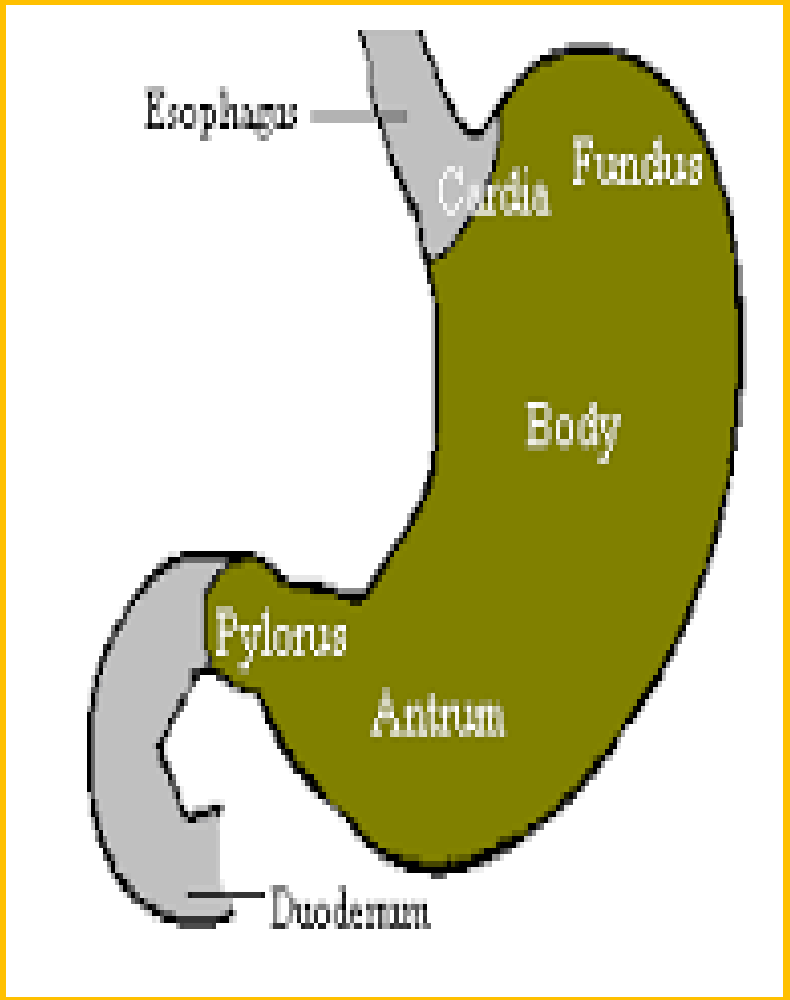
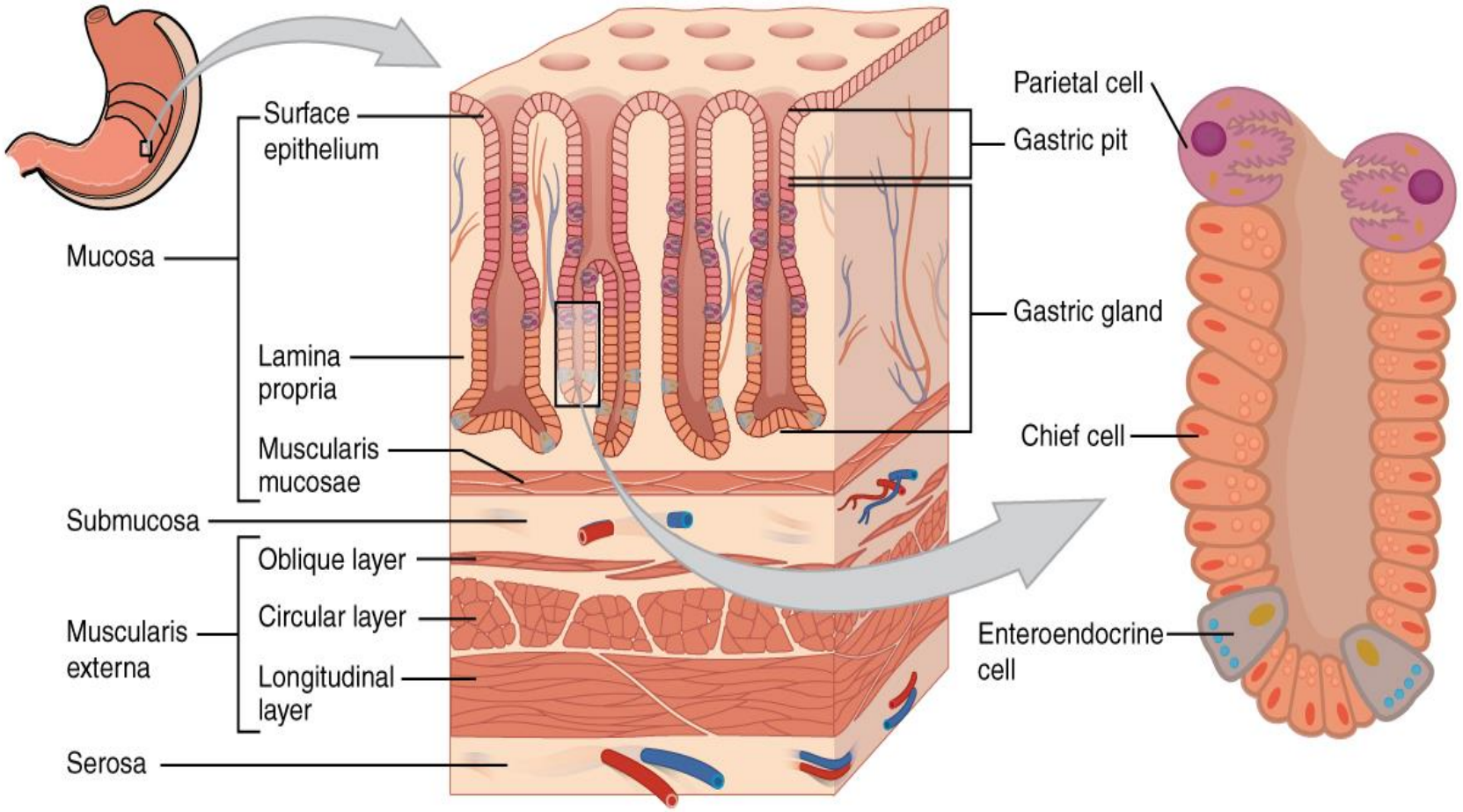
II. The glandular stomach (true-stomach or abomasum)

STRUCTURE OF STOMACH

- is a mixed exocrine– endocrine organ that digests food and secretes hormones.
- It is a dilated segment of the digestive tract main functions :
- continue the digestion of carbohydrates initiated in the mouth, add an acidic fluid to the ingested food, transform it by muscular activity into a viscous mass (**chyme**), and promote the initial digestion of proteins with the enzyme **pepsin.** It also produces a gastric lipase that digests triglycerides with the help of lingual lipase.
- Gross inspection reveals four regions: **cardia, fundus, body,** and **pylorus** (Because the fundus and body are identical in microscopic structure, only three histological regions are recognized.



HISTOLOGICAL STRUCTURE:



- The mucosa and submucosa of the undistended stomach lie in longitudinally directed folds known as **rugae.** When the stomach is filled with food, these folds flatten out.

- **Each gland consists of three parts**:
- 1. **the neck**: continuous with the gastric pits and lined with mucous neck cells and parietal cells.
- 2. **The body**: the middle part of the gland contains mainly chief cells and parietal cells
- 3. **The fundus (the base):** the deepest part of gland which is made up of chief cells.

Each gland is lined by five types of cells:

1. Isthmus mucous cells.
2. Mucous neck cells.
3. Parietal (oxyntic) cells.
4. Chief (zymogentic) cells.
5. Enteroendocrine cells.

