

Biology Chap 1 - Digestive System of Man

Nutrition:- Sum of all the processes involved in the processing of nutrients.

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

→ all chemical runs happening within the living system.

Types:-

① Anabolism

Small molecules combine to form large molecules.

Eg:- Photosynthesis

Protein Synthesis

Known as nutrients because they are essential elements for growth.

② Catabolism

Large molecules combine to form/breakdown to form smaller ones.

Eg:- Respiration

Processing of Nutrients.

Carbohydrates
($C_6H_{12}O_6$)

Proteins

($C_6H_{12}O_6, N, S$)

Lipids
($C_{18}H_{36}O_2$)

* Processes involved in Nutrition:-

- ① Ingestion (taking in of food)
- ② digestion (breakdown of substances/food)
- ③ Absorption (into the blood stream of the nutrients obtained (food))
- ④ Assimilation (Cells obtained Energy from the food and it is utilized by the cells to perform specific functions)
- ⑤ Egestion (Undigested waste material is removed from the body)

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Topic:- Digestion (Lecture 02)

Digestion:- breakdown of undiffusible form of food into diffusible form.

The Digestive System:-

Consists of:- long digestive tract / GIT

Alimentary tract.

→ gastro intestinal tract.

• Human digestive tract/System is a tube like structure

Having 2 openings

mouth

Anus

(Anterior/proximal)

(Posterior/distal)

Digestive System:-

- mouth
- oral cavity
- Pharynx
- Esophagus
- Stomach
- Small intestine
- large intestine.

site for digestion

Accessory Digestive Organs

- Teeth
- Tongue
- Salivary Glands
- liver
- gall bladder
- Pancreas.

Associated organs

Digestive Glands

- ① Salivary glands (Mouth)
- ② Gastric glands (Stomach)
- ③ Intestinal glands (intestine)

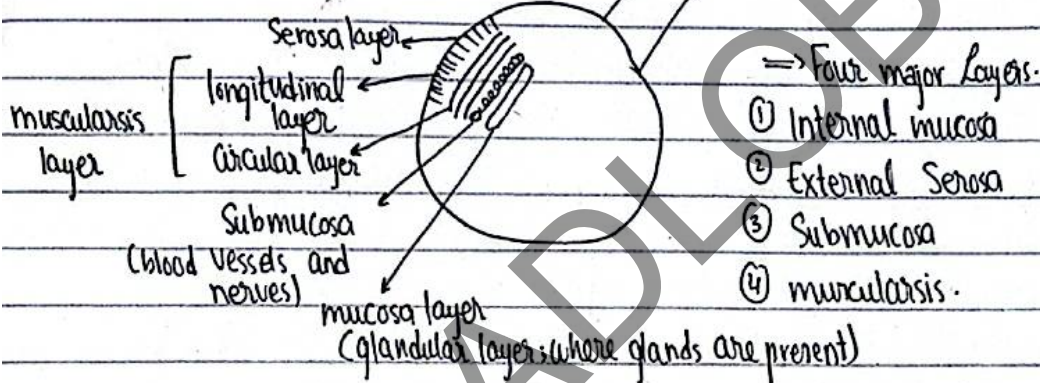
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★ Structure of GIT (wall of GIT)

it has 4 layers.

