UNIT-II

☆ Digestive System :-

Introduction :-

The digestive system transfer nutrients from the external environment (in the form the food) to the internal environment (via ingestion of food).

→ In the internal environment nutrients are distributed to different cells of the body via circulatory system.

→ The digestive system includes the Alimentary canal (gastrointestinal tract). Some accessory digestive gland, and a range of digestive processes which take place a different level in the alimentry canal for the absorption of digested food.

→ The process of breakdown and absorption of the consumed food is termed as digestion

→ It involves the following processes :-

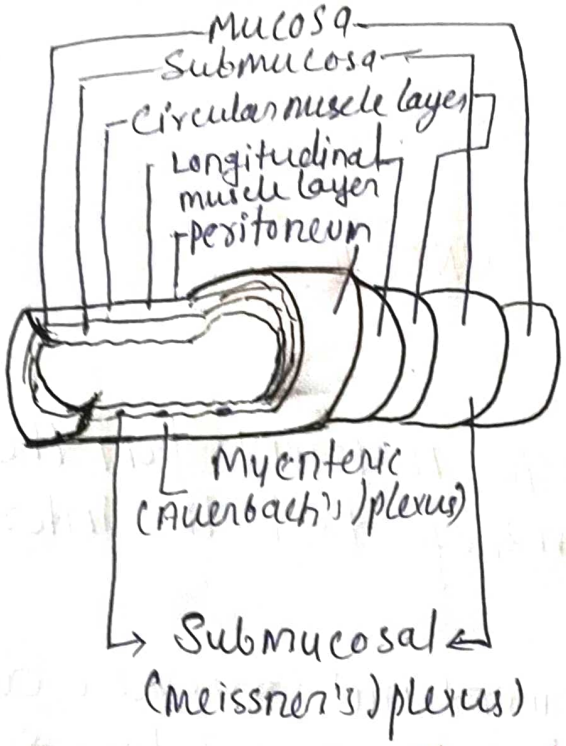
1. Mechanical breakdown :- of food by processes like mastication (chewing), mixing, churning and segmentation.

2. Chemical breakdown :- of food into their chemical building blocks via digestive enzymes present in the secretion of digestive glands and the accessory organs of the digestive system.

Histology of GI Tract :-

The gastrointestinal tract is a muscular tube-like structure and its walls are made up of the following four layers

- of tissue ↓



∴ structure of the Alimentary Canal

Anatomy of GI Tract:-

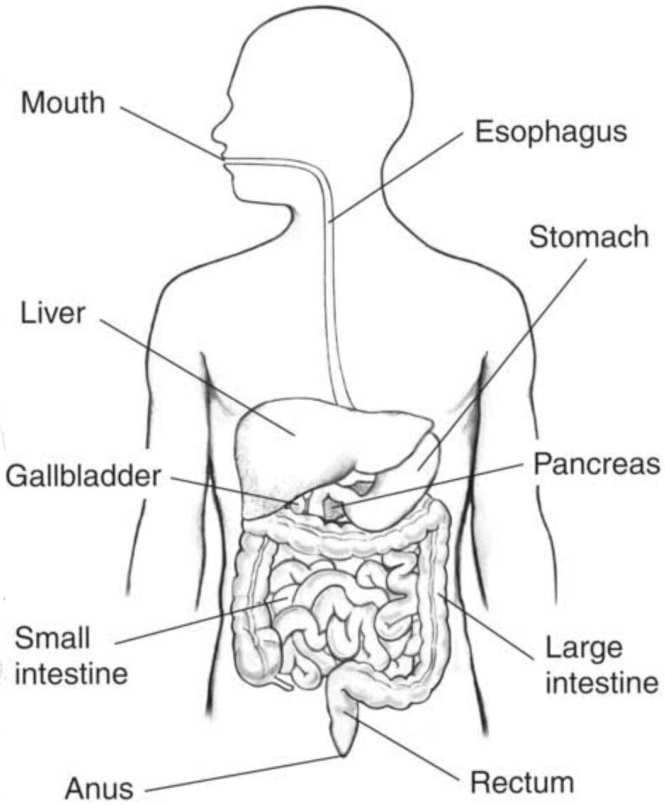
The alimentary canal (or the gastrointestinal or digestive tract) begins at the mouth and terminates at the anus.