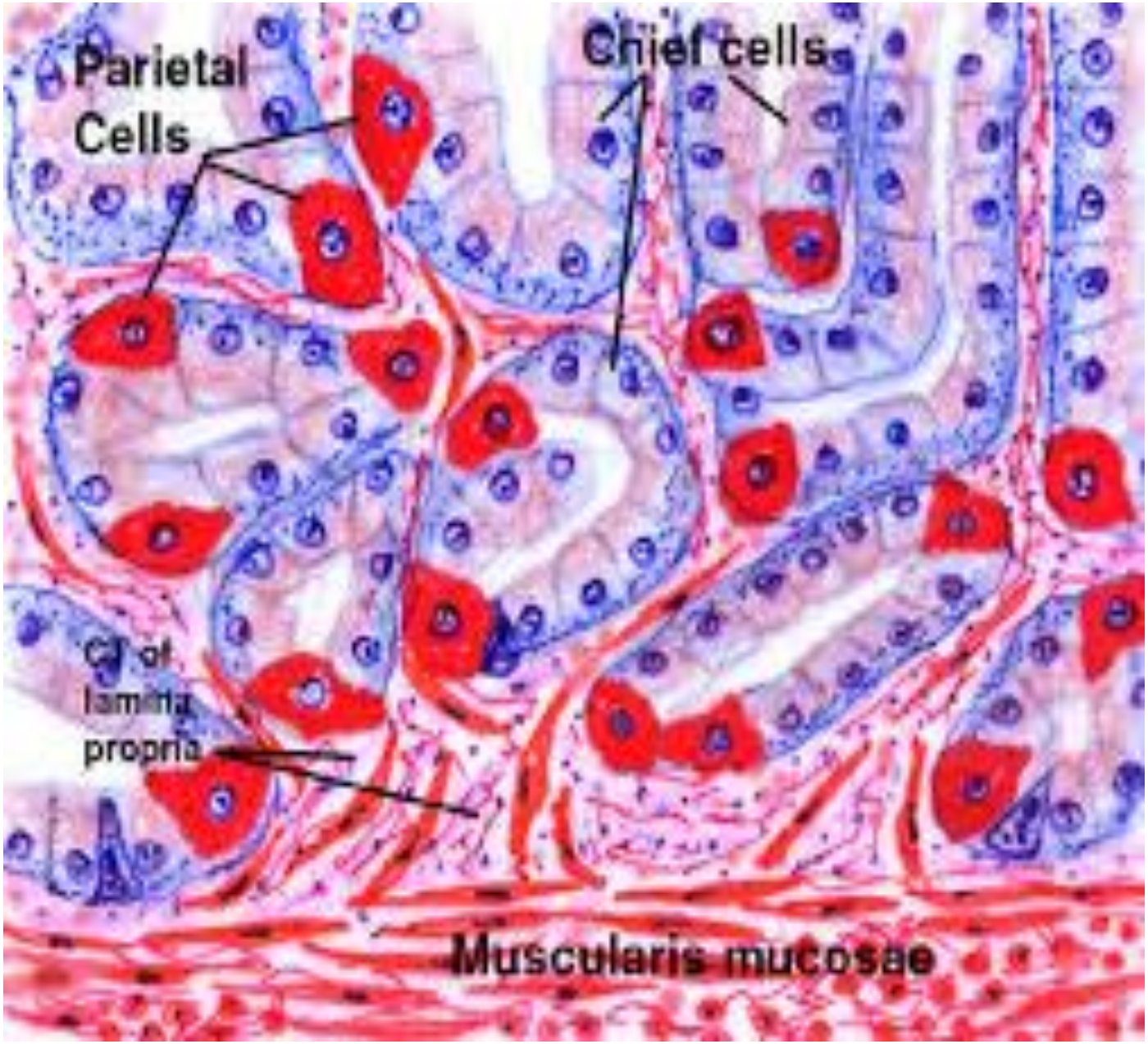
- **1) Isthmus mucous cells**:
- cuboidal cells, similar to the surface epithelium, but they have few mucous granules.
- - They secrete mucus (neutral) which protects the epithelial surface.
- **Function:**
- - They are responsible for the replacement of the lining and glandular epithelium.

2) Mucous neck cells

They are cuboidal (low columnar) or irregular (triangular) in shape.

- They have flattened nuclei located at the base of the cells.

- Their cytoplasm is foamy in appearance.
- They secrete acidic mucus and lubricate the gastric contents


Parietal
Cells
Chief cells
of
lamina
propria
Muscularis mucosae

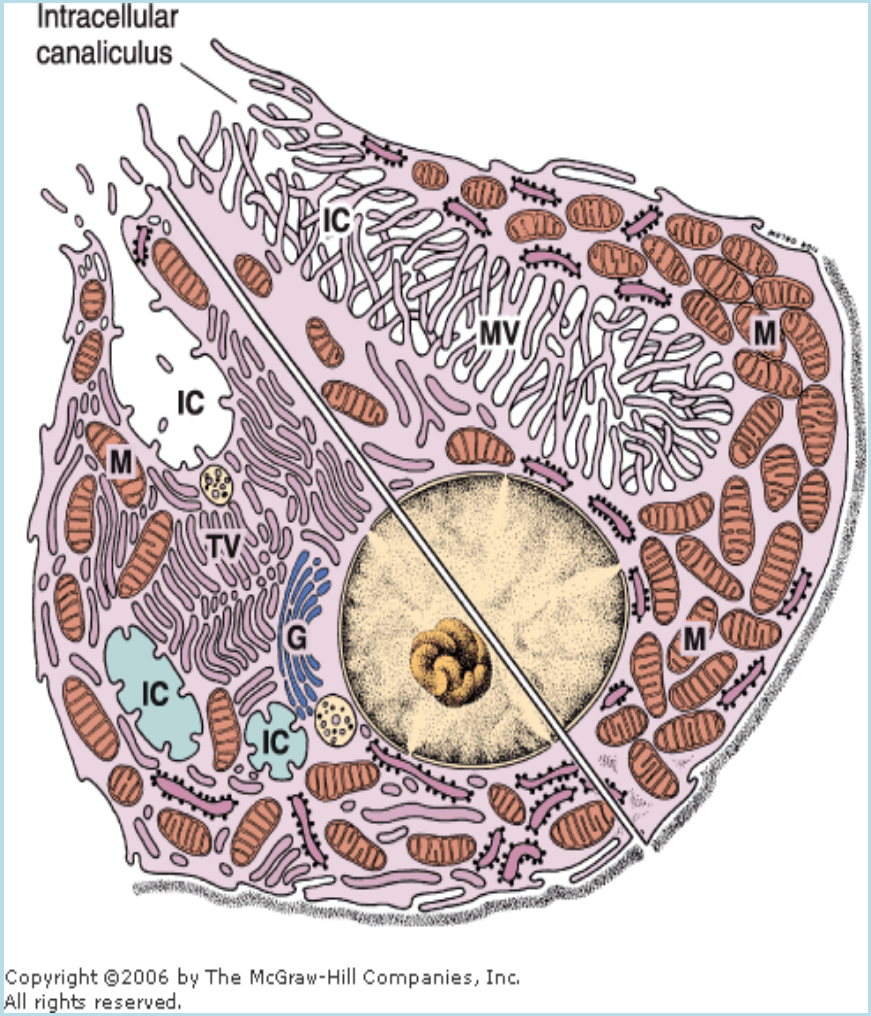
3) PATRIETAL CELL

- They are present mainly in the upper half of the gland.
- - They are intercalated between mucous neck cells and chief cells.

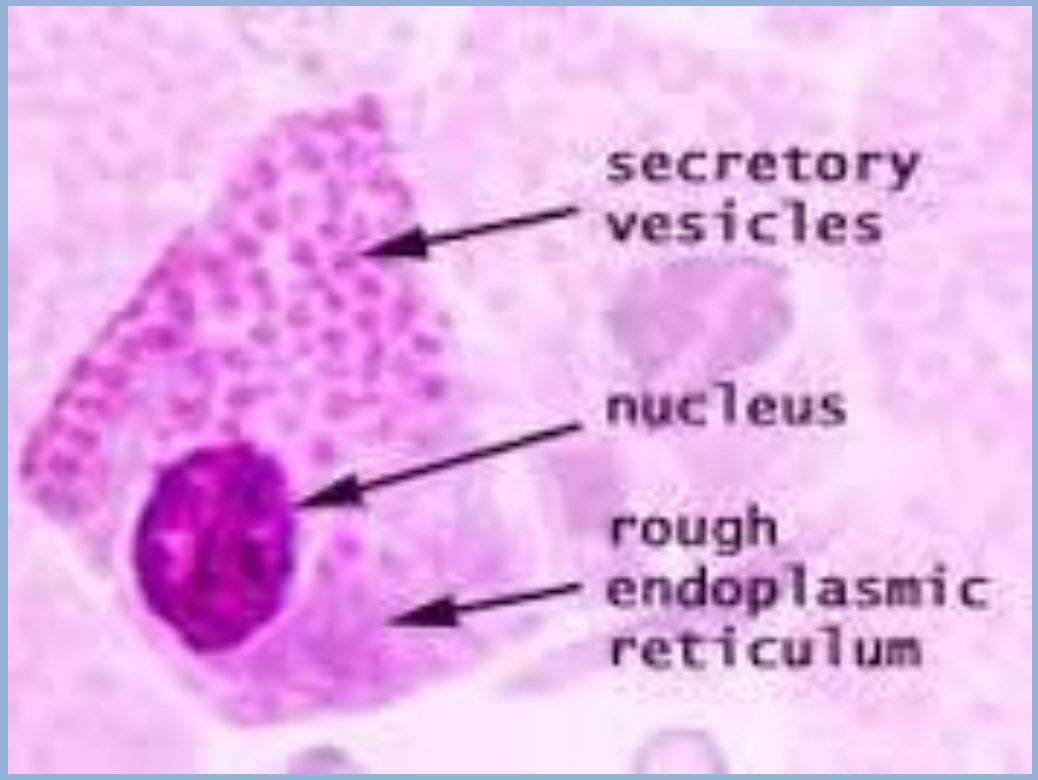
L/M:

large with rounded nucleus.