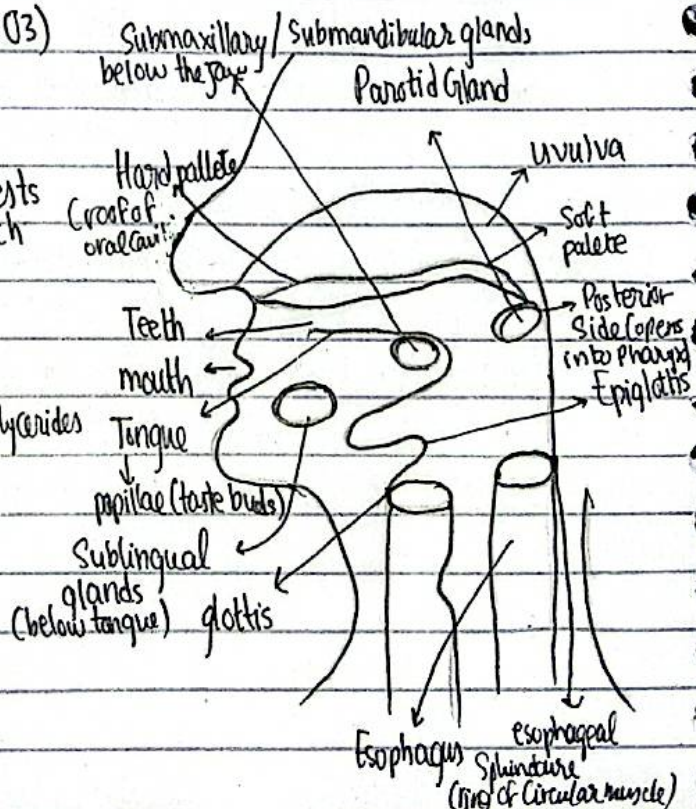


Topic:- Oral /Buccal Cavity (Lecture 03)

→ chemical digestion

- Salivary Amylase (Ptyalin) → digests Starch
- lingual lipase (digests lipids or fats) → Triglycerides → diglycerides or monoglycerides

→ bolus
→ oval shaped structure



Topic:- Swallowing and Peristalsis

involves 3 Phases.

→ Phase 1:- oral phase

- voluntary phase

- Tongue movement & lips closing

→ Phase 2:- Pharyngeal Phase

- involuntary

- tongue moves upward → Soft Palate moves upward

opening of nasal cavity closes so that food doesn't enter the nasal cavity.

→ Phase 3:- Esophageal phase

Peristalsis → food pushed downwards.

Topic:- Peristalsis (Lecture 04)

- characteristic movement of GIT

- moves food in Anterograde (forward direction)

→ mouth → Anus

* Mechanism:-

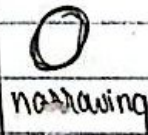
Takes place by Alternative Contraction and Relaxation in Circular and Longitudinal muscles in muscularis in GIT

Circular muscle

Contraction
narrowing

Longitudinal muscles

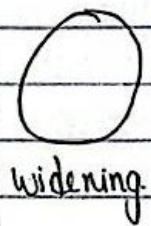
Relaxation



Antagonistic to each other.

Circular muscle

relaxation
Longitudinal muscle
Contraction



→ other than GIT Peristalsis takes place in:-

viscera:- (1) Carries ~~water~~ the urine from kidney to urinary bladder.

(2) Carries bile from liver & gall bladder in the duodenum.

⇒ Stomach

- 25cm → length

- 1.5 - 2.0 → diameter.

- located in the mediastinum behind the heart.

→ Space b/w the lungs.

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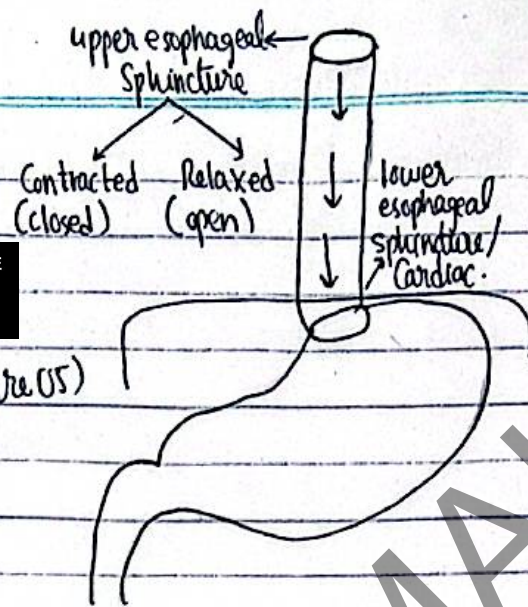
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Function:-

- ① Generally no digestion takes place
- ② Provides a passage of bolus into the food pipe.

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Topic:- Structure & functions of stomach (lecture 05)

- muscular bag
- J-shaped
- provides Temporary storage of food.

Location:-

- left upper quadrants
- below the diaphragm
- Anterior end Connected with the esophagus
- Posterior end Connected with duodenum.

⇒ Greater Curvature :-

- forms a long, Convex and lateral border of the stomach.
- arises from the Cardia & it arches backwards & paves inferiorly to the left.
- Curves to the right, continues medially to reach the pyloric Antrum.

