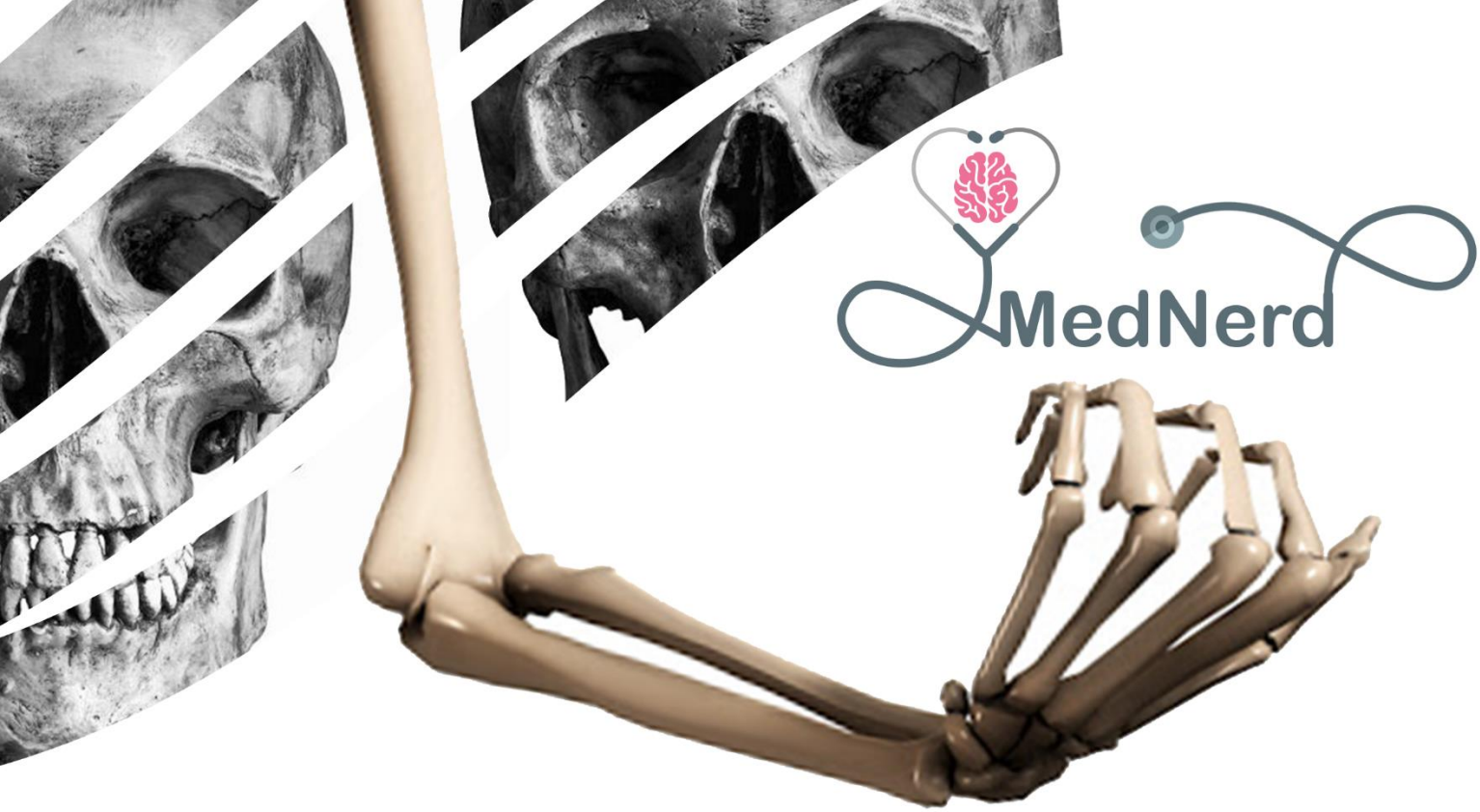

MedNerd

Human Anatomy & Embryology

Lecture: Gastrointestinal system

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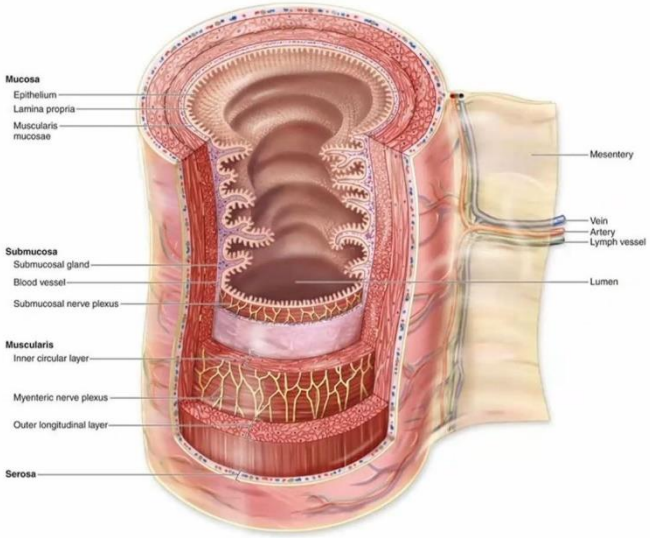
Edited by: Attaieb Shqeerat

#21

Gastrointestinal system

- It starts with the mouth (one of the 4 openings in the face: 2- orbital, one midline nasal opening and lower midline oral opening) → pharynx. → food into the GI tract (esophagus). Majority of organs of the GIS is in the abdomen, and we have organs in the pelvis where the GIT ends.
- In the neck we have the end of the pharynx and the start of esophagus

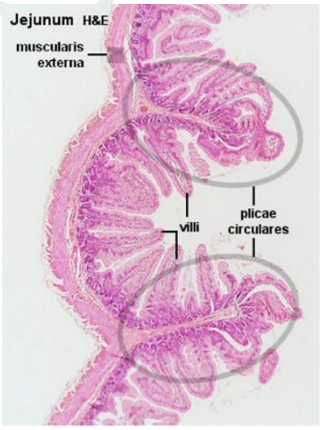
Layers of this tube:



I. Mucosa (tunica mucosa): 3 layers:

- **Epithelium** → absorptive cells (simple columnar epithelium)
- Loose areolar connective tissue **(Lamina propria)**→ basement membrane (has blood vessels, lymphatics and nerve).
- Thin layer of smooth muscle **(Muscularis mucosa)** → not part of the muscular layer of the tube, it acts on the mucosa only and when contracts make simple folds of the mucosa.