- triangular in shape
- The apex of such cell does not reach the lumen of the gland, thus, the cells are called parietal cells.
- - They have extensive acidophilic cytoplasm (that is why called oxyntic cells).
- **E/M:**
- - Their cytoplasm is very rich in intercellular canaliculi with numerous microvilli.
- **- Functions:**
- Formation and secretion of HCl



4) Chief cell (protein secreting cell) zymogenic or peptic cells



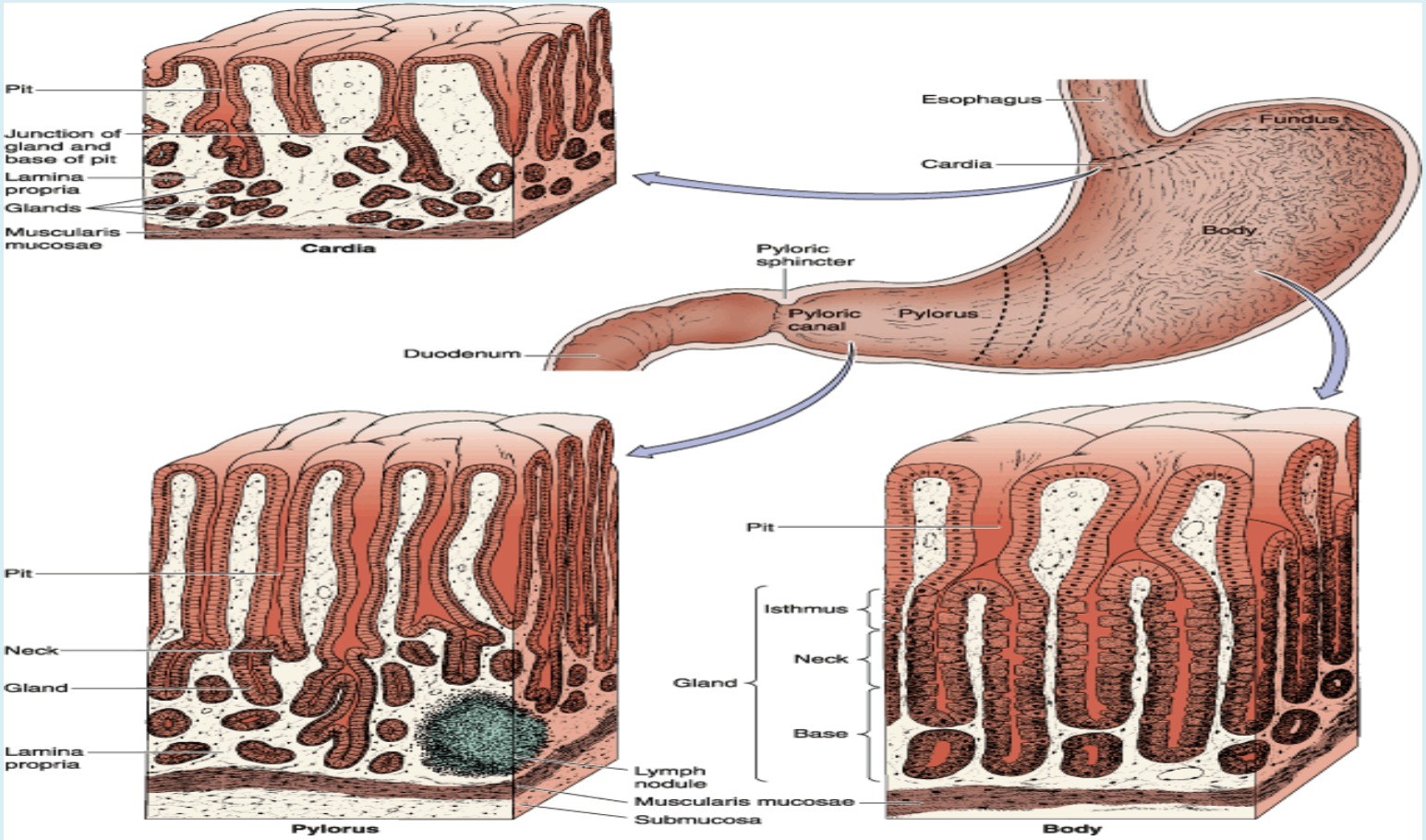
Function:

- These cells secret most of the gastric enzymes as **pepsinogen and rennin.**
- They also secrete **lipase** that has only weak lipolytic activity.