⇒ Lesser Curvature

- Shorter, Concave, medial Surface of Stomach.

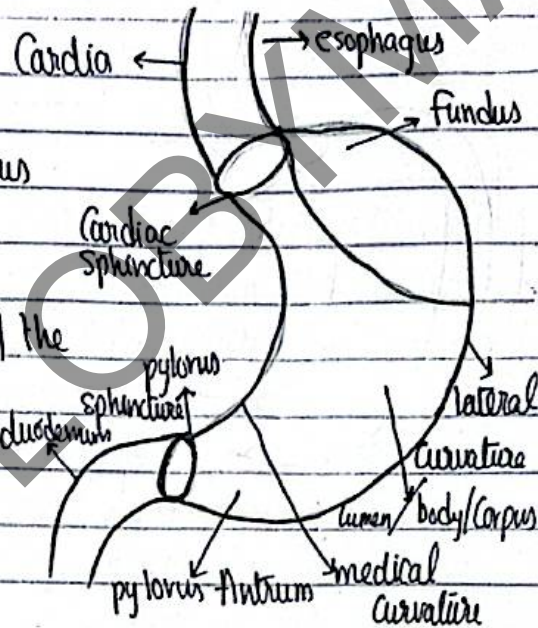
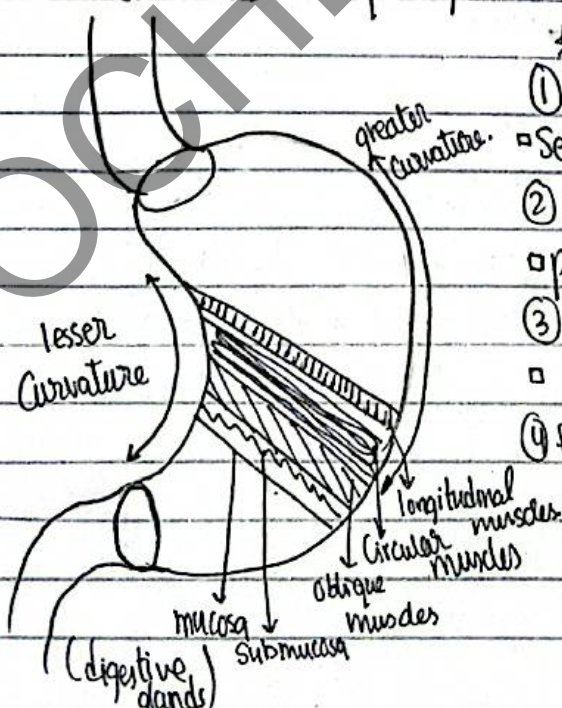


Fig. 8 Division of stomach.



* Four Epithelial Cells of stomach

- ① Surface mucous Cells
 - Secrete mucous to protect stomach from HCl.
- ② Parietal Cell/Oxyntic Cells.
 - produces HCl/and intrinsic factor
- ③ Chief/ Zymogen Cells
 - Secrete pepsinogen
- ④ Endocrine Cell
 - Release hormone → gastrin → blood

(not part of gastric Gland) or juice

Topic:- Functions of Different regions of stomach. (Lecture 06)

→ Cardiac Region

- Receive food from the esophagus
- prevents backflow of food (through Cardiac Sphincture)

→ Fundus

- Contains gas bubbles through Swallowing of air

→ Body / Corpus

- Main Sink for the mixing of food with Gastric juices
- Secretes enzymes (pepsin) and HCl for digestion.

→ Pyloric Antrum:-

* Pyloric Antrum:-

Digestion and mixing of Chyme

* Pyloric Canal:-

It pushes the food to the pyloric Sphincture to enter into the Small Intestine.

⇒ Function of stomach

→ Mechanical digestion

by means of mixing / Churning

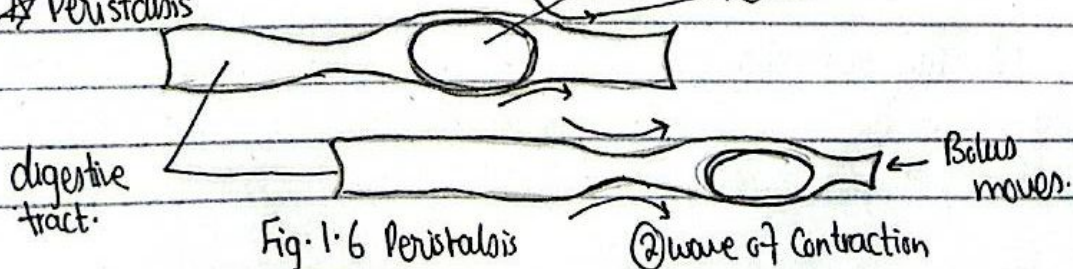
Boluses
↓
mechanical
digestion
↓
Chyme.

