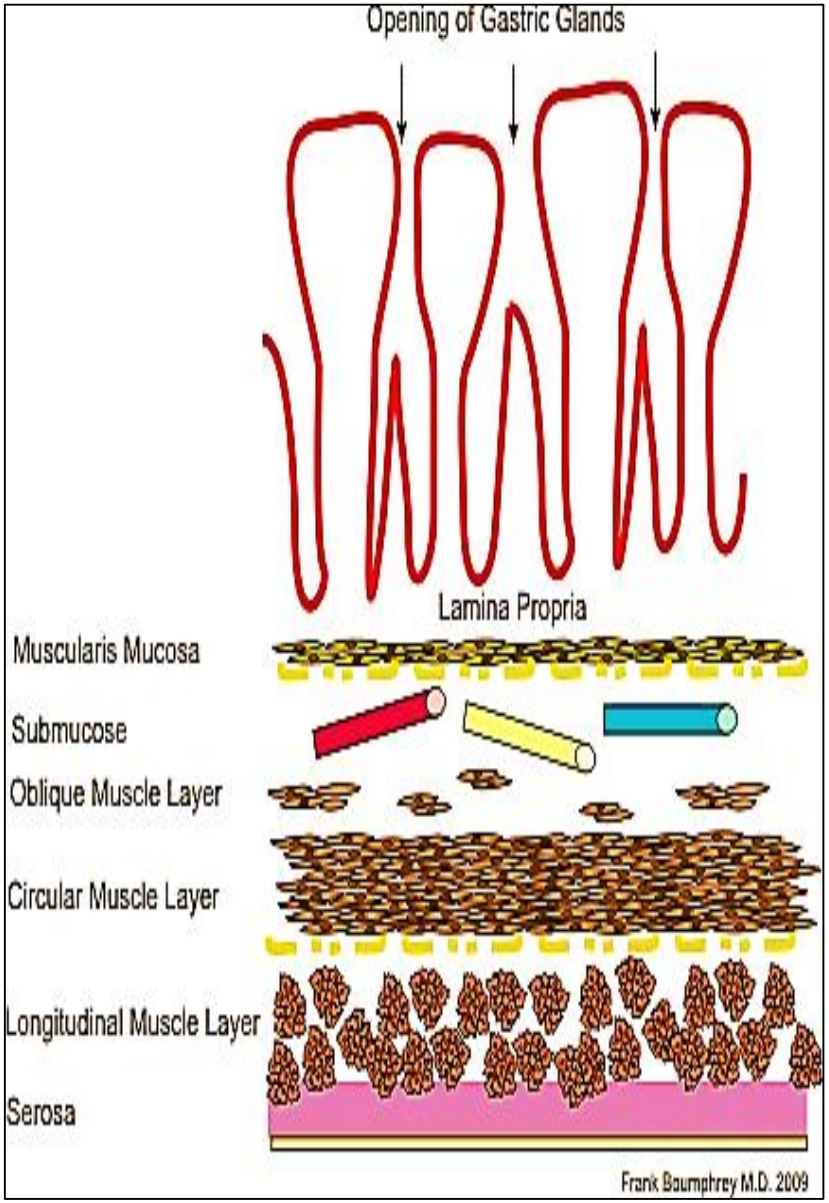
Changes at gastro- esophageal junction

1. The stratified Squamous → simple columnar epithelium
2. The lamina propria of stomach is wide & contains gastric glands (branched tubular)
3. The esophageal glands in the submucosa of esophagus stops in that of stomach
4. The musculosa becomes more thick in stomach due to the appearance of inner oblique layer

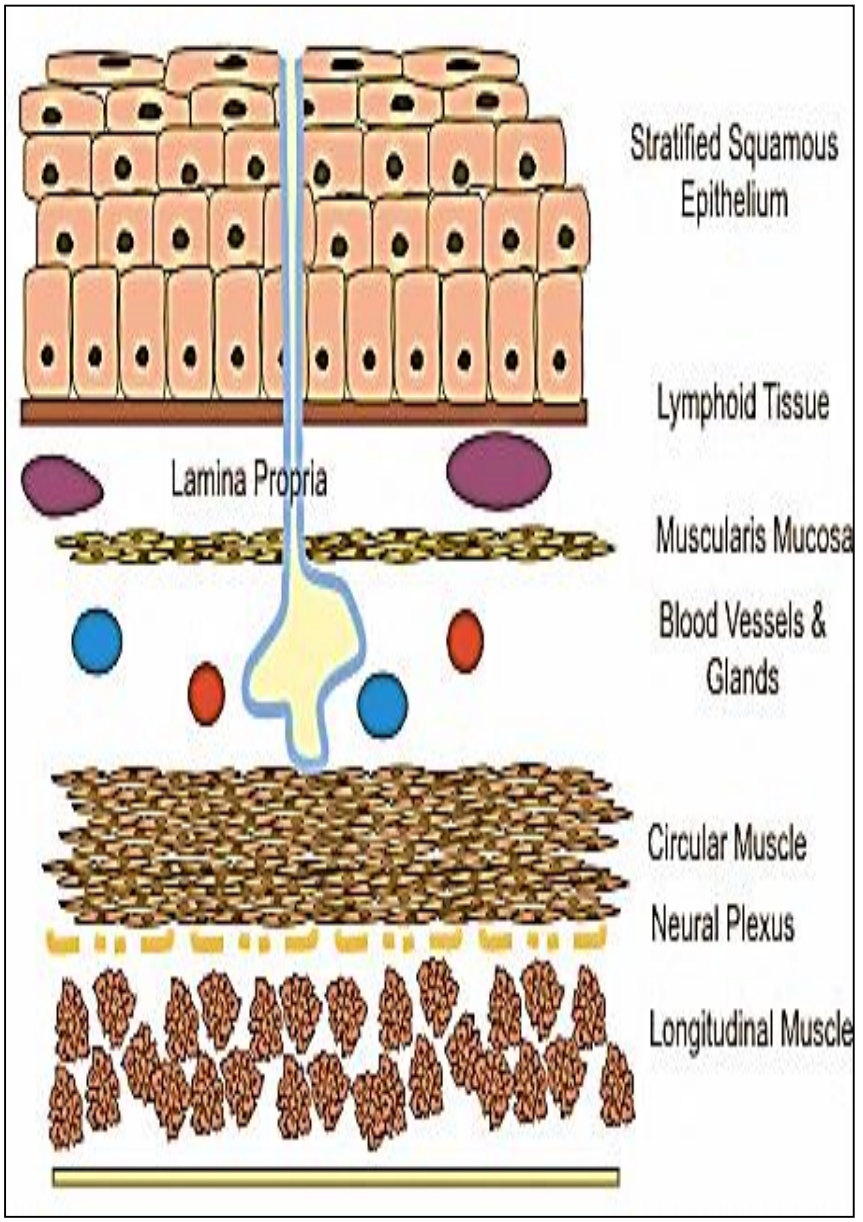




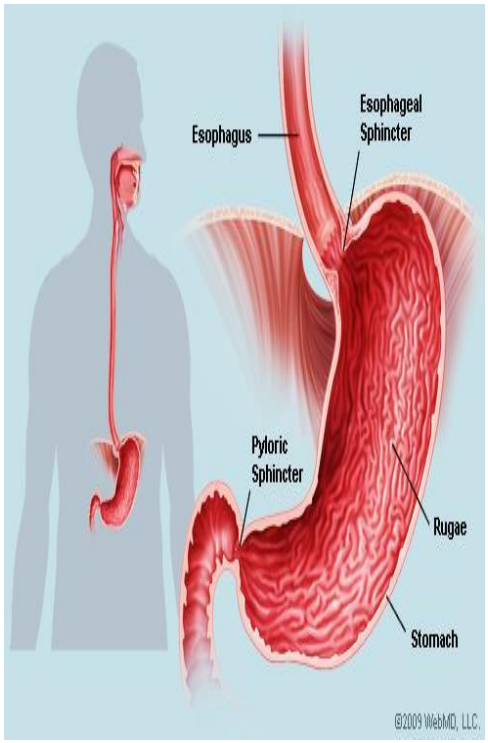
Layers of wall of stomach



Layers of wall of esophagus



The stomach

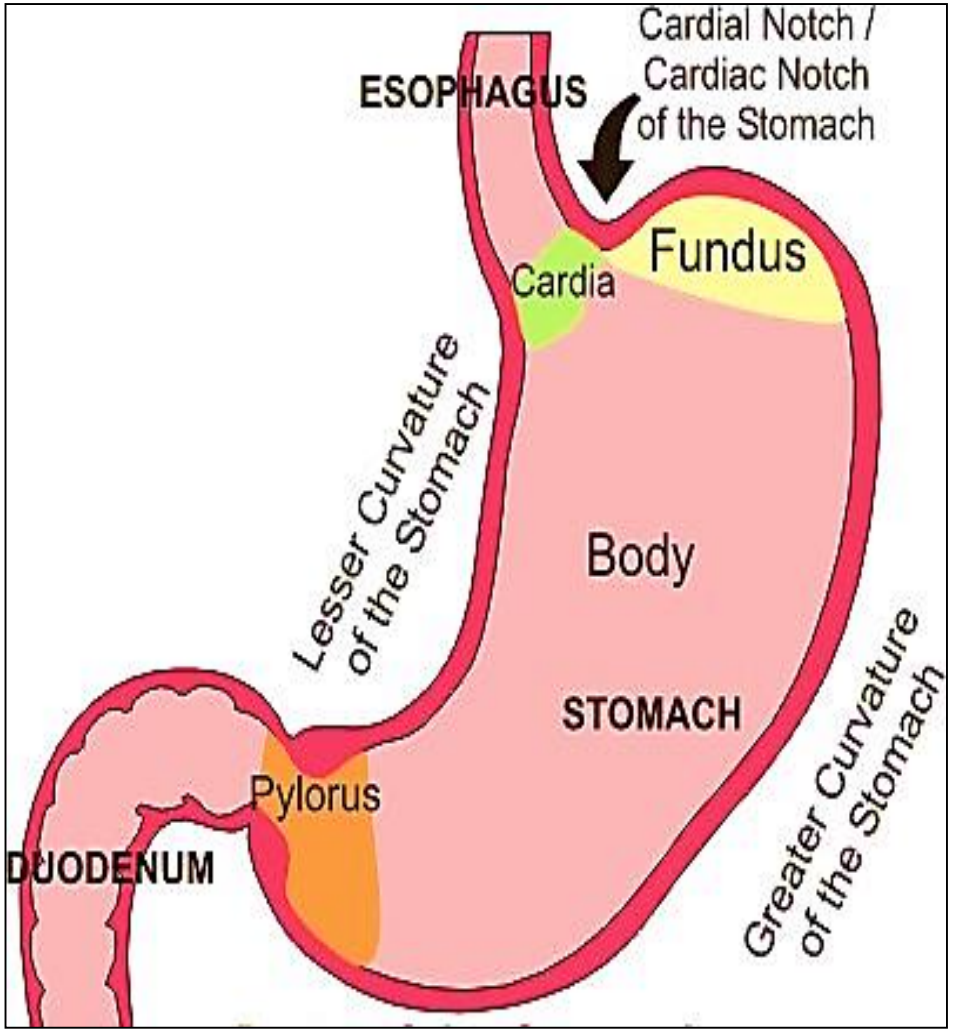


- The most dilated part of the GIT
- The mucosa in empty stomach forms longitudinal folds called gastric rugae
- It acidifies & converts the food → **chyme**
- The mucosa of stomach contains gastric glands (cardiac, fundic , pyloric)
- These glands secrete gastric juice which contains:
  - Acid: HCl
  - Mucus
  - enzymes: pepsinogen, lipase

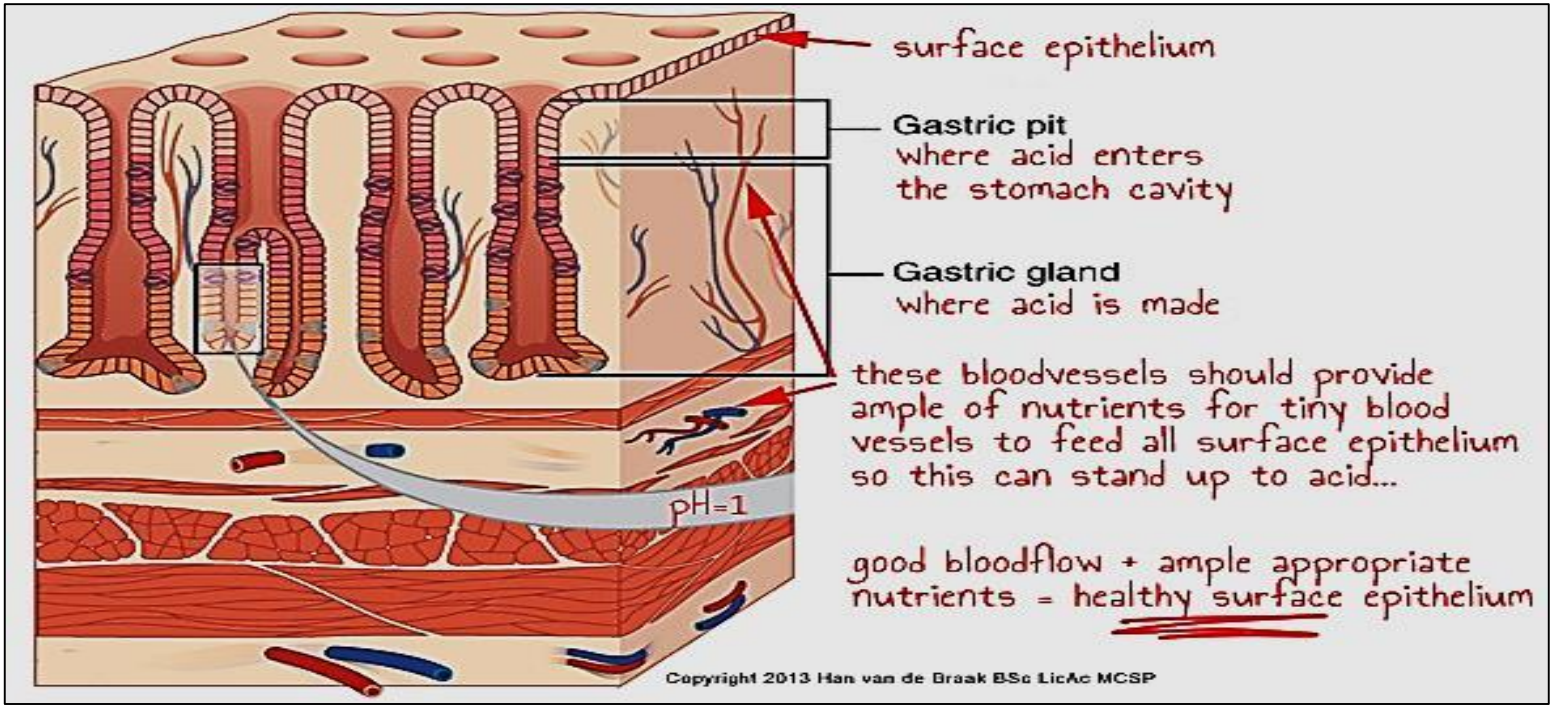
The stomach

The stomach is subdivided into 4 regions:

1. The cardiac region
2. The fundus
3. The body
4. The pyloric region



The fundus & body of the stomach



1- The mucosa:

- **epithelium**: ***simple columnar cells***, **these cells secrete neutral mucus for lubrication & protection***

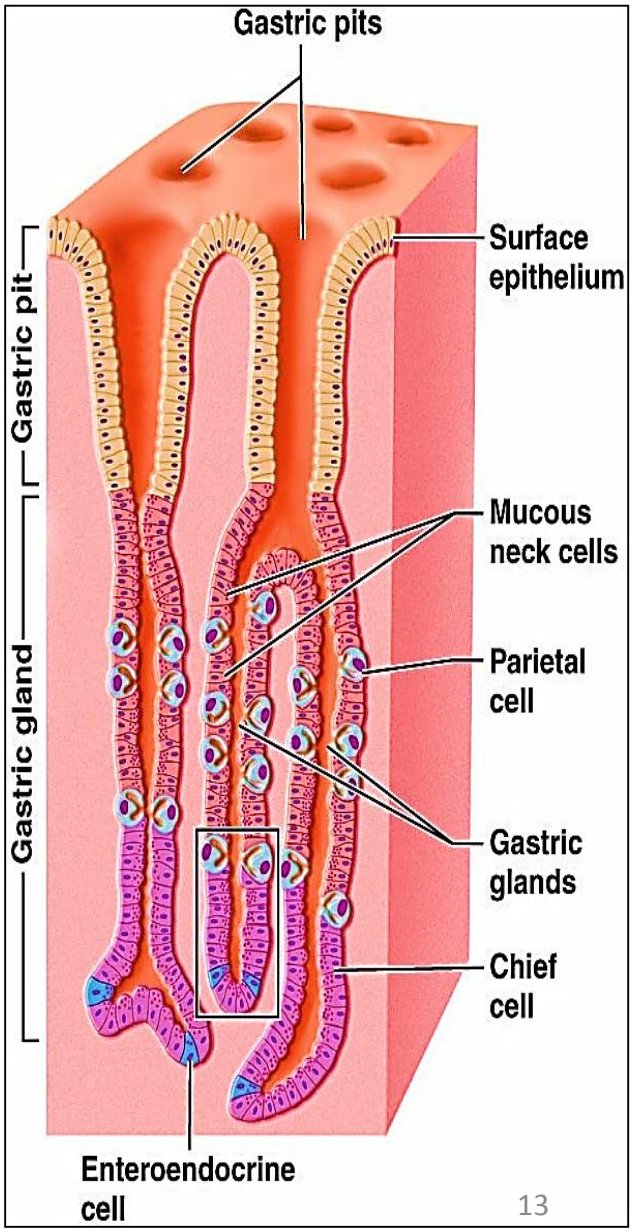
- **lamina propria**: **contains *gastric glands* & C.T. fills the spaces between the glands . It also contains B.V., lymphatics, nerves**

- **Muscularis mucosa: layer of smooth muscles arranged as (IC & OL) inner circular & outer longitudinal**

Gastric glands (fundus)

- simple branched tubular.
- occupy the entire thickness of the mucosa .
- They open onto the surface epithelium through gastric pits.