Other characteristics:



- Between epithelial cells are endocrine gland cells (made of epithelial tissue) and opening of ducts of major glands of GIS. (Liver or pancreas or salivary gland).
- Has circular folds that has elevations (called plicae circularis) and depression (elevation contains mucosa/ epithelium, lamina propria, and submucosa)
- Epithelium makes a structure called villi to increase absorptive surface, and the epithelial cells has microvilli which increase surface area and absorption even more.

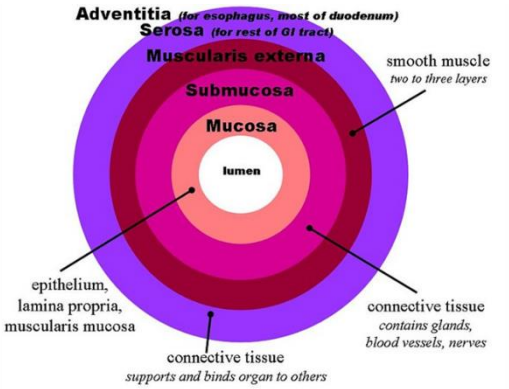
II. Submucosa: (thicker than lamina propria)

- Is a thin loose areolar tissue that contains many blood, neural, and lymphatic vessels. (important for absorbing molecules into the blood stream → through Blood vessels/ important for absorbing fats→ lymphatic vessels/ and has a nerve plexus→ submucosal plexus (Meissner's plexus).
- It is sensory, motor, and autonomic→ symp and parasymp. All = (Enteric nervous system.)
- The neurovascular bundles reach the tube through two folds of peritoneum called: Mesentery.

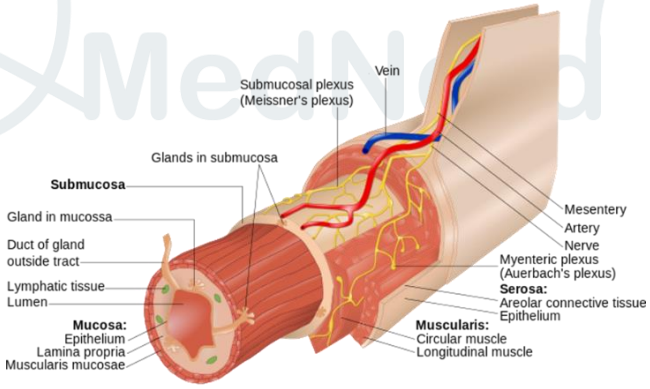
III. Muscularis: (muscular layer)

- Upper part (upper esophagus)→ skeletal muscles
- Lower part (starting from the esophagus)→ smooth muscles
- Their arrangement is (generally): inner circular and outer longitudinal (with some variations and exceptions.)
- Between the two muscle layers we have a nerve plexus called myenteric plexus (Auerbach's plexus.)

IV. Serosa: Outermost layer



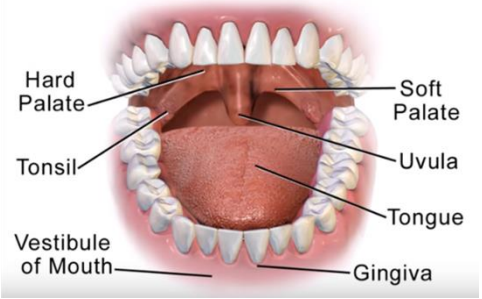
- Visceral serous membrane (peritoneum).
- Made of squamous cells epithelium like any other serous membrane.
- Beneath it a thin layer of loose areolar connective tissue.
- Same arrangement as plural and pericardial cavities.
- Nothing is inside it, and it provides partition between internal organs and abdominal cavity.
- Special arrangement of serous membrane of abdominal organs →mesentery: part of the tube invaginates the parietal peritoneum and get inside the abdominal cavity but not inside the peritoneal cavity (it takes two layers of peritoneum these two layers are called mesentery.)



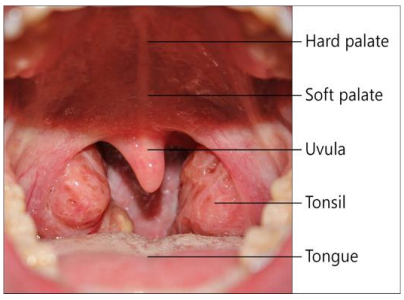
Gastrointestinal tract:

A. Oral canal:

- Has the tongue and salivary glands.
- Vestibule: space between the lips and the teeth, outside the arch of the teeth and most posteriorly it is connected to the proper mouth cavity (inside the arch of teeth) which leads to the oropharynx.
- Door/space between mouth and oropharynx is called → Fauces.



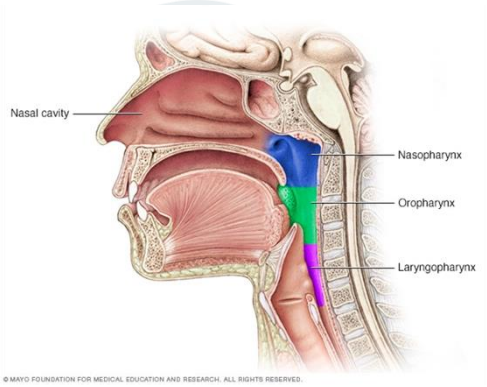
- Tonsils: lymphatic organ that guard the fauces and has an arch Infront of it called anterior arch of soft palate.
- Non keratinized squamous epithelial
- Skeletal muscles.
- Laterally: By the cheeks (outside: skin and buccinator muscle and inside: non keratinized stratified squamous epithelium.)
- Floor: tongue
- Roof:
  1- Hard palate (palatine processes of maxilla and horizontal plate of palatine bone)
  2- Soft palate Muscles and acts as a valve separating nasopharynx from oropharynx when it goes up → swallow food.
  when you're breathing and not eating → It comes down



- Uvula: a protrusion in the middle of the soft palate
- The mouth has salivary glands' openings:
  1- Submandibular glands
  2- Sublingual glands

B. Pharynx:

- non-keratinized
- ends within the neck.