→ Chemical digestion

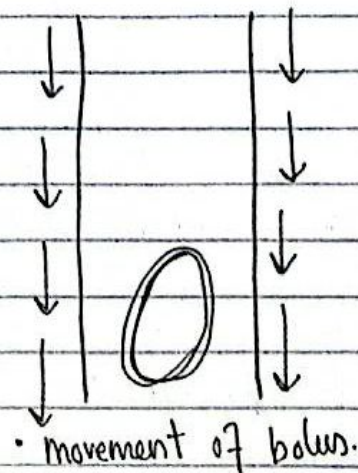
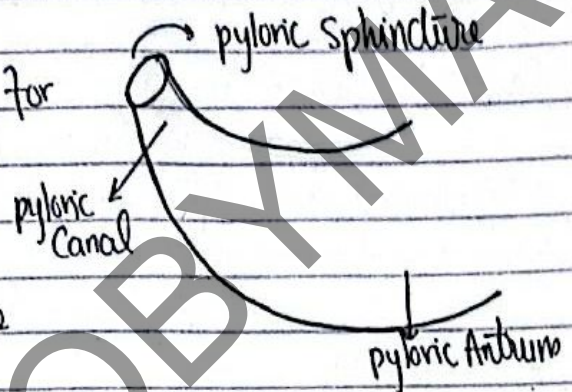
by means of gastric juices

Secreted by gastric glands & are released in the lumen of Stomach.

* Peristalsis



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Topic:- Role of nervous System & Gastrin hormone on the Secretion (Lecture 07):-

- through Smell, Sight & Chewing of Food.
receptor → brain (medulla)
- Brain $\xrightarrow{\text{nerve}}$ Stomach
- produces a chemical $\rightarrow$ Acetylcholine.
- Acetylcholine $\xrightarrow{\text{increase}}$ activity of parietal Cells $\rightarrow$ produces HCl.
- Stimulate the Secretion of Gastrin hormone from the Endocrine Cells.
- Gastrin $\rightarrow$ stimulate parietal Cells $\rightarrow$ produce gastric Juice.

Topic: Small intestine:-

Pancreatic Juices :- mouth $\rightarrow$ Salivary amylase (ptyalin)
 $\rightarrow$ produces in Pancreas (exocrine Cells)

- Transported through pancreatic duct into duodenum
- works in duodenum

Trypsinogen $\xrightarrow{\text{Enterokinase}}$ trypsin $\xrightarrow{\text{secreted by duodenal wall}}$

$\Rightarrow$ Composition:-

- mucus & water
- Sodium bicarbonate & other Salts (Amylopsin)

$\rightarrow$ Enzymes:

- ① Carbohydrates $\rightarrow$ Pancreatic Amylase $\rightarrow$ starch $\rightarrow$ maltose
- ② Protease $\rightarrow$ Trypsinogen (trypsin)
 $\rightarrow$ Chymotrypsinogen (Chymotrypsin)
 $\rightarrow$ Procarboxypeptidase (Carboxypeptidase)
- ③ Lipases $\rightarrow$ Small lipid granule $\rightarrow$ fatty Acid & glycerol
- ④ Nuclease $\rightarrow$ ① DNAse $\rightarrow$ DNA.
② RNAse $\rightarrow$ RNA.