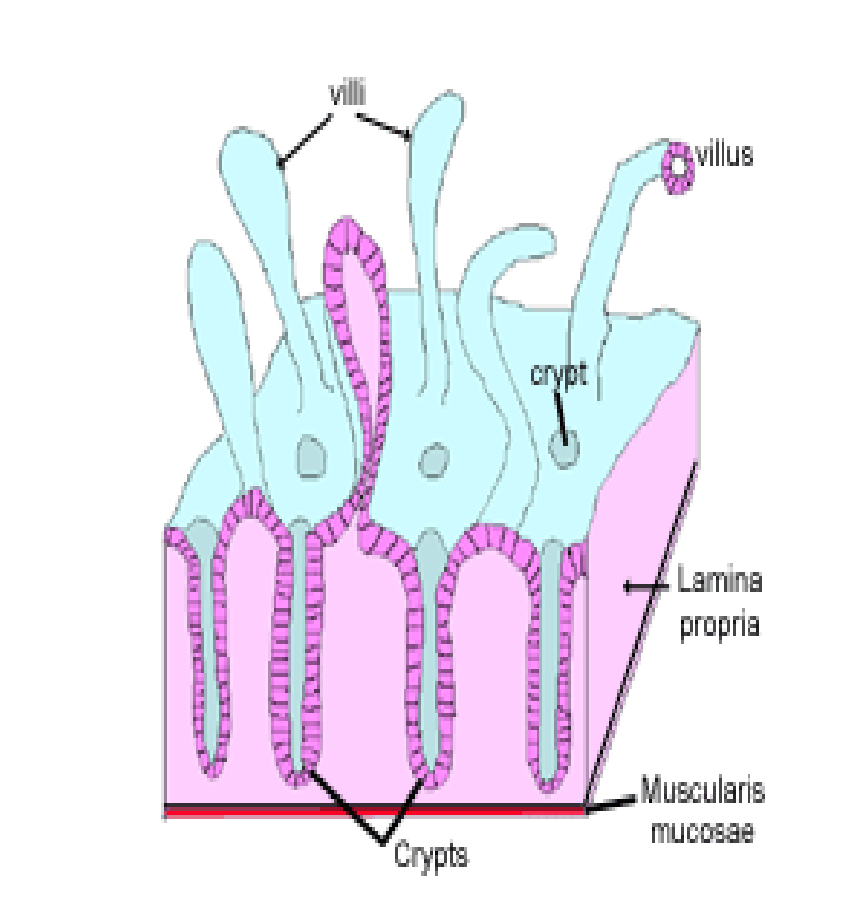
5) Enteroendocrine cells

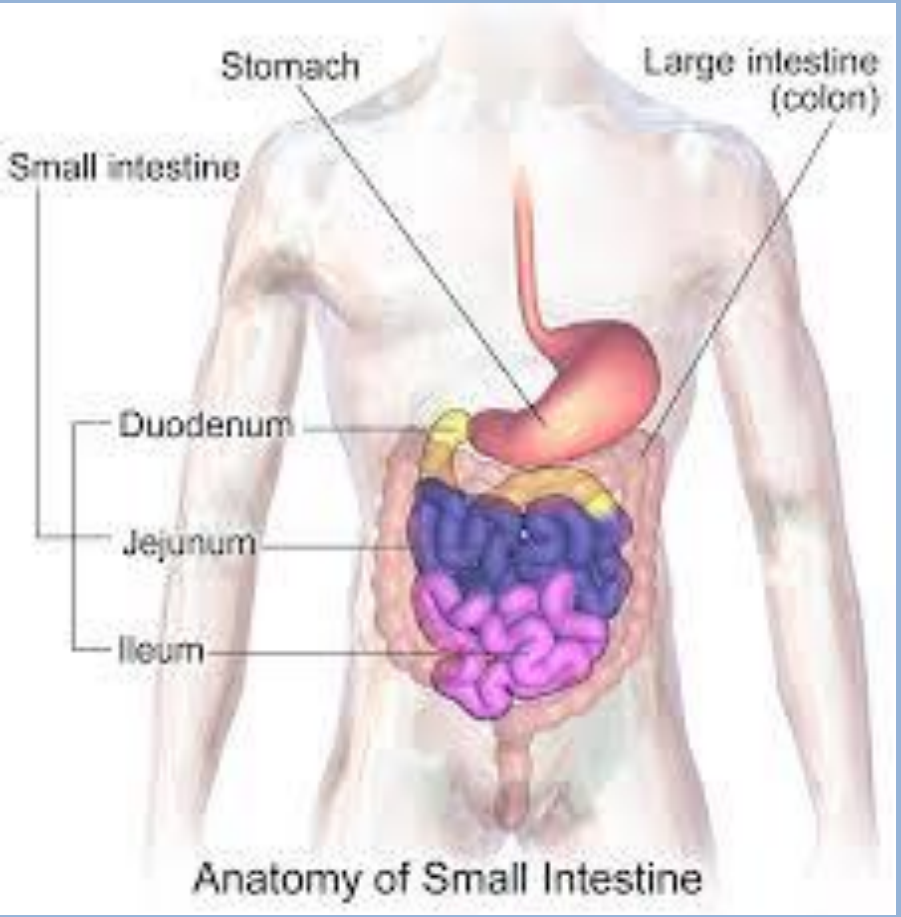
- They are also called ***Argentaffin cells or Enterochromaffin cells***.
- ***Site:***
- - They are present at the **base of the glands**.
- They are flattened or polyhedral cells with eccentric oval nuclei
- **E/M:**
- - The cytoplasm contains many basal and scattered small electron dense secretory granules
- **Functions**
- 1. **Gastrin**: a hormone stimulates gastric secretion. It is secreted from G-cells.
- 2**. Somatostatin**: a hormone inhibits the release of growth hormone and other hormones. It is secreted from D-cells.
- 3. **Enteroglucagon hormone**: It increases blood sugar level and therefore, antagonistic to insulin. It is secreted from EG cells.
- 4. **Endorphin:** It is a pain-killer resembling morphine.
- 5. **Serotonin:** It causes local constriction of smooth muscle of blood vessels. It is secreted from EC cells.

Cardiac glands	Fundic glands	Pyloric glands
- moderate in length - branched - coiled - they have wide lumen - they are serous in type	- long - less branched - less coiled - have wider lumen - have four types of secretory cells	- short - highly branched - highly coiled - prominent lumen - mucous in type