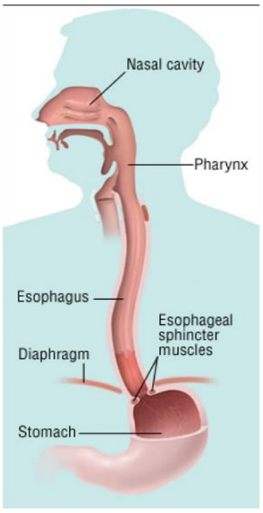
Divided into two ways:

- Anteriorly: RS (larynx)
- Posteriorly GIT (esophagus)

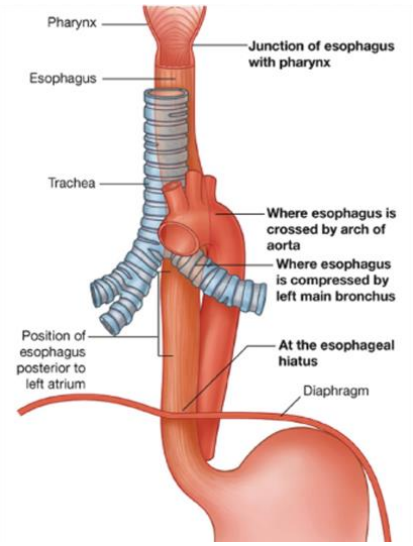
3 parts:

- Nasopharynx: receives air from nasal cavity
- Oropharynx: posterior to mouth opening
- Laryngopharynx: posterior to larynx and opens to esophagus, has epiglottis which control entry of air and block food.

C. Esophagus:

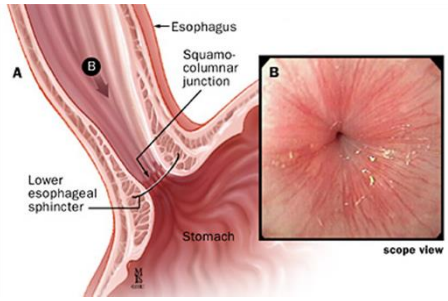


- Starts within the neck (in the posterior mediastinum/ posterior to the heart)
- Upper one third (skeletal)
- Middle third (Combination of skeletal and smooth)
- Lower end of esophagus to the inner anal canal (smooth)
- A muscular collapsed tube (continuation of the pharynx) 25 cm→ right to the descending aorta and as it reaches the diaphragm it has a special opening. (esophageal hiatus (T10): right crus of diaphragm goes up and turns toward the left to surround the cavity), then opens to the stomach.
- Fold of mucosa is longitudinal → allows expansion when we swallow a bolus of food
- Stratified non keratinized squamous epithelial
- Submucosa made of connective tissue has esophageal mucus glands that sends ducts to lumen of esophagus.
- Wavey line at the end of the esophagus is due to sudden change in type of epithelium to the stomach's epithelium (columnar)
- NO VALVE (between stomach and esophagus) / NO THICKNING OF INNER CIRCULAR MUSCLES OF ESOPHAGUS.
- Heartburn → content of stomach goes opposite to the physiological direction and burn the epithelial of esophagus (changes from squamous into columnar)
- Endoscope: camera attached to a tube to observe the stomach and esophagus from the inside.



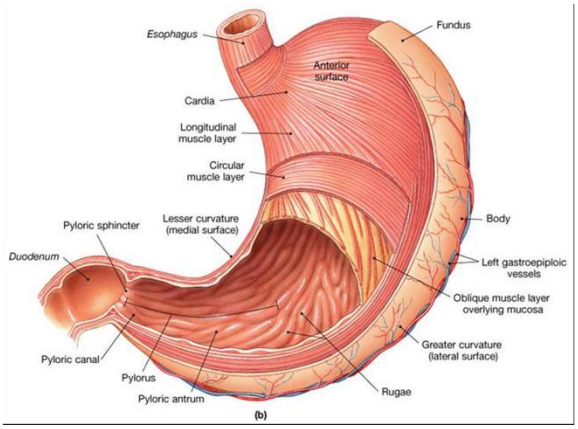
- Blood supply: segmental → multiple and come from descending thoracic aorta, and drainage is done by portal system.

3 parts:

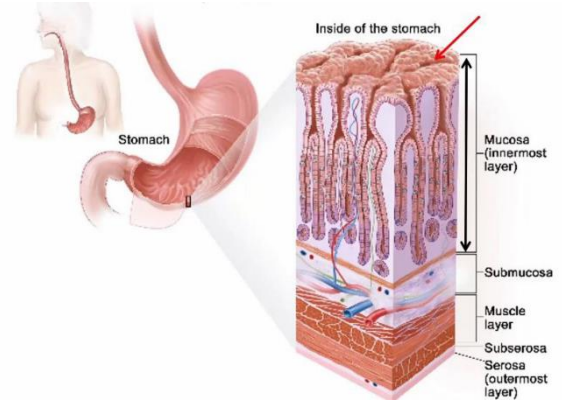


- Neck → short one (C6) inferior to pharynx
- Thorax → longest one (posterior mediastinum)
- Abdomen (where we have the majority of the digestive system's organs) → short part and turns to the left to join the stomach. (2 cm)

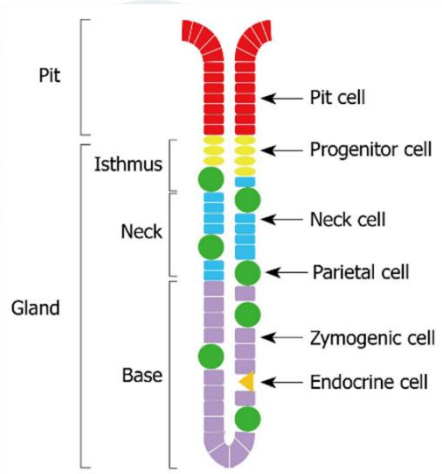
D. Stomach: *(simple columnar – absorptive type of epithelial)*



- Dilated part and stores food for short period of time and J shaped
- It is not smooth and has longitudinal folds called Rugae (wrinkles or creases)
- Mixing food and deal with it chemically by adding enzymes
- When ready for absorption sends it to the small intestine
- 3 muscular layers not two (third layer is the inner most, *oblique -not circular or longitudinal-*, and helps in mixing food.)
- Blood supply: multiple blood supply (stomach almost never infarcts)
- Blood drainage: Portal system (anything absorbed will go to the liver، not blood circulation directly – example: drugs metabolized)
- Nerve supply: Vagus nerve→ production of hydrochloric acid.

