

CHAPTER 1

DIGESTIVE SYSTEM OF MAN

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* Nutrition:-

Sum of all the processes involved in the processing of nutrients.

- Ingestion → Taking in of food
- Digestion → Breakdown of food
- Absorption → Absorption in blood
- Assimilation → Use of energy from food by body
- Egestion → Excretion of undigested food

Metabolism

(all the chemical reactions happening in living body)

Anabolism

- ↳ Small molecules combine and form large molecules.
- Photosynthesis

Catabolism

- ↳ Large molecules breakdown into smaller molecules.
- Respiration

* Nutrient:-

Any substance that provides necessary elements to the body for growth and metabolism.

Example:-

Carbohydrates, Proteins, Lipids

* Digestion:

The breakdown of undiffusible form of food into diffusible form.

OR

The breakdown of complex food particles into simpler food particles.

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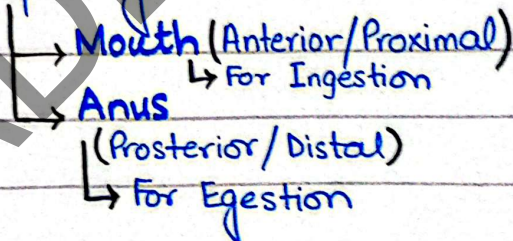
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* Digestive System:

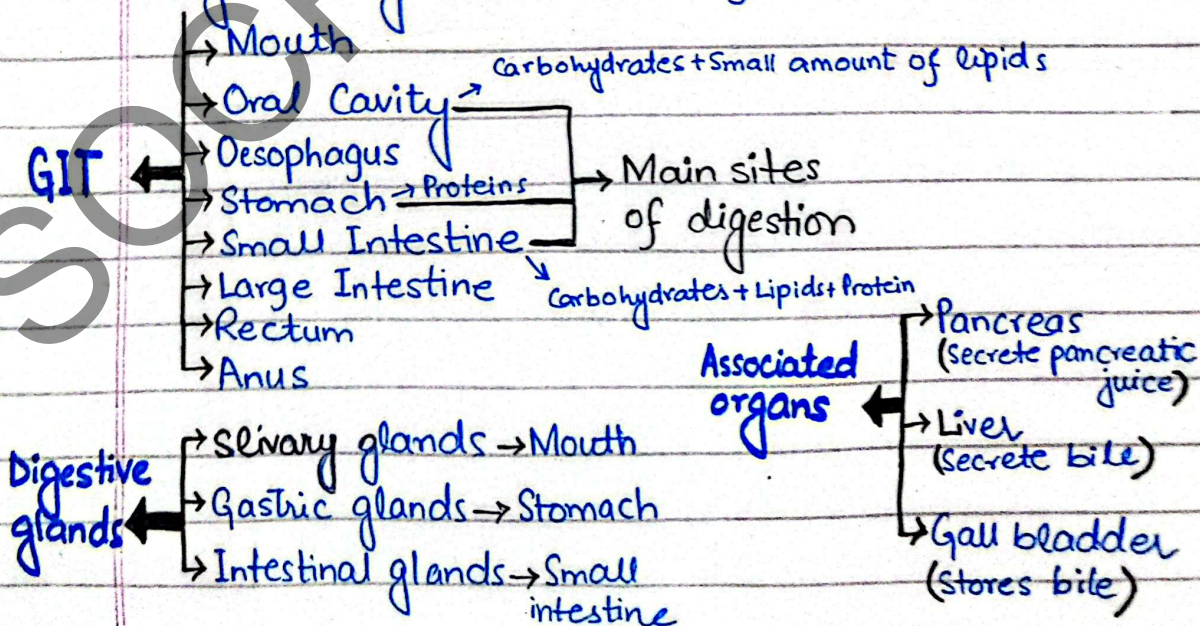
Consist of long digestive tract/
Gastrointestinal tract (GIT) / gut / alimentary canal.

- Human digestive system is tube type:-

Having 2 openings.



