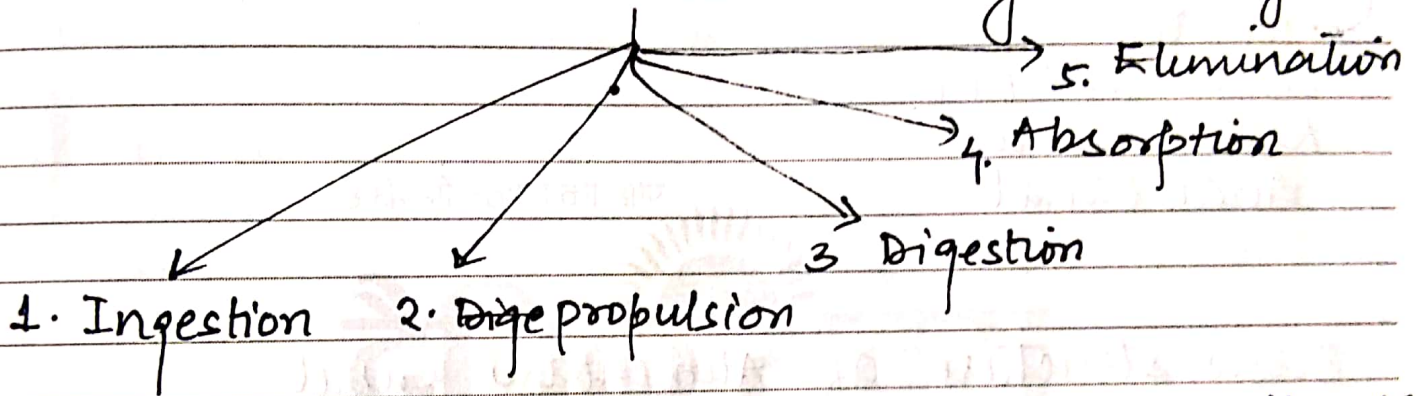


## Unit - II Digestive System

→ Digestive System is used for breaking down food into nutrients which then pass into the circulatory system and are taken to where they are needed in the body.

Processes involve in the Digestive System



→ Ingestion → taking of food, eating & drinking  
→ Propulsion → mixing and movement of content in alimentary tract.

→ Digestion →

- mechanical breakdown of food (chewing)
- chemical digestion of food by enzymes

→ Absorption → Digested food absorbed into the blood and lymph capillaries whereas the food that cannot be digested and absorbed are excreted from the alimentary canal as faeces.

# Organs of DS

II - Trish  
Digestive System

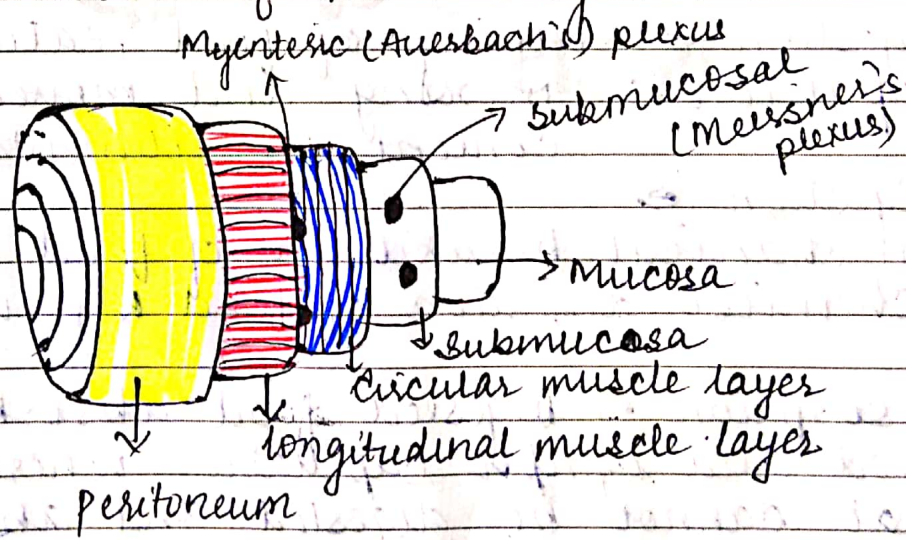
## Alimentary tract / GIT

- Mouth
- pharynx
- Esophagus
- Small intestine
- Stomach
- Large intestine
- Rectum and
- Anal canal

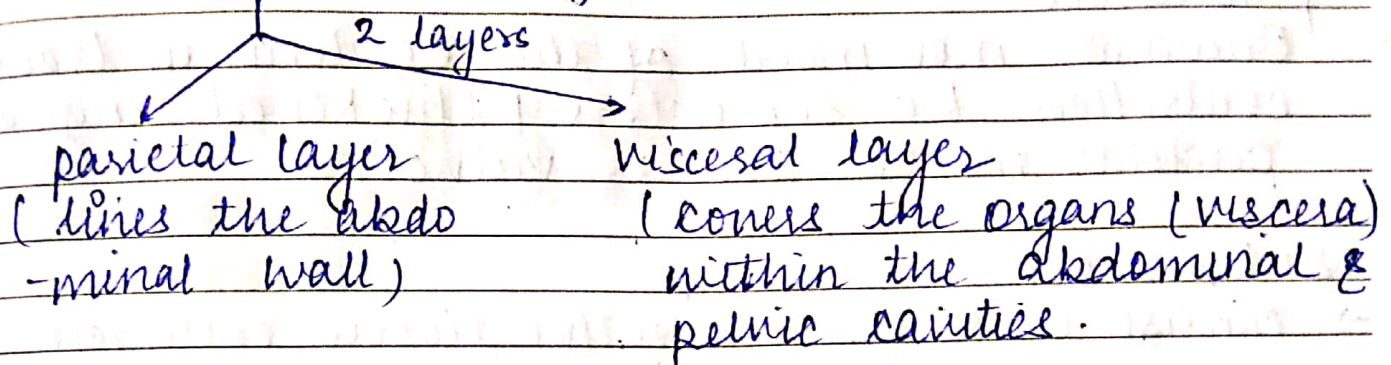
## Accessory organs

- 3 pairs of salivary glands
- the pancreas
- liver and
- Biliary tract

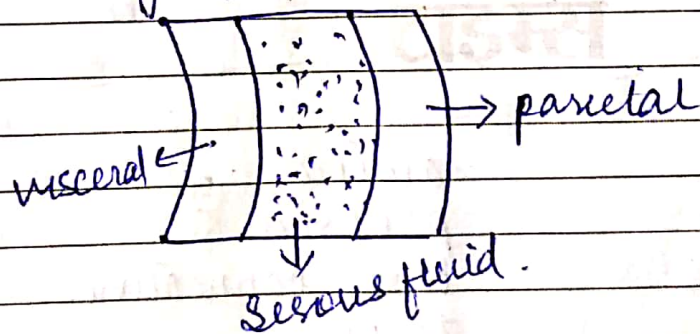
## Basic structure of Alimentary Canal



1. Adventitia or serosa or peritoneum → outermost layer  
→ peritoneum (largest serous membrane of body)



⇒ peritoneum → closed sac, contains small amount of serous fluid  
→ richly supply with blood & lymph vessels  
→ prevent local spread of infection (due to lymph nodes)



