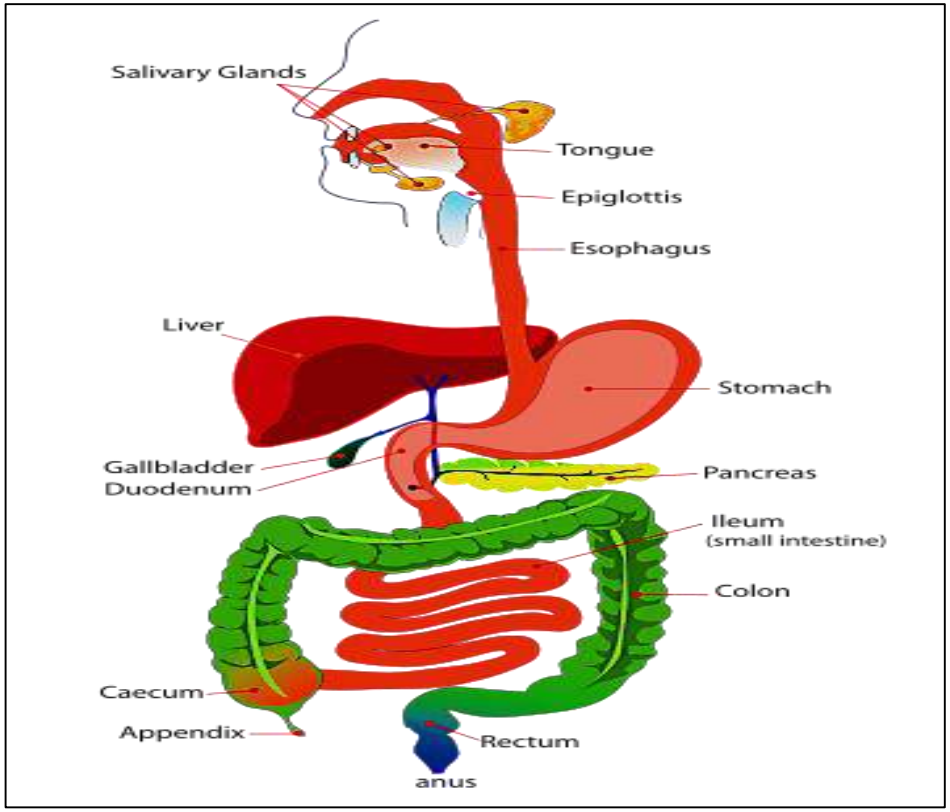
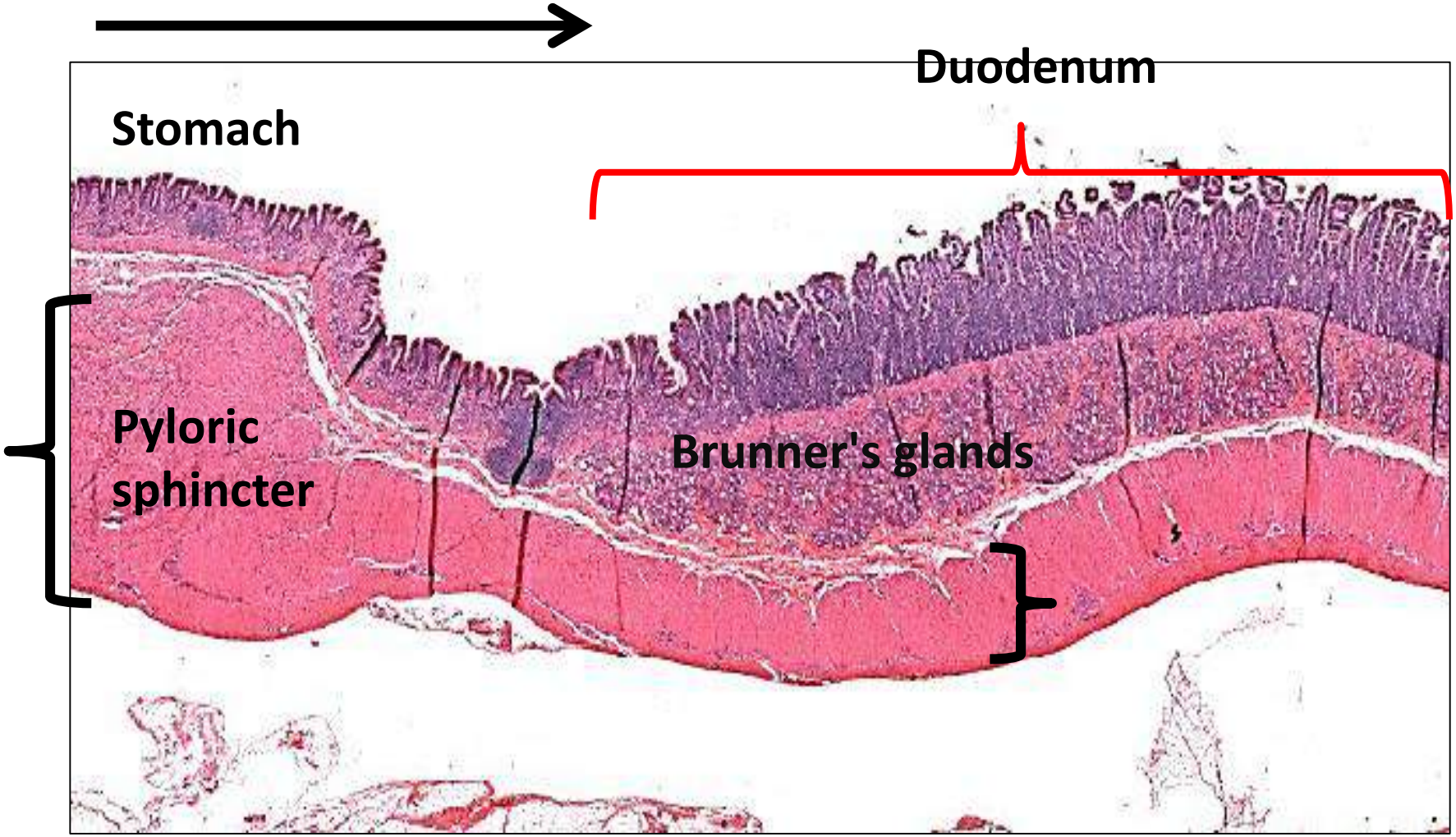
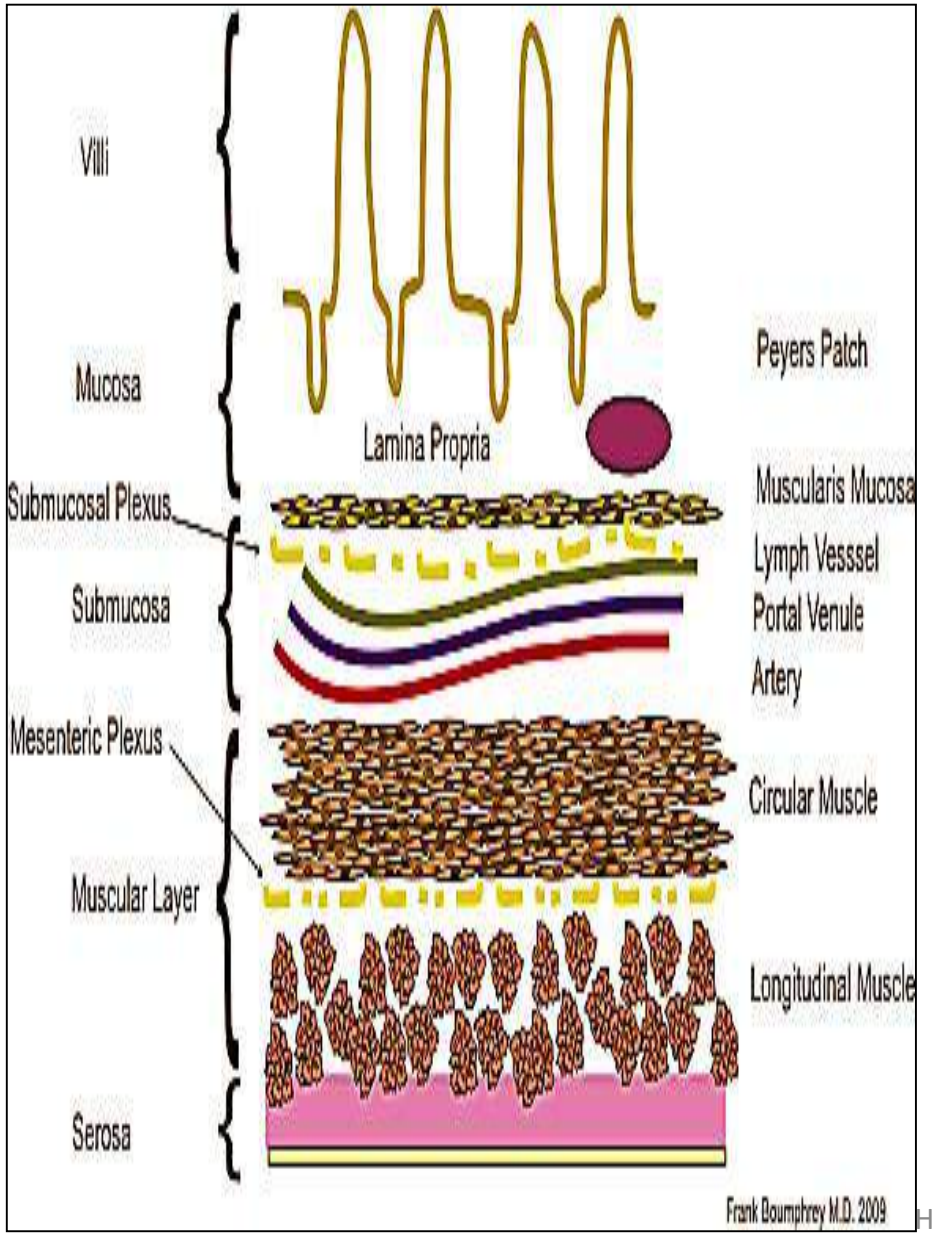
The Digestive system III