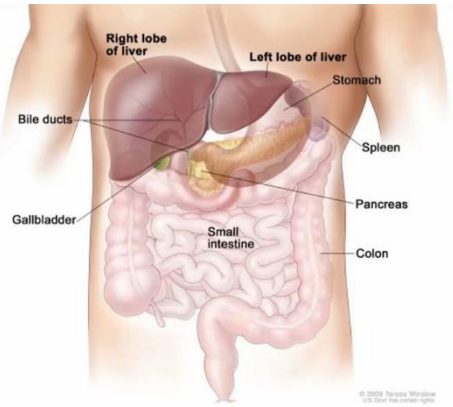


- Tubular glands that go down and make the mucosa the thickest part of the GIT and it secrets hydrochloric acid, enzymes, and mucus for (protection).
    1. Higher part → pit cell (mucus secreting)
    2. Gland (Parietal cells are distributed all over the following)
        - Isthmus → mostly progenitor cells (develop onto another type of cells to replace damaged and dead cells)
        - Neck → mostly Neck cells
        - Base → Zymogenic cells and few endocrine



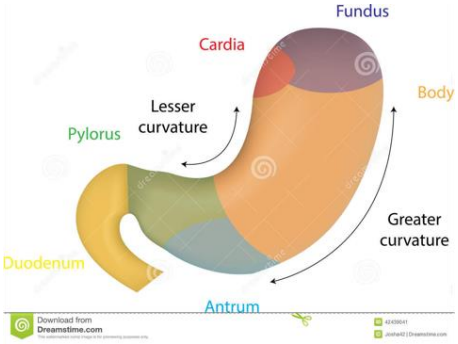
Relations of stomach:

- Stomach is inferior to the left lobe (crosses midline- has depression for fundus of stomach and esophagus) of the liver
- Spleen is to the far left of the stomach
- Stomach is superior to the transverse segment of large intestine
- Fundus of stomach is also covered by diaphragm.



Parts of the stomach:

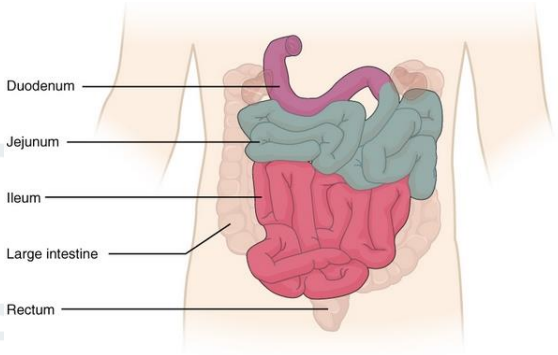
- Cardia: where esophagus joins the stomach
- Fundus: Upper most dome-shaped structure
- Body: major central part
- As stomach goes down toward the right → antrum
- Pyloric area: last portion where it connects to the duodenum.
- Lesser curvature: inside and shorter and connected to two layers of peritoneum going to the liver called lesser omentum.

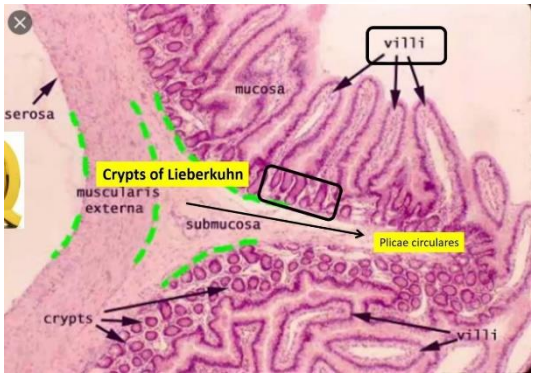


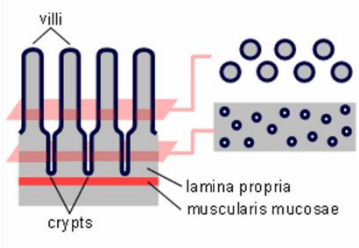
- Greater curvature: long from cardia → fundus → body → antrum → pylori where it ends and connected to two layers of peritoneum that goes back up again (total of 4 layers) and called greater omentum

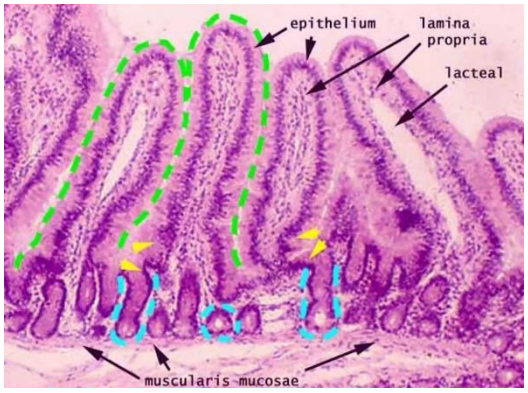
E. Small intestine: *(simple columnar – absorptive type of epithelial)*

- Duodenum 1st and the 2nd jejunum and 3rd ilium.
- Where absorption occurs
- Then the rest is sent to the large intestine
- Mucosa is not smooth, has villi and cells has microvilli (increase surface area, thus increase absorption), and it has an extra fold of mucosa.
- Underneath villi there are glands for enzymes and some hormones at bottom of mucosa.
- Plicae circularis: circular folds to increase surface area -- submucosal center that has all type of vessels and villi on surface which are absorptive simple columnar cells with microvilli -- (more in jejunum (why?) → more absorptive.)
- Crypts of Lieberkühn are the simple tubular glands within the lamina propria between and beneath the villi.
- Blood supply: celiac trunk and superior mesenteric artery.



