

# Digestion Physiology

## 1. Digestive System (GM)

The GIT (gastrointestinal tract) / digestive tract, gut or alimentary canal is an organ system within humans and other animals which takes in food, digests it and absorb energy and nutrients and expel remaining.

The major organs of the digestive system are:

- Mouth
- Pharynx
- Oesophagus
- Stomach
- Small intestine
- Large intestine
- Rectum

Accessory digestive ~~systems~~ <sup>organs</sup> are:

- Liver
- Gall bladder
- Pancreas
- Salivary Gland

**Mouth:** The mouth is beginning of digestive tract. In mouth chewed food mixed with saliva passes into pharynx. 30% starch digestion takes place here.

**Pharynx:** It is common passage of food pipe and wind pipe. food pass through pharynx travels to esophagus.

**Oesophagus:** Muscular tube extending from pharynx to stomach. By series of contract<sup>n</sup> and relaxation i.e peristalsis, the esophagus delivers food to stomach.

**Stomach:** It is sac-like organ with strong muscular walls. It secrete acid and powerful enzymes i.e pepsin and Rennin that continue the process of breaking down the food. From stomach food move to small intestine.



Small intestine: It made up of three segments, the duodenum, jejunum and ileum, the small intestine is a long tube loosely coiled in abdomen.

SI continues the process of breaking down food by releasing enzymes by pancreas and bile from liver.

Duodenum responsible for breaking down the food, while jejunum & ileum responsible for absorption of nutrients.

Large intestine: Muscular tube that connect to rectum. Waste left over from digestive process is passed through colon by peristalsis. A stool is stored in sigmoid colon emptied into rectum.

Rectum: It connects to anus. It receive stool from colon. It store stool temporarily and finally stool excrete out through anus.

Functions of digestive System:

It is responsible for breaking down food and supplying the body with water, nutrient electrolytes needed to sustain life

1. Ingestion (placing food in mouth and chewing food into smaller pieces) and swallowing the food.
2. Digestion food is broken down into small particles and then enzymes act on food.
3. Absorption During absorption, nutrients, water & electrolytes are transported from GIT.
4. Egestion During egestion, the undigested food, along with various secretions, ~~& ~~starched off~~~~ pass into rectum and constitute faeces which remove through anus.

Write short note on Salivary Glands (5M)

• There are three pairs of salivary glands

1. Parotid salivary gland
2. Submandibular s. gland or (submaxillary)
3. Sublingual salivary gland

Salivary gland (contain)

Mucous Cells

It form viscous secretion  
contain mucin

Serous Cells

It form thin watery  
subs. contain Ptyalin  
also called Salivary- $\alpha$   
amylase.

• Daily 1500ml secretion per day.

• Digestive enzymes in saliva

Ptyalin or salivary  $\alpha$ -amylase  
Lysozymes, (bactericidal)  
Lipase, (lipolytic enzyme)

Mucin

$Na^+$ ,  $K^+$ ,  $Ca^{2+}$

$Cl^-$ ,  $HCO_3^-$ , phosphate

• pH of saliva is 6.5

• Glands and location

25%  
of 1500ml

1. Parotid gland (in front of ears)

Duct name

Stenson duct

Histology

purely (serous cells)

70%  
of 1500ml

2. Submaxillary or (Medial to Submandibular mandible)

Wharton duct

Mixed (Serous + mucin)