→ All the different parts are named separately.

→ After ingestion the food passes through this long tube in the stomach and intestines for further digestion absorption and assimilation.

• Different parts of the alimentary canal include

① Oral Cavity (mouth)
② pharynx
③ oesophagus
④ Stomach
⑥ Large Intestine
⑦ Accessary organs of the digestive System
  (i) Three pairs of Salivary gland
  (ii) pancreas
  (iii) Liver
  (iv) Gall bladder.

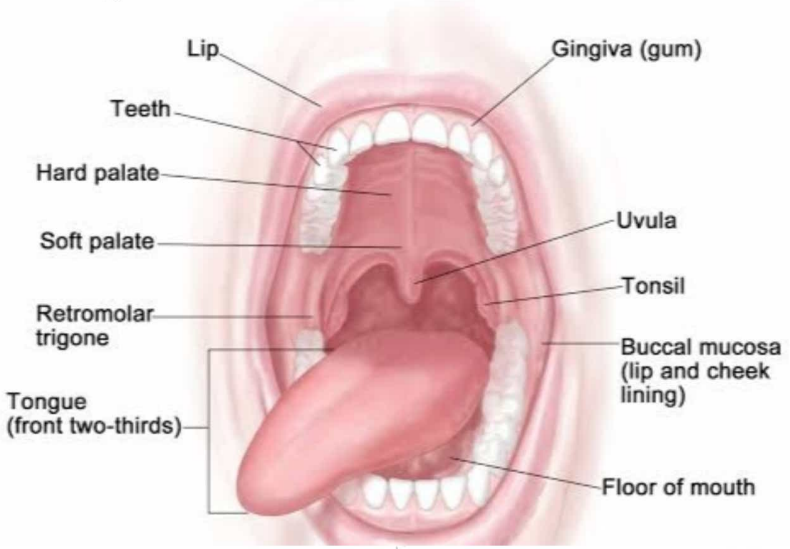


① Oral Cavity (mouth) :-

→ oral cavity forms the first part of alimentary canal. It is surrounded by the muscles and bones.

→ The oral cavity, or mouth, is the first part of the digestive tract.

→ It is bounded by the lips and cheeks and contains the teeth and



Functions of oral Cavity :-

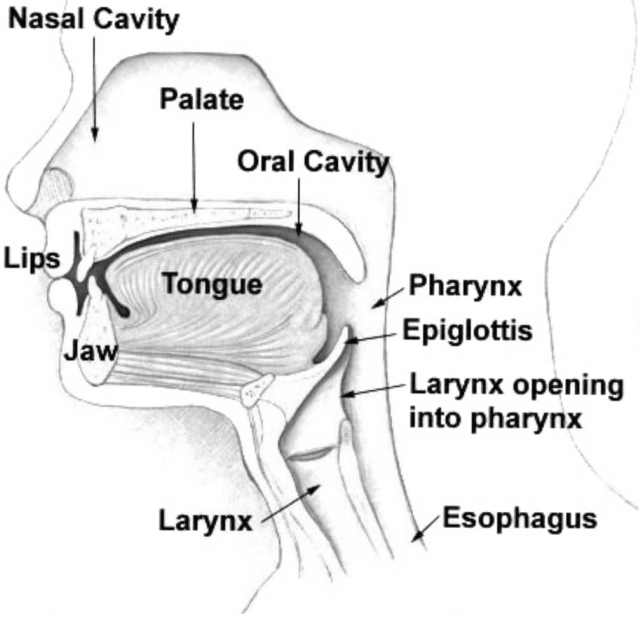
→ Ingestion of food.
→ perception of taste of food.
→ Lubrication of food.
→ Mechnical digestion of food with the help of Salivary enzyme.
→ Aids in Speech

