Digestive System

222 Descriptive Histology

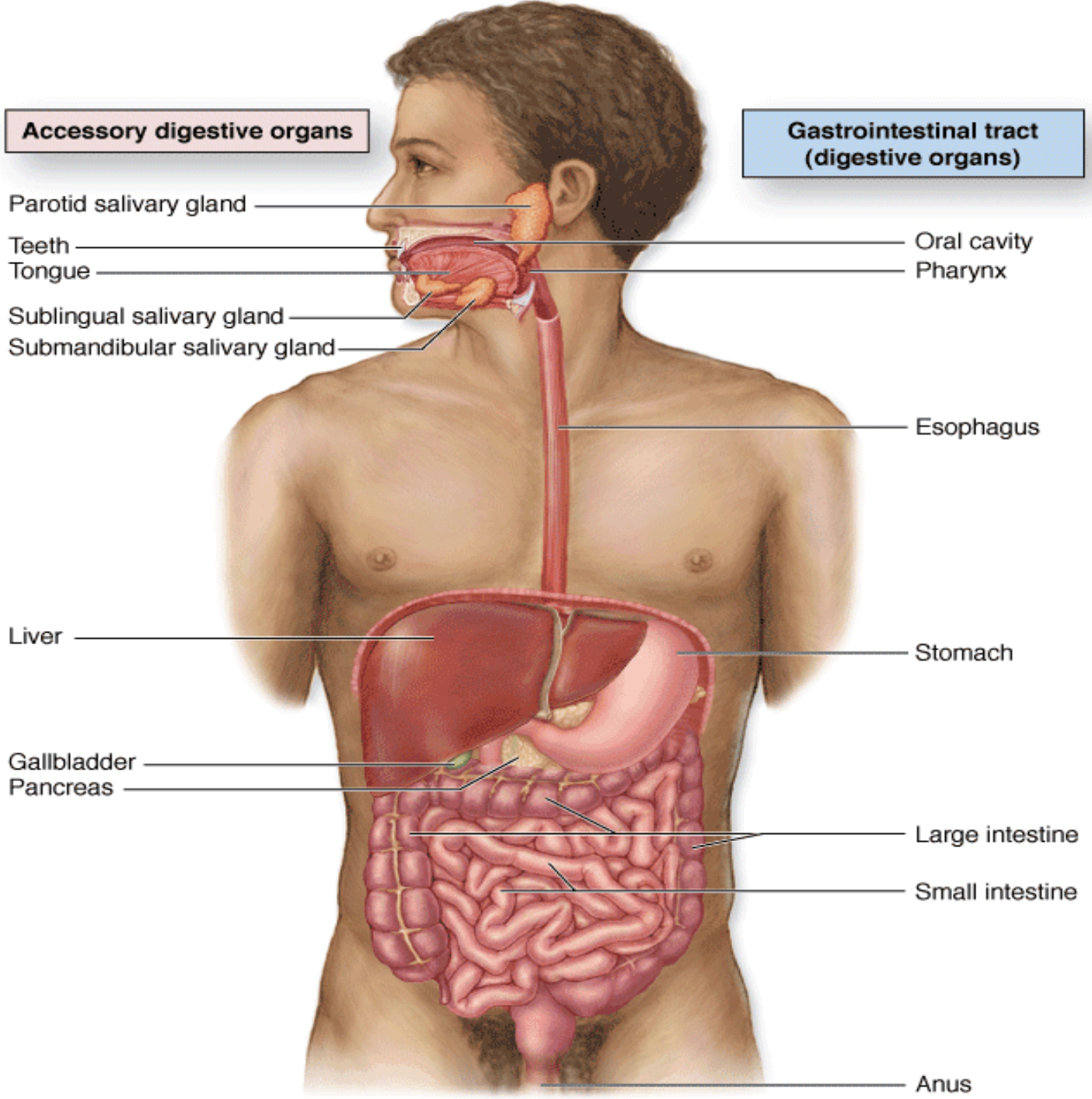
Components of the digestive system

A. Alimentary Canal

- Oral Cavity and the pharynx
- Esophagus
- Stomach
- Small intestine (duodenum, jejunum, ileum)
- Large intestine (cecum and appendix, ascending, transverse, descending, sigmoid colon)
- Rectum
- Anal canal

B. Accessory Digestive Organs

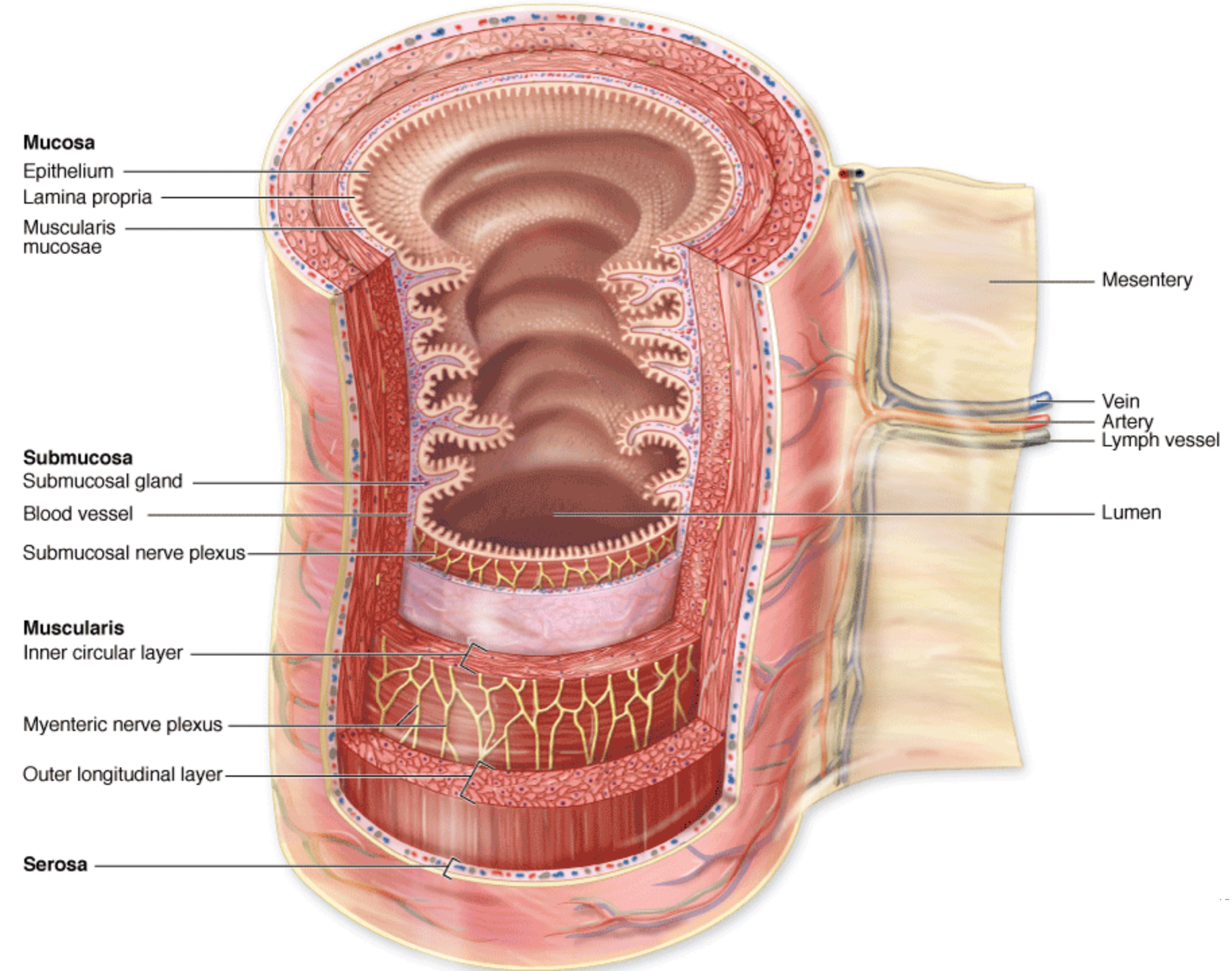
- Teeth
- Tongue
- Salivary Glands
- Liver
- Gall Bladder
- Pancreas

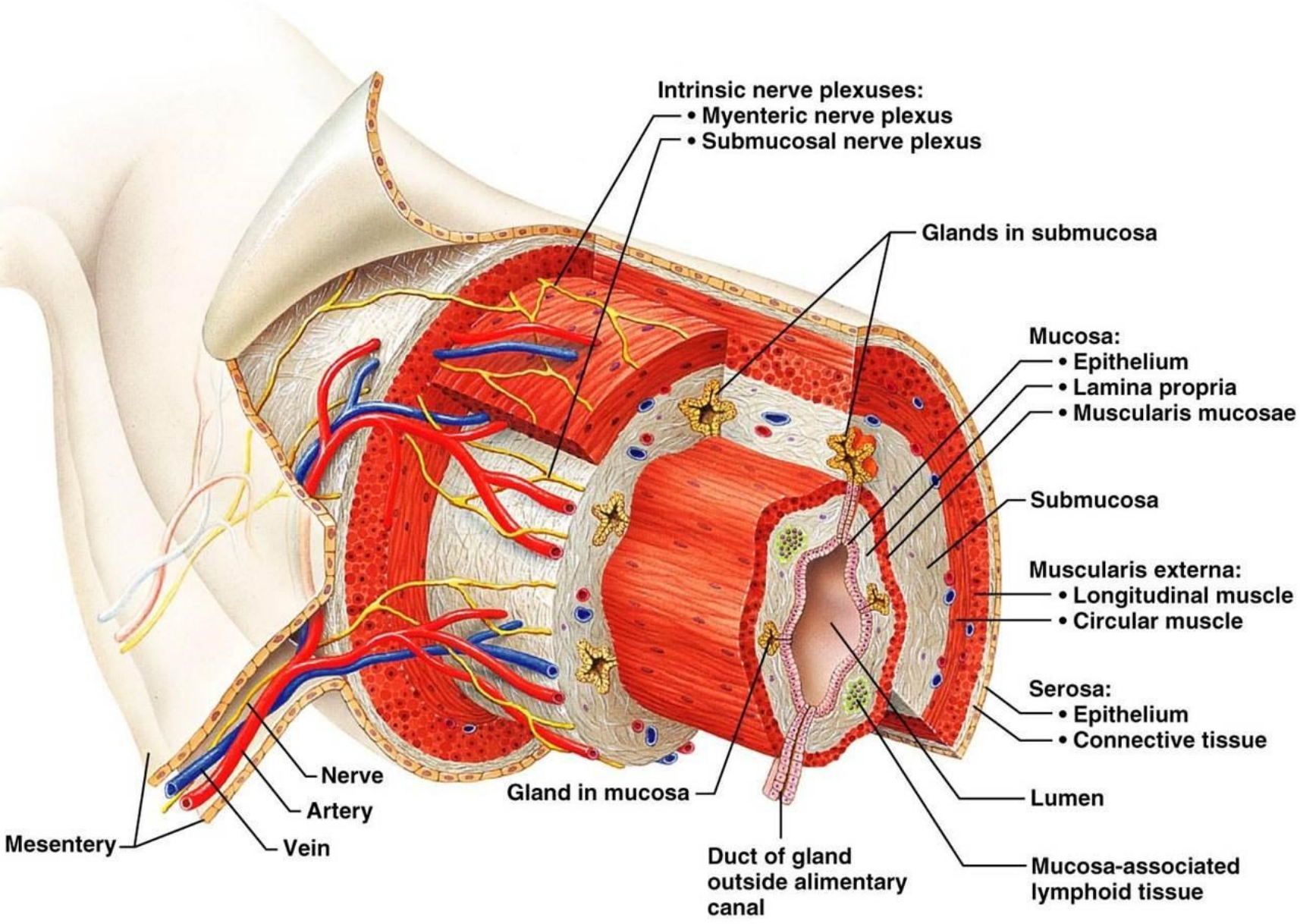

Accessory digestive organs
Gastrointestinal tract (digestive organs)
Parotid salivary gland
Teeth
Tongue
Sublingual salivary gland
Submandibular salivary gland
Oral cavity
Pharynx
Esophagus
Liver
Stomach
Gallbladder
Pancreas
Large intestine
Small intestine
Anus

Histology of Alimentary canal wall

Same four layers from esophagus to anal canal

1. Mucosa
2. Submucosa
3. Muscularis externa
4. Serosa or adventitia


Mucosa
Epithelium
Lamina propria
Muscularis mucosae
Submucosa
Submucosal gland
Blood vessel
Submucosal nerve plexus
Muscularis
Inner circular layer
Myenteric nerve plexus
Outer longitudinal layer
Serosa
Mesentery
Vein
Artery
Lymph vessel
Lumen



Functions of the digestive tract

- **Ingestion,** or introduction of food and liquid into the oral cavity.
- **Mastication,** or chewing, which divides solid food into digestible pieces.
- **Motility**, muscular movements of materials through the tract.
- **Secretion** of lubricating and protective mucus, digestive enzymes, acidic and alkaline fluids, and bile.
- **Hormone release** for local control of motility and secretion.
- **Chemical digestion** or enzymatic degradation of large macromolecules in food to smaller molecules and their subunits.
- **Absorption** of the small molecules and water into the blood and lymph.
- **Elimination** of indigestible, unabsorbed components of food.