5%  
of 1500ml

3. Sublingual (Adjacent to mucosa of floor of mouth)

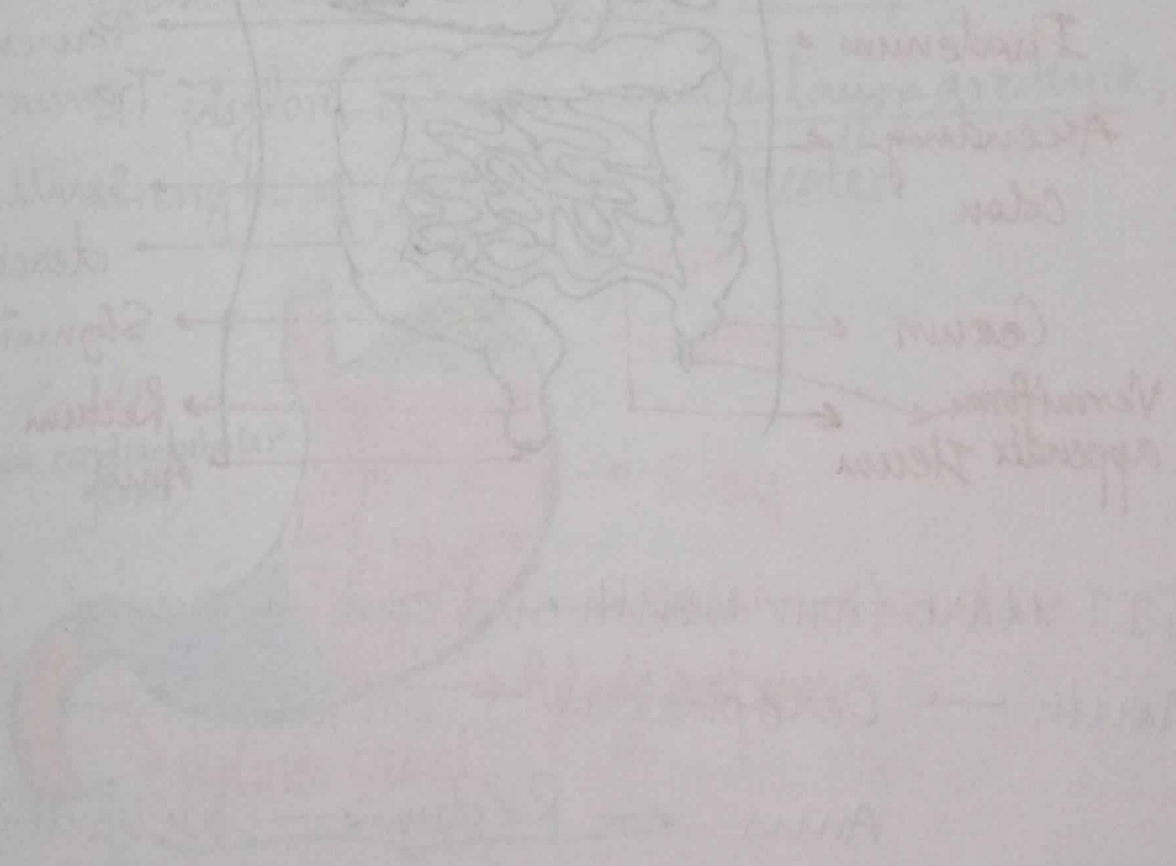
Rivinus duct

Mainly (mucin cells)