② pharynx :-

→ pharynx (throat) is a Funnel-Shaped tube extending from the internal nares to the posterior part of oesophagus and anterior part of Larynx.
→ pharynx is made up of skeletal muscle, is lined with Mucous membraine, and is divided into nasopharynx, oropharynx, and Laryngopharynx.
→ Nasopharynx Contributes to respiration: while oropharynx and Laryngopharynx have respiratory as well as digestive functions.

Function of pharynx :-

→ passageway for Air and food.
→ Taste
→ Warming and humidifying.
→ Hearing
→ Protection
→ Speech.

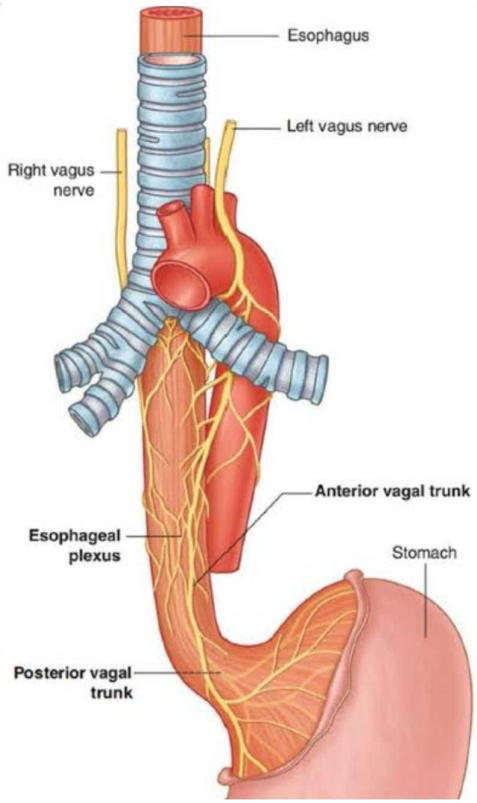


③ Oesophagus :-

Oesophagus or the food pipe is a long muscular tube (10 inches or 25 cm long) which forms a passage for the food to pass from the pharynx to the stomach.

→ It begins at the inferior end of the Laryngopharynx lies posterior to the trachea and anteriorly bounded by the trachea.

→ When the food is swalled, the oesophagus walls squeeze together (contract) to move the food down the oesophagus to the stomach.