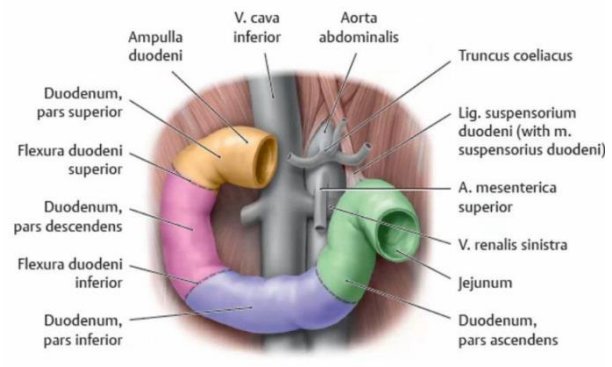






1. ***Duodenum*** receives stomach's contents through pyloric sphincter: thickening of the inner muscular circular muscle that act as a valve

Parts:

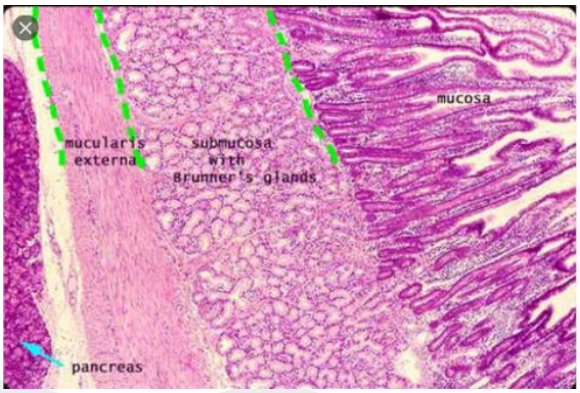


⇒ First part of duodenum → ampulla (horizontal)

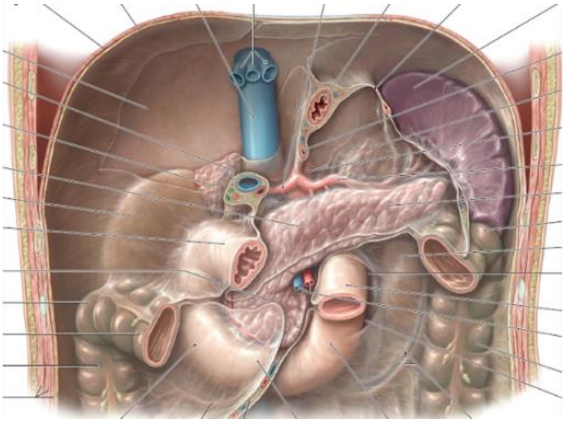
⇒ Second part→ vertical (descending part)

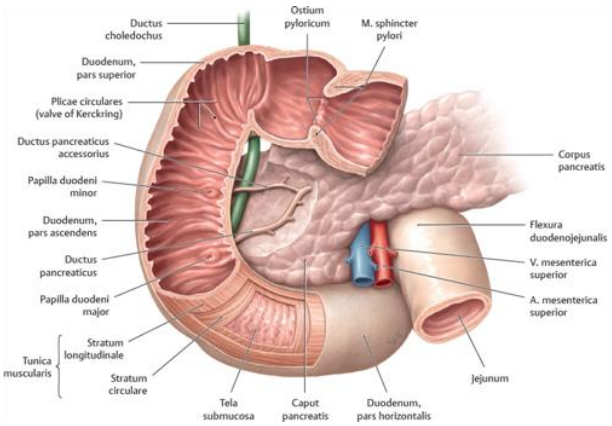
⇒ Third part → horizontal crosses the midline (transverse)

⇒ Fourth → ascends up and joins the jejunum. (ascending)



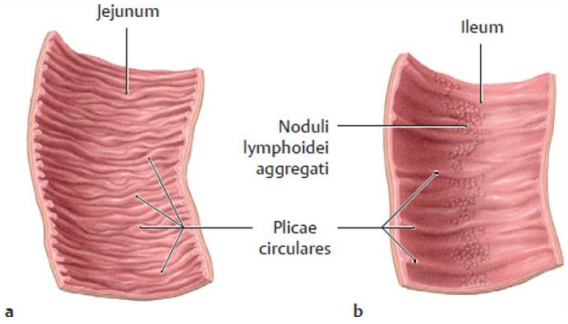
- It is stuck on the posterior abdominal wall because it lies deep to the peritoneum (extraperitoneal) peritoneal wall fixes it on the posterior abdominal wall.
- Then the rest is sent to the large intestine
- Brunner's glands: produce mucus and bicarbonate (in the submucosa)
- Common bile duct from liver is posterior to 1st part of duodenum and on inner side of the second part it joins pancreatic duct and opens to the greater duodenal papilla on the medial side of the second part of duodenum.
- Pancreas goes through the C shaped duodenum and it is superior to the 3rd part of duodenum (head of pancreas inside the C shaped.)
- Deep and posterior to the neck of pancreas there are mesenteric artery and vein
- Lymphatic tissue that produces lymphocytes (MALT)





2. *Jejunum:*

- Very absorptive upper part of small intestine and inferior to body of pancreas
- More absorptive, thus more plicae circularis.
- Upper left part of the abdominal cavity.
- The Widest
- Longer villi and more microvilli
- Crypts are deeper