- Digestive System consists of :



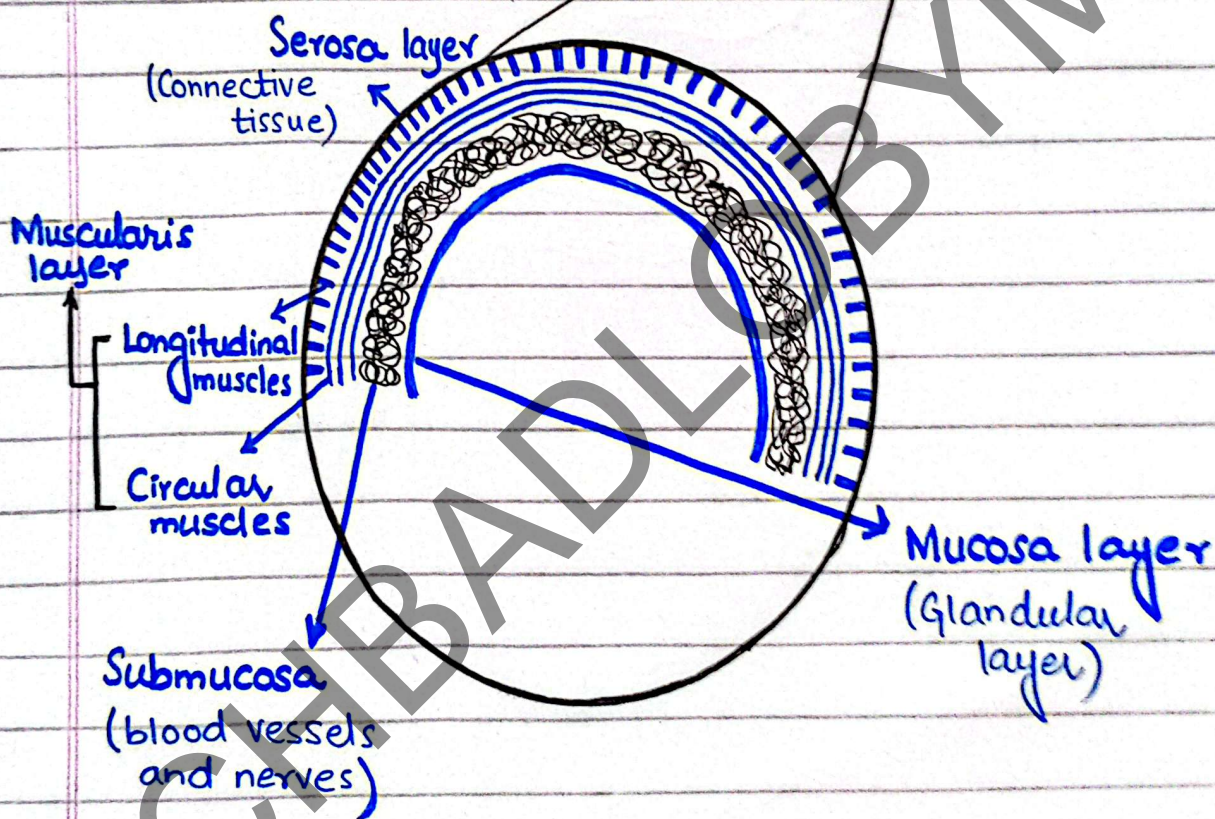
* Wall of GIT :

Has 4 layers (Tunics).

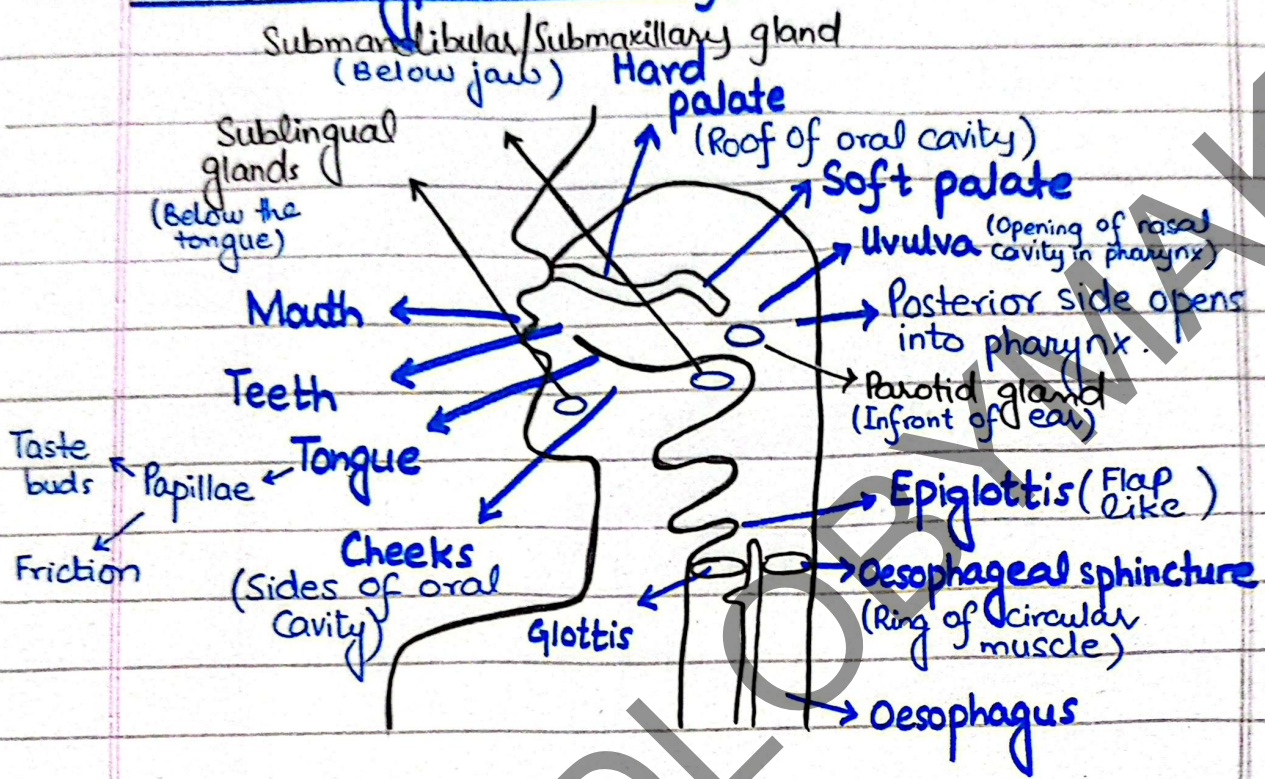
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* Oral Cavity/Buccal Cavity:-