2. Muscle layers → 2 layers  
a. longitudinal muscle layer → outermost  
b. circular muscle layer → inner  
B/w these 2, a plexus (network) of sympathetic & parasympathetic nerves called

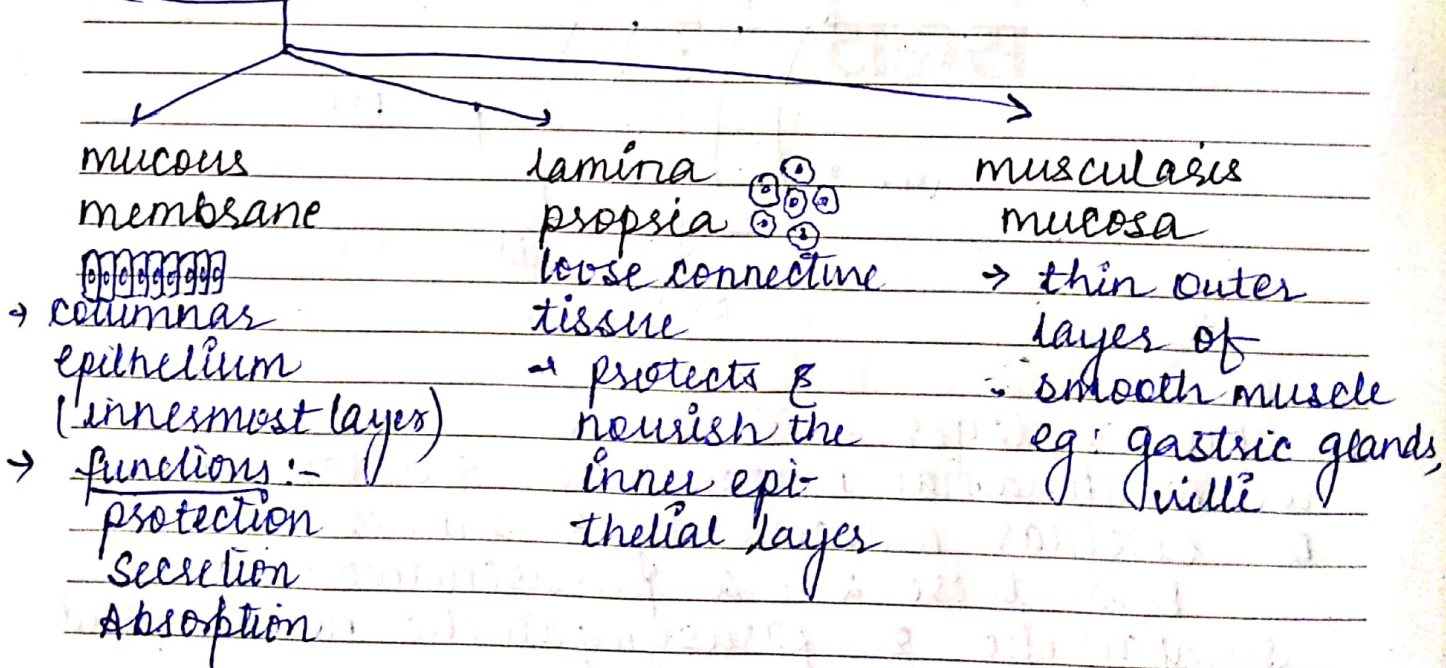
myenteric or Auerbach's plexus

- Contraction of smooth muscles is called peristalsis.
- Onward movement of the contents in tract controlled by sphincters (thickened rings of circular muscle, act as valves)

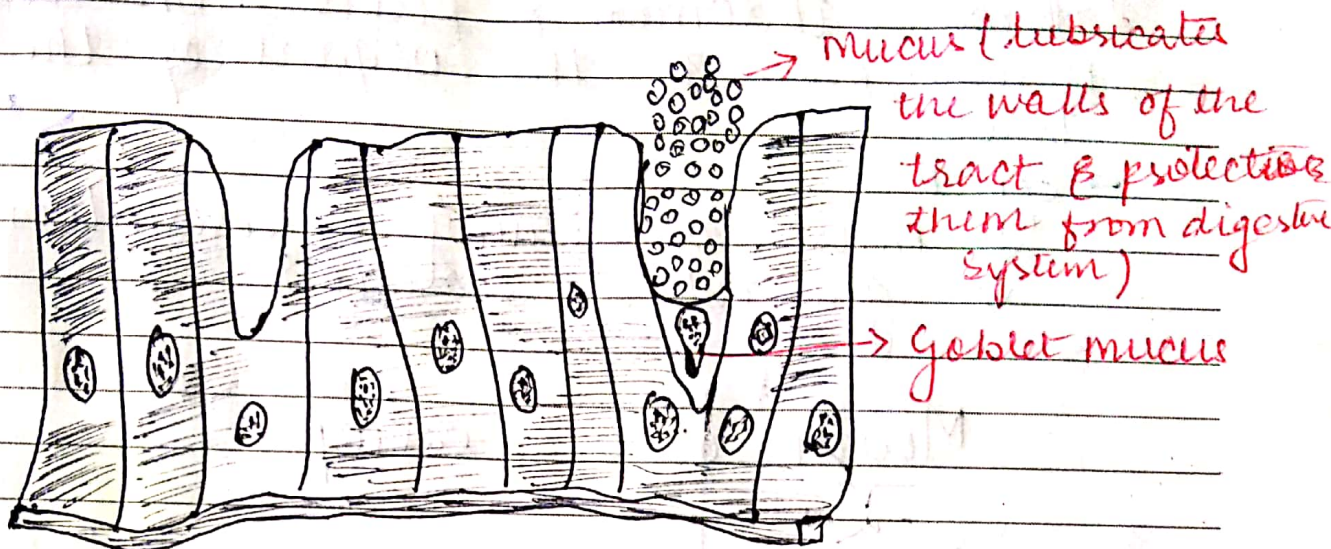
Submucosa

- consist of loose connective tissue collagen and some elastic fibres.
- B/w it, are the network of sympathetic and parasympathetic nerves called Meissner's plexus that supply the mucosal lining

Mucosa



## Mucous membrane



→ Mucus (lubricates the walls of the tract & protects them from digestive system)

→ Goblet mucus

columnar epithelium & goblet cells

## Nerve supply

Parasympathetic supply - 1 pair of cranial nerves, the vagus nerves, provides supply to most of the alimentary tract & the accessory accessory organs.