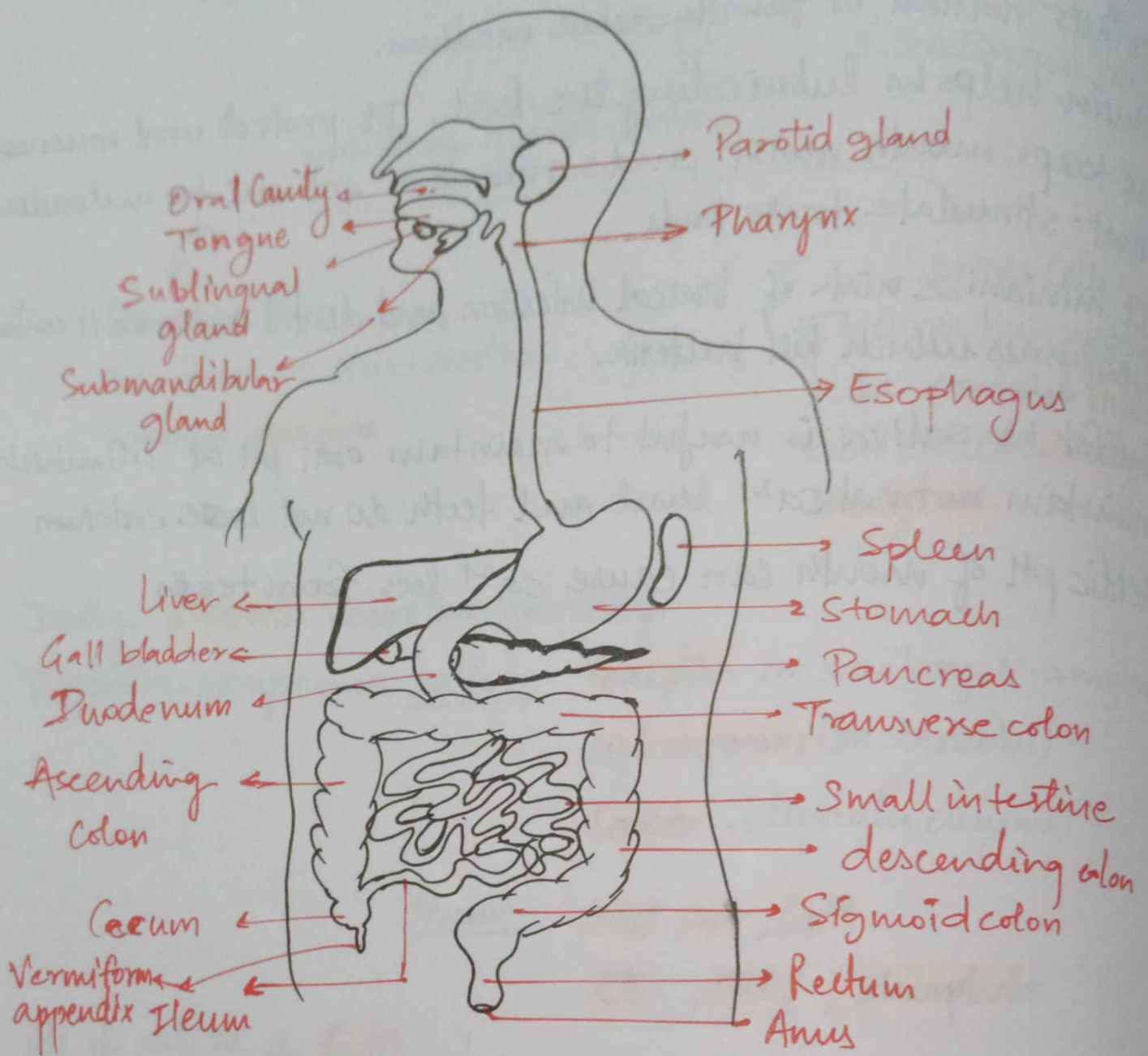


## Functions of Salivary glands!

- (i) Ptyalin helps in the digestion of starch to maltose.
- (ii) It acts neutral or faintly acidic medium.
- (iii) Mucin helps in lubricating the food. It protect oral mucosa. It keeps mouth moist and serves as a solvent for molecules that stimulate taste buds.
- (iv) It minimize risk of buccal infection and dental caries as it contain lysozymes which kill bacteria.
- (v) Buffer in saliva is useful to maintain oral pH at 7.0 which maintain normal  $Ca^{2+}$  level and teeth do not lose calcium. Acidic pH of mouth can cause  $Ca^{2+}$  loss from teeth.



Draw diagram of gastro-intestinal tract and add note on stomach? (5m + 5m)



GIT start from mouth and end at anus.

Mouth → Oesophagus → stomach → Small intestine  
 Anus ← Rectum ← Large intestine



## Stomach (5M)

It is situated in epigastric, umbilical and left hypochondriac region of abdominal cavity.

The stomach is a hollow muscular organ which consists of different parts:

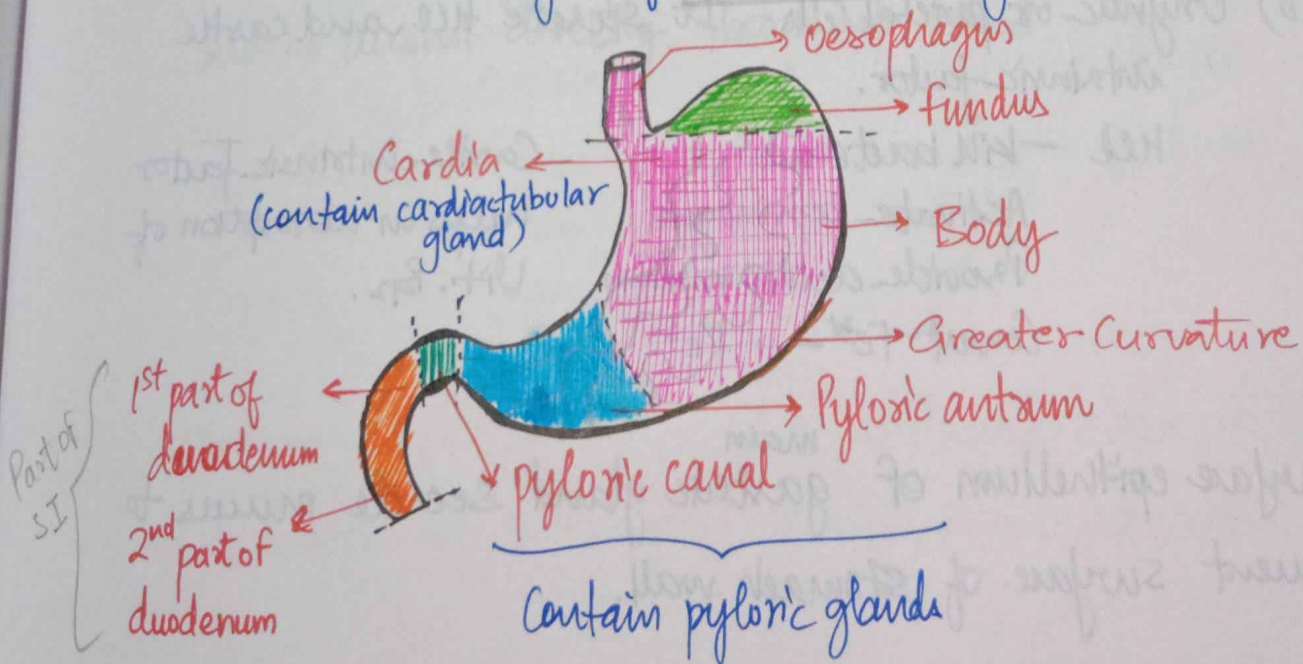
1. Fundus: It is upper part of the stomach above the cardiac orifice.