- through the pits the mucus, HCl & gastric enzymes reach the lumen of the stomach

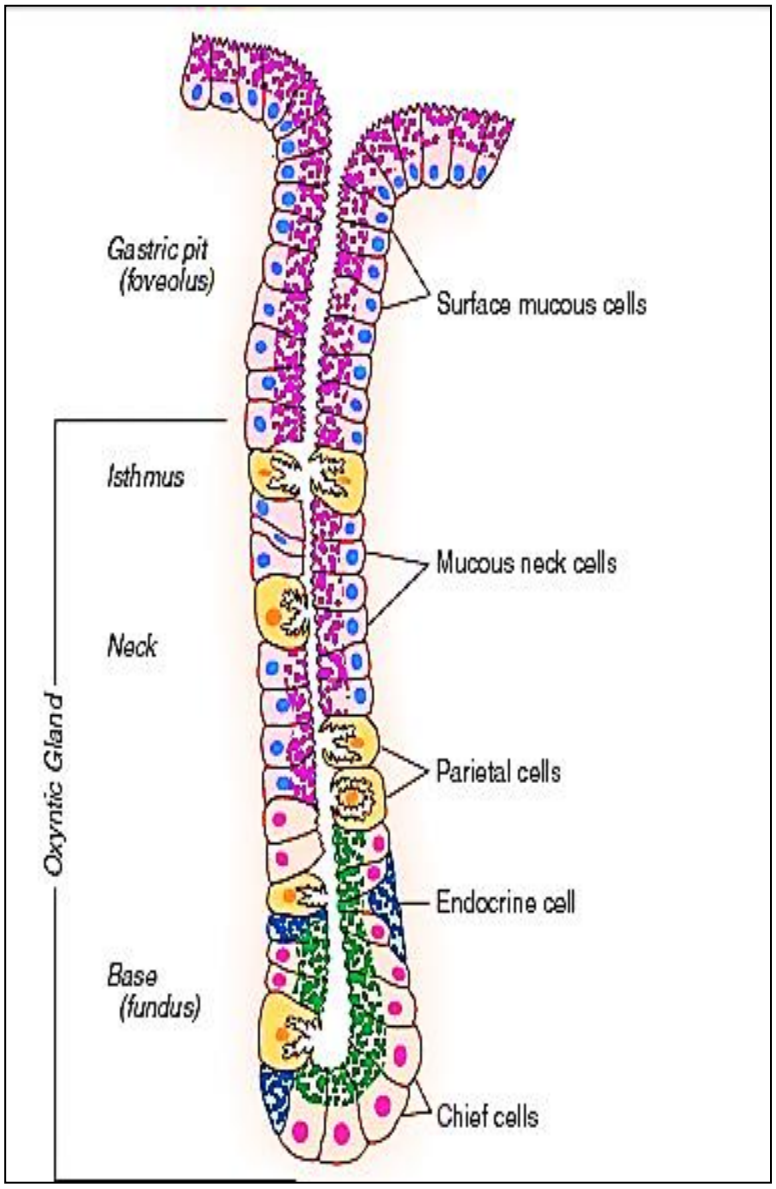


- **Each gland is formed of 3 parts: isthmus, neck & base**

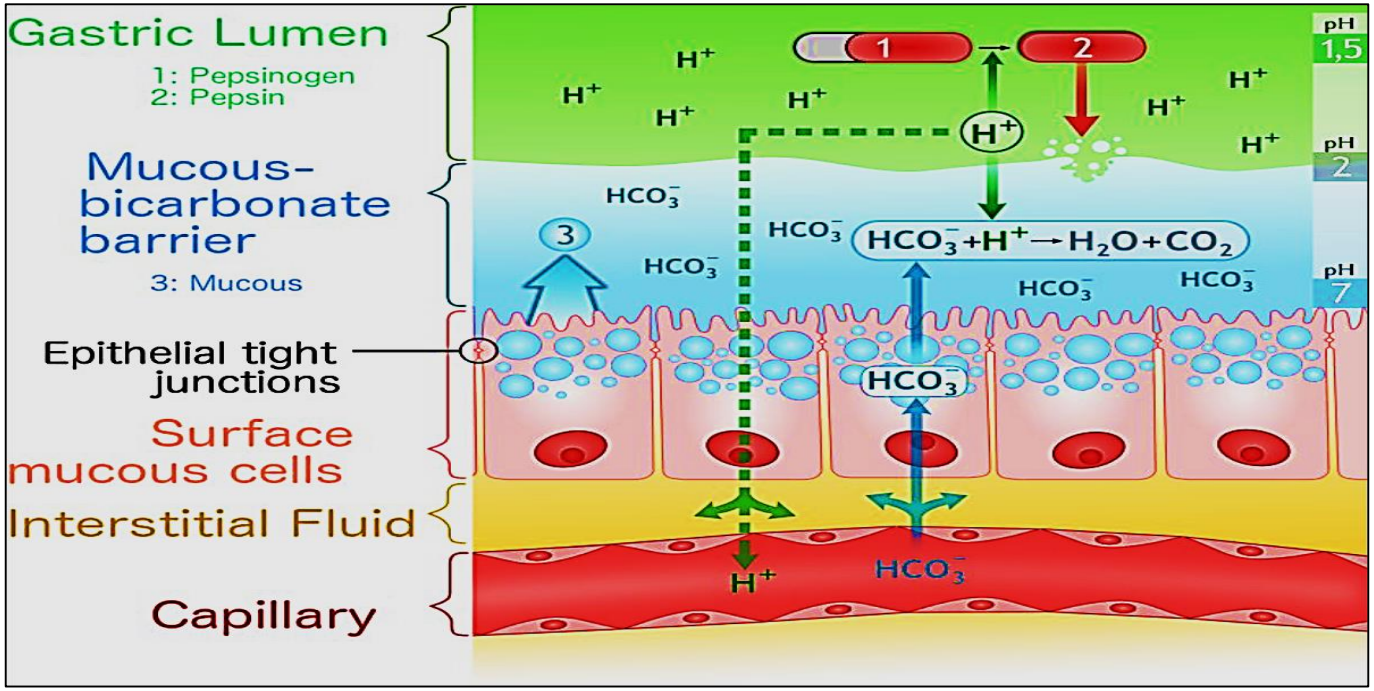
- **6 types of cells line the fundic glands:**

1- Surface mucous cells (Foveolar cells):
cover the surface & line the gastric pits & isthmus. Their apical cytoplasm contains mucin granules.
They sec. *neutral mucus* for protection (Gastric mucosal barrier)

2- Mucous neck cell: present in neck of gastric glands,
low columnar cells e foamy cytoplasm.
They secrete *acidic mucus*



Gastric mucosal barrier



1- epithelial cell lining. Cells in the epithelium of the stomach are bound by tight junctions

2- A special mucus covering, secreted by surface epithelial cells. This insoluble mucus forms a protective gel-like coating over the entire surface of the gastric mucosa.

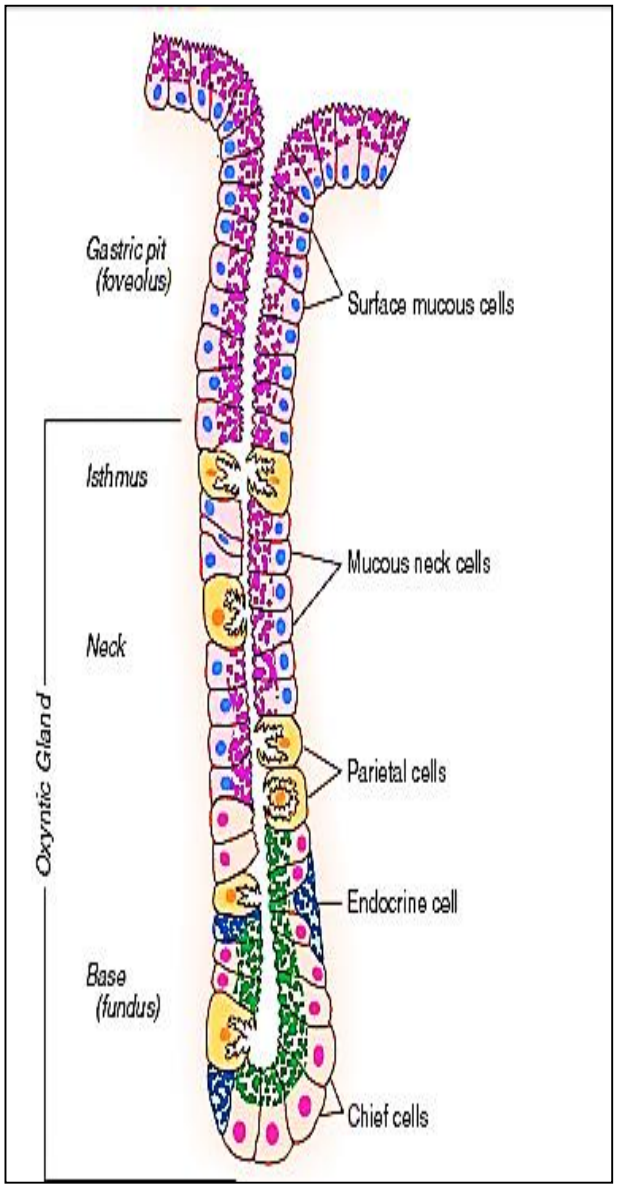
3- Bicarbonate ions, secreted by the surface epithelial cells. The bicarbonate ions act to neutralize harsh acids that find access to cells

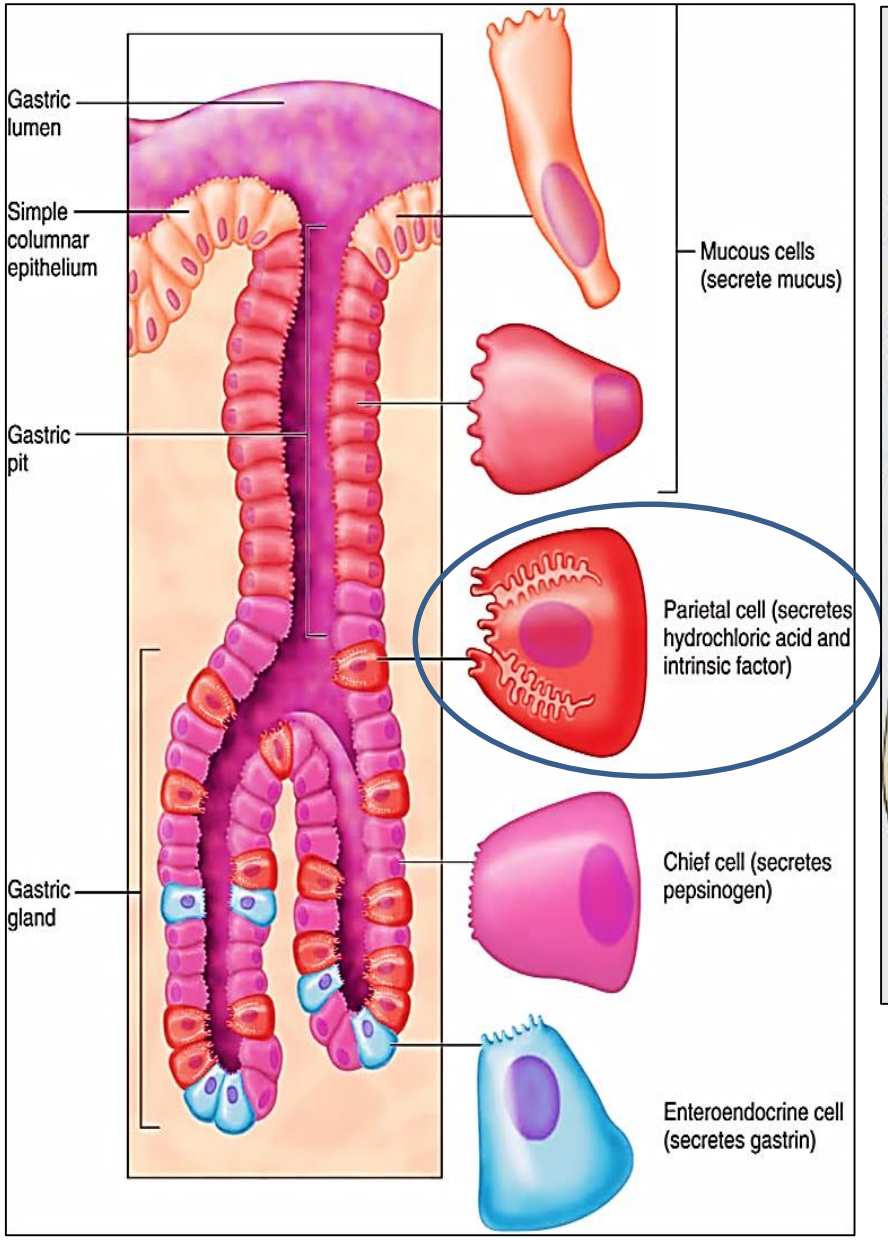
3- stem cells: present in neck region, low columnar. They differentiate to other gastric cells

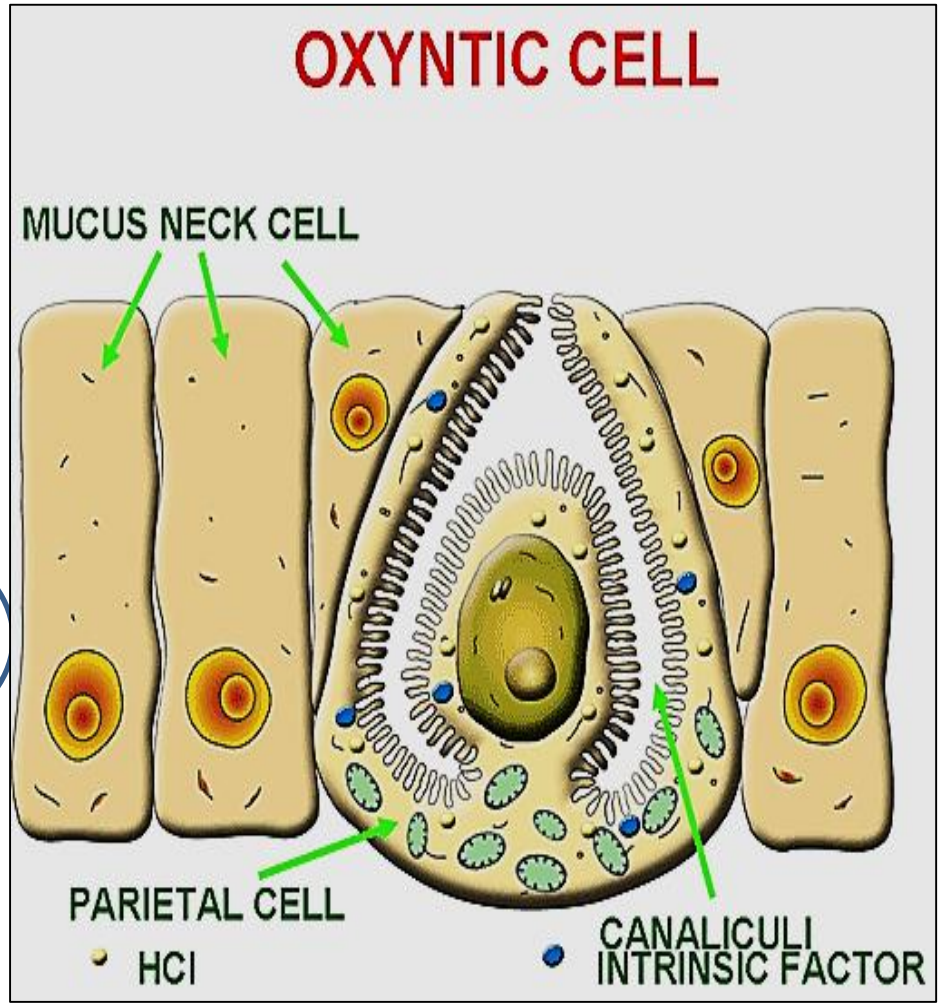
4- Parietal (oxyntic) cells :