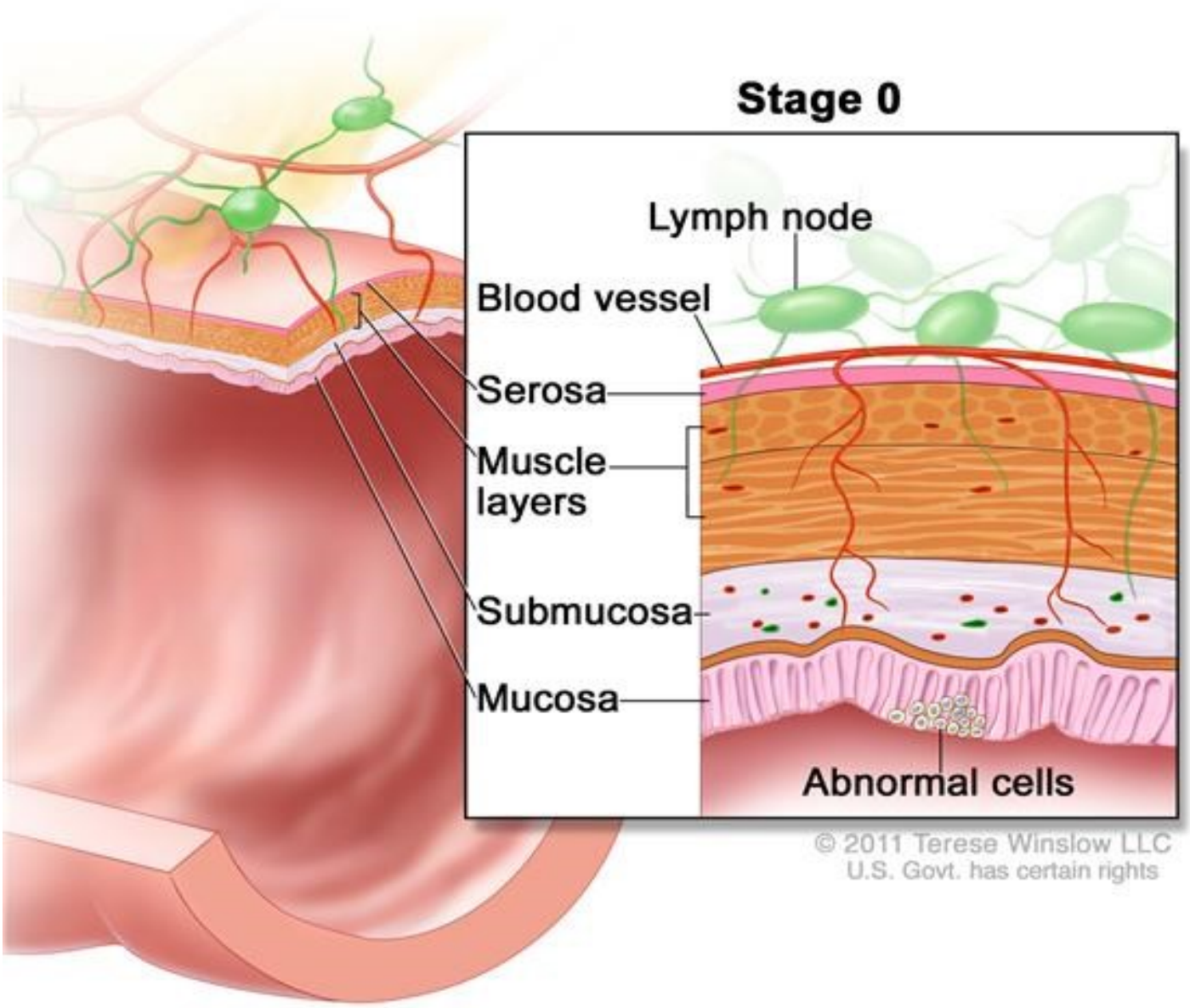
1. Mucosa (Inner Layer)

Three sub-layers

1. Lining epithelium
2. Lamina propria
3. Muscularis mucosae

Mucosa con.

- Epithelium: absorbs nutrients, secretes mucus
  - Continuous with ducts and secretory cells of intrinsic digestive glands (those within the wall)
  - Extrinsic (accessory) glands: the larger ones such as liver and pancreas
- Lamina propria
  - Loose connective tissue with nourishing and absorbing capillaries
  - Contains most of mucosa-associated lymphoid tissue (MALT)
- Muscularis mucosae
  - Thin layer of muscle producing only local movements


Stage 0
Lymph node
Blood vessel
Serosa
Muscle layers
Submucosa
Mucosa
Abnormal cells
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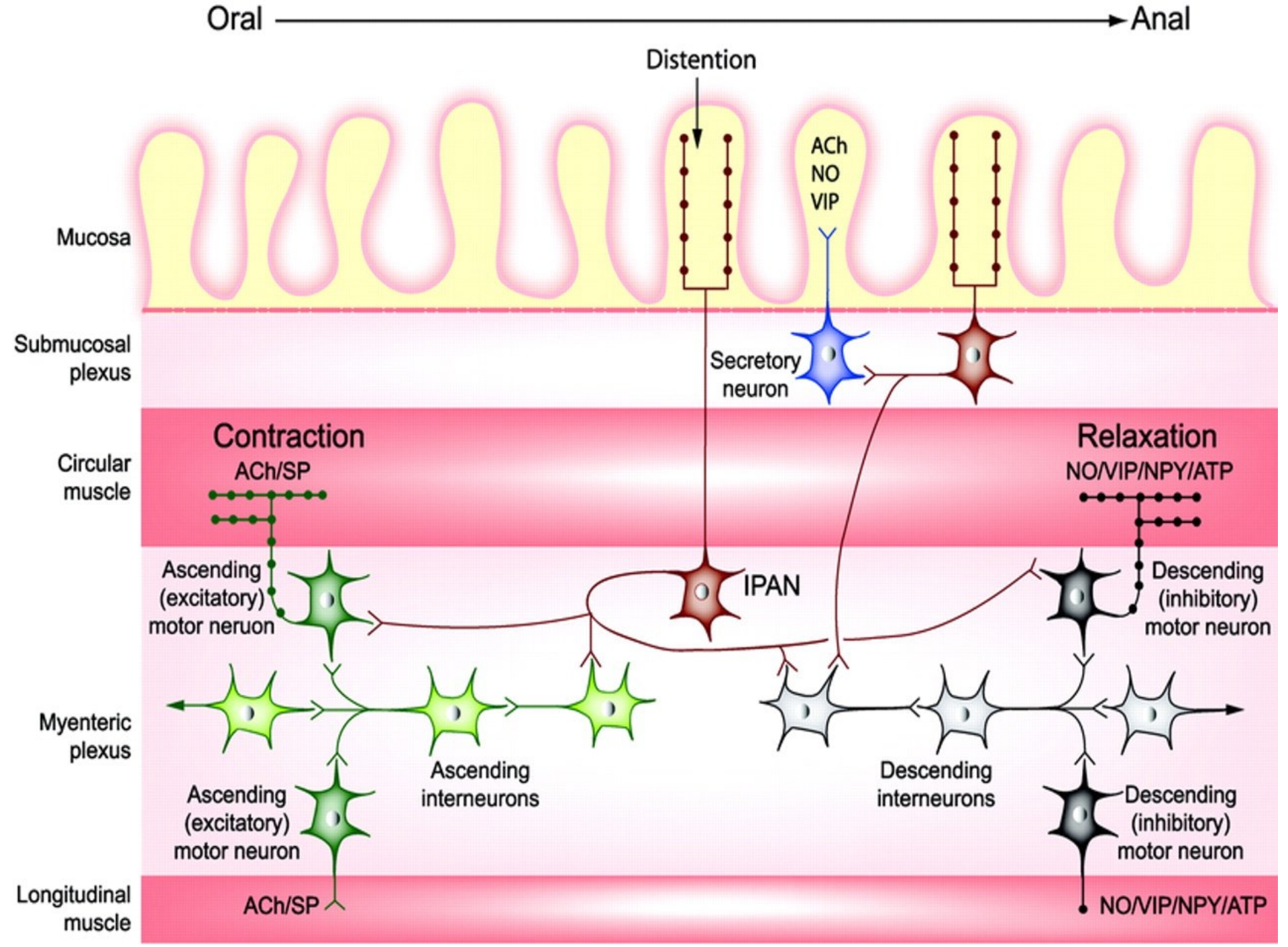
2. Submucosa

- Dense Connective tissue containing major blood and lymphatic vessels
- Submucosal nerves plexus
- Contain Glands and lymphoid tissue
- Contain many elastic fibers so gut can regain shape after food passes

3. Muscularis externa

Two layers of smooth muscle responsible for peristalsis and segmentation

- Inner circular layer (circumferential)
  - Squeezes
  - In some places forms sphincters (act as valves)
- Outer longitudinal layer: shortens gut
- In between lies Myenteric nerve plexus, blood and lymph vessels