In fundus layers are relatively thin, strength of contraction is weak.

2. Body: It is main part of stomach.

3. Pyloric part: It is lower part of stomach divided into pyloric antrum and pyloric canal.

In pyloric antrum muscle layers are thick, strength of contraction is greater.



The stomach having folds layers known as Rugae.

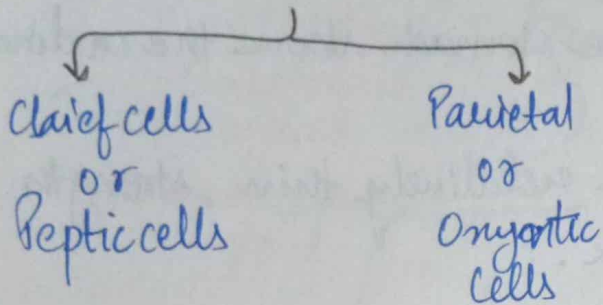
The layers present in stomach is gastric mucosa layer or gastric mucosa membrane.

@surgeon911

Gastric mucosal layer has 3 types of Glands

I. Main gastric gland

- present max. in number
- It contain two types of Cells



II. Cardiac tubular gland

III. Pyloric / antral gland

I. Main gastric Gland

- a) Chief cells or peptic cells - It secrete pepsinogen.
- Pepsinogen activate by HCl into pepsin help in ~~active~~ breakdown of protein.
- b) Oxyntic or parietal cells - It secrete HCl and castle intrinsic factor.

HCl - kill bacteria

Activate pepsinogen

Provide acidic medium

Convert  $Fe^{3+} \rightarrow Fe^{2+}$

Castle intrinsic factor helps in absorption of Vit. B<sub>12</sub>.

Surface epithelium of <sup>main</sup> gastric gland secrete mucus to prevent surface of stomach wall.

II. Cardiac tubular Gland

- Secrete soluble mucus.
- Use to lubricate large surface on which chyme move back and forth during digestion.



### III. Pyloric (Antral) Glands

It secrete soluble mucus which is rich in alkali and poor in enzymes.

Deeper portion have G-cells or gastrin cells which secrete hormone gastrin.

- + stimulate gastric acid secret<sup>n</sup>.
- + gastric motility
- + growth of mucosa in stomach, SI, LI.

### Function of stomach:

1. ~~It~~ It helps in storage of food for about 3-4hr and gradually passes into intestine.
2. Protein undergo breakdown.
3. HCl in stomach help to kill bacteria, activate pepsinogen.
4. Intrinsic factors help in absorption of Vit-B<sub>12</sub>.
5. There is hardly any absorpt<sup>n</sup>. Only fat soluble subs. such as alcohol directly absorb into blood.



Write short note on Pancreas? (5M)

Pancreas is an elongated organ. It is situated **retroperitoneally** in the **epigastric** and **left hypochondriac** regions of **abdominal cavity**.

Structure of Pancreas:

Pancreas is a mixed gland i.e. Endocrine and Exocrine.

(A) Exocrine function consists of **secretory acini** and **duct cells** that secrete pancreatic juice.

Pancreatic juice is secreted from the cells and into the lumen of the ducts. Then it is collected by two ducts named, duct of Wirsung and duct of Santorini.

Duct of Wirsung: Single major pancreatic duct formed by joining smaller intercalated & excretory ducts.

Duct joins with common bile duct and forms ampulla of Vater, which opens into the 2<sup>nd</sup> part of the duodenum.

Duct of Santorini: Accessory duct which also opens into the duodenum but a little away from the proximal part of ampulla of Vater.

(B) Endocrine function consists of **Islets of Langerhans** which secrete hormones such as **insulin** & **glucagon**.

Pancreatic Juice: 1200-1500 ml per day  
pH - 7.4 to 8.4

It is highly alkaline due to  $\text{HCO}_3^-$  concentration.

Pancreatic juice along with bile makes the acidic concentration of gastric acid alkaline.

## Functions of Pancreas

There are many enzymes secreted by acinar cells which help in digestion.

### 1. Pancreatic proteolytic enzymes.

Trypsinogen  $\longrightarrow$  Trypsin

• It hydrolyses protein into small poly peptides.