- ***triangular* in shape e *acidophilic cytoplasm* & *rounded central nucleus*.**
  present mainly in the upper half of the glands – fewer in the base

- **E/M : their apical surfaces show branching Intracellular canaliculi that open at the apex.**
- **↑ mitochondria, ↑SER, NO sec. granules**
- **They secret HCl & intrinsic factor(glycoprotein) needed for vit. B12 absorption**







Oxyntic cell secretes HCl & intrinsic factor showing <u>tubulovesicular</u> system

Pernicious Anemia

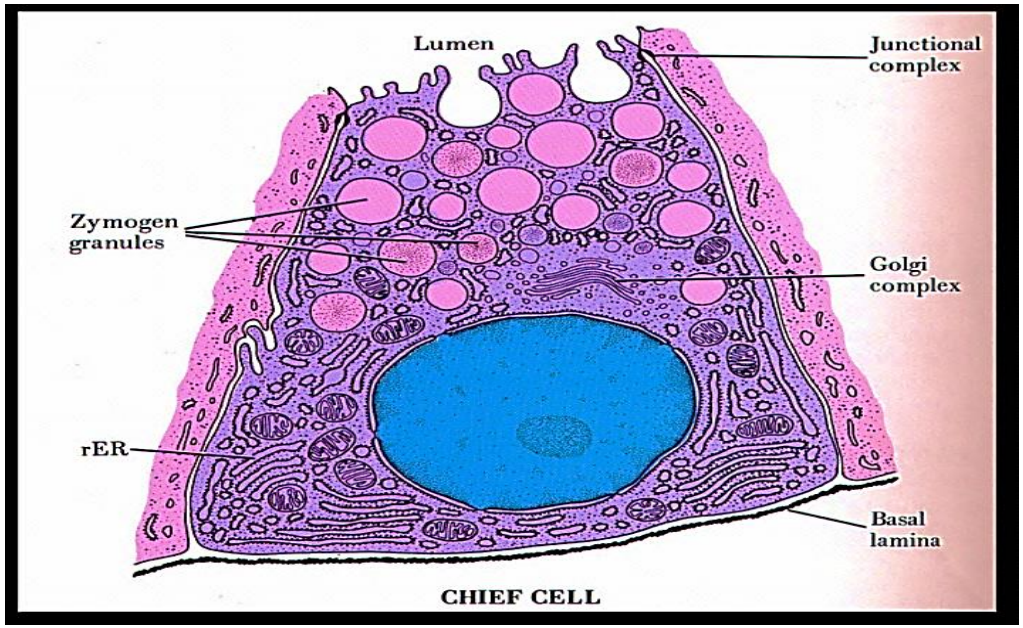
- Pernicious anemia is caused by a lack of intrinsic factor
- Intrinsic factor is a protein made in the stomach. It helps your body absorb vitamin B12, necessary for normal RBC production; RBCs are larger

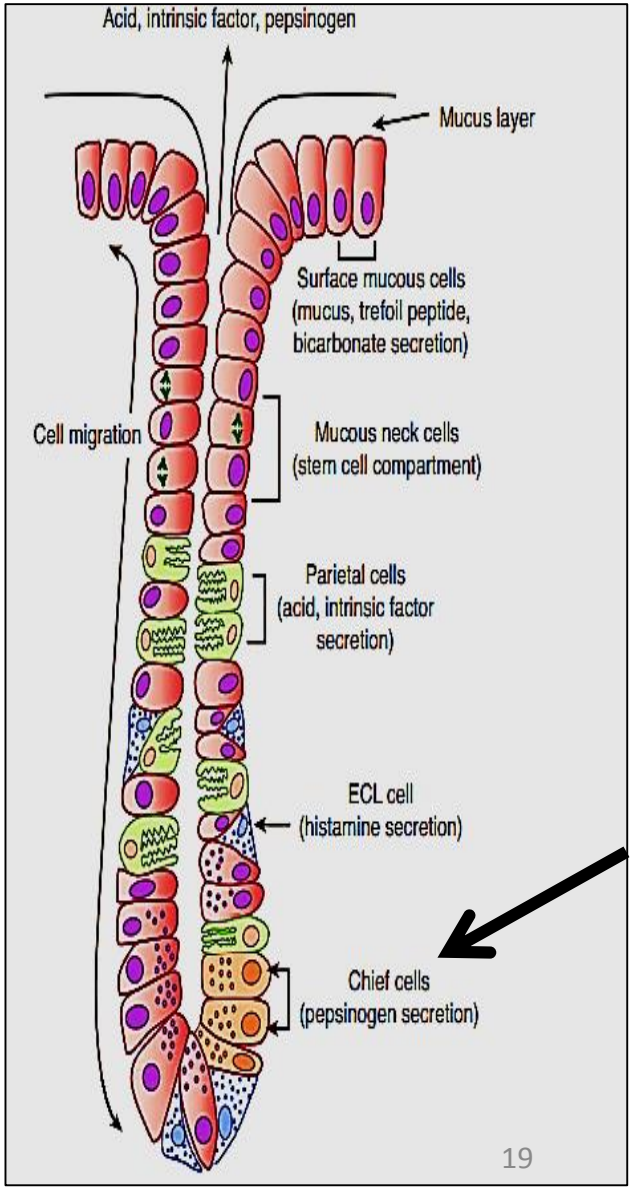
One of the signs of pernicious anemia is red tongue with smooth surface (Beefy tongue)

5-Peptic (Chief, Zymogenic) cells: mainly at the base of gastric glands. columnar cells e basal rounded nuclei.

- **The basal cytoplasm is basophilic due to ↑rER, while the apical part contains ↑↑ zymogen granules**

- **E/M : protein secreting cells**
- **These cells secrete pepsinogen & G. lipase**





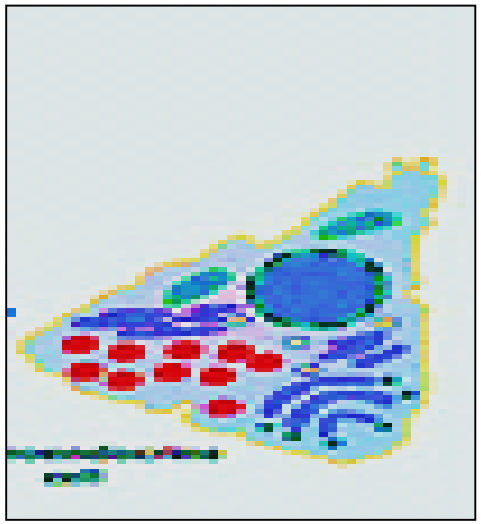
6- Entero-endocrine cells :

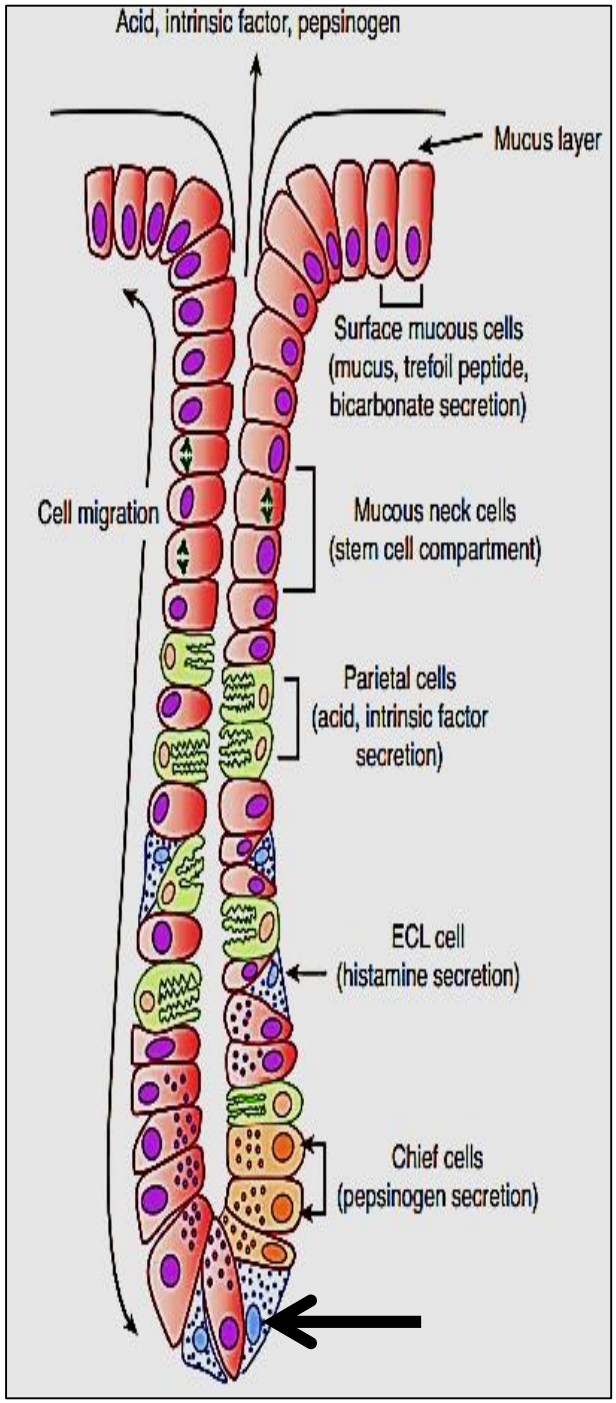
- present in the base of the glands.
- Hormone secreting cells
- (diffuse neuroendocrine system)

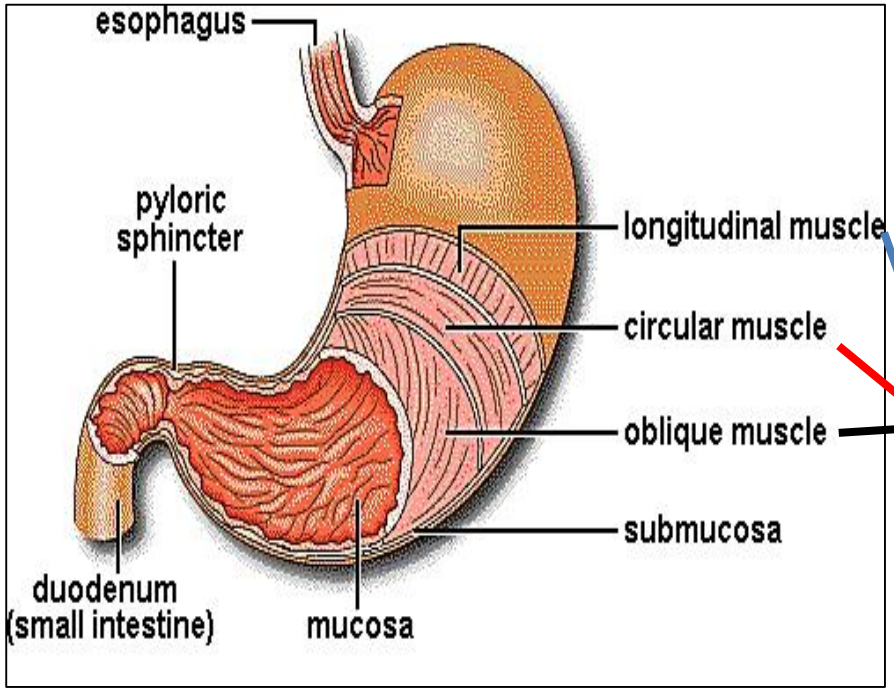
- Their secretions accumulates in the basal part to be released to the B.V.

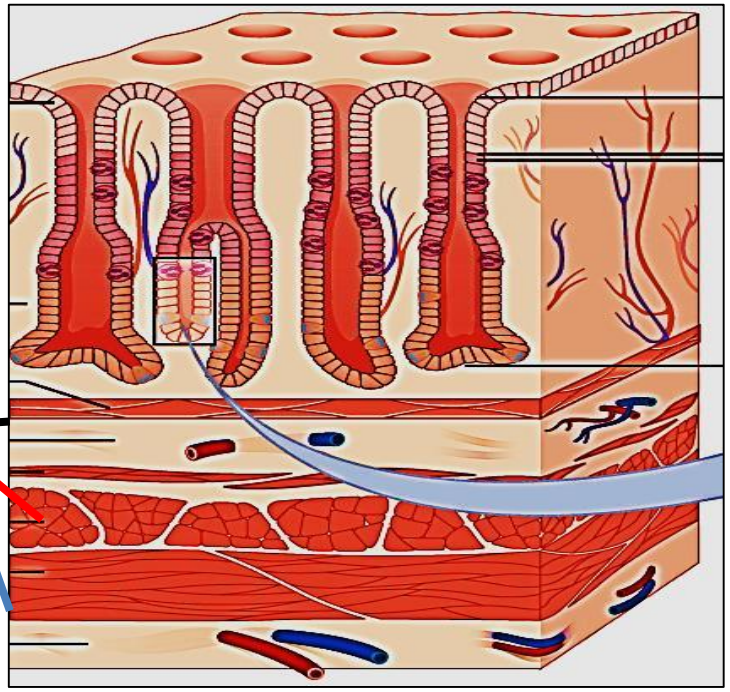
- They secrete:

✓ Gastrin
✓ Enteroglucagon
✓ Serotonine
✓ Somatostatin(D cells)









2- The submucosa: **loose C.T. with B.V., lymphatics, meissner's plexus of nerves**

3- The musculosa: formed of 3 layers of smooth ms.

Inner oblique - middle circular - outer longitudinal.