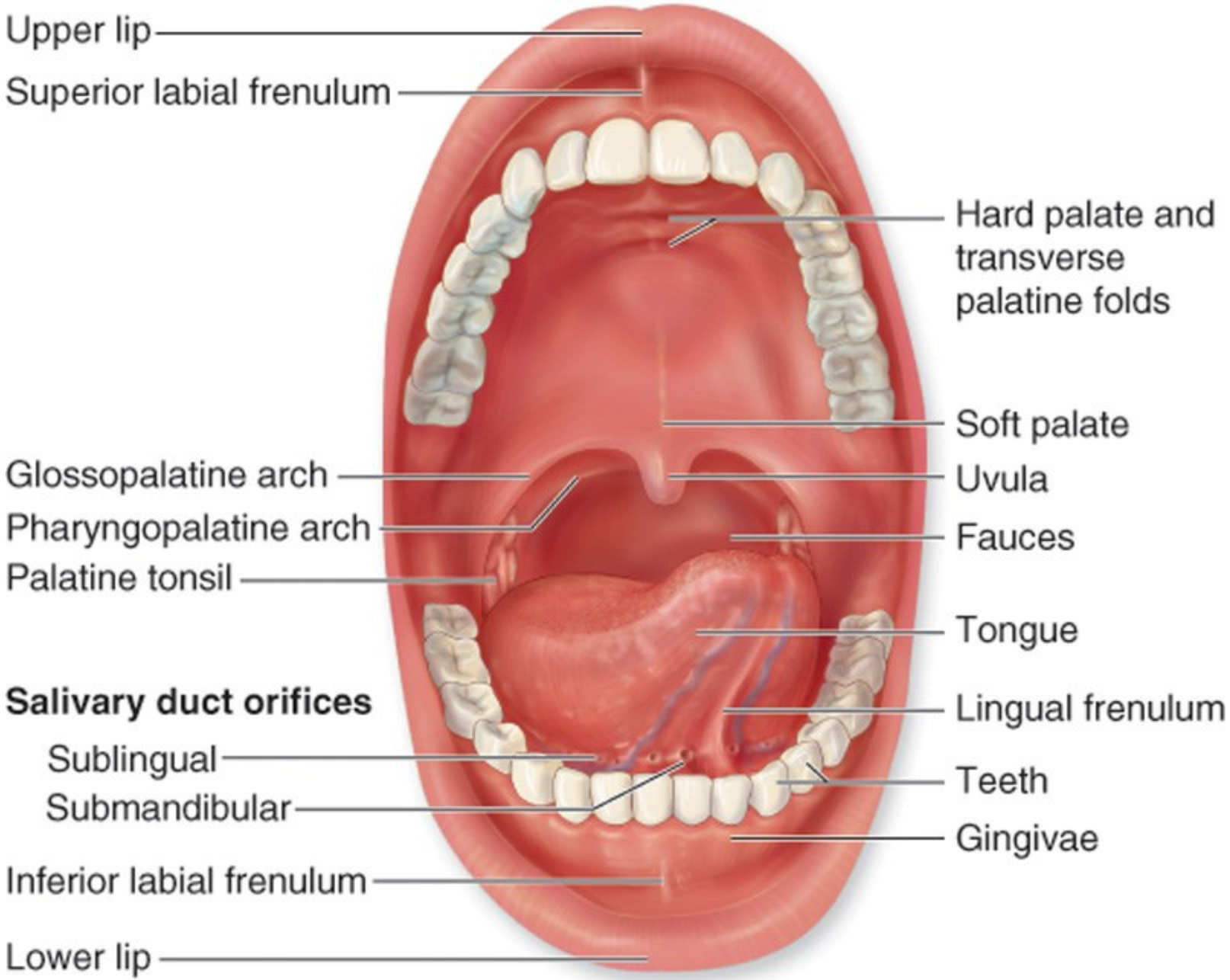

Oral
Anal
Distention
ACh
NO
VIP
Mucosa
Submucosal plexus
Secretory neuron
Contraction
ACh/SP
Relaxation
NO/VIP/NPY/ATP
Circular muscle
Ascending (excitatory) motor neruon
IPAN
Descending (inhibitory) motor neuron
Myenteric plexus
Ascending interneurons
Descending interneurons
Ascending (excitatory) motor neuron
Descending (inhibitory) motor neuron
Longitudinal muscle
ACh/SP
NO/VIP/NPY/ATP

4. Serosa

- Simple squamous epithelium (mesothelium)
  - Thin layer of loose connective tissue underneath rich in blood and lymph vessels and adipose tissue.
- Exceptions:
  - Parts not in peritoneal cavity have thick adventitia, lack serosa
  - Some have both, e.g. retroperitoneal organs

Oral Cavity

- Stratified Squamous epithelium
  - Keratinized layer (gingiva)
  - Nonkeratinized layer (soft palate, lips, cheeks and the floor of the mouth)



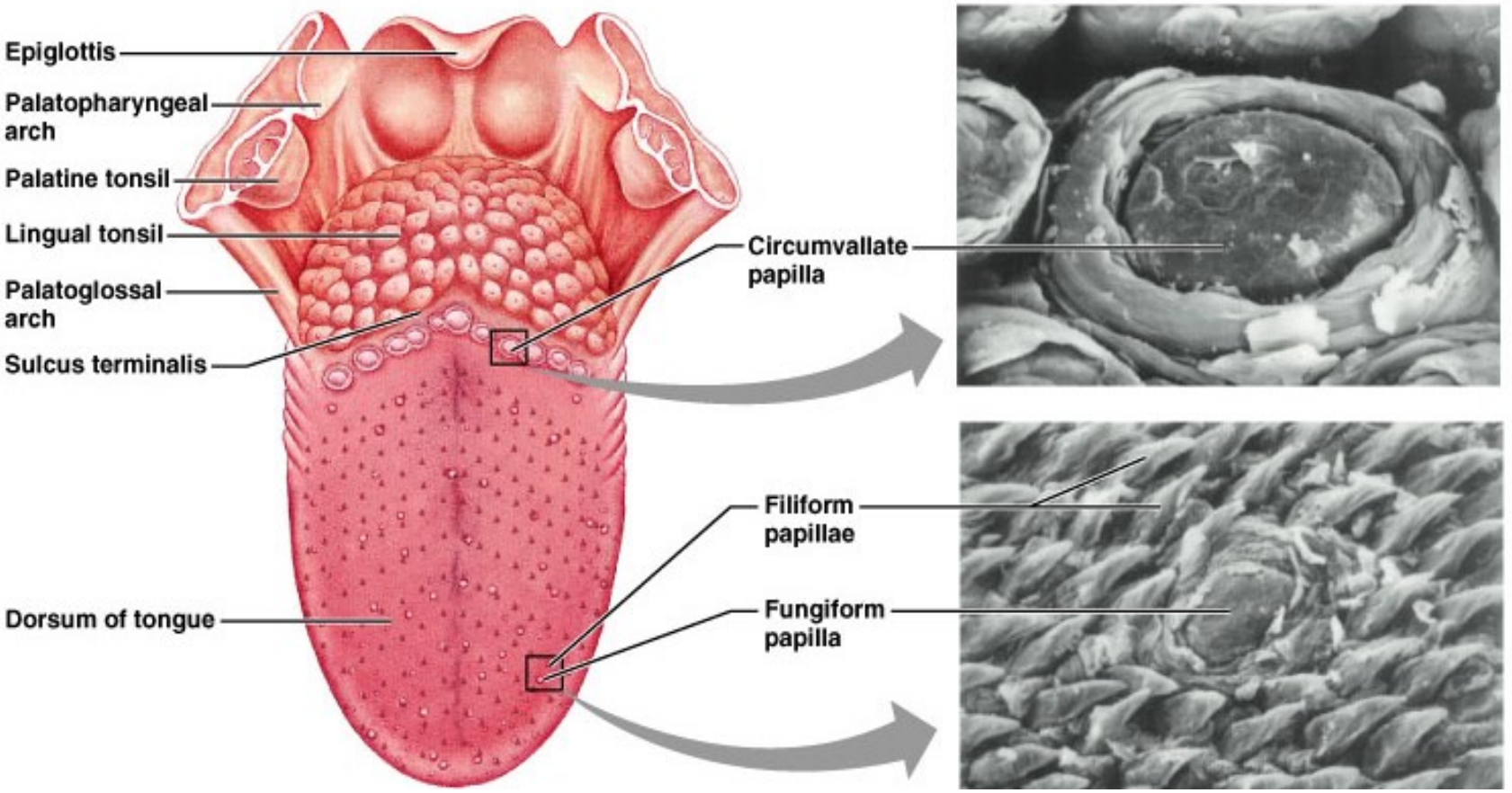
(a)

Tongue

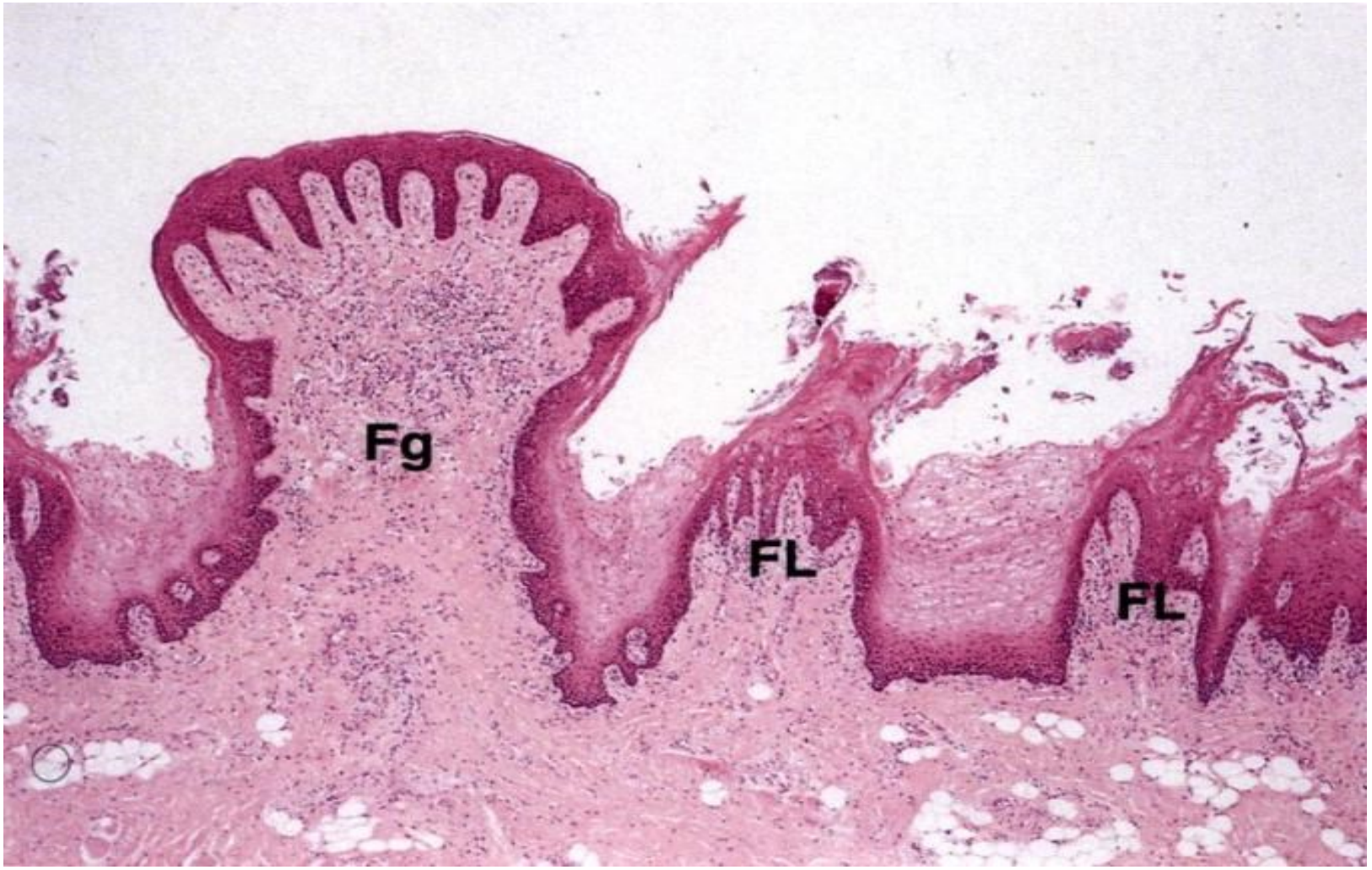
- Striated muscles covered by mucous membrane
  - Grip and reposition food
  - Forms "bolus" of food (lump)
  - Help in swallowing
  - Speech – help form some consonants
- Taste buds contained by circumvallate and fungiform papillae
- Lingual tonsil – back of tongue