Sacral nerves supply → distal part of tract.

## effects

- ↑ed muscular activity esp. peristalsis
- ↑ed glandular secretion

Sympathetic supply :- These form plexus in thorax, abdomen & pelvis from which nerves pass to the organs of the Alimentary tract.

→ effects

- ↓ muscular activity eg peristalsis
- ↓ glandular secretion

### Mouth or Oral cavity

vestibule  
(part of the mouth between the gums & the cheeks)

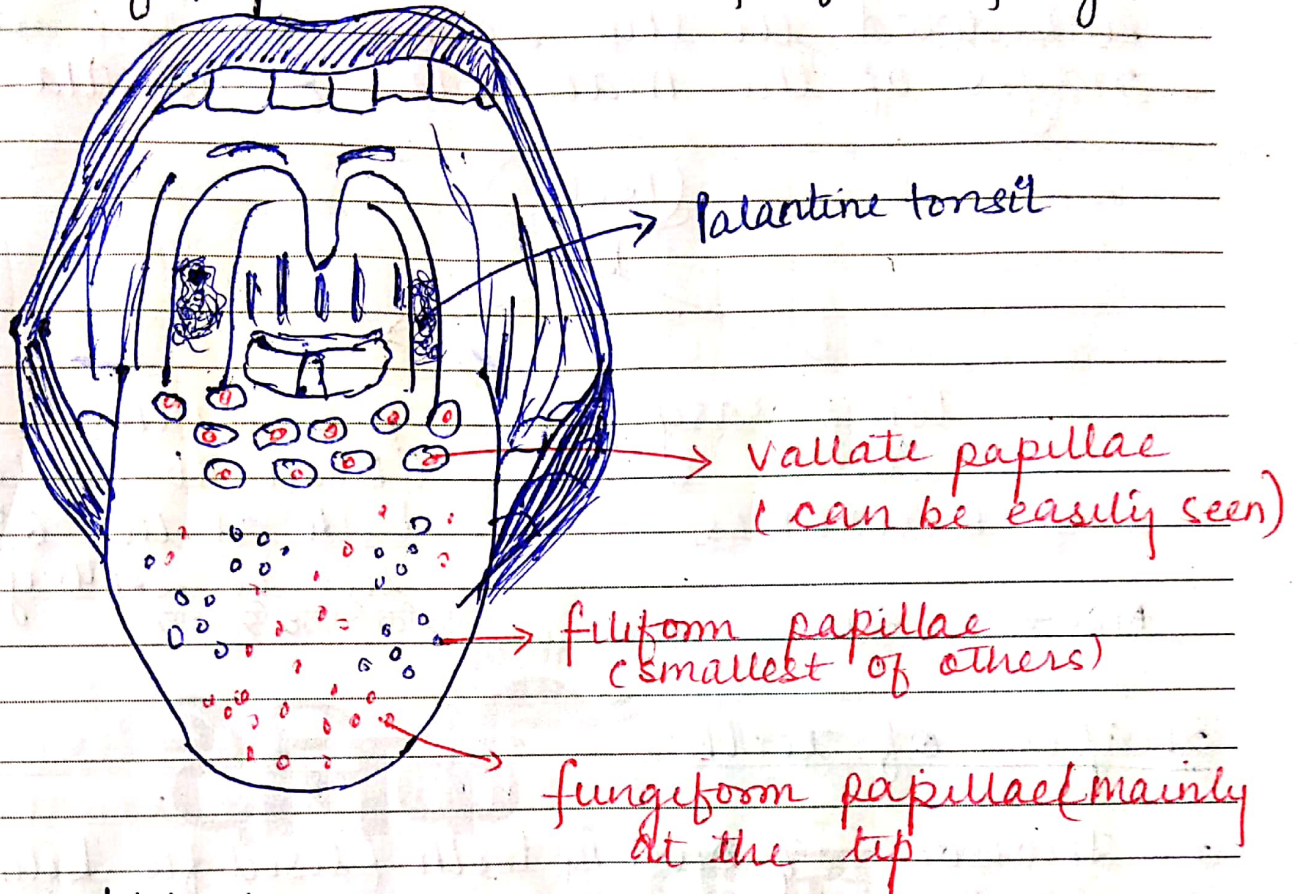
### Oral cavity

1. Teeth
2. Soft & hard palate (posterior Anterior)
3. uvula
4. palatine tonsil (lymphoid tissue)
5. tongue

### Tongue

- ~~is~~ voluntary muscular structure
- consist of papillae (little projections) on the superior surface of tongue, contain sensory receptors for the sense of taste in the taste buds.