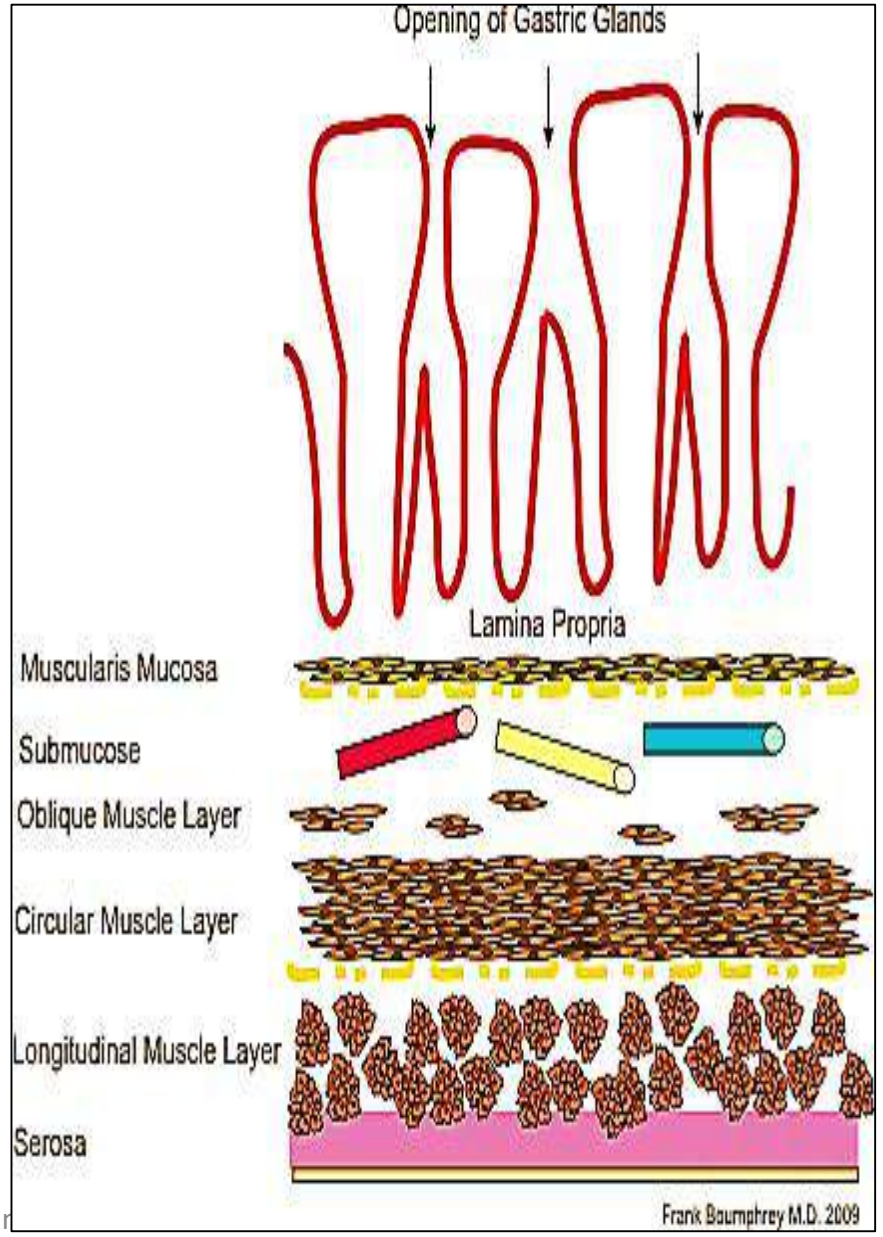


Gastro duodenal junction

Wall of intestine



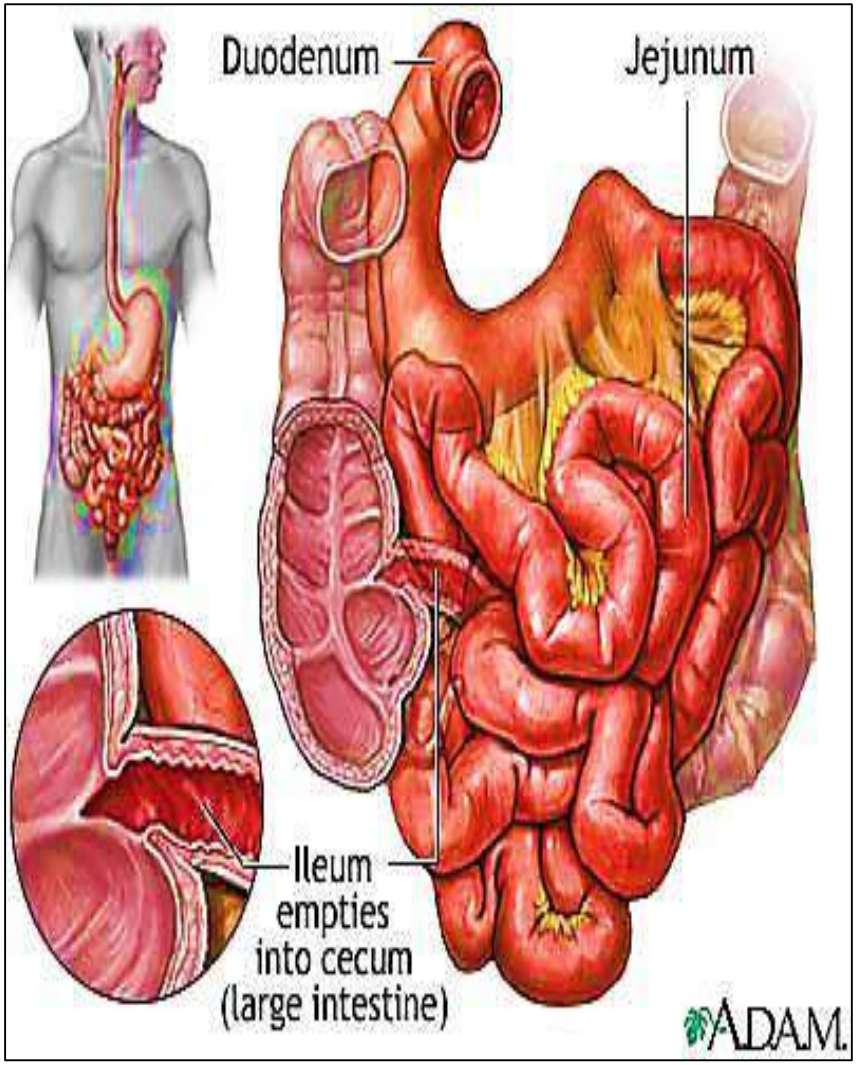
Wall of stomach



Small intestine

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

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



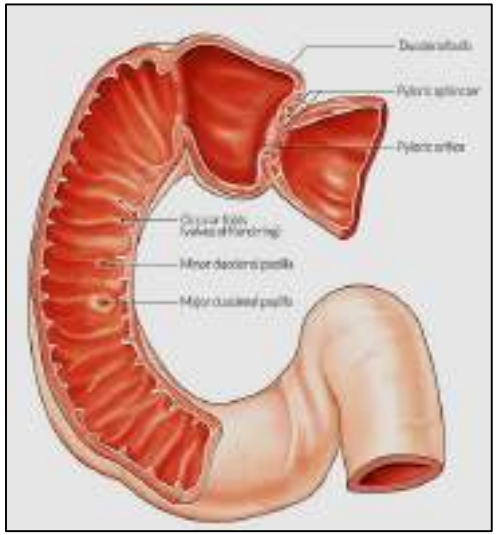
Adaption of Small intestine to its function

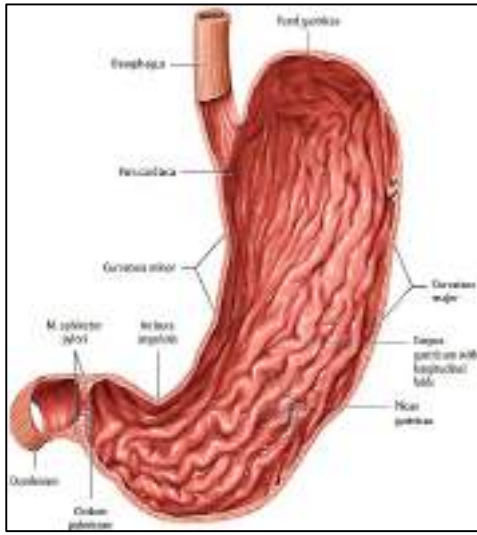
- The small intestine is the longest segment (7.5m) of the GIT which provide long contact between food & digestive enzymes

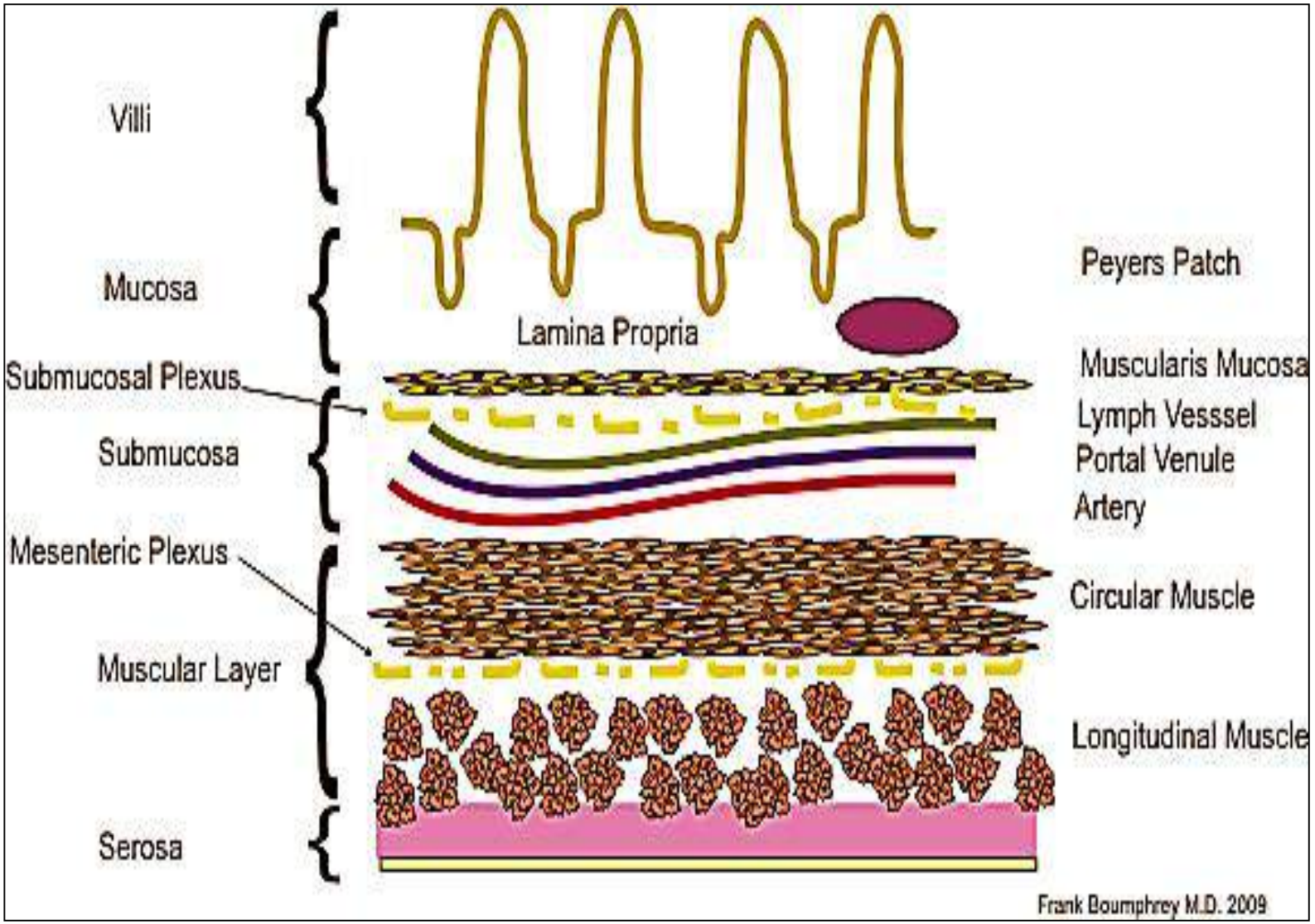
- The presence of Plicae circulares (valves of Kerckirng) which is more prominent in the **lower part of duodenum jejunum** because maximum absorption occurs there

- The presence of villi

- The presence of microvilli







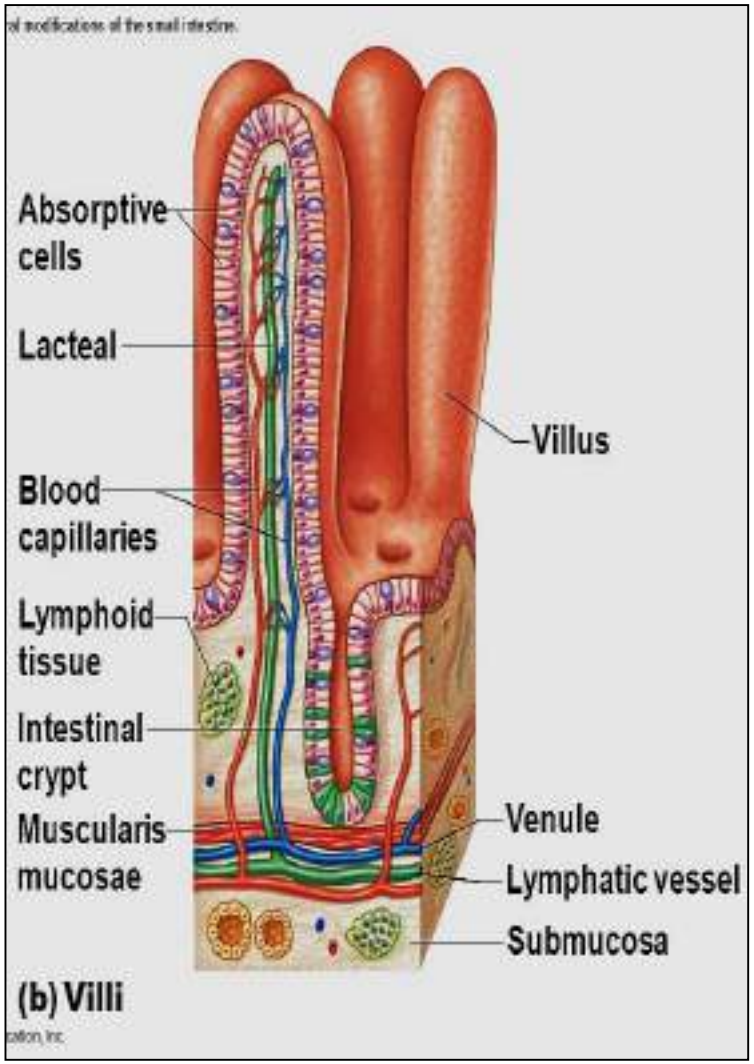
General structure of the small intestine

I- The mucosa

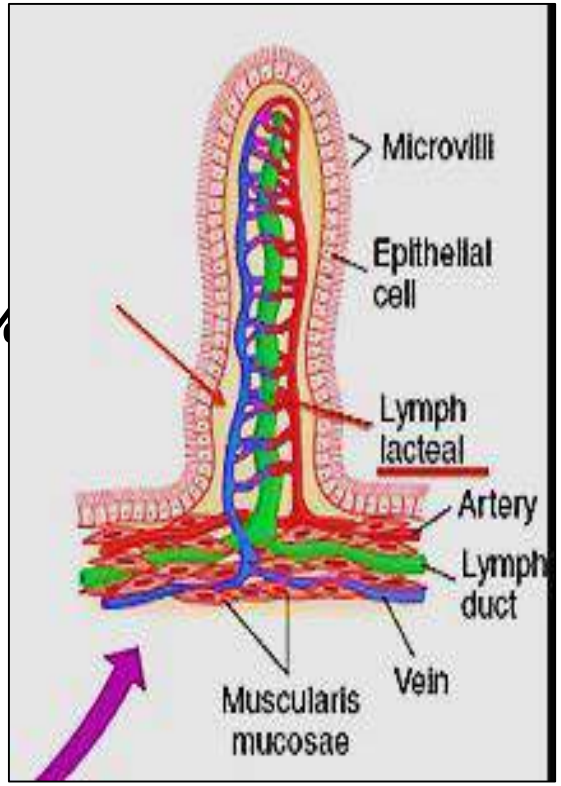
Contains : villi & crypts,

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

The crypts of Lieberkühn (intestinal glands) : simple tubular glands in the C.T. of lamina propria between the bases of the villi



The intestinal villi



- Each villus is formed of:

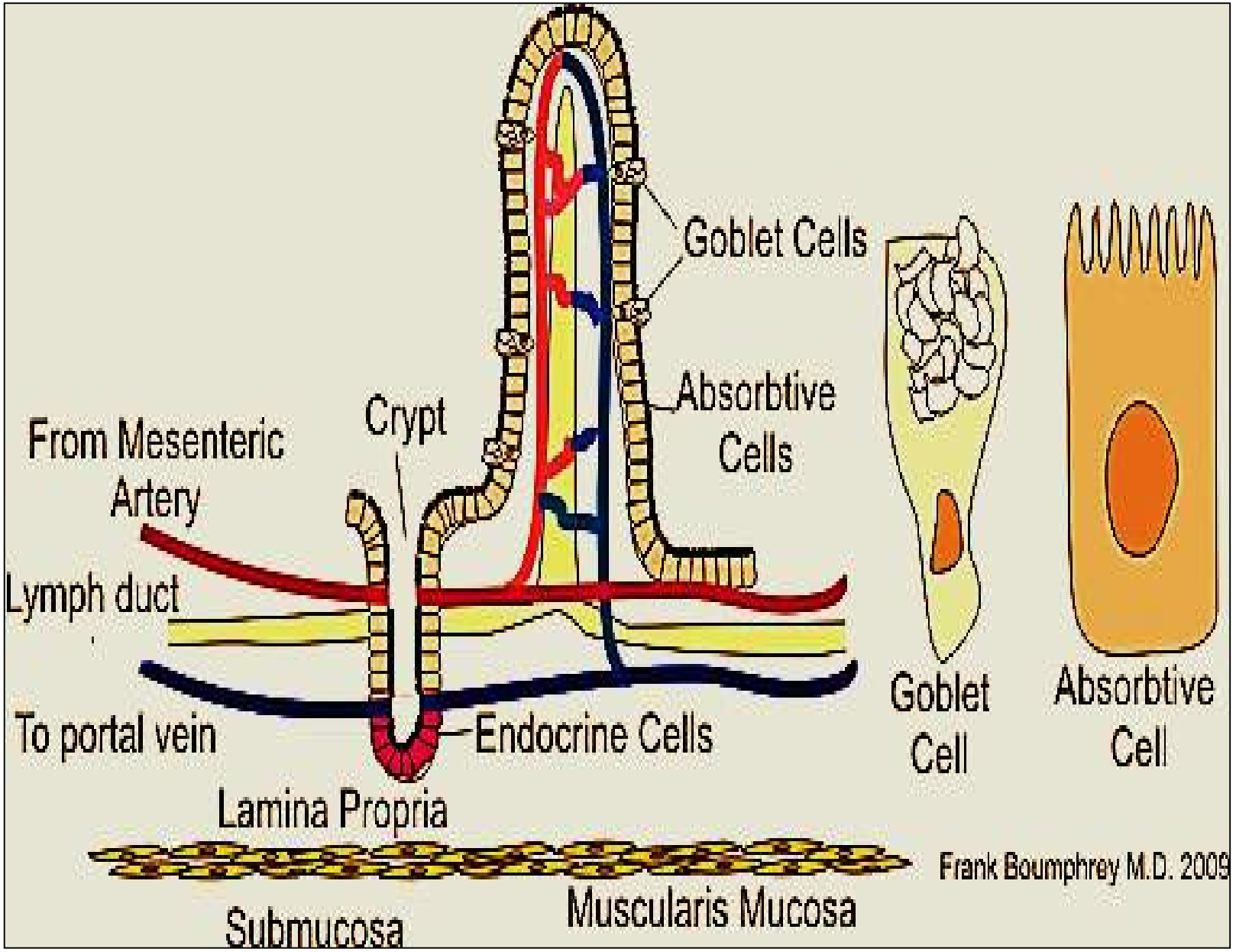
a) Epithelium: showing only 3 types of cells :
Enterocytes(columnar absorbing cells) (90%
goblet cells (9.5%), endocrine cells (0.5%)