Chymotrypsinogen  $\longrightarrow$  Chymotrypsin

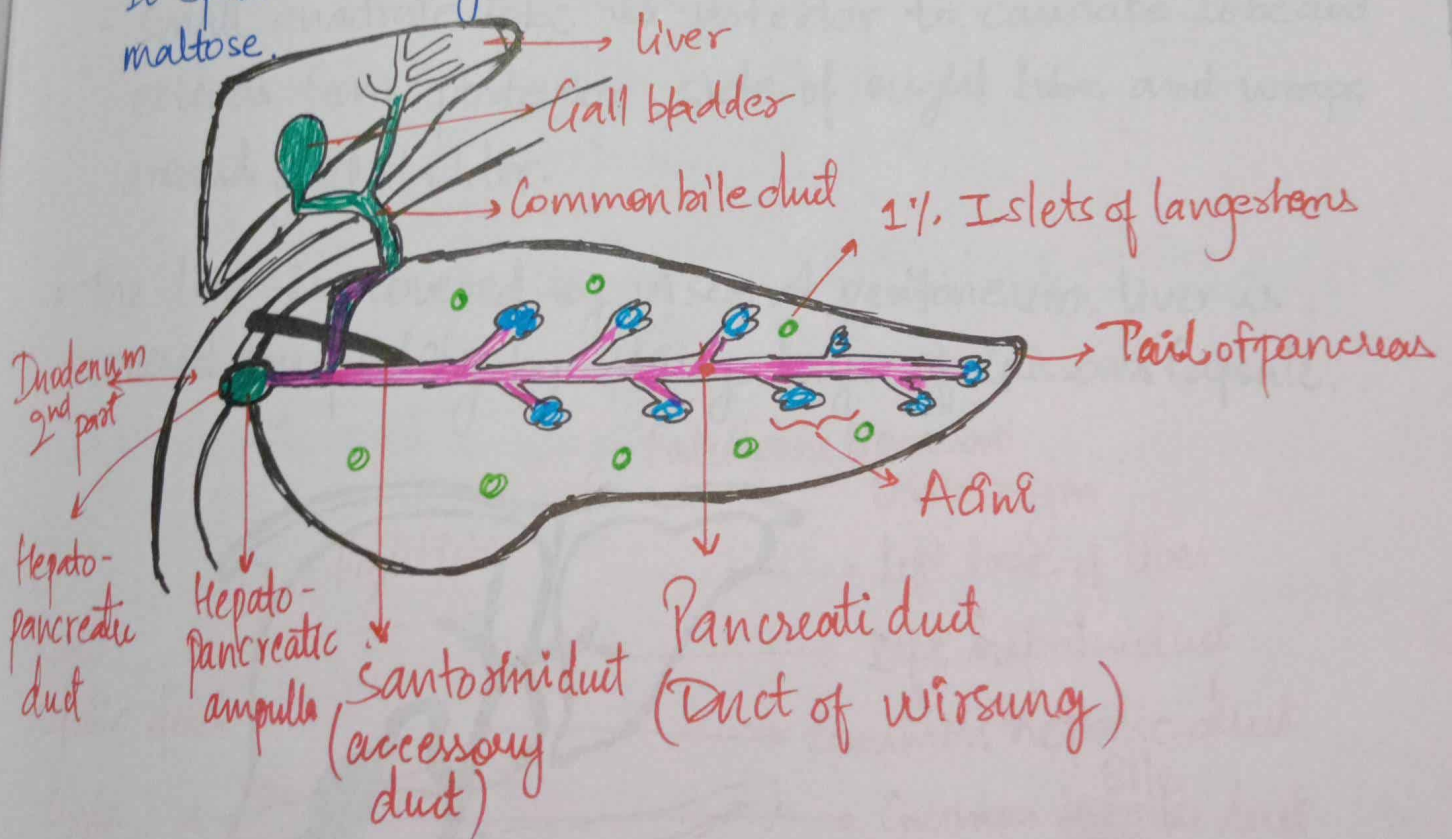
• It digests proteins to small poly-peptides.

### 2. Pancreatic lipase

Hydrolyses fats to glycerol and fatty acids.