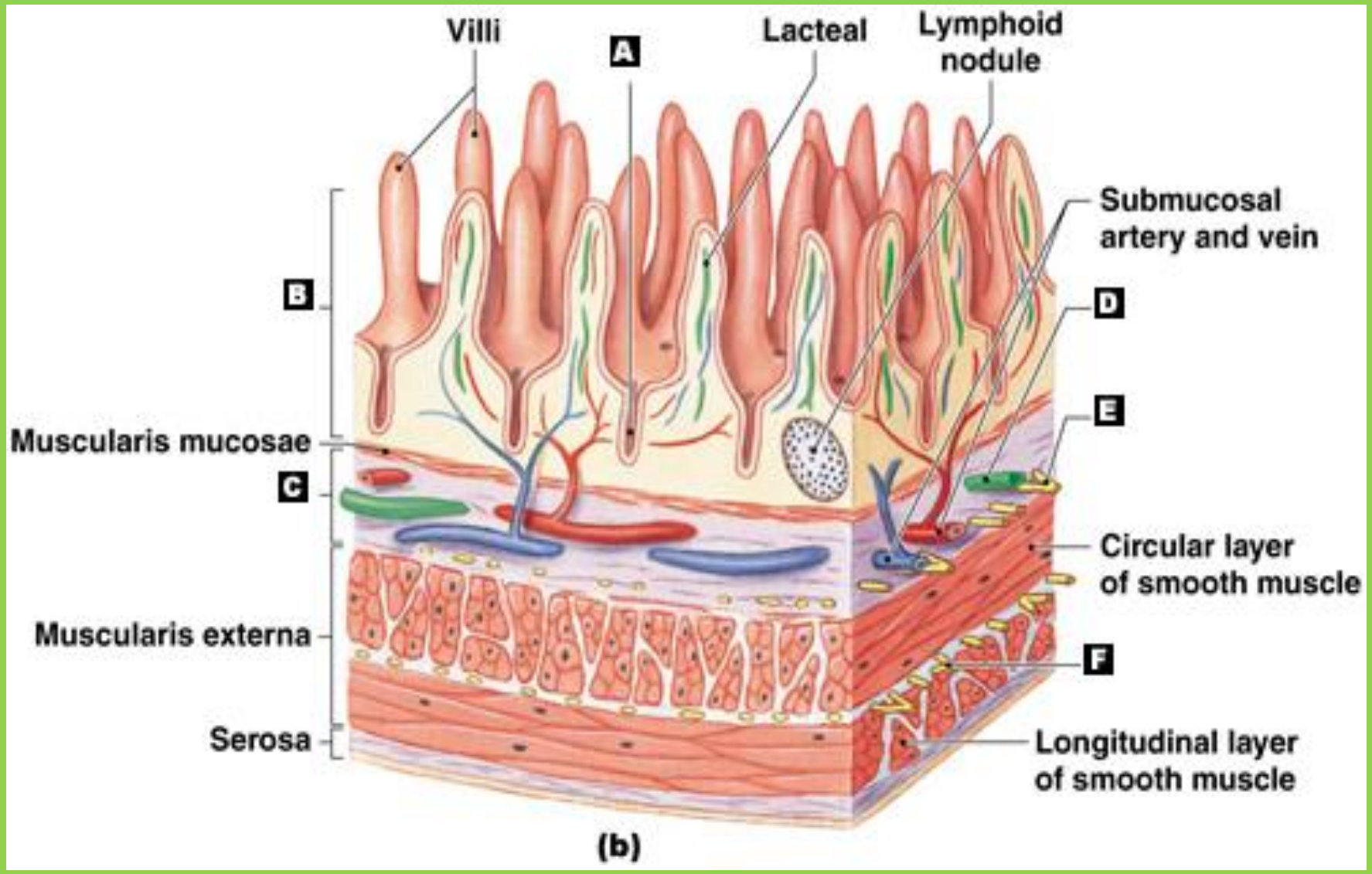


The intestine

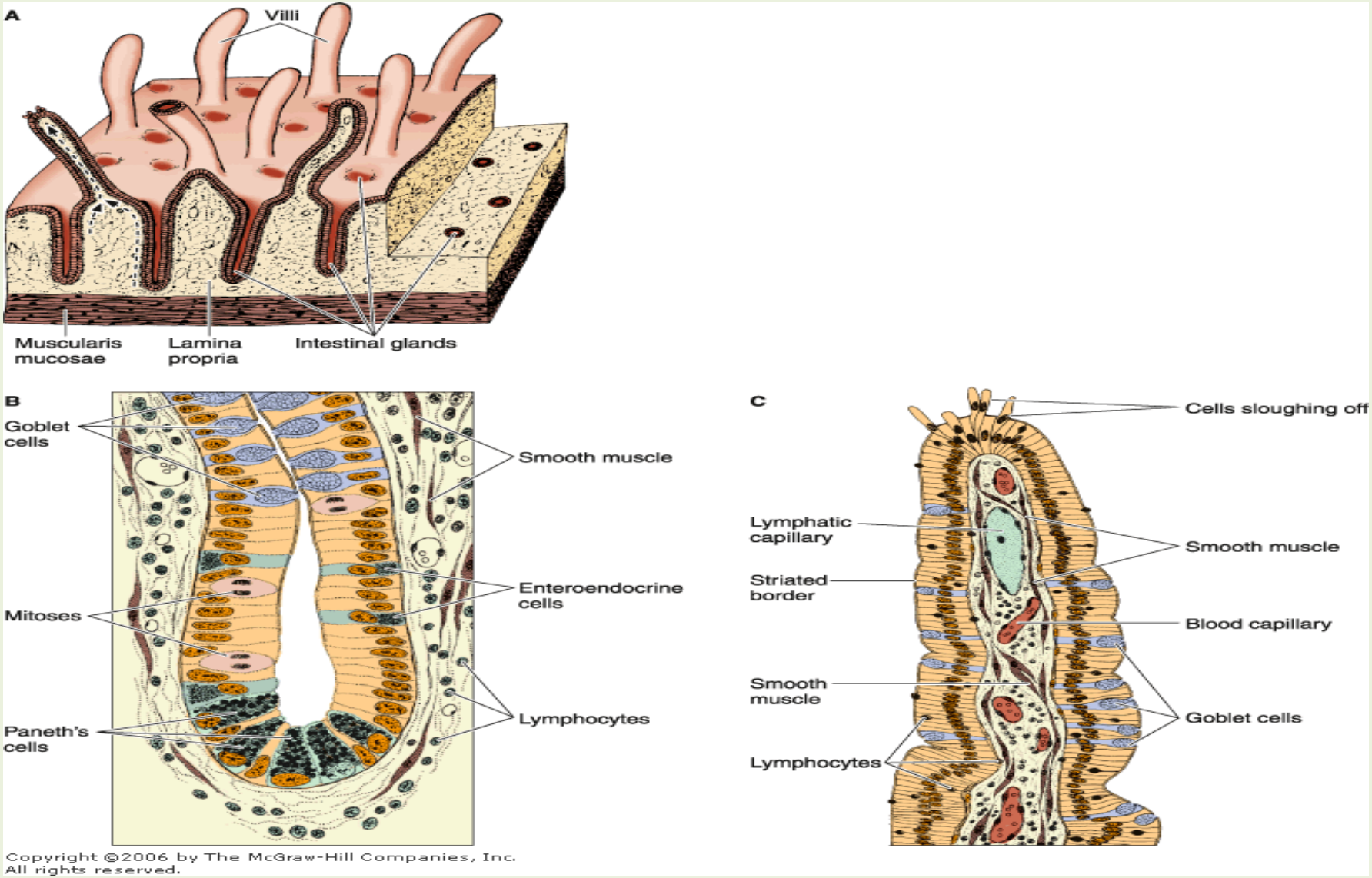




Histological structure of small intestine

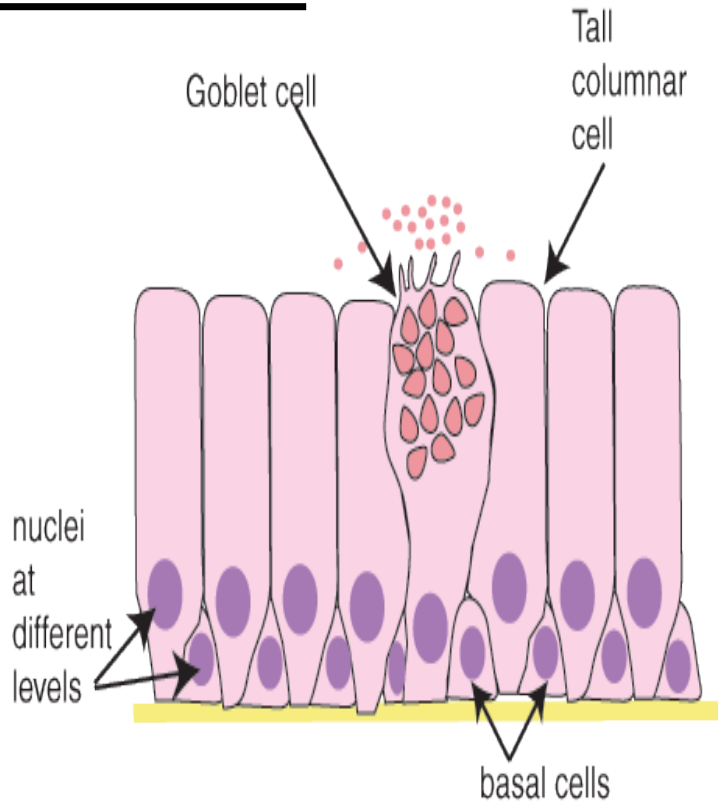


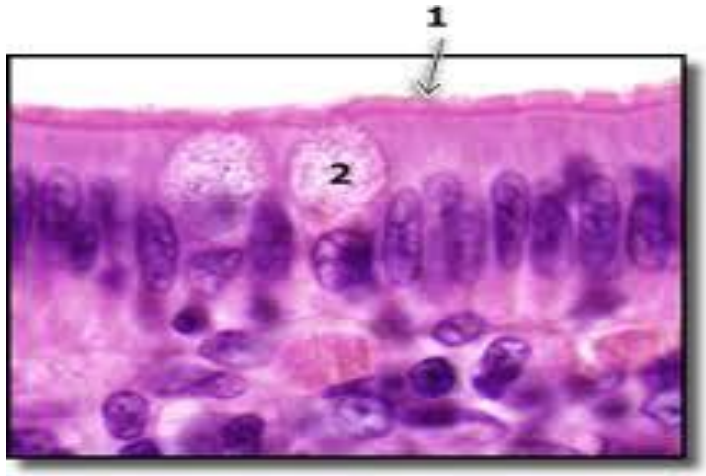
The villus & intestinal crypt



The intestinal villi

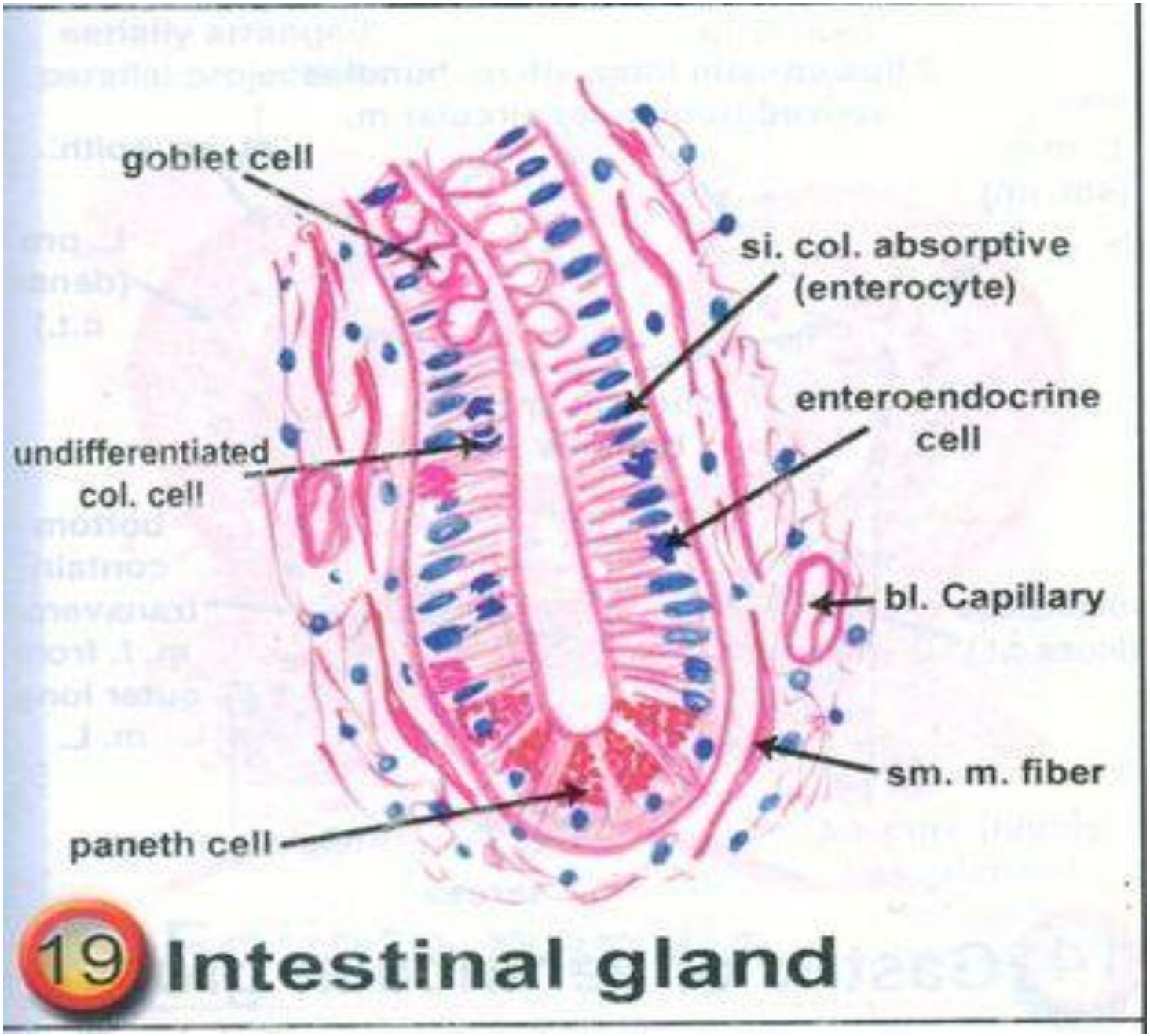
- They are finger-like projections.
- Each villus is lined by types of cells as:
- **1) Absorptive columnar cells:**
- They appear as tall columnar cells provided with acidophilic brush border (micovilli). They have basal oval nuclei.
- They are specialized for absorption of digested food.
- They produce certain enzymes for carbohydrates (disaccharides) and protein (peptidase) digestion.
- **2) Goblet cells:**
- They are columnar cells with narrow base contain the nucleus and wide apical part distended with mucus globules. They produce glycoprotein