The papillae of tongue

- **FILIFORM** (sharp, often partyl keratinized conical projections; most numerous; lacks taste buds
- **FUNGIFORM** (resemble mushrooms; occur singly and scattered; each papilla with taste buds)
- **FOLIATE** (poorly-developed in humans; occur in rows separated by furrows into which serous glands drain; many taste buds)
- **CIRCUMVALLATE** (largest and least numerous (7-12 only; each papilla surrounded by a ring like ridge of mucosa separated by a circular furrow; furrow wall with many taste buds; also with serous (von Ebner's gland)

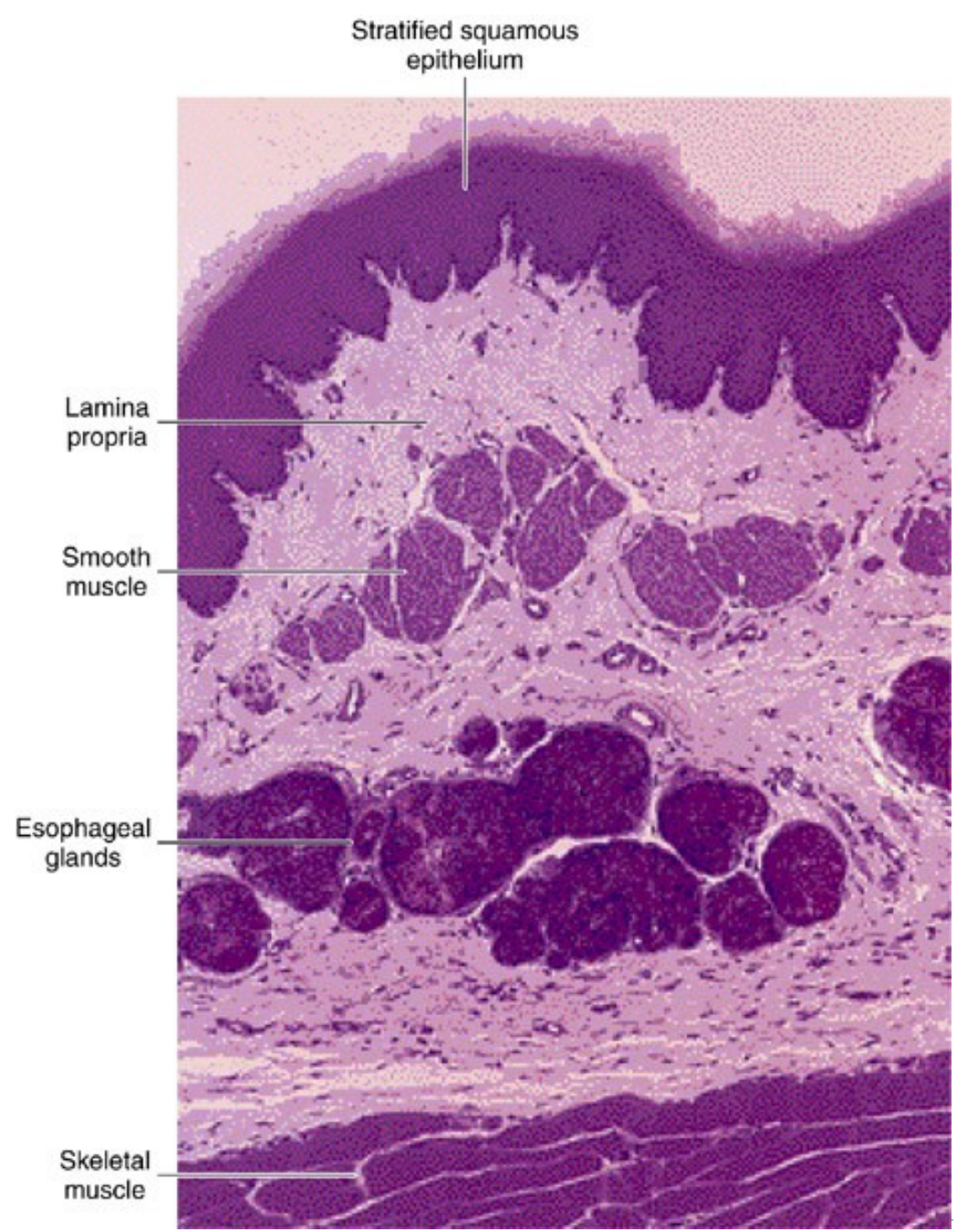

Epiglottis
Palatopharyngeal arch
Palatine tonsil
Lingual tonsil
Palatoglossal arch
Sulcus terminalis
Dorsum of tongue
Circumvallate papilla
Filiform papillae
Fungiform papilla

Filiform and Fungiform Papillae

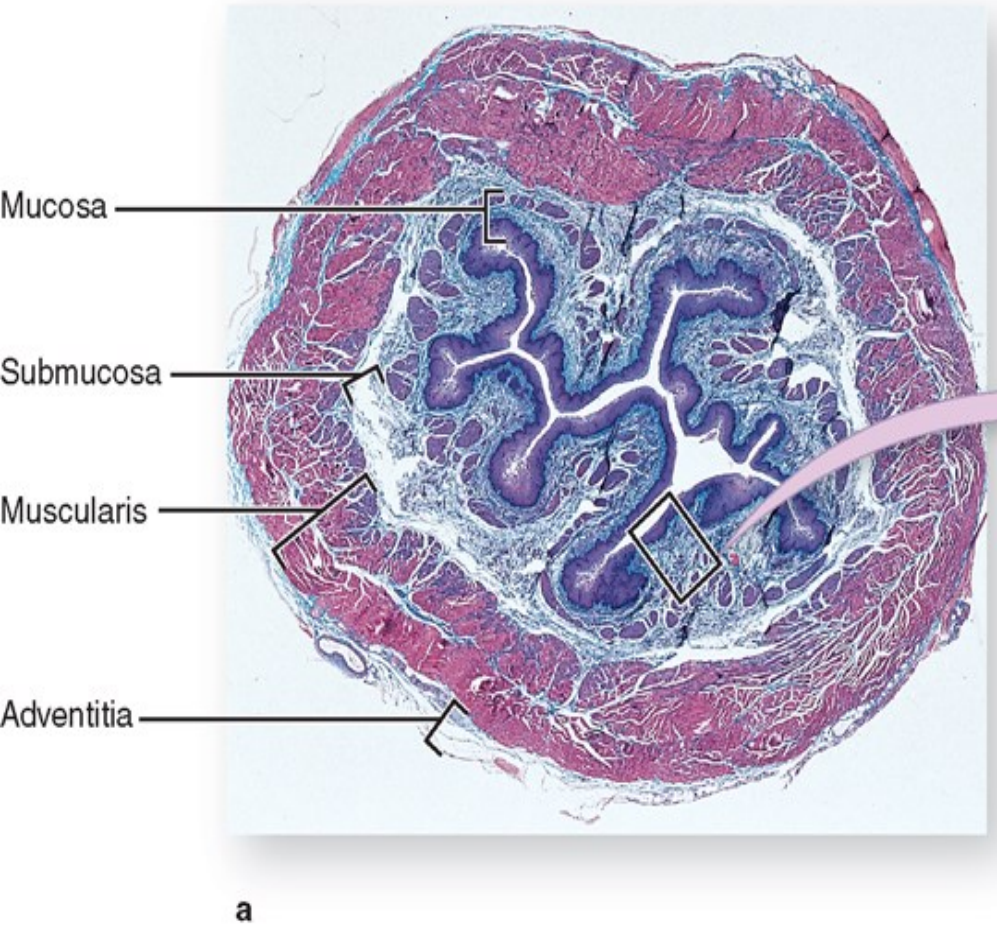


Esophagus

- Muscular tube that transports food from mouth to stomach.
- Lining same as in much of the oral cavity - nonkeratinized stratified squamous epithelium.
- Layers same as general digestive tract as outlined above.



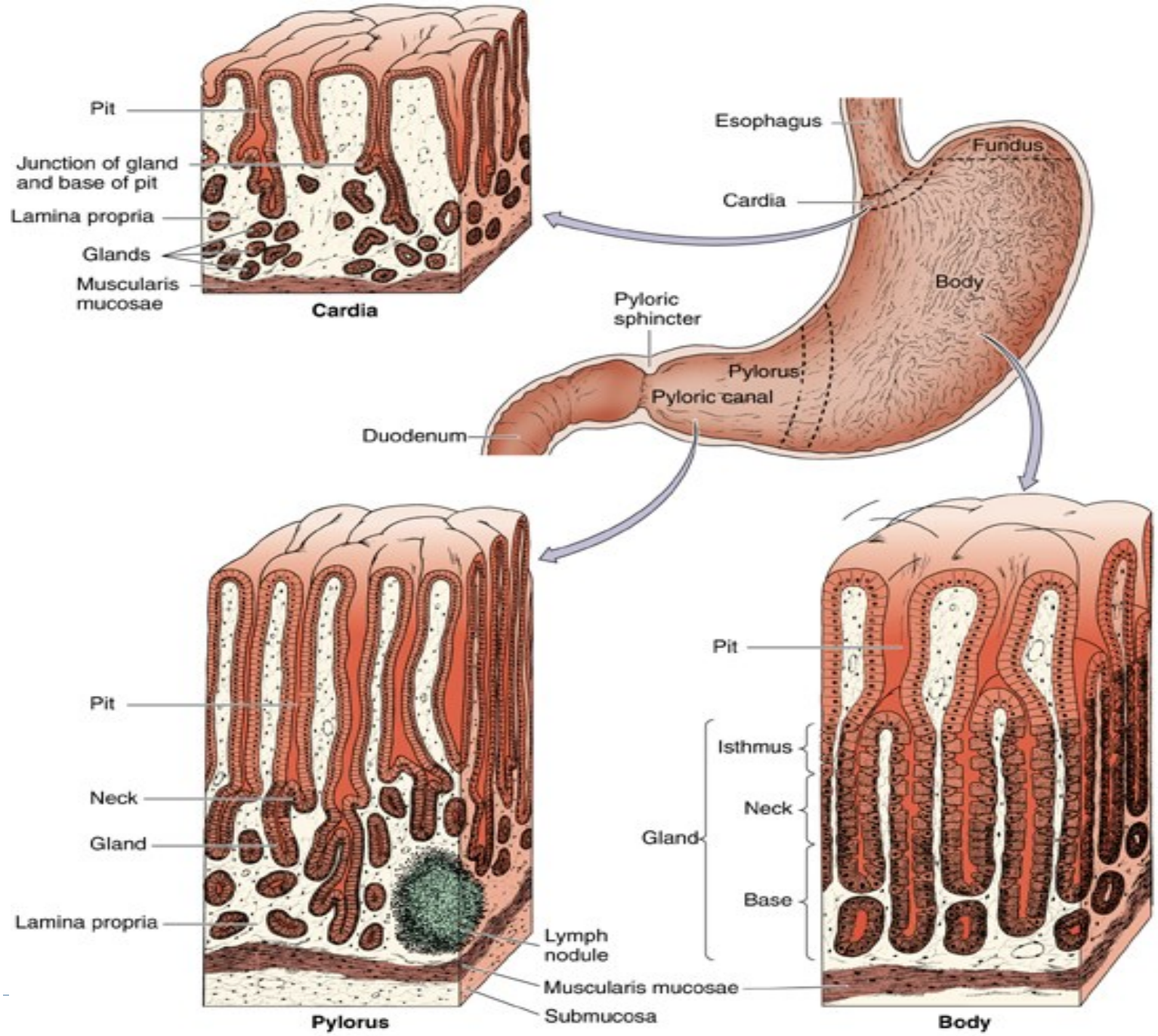
Section of the upper region of the esophagus. Mucous esophageal glands are in the submucosa; striated skeletal muscle is in the muscularis. PAS and PT stain. Low magnification.