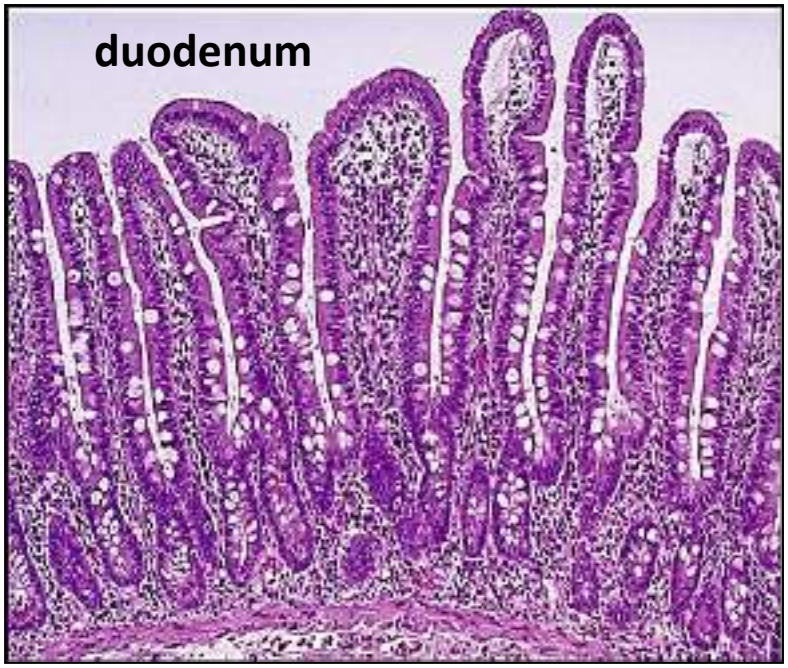
b) Central CT core (lamina propria) contains:

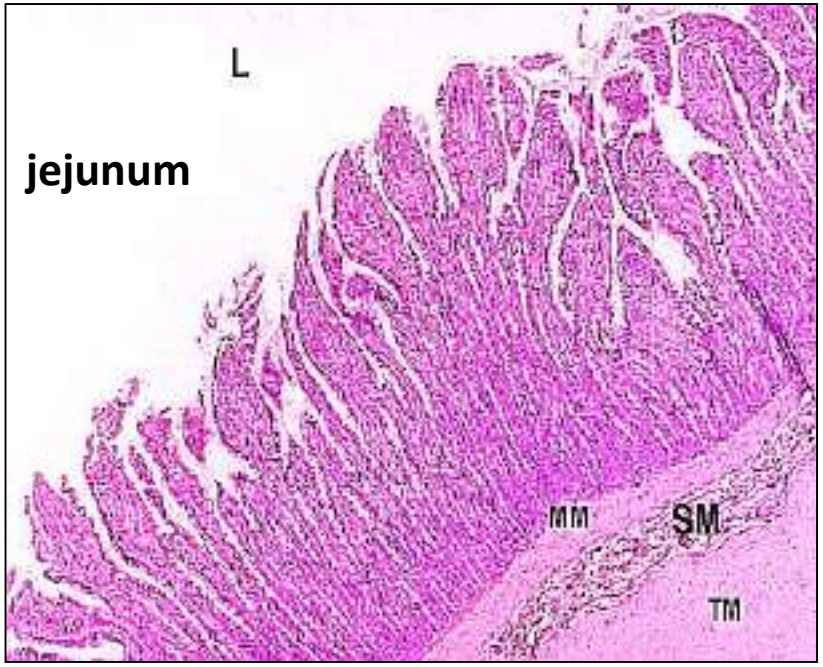
1- Network of fenestrated capillaries

2- Central blind end lymphatic (lacteal) needed for the absorption of fat . The fat is absorbed in the form of chylomicron (large molecules)to end in the thoracic duct

3- smooth muscle fibers . Its contraction aid in the flow of lymph in the lymphatic capillaries. Since lymphatic capillaries wall is devoid of smooth muscle fibers

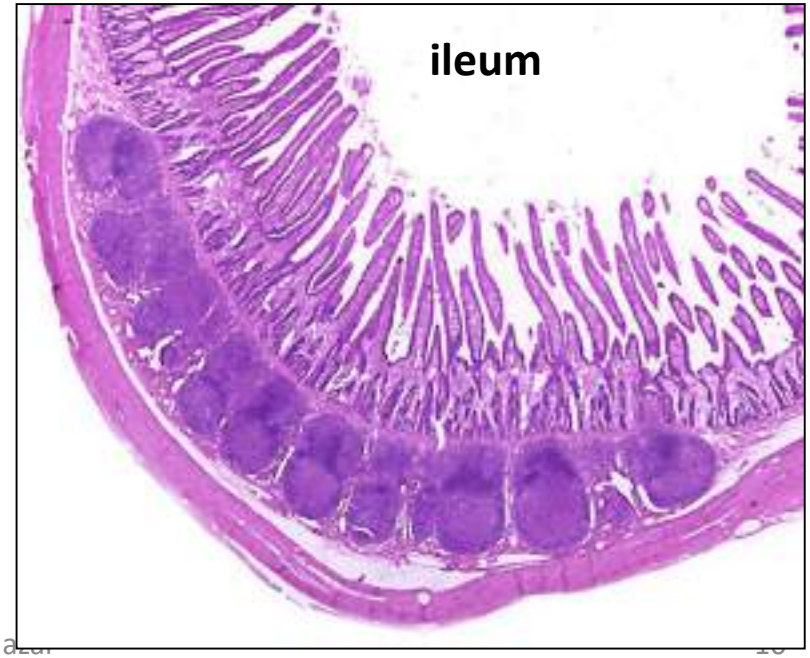

Goblet Cells
Absorbtive Cells
Crypt
From Mesenteric Artery
Lymph duct
To portal vein
Endocrine Cells
Lamina Propria
Submucosa
Muscularis Mucosa
Goblet Cell
Absorbtive Cell
Frank Boumphrey M.D. 2009





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

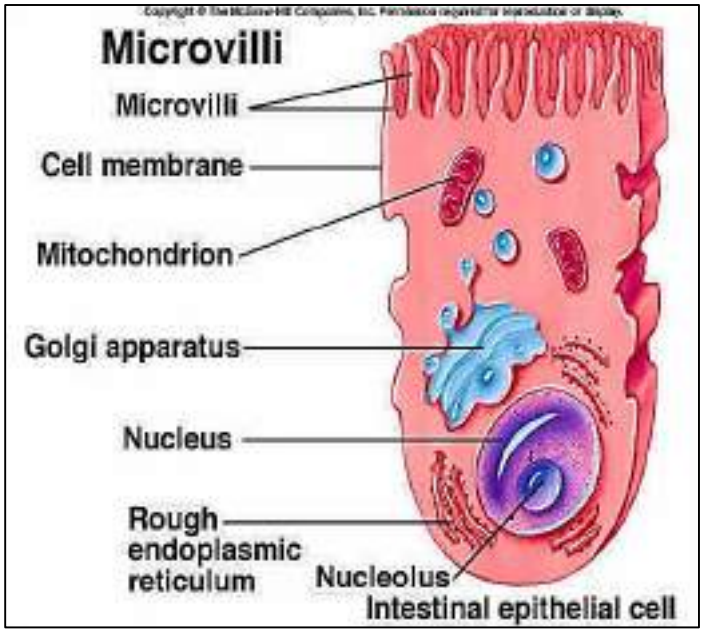
- Duodenum: broad, leaf- like
- Jejunum : long & slender (↑absorption)
- Ileum: short, absent over Peyer's patches (↓ absorption)



Type of cells on villi

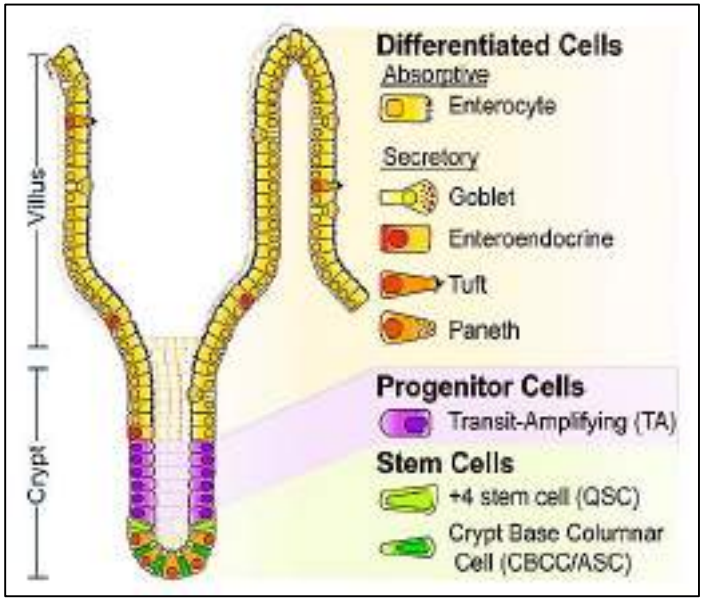
1- Enterocytes:

- **Absorptive cells**

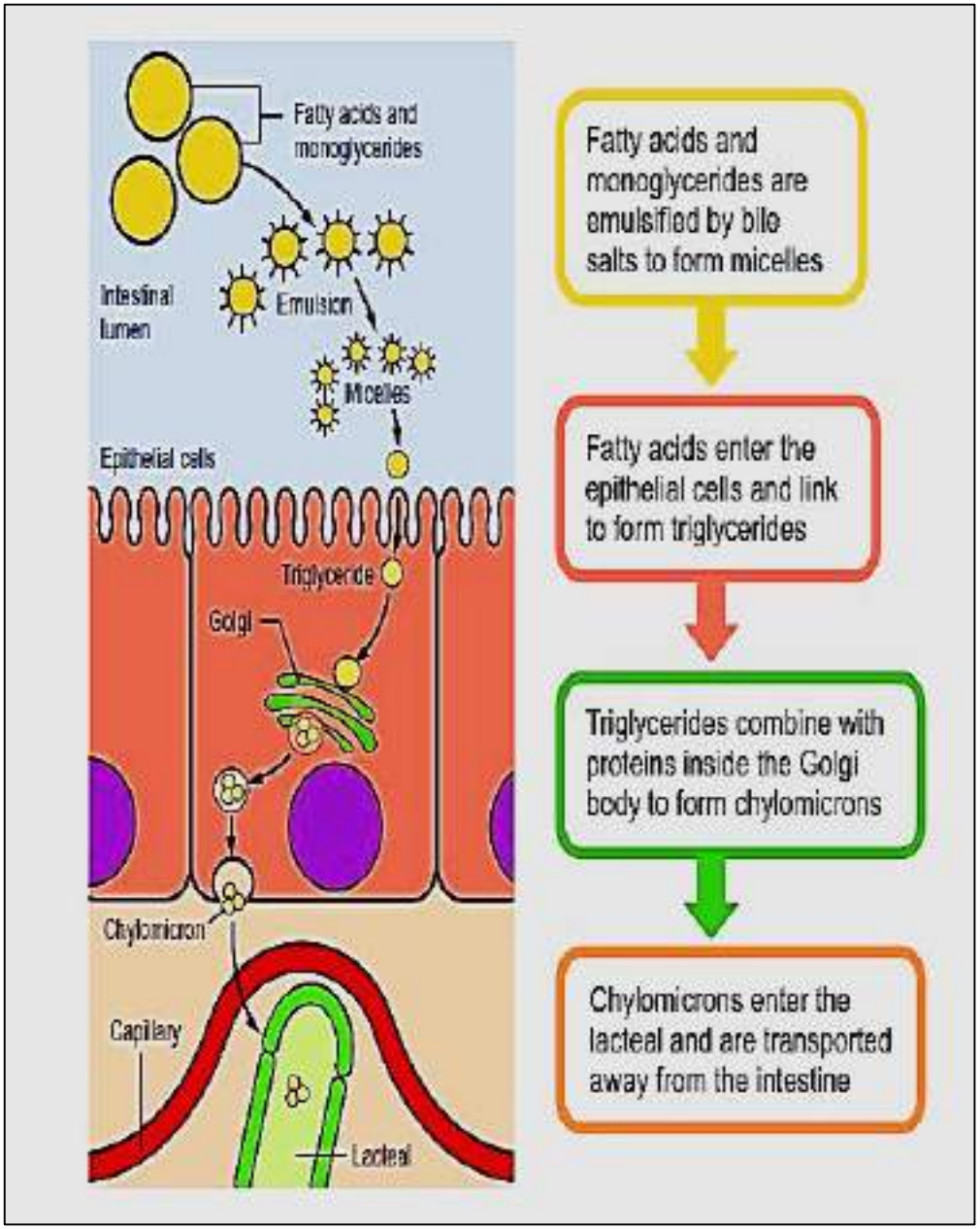


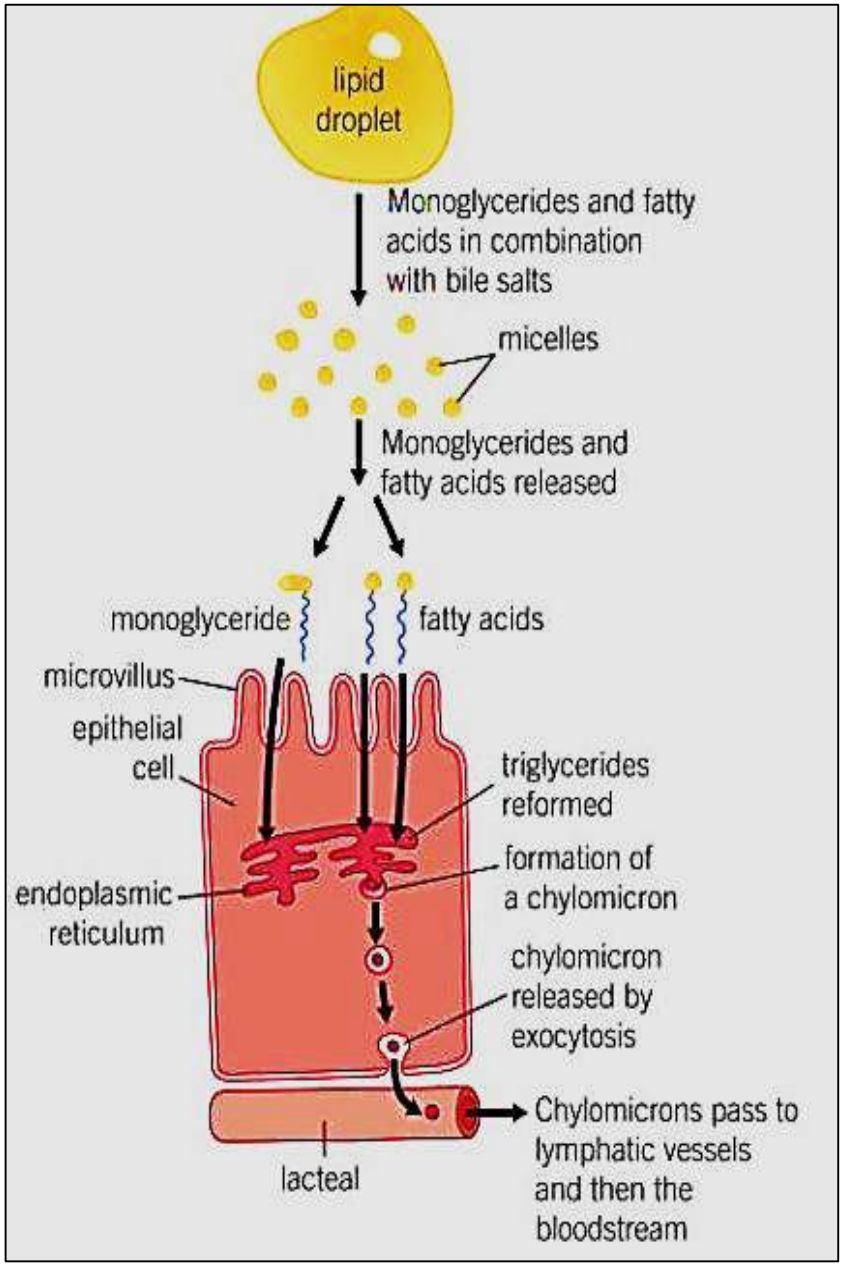
- **Tall columnar cells e basal oval nuclei & brush border of microvilli to increase The absorptive surface area (10 folds) covered with cell coat**