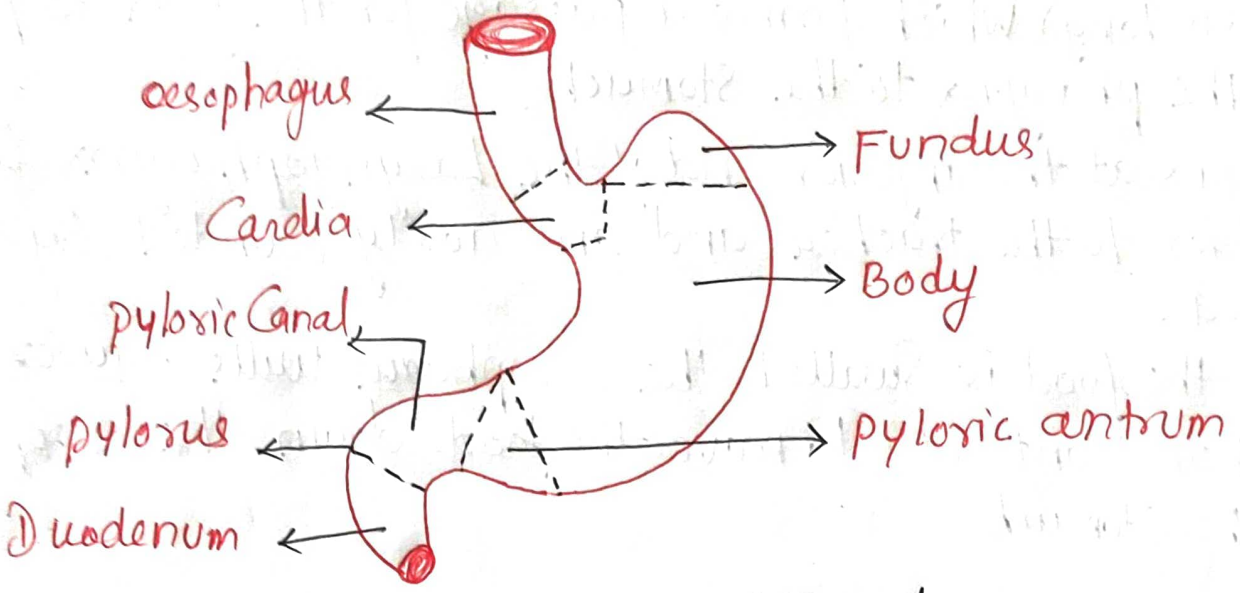


Functions :-

- Main function of oesophagus is deglutation (swallowing)

④ Stomach:—

- Stomach is positioned on the left side of the abdominal cavity, between the oesophagus and the duodenum (upper-most part of the small intestine).



∴ Internal Stucture of Stomach

- The stomach is divided into four regions

① Cardia: The part is continuous from the oesophagus.

② Fundus: The dome-shaped part is formed by the upper curvature of the stomach.

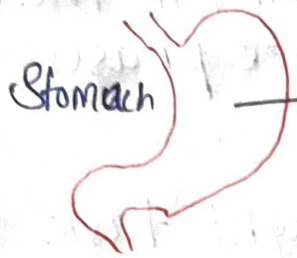
③ Body or Corpus: This is the central region of the stomach.

④ pylorus — This is the lower region of the stomach that continues into the duodenum.

Functions:-

- Digestion of food
- produce acid
- Reservoir of food
- Slows food entering intestines
- Helps in vit. absorption (vit. B12).

* Acid production in Stomach :-



→ oxyntic Gland Area : 80%
→ pyloric Gland Area : 20%.

- parietal cells :- predominate in the oxyntic gland, Secrete hydrochloric acid and intrinsic factor.
- chief cells :- Located at the base of oxyntic glands, are responsible for secreting the digestive enzyme precursor pepsinogen
- Neuroendocrine cells Containing hormonal and paracrine Signaling agents that regulate the activity of the parietal Cell reside within the glands.

Hydrochloric Acid (HCL)

- Convert pepsinogen to pepsin for chemical digestion.
- provides optimal pH environment for pepsin.
- Destroys some bacteria
- Stimulates the Small intestinal mucosa to release Secretion and CCK.
- promotes the absorption of Ca^{+2} and Fe^{+2} in Small intestine

Pepsinogen (precursor of pepsin) :-

- Digestion of protein.

How to Gastric acid produced :-

Step-1
- Gastrin
- Histamin
- Acetylcholin

Sight, smell, taste, eating of food
Leads to release of biochemical Substance

→ Step-2
Biochemicals get attached to respective receptors on parietal Cells

→ Step-3
Activation of proton pump and release HCl.

✱ Regulation of acid production through Parasympathetic nerves System :-

- Acid production is regulated by the parasympathetic nervous system. Gastric Secretion occuring in the presance of food take place in the following three phases.

(i) Cephalic Phase :-

Cephalic phase is activated by the thought, taste, Smell and Sight of food, and Swallowing. mediated mostly by Cholinergic / vagal mechnisms.

