

HUMAN ANATOMY & PHYSIOLOGY

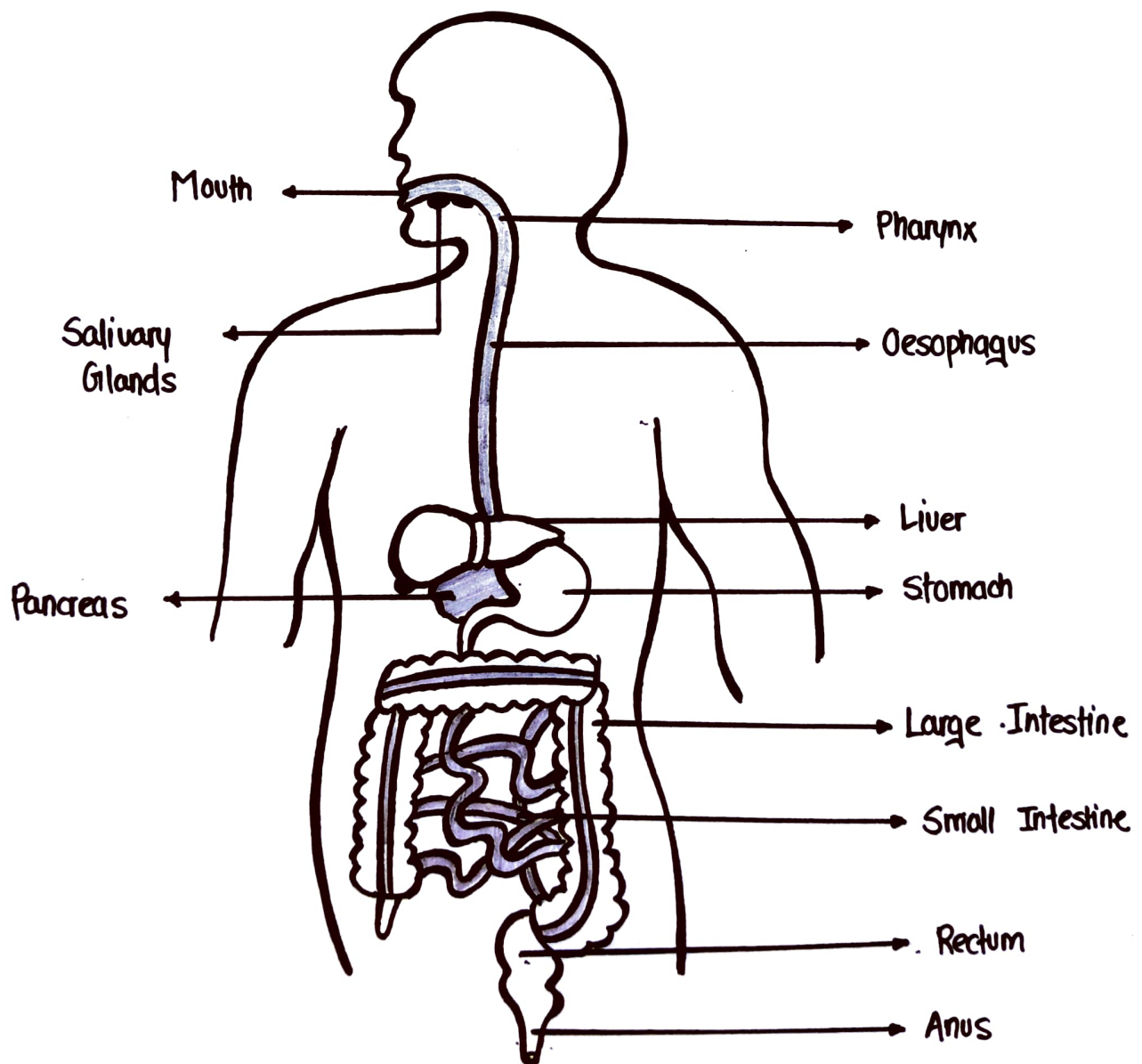
IMPORTANT QUESTIONS

UNIT 2



DIGESTIVE SYSTEM

- The major objective of eating food is to get nutrients.
- The conversion of complex food into simple & absorbable form is known as digestion & the system that performs the process of digestion is known as digestive system.
- Digestive system simply breakdown the food into nutrients.