- **E/M: ↑sER (form chylomicron), Golgi, ↑ mitochondria, their lateral borders show tight junctions (Leaky Gut syndrome)**



- **function : Terminal digestion & absorption of carbohydrates , proteins & Fat**





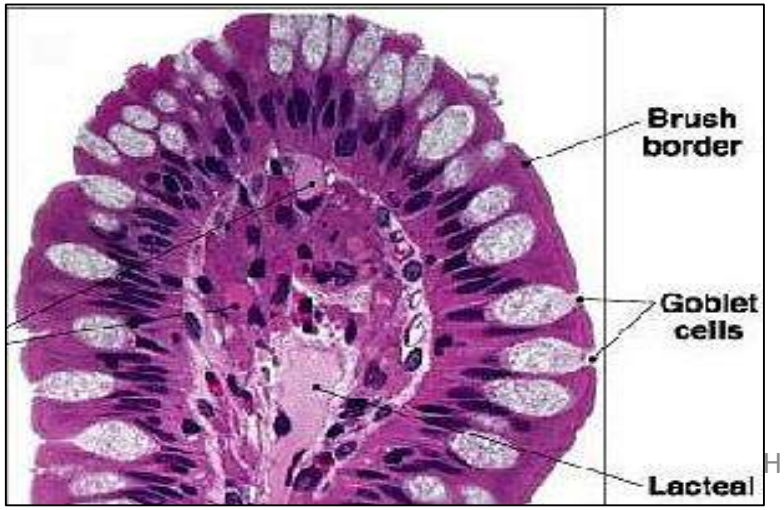
Absorption of fat & formation of chylomicron in enterocytes

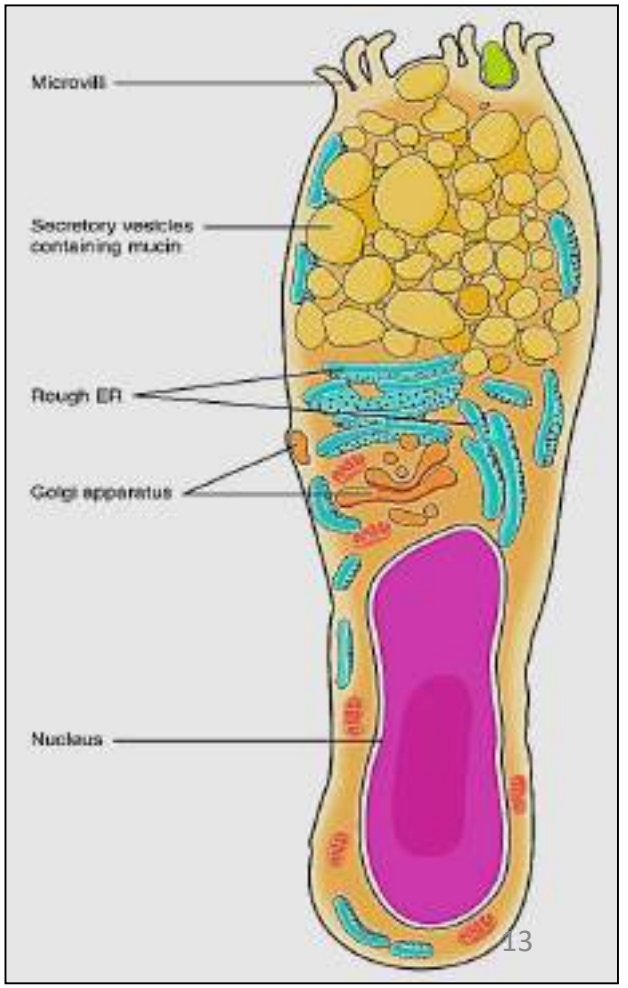
2- Goblet cells:

- Present between the enterocytes on the villi & in the upper part of the crypts and increase in # toward the ileum
- Unicellular mucous (glycoprotein) secreting cell

- 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 mucosa /lamina propria
- 6 types of cells line the crypts:

1- Enterocytes

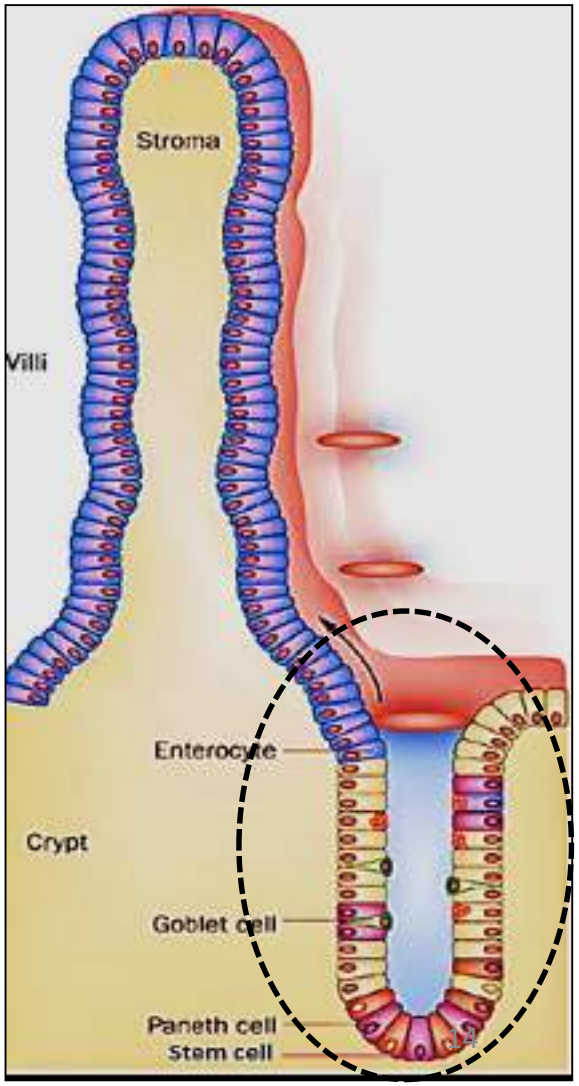
2- Goblet cells

3- **Paneth cells**

4- endocrine cells

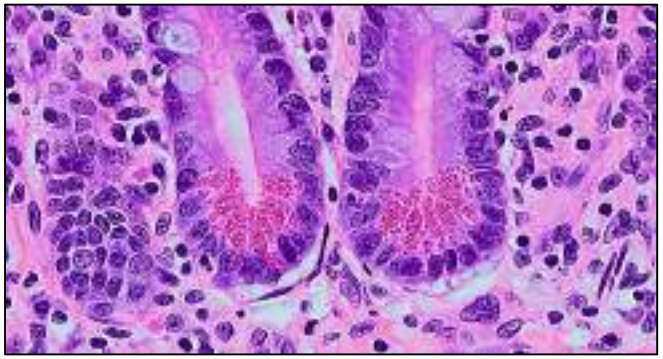
5- stem cells

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



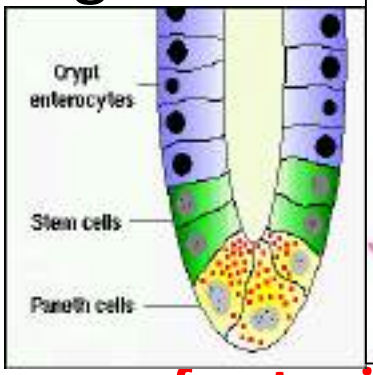
3- Paneth cells:

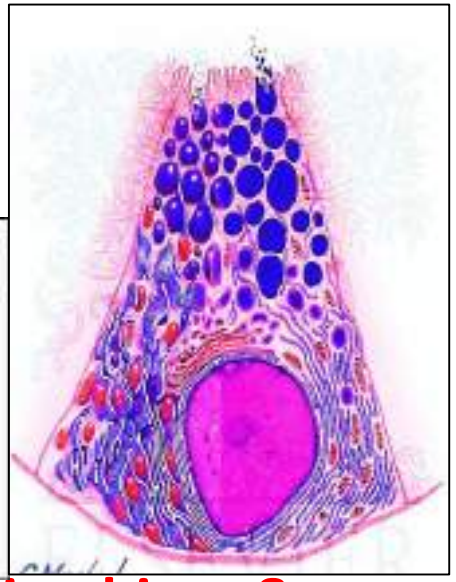
- Present in groups at **bottoms/ base of crypts** only



- Pyramidal cells e basal oval nuclei & narrow apical part

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



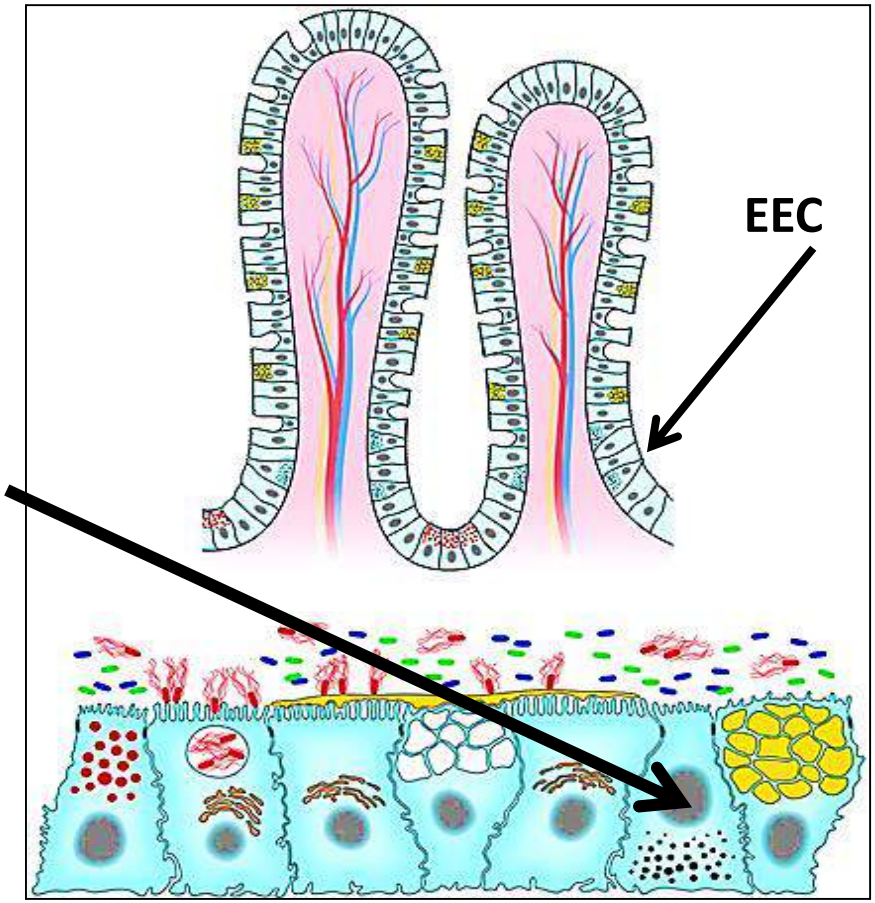


- They secrete **intestinal lysozyme** which has bactericidal effect

Role in innate immune system & balance of gut microbiota & intestinal homeostasis

4- Enteroendocrine cells:

- Secrets intestinal hormones
  e.g Secretin
- Present mainly in base of crypts,
- Their secretions released to blood
- Their secretions control peristalsis
  e.g. motilin H & sense of being satisfied after eating

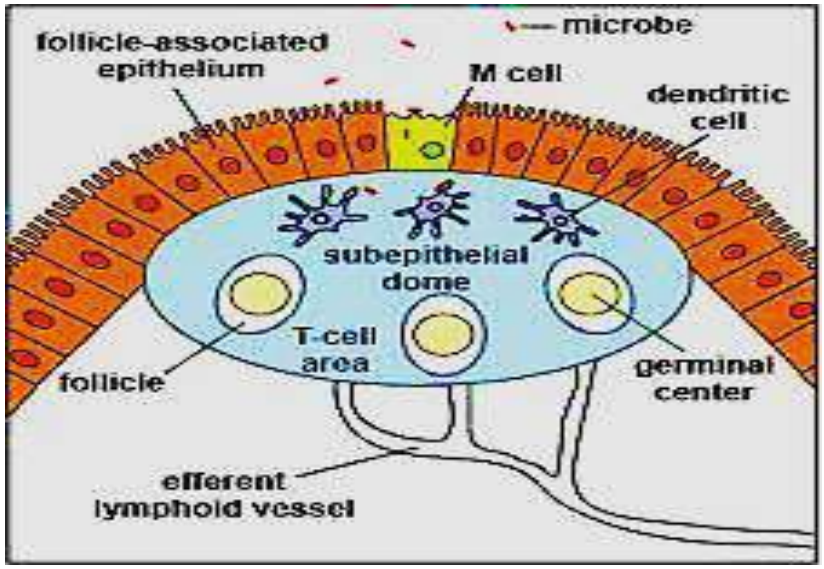


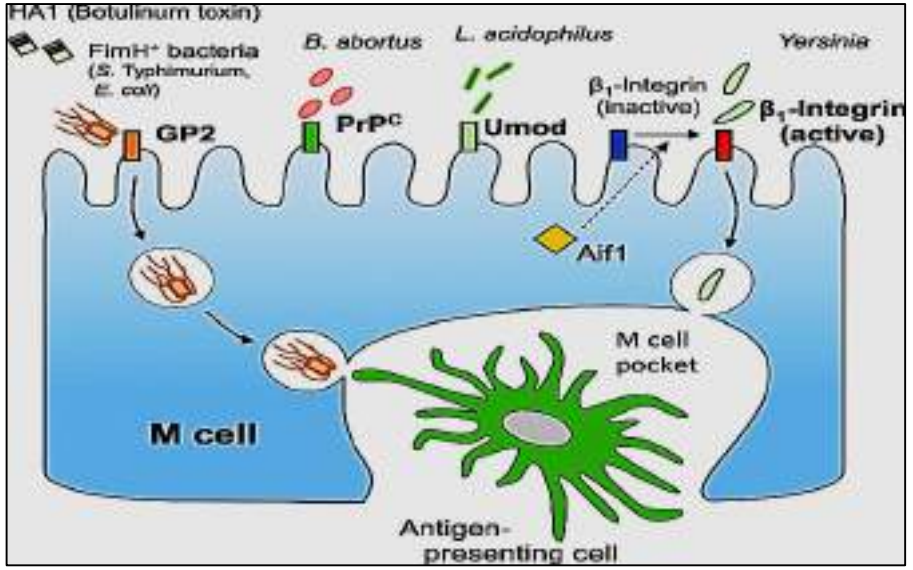
5- Stem cells:

- 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 between enterocytes of ileum in association with **lymphoid nodules of Peyer's patches.** Play a role in intestinal mucosal immunity
- Have microfolds on their apical surface & invaginations forming pockets on the basal surface .
- Phagocytosis & transport antigens from intestinal lumen to the underlying macrophages & lymphocytes





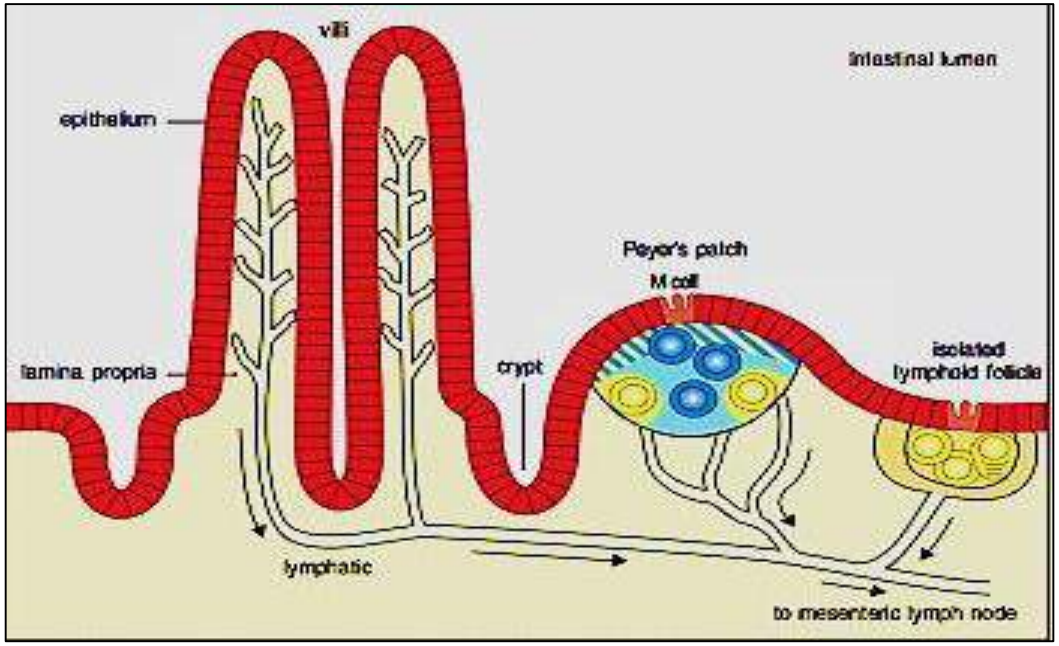
Peyer's patches (ileum)

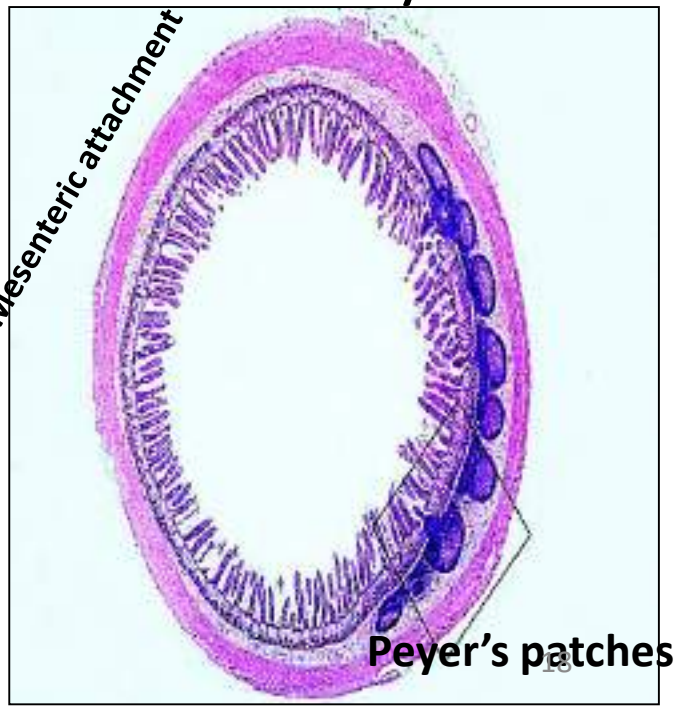
a) present mainly in the ileum. In both lamina propria of mucosa & submucosa

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

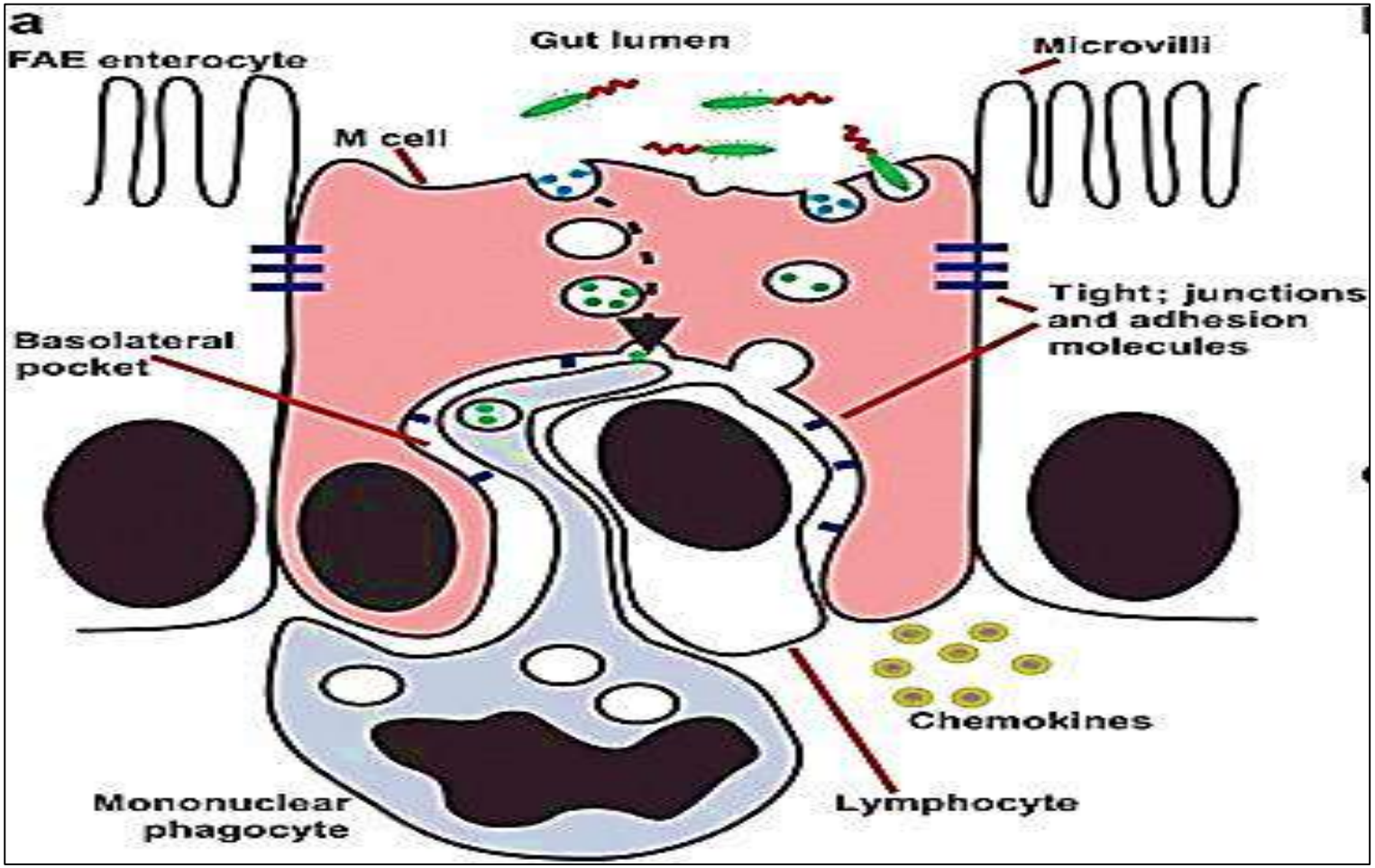
c) the intestinal villi absent over Peyer's patches

d) They are important for intestinal mucosal immunity





M- cells



M cells function as guards against intestinal toxins and/or pathogens, transporting them (trans-epithelial) to immune cells under . M cells specialize in transcytosis (i.e., trans-epithelial transport)

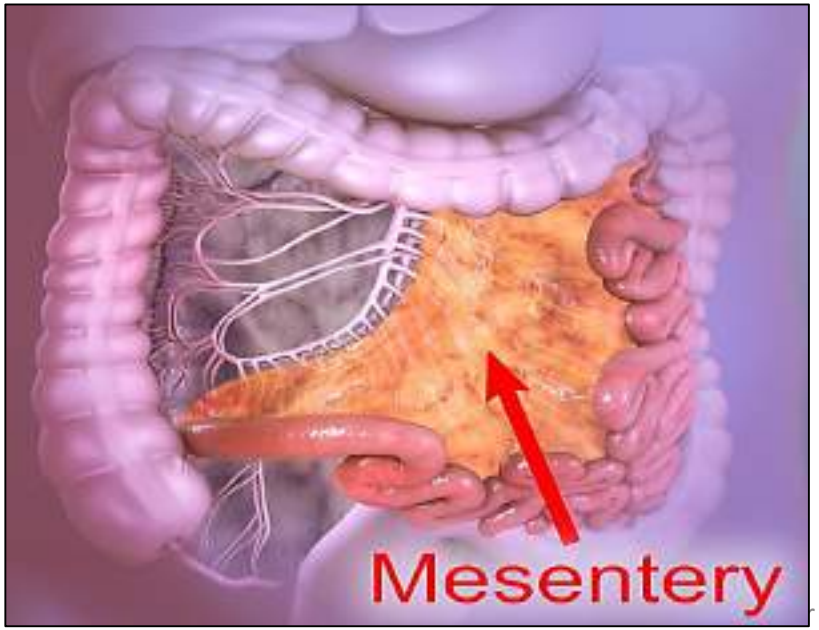
Peyer's patches (ileum)

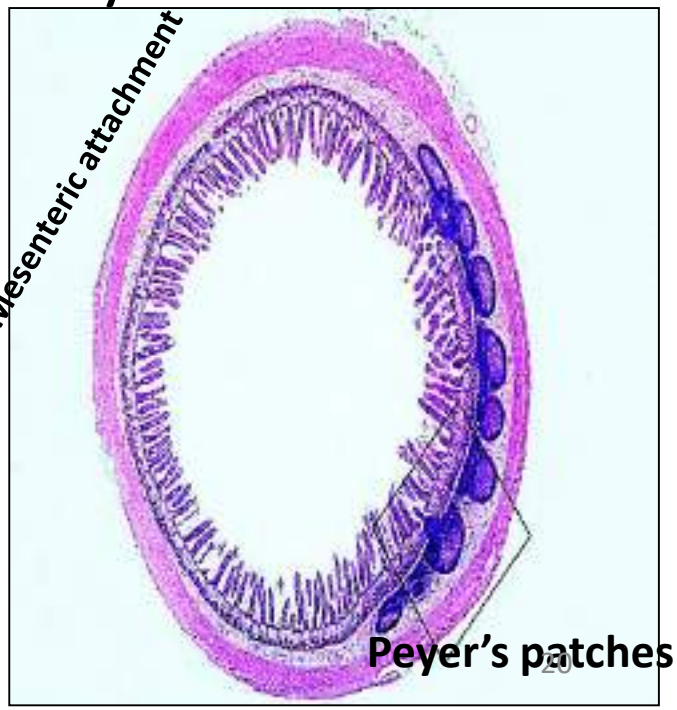
a) present mainly in the ileum. In both lamina propria of mucosa & submucosa (**MALT**)

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

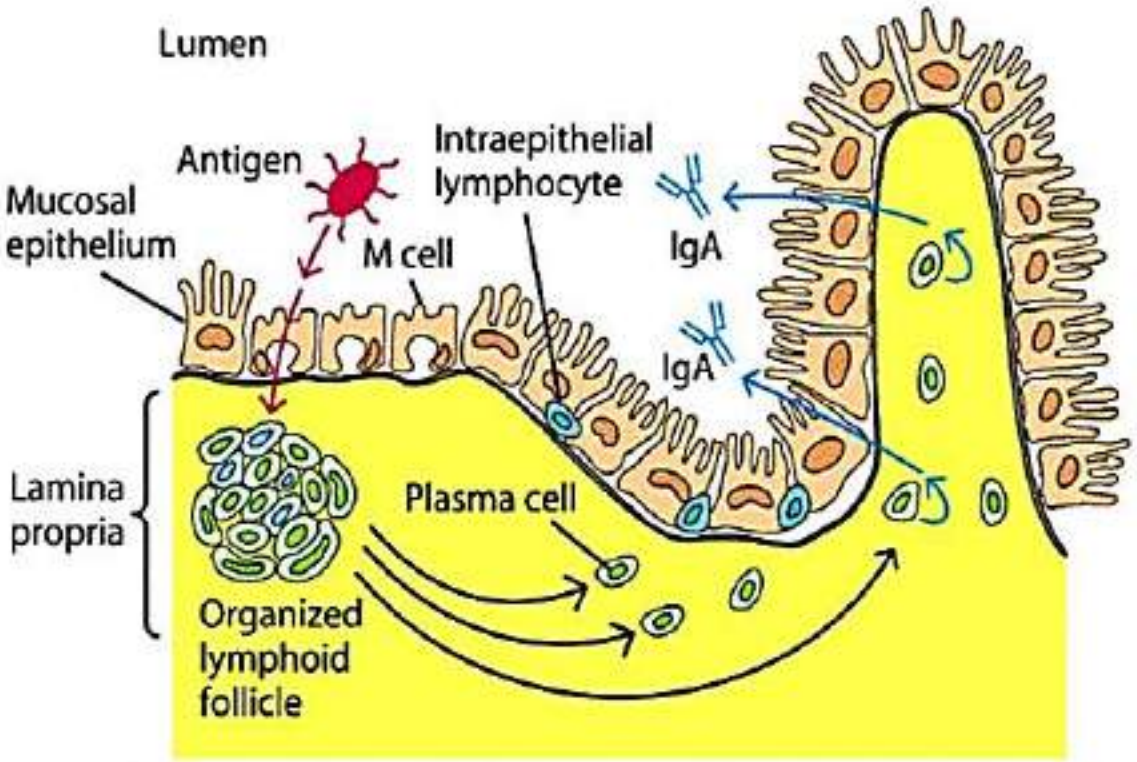
c) the intestinal villi absent over Peyer's patches (why?)