Topic:- Bile / Pancreatic juice (Lecture 08)

$\rightarrow$ Pancreatic juice

proteases $\rightarrow$ Trypsinogen (trypsin) large polypeptides $\rightarrow$ peptones $\rightarrow$ small polypeptides.
 $\rightarrow$ Chymotrypsinogen (Chymotrypsin) large polypeptide $\rightarrow$ peptones
 $\rightarrow$ Procarboxypeptidase (Carboxypeptidase) peptones $\rightarrow$ Dipeptides

* Role of Bile Juice in Digestion

- produced in liver
- stored $\rightarrow$ gall bladder

worked → duodenum

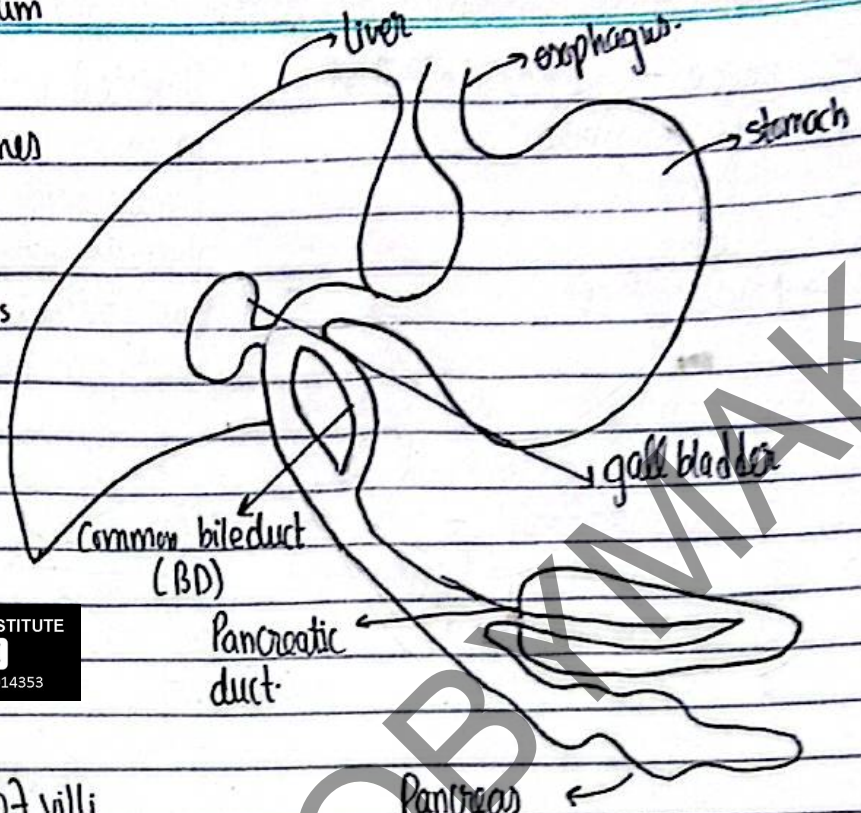
★ Composition

- Contains no enzymes

Bile Salts

↓
emulsification of lipids

↓
breakdown of large lipid molecules in small lipid granules.



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Topic - Structure of villi

Bolus → partially digested food of oral cavity → oral clump

Chyme → partially digested food of stomach cavity
→ soft paste

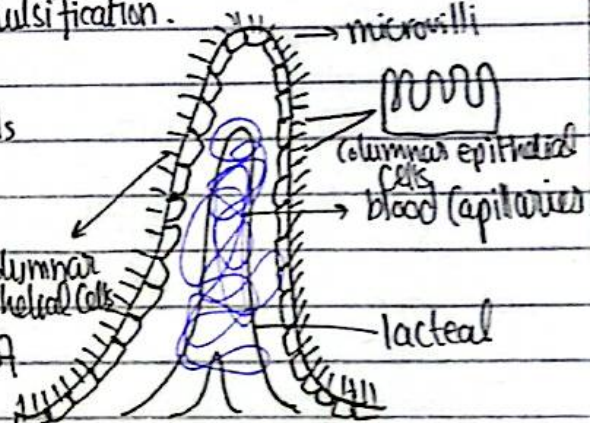
Chyle → watery emulsion or emulsification.



large circular folds
villi/Villus

- large circular folds
- villi
- microvilli

increase the overall surface area of small intestine.



structure of villi

Topic :- Difference b/w pepsin & trypsin (lecture 09)

	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 environ.	Acidic Environ. low pH 2 pH	Alkaline environ. high pH 8 pH.