Mechanical Digestion:

Food is broken down into smaller pieces by chewing or mastication.

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Chemical Digestion:

Two enzymes are secreted:-

↳ Salivary amylase (ptyalin) → Digests starch
 ↳ Lingual lipase → Digests lipids/fat

Triglycerides → Diglycerides/Monoglycerides

⇒ After digestion in oral cavity, bolus is formed.

* Swallowing & Peristalsis:-

↳ Phase 1 :- Oral Phase

↳ Voluntary Phase

↳ Food is moistened with saliva and forms bolus.

↳ Tongue movement

↳ Lip Closure

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↳ Phase 2 :- Pharyngeal Phase

↳ Involuntary Phase

↳ Tongue moves upward

↓
Soft palate moves upward

↓
Opening of nasal cavity closes
so that food do not enter into
nasal cavity.

↳ Tongue moves backward

↳ Epiglottis is pushed over larynx

↓
Opening into trachea closes

↳ Esophageal sphincture opens

↳ Phase 3 :- Esophageal Phase

↳ Involuntary Phase

↳ Peristalsis → Food is pushed downward

* Peristalsis:-

- ↳ A characteristic movement of GIT.
- ↳ Moves food in anterograde (forward direction) from mouth to anus.
- ↳ Rhythmic, wave like movement.
- ↳ Each region of GIT shows its own peristalsis.

Mechanism:

Takes place by alternative contraction and relaxation in circular and longitudinal muscles in Muscularis.

Antagonistic to each other
(One contracts and other relaxes)

Other than GIT:

Peristalsis also occurs in following other than GIT:-

→ Ureter:

Carries urine from kidney to urinary bladder.

→ Carries bile from liver and gall bladder in duodenum.

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Circular muscle

↓
Contraction

Longitudinal muscle

↓
Relaxation

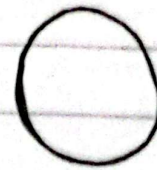
→ O
▲ Narrowing

Circular Muscle

Relaxation

Longitudinal Muscle

Contraction



Widening

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Starting of Peristalsis:

Peristalsis starts on:

- 1) Swallowing
- 2) Hunger pangs (On fasting for 12-14 hours)

Uncomfortable sensations like cramping that occur when the stomach is empty and signals the body to seek food.

* Esophagus:-

↳ Located in center of chest → Mediastinum] → Space between lungs

↳ 25cm length & 1.5-2.0cm diameter

↳ Esophageal sphincter (Ring-shaped muscles)

↳ Upper esophageal sphincter (Opening of upper esophagus)

↳ Lower esophageal sphincter (Opening of lower esophagus)