Stages Of Digestion

- Ingestion : Receiving of food
- Propulsion : Movement of food
- Digestion : Mechanical & chemical breakdown
- Absorption : Absorption of nutrients
- Excretion : Removal / Excretion of food

Parts of Digestive System

- The digestive is mainly consist of Gastrointestinal Tract & Digestive Glands also known as Accessory Glands.
- The major organs of GIT includes :
 - (1) Mouth
 - (2) Pharynx
 - (3) Oesophagus
 - (4) Stomach
 - (5) Small Intestine
 - (6) Large Intestine
 - (7) Rectum
 - (8) Anus

① MOUTH

- It is also known as Oral cavity or buccal cavity.
- It is the first part of gastrointestinal tract.
- It is surrounded by upper & lower lips.
- The mouth mainly consist of lips, cheeks, gum, teeth, salivary glands & Tongue.
- The space b/w gums & cheeks is known as Vestibule
- The roof buccal cavity is known as Palate.
- Palate are of two types : Soft Palate & Hard Palate.



- Teeth** :
- Teeth mainly perform mechanical digestion.
 - They breakdown the food into smaller pieces
 - There are total 32 teeth in mouth
- ① Incisors : 8
 - ② Canines : 4
 - ③ Premolars : 8
 - ④ Molars : 12

- Tongue** :
- The tongue lies on floor of mouth
 - It is attached with Hyoid bone
 - It mixes saliva into food & convert into bolus
 - It contains taste receptors.
- ① Sweet
 - ② Salty
 - ③ To Sour
 - ④ Bitter

② PHARYNX

- It is a muscular tube like structure
 - It lies b/w mouth & oesophagus.
 - It is the common pathway for digestive & respiratory tract.
 - It is also known as Throat.
 - It passes the bolus into oesophagus
 - Epiglottis make sure the pathway of food (bolus) from pharynx to oesophagus.
 - It is further divided into three parts.
- (1) Nasopharynx
 - (2) Oropharynx
 - (3) Laryngopharynx

③ ESOPHAGUS

- It is also known as food pipe.
- It is a hollow tube like structure that carries food (bolus) from pharynx to stomach.
- It lies b/w trachea in front & vertebral column at back.
- No digestion takes place in oesophagus as digestive enzymes are absent.
- Oesophagus opens into stomach

④ STOMACH

- It is a J shaped pouched like structure.
- It lies in the left side of abdominal cavity.
- Capacity : 30 ml - 1.5 Litre.
- It secretes digestive fluids called Gastric Juice.
- It receives food from oesophagus.
- It secretes gastric juice into bolus & convert into Chyme.

Wall of Stomach

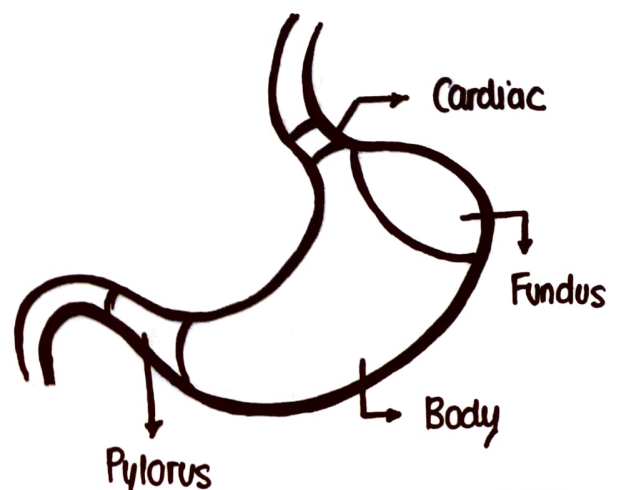
The wall of stomach is made of 4 layers :