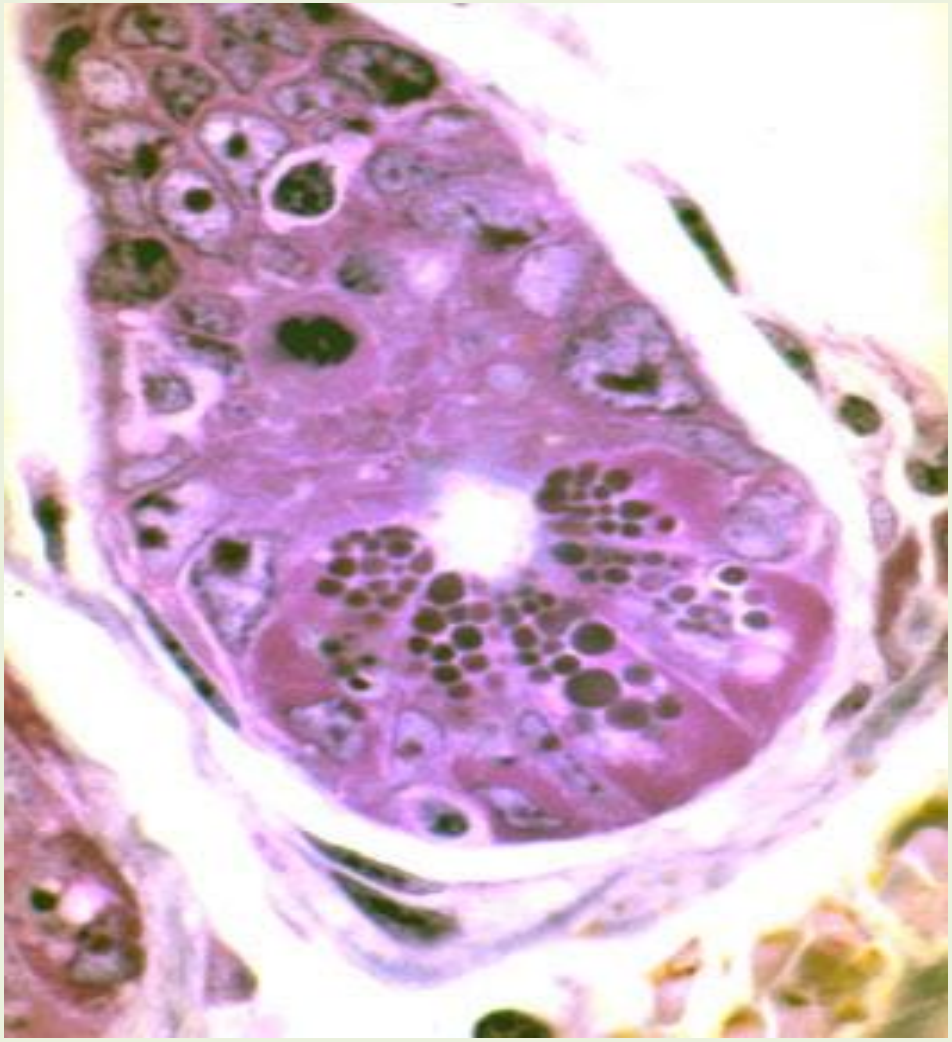
Intestinal glands (the crypts of Lieberkuhn)

- They are invaginations from the surface epithelium between the bases of the villi (tube-like structure
- are lined with the following cells:
- **A- Undifferentiated low columnar cells**:
- They are responsible for the replacement of the surface columnar absorptive cells.
- **B- Paneth cells:**
- Site: They are found only at the bases of the crypts of small intestine
- **Functions:**
- 1. They secrete intestinal enzymes.
- 2. They also secrete an enzyme called **lysozome** which can kill certain bacteria



19 Intestinal gland

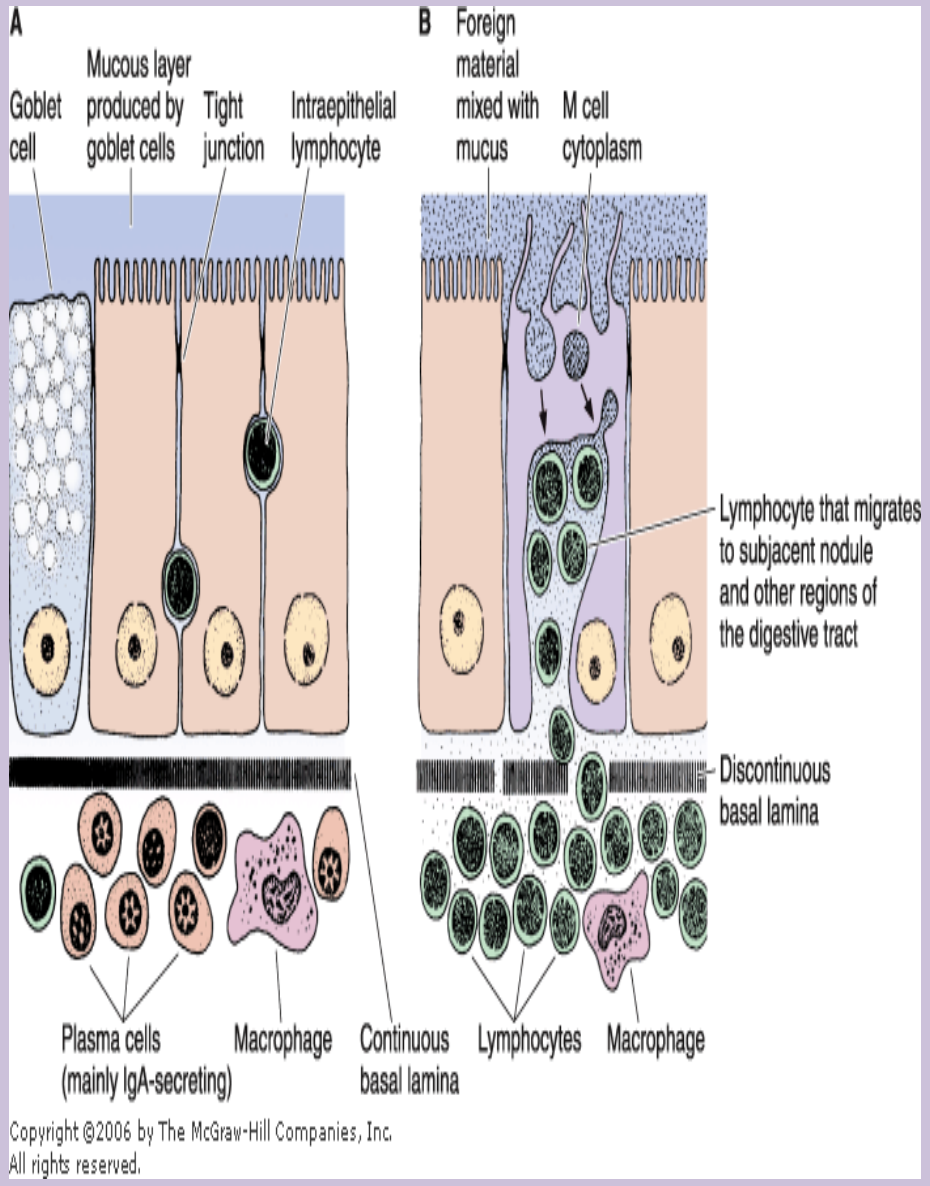
Paneth cells:



- **C- M-cells:**
- They are called ***membrane cells or macrophage cells***
- Site: They are present in association with lymphoid nodules.
- Structure:
- They are large low cuboidal or squamous-like cells lacking microvilla and lateral junction complex
- *Functions:*
- 1. They play a role in the immune system of the intestine.
- 2. These cells phagocytose and transport Ags present in the intestinal lumen.

