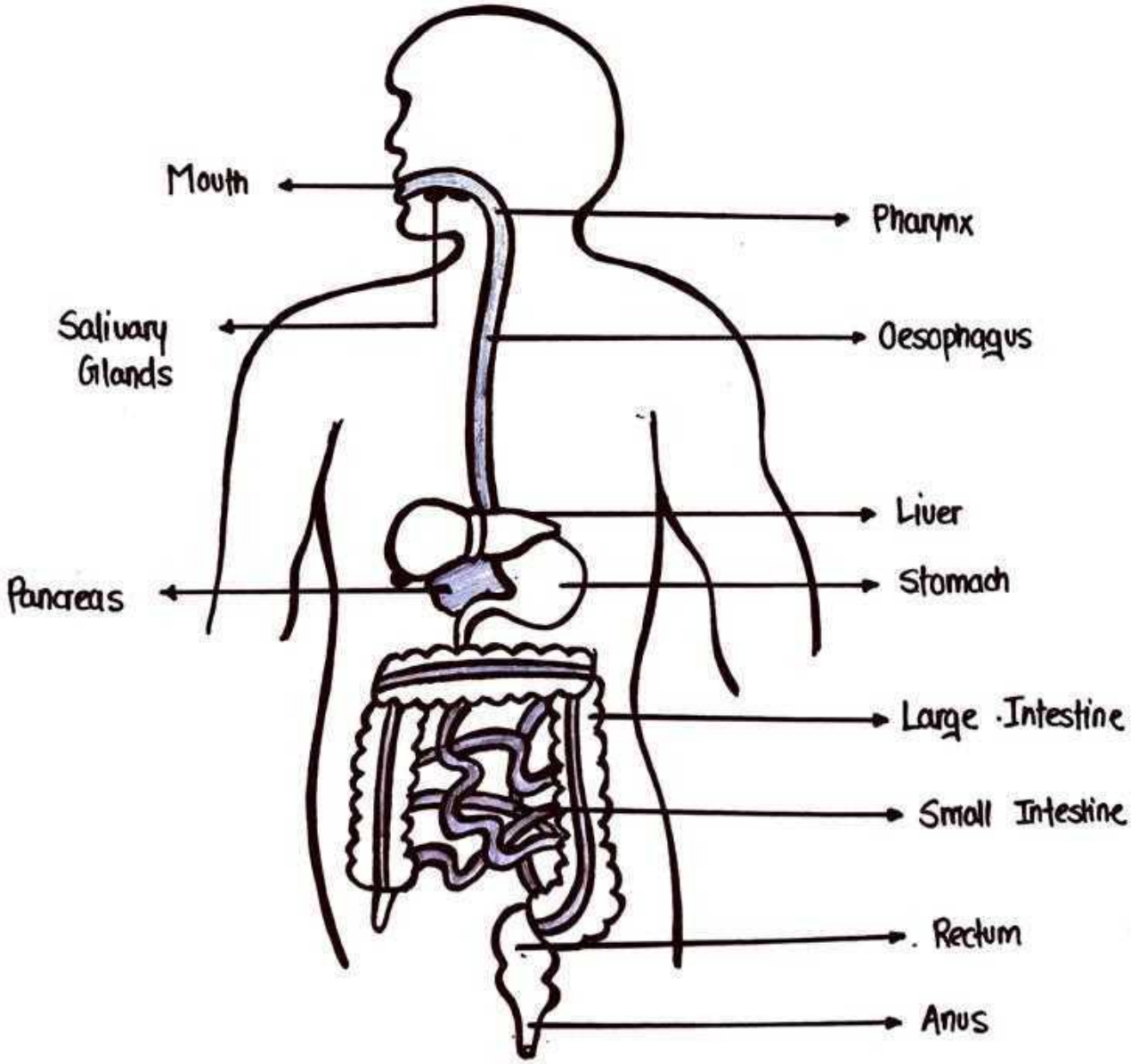
HUMAN ANATOMY & PHYSIOLOGY

UNIT 2

Rx Pharma Education

DIGESTIVE SYSTEM

- The major objective of eating food is to get nutrients.
- The conversion of complex food into simple & absorable 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
- Absorbtion : Absorbtion 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 boccal 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 masculor tube like structure
- It lies blw 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 OESOPHAGUS

- 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 also receives food from oesophagus.
- It secretes gastric juice into bolus & convert into Chyme.