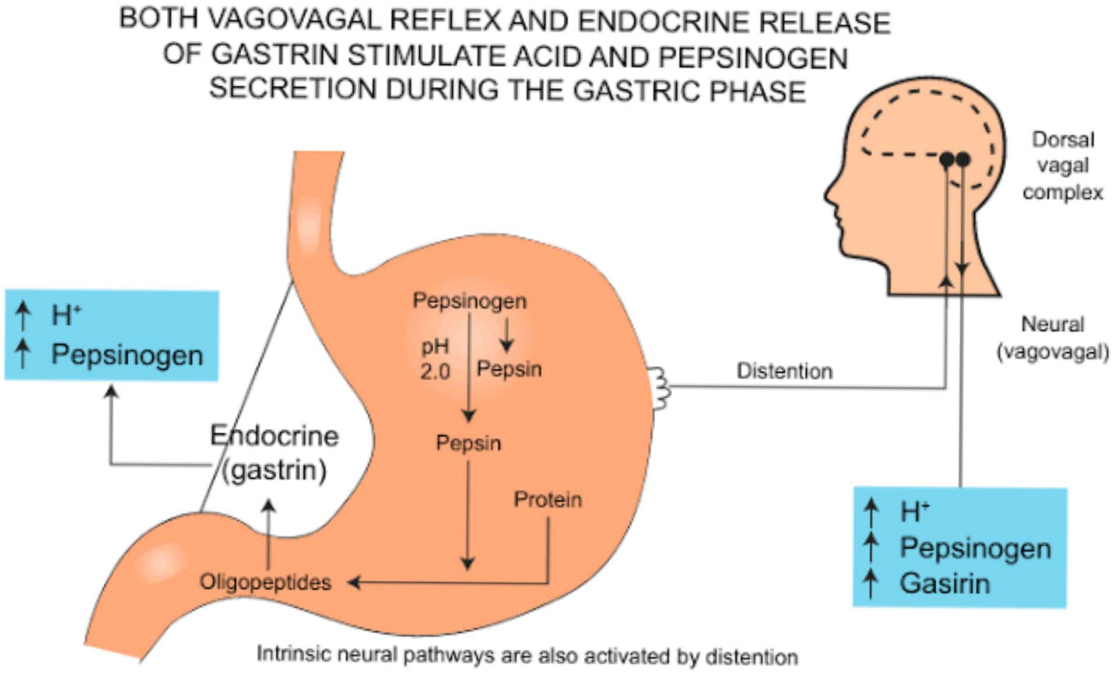
(ii) Gastric phase :-

Gastric phase is due to the chemical effects of food and distension of the Stomach.

→ Gastrin appears to be the major mediator Since the response to food is Largely Inhibited by blocking gastrin action at its receptor.

(iii) Intestinal phase :-

Intestinal phase accounts for only a small proportion of the acid Secretory response to a meal, its mediators remain Controversial.



★ Pepsin role in protein digestion :-

Pepsin is an enzyme whose pepsinogen is ~~rease~~ released by Cheif Cells in the Stomach and that degrades food Proteins into peptides.

→ Pepsin is one of three principle proteine degrading enzyme in the digestive System, the other two being Chymotrypsin and trypsin.

Role of pepsin :-

I. It activated by HCl by auto activation
II. Its optimum pH is 1.5 – 2.2.
III It is an end peptidases acting on the central peptide bond.
IV It is Secreted in active form Called pepsingen

pepsinogen $\xrightarrow{HC}$ pepsin.

(5) Small intestine :-

- It is the part of Alimentary Canal which extends from the Pyloric end of the Stomach to Caecum (first part of intestine).

Three parts of Small intestine :-

i. Duodenum (Shortest and wider part)
ii. Jejunum (Thicker and vascular)
iii. Ileum (Thinner than Jejunum and less vascular)

Digestion in Small intestine :-

- The acidic chyme from the Stomach enters into the duodenum.
- Then, it mixes with
  1. Alkaline intestinal juice called Succus entericus
  2. Alkaline secretions from liver and pancreas.

Enzymes responsible for the digestion :-

① Enterokinase - It converts trypsinogen of pancreatic juice into trypsin.