M- cell

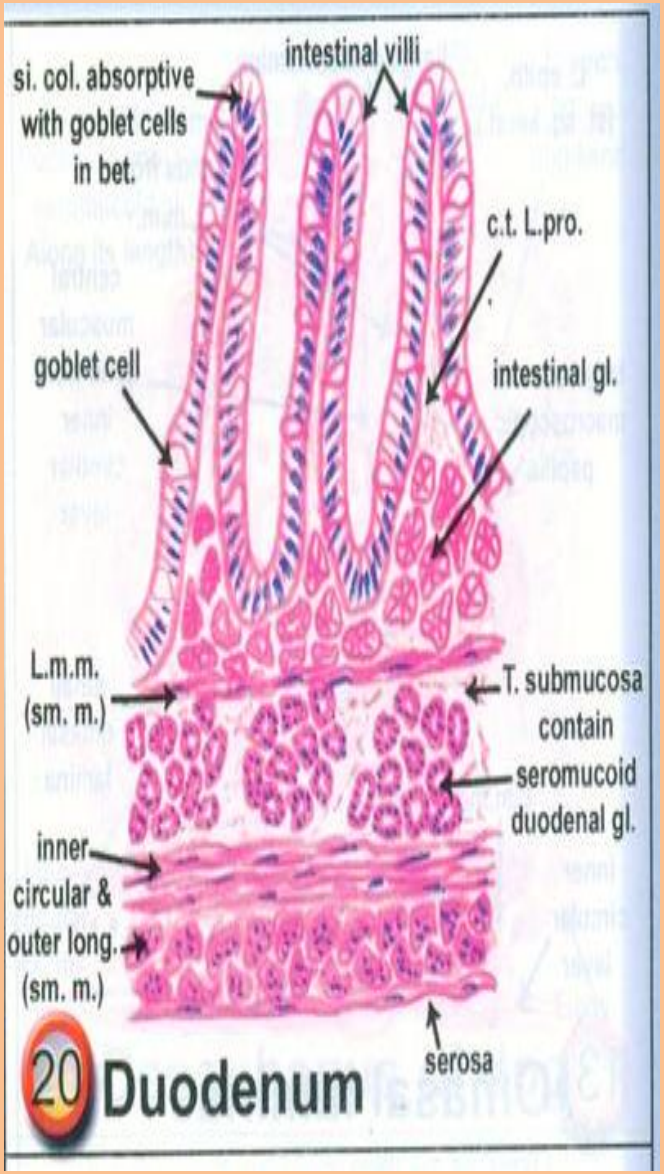
M (microfold) cells are specialized epithelial cells overlying the lymphoid follicles of ***Peyer's patches*** These cells are characterized by the presence of **numerous basal membrane invaginations** that form pits containing many intraepithelial lymphocytes and antigen-presenting cells (macrophages). **M cells** can endocytose antigens and transport them to the underlying macrophages and lymphoid cells, which then migrate to other compartments of the lymphoid system (nodes), where immune responses to foreign antigens are initiated. M cells represent an important link in the intestinal immunological .The basement membrane under M cells is discontinuous, facilitating transit between the lamina propria and M cells

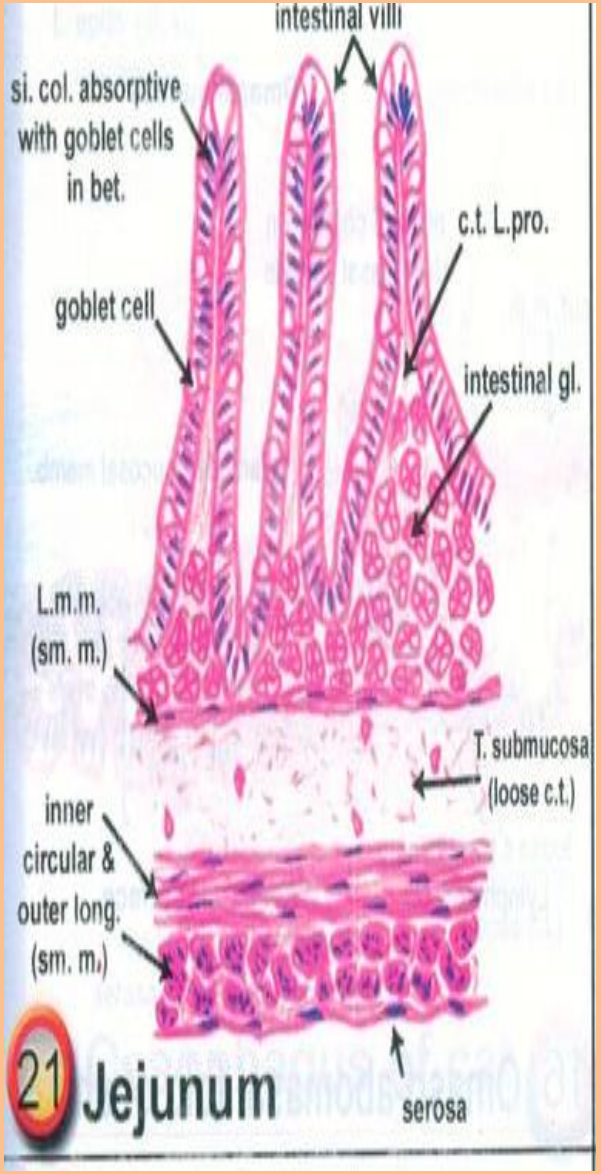


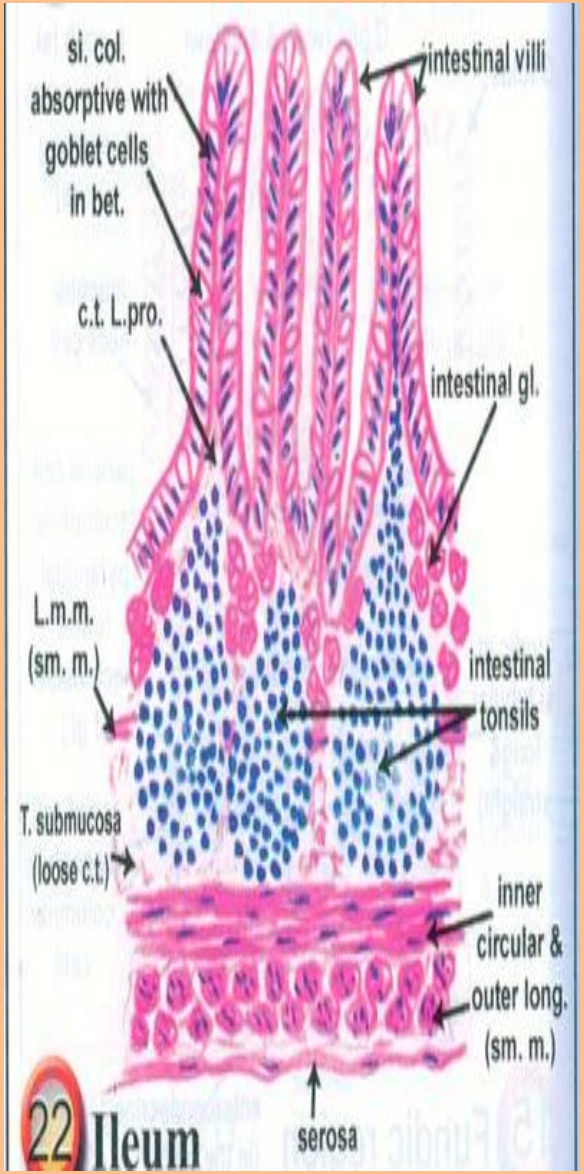
D- Entero-endocrine cells:

N-cells… secrete Neurotension hormone.