3 types of papillae: vallate, filiform, fungiform



Blood supply :-

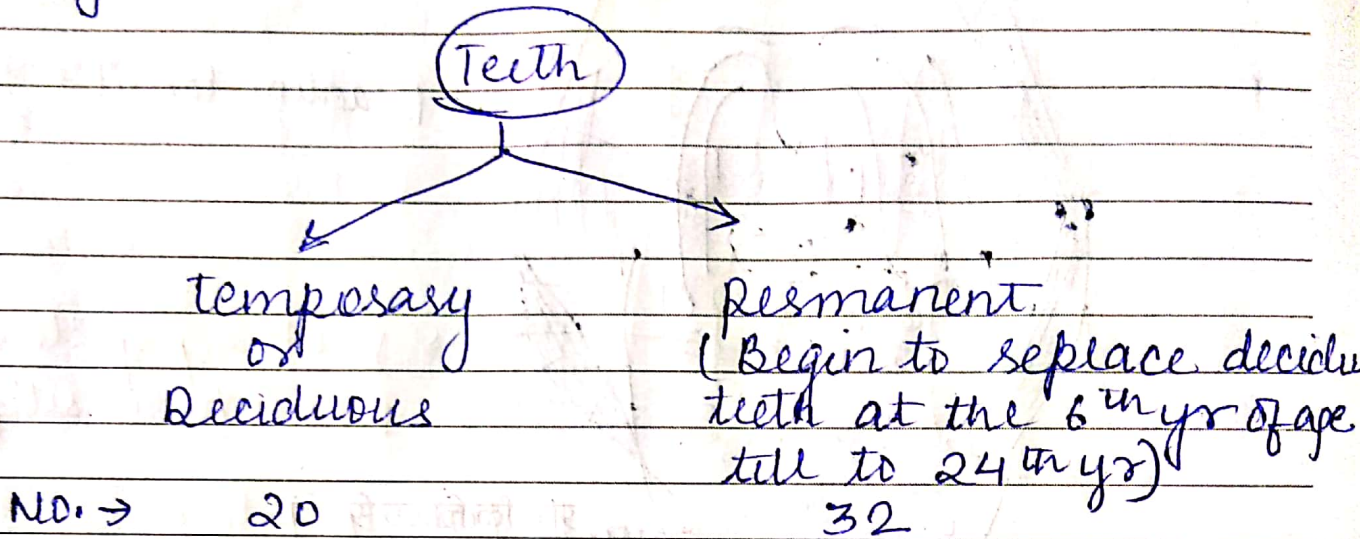
Artery → lingual branch of external carotid artery  
vein → lingual vein

Nerves : Hypoglossal  
Mandibular  
facial & glossopharyngeal nerves

functions: Chewing (Mastication)  
Swallowing (Deglutition)  
speech & taste

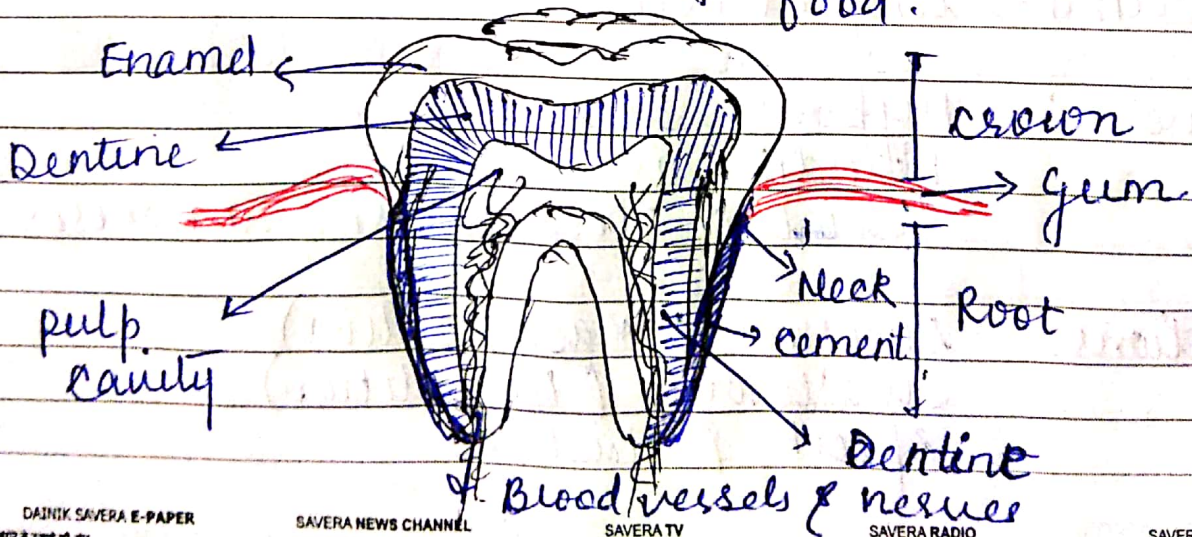
Teeth

embedded in the sockets of the alveolar ridges of the mandible & Maxilla



Shapes of teeth

- 1. Incisor } cutting teeth (used for biting off
- 2. Canine } pieces of food)
- 3. premolar } used for grinding or chewing
- 4. molar } food.



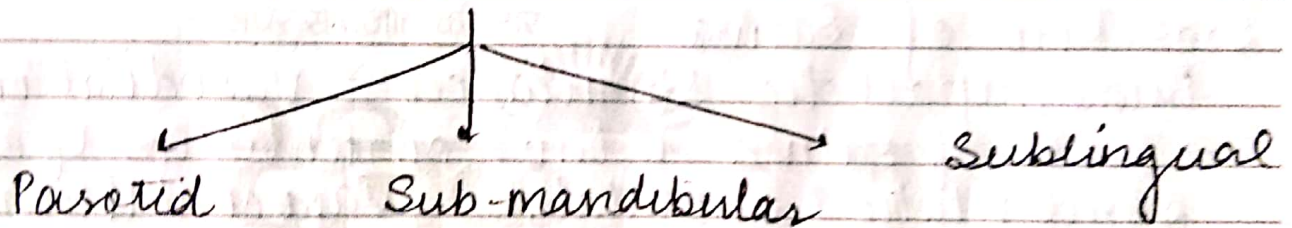


Blood supply  
Upper teeth → Maxillary artery & internal jugular veins

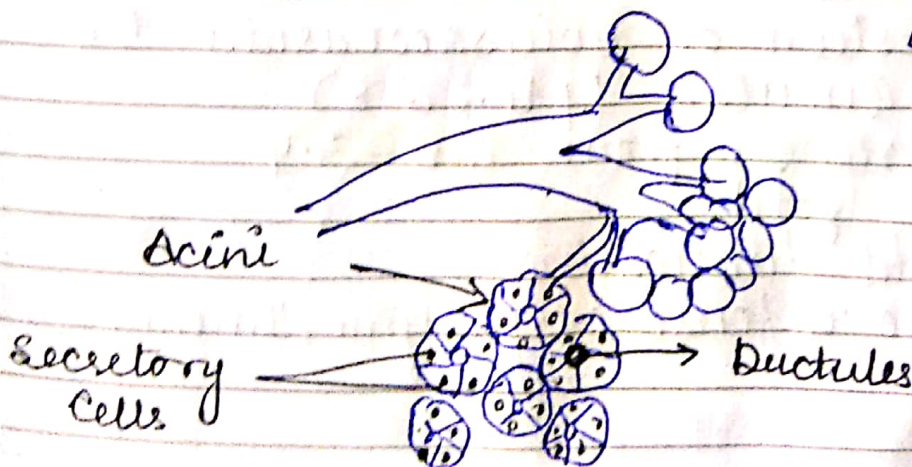
Nerve supply  
Upper teeth → Maxillary  
Lower → mandibular

### Salivary glands

→ Release their secretions into ducts that leads to the mouth.