### 3. Pancreatic amylase

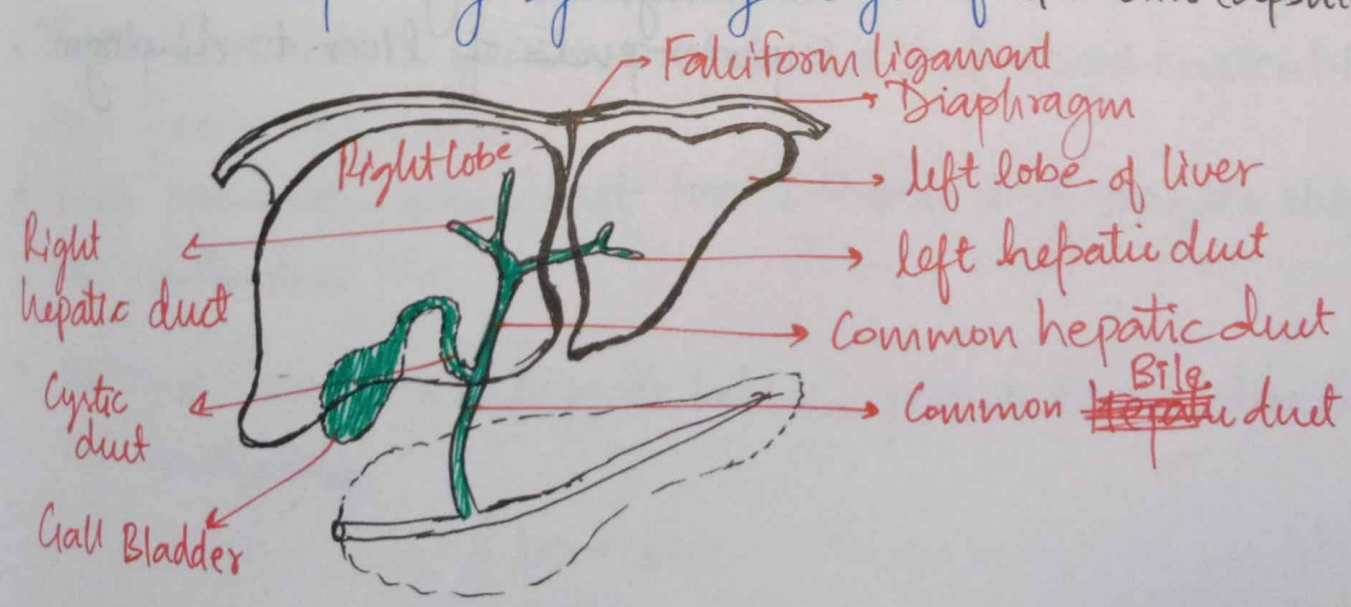
It splits and digests starch (both boiled and unboiled) to maltose.





Q Describe gross anatomy of liver and various ligaments related to liver?

- Liver is largest gland in body i.e. about 1.5kg in a adult.
- It is situated in upper part of abdominal cavity occupy the greater part of right hypochondriac region. (Inferior to the diaphragm).
- The liver consist of 4 distinct lobes - Left, Right, caudate and quadrate lobes.
  - The left and right lobes are largest lobes and separated by falciform ligament
  - Small caudate lobe extends from posterior ~~lobe~~ side of right lobe and wraps around inferior vena cava.
  - Small quadrate lobe is inferior to caudate lobe and extends from posterior side of right lobe and wraps around gall bladder.
- The liver is covered by visceral peritoneum. Liver is covered completely by shiny layer of Glisson's Capsule.



There are ~~the~~ ligaments that are directly related to liver and called:

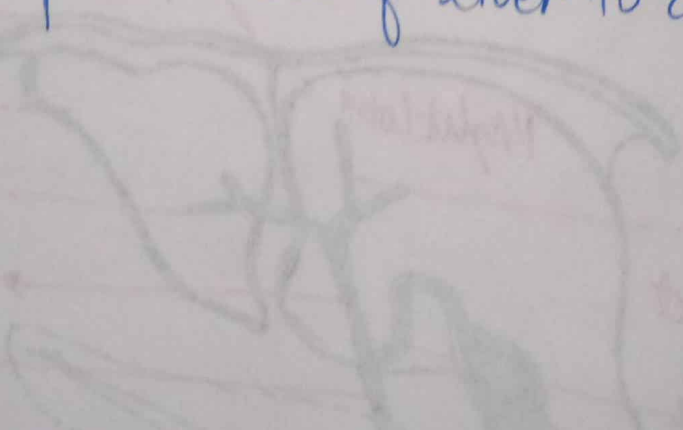
- Coronary ligament: It formed by peritoneal reflection from diaphragm to liver which has two layers that meet on right.

~~Left triangular ligament: It is mix of falciform ligament and lesser omentum.~~

- Falciform ligament: It runs inferiorly from diaphragm across anterior edge of liver to its inferior border.

At inferior end of liver, the falciform ligament forms round ligament (ligamentum teres) of liver and connect liver to umbilicus.

- Left and right triangular ligaments: The left and right triangular ligaments connect the superior ends of liver to diaphragm.