Topic:- Absorption of Carbohydrates and proteins

principle Components of food

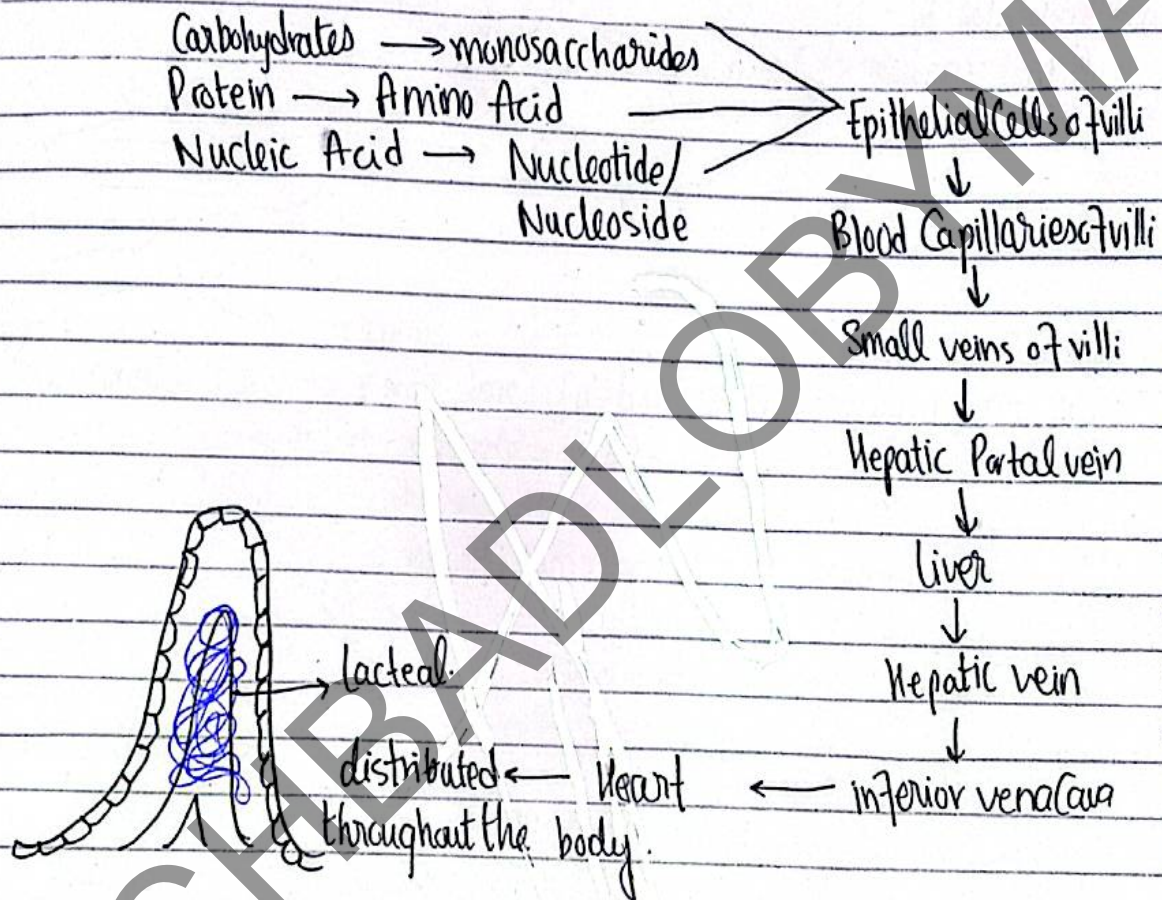
- ↳ Carbohydrates
- ↳ Proteins
- ↳ Lipids
- ↳ Nucleic Acid

Digested product-

- monosaccharides
- Amino Acids
- glycerols, fatty acids, cholesterol
- Nucleotide, Nucleoside.

Flow Chart

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Topic:- Absorption of lipid

~~Superior vena cava~~ The Absorption of lipids in the human digestive System begins when fatty acids & glycerol mix with bile salts to form micelles. These enter the intestinal villi cells and combine with cholesterol & proteins to form chylomicrons.

Chylomicrons move through lymphatic vessels into the bloodstream, reaching the heart and then fat tissues.

They are converted into HDL, LDL & VLDL, which help in lipid transport.