Cardiac sphincter

Contracted

Relaxed

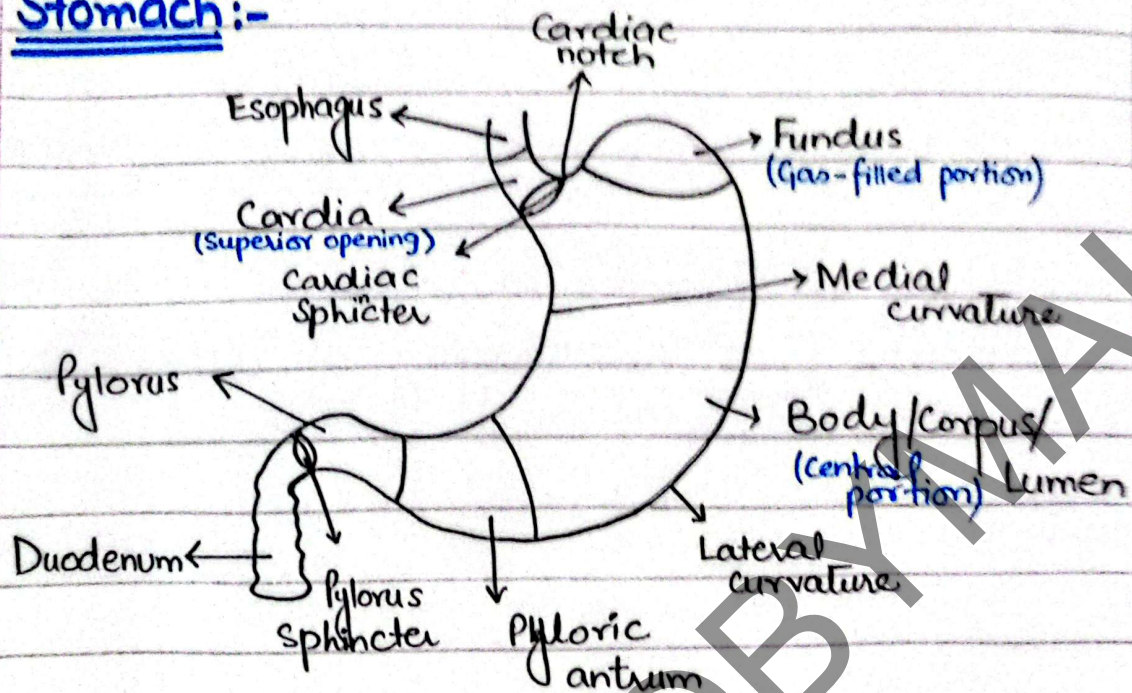
Close

Open

Function:

- 1) Generally no digestion takes place (Digestion due to secretions of mouth continues)
- 2) Provide a passage to bolus that is why it is also called food pipe.

* Stomach:-



- ↳ 2nd main site for digestion
- ↳ Muscular bag.
- ↳ J-shaped (when not eating)
- ↳ Provide storage of food.

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Location:-

- Upper left quadrant of the body.
- Just below the diaphragm.
- Anterior end connected with esophagus.
- Posterior end is connected with duodenum.

Greater Curvature:-

- It forms long, convex and lateral border of stomach.
- It arises from cardiac notch, arches backward and passes inferiorly to the left.
- It curves to the right as it continues

medially to reach the pyloric antrum.

Lesser Curvature:

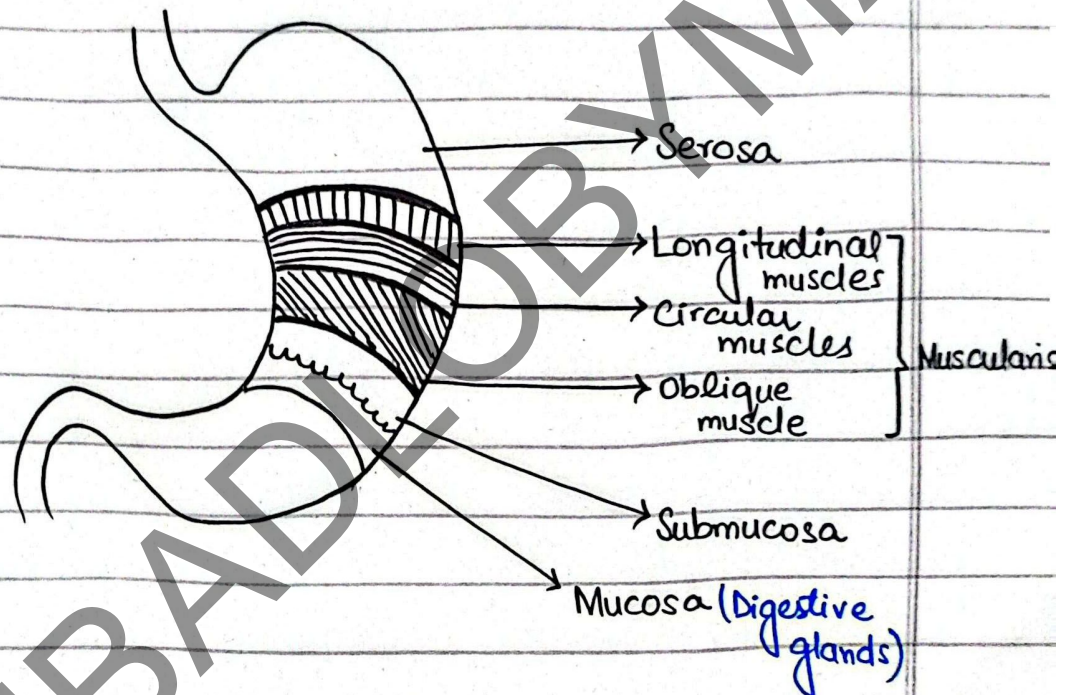
→ It is shorter, concave and medial surface of stomach.