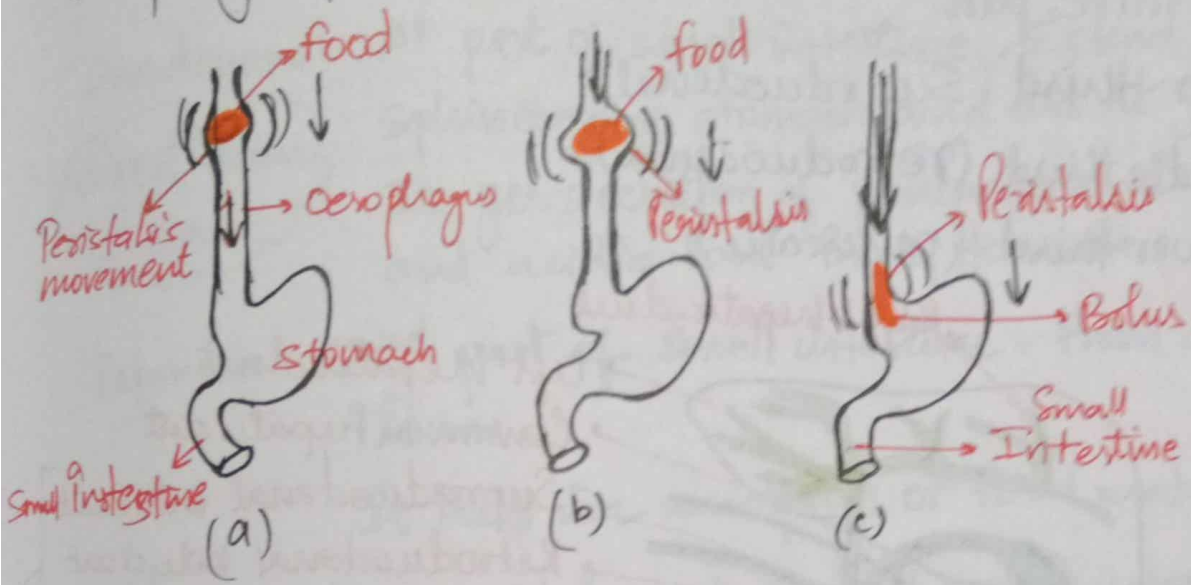


Write note on peristalsis.

Peristalsis is reaction in which a wave of contraction preceded by a wave of relaxation.

This movement is involuntary and necessary for the movement of food down the stomach and bowel down the anus. It also helps to bring about the motion of liquids right from kidney up to bladder.

### Oesophageal peristalsis:



- Peristalsis wave start from oesophagus and it occurs till down the anus.
- These peristalsis wave propel the intestinal content towards the ileocaecal valve.
- Each peristaltic wave last for 1-2 sec and propels chyme a few centimeters.
- When there is no peristalsis, person faces diarrhoea or constipation.

Q Short note on common bile duct? (CBD) (4M)

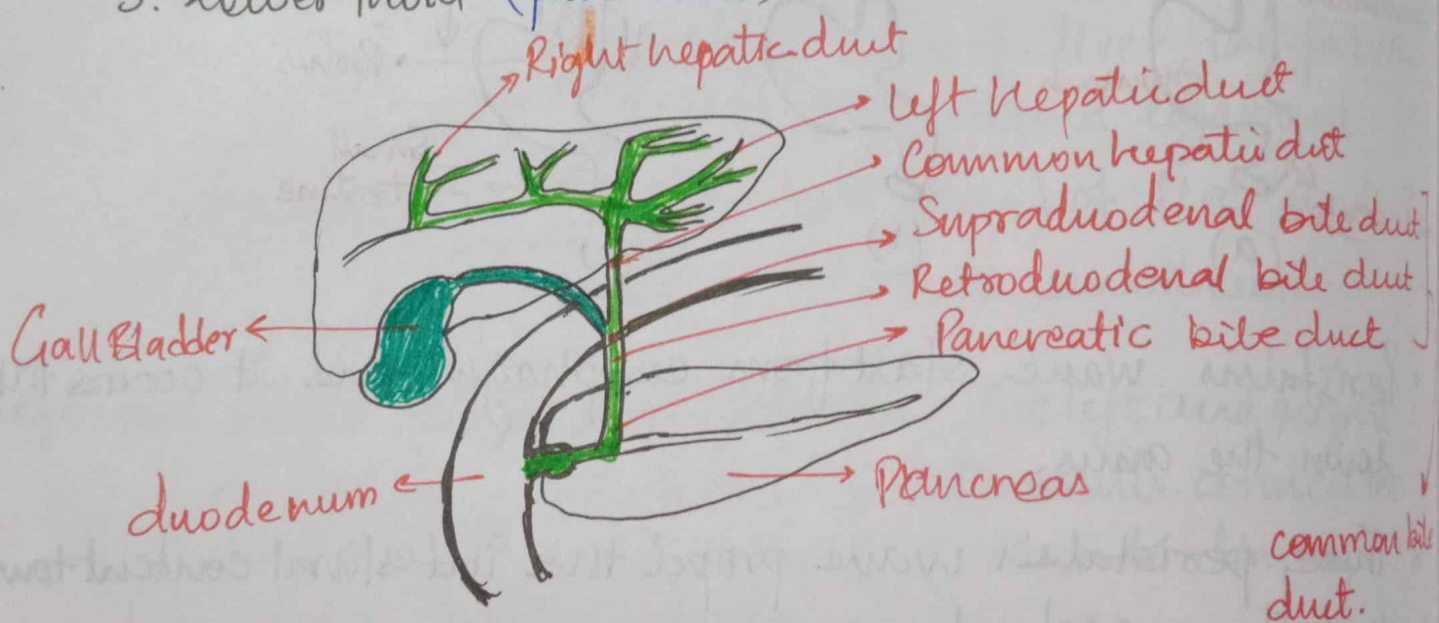
Common bile duct or bile duct is formed by the union of Cystic duct and Common hepatic duct (CHD).