Topic:- Large Intestine (Lecture 10)

Structure

→ Caecum (or Cecum)

- first part of the large intestine
- located at the Junction of Ileum and large intestine.
- ~~is~~ Guarded by ileocaecal sphere

→ Appendix

- Blind tube (9cm) attached to Caecum
- Called vermiform appendix
- Contains many lymph Nodules

→ Colon

- 1.5m long
- Divided into four parts:-
 - ① Ascending
 - ② transverse
 - ③ Descending
 - ④ Sigmoid.

→ Rectum

- Straight, muscular tube
- Begins at the end of Sigmoid Colon
- Ends at Anus, guarded by Sphincter

* Functions of the large intestine

① Absorbs water and electrolytes

- Makes stool Solid by reabsorbing water

② Absorbs vitamins

- mainly vitamin K and Biotin produced by bacteria.

③ Reduces acidity

- Secretes bicarbonates to neutralize Acids

④ Protects from Infections

- Acts as a barrier against microbes and harmful Substances.

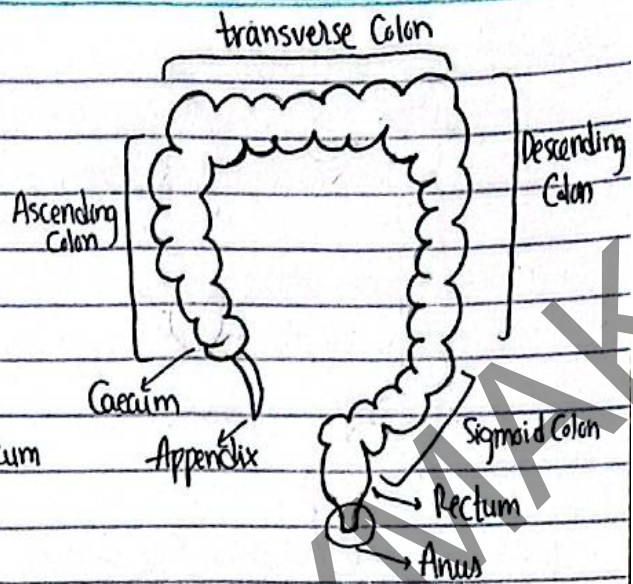


Fig. 1.13: Large Intestine.

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Topic:- Defaecation

- process of expelling unwanted / Undigested or ~~few~~ ~~fewer~~ feces from the digestive tract through the anus.

→ Defaecation Reflex in Infants.

- Involuntary process
- Anal sphincter relaxes automatically after feeding

• Common in infants below two weeks.

→ Defaecation Reflex in Adults.

- Can be voluntarily initiated by - ① Taking a deep breath
- ② Contracting Abdominal muscles.

▫ This increases internal pressure, pushing the feces into the Rectum.

▫ Stretching of the rectum trigger the reflex:- → Signals are sent to the Spinal Cord.

→ muscles Contract, Anal sphincter relaxes, expelling feces.

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★ Storage and Metabolic Role of Liver:

Liver Anatomy:

- 2 main lobes:- larger right lobe and smaller left lobe.
- Contains many lobules (small lobes) filled with blood vessels.
- Connected to:-

→ gall bladder (stores bile)

→ Common bile duct (transport bile to the intestine)

→ Blood Supply:

receives blood from two sources:-

① Hepatic artery

(oxygenated blood)

② Hepatic Portal vein

(nutrient rich blood from intestines)

falciform ligament

right lobe

left lobe

hepatic duct

Cystic duct

Common bile duct

gall bladder

★ Functions of the liver

① Produces bile

(helps break fat in small intestine)

② Produces plasma proteins (e.g. Albumin, globulins, fibrinogen)

③ Modifies proteins for easy transport

④ Stores glucose as glycogen and converts it when needed.

⑤ Regulates Amino Acids and builds proteins

⑥ Stores iron & helps form hemoglobin

⑦ Converts toxic ammonia into urea

⑧ Detoxification of harmful substances

⑨ Breaks down hormones

⑩ Removes microbes and damaged RBCs.

* Composition and Role of bile

→ Gall bladder:-

- Saclike structure located on the inferior surface of the liver
- length → 8 cm • wide/diameter → 4cm
- Connects to the Common bile duct via the Cystic duct.
- Bile → Continuously produced by the liver
→ Stored in the gall bladder.