Walls of Stomach:-

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The stomach is lined with epithelium which is made of 4 types of epithelial cells:-

1) Surface mucous cell:

It secretes mucous to protect the stomach from HCl.

2) Parietal cell/Oxyntic Cells:

It produces HCl and intrinsic factor (glycoprotein).

3) Chief/Zymogen Cells:

Secrete pepsinogen.

4) Endocrine Cell:

Endocrine cells release hormone called gastrin, which is released into the blood.

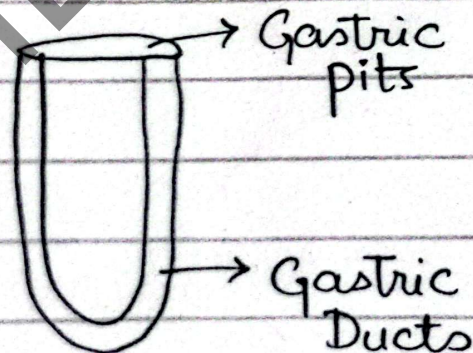
It is not part of gastric juice.

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⇒ The mucosa layer also forms tube like gastric pits, which are opening for gastric glands.



• Function of Regions of Stomach:-

• Cardiac Region:

- Receives food from esophagus.
- Prevent backflow of food (through cardiac sphincter).

• Fundus:

- Contains gas bubbles through swallowing of air.

• Body/Corpus:

- Main site for mixing of food with gastric juices.
- Secrete enzymes (pepsin) and HCl for digestion.

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• Pyloric Region:

- Pyloric Antrum: Digestion and mixing of chyme.
- Pyloric Canal: It pushes the food into the pyloric sphincture to enter into small intestine.

* Function of Stomach:-

• Mechanical Digestion:

Mechanical digestion takes place by mixing/churning waves. As a result, boluses are digested to chyme.

• Chemical Digestion:

It takes place by means of gastric juices which are secreted by gastric glands and released

in lumen of stomach.

Q Why salivary amylase denatures in stomach?
OR

Why carbohydrates are not digested in the stomach?

Ans Salivary amylase is alkaline in nature and because HCl is released in stomach, the pH in the stomach drops. As a result, salivary amylase denatures ^{due to} which carbohydrates are not digested in stomach.

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Q What are proteolytic enzymes?

Ans Proteolytic enzymes are protein digesting enzymes that breakdown protein by breaking the peptide bonds in protein molecules.

* Role of Nervous System and Gastrin in secretion of gastric juice:-

- ↳ Through smell, seeing and chewing of food
 Receptor $\rightarrow$ Brain (medulla)
- ↳ Brain $\xrightarrow{\text{Nerves}}$ Stomach $\rightarrow$ Message
- ↳ Produce a chemical $\rightarrow$ Acetylcholine
- ↳ Acetylcholine $\xrightarrow{\text{increase}}$ Activity of parietal cell $\rightarrow$ Produce HCl
- ↳ ~~Secrete~~ ^{Stimulate} the secretion of Gastrin hormone from endocrine cell.
- ↳ Gastrin $\rightarrow$ Stimulate parietal cell $\xrightarrow{\text{Produce}}$ Gastric Juice

* Small Intestine:-

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- Small intestine is the longest part of GIT.
- Maximum digestion takes place in small intestine.

⇒ Small intestine has three parts:-

1) Duodenum:

- First part
- 20-25 cm (8-10 inch)
- C-shaped and short
- Surrounds head of pancreas
- Pancreas releases pancreatic juice in duodenum.