CBD is approx. 8cm long and <6mm wide.

It joins the pancreatic duct at the ampulla of Vater, which drains its secretion into the second part of the duodenum.

It has three part

1. Upper third (Supraduodenal)
2. Middle third (Retroduodenal)
3. Lower third (pancreatic)



Common bile duct contains bile juice from cystic bile duct and ~~com~~ from right and left hepatic duct.

It has bile juice which along with pancreatic juice secrete into duodenum through "ampulla of Vater".

<sup>Juice</sup> Bile<sup>^</sup> Help in digestion of fat and makes gastric juice alkaline.



## Structure of small intestine? (8m)

Small intestine is the longest part of digestive system. It extends from stomach (pylorus) to the large intestine (caecum) and consist of three parts: duodenum, jejunum, ileum.

The duodenum has both intraperitoneal and retroperitoneal parts.

The jejunum and ileum are entirely intraperitoneal parts.

**Duodenum!** 1<sup>st</sup> part of small intestine. Extend from Pyloric sphincter of stomach and end at jejunum.

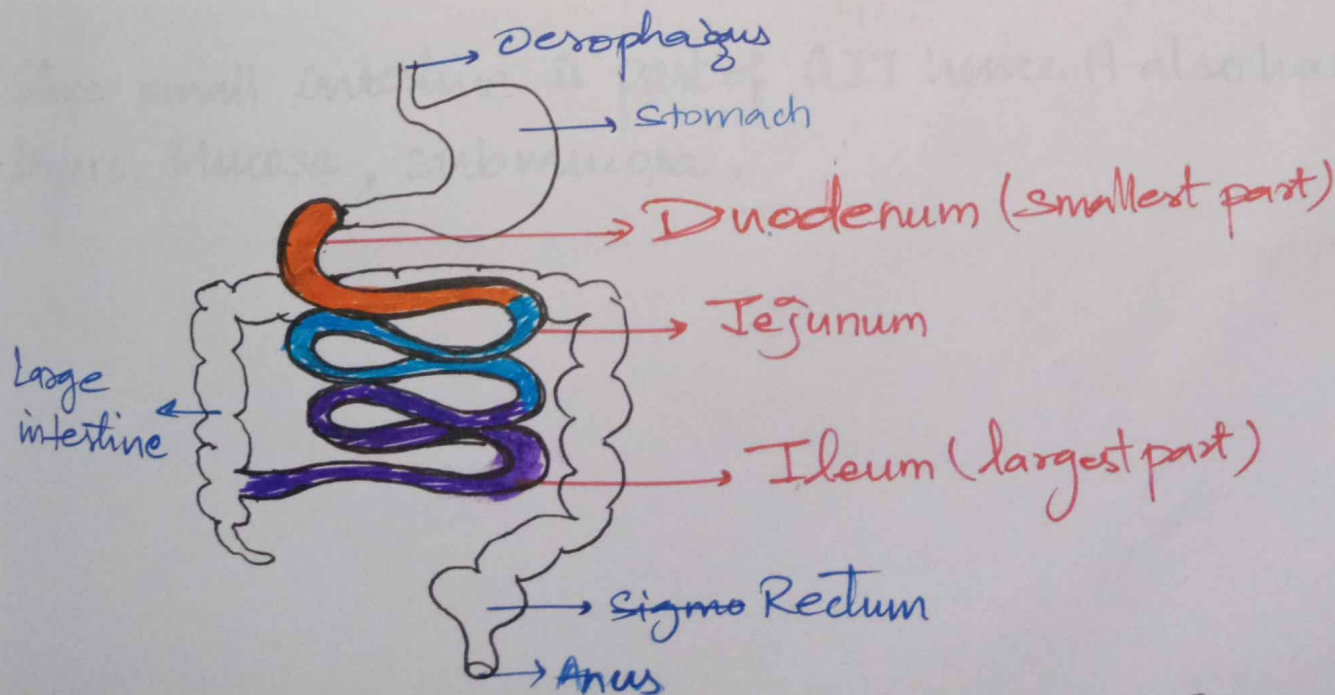
Digest<sup>n</sup> takes place

It get secretion of pancreas and ~~small~~ gallbladder and acidic food from stomach.

**Jejunum!** 2<sup>nd</sup> part of small intestine. From duodenum to ileum.

It Help in absorption of food material.

**Ileum!** Last and longest part of small intestine. It end at caecum.



Since small intestine is part of GIT, so, it has four layers.  
Mucosa → Submucosa → Muscularis → Serosa.  
(inner most layer) (outer layer)

Glands and folds present in layer of small intestine:  
Plicae circularis is the 1<sup>st</sup> fold of the submucosal layer of small intestine.

Villi (finger-like projection) present above plicae circularis.  
Microvilli (Brush border) present in villi.

Villi and microvilli provide large surface area for absorption of food.