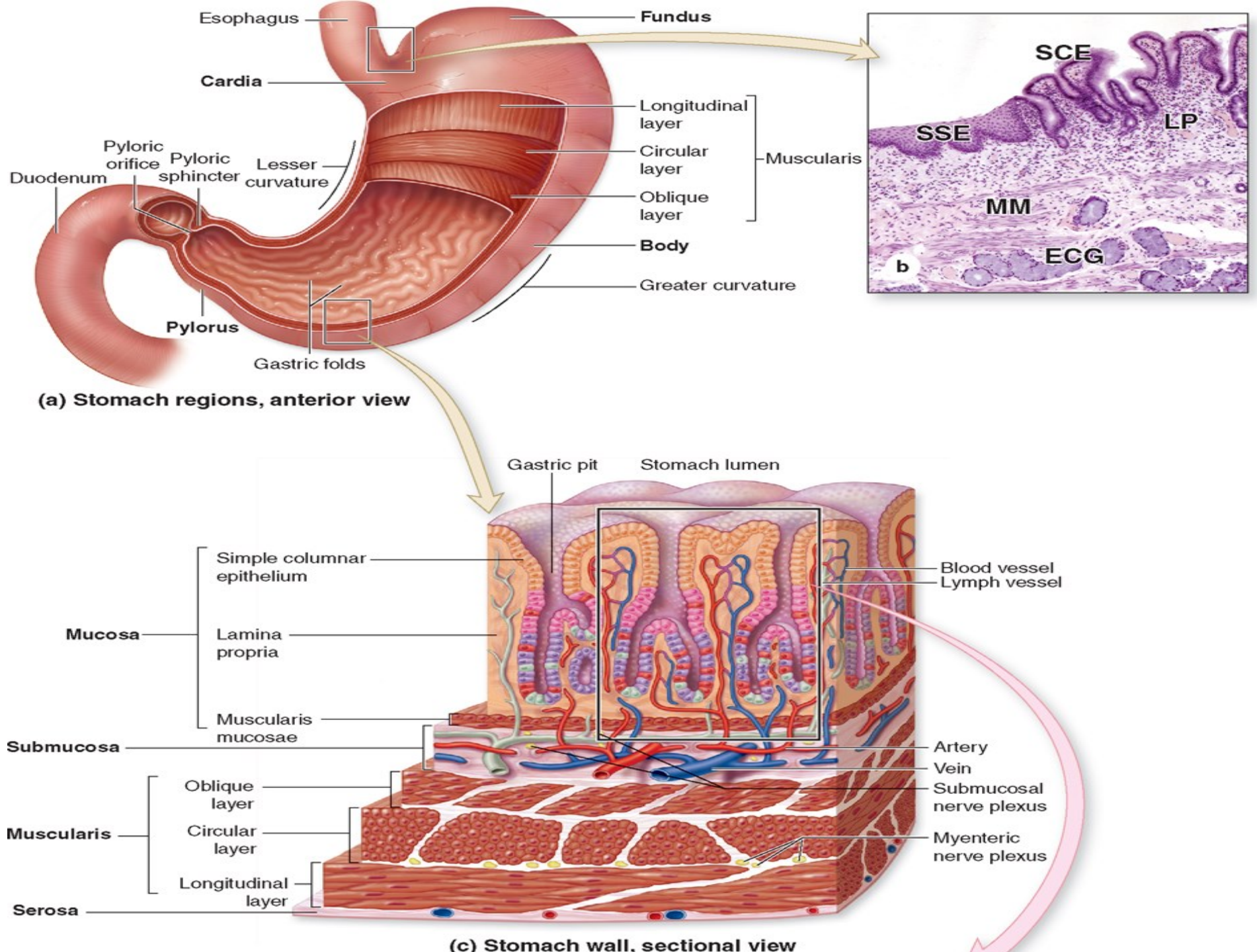


Stomach

There are 3 major regions of the stomach, each with a different histological structure.

1. The cardia - cardiac stomach
2. The body (corpus) and fundus
3. The pylorus - pyloric stomach


Pit
Junction of gland and base of pit
Lamina propria
Glands
Muscularis mucosae
Cardia
Esophagus
Fundus
Cardia
Body
Pyloric sphincter
Pylorus
Pyloric canal
Duodenum
Pit
Neck
Gland
Lamina propria
Lymph nodule
Muscularis mucosae
Submucosa
Pylorus
Pit
Isthmus
Neck
Gland
Base
Body


Esophagus
Fundus
Cardia
Longitudinal layer
Circular layer
Oblique layer
Muscularis
Pyloric orifice
Pyloric sphincter
Lesser curvature
Duodenum
Body
Greater curvature
Pylorus
Gastric folds
SCE
SSE
LP
MM
ECG
b
(a) Stomach regions, anterior view
Gastric pit
Stomach lumen
Simple columnar epithelium
Mucosa
Lamina propria
Muscularis mucosae
Submucosa
Blood vessel
Lymph vessel
Artery
Vein
Submucosal nerve plexus
Myenteric nerve plexus
Oblique layer
Circular layer
Longitudinal layer
Muscularis
Serosa
(c) Stomach wall, sectional view

Stomach

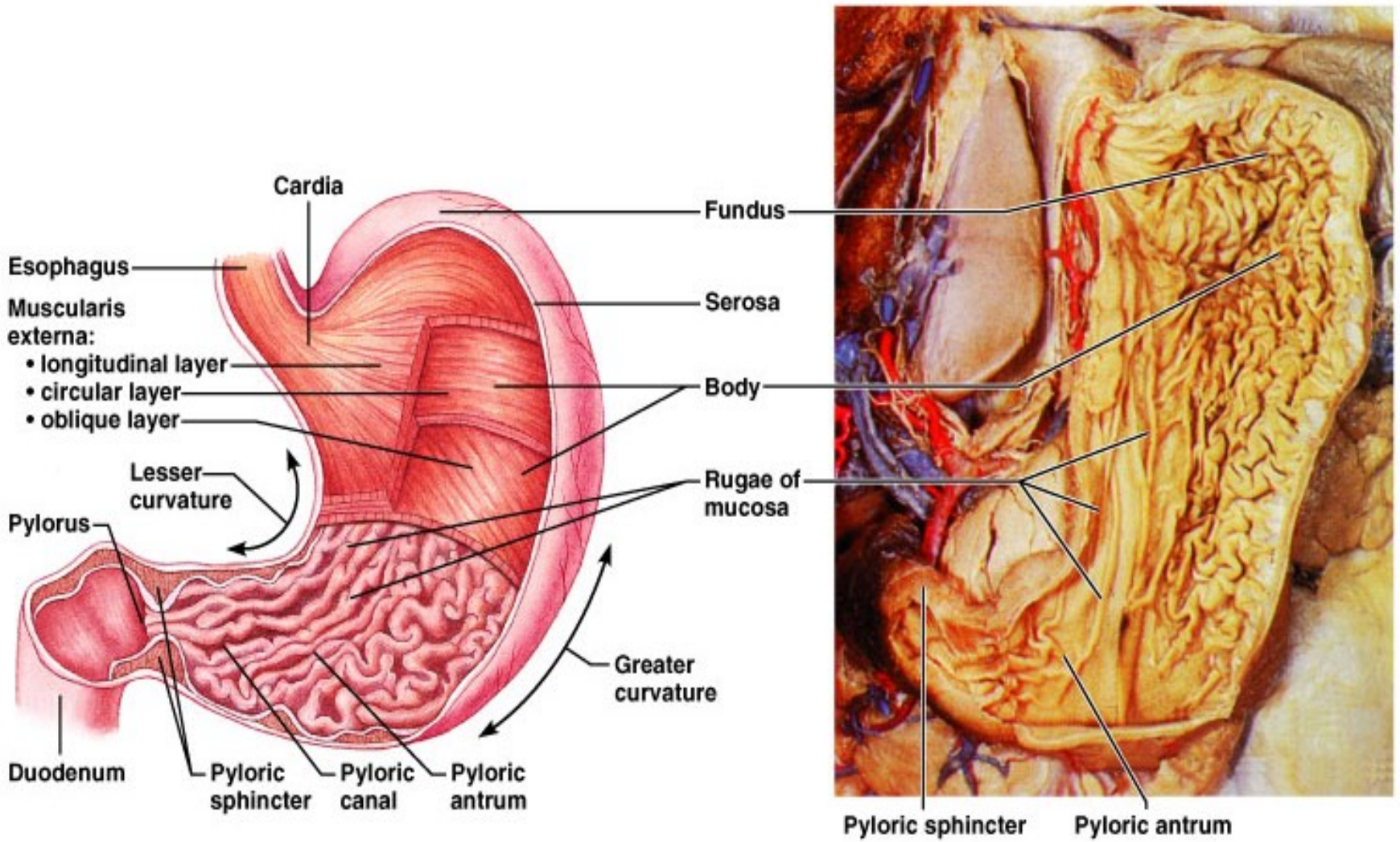
The inner surface of the stomach is thrown into folds called rugae that include both mucosa and submucosa. (see next slide)

1. The mucosa of the rugae is also folded. These folds form invaginatoins, such that the basal areas of the invaginations penetrate into mucosal lamina propria.

2. The upper portion of these invaginations in the mucosa are called the gastric pits - foveolae gastricae.

The epithelial lining of the the pits and general surface area of the stomach consists of simple columnar epithelium of mucous secreting cells in all parts of the stomach.

3. The gastric glands of the stomach connect to the bottoms of the gastric pits. The cellular structure of these glands is different in the different parts of the stomach.