d) They are important for mucosal immunity





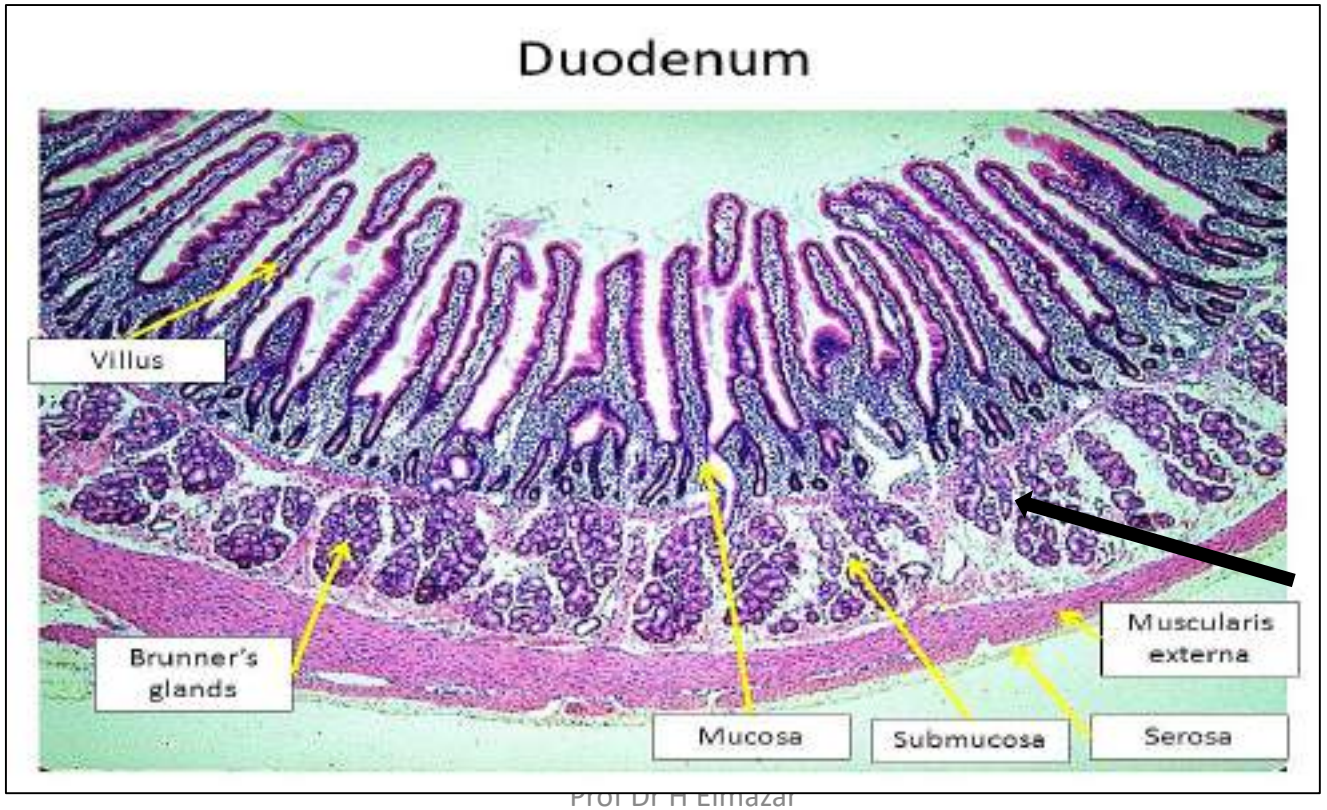
Mucosal Associated Lymphoid Tissue



Antigen transported across the epithelial layer by M cells at an inductive site activates B cells in the underlying lymphoid follicles. The activated B cells differentiate into IgA-producing plasma cells, which migrate along the submucosa. The outer mucosal epithelial layer contains intraepithelial lymphocytes, of which are T cells.

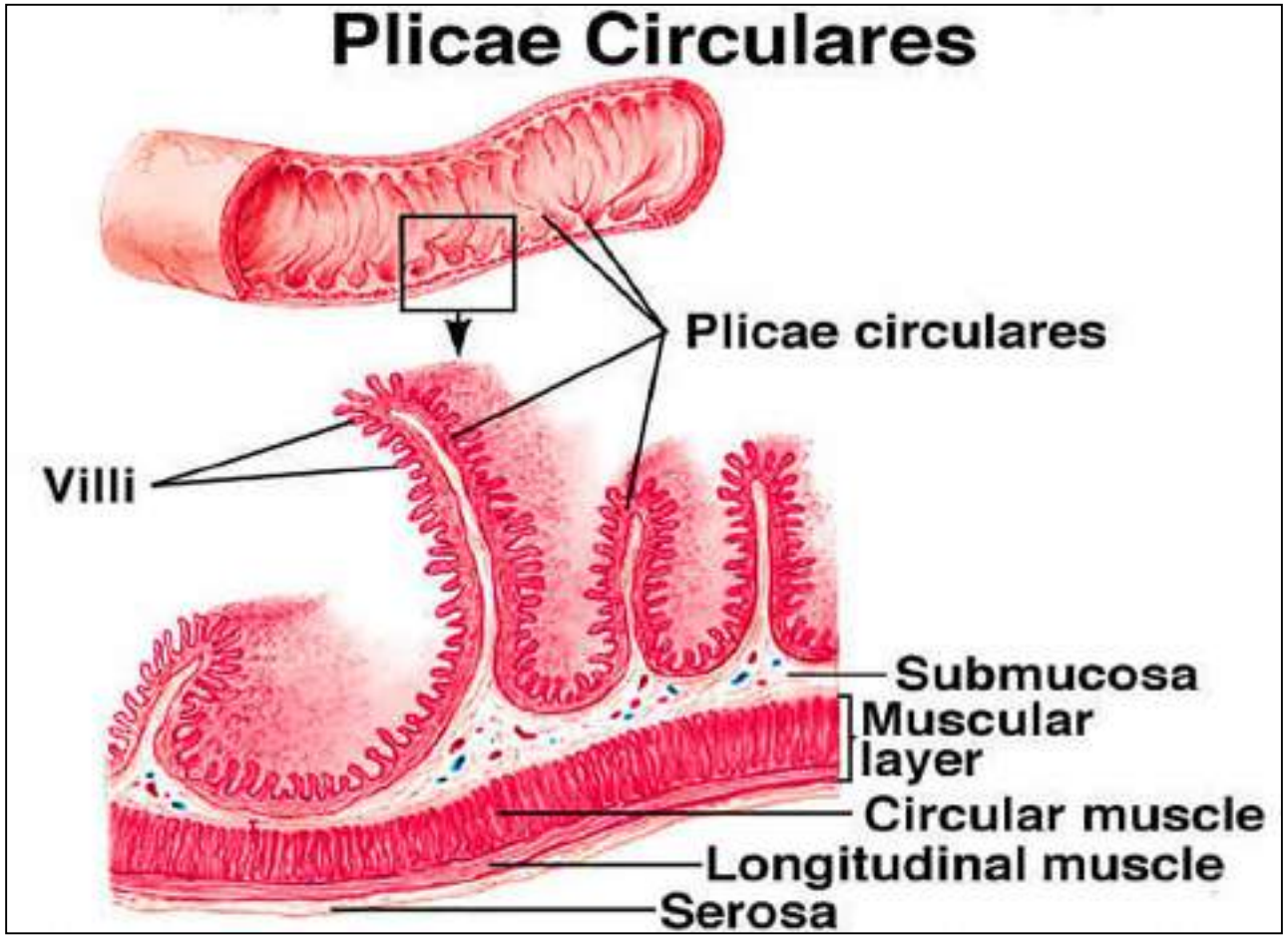
Brunner's glands

- 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



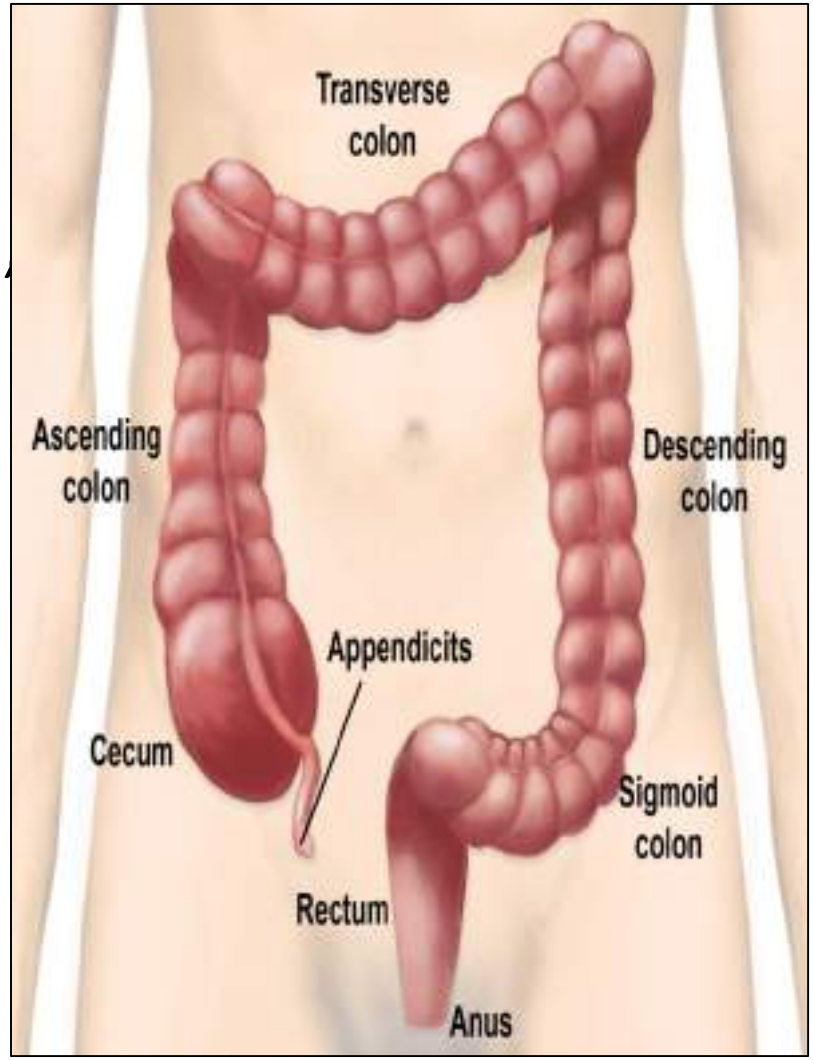
Large intestine

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: thick, smooth contains No villi only crypts (deep & wide)

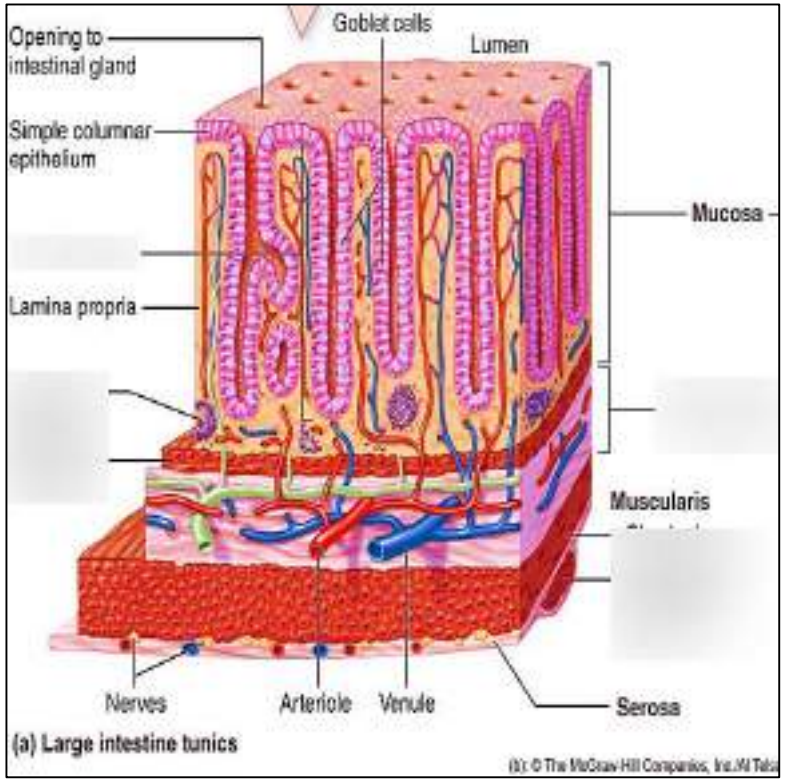
a) The epithelium: Enterocytes, MANY goblet cells, stem cells and endocrine cells