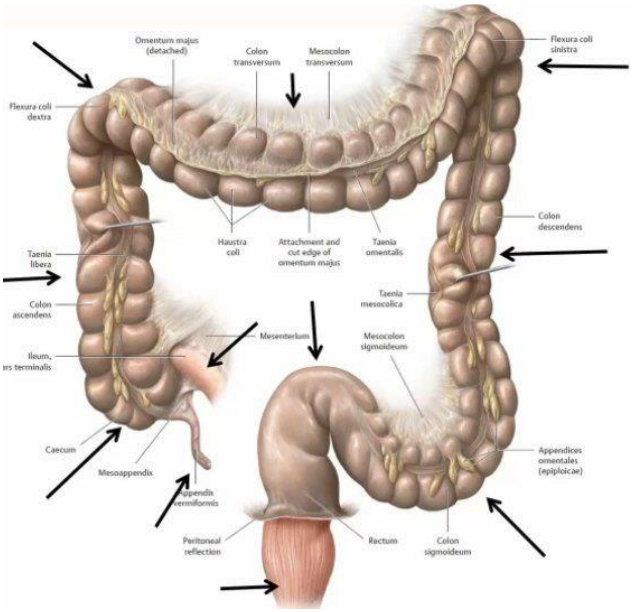


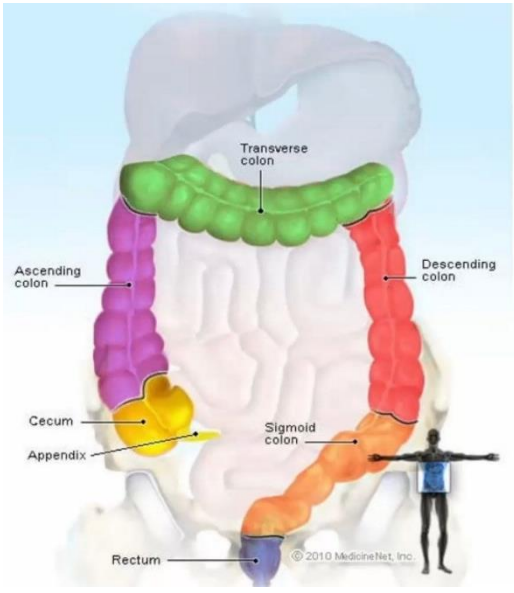
3. *Ilium:*

- Right iliac fossa/ lower right side of the pectoral girdle.
- Lower plicae circularis
- Shorter villi
- Low absorption
- High lymphatic tissue

F. Large intestine: *(8 parts) (simple columnar –absorptive type of epithelial)*

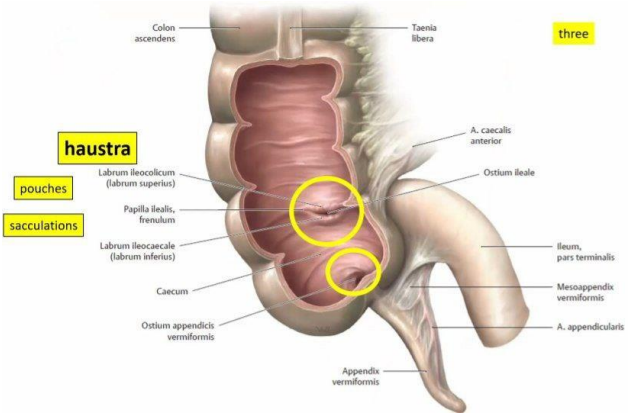
- Goes across the abdominal cavity.
- Special glands, mucosa, and muscular arrangement
- Ascending part → transverse → descending → curved part (in the left iliac fossa) → ready to be expelled through anal canal (also made of non-keratinized squamous epithelial) that has two sphincters, the first which is involuntary (smooth muscles) while the second external one is voluntary (skeletal muscles.)
- Sacculated and there's a line anteriorly due to the arrangement of inner circular and outer longitudinal (why?) because the outer longitudinal Is not 360 around the large intestine, instead it collects in three bands that are called taeniae coli.
- Blood supply: inferior mesenteric artery
- Few microvilli (absorption not needed only water)
- Plenty of crypts with glands (goblet cells = mucus)



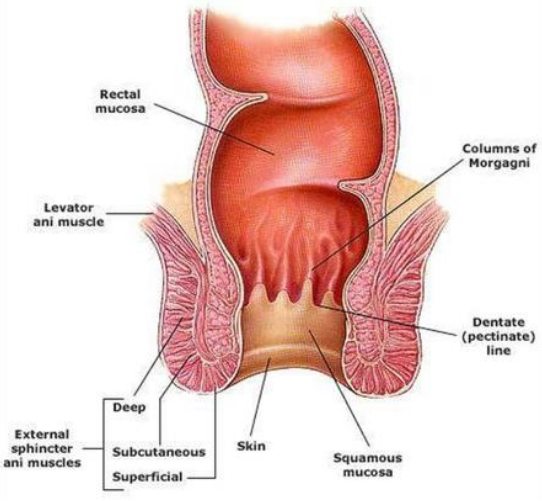


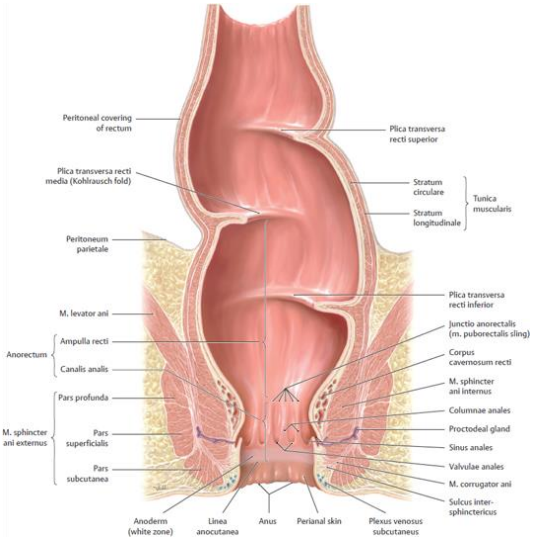
Order and parts of large intestine:

1. **Terminal ilium into (1st) Cecum**
   - Dilated blind-ended structure.
   - Extension: vermiform appendix and its opening
   - Valve → ileocecal valve made of the mucosa of large intestine.
   - Sacculation (Haustra) → this arrangement makes the circular free muscle free from the outer longitudinal muscles → form successful sacs called sacculation.
   - Tinea coli (anterior line) one band of the 3.



2. **Ascending colon**
   - Liver makes it turn to the midline (forms an impression on the liver)
3. **Transverse colon:**
   - Across the abdominal cavity
   - Attached to greater momentum coming from the greater curvature
   - At the left geos higher because there's nothing to block it, and it reaches the spleen forming splenic flexure.
4. **Descending colon** (left side) → in the left celiac fossa there is an (S)-shaped part → sigmoid part that goes toward the midline and forms →
5. **Rectum:**
   - It loses its visceral peritoneum and goes down to join the anal canal.
   - Connects segmented colon into anal canal
   - No tinea coli: because outer longitudinal muscles become normally distributed.
   - Rectum has longitudinal folds (column of Morgagni), when join anal canal forms anal columns of mucus membrane, and there's a space between these columns called anal sinuses.
   - Anal canal has transverse folds called anal valves (oblique movement for separating air from feces.)
   - Skin meets mucosa of lower end of rectum →dentate (pectinate) line.