→ Composition of bile

- produced & secreted by the liver
- no digestive enzymes
- Major Components :-

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- water → Cell debris.
- Bile Salts (eg sodium glycocholate, sodium taurocholate)
- Bile Pigments (eg Bilirubin)
- Cholesterol
- Lecithin (a phospholipid)
- mucus

→ Role of bile Constituents

- Bile Salts help emulsify fat:

- ↳ They reduce the Surface tension of fat globules
- ↳ This breaks fat into tiny droplets, increasing Surface area.
- ↳ The process is called Emulsification & enhances enzyme action.

- Bilirubin:-

- Formed from the breakdown of hemoglobin
- bacteria in the intestine Converts it into pigment
- These pigments give feces its brown color
- Some are absorbed into the blood, modified by the liver, and excreted in urine.

- Also helps in absorption of fatty acids in Small intestine.

* Structure and Function of Pancreas

→ Structure of Pancreas:-

- The Pancreas is made of both:-

- ↳ Endocrine Tissues (producing hormones like insulin & glucagon)
- ↳ Exocrine Tissues (producing digestive enzymes)

• The Endocrine parts Consists of Islets of Langerhans.

- It Consists of:-
- ① Head: located in the C-shaped Curve of the duodenum
 - ② Neck: Connects the head to the body.
 - ③ Body:- lies behind the stomach & in front of the Spine
 - ④ Tail:- Tapered end near the Spleen.

→ Pancreas as an Exocrine Gland:-

The exocrine portion produces pancreatic juice, which has 2 Components

① Aqueous Component

Contains bicarbonates to neutralize acidic Chyme from the stomach

② Enzymatic Component.

Contains Enzymes for digestion of all major food types.

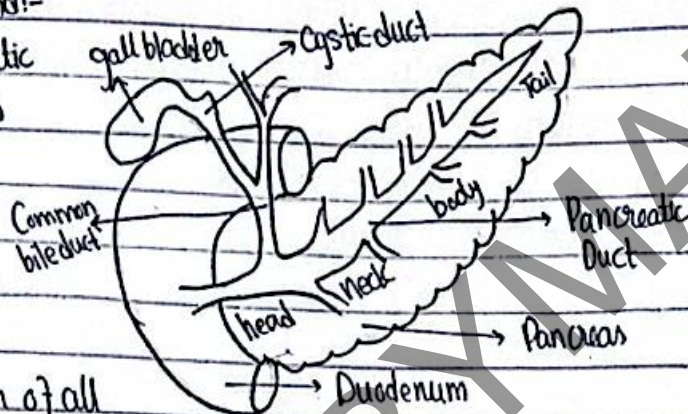


Fig 1.15 Structure of Pancreas

⇒ Major Digestive Enzymes in Pancreatic Juice

↳ Protein Digestion

- Trypsinogen → trypsin
- Chymotrypsinogen → Chymotrypsin
- Procarboxypeptidase → Carboxypeptidase

break proteins into peptides & Amino Acid

↳ Carbohydrate digestion

Amylase → Starch into Sugar

↳ Fat digestion

Lipase → fats → Fatty Acids — glycerols

↳ Nucleic Acid digestion

Nucleases → DNA & RNA → nucleotides

⇒ Secretion of bile and Pancreatic juice is regulated by hormones especially:-

- Cholecystokin (CCK)
- Secretin

★ Secretion of bile is related to Secretin hormone

• Fatty Acids in duodenum stimulates endocrine cells to release CCK

→ CCK

• Causes contraction of gall bladder smooth muscles

• This pushes bile into the duodenum

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- Acidic Chyme (from stomach) entering the duodenum stimulates cells to release Secretin.

→ Secretin:-

- is released into the bloodstream
- travels to the liver, where it stimulates bile production.
- Also signals bile release into the duodenum.

★ Secretion of Pancreatic Juice is related to Secretin hormone

- Pancreatic juice is stimulated by:-

↳ Secretin (stimulates duct cells of pancreas to release H_2O & bicarbonates)

↳ Cholecystikinin (CCK)

↳ stimulates acinar cells of the pancreas to release enzymes.

→ has:- Aqueous bicarbonates in components (from duct cells)

Enzymatic components.

Clear alkaline fluid containing enzymes to digest:-

- Proteins
- Carbohydrates
- Fats.

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