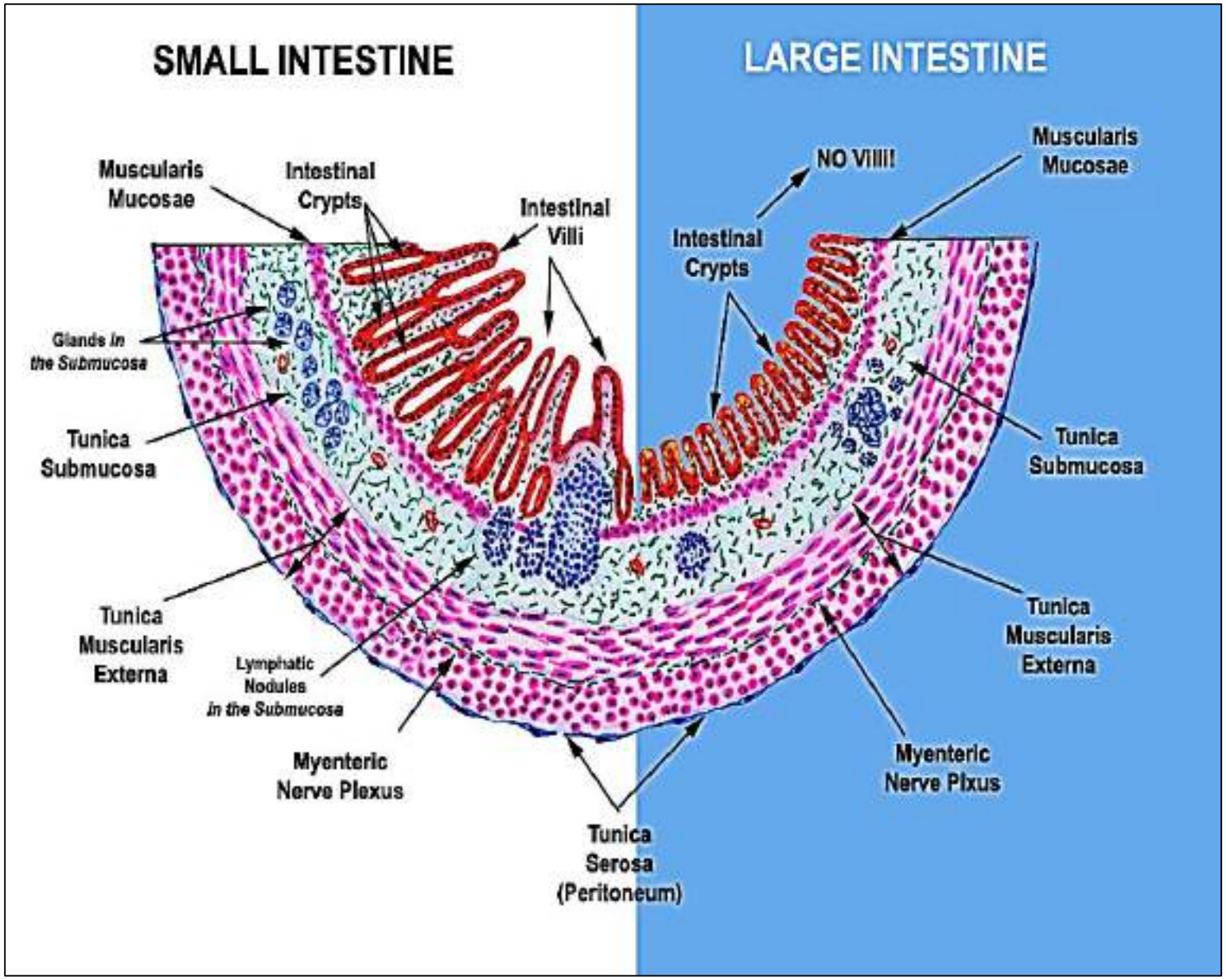
b) The lamina propria :

contains the crypts, lymphoid follicles

c) the muscularis mucosa:

well developed layer




SMALL INTESTINE
LARGE INTESTINE
Muscularis Mucosae
Intestinal Crypts
Intestinal Villi
Glands in the Submucosa
Tunica Submucosa
Tunica Muscularis Externa
Lymphatic Nodules in the Submucosa
Myenteric Nerve Plexus
Tunica Serosa (Peritoneum)
NO VIIII
Intestinal Crypts
Muscularis Mucosae
Tunica Submucosa
Tunica Muscularis Externa
Myenteric Nerve Plxus

cells lining **The crypts of large intestine**

1- Enterocytes: Simple columnar cells
e brush border (short & few in #)
for absorption of water

2- Goblet cells: very numerous to
secrete mucus

3- Endocrine cells: secrets Serotonin

(Although is best known as a neurotransmitter critical for central nervous system (CNS) development and function. **95% of the body's serotonin, however, is produced in the intestine** …
(irritable bowel syndrome)

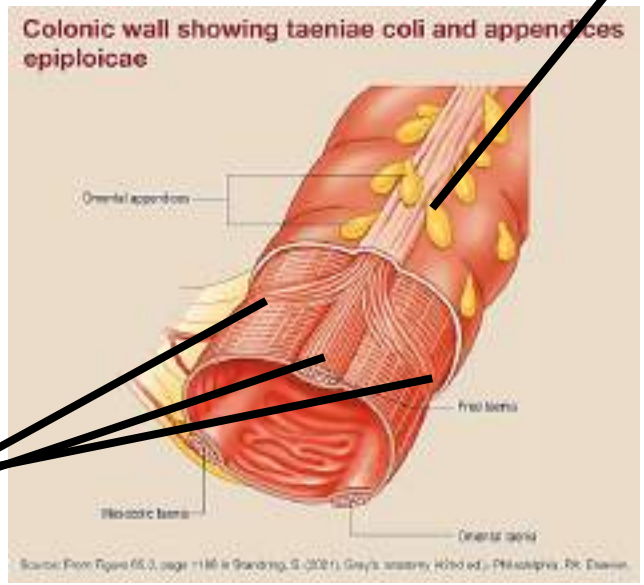
4- stem cells: at the base of the crypts

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

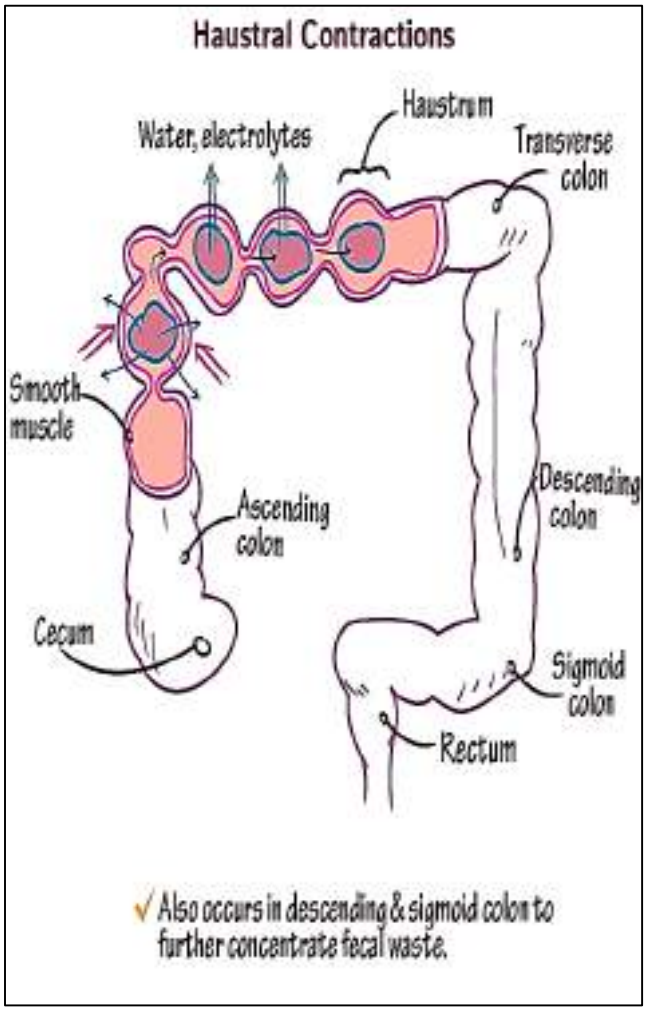
Appendices Epiploicae

The serosa: shows small pouches filled with fat & covered e pertonium



Importance of taenia coli

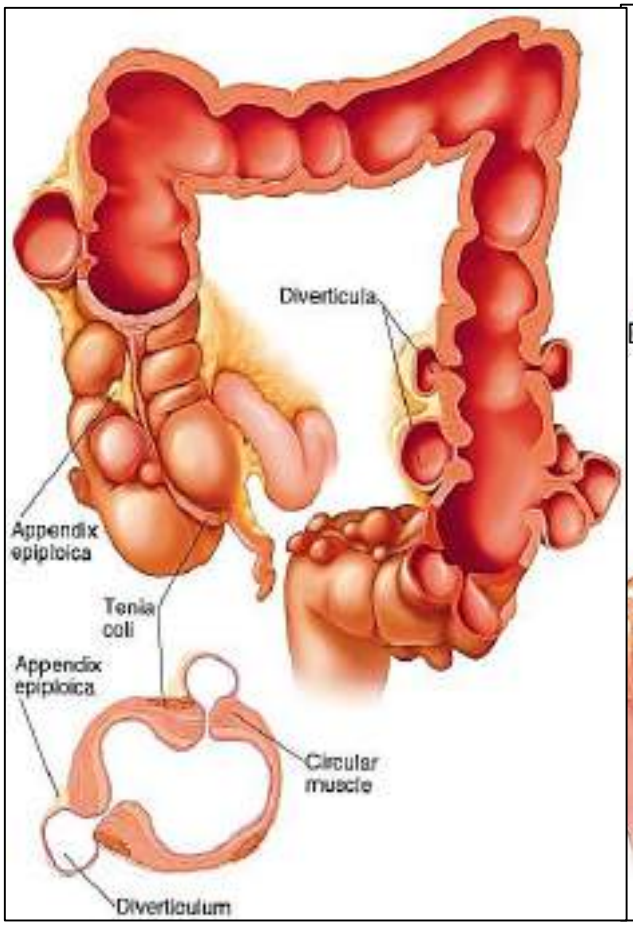
There are 2 types of ms. contractions in the large intestine Haustral & peristaltic contractions

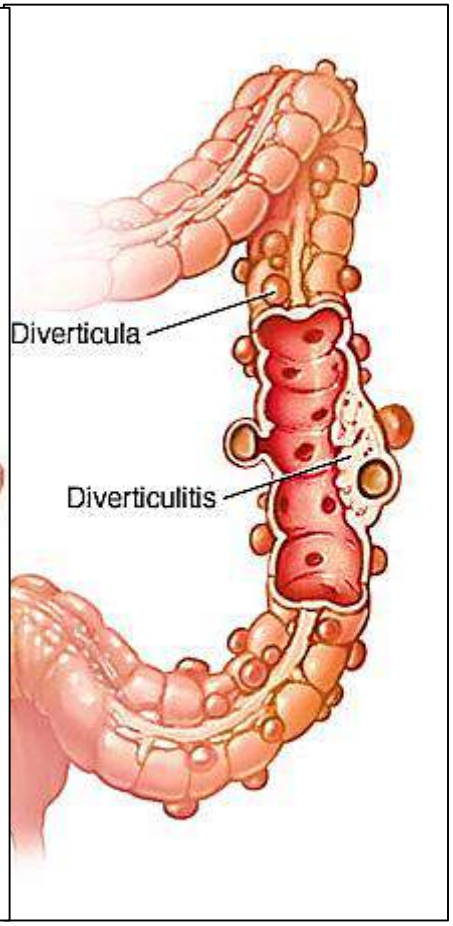


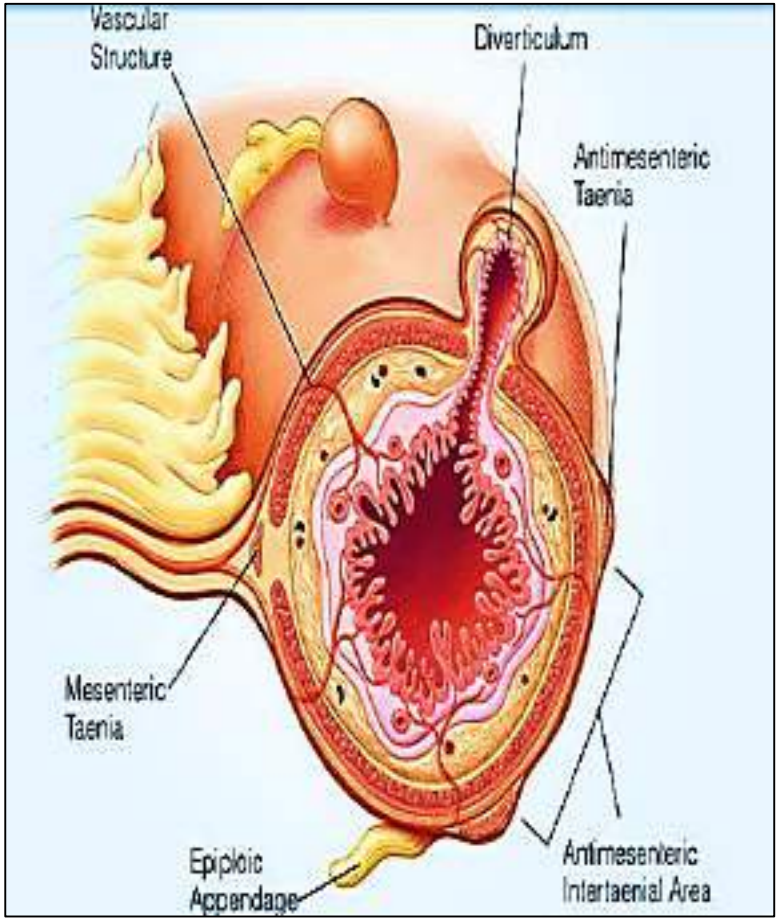
Haustral movement : localized slow movement. The distension of one Haustrum initiate contraction T Coli which pushes the waste product to the next Haustrum → slow to allow time for water absorption

Peristaltic movement involve both IC & OL ms → distal mass movement of colonic content from part to another (once/day)

Diverticulosis



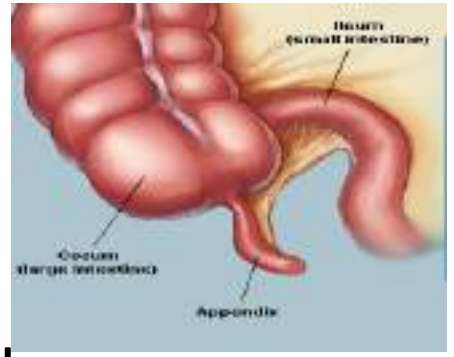




Diverticulosis is caused by small outward bulges in the large intestine (diverticula) wall in areas that lack Taenia coli which can be blocked with food residue . If any of the diverticula become infected, this leads to symptoms of diverticulitis. The exact reason why diverticula develop is not known, but they are associated with not eating enough fiber