- These glands are all surrounded by a fibrous capsule
- consist of no. of lobules made up of small acini lined with secretory cells.



BS : Arteries: External carotid artery and external jugular veins

- Saliva consist of → (1.5 l saliva produced daily)
- water
  - mineral salts
  - an enzyme: salivary amylase
  - mucus
  - lysozyme
  - immunoglobulins
  - Blood-clotting factors

### Secretion of Saliva

Parasympathetic stimulation → vasodilation

→ excess of saliva & low concentration of enzymes

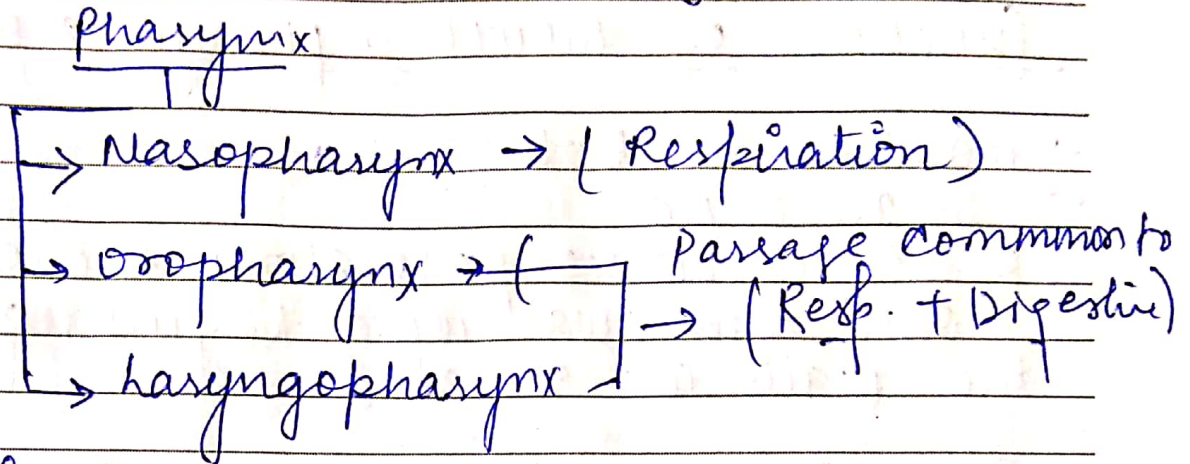
Sympathetic stimulation - vasoconstriction

→ Small amount of saliva & high content of enzyme & organic substances

### functions of saliva

- Chemical digestion of polysaccharides by salivary amylase (pH - 6.8)
- saliva pH ranges from 5.8 - 7.4
- Lubrication of food
- Cleaning and lubricating
- Non Specific defense (Lysozyme, Immunoglobulin)
- Taste

Pharynx Food passes from the oral cavity into the Pharynx then to oesophagus below.



B.S :- facial arteries and internal jugular veins.

N.S :- Glossopharyngeal & vagus nerves (parasymp.)  
Cervical ganglia (sympathetic)

## Oesophagus

- 25 cm long & 2 cm in diameter
- muscular tube, 1 a sphincter (valve) at each end
- help to transport food & fluid
- No absorption takes place in oesophagus

B.S → Oesophageal artery, inferior phrenic arteries, left gastric branch of coeliac artery.

→ Azygos and Hemiazygous vein, left gastric vein

## function of mouth, pharynx & oesophagus

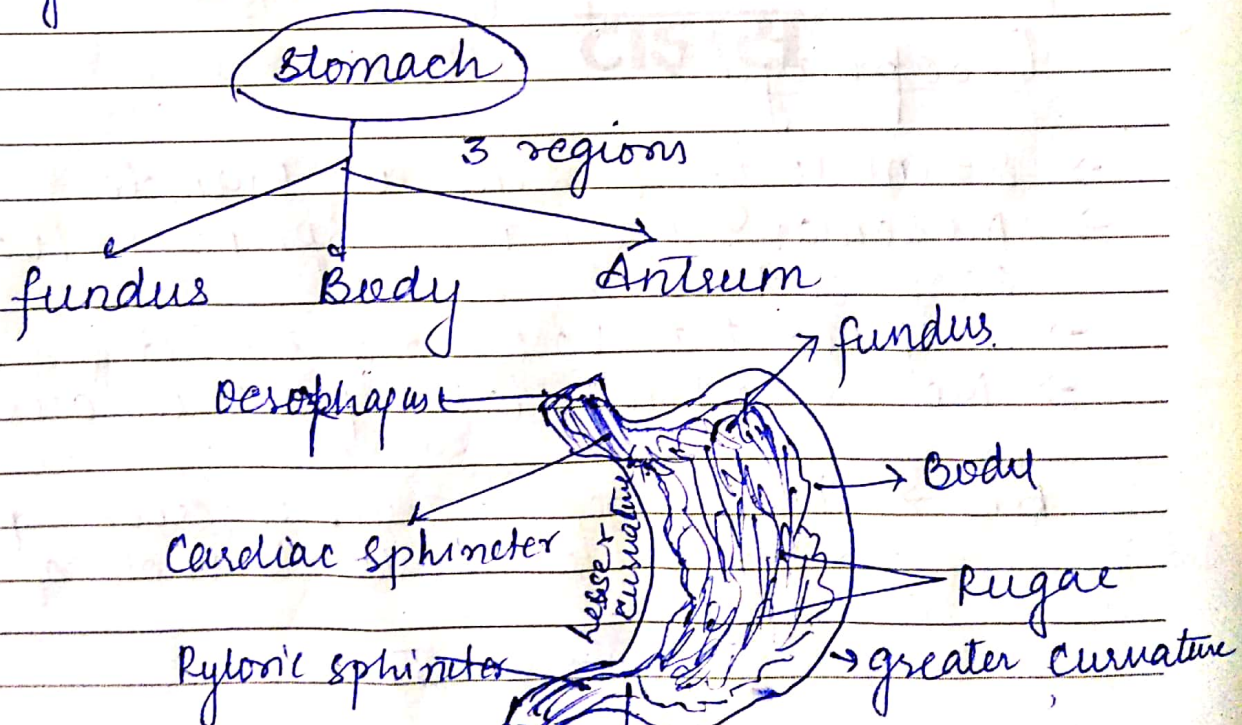
→ formation of Bolus

→ Swallowing

peristaltic waves pass along the oesophagus only after swallowing begins, otherwise the walls are relaxed.