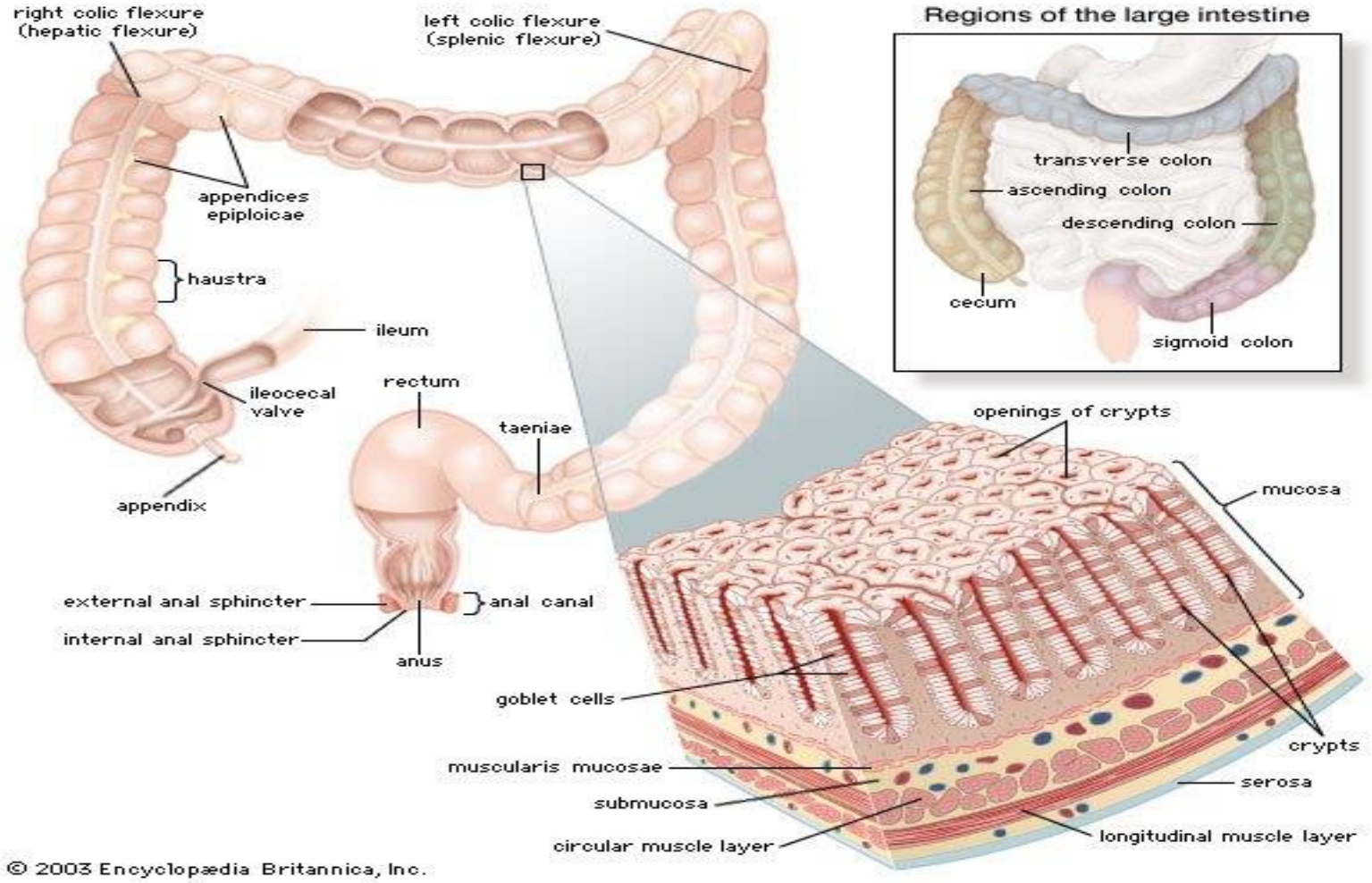
- **M-cells** … secrete Motilin hormone.
- **Kcc-cells** … secrete Cholecytokinin hormones.
- **Neuro-receptor cells** which receive intestinal nerves and food stimuli.


si. col. absorptive with goblet cells in bet.
intestinal villi
c.t. L.pro.
goblet cell
intestinal gl.
L.m.m. (sm. m.)
T. submucosa contain seromucoid duodenal gl.
inner circular & outer long. (sm. m.)
serosa
20 Duodenum


intestinal villi
si. col. absorptive with goblet cells in bet.
c.t. L.pro.
goblet cell
intestinal gl.
L.m.m. (sm. m.)
T. submucosa (loose c.t.)
inner circular & outer long. (sm. m.)
serosa
21 Jejunum


si. col. absorptive with goblet cells in bet.
intestinal villi
c.t. L.pro.
intestinal gl.
L.m.m. (sm. m.)
intestinal tonsils
T. submucosa (loose c.t.)
inner circular & outer long. (sm. m.)
serosa
22 Ileum

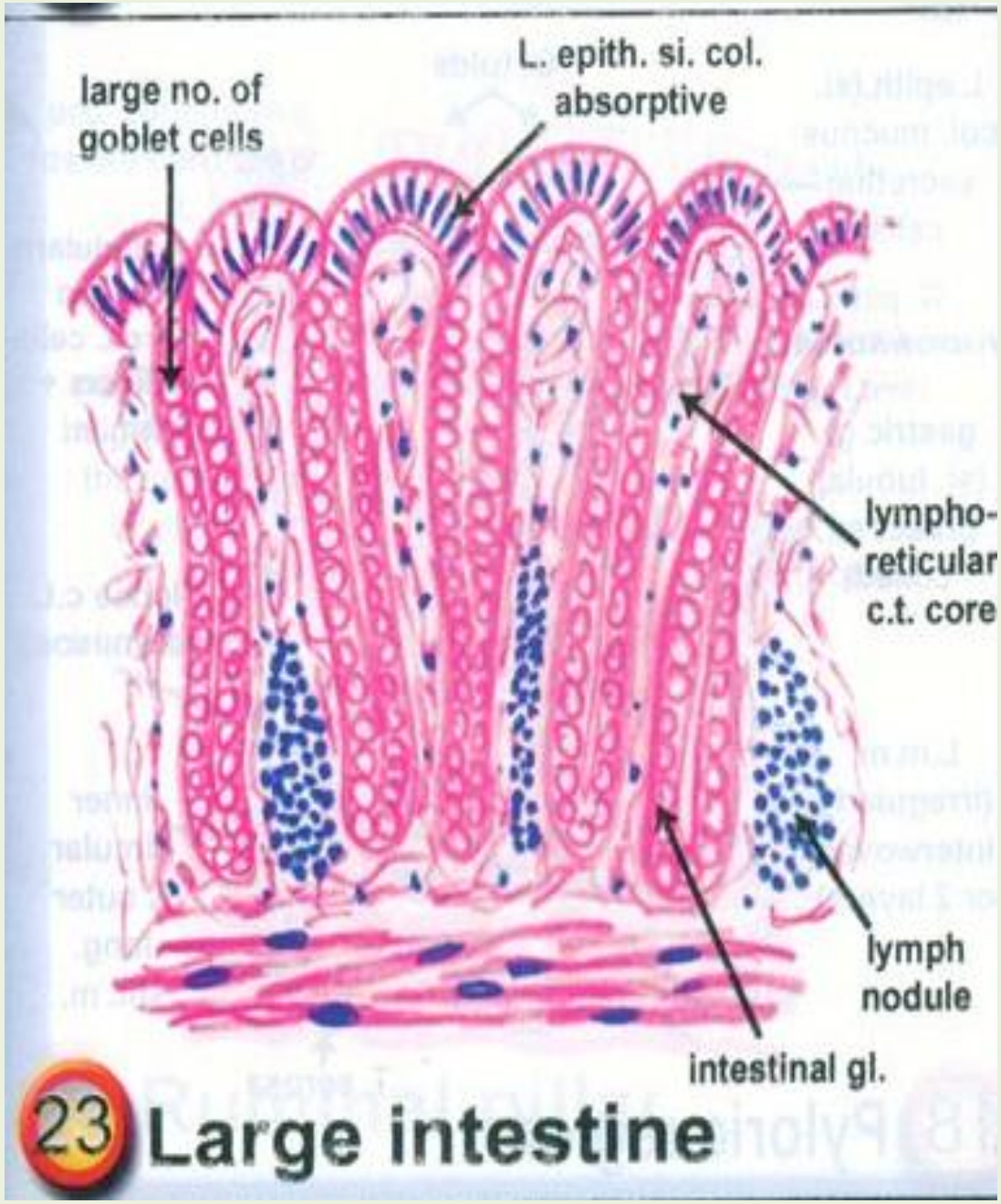
Large intestine



- **The Mucosa** has no villi

the crypts are deeper.

- The crypts have many goblet cells
- No paneth cells.
- Simple columnar epithelium with striated borders (colonocytes)
- many goblet cells,
- entero-endocrine cells
- undifferentiated columnar stem cells which present at the bases of the crypts of large intestine.
- **The submucosa**



- **3) Musclosa**:
- It is formed of smooth muscles arranged as continuous inner circular muscles.
- The outer longitudinal muscles are present in three bundles only, forming the **taenia coli** on the external surface of the colon.

Taenia coli

Three separate thin layers of the outer longitudinal muscle which penetrate the inner circular layer at irregular intervals

- Allows for segments of colon to contract individually creating haustra (sacculations)

- Not present in rectum

Functions:

- 1) It **absorbs** most of fluid, water and ions from the chyme it receives from the small intestine and compacts the chyme into fecal mass to be eliminated.
- 2) It produces abundant protective mucus from abundant goblet cells to **lubricate** against the solid fecal mass.
- 3) It secretes peptide hormones from enter-endocrine cells


Thank you