Auerbach's plexus is present between middle & outer layers

4- The Serosa: is the peritoneal covering, is formed simple squamous mesothelium & loose C.T. It contains B.V., lymphatics, & nerves

The difference between fundus & pylorus

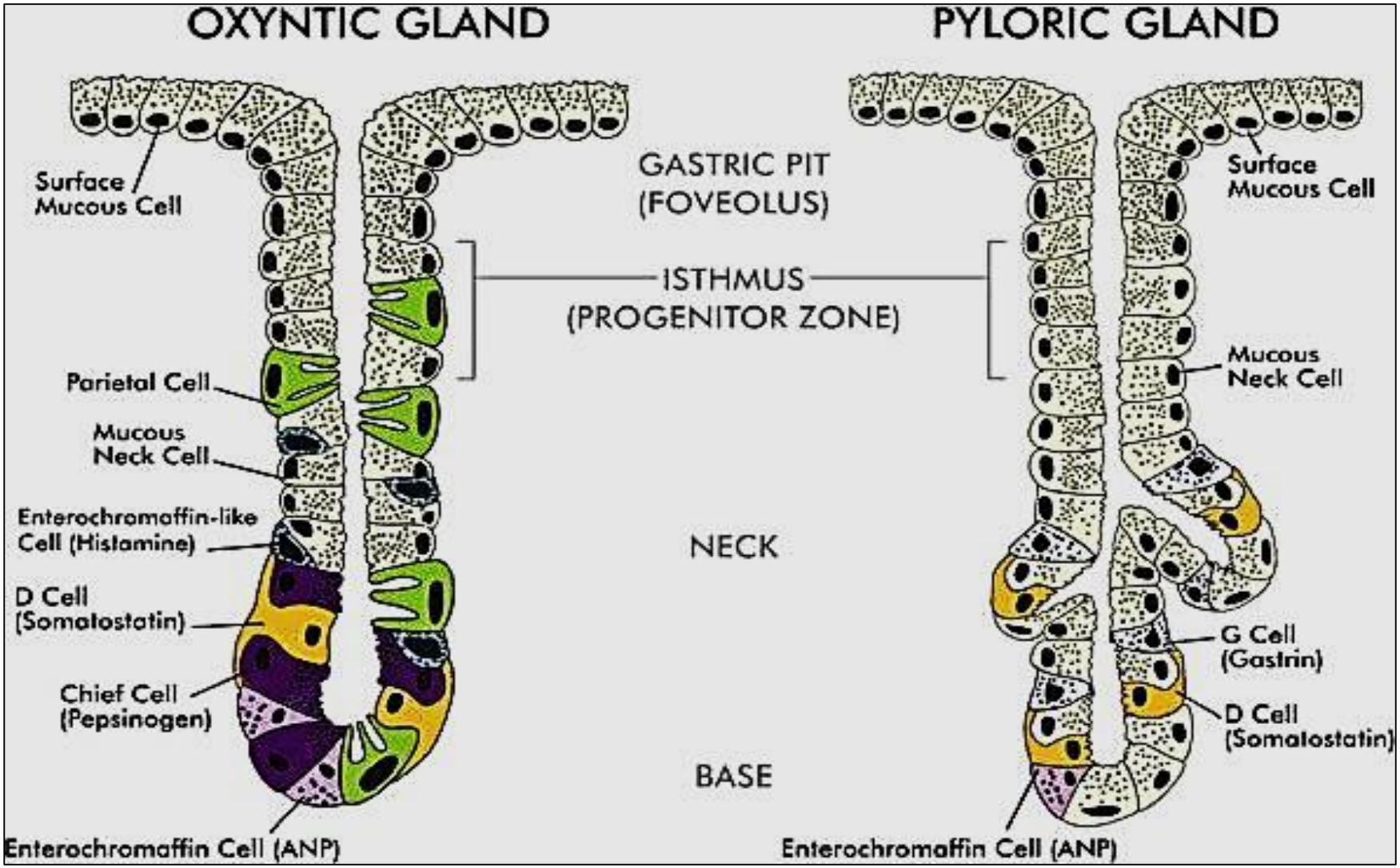
Fundus

- Thick mucosa
- Pits are narrow & short
- F. Glands are simple branched tubular & long
- occupy most of mucosal thickness
- Lined e 6 types of cells
- Corium: lymphocytic infiltration
- Musculosa: thinner formed of 3 layers of ms. (IO, MC,OL)

Pylorus

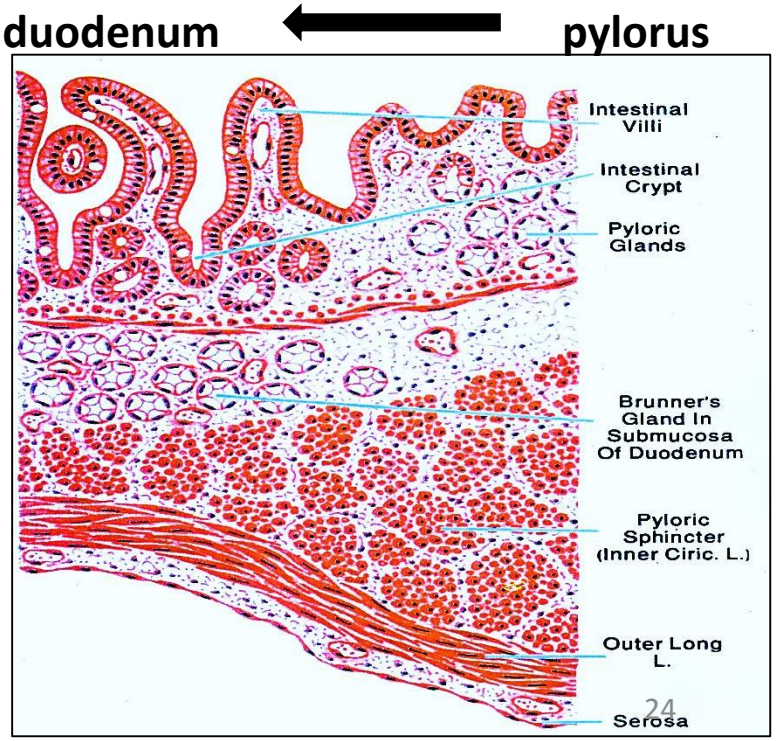
- Thin mucosa
- Pits are wide & long
- P. Glands are coiled branched tubular & short
- Occupy ½ of mucosal thickness
- Lined e mucous secreting cells
  No oxyntic, No peptic cells
- Lymphocytic infiltration & lymph nodules
- Thicker , formed of 2 layers of muscles. Thick IC to form the p. sphincter & OL

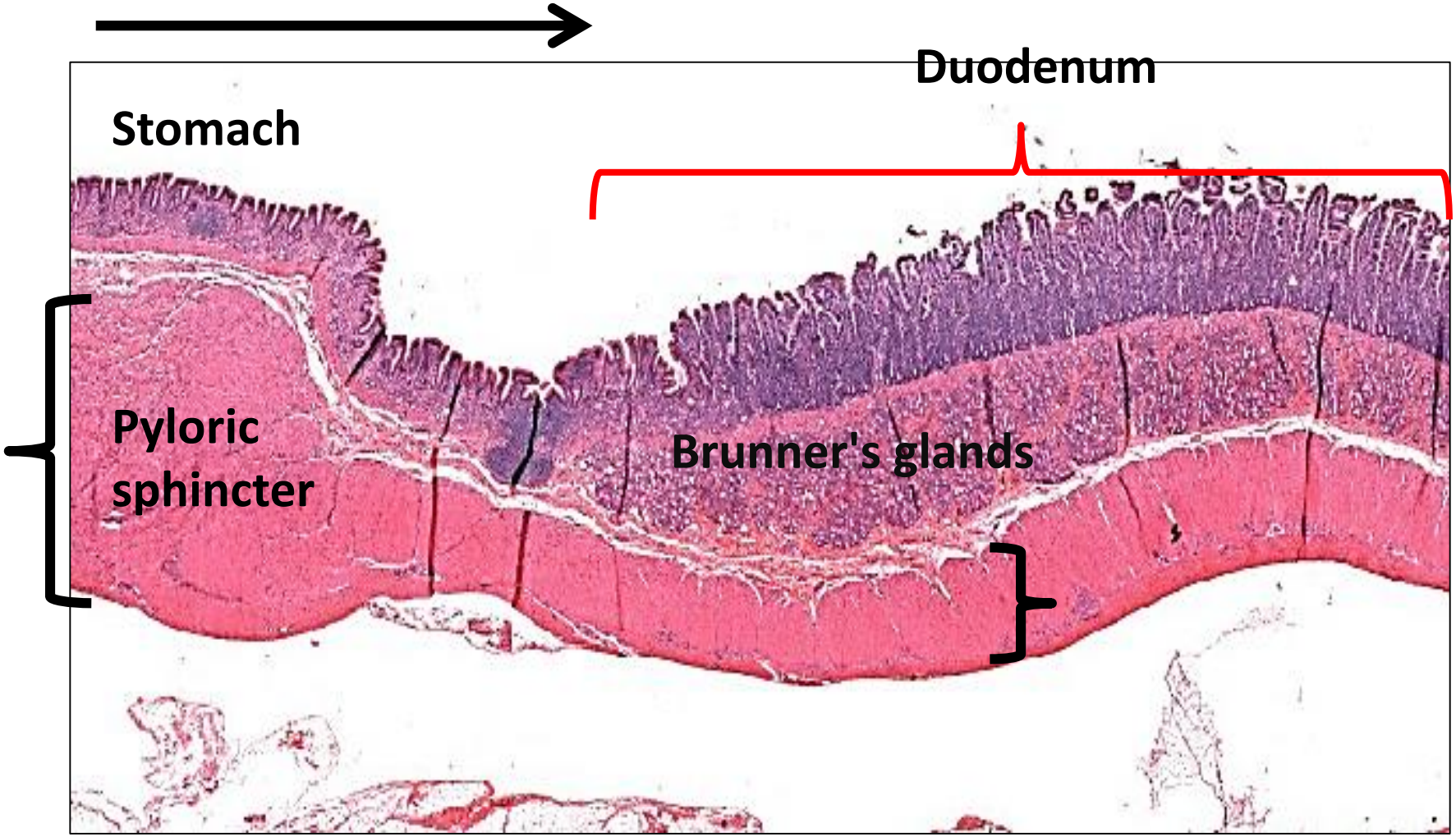
Difference between fundic & pyloric glands



Changes at gastro duodenal junction

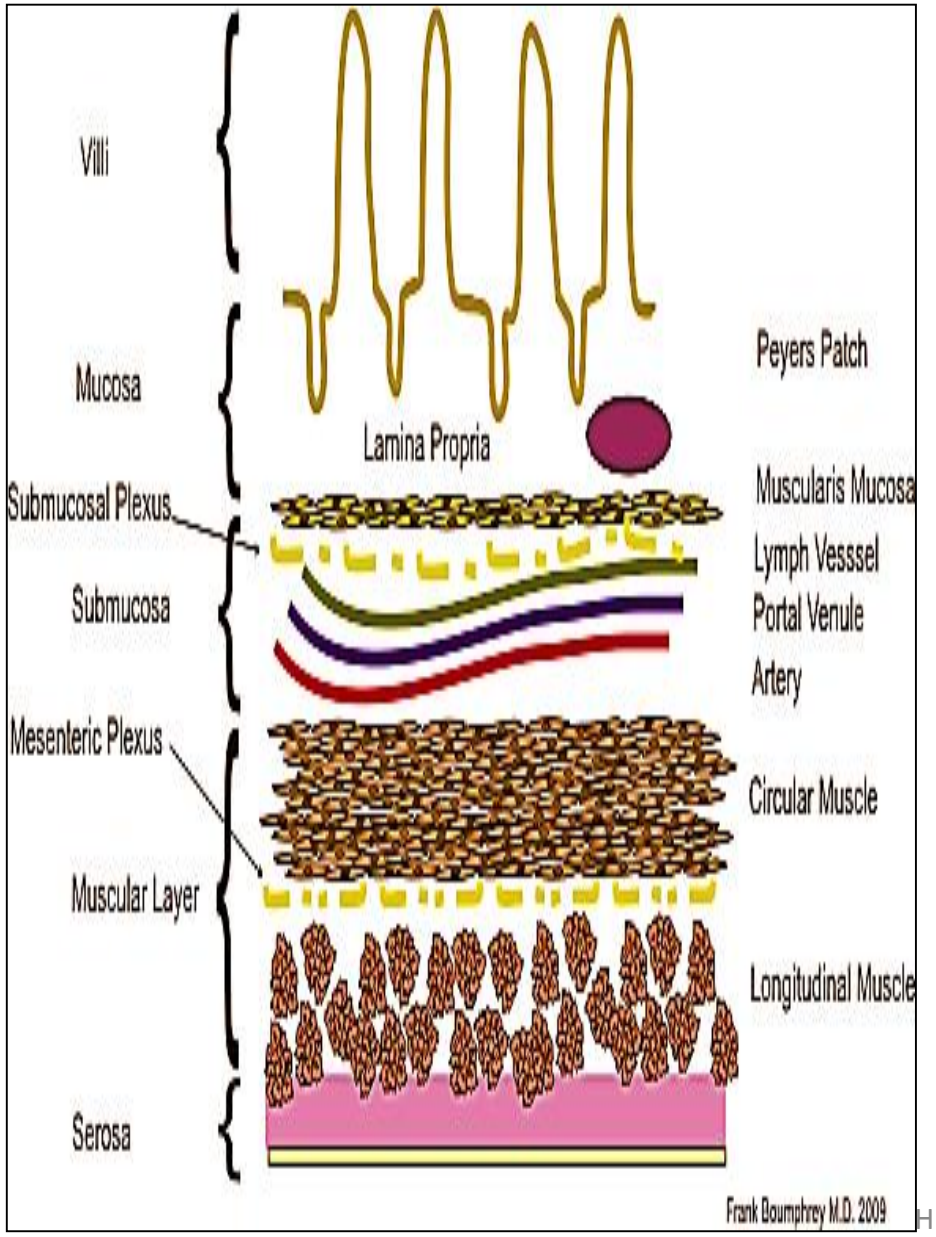
- **intestinal villi** start to project from mucosa
- **Intestinal crypts** replace pyloric glands in the corium of duodenum
- **Surface columnar cells** with **brush border. Goblet cells** appear between cells
- Muscularis mucosa: pass unchanged
- **Brunner's glands** appear in duodenal submucosa
- Musculosa is **thinner** in the duodenum
- Serosa pass unchanged