② Erepsin - It converts polypeptides into amino acids.

③ Sucrase, Maltase and Lactase - It converts the corresponding disaccharides into monosaccharides

Absorption in Small intestine :-

The absorption of digested food occurs in Small intestine through villi.

→ Villi are minute projections present in the inner mucous coat of the intestine.

⑥ Large Intestine :-

- Large intestine(Colon) extends from the end of Ileum to rectum

→ Large intestine Consists of the following parts

1. Appendix
2. Ascending Colon
3. Transverse Colon
4. Sigmoid Colon
5. Caecum

Functions of Large intestine :-

1. **Digestion :-**
   - It Carried out by Microorganism of Colon.
   - They act on undigested and unabsorbed residue from Small Intestine.
2. **Absorption :-**
   - After Small Intestine, only water and glucose are absorbed in the Colon.
3. **Secretion :-**
   - Mucin is the only Secretion which Lubricates the Colon and facilitates the passage of fecal matter.
4. **Excreation :-**
   - Iron and Some purgatives are excreted in Large Intestine

⑦ Rectum :-

- It occupies the Lower posterior part of pelvis and extends between Sigmoid ~~form~~ Colon and anus.
- The lower part of rectum is dilated and it is called rectal ampulla.

⑧ Anus :-

- It is a small canal measuring about one inch in length.
- The opening of anus is guarded by a sphincter called anal sphincter.
- This sphincter is under voluntary control.

✱ Anatomy & Functions of Accessory Gland :-

There are Three accessory organs that aid the process of digestion which are Located outside the alimentry Canal.

① Liver
② Bile ducts
③ Gall bladder
④ Pancrease

① Liver :-

- Liver is the Largest abdominal organ.
- It Lies in the right upper quadrant of abdominal Cavity Inferior to the diaphragm.

#Anatomy :-

- It Contains, two Lobes (i) Right Lobe (ii) Left Lobe
- They have four Surface -
  (i) Superior Surface
  (ii) Inferior Surface
  (iii) Anterior Surface
  (iv) posterior Surface

Functions of Liver :-

- Secretion of bile.
- Synthesis and Storage of glycogen.
- Formation of urea by the de-amination of amino acids.
- Synthesis of plasma proteins like albumin and globulin.
- Synthesis of heparin (natural anticoagulants)
- Detoxification and purification of blood.

(2) Bile ducts :-

- The Secretion of liver (bile) is carried through bile ducts which are formed by the union of biliary canaliculi.
- They present in between the lobules of liver.

(3) Gall Bladder :-

- It is a pear-shaped, hollow structure located on the inferior surface of the liver.
- It is divided into three regions.
  1. Fundus
  2. Body
  3. Neck

Functions of gall bladder :-

(1) Reservoir of Bile -
- Bile is an alkaline fluid produce by hepatocytes in Liver and stored in gall bladder.
- Liver produce 500ml to 1000ml of bile per day.

(2) Bile Salts :-
- Bile Salts present in the bile are Sodium taurocholate and Sodium glycocholate.
- They act as emulsifying agent

(3) Bile pigments -
- Two important bile pigments are bilirubin and biliverdin
- They are waste product produce from hemoglobin.

(4) Pancreas :-

- The pancreas is located behind the stomach in the upper left abdomen and surrounded by other organs.

Structure of pancrease :-

- Substance of pancrease contains a number of lobules of secretory cells called Acini.
- In blw the acini there are groups of endocrine cells called Islets of Langerhans.

Secretion of pancreas :-

(i) Exocrine secretion -
(pancreatic juice with digestive in function)
- Lipase, Amylase, Trypsin are containt of pancreatic juice.

(ii) Indocrine Secretion :-
(secreted by Islets of Langerhans)
- It is directly poured into circulation.
  (i) Glucogon - Secreted by alpha cells
  (ii) Insulin - Secreted by beta cells.