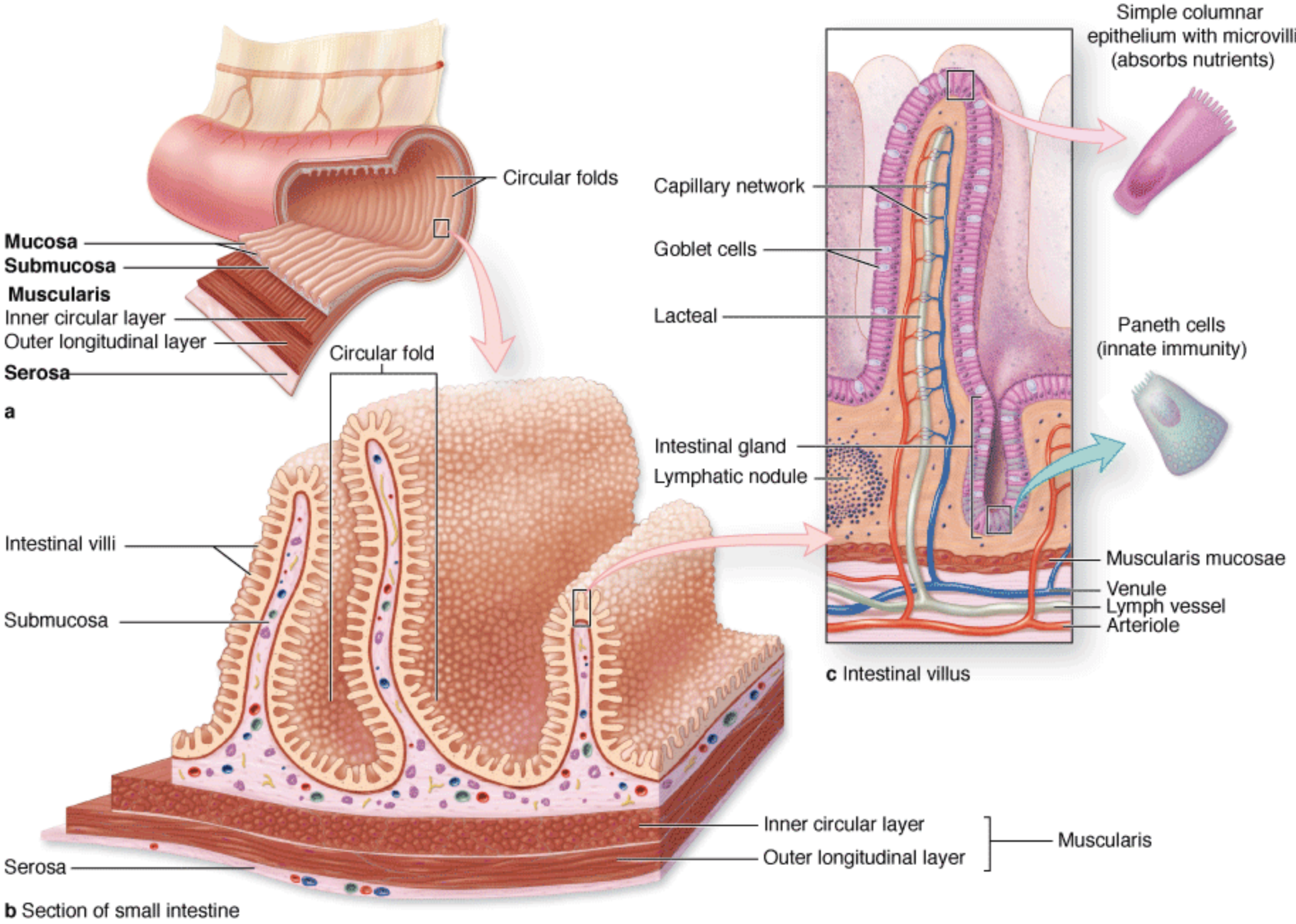

Cardia
Fundus
Esophagus
Serosa
Muscularis externa:
• longitudinal layer
• circular layer
• oblique layer
Body
Lesser curvature
Rugae of mucosa
Pylorus
Greater curvature
Duodenum
Pyloric sphincter
Pyloric canal
Pyloric antrum
Pyloric sphincter
Pyloric antrum

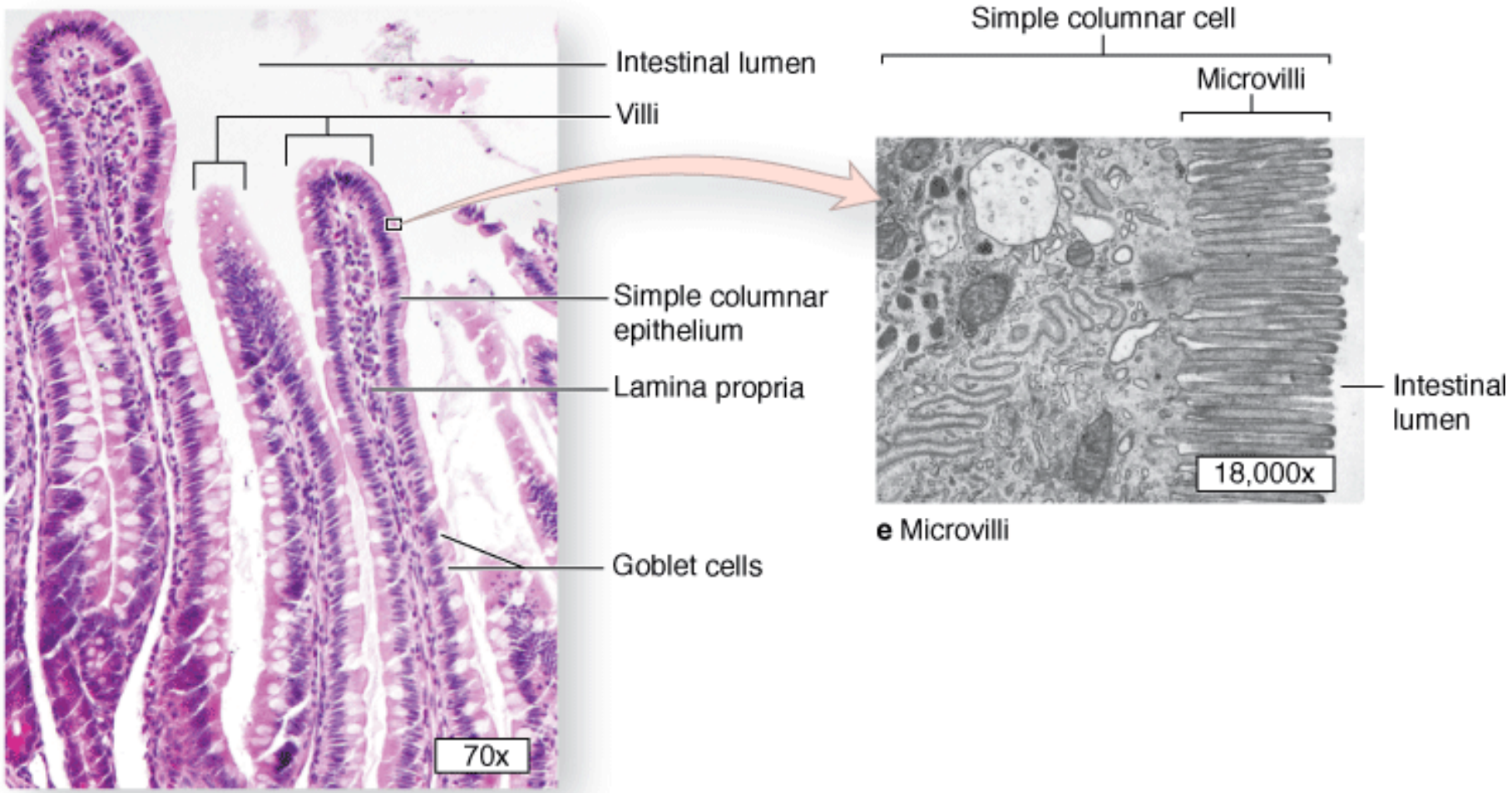
Small Intestine

- Consists of 3 segments

1. Duodenum
2. Jejunum
3. Ileum

- Receives chyme from the stomach, bile from the liver, and digestive enzymes from……...
- Site of complete digestion and absorption.
- Undigested fraction is channeled to large intestine





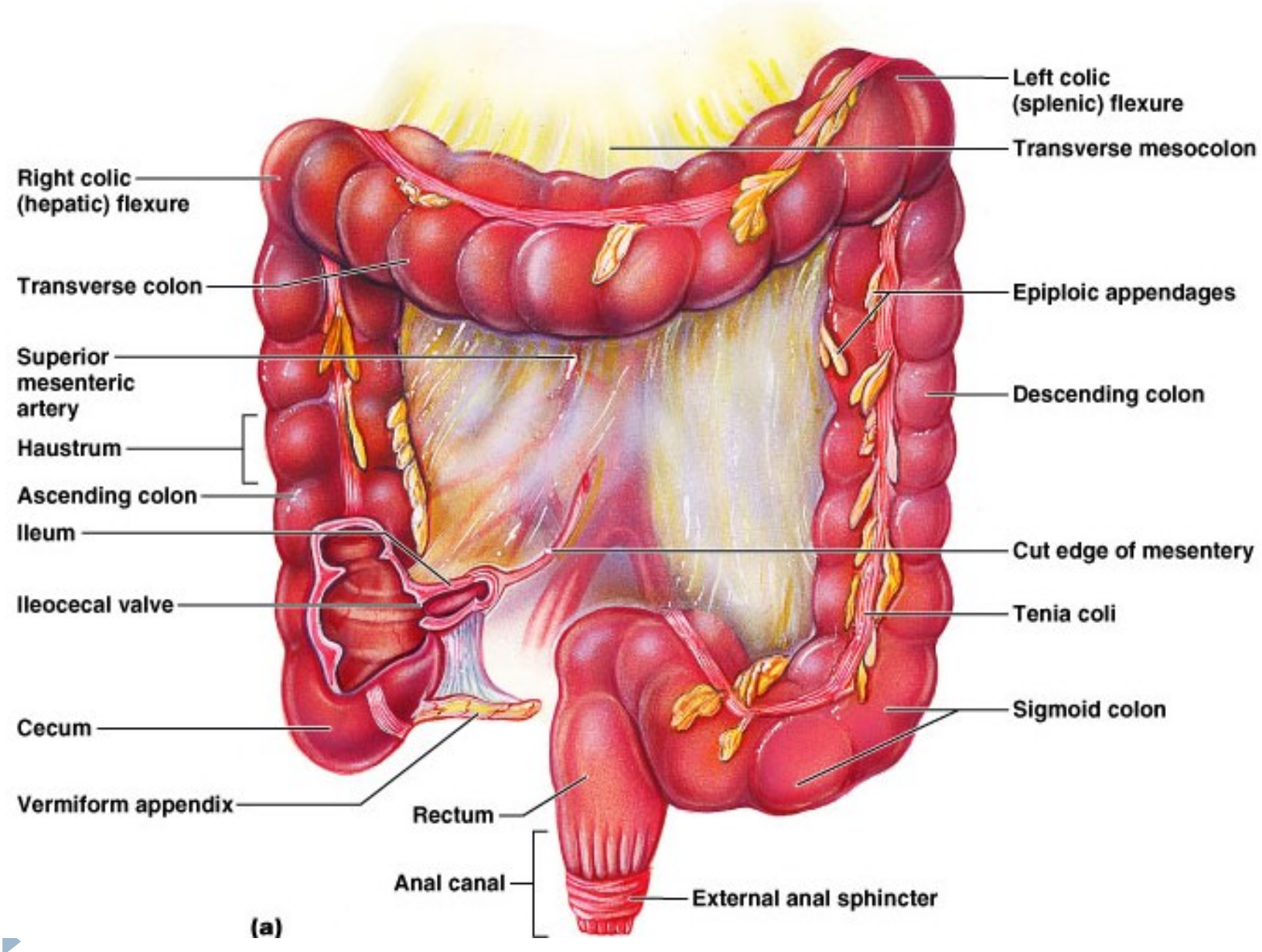
Source: Mescher AL: *Junqueira's Basic Histology: Text and Atlas, 12th Edition:* http://www.accessmedicine.com