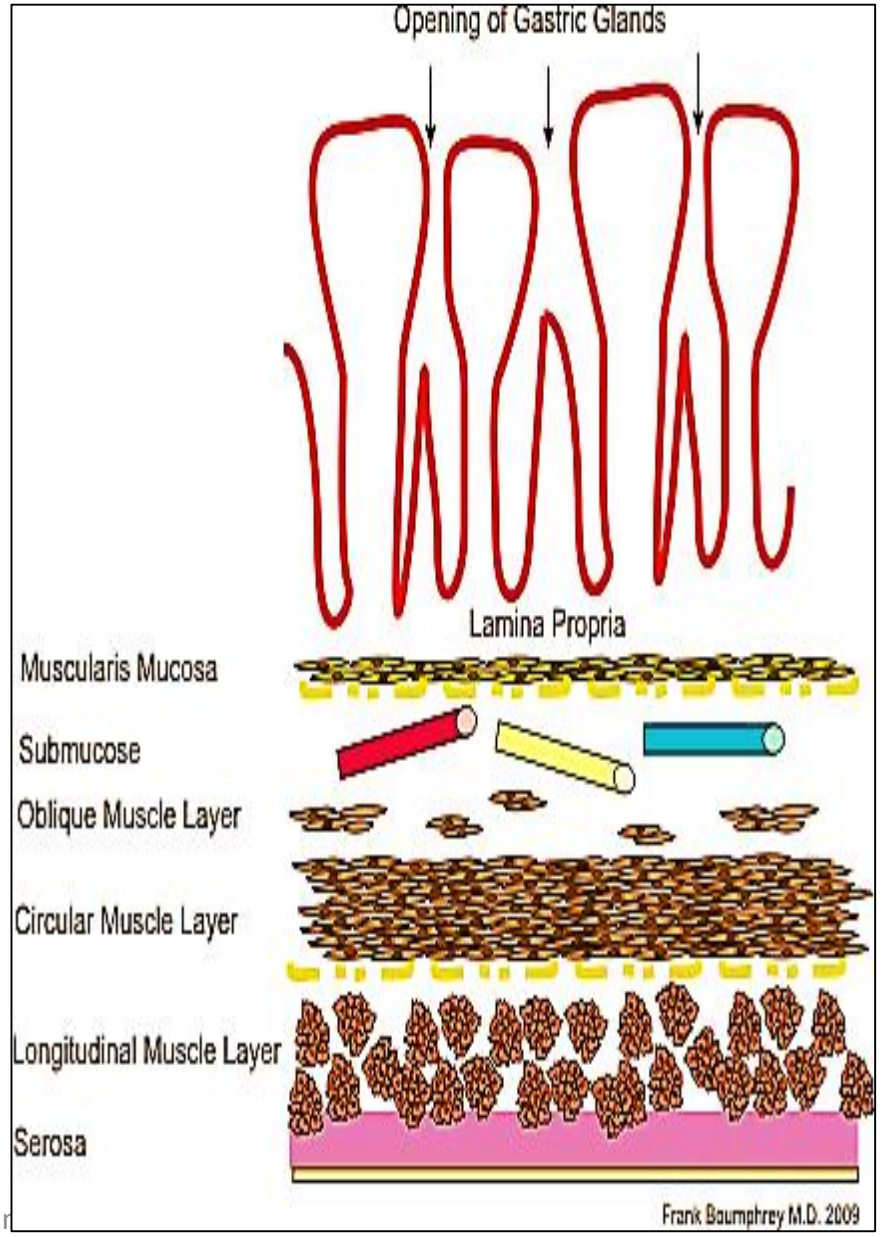


Gastro duodenal junction

Wall of intestine



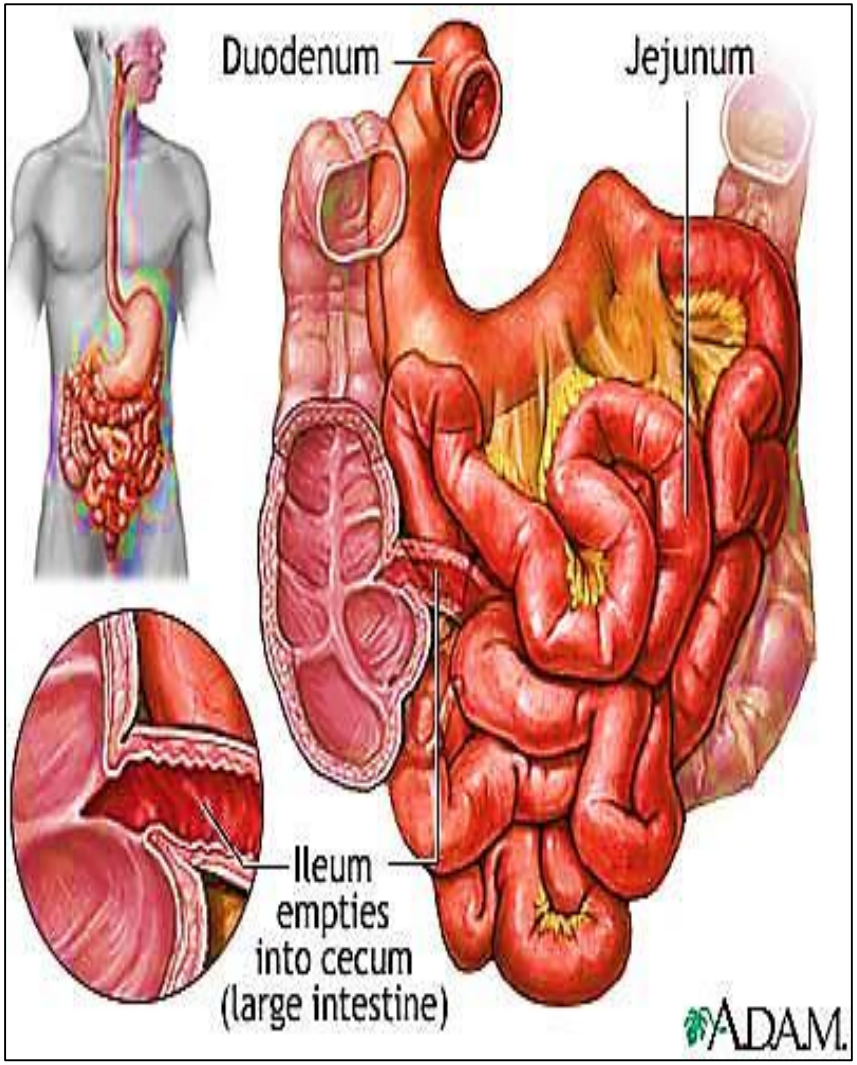
Wall of stomach



Small intestine

- **Parts of small intestine:**
- Duodenum
- Jejunum
- Ileum

- **Function:**
- Digestion
- Absorption
- Endocrine secretion

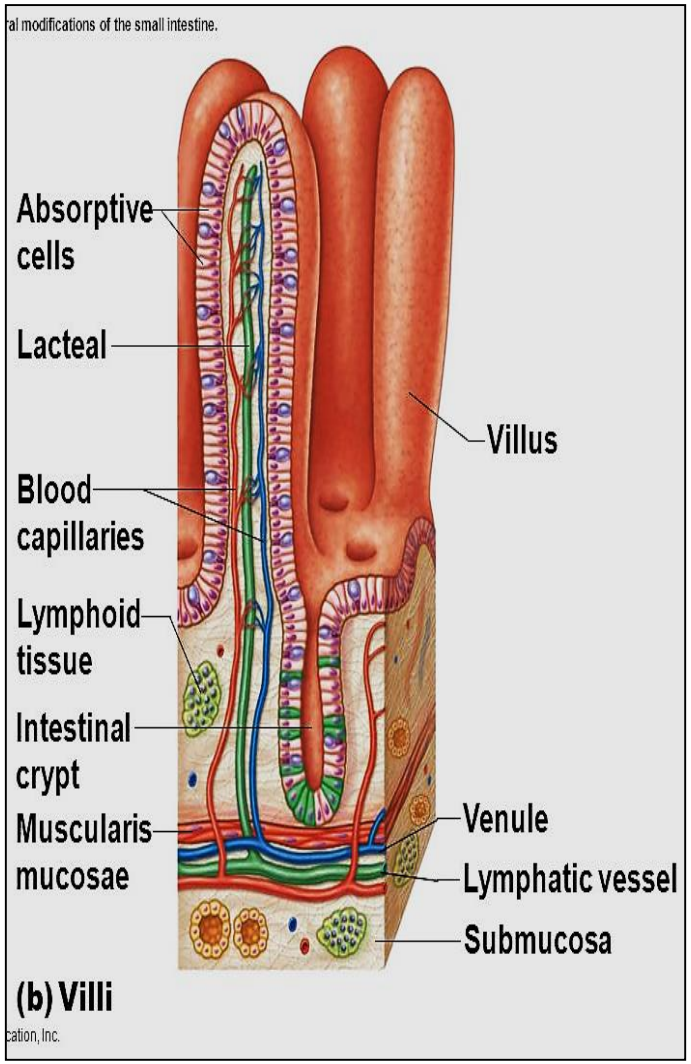


I- The mucosa

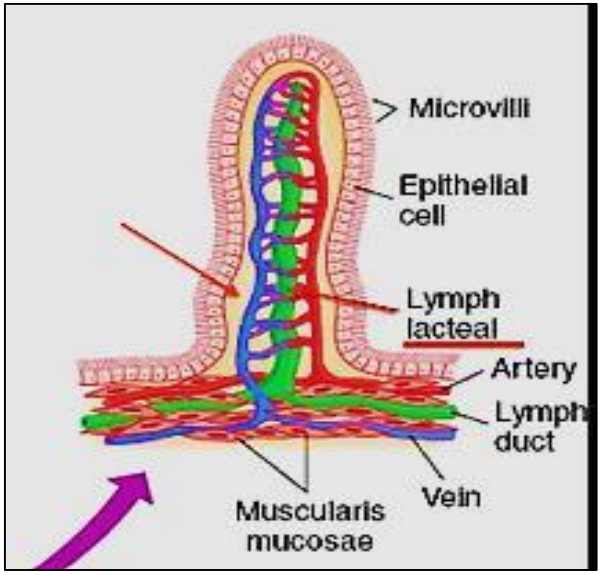
Contains : villi & crypts,

- The villi are finger like projections, extend into lumen of SI. They have central core of C.T. (lamina propria)

- The crypts of Lieberkuhn (intestinal glands) : simple tubular glands in the C.T. of lamina propria



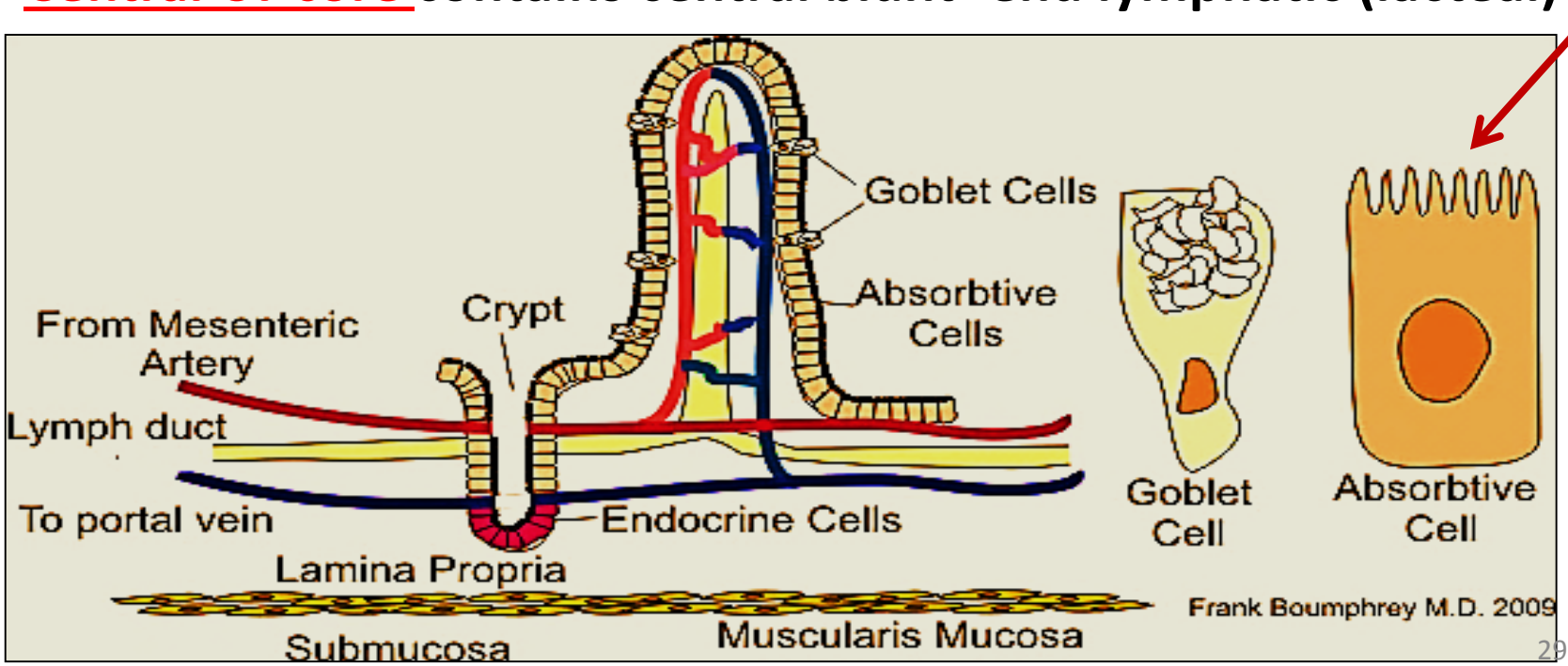
The intestinal villi

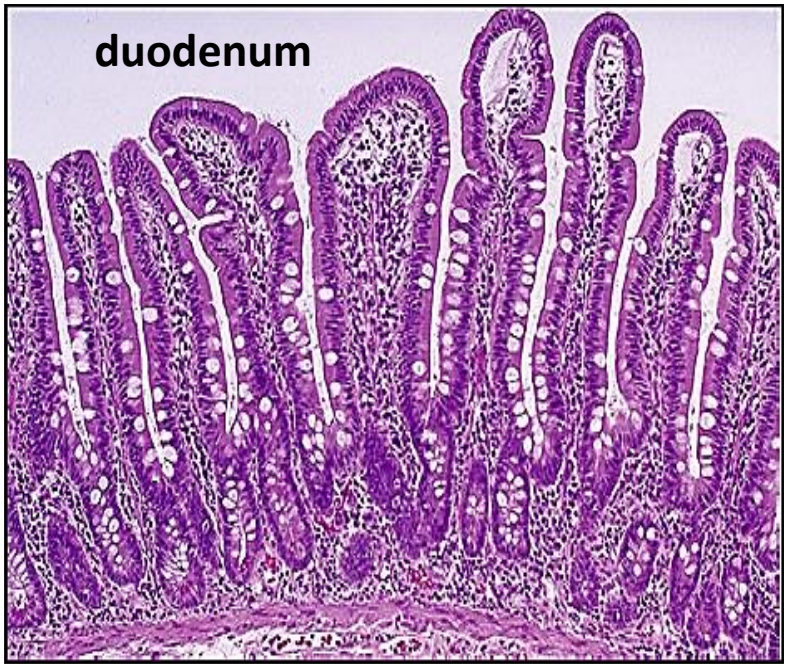


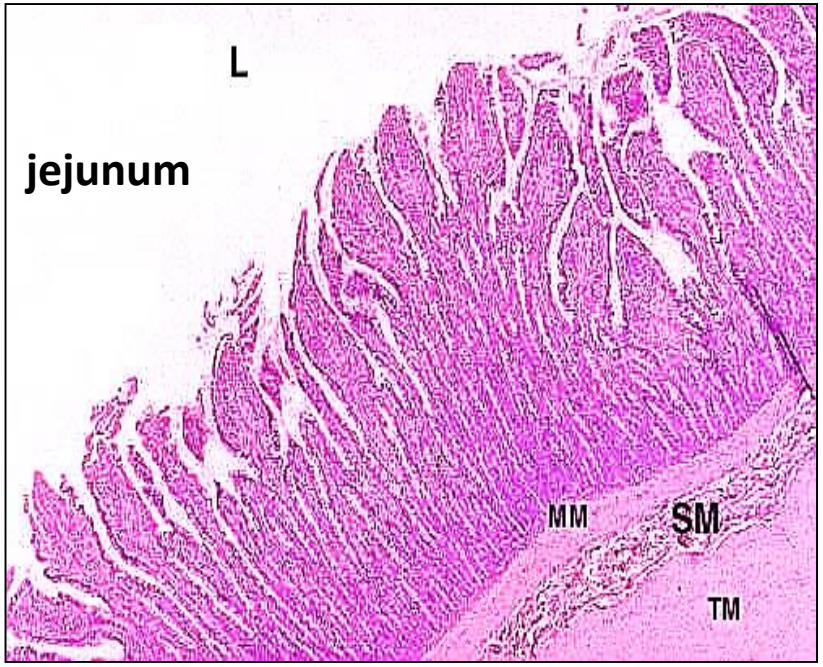
- Each villus is formed of:

a) **Epithelium**: showing only **3 types** of cells : columnar absorbing cells (90%), goblet cells (9.5%), endocrine cells (0.5%)

b) **Central CT core** contains central blunt- end lymphatic (lacteal)

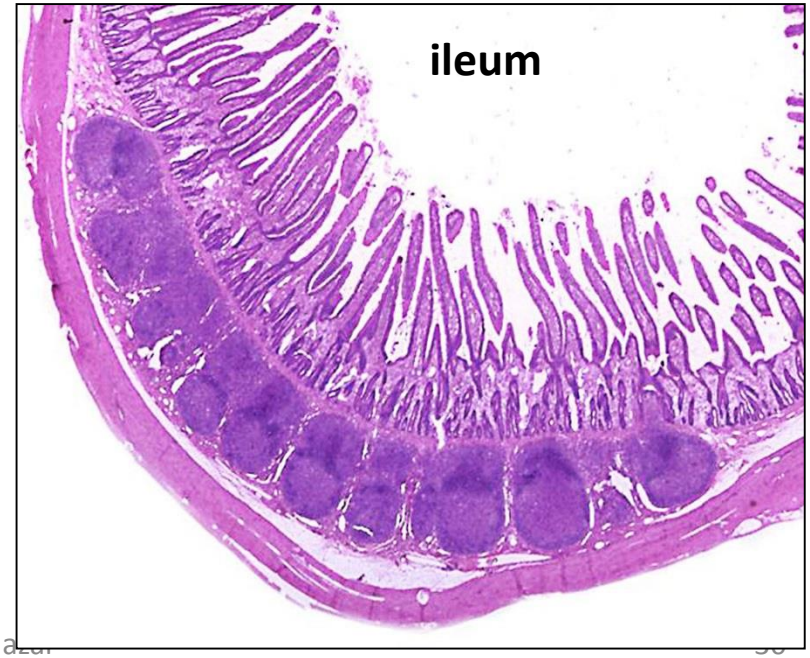






Villi vary in shape throughout the different segments of Small Intestine:

- **Duodenum: broad, leaf- like**
- **Jejunum : long & slender**
- **Ileum: short, absent over Peyer's patches**