- ① Serosa
- ② Muscularis
- ③ Submucosa
- ④ Mucosa

Parts of Stomach

It can be divided into 4 parts

- ① Cardiac
- ② Fundus
- ③ Body
- ④ Pylorus



Cardiac

- It is the uppermost part of stomach.
- It is attached with lower end of oesophagus.
- It contains cardiac sphincter.
- It prevents backflow of food from stomach to oesophagus otherwise it can cause heartburn

Fundus

- It is also the upper part of stomach.
- Fundus contains special types of cells known as Chief cells & Parietal Cells.
- CHIEF CELLS : It produces various enzymes includes-
 - ① Pepsin
 - ② Renin
 - ③ Lipase
- PARIETAL CELLS : It mainly produces HCl

Body

- It lies in the central region of stomach.
- It is the largest part of stomach
- It digest protein & stores food until it reaches into small intestine

Pylorus

- It is the lower part of stomach.
- It is connected with duodenum of small intestine.
- It transfers the food from stomach to small intestine.
- It contains special types of cells known as G-CELLS.
- G Cells Secrete Gastrin Hormone.

NOTE : In the complete epithelium of stomach there are so many goblet cells are present that secrete mucus & it protects stomach from HCl.

Role of Gastric HCl

- The HCl (Hydrochloric acid) plays major role in digestion of food in the stomach.
- It is secreted by parietal cells of stomach.
- It helps to convert bolus into chyme.
- It helps in the breakdown of complex food.
- It converts pepsinogen into pepsin that helps in protein digestion.
- It also shows antiseptic action by killing bacteria.

Functions of Stomach

- It stores the food for a long time & after that transferred into small intestine slowly. and it provides enough time for digestion & absorption of food in small intestine.
- Storage Time :
 - (i) Fat : 6-8 hours
 - (ii) Proteins : 4-5 hours
 - (iii) Carbohydrates : 1-2 hours
- It helps in the chemical breakdown of food.
- Gastric juice mainly helps in the digestion of protein.
- It secretes mucous that protects the stomach from HCl.
- It kills bacteria & other dust particles from food.

⑤ SMALL INTESTINE

- Small intestine is the site of final digestion of food.
- It is a long & narrow tube whose upper part is attached to stomach while lower part is attached with large intestine.
- It is about 6-7 meter long.
- It is the site of major absorption & digestion
- It is further divided into three parts

① Duodenum

② Jejunum

③ Ileum

Duodenum :

- Duodenum accepts only Alkaline food.
- It is shortest & widest part of small intestine.
- It is approx 10-11 inches long.
- It receives bile juice, pancreatic juice & food from liver, pancreas & stomach respectively.
- Secretions of Duodenum :
 - (i) Enterogastrone
 - (ii) Secretin
 - (iii) Pancreoenzyme
 - (iv) Cholecystokinin

Jejunum

- It is about 4-8 feet long.
- It is the major site for absorption of sugars, amino acids & fatty acids.
- Final breakdown of food completed here.
- It secretes intestinal juice.

ILEUM

- It is last part of small intestine connected with the cecum (first part of large intestine).
- It is about 10-11 feet long.
- It is the largest section of small intestine.
- It is the major site of absorption of nutrients, bile, vitamins etc.

Enzymes Responsible For Digestion in Protein

- Enterokinase : Converts trypsinogen into trypsin
- Erepsin : Converts polypeptides into amino acids.
- Sucrase, Maltase & Lactase : Converts disaccharides into monosaccharides.

Absorption in Small Intestine

- The absorption in small intestine mainly occurs through Villi & Microvilli
- Villi : Finger like projections
- Microvilli : Tiny hair like structures on Villi

⑥ LARGE INTESTINE

- It starts from ileum & ends on rectum.
- It is approx 1.5 m long.
- It mainly absorbs water from digested food.
- It is further divided into 5 parts.