## Stomach

J shaped dilated portion of the alimentary tract situated in the epigastric, umbilical & left hypochondriac region of the Abdominal cavity



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## Walls of the Stomach

→ Muscle layers (3 layers of smooth muscle fibres)

- Outer layer (longitudinal fibres)
- Middle layer (circular fibres)
- Inner layer (oblique fibres)

→ Mucous membrane → Numerous gastric glands are situated below the surface.

BS :- left gastric artery & Right gastric artery.  
portal vein

## Functions :-

### Gastric juice

Stomach size (1.5L or more)

→ about 2 litres of gastric juice are secreted daily. by

→ It consists of

- water
- mineral salts
- mucus ✓ → secreted by goblet cells
- HCl
- Intrinsic factor
- inactive enzyme precursors → pepsinogens, are activated to pepsins by HCl, begin digestion of proteins (pepsins act most effectively at pH 1.5 to 3.5)

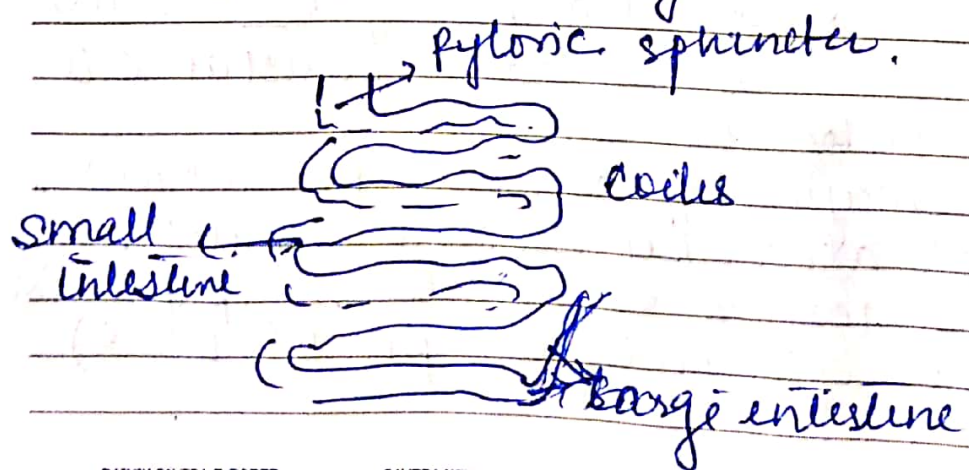
→ Intrinsic factor (protein) necessary for the absorption of vitamin B<sub>12</sub> from the ileum

### functions of the stomach

- temporary storage allowing time for the digestive enzymes, pepsins, to act
- chemical digestion of protein by pepsin
- churning of food
- Non specific defence against microbes by gastric juice
- preparation of iron for absorption (solubilize into salt)
- production & secretion of intrinsic factor
- Regulation of passage of gastric contents into the duodenum.
- Secretion of the hormone gastrin.

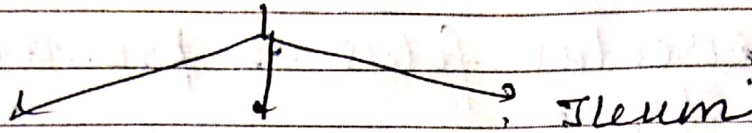
### Small intestine & Digestive tract / Alimentary canal

- It lies between the stomach & large intestine
- 90% of the digestion and absorption of food occurs, other 10% taking in stomach & large intestine.



→ 5 metres long, 2.5 cm in diameter.

Small intestine



**Duodenum**  
125 cm long  
contains the Hepato pancreatic Ampulla (Bile duct + pancreatic duct)

**Jejunum**  
2 metres  
→ middle portion of the small intestine

**Ileum**  
3 metres long  
ends terminal section  
→ joins the large intestine by ileocecal Sphincter.

→ opening is guarded by Hepatopancreatic Sphincter (of Oddi)

Structure of Small intestine -

- walls of Small intestine composed of 4 layers
  - Serosum
  - Muscle layer
  - Submucosa
  - Mucosa

Mucosa - surface area of small intestine is greatly ↑ed by permanent circular folds, villi & microvilli.

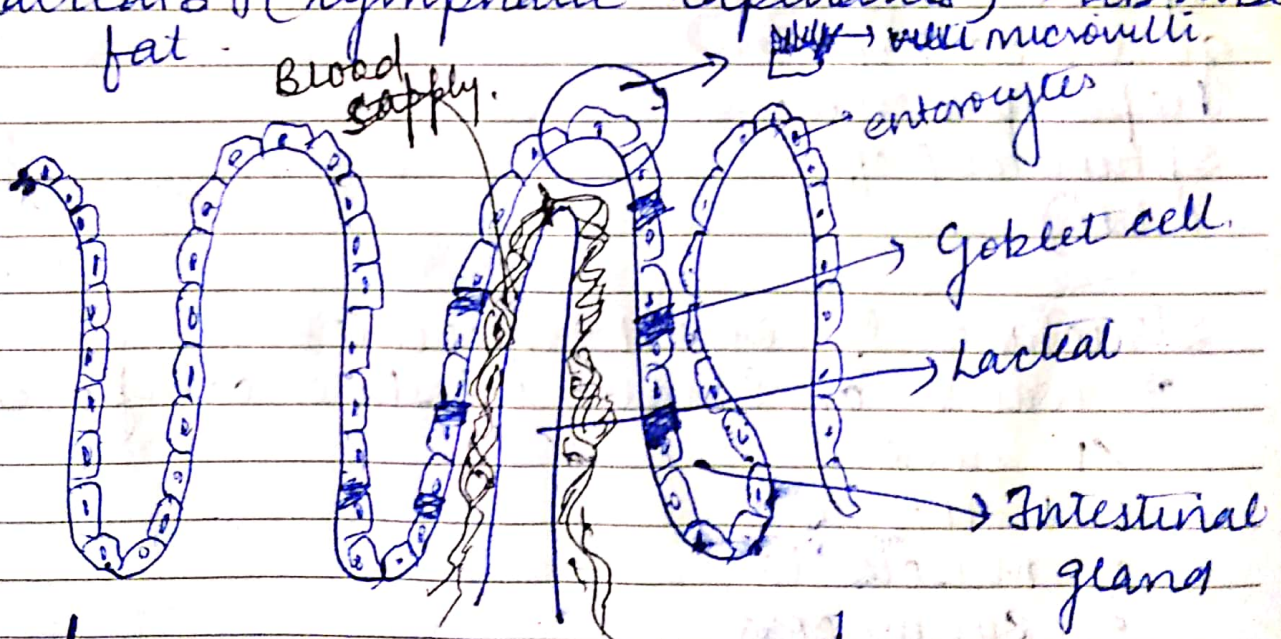
→ permanent circular folds → promote mixing of chyme