→ Pancreatic Juices:

- Produce in pancreas
- Transports from pancreas through pancreatic duct into duodenum
- Works in duodenum

Composition of Pancreatic Juice:-

→ Water and mucous → Lubrication

→ Sodium bicarbonate and other salts → Acidic to Basic medium

→ Enzymes

→ **Carbohydrases**

→ Pancreatic amylase (amyllopsin)

→ Starch or glycogen

→ Maltose

secreted by duodenal cells

→ **Proteases**

→ Trypsinogen (Inactive)

→ Enterokinase

→ Trypsin (Active)

large polypeptides → Peptones

→ Chymotrypsinogen (Inactive)

→ Trypsin

→ Chymotrypsin (Active)

→ Procarboxypeptidase (Inactive)

→ Trypsin

→ Carboxypeptidase (Active)

Peptones → Dipeptides

→ **Lipases**

→ Small lipid granule

→ Fatty acid and glycerol

→ **Nuclease**

→ DNAase

→ DNA

→ Deoxyribonucleotide

→ RNAase

→ RNA

→ Ribonucleotide

* Bile:-

→ Manufactured in liver

→ Stored in gall bladder

Role of bile juice in digestion:

Bile juice work in the

duodenum

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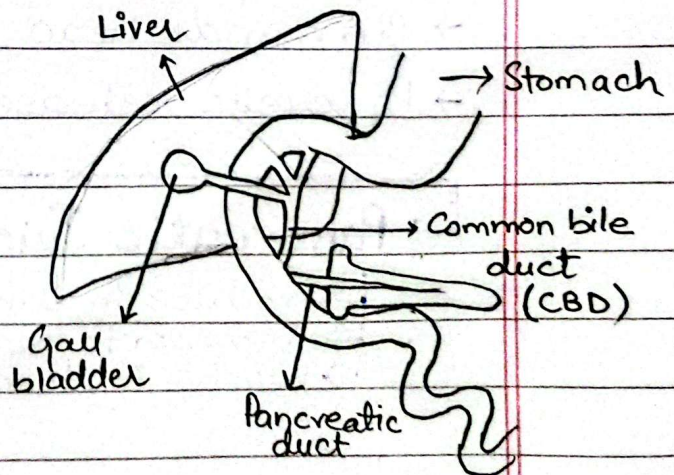
Composition:-

→ Contains no enzyme

→ Contains bile salts

↓
Emulsification of lipids

↓
Breakdown of large lipid molecules in small lipid granules (emulsions)



2) Jejunum:-

Jejunum is about 2.5m long.

3) Ileum:-

Ileum is about 3.5m long.

• Digestion in Jejunum and Ileum:-

↳ Here digestion of proteins, carbohydrates and fats is completed.