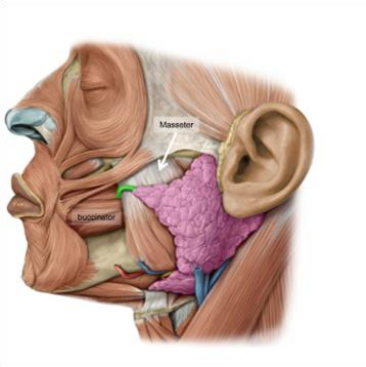


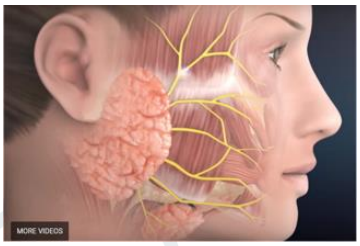
Accessory organs: *(send secretions to the GIT to complete digestion and absorption - not part of the tract.)*

A. Salivary Glands:

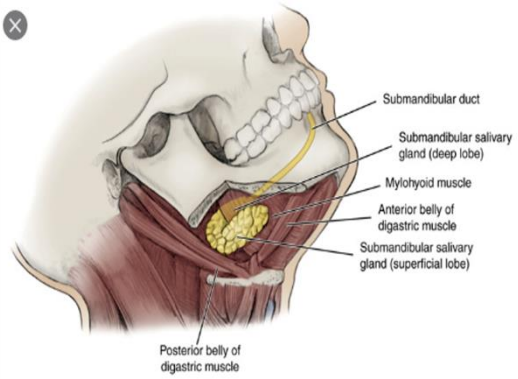
Major salivary glands: Specific structures with their own capsule, a major duct that opens to the mouth, present on the outside of oral mucosa.

- **Parotid**:
  1. largest opening to the mouth
  2. serous = secretes enzymes in addition to water (amylase)
  3. two on each side (pair)
  4. anterior and inferior to the ear (preauricular),
  5. has its own capsule and duct.
  6. Duct → runs on masseter muscle goes deep to the buccinator → opens to the vestibule of the mouth opposite to upper second molar (Steensen duct)
  7. Pierced by cranial nerve VII (facial nerve) which divide the gland into large superficial and smaller deep (the deep has little expansions deep in the face one around tempo mandibular joint. (pain when open the mouth.)
  8. Double nerve supply (autonomic NS→ symp = thick/ parasymp = thin)

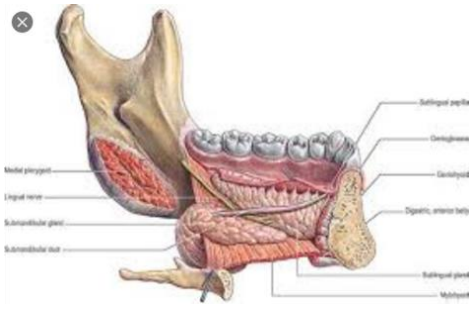




- **Submandibular:**
  1. Neck, below margin of the mandible in the submandibular triangle → specifically digastric triangle.
  2. Divided into two lobes by the mylohyoid muscle into superficial (outside mouth) and deep (inside the mouth). (continuous with each other posteriorly.)
  3. A Duct from each lobe on the floor of the mouth and it opens into both sides of the frenulum of the tongue (called Wharton duct)
  4. Serous and mucus (mixed).

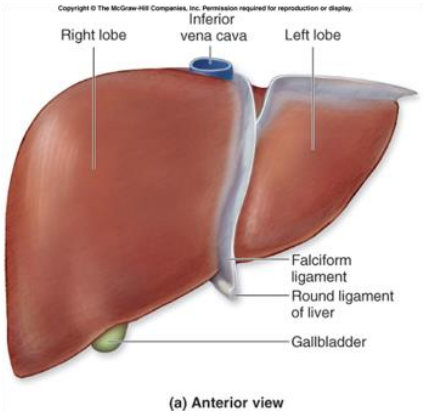


- **Sublingual:**
  1. Under the tongue/ floor of mouth
  2. Smallest gland of them
  3. 11 ducts that opens directly to the floor of the mouth.



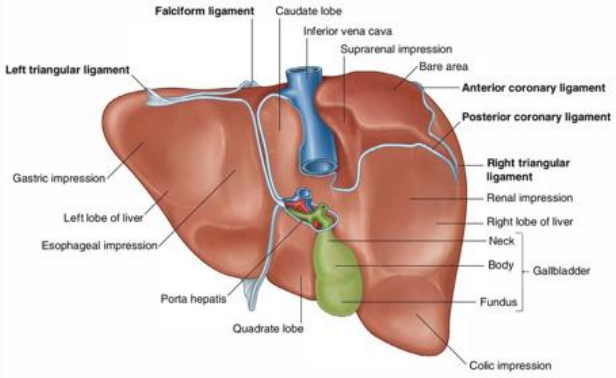
Minor salivary glands: ***all over mouth, have no capsule or major ducts. Found in lips and around mouth and have minor contribution to salivary production.***

B. Liver: *largest gland of the body 1.5kg*

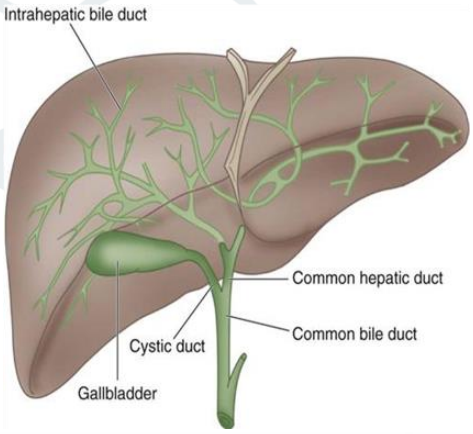


(a) Anterior view

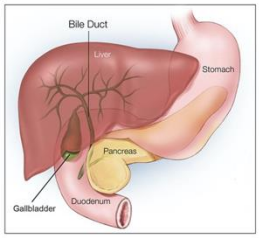
- Two lobes, right and left.
- Anteriorly → two false of peritoneal covering going from the area between the two lobes to the anterior abdominal wall (falciform ligament)
- The falciform ligament splits into two superiorly and posteriorly (one goes to the right and one goes to the left) coronary ligament
- At the lower end of the falciform ligament there's a cord like ligament extending from the umbilicus and leaves and impression on the liver and ends in inferior vena cava (it was the umbilical vein that drains the placenta into the inferior vena cava.) cross sectionally round → called round ligament of liver or ligamentum teres.)