→ villi are tiny finger like projections  
0.5 to 1 mm long

→ Microvilli (1 μm long)

Structure of villi consist of :-

- Goblet cells → secrete Mucus
- Enterocytes → Absorption of nutrients
- Intestinal gland → secrete intestinal juices
- solitary lymphatic follicles
- aggregated lymphatic follicles } → defensive cells  
(Peyer's patches)
- Lacteals (lymphatic capillaries) → absorbed fat



villi structure in small intestine



BS :- Superior mesenteric artery &  
Superior mesenteric vein

- Intestinal juice (1500 ml) consist of → PH (7.8 - 8)
- water → peptidases
- Mucus → lipase
- Mineral salts → sucrase, maltase & lactase

functions of small intestine

- peristalsis for onward movement of food
- Secretion of intestinal juice
- chemical digestion of carbohydrate, proteins & fats in enterocytes by pancreatic enzyme.

pancreatic juice (PH 8) enters the duodenum at the hepatopancreatic sphincter & consist of

- water
- Mineral salts
- enzymes
  - amylase → Digestion of carbohydrate.
  - lipase → Digestion of fats
- inactive enzyme precursors
  - trypsinogen
  - chymotrypsinogen
  - procarboxypeptidase

} activated by enterokinase (Digest protein)

- protection against infection by microbes by lymph follicles.

- secretion of hormone cholecystokinin (CCK) and secretin (stimulate pancreatic juice secretion) by endocrine cells in the walls of duodenum
- Absorption of nutrients

Bile - secreted by liver, enter in duodenum by hepatopancreatic sphincter.

- Also stored in gall bladder
- pH → 8
- 500 - 1000 ml daily.
- consist of water, mineral salts, mucus, Bile salts, Bile pigments mainly bilirubin & cholesterol.

functions of Bile:-

- emulsify fats in small intestine.
- Erythrocytes

↓ Breakdown

stercobilin (colour & deodorises faeces) → Bilirubin → urobilinogen (excreted in urine)

Food Reaches to  
Duodenum



Release of cholecystokinin & secretin



contraction of Gall Bladder



Release of Bile & pancreatic juice  
in to the duodenum.



Digestion



Absorption

Large intestine:

1.5 meters long, 6.5 cm diameter

Caecum

Rectum (13 cm)

Anal canal (3.8 cm)

Ascen-  
ding  
colon

Trans-  
verse  
colon

Descen-  
ding  
colon

Sigmoid  
colon

Attached to the caecum is a twisted, coiled tube measuring about 8 cm in length called appendix or vermiform appendix.

### Structure

- All 4 layers present
- Mucosa

↓  
No folds or villi

crypts → consist large no. of goblet cells that secrete mucous for protection & lubrication.

### functions -

- Absorption
- Microbial Activity → include *E. coli*, *Enterobacter aerogenes*, *Streptococcus faecalis* & *Clostridium perfringens*. These microbes are commensals, i.e normally harmless in human.

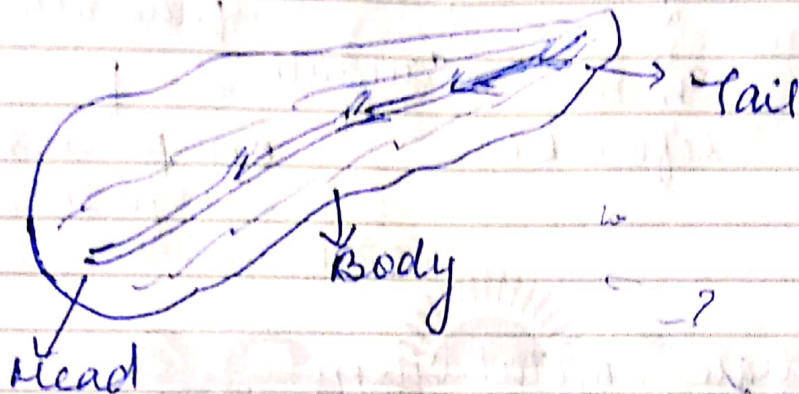
↓  
ferment indigestible carbohydrates  
produces about 500ml of gas/day

Synthesize B complex vitamins & most vitamin K

- Mass movement
- Defaecation

**Pancreas :** Pancreas is a pale grey gland weighing 60 grams.

- 12 to 25 cm long
- situated in the epigastric and hypochondriac regions of the abdominal cavity.
- 



→ Pancreas is both an exocrine and endocrine gland.

**Exocrine pancreas** → consist of a large number of lobules made up of small alveoli, the walls of which consist of secretory cells.

→ to produce pancreatic juice containing enzymes that digest carbohydrates, proteins & fats.

**Endocrine pancreas** consist of specialised cells called the pancreatic islets (of Langerhans).

It secretes hormones insulin & glucagon.

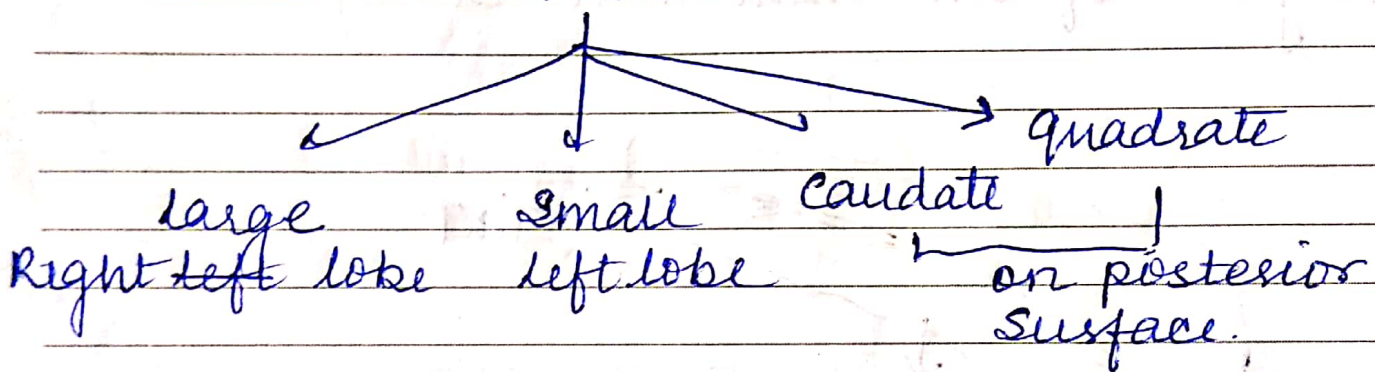
Liver :- largest gland of the body

weighing 1 - 2.3 kg.