The appendix

It is a projection from the cecum, 8 cm

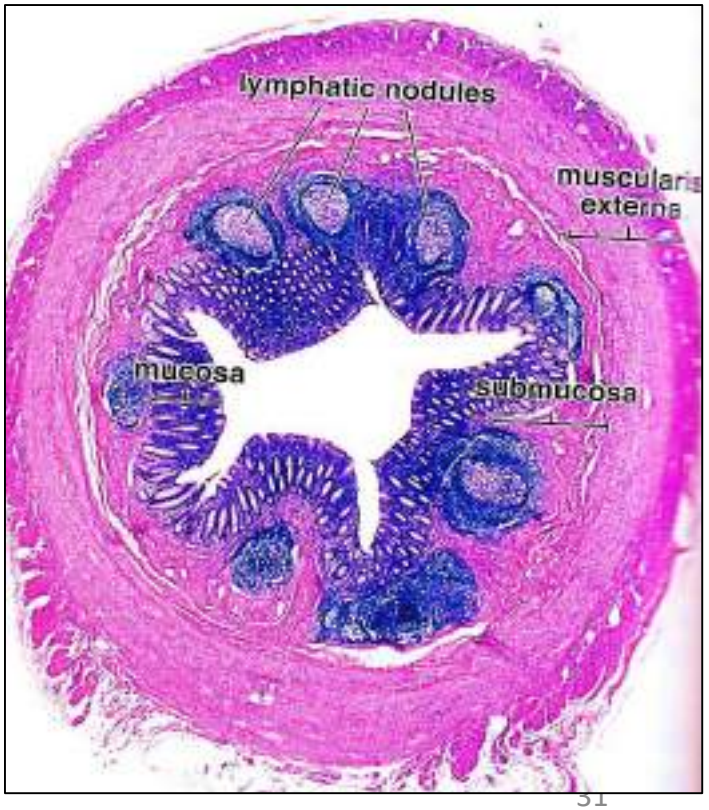


- The mucosa: the crypts short & few in number

a) Epithelium: Enterocytes + Goblet cells + Enteroendocrine

b) Mucosa & submucosa: rich in **lymphoid follicles**

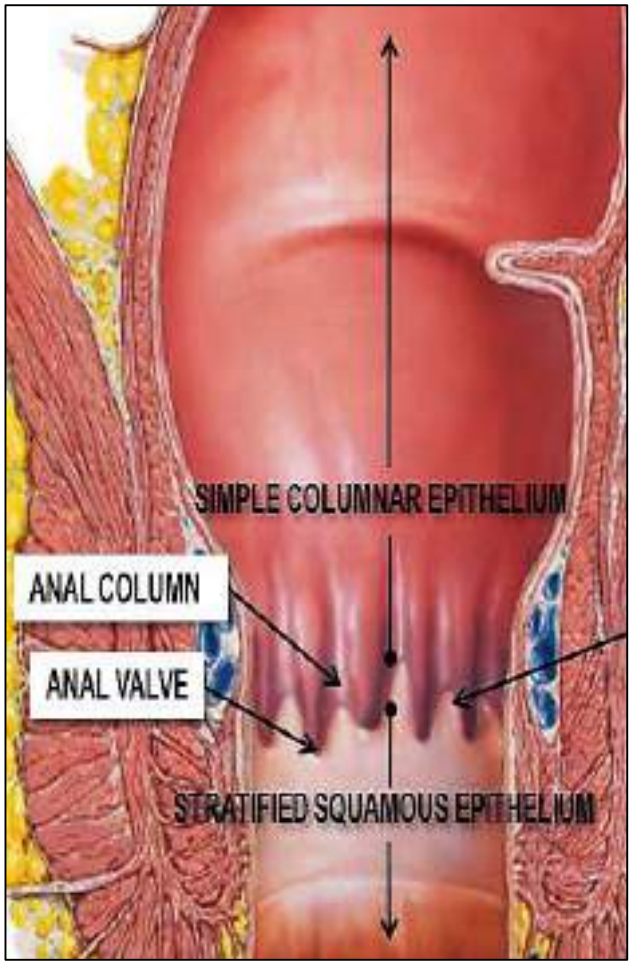
c) No muscularis mucosa, NO taenia coli No appendices epiploicae



The anal canal

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

The ends of Morgagni columns connected together with transverse mucosal folds called **anal valves which mark the pectinate line**



The columns mark the recto-anal junction

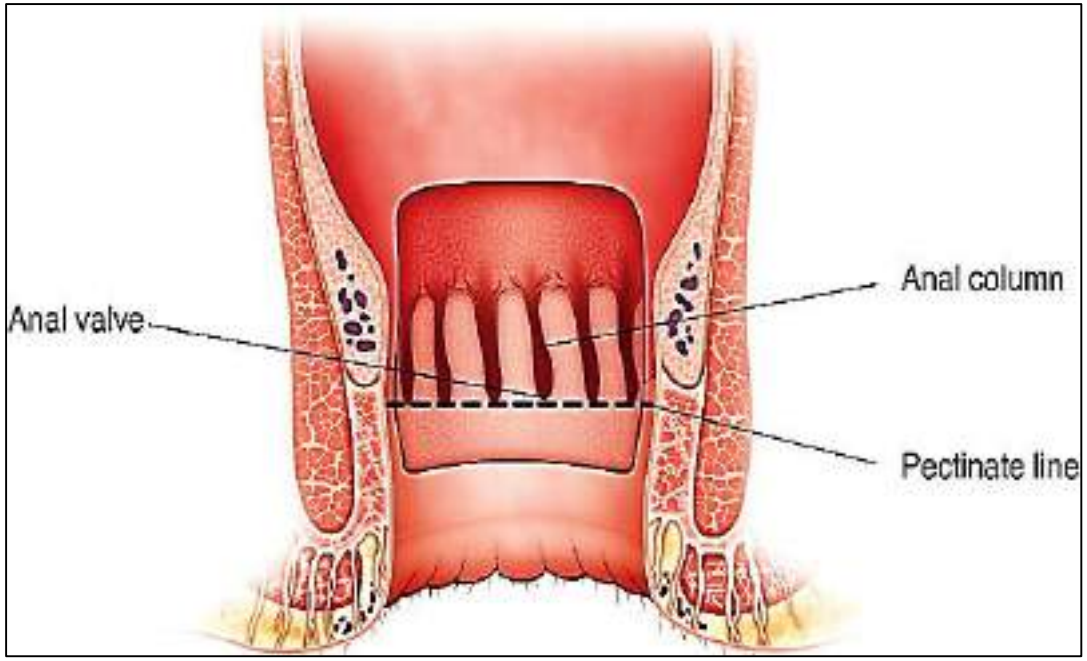
The epithelium is stratified columnar on columns of Morgagni

Importance of the pectinate line

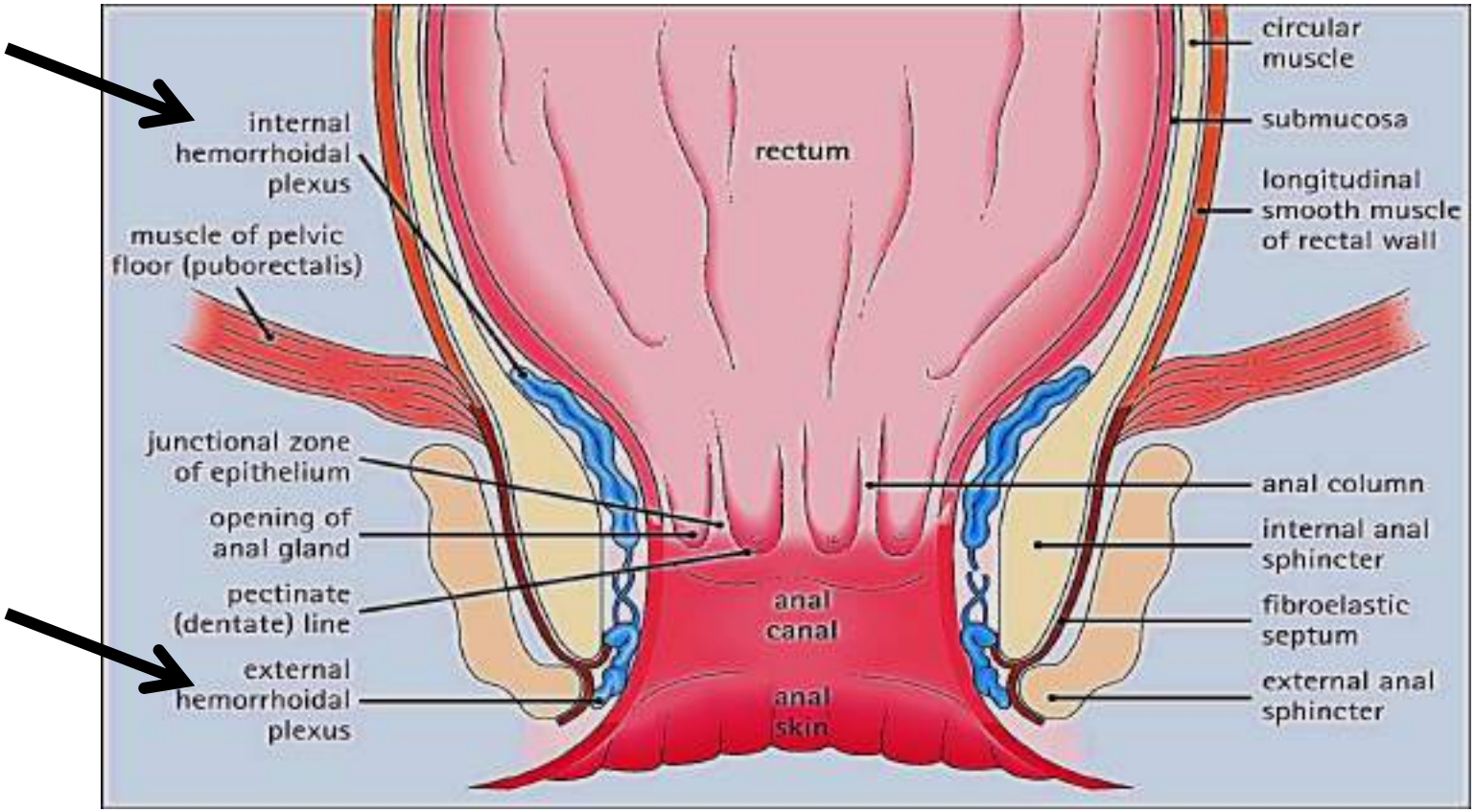
The pectinate line demarcates the upper two-thirds of the anal canal from the lower one-third.

It also serves as an embryologic landmark that explains the different arterial supply, venous drainage, lymphatic drainage, and nervous supply of the segments of the anal canal

Even tumors arise in the upper 2/3 different from tumors arise in the lower 1/3

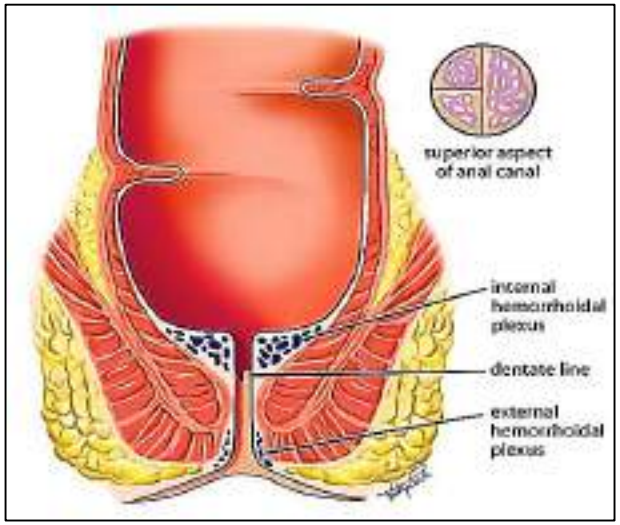


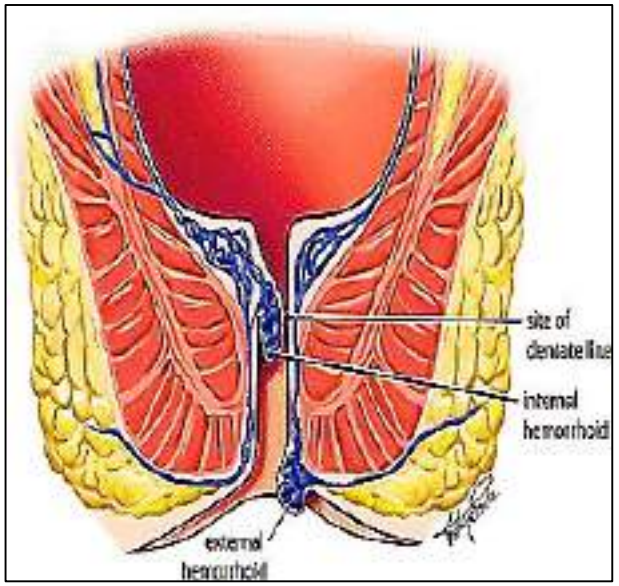
- C.T. under the level of the valves is rich e convoluted veins → the internal piles (plexus of veins)
- At the anus another group of veins under the skin forms the external piles



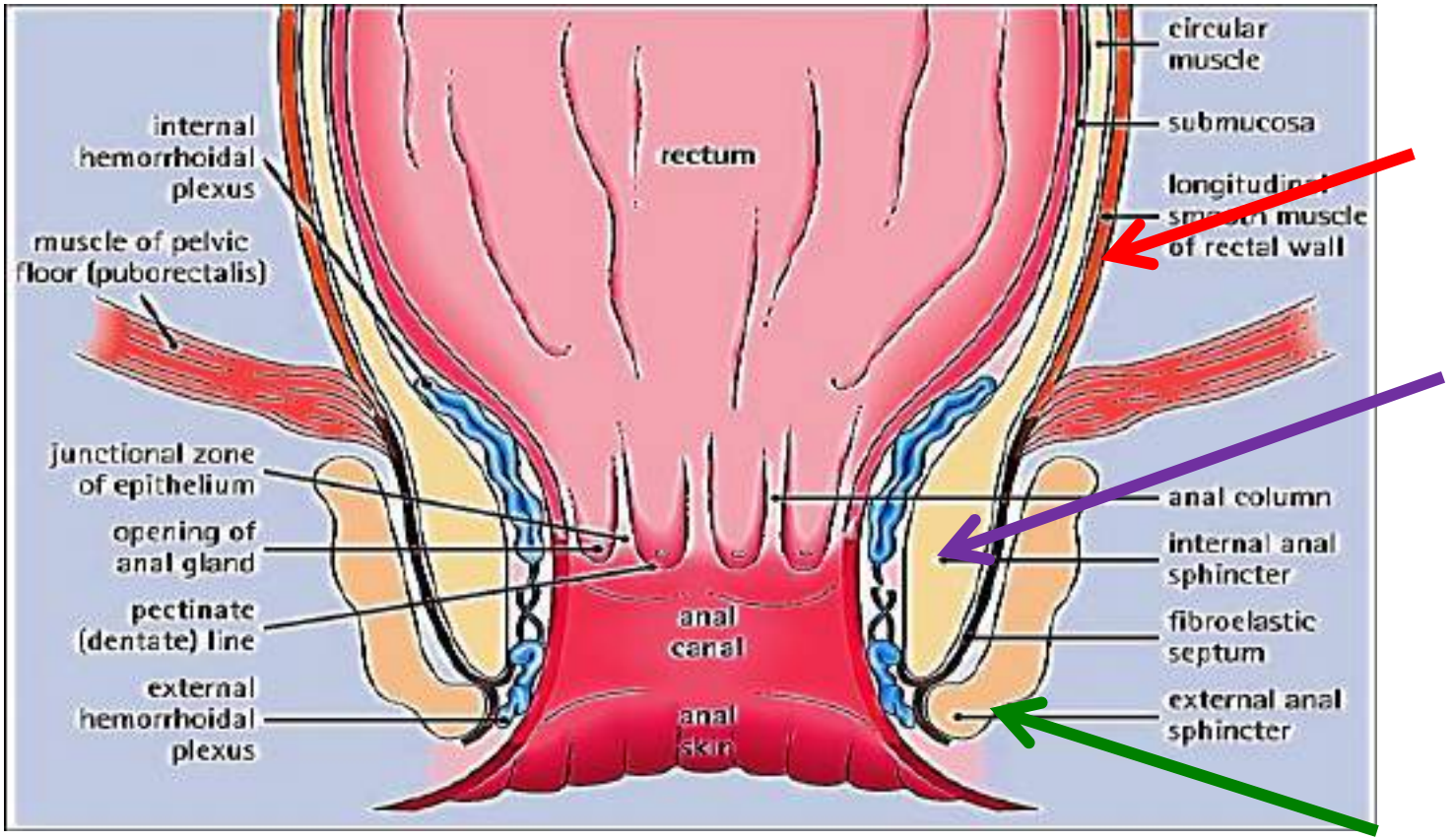
Hemorrhoids also called piles, are swollen veins of the anus and lower rectum, similar to varicose

Internal hemorrhoids are usually painless, but tend to bleed. External hemorrhoids may cause pain





- 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