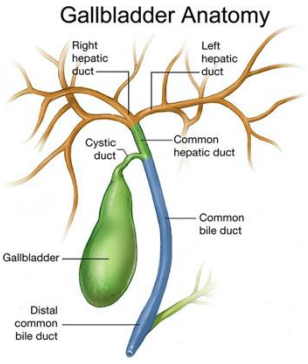


- Right lobe posteriorly has many areas; *major right lobe*, *Quadrate lobe:* between gallbladder and falciform ligament, and named because it has four sides, *Caudate lobe*: left to the inferior vena cava named because it's like a tail.
- Covered by peritoneum except for an area (Bare area) covered by coronary ligament (which comes from the two layers of falciform).
- Fundus leaves an impression on the inferior left lobe of the liver, so does the esophagus, on the left lobe inferiorly the kidney also leaves an impression.
- Gallbladder: biliary system that secrets bile to the first part of the small intestine (store bile produced from liver) and has fundus body and neck + smooth muscles and made of columnar epithelial



⇒ Between two cells of the liver secretes bile → into small duct called canaliculus → canaliculi (collection) → intrahepatic ductules → left and right hepatic ducts from each lobe of the liver (extrahepatic biliary passage).





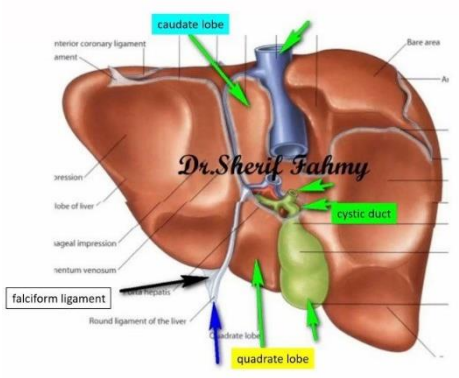
⇒ Liver hilum where vessels either leave or enter (extrahepatic passages leaves the liver while arteries and portal vein.)

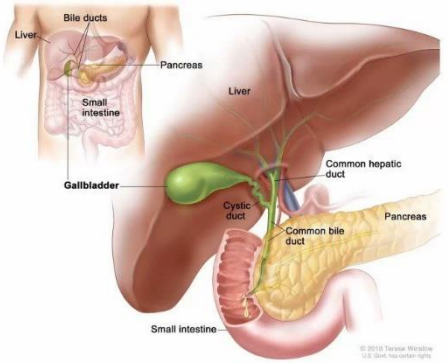
⇒ Green ducts and vessels within the liver are intrahepatic ductules.

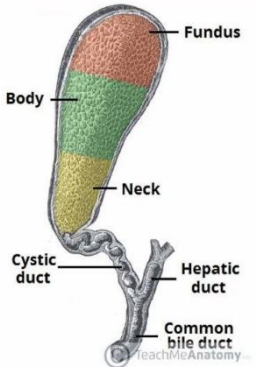
⇒ Left and right hepatic ducts combined to form common hepatic duct.

⇒ Common hepatic duct + cystic duct (from gallbladder) = common bile duct.

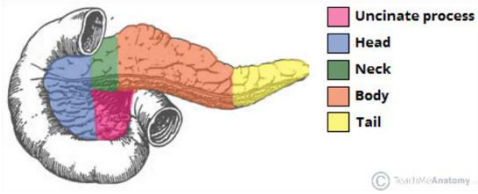
⇒ As it comes down posterior to duodenum + joins the major pancreatic duct→ opens into 2nd part of duodenum (duodenal papilla) through an opening called Ampulla of Vater.



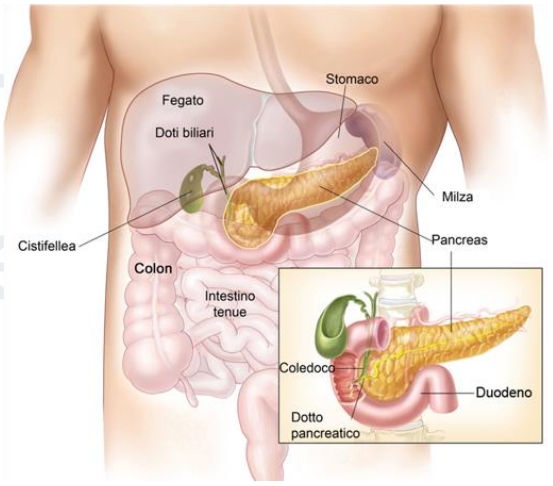


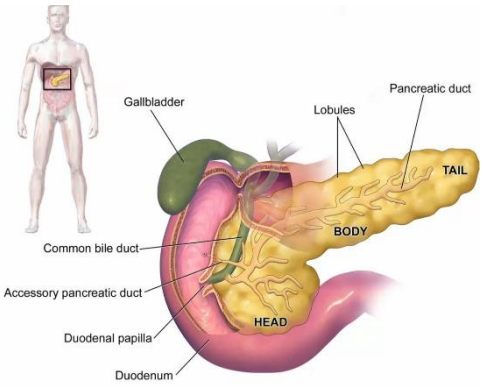


C. Pancreas: *is a mixed gland, endocrine and exocrine very supportive hand in digestion. Tail reaches hilum of spleen and goes left oblique while its head is within the curve of the duodenum.*



- **Endocrine** →(spherical) million small masses of cells called Islets of Langerhans (collection of different type of cells) surrounded by fine capsule and also have capillaries that pick-up hormones to the circulation. (secrets Beta cells=insulin present in center, Alpha cells (fewer in number) =glucagon, others)
- **Exocrine part** → Acinar (major) secretes enzymes → ducts because they are inside the acini (called intercalated ducts), lined with columnar epithelium→intercalated ducts join to form interlobular ducts → join to form main pancreatic duct connected to common bile duct as mentioned earlier. (it usually has an extra duct = accessory duct)
- Uncinate process (part of the head), Head, Neck, Body, Tail.
- Stuck to the posterior abdominal wall (by peritoneum), posterior to stomach, anterior to IVC and Aorta, anterior to left kidney, reaches spleen and within C-shaped duodenum.





The End