• Enzymes secreted:-

Enzymes secreted by jejunum and ileum are:-

↳ Amino Peptidase: Polypeptides → Dipeptides

↳ Erepsin: Peptides → Amino Acids

↳ Lactase: Lactose → Glucose + Galactose

↳ Maltase: Maltose → Glucose

↳ Sucrase: Sucrose → Glucose + Fructose

↳ Pancreatic Lipase: Fats → Fatty Acids + Glycerol

Bolus → Partially digested food of oral cavity
↓
Oval lump

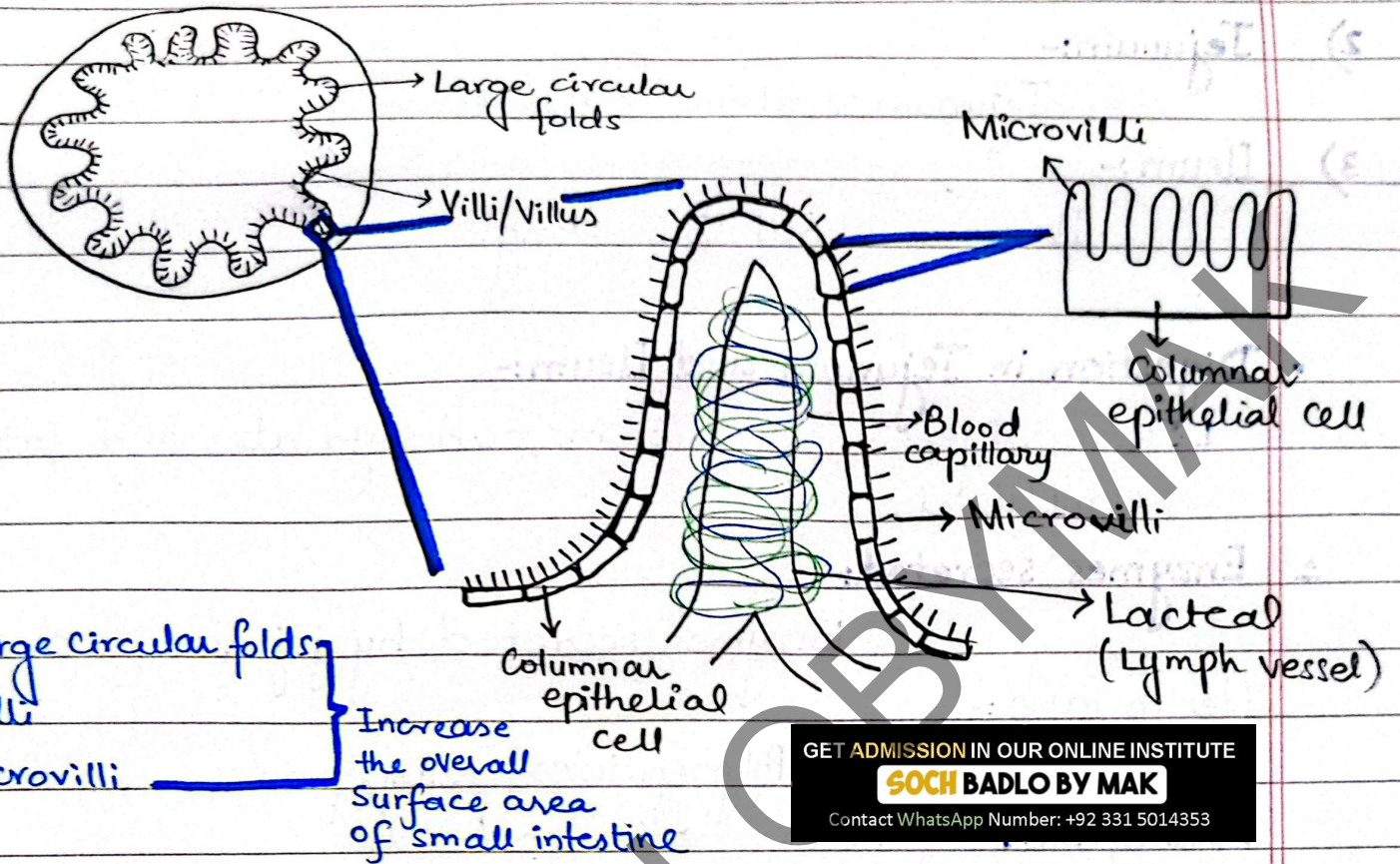
Chyme → Partially digested food of stomach cavity
→ Soft Paste

Chyle → Watery emulsion

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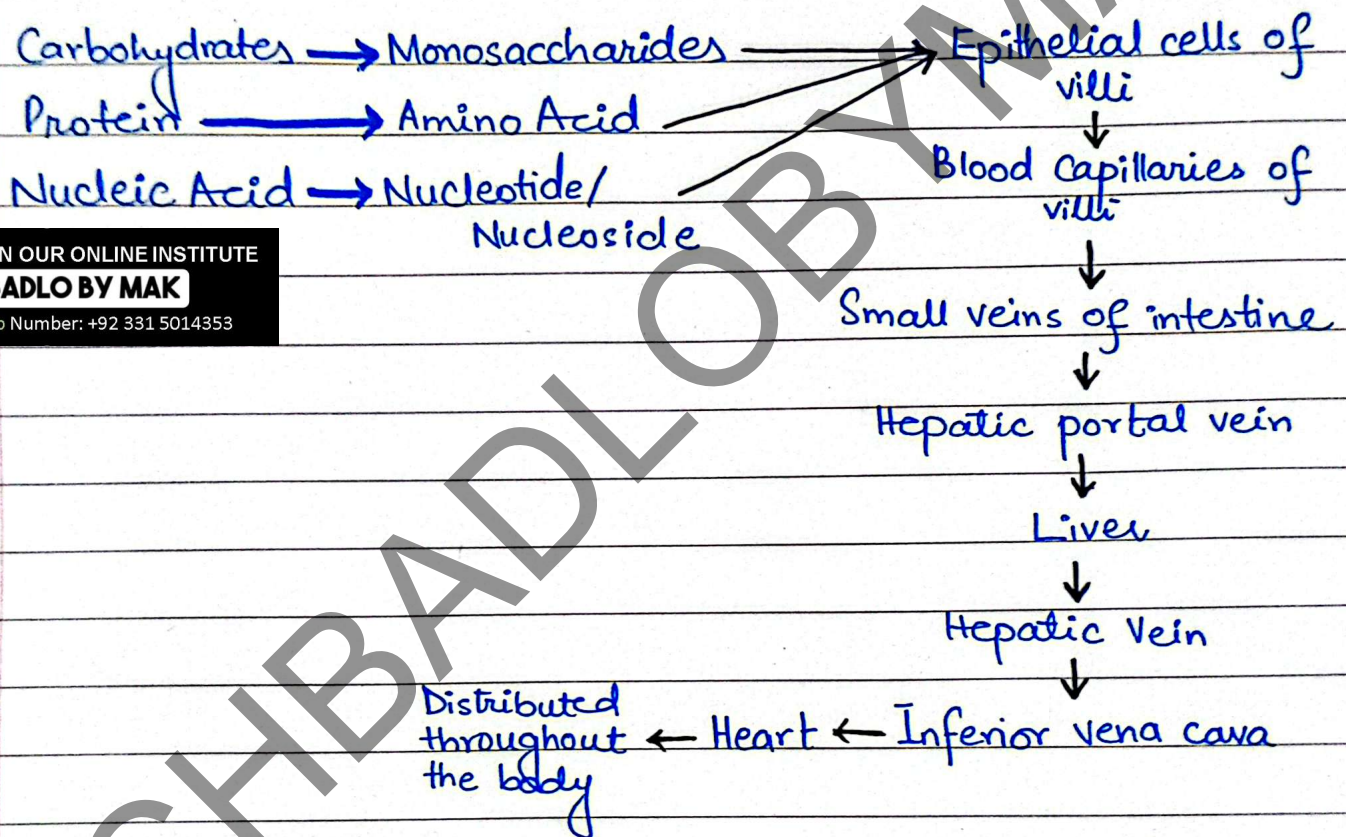