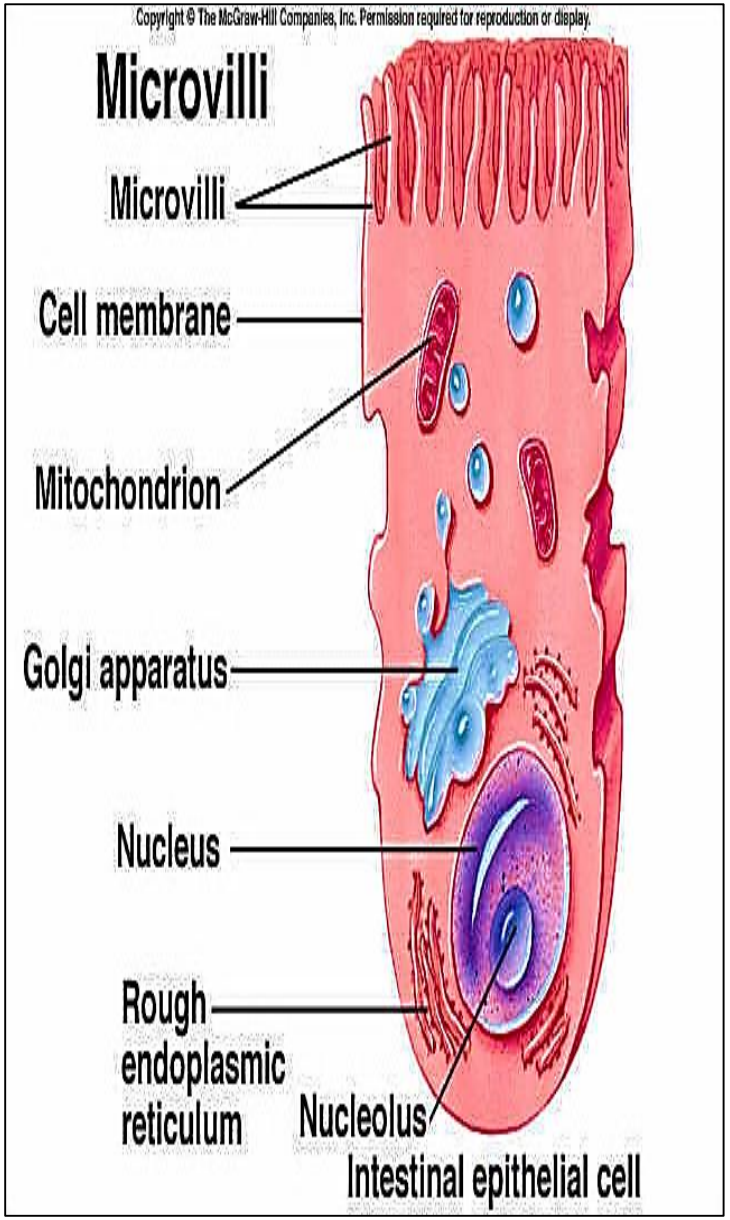
1- Enterocytes:

- **Absorptive cells**

- **Tall columnar cells e basal oval nuclei & brush border of microvilli to increase The absorptive surface area (10 folds)**

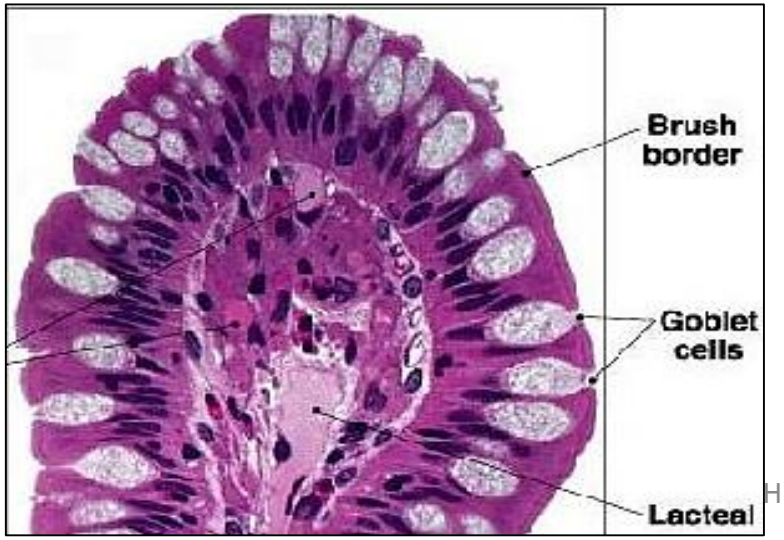
- **E/M: rER, Golgi, ↑ mitochondria, their lateral borders show tight junctions**

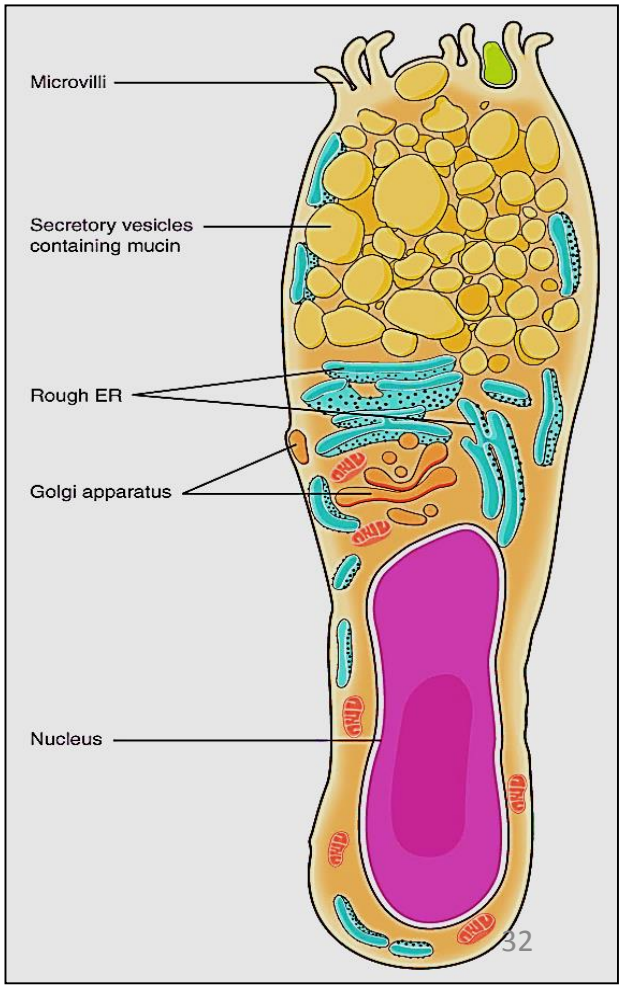
- **their function is : Terminal digestion & absorption of carbohydrates**



2- Goblet cells:

- Present between the enterocytes on the villi & in the crypts
- Unicellular mucous secreting gland
- Each cell has expanded apical part full of mucin granules & basal cylindrical part contain the deeply nucleus
- Secrets mucus at intervals for lubrication





Crypts of Leiberkuhn

- They are simple tubular glands occupy the thickness of the corium till the muscularis mucosa

- 6 types of cells line the crypts:

1- Enterocytes

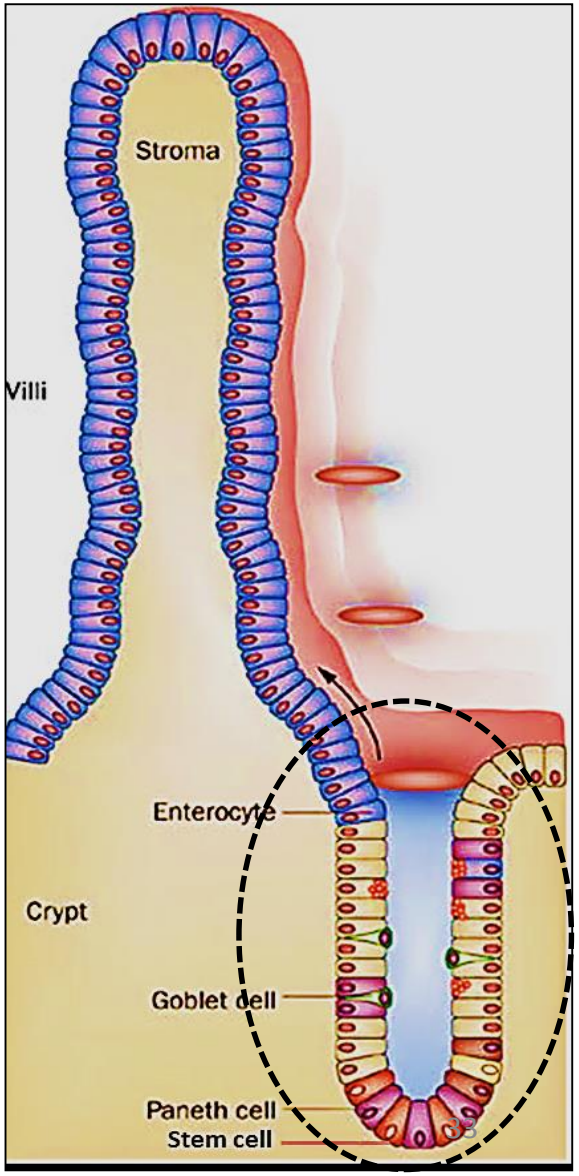
2- Goblet cells

3- **Paneth cells**

4- endocrine cells

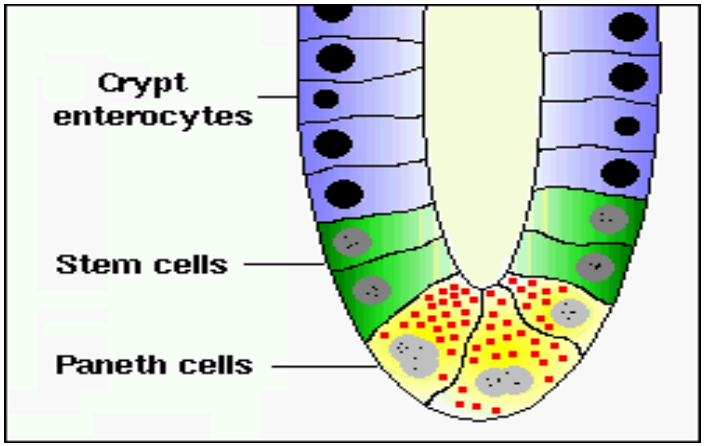
5- stem cells

6- **M cells** (Microfold, macrophage)



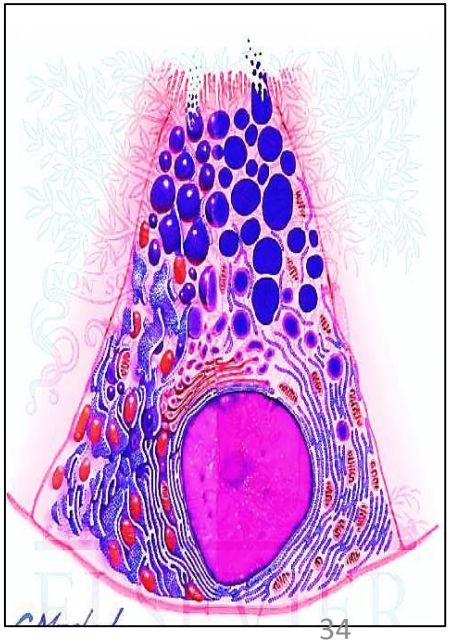
3- Paneth cells:

- Present in groups at **bottoms of crypts** only



- Pyramidal cells e basal oval nuclei & narrow apical part

- Basal cytoplasm is basophilic due to↑ rER , apical part has acidophilic zymogen granules

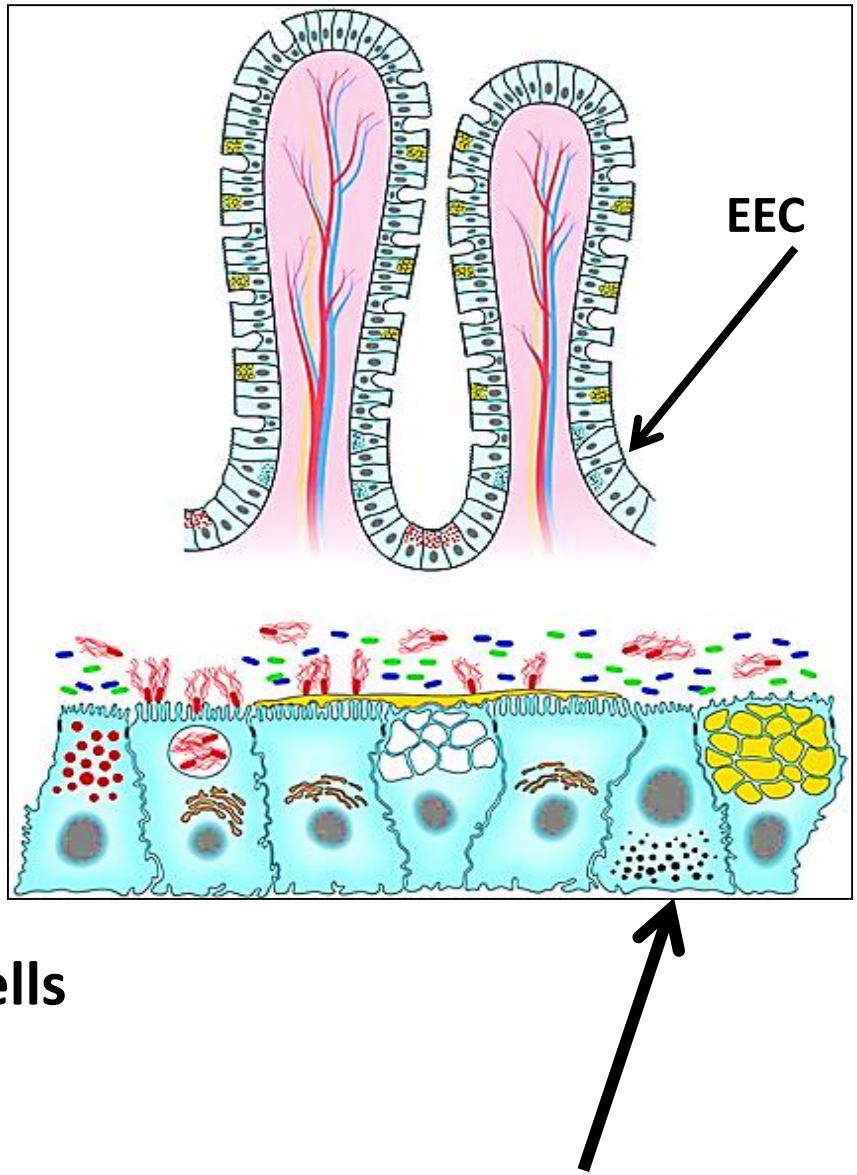


- They secrete intestinal lysozyme which has bactericidal effect

4- Enteroendocrine cells:

- Secrets intestinal hormones
- Present mainly in base of crypts,
- Their secretions released to blood
- Their secretions control peristalsis,

sense of being satisfied after eating

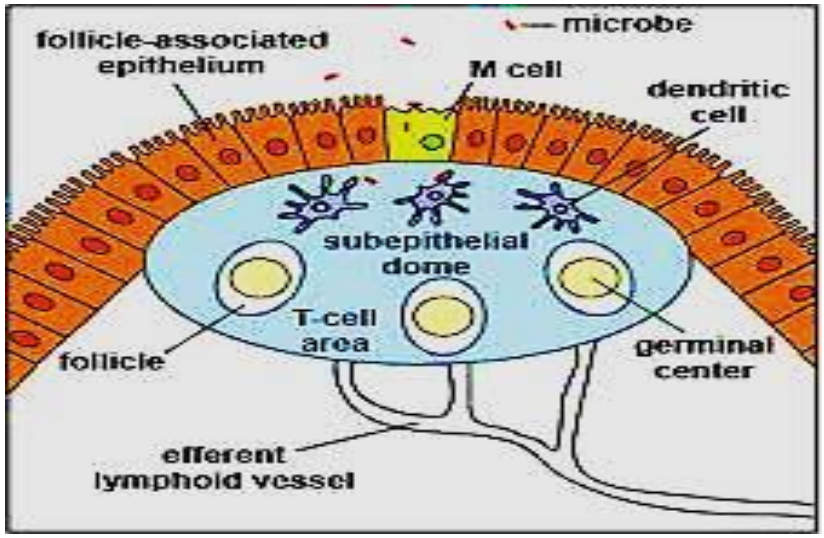


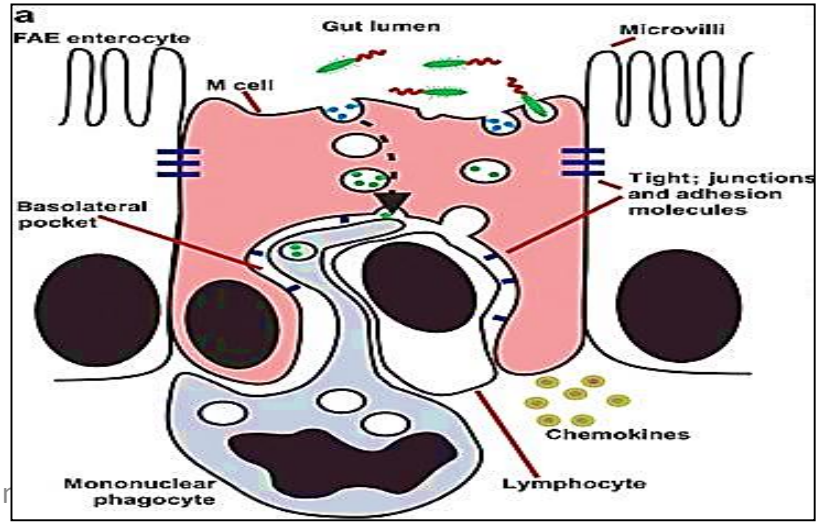
5- Stem cells:

- Short columnar cells ,present at base of crypts in between Paneth cells
- Differentiate to replace other cells

6- M (microfold) cells:

- Squamous - like cells present in association with **lymphoid nodules of Peyer's patches in ileum**
- play a role in mucosal immunity response
- Have microfolds on their apical surface & basal membrane invaginations. The Basal lamina under M-cells is porous
- Phagocytosis & transport antigens from intestinal lumen to the underlying macrophages & lymphocytes





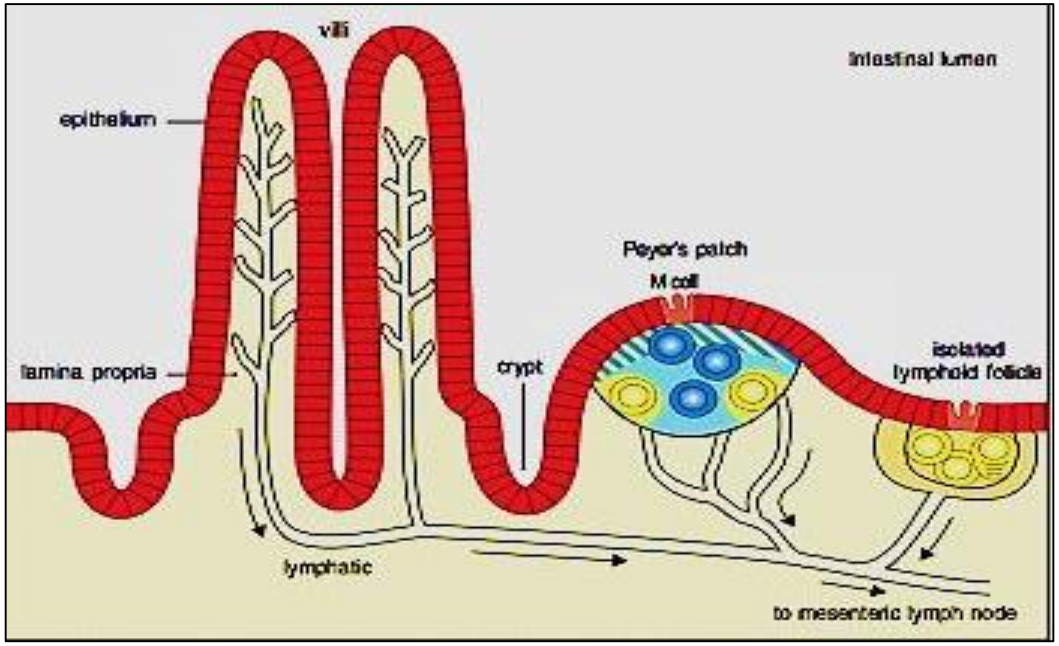
Peyer's patches (ileum)

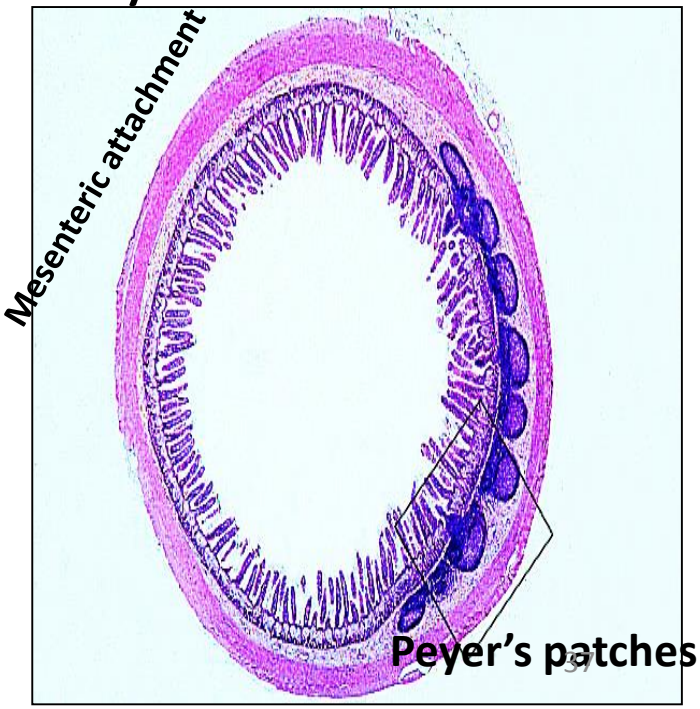
a) present mainly in the ileum. In both lamina propria of mucosa & submucosa

b) They are aggregations of lymph follicles, lies in the side opposite to the mesenteric attachment.

c) the intestinal villi absent over Peyer's patches

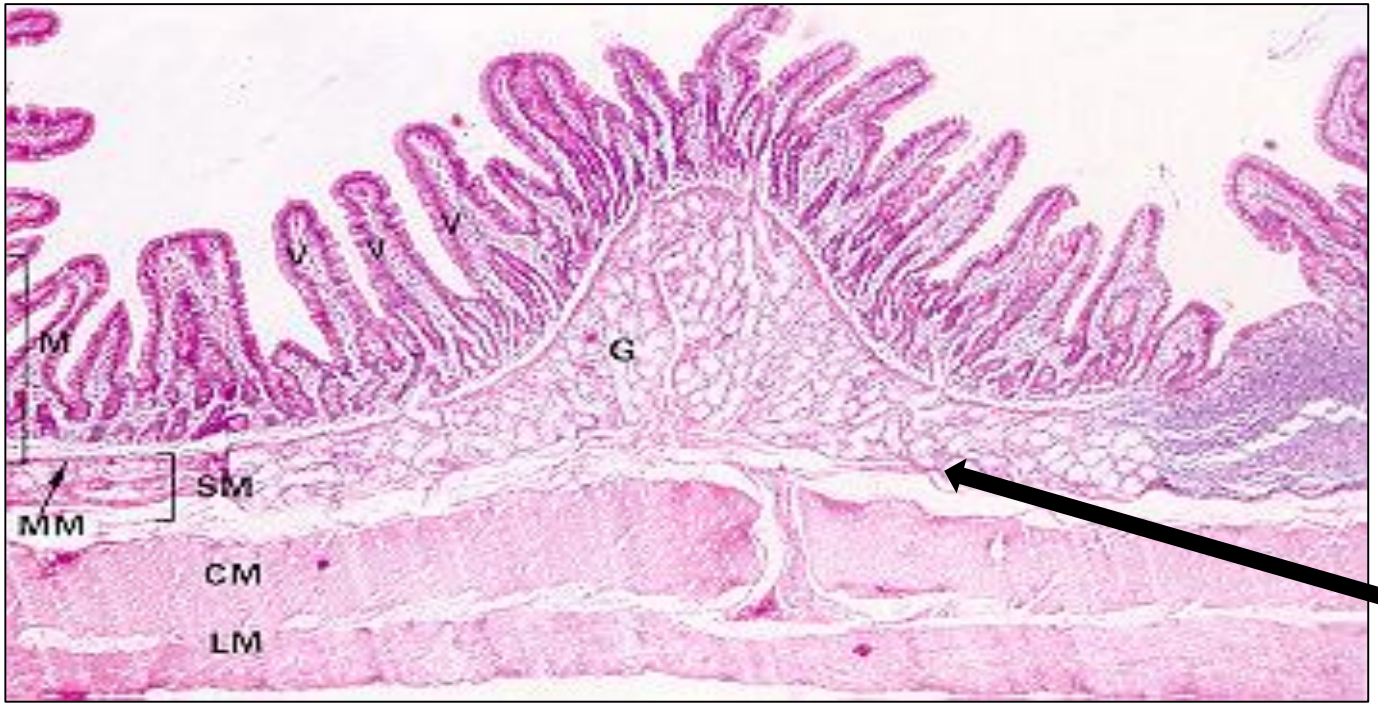
d) They are important for mucosal immunity





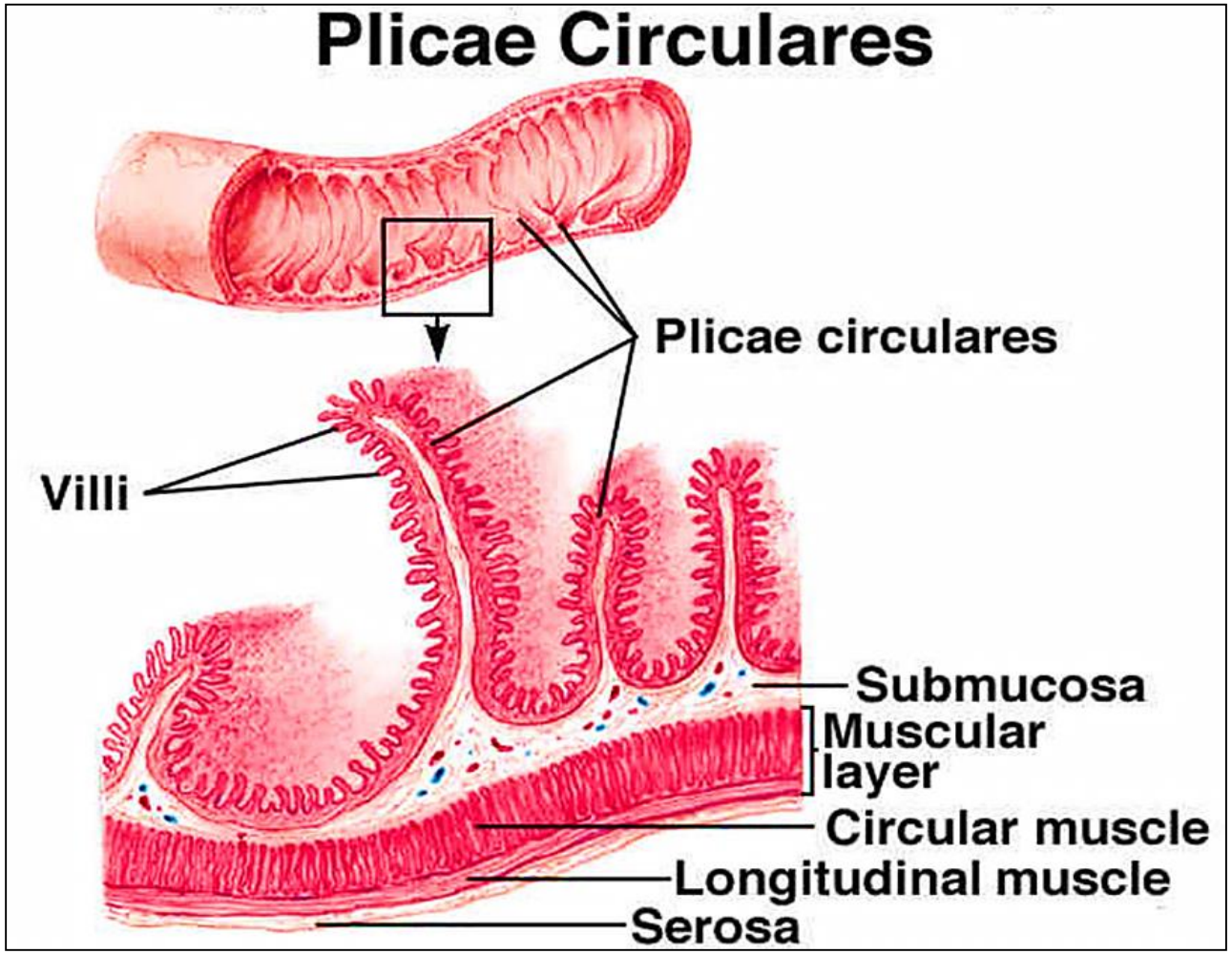
Brunner's glands

- Found in the **submucosa** of the duodenum
- Their ducts open into the bases of intestinal crypts
- They secrete alkaline mucous



Brunner's glands

Plicae circularis: circular folds of mucosa & submucosa projecting into the lumen of small intestine



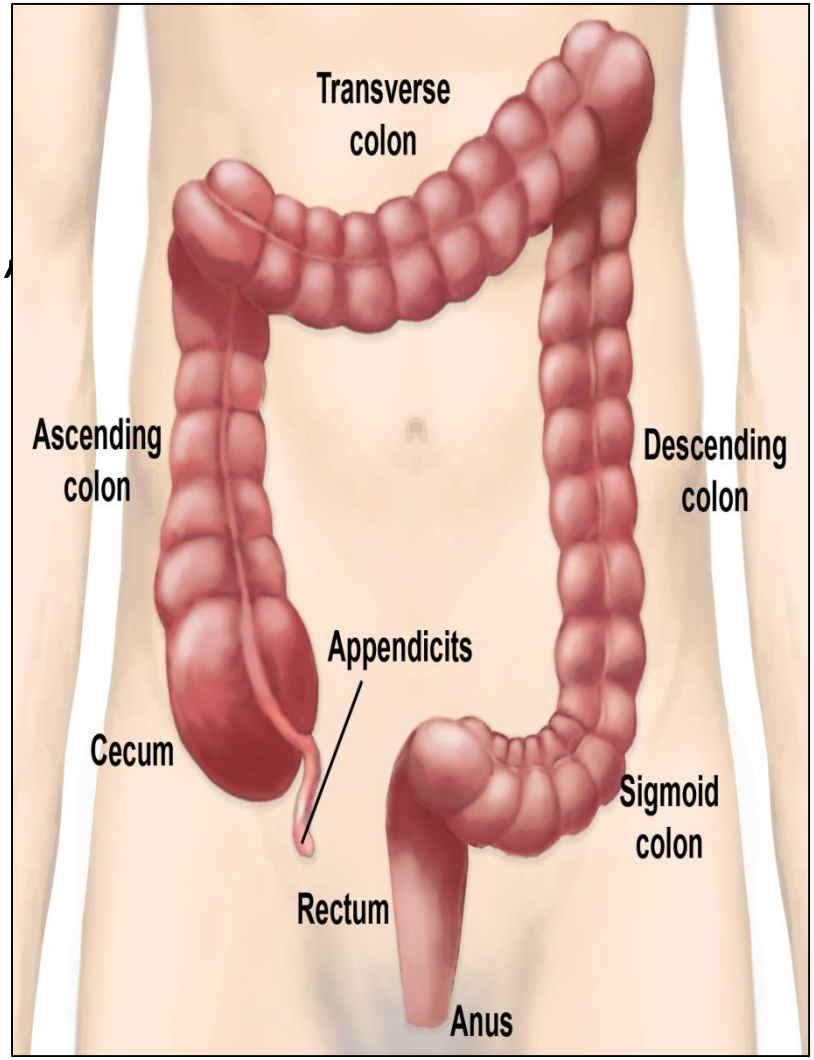
Large intestine

Composed of:

- Cecum
- Colon (ascending, transverse, descending, sigmoid)
- Rectum
- Anal canal

Function:

- Absorption of water & ions
- Production of mucus
- Formation of fecal mass



The large intestine

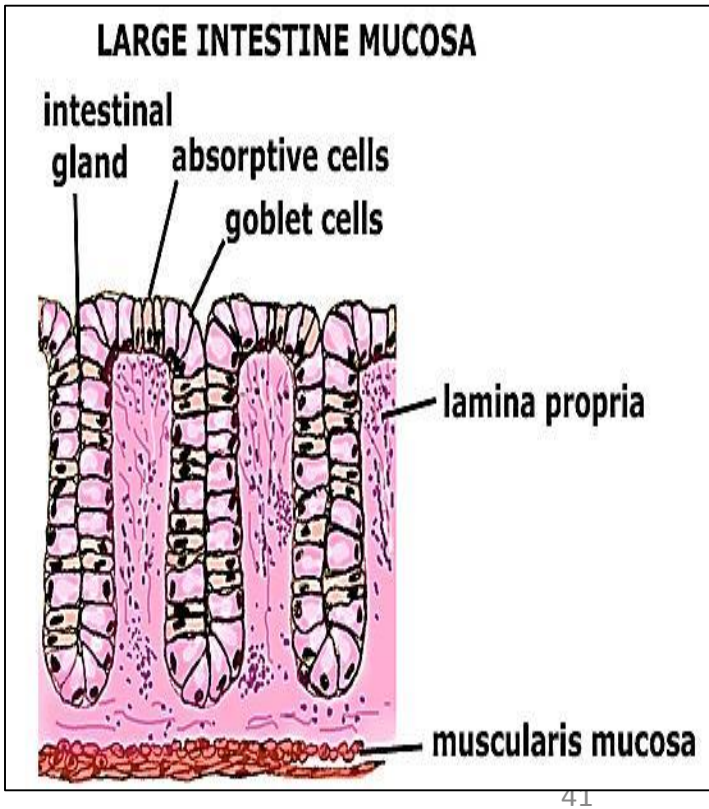
1- the mucosa: are thicker, contains only crypts (deep & wide)