① Cecum

② Ascending colon

③ Descending Colon

④ Transverse Colon

⑤ Sigmoid Colon



⑦ RECTUM

- It stores the remaining waste of Food.
- It opens outside through anus.
- The undigested or unabsorbed substances that is stored in the anus are called Faeces.

⑧ ANUS

- It is the final portion of the Gastrointestinal Tract.
- The undigested and unabsorbed food that is simply known as
- Faeces excreted out from body through anus & it is a Voluntary process.
- Two types of sphincter muscles found in anus.
 - ① Internal : Involuntary
 - ② External : Voluntary

DIGESTIVE GLANDS

- Digestive glands are the accessory glands of digestive system that helps in the process of digestion.
- They mainly includes :
 - ① Salivary Glands
 - ② Liver
 - ③ Gall Bladder
 - ④ Pancreas

① SALIVARY GLANDS

- Salivary glands are the exocrine glands present in the mouth that secretes saliva in GIT
- Saliva mixes with food & convert it into Bolus.
- Human salivary glands produces 0.5 L to 1.5 L saliva daily.
- Saliva contains digestive enzymes mainly Salivary Amylase which helps in the carbohydrate digestion.
- It also have antibacterial effect of fighting off bacteria.
Saliva contains 99.5 % water & 0.5% proteins & mineral salts.

Types of salivary glands

There are mainly 3 types of salivary glands present in humans :

- ① Parotid Glands
- ② Submandibular Glands
- ③ Sublingual Glands.

Parotid Glands

- These are the largest salivary glands.
- They are located below the auditory capsule ear
- Duct : Stenson's Duct.
- It opens in upper jaw.
- It contributes 25% saliva.
- It secretes serous type saliva

Submandibular Glands

- They are second largest salivary glands (smaller than parotid & bigger than sublingual).
- It opens in the buccal cavity.
- Duct : Wharton's Duct.
- It makes 70% of total saliva
- It secretes both serous & mucous saliva

Sublingual Glands

- They are the smallest salivary glands.
- They are located below the tongue.
- It makes 5% of total saliva.
- Duct : Bartholin's Duct.
- They don't contain enzymes.

② LIVER

- Liver is the largest gland or largest organ of our body.
- Its weight is about 1.5 kg.
- It has highest regeneration powers
- Liver performs maximum number of functions in our body.
- It contains lots of mitochondria.
- It is reddish brown - colour in human

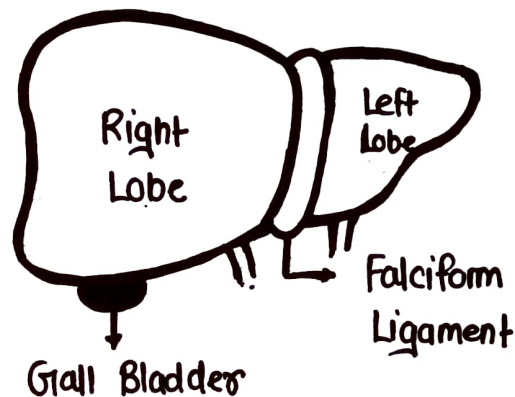
Surfaces of Liver

Liver have four surfaces :

- ① Superior Surface
- ② Inferior Surface
- ③ Anterior Surface
- ④ Posterior Surface

Lobes of Liver

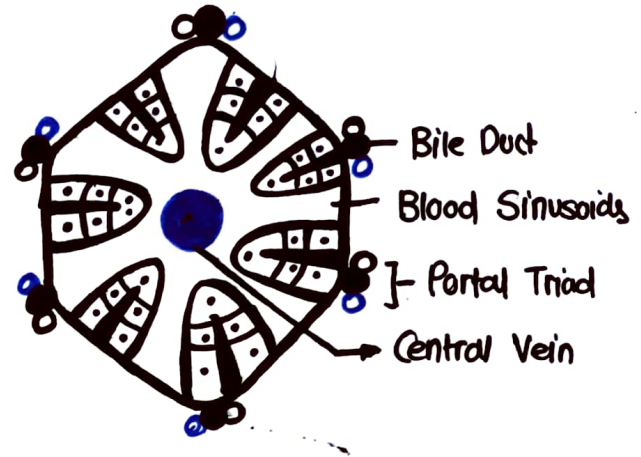
- Liver contains two lobes.
- ① Right Lobe
- ② Left Lobe
- Right lobe is much larger than left lobe.
- Right lobe forms $\frac{5}{6}$ th part while left lobe forms $\frac{1}{6}$ th part
- Right & Left lobes are separated by Falciform Ligaments.
- Right duct arises from right lobe & Left duct arises from left lobe of liver.
- Both right & left ducts combines & form a common hepatic duct