	Pepsin	Trypsin
Origin	Pepsinogen	Trypsinogen
Activation	Exposed in HCl/already present pepsin	Enterokinase
Site of secretion	Gastric gland of stomach	Pancreas
Site of action	Stomach	Duodenum
Working environment	Acidic environment/ Low pH $\Rightarrow$ 2 pH	Alkaline environment/ High pH $\Rightarrow$ 8 pH

* Principle components of food → Digested Product

- Carbohydrates → Monosaccharides
- Proteins → Amino Acids
- Lipids → Glycerol, Fatty Acids, Cholesterol
- Nucleic Acid → Nucleotide, Nucleoside

* Absorption of Carbohydrates and Protein:-

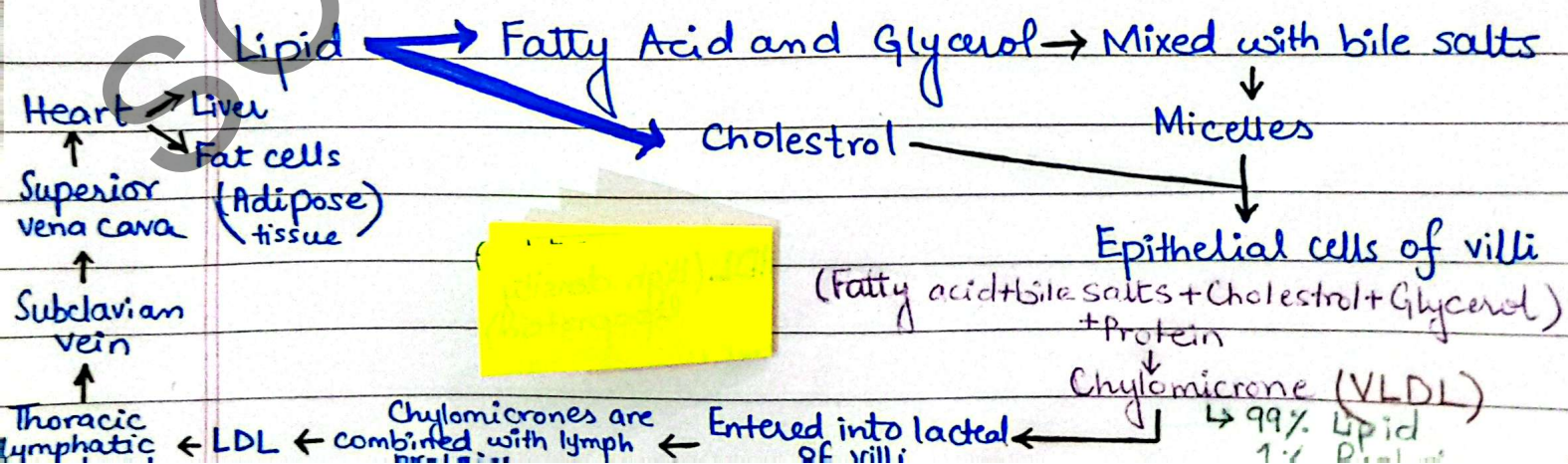


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* Absorption of Lipid:



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