No villi

a) The epithelium: layer of Enterocytes & many goblet cells lining of the crypts

b) The lamina propria : contains the crypts, lymphoid cells & follicles

c) the muscularis mucosa: well developed



cells lining The crypts of large intestine

1- Simple columnar cells e brush border for absorption of water

2- Goblet cells: very numerous to secrete mucus

3- endocrine cells

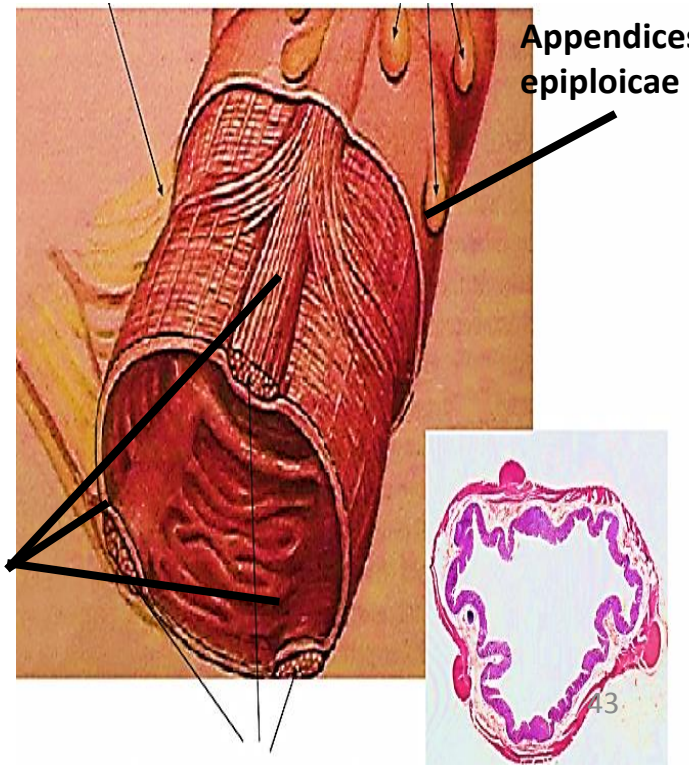
4- stem cells: at the base of the crypts

Taenia coli

- **The musculosa** of the large intestine 2 layers (IC & OL).
- **IC** is continuous but the **OL** breaks up into 3 longitudinal bands to forms the taenia coli
- Responsible for haustra (segmentation) of colon. Haustra helps to push contents of colon through under peristalsis

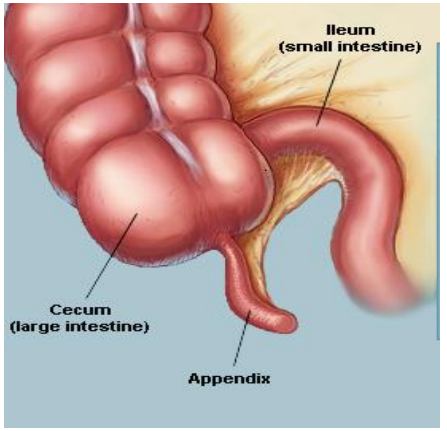
appendices Epiploicae

The serosa: shows small pouches of peritoneum contains fat



The appendix

It is a projection from the cecum, 8 cm

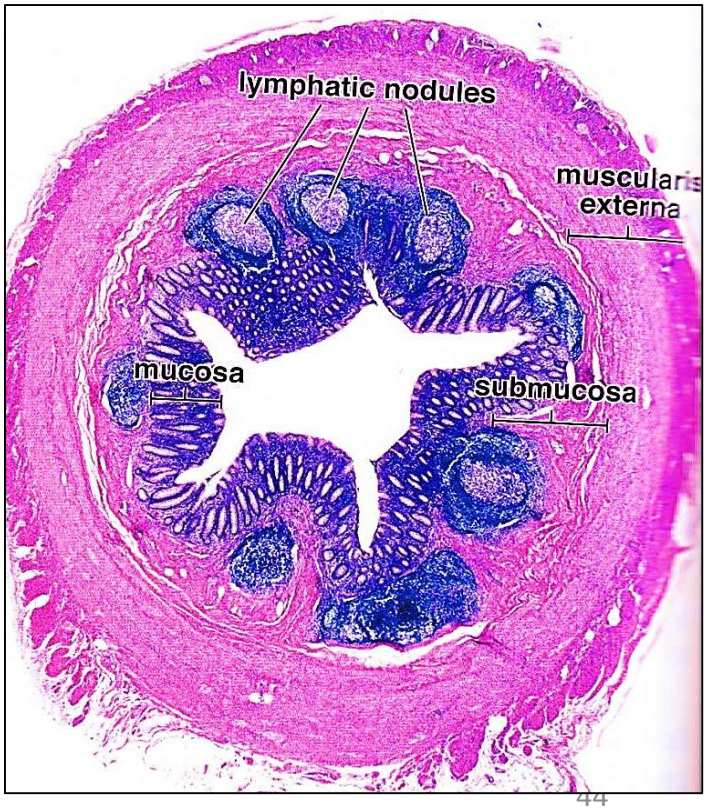


- The mucosa: crypts short & few in number

a) Epithelium: simple columnar + goblet cells enteroendocrine cells

b) The corium & submucosa: rich in **lymphoid follicles**

c) No muscularis mucosa, NO taenia coli No appendices epiploicae



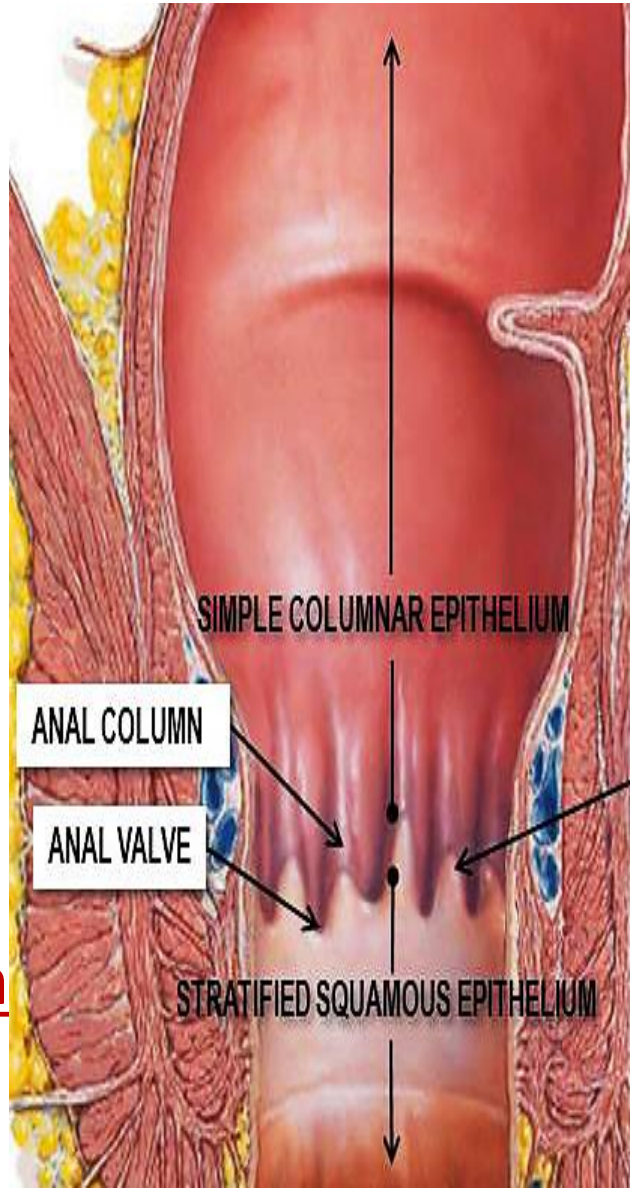
The anal canal

The mucosa of the anal canal shows permanent vertical folds called **columns of Morgagni**

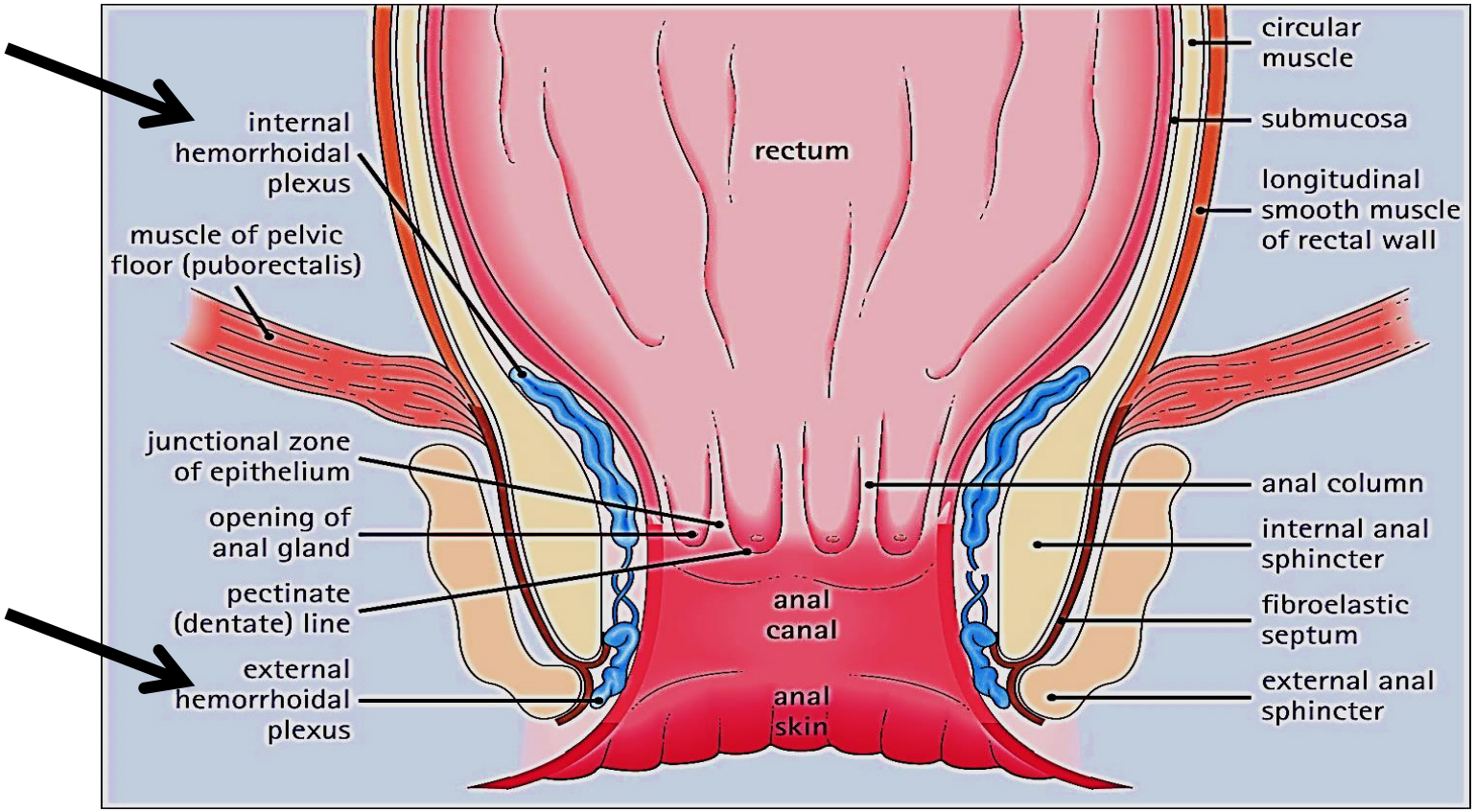
The ends of Morgagni columns form **anal valves** which are separated by **anal sinuses**

The columns mark the rectoanal junction

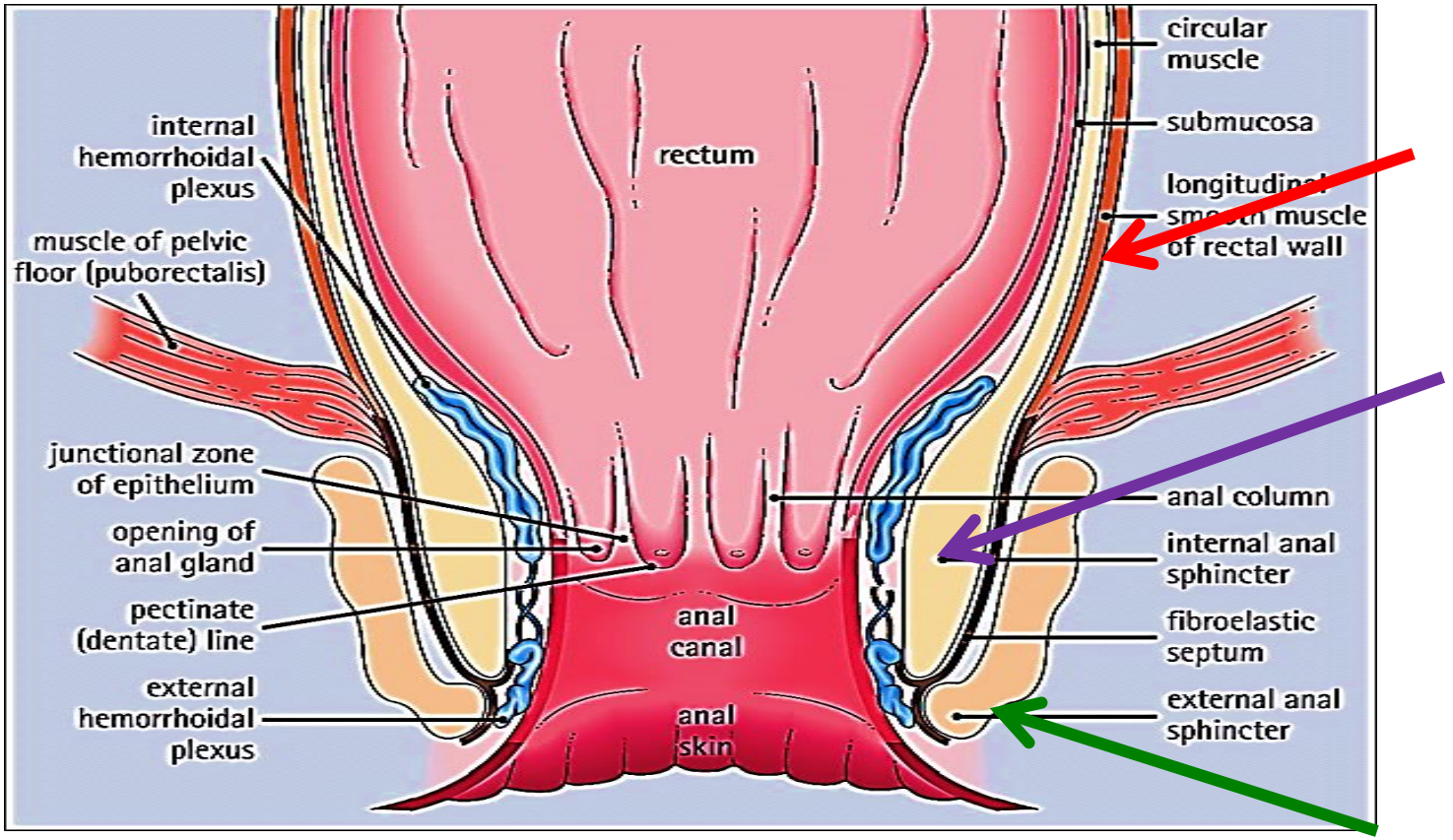
The epithelium is stratified columnar on columns of morgagni



- C.T. under the level of the valves is rich e convoluted veins → the internal piles (plexus of veins)
- At the anus another group of veins under the skin forms the external piles



- The inner circular becomes thick to form internal anal sphincter
- The outer longitudinal layer of rectum pass unchanged the between internal & external sphincters of the anal canal
- The skeletal ms of pelvic floor form the external sphincter



Thank you