Internal Structure of Liver

- The liver is made up of small hexagonal units present in large number in liver.
- Each lobule has a central vein or intralobular vein surrounded by several portal Triads
- The portal triad is consist of

- ① Portal Vein
- ② Bile duct
- ③ Hepatic Artery



Functions of Liver

- Secretion of bile juice
- Synthesis & storage of Glycogen
- Synthesis of Urea
- Metabolism of carbohydrates, fats & Proteins.
- Vitamins & Minerals Storage.
- Synthesis of Heparin
- Blood-sugar regulation
- Detoxification & Purification of blood.

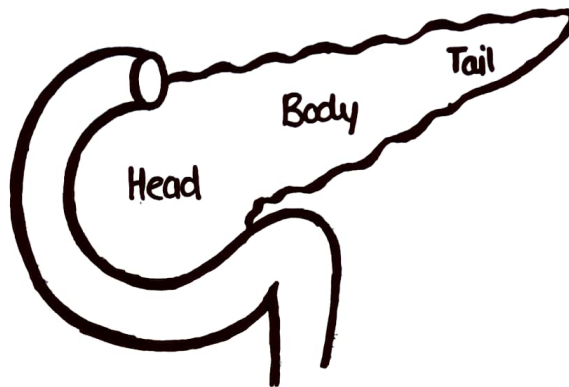
③ GALL BLADDER

- Gall bladder lies below the right lobe
- It stores & concentrates the bile from liver.
- Gall bladder contains cystic duct
- Microvilli on gall bladder absorbs moisture from bile & makes it concentrated

④ PANCREAS

- It is a mixed gland
- It is located behind the stomach in upper left abdomen.
- It secretes both enzymes & hormones
- It can be divided into three parts :

- ① Lipase Head
- ② Amylase Body
- ③ Trypsin Tail



Enzymes Secretion by Pancreas

Pancreatic Juice mainly contains :

- Lipase : Converts Fatty ~~acid~~ into Fatty acids & glycerols.
- Amylase : Converts Starch Into Maltase
- Trypsin : Converts Peptones Into Amino acids.