→ situated in the upper part of the abdominal cavity

→ The liver is enclosed in a thin inelastic capsule & a layer of peritoneum.

→ liver has 4 lobes



functions :-

1. Carbohydrate metabolism

2. fat metabolism

3. protein metabolism

→ Deamination of amino acids

→ Transamination

→ Synthesis of plasma proteins & most blood clotting factors from amino acids

4. Breakdown of erythrocytes & defence against microbes - carried out by phagocytic hepatic macrophages (Kuffer cells) in the sinusoids.

5. Detoxification of drugs and noxious substances.

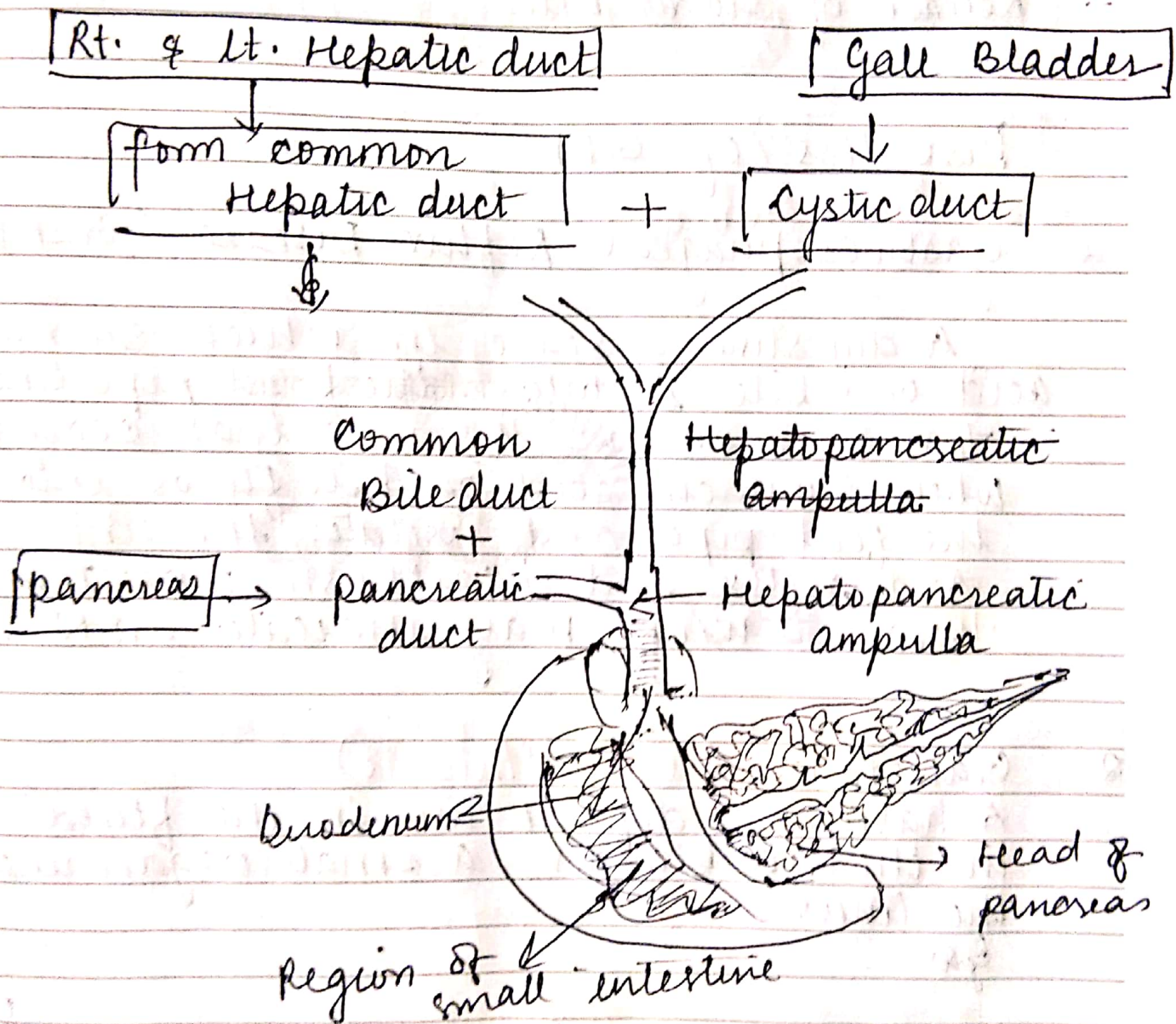
6. Inactivation of hormones

7. Production of heat

8. Secretion of bile.

1. Storage :- → glycogen, fat-soluble vitamins A, D, E, K  
iron, copper, some water-soluble vitamins  
eg vitamin B<sub>12</sub>

Bile Ducts :-



Gall bladder is a pear shaped sac attached to the posterior surface of the liver by connective tissue

functions of gall bladder -

- Reservoir of Bile
- Concentration of the bile by up to 10 to 15 fold by absorption of water
- Release of stored bile.

## Disorders of GIT

### 1. Gastroesophageal Reflux Disease (GERD)

A digestive disease in which stomach acid or bile irritates the food pipe lining. This is a chronic disease that occurs when stomach acid or bile flows into the food pipe and irritates the lining. Acid reflux and heartburn more than twice a week may indicate GERD.

### 2. Gallstones (Cholelithiasis)

A hardened deposit within the fluid in the gallbladder, a small organ under the liver.

### 3. Celiac disease - An immune reaction to eating gluten, a protein found in wheat, barley & rye.



Over time, the immune reaction to eating gluten creates inflammation that damages the small intestine's lining, which prevents absorption of some nutrients.

4. Ulcerative colitis

5. Irritable Bowel disease

6. Hemorrhoids

7. Diverticulitis

8. Anal Fissure