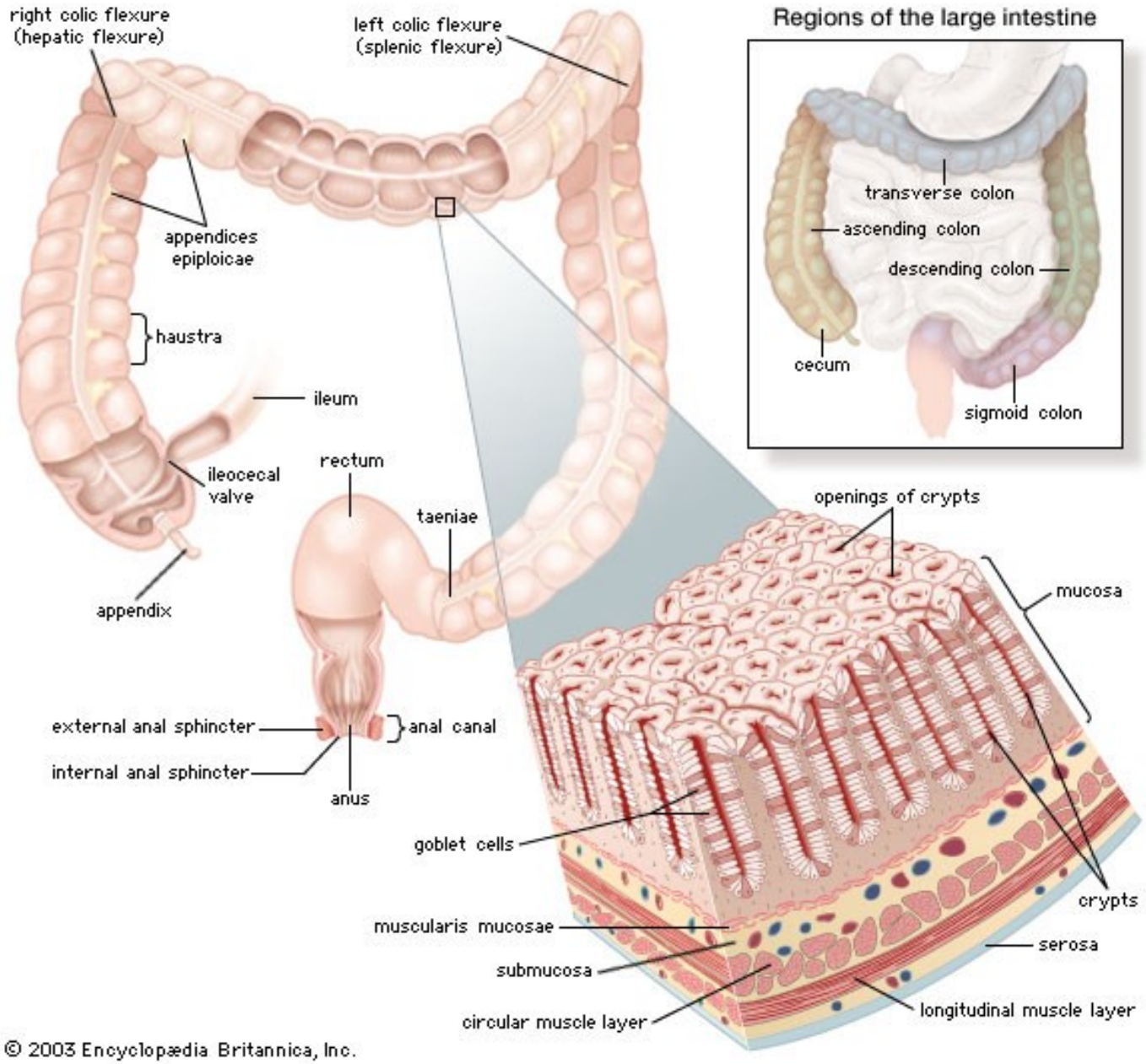
Large Intestine

Consist of

1. Cecum
2. Appendix
3. Colon
4. Rectum
5. Anal canal

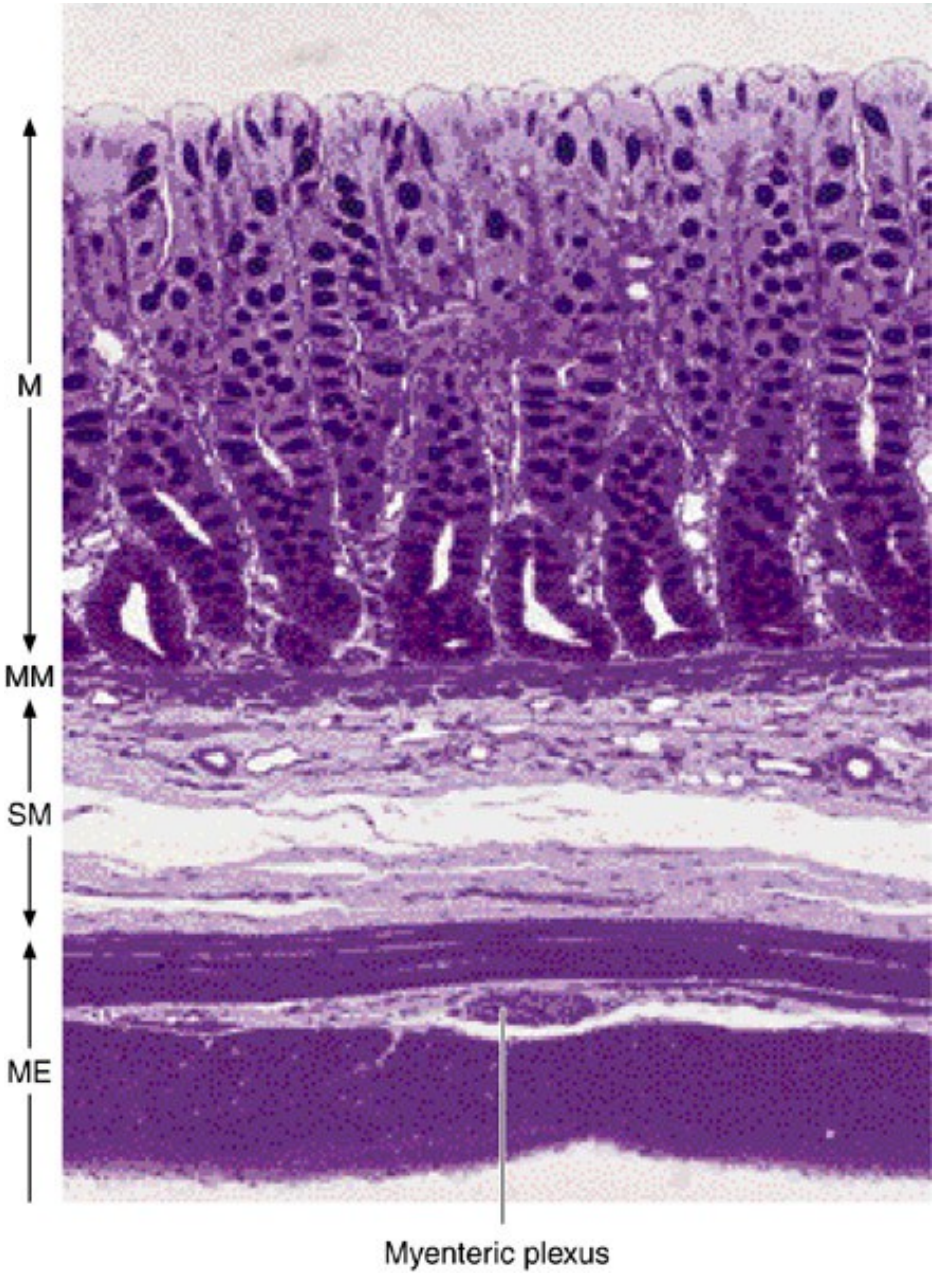
Main Function to absorb water and electrolytes


Left colic (splenic) flexure
Transverse mesocolon
Right colic (hepatic) flexure
Transverse colon
Epiploic appendages
Superior mesenteric artery
Descending colon
Haustrum
Ascending colon
Ileum
Cut edge of mesentery
Ileocecal valve
Tenia coli
Sigmoid colon
Cecum
Vermiform appendix
Rectum
Anal canal
External anal sphincter
(a)



Large Intestine

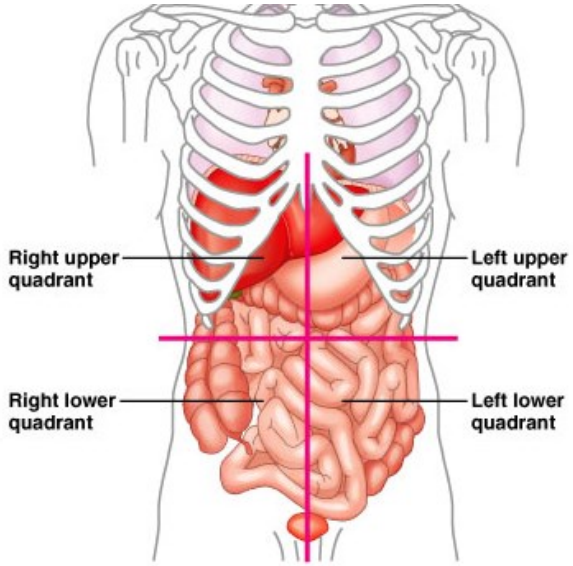
- No villi
  - Fewer nutrients absorbed
- "Columnar cells" = absorptive cells
  - Take in water and electrolytes
- A lot of goblet cells for mucus
  - Lubricates stool
- More lymphoid tissue
  - A lot of bacteria in stool

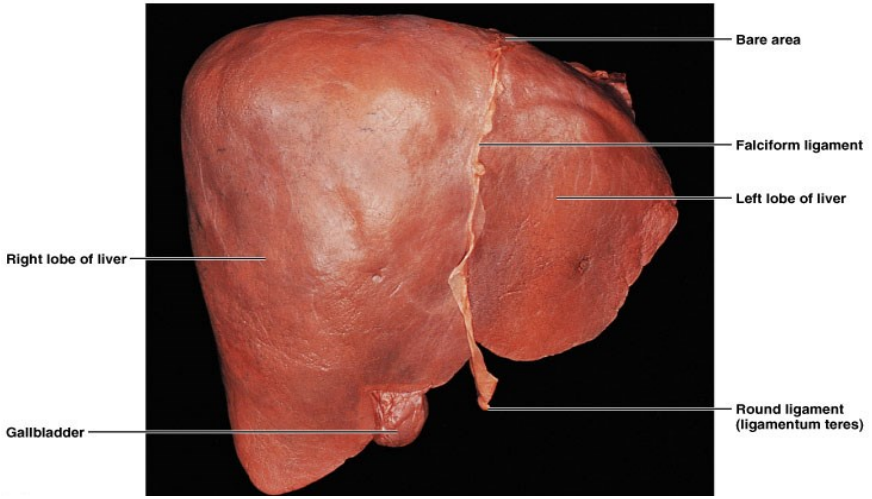


Section of large intestine with its various layers. Note the absence of villi. M, mucosa; MM, muscularis mucosae; SM, submucosa; ME, muscularis externa. PT stain. Low magnification.