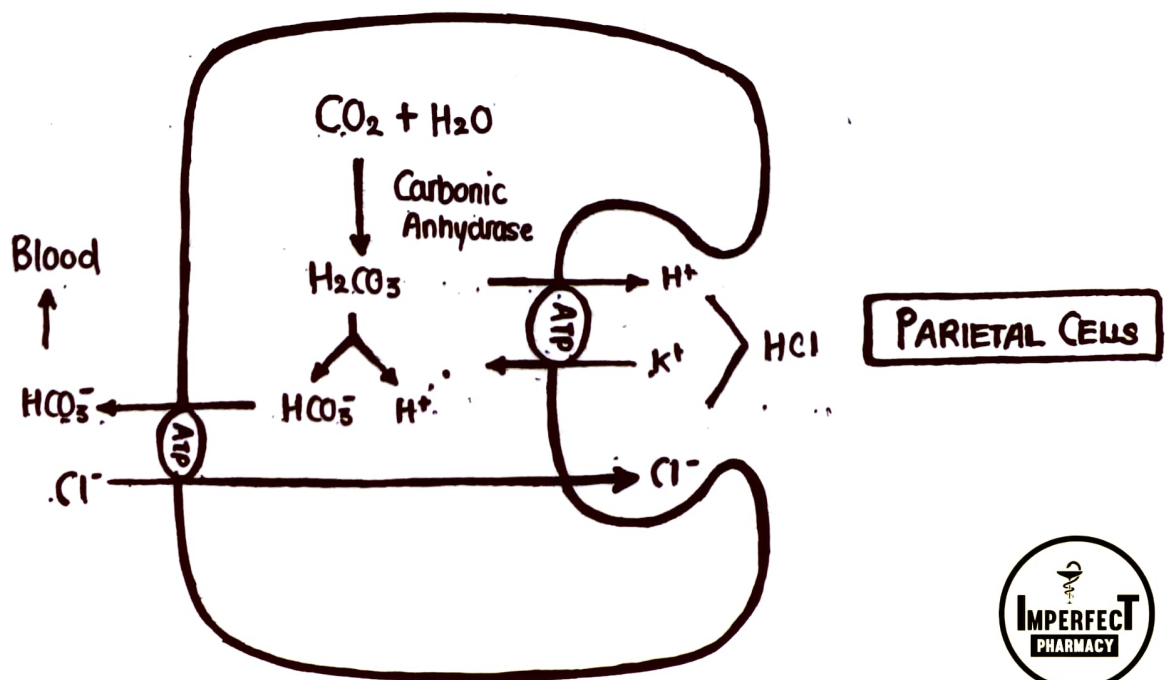
Hormones Secretion by Pancreas

Islets of Langerhans contains mainly 3 types of cells that secretes following hormones.

- Alpha Cells : Glucagon
- Beta cells : Insulin
- Delta Cells : Somatostatin

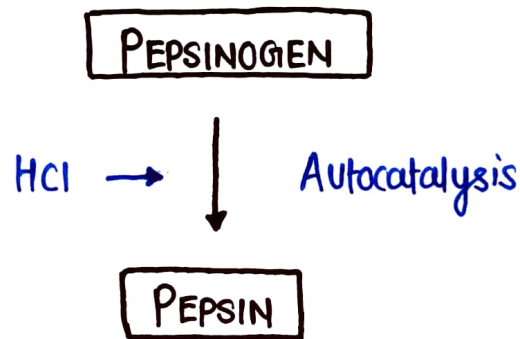
ACID PRODUCTION IN STOMACH

- HCl is produced by the parietal cells of stomach
- Hydrochloric acid secretion is an active process that takes place in the canaliculi of parietal cells.
- Carbon di oxide is derived from metabolic activities of parietal cells.
- The carbon di oxide ~~is~~ present in parietal cells combines with H_2O & form carbonic acid (H_2CO_3) in the presence of carbonic anhydrase.
- The enzyme carbonic anhydrase present in high concentration in parietal cells.
- Carbonic acid is most unstable compound & hence it immediately splits into hydrogen ion (H^+) & bicarbonate ion (HCO_3^-)
- The hydrogen ion is actively pumped into canaliculus of parietal cells. through K^+/H^+ ATPase pump & the energy for this process is derived from glucose
- Now simultaneously along with this process Cl^- ions also pumped into canaliculus of parietal cells.
- Chloride (Cl^-) is derived from NaCl in blood.
- Now in the final step H^+ combines with Cl^- & form HCl



ROLE OF PEPSIN IN PROTEIN DIGESTION

- Pepsin is the enzyme secreted by chief cells of stomach
- It is the only proteolytic enzyme present in Gastric Juice
(proteolytic enzymes are those that help in breakdown or digestion of protein).
- The chief cells produce pepsin in the inactivated form known as Pepsinogen.
- Now this pepsinogen activates in the form of Pepsin with the help of HCl secreted by parietal cells.



- After activating in the form of pepsin it breakdowns the proteins into smaller Peptides & Amino acids that can be easily absorbed in small intestine.
- Although pepsin plays major role in protein digestion but most of the protein are digested by in the duodenum & jejunum of small intestine by pancreatic juice

THANK YOU

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