Wall of Stomach

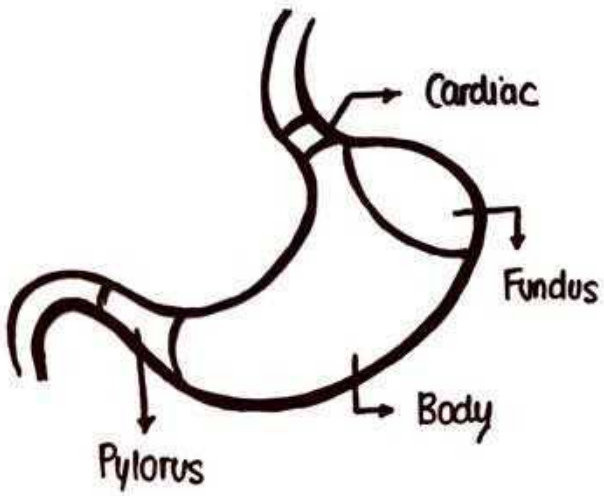
The wall of stomach is made of 4 layers :

① Serosa
② Masculanis
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 spinchter.
- 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 Secretes Gastrin Harmone.

NOTE : In the complete epithelium of stomach there are so many goblet cells are present that secretes mucous & 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 & absorbtion 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 absorbtion & 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 absorbtion 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 absorbtion 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 monosaccharids.

Absorbtion in Small Intestine

- The absorbtion 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 lang.
- 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 spinchter 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.

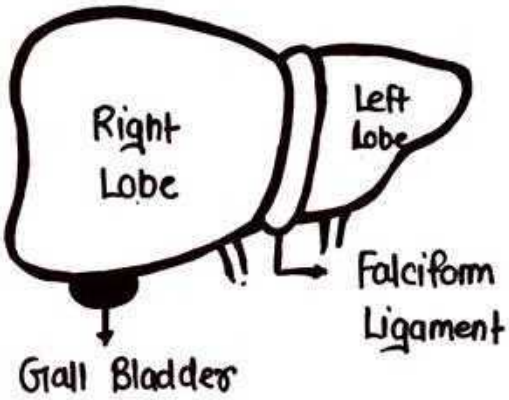
② LIVER

- Liver is the largest gland or largest organ of our body.
- Its weight is about 1.5 kg.
- It has highest regeneration power
- 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

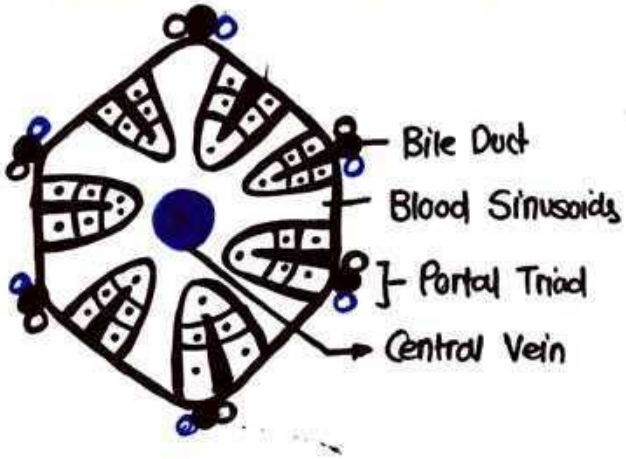
① Right Lobe
② Left Lobe

- Right lobe is much larger than left lobe.
- Right lobe forms 5/6th part while left lobe forms 1/6th 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.