Liver structure

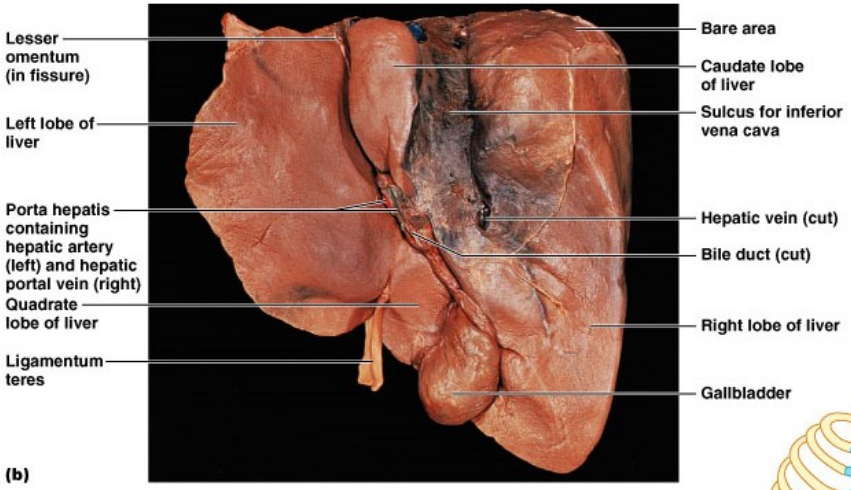
- Largest gland in the body (about 1.5 kg)
- Over 500 functions
- Inferior to diaphragm in RUQ and epigastric area protected by ribs
- R and L lobes
  - Plus 2 smaller lobes
- Falciform ligament
  - Mesentery binding liver to anterior abdominal wall
- 2 surfaces
  - Diaphragmatic
  - Visceral
- Covered by peritoneum
  - Except "bare area" fused to diaphragm

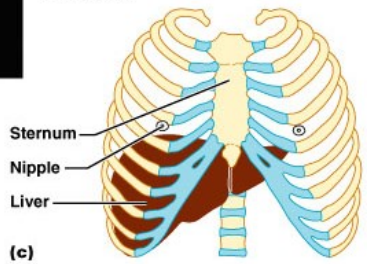


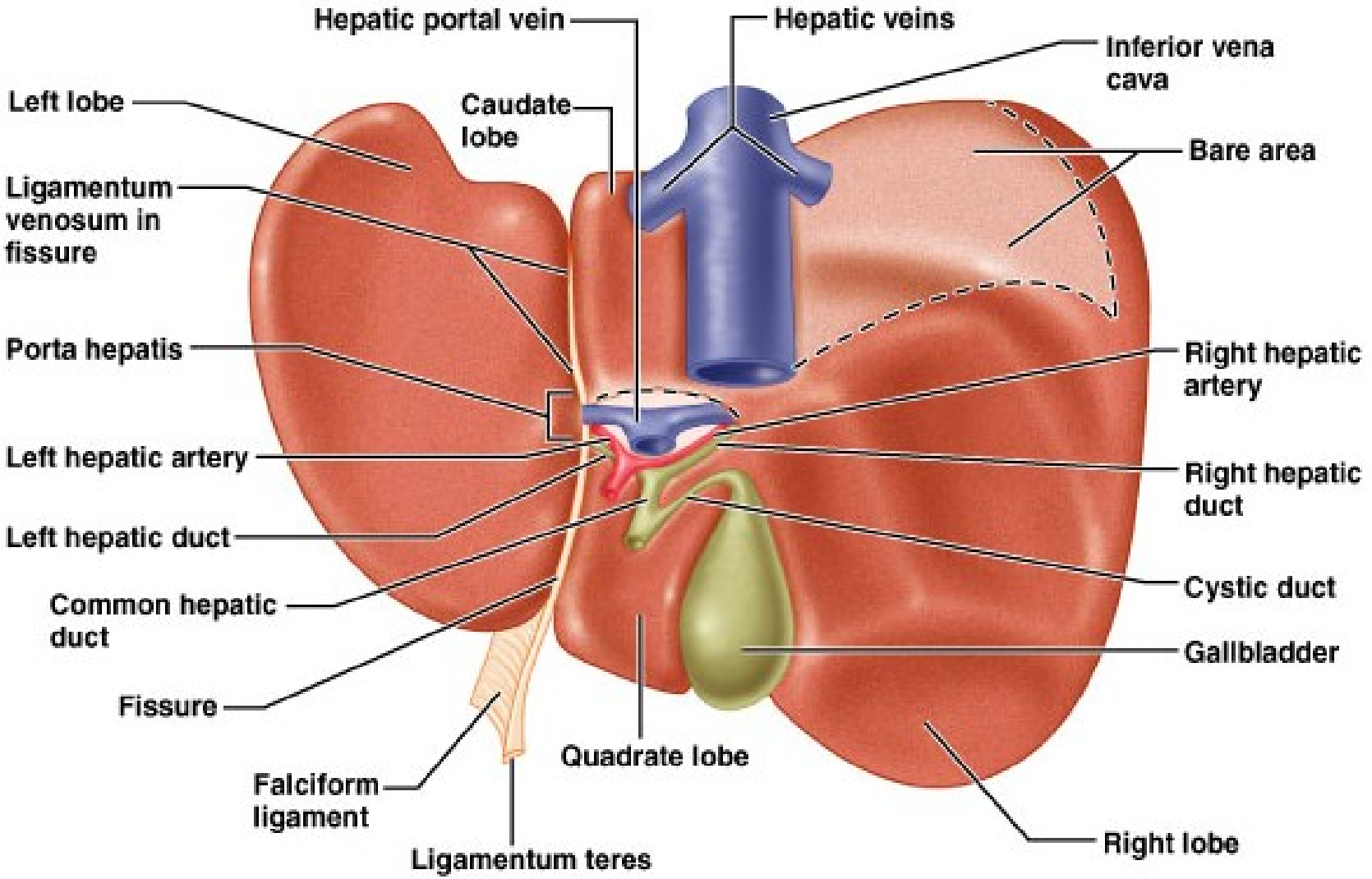


Liver structure con

- Fissure on visceral surface
- Porta hepatis: major vessels and nerves
  - enter and leave
  - Ligamentum teres: remnant of umbilical vein in fetus, attaches to navel

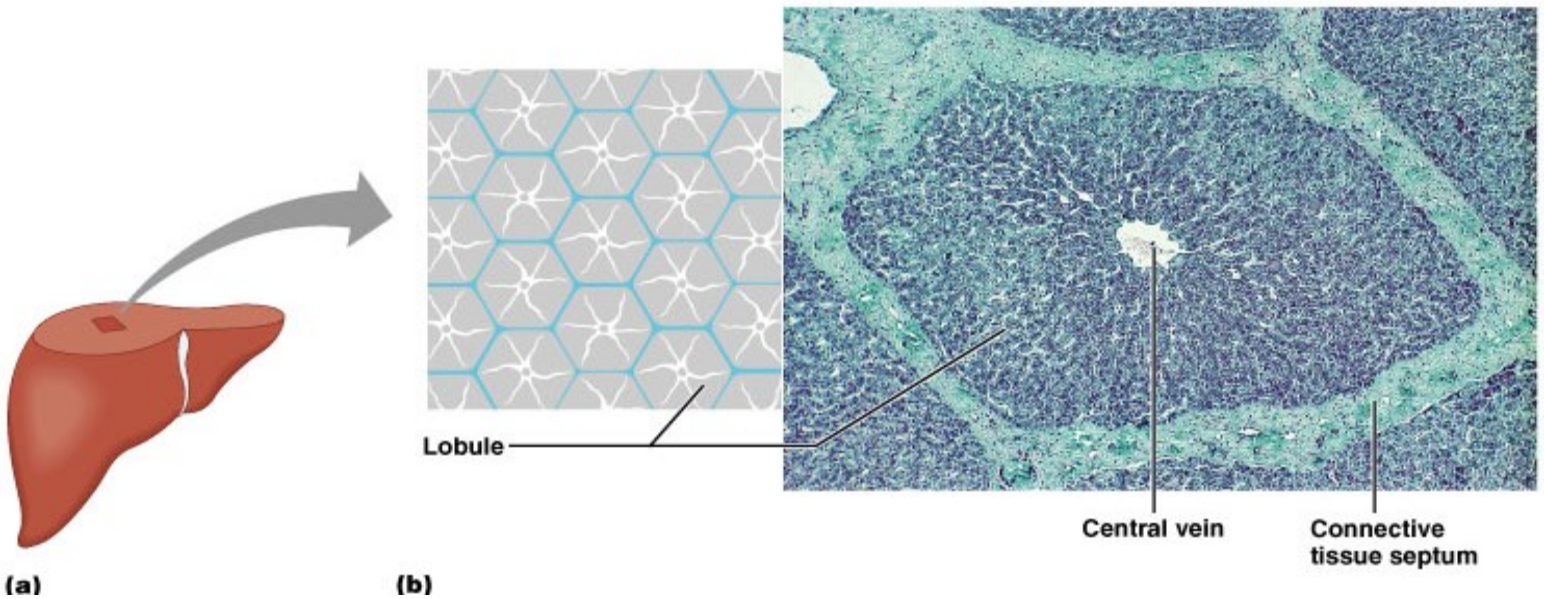





Hepatic portal vein
Hepatic veins
Inferior vena cava
Left lobe
Caudate lobe
Bare area
Ligamentum venosum in fissure
Porta hepatis
Right hepatic artery
Left hepatic artery
Right hepatic duct
Left hepatic duct
Cystic duct
Common hepatic duct
Gallbladder
Fissure
Quadrate lobe
Falciform ligament
Right lobe
Ligamentum teres

Liver Histology

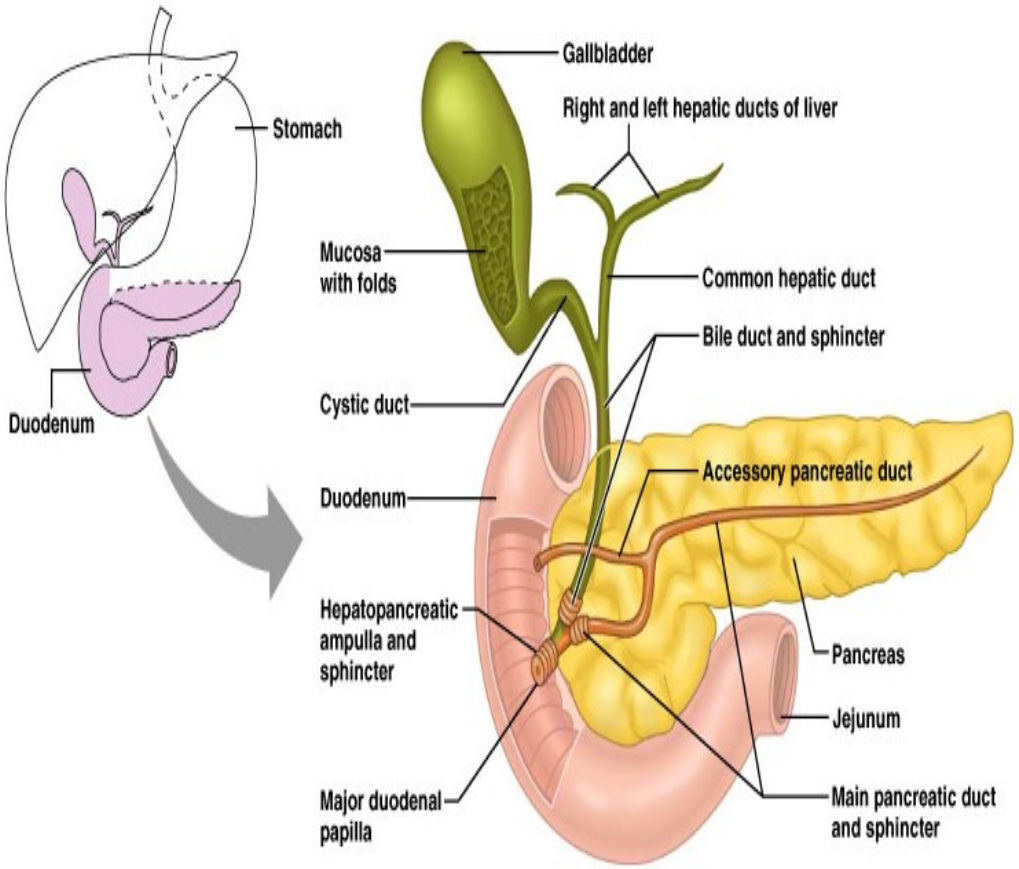
- Liver lobules (about one million of them)
  - Hexagonal solid made of sheets of ***hepatocytes*** (liver cells) around a central vein
  - Corners of lobules have ***"portal triads"***



Gallbladder

- Bile is produced in the liver and stored in the gallbladder then excreted into the duodenum when needed (fatty meal)

- If bile salts crystallize, gall stones are formed



Extra references

- http://instruction.cvhs.okstate.edu/histology/HistologyReference/hrd1.htm
- http://www.youtube.com/watch?v=HA8iL7hs5YY