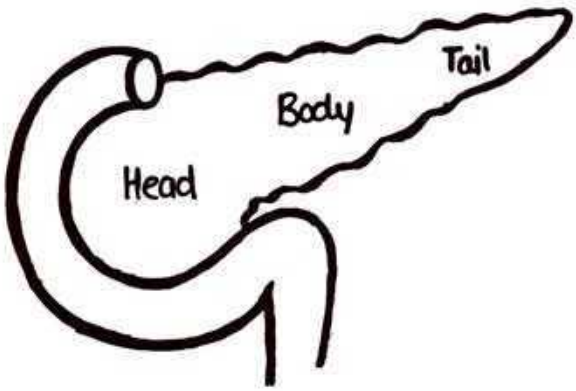
③ GALL BLADDER

- 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 & harmones
- 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 Maltose
- Trypsin : Converts Peptones into Amino acids.

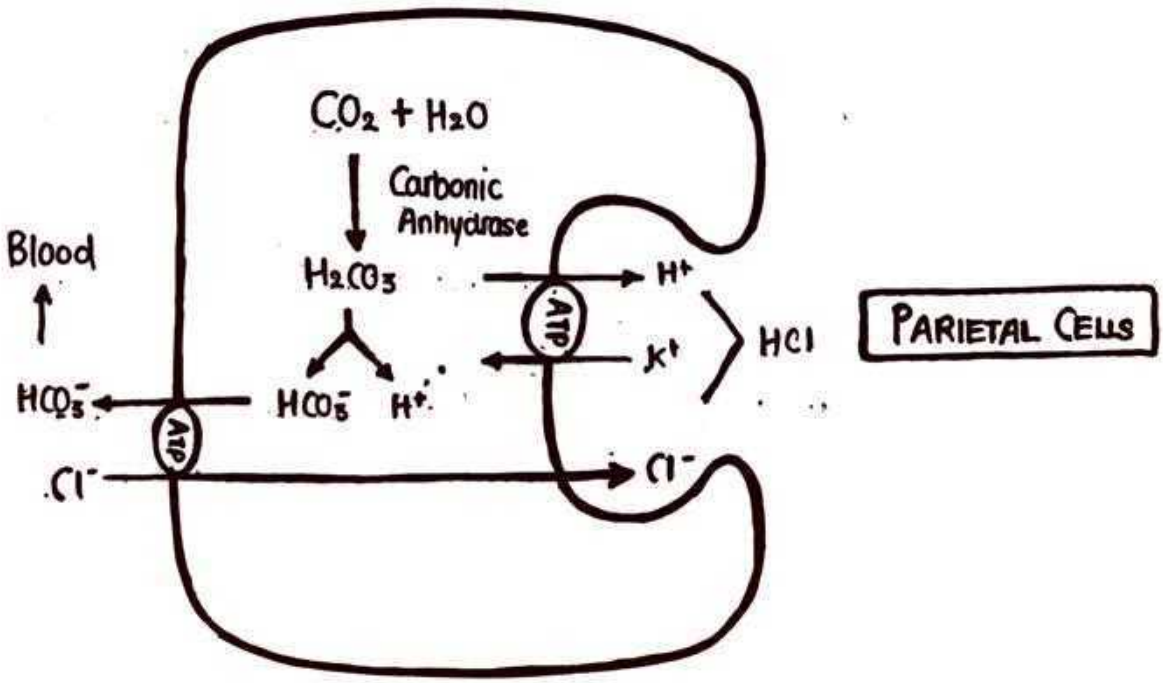
Harmones Secretion by Pancreas

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

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

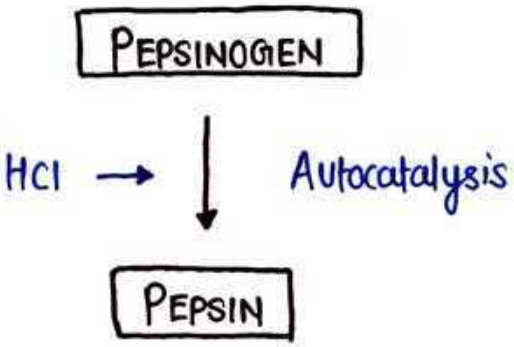
ACID PRODUCTION IN STOMACH

- 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 helps 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