☆ Movements of GIT :-

- Mastication or chewing is the first Mechnical process in the gastrointestinal (GI) tract, by which the food Substance are cut into small particles and crushed or ground into a Soft bolus.

Significance of mastigation :-

- Breakdown of foodstuffs into Smaller particles.
- Mixing of Saliva with food Substance thoroughly.
- Lubricating and moistening of dry food.

Deglutation :-

Deglutition or Swallowing is the process by which food moves from mouth into Stomach.

Movement of stomach :-

Activities of Smooth muscles of stomach increase during gastric digestion (when Stomach is filled with food) and when the Stomach is empty.

Movement of Small intestine :-

They are essential for Mixing the Chyme with digestive juices, propulsion of food and absorption.

movement of large intestine :-

- Usually, the large intestine Shows Sluggish movement Still these movements are important for mixing, propulsiv and absorptive functions.

Defection :-

- Voiding of feces is known as defection.
- Feces is formed in the Large Intestine and Stored in Sigmoid Colon.
- By the influence of an appropriate Stimulus; it is expelled out through the anus.

★ Digestion And Absorption of nutrients :-

Digestion of Carbohydrates in the mouth :-

- Enzyme involved in the digestion of Carbohydrates are known as Amylolytic enzymes.
- The only amylolytic enzyme present in Saliva is the Salivary amylase or ptyalin.

→ Gastric juice Contains a weak amylase, which plays a minor role in digestion of Carbohydrates.

absorption of Carbohydrates :-

- Carbohydrates are absorbed from the Small Intestine Mainly as monosaccharides. via glucose, galactose and fructose.

Digestion, absorption of protein :-

★ Digestion of protein :-

- Enzyme responsible for the digestion of proteins are Called proteolytic enzymes.
- pepsin is only proteolytic enzyme in gastric juice.

- Rennin is also present in gastric juice. But it is absent in human.

absorption of protein :-

- Protein are absorbed in the form of amino acids from small intestine.
- The Levo amino acids are actively absorbed by means of Sodium Cotransport.
- The dextro amino acids are absorbed by means of facilitated diffusion.
- Absorption of amino acids is faster in duodenum and jejunum and slower in ileum.

☆ Disorder of GIT :-

① Gastritis :-

- Inflammation of gastric mucosa is called gastritis. It may be acute or chronic

② Gastric Atrophy :-

- It is the condition in which the muscles of the Stomach shrinks and become week.
- Gastric gland also shrink, resulting in the deficiency of gastric juice.

③ Peptic ulcer :-

- Peptic ulcer means an ulcer in the wall of Stomach or duodenum, Caused by digestive action of gastric juice.

④ Hepatitis :-

- It is characterized by Swelling and inadequate functioning of liver. Hepatitis may be acute or chronic.

⑥ Gallstones :-

- Gallstone is a solid crystal deposit that is formed by cholestrol, Calcium ions and bile Pigment in the gallbladder or bile duct.

⑦ Crohn's Disease or Enteritis :-

- Enteritis is an inflammatory bowel disease (IBD), characterized by inflammation of small intestine.

☆ Energetics :-

Formation of And Role of ATP :-

Intro :- Metabolism is an energy-balancing act b/w Catabolic (decomposition) reaction, and anabolic (Synthesis) reactions.

→ The molecule that participates most often in energy exchanges in living cells is ATP (adenosin triphosphate).

Mechanism of ATP Formation :-

- The high-energy phosphate bond that attaches the third Phosphate group Contains the energy Stored in this reaction
- Organism use three mechnism of phosphorylation to generate ATP :-

1. Substrate level Phosphorylation :-

Generates ATP by transferring a high-energy phosphate group from an intermediate phosphorylated Metaboli

Compound - a Substrate directly to ADP. In human Cells, this process occur in the Cytosol.

2. **Oxidative phosphorylation** :-

Removes electron from organic Compounds and passes them through a series of electron acceptors, Called the electron transport chain, to molecule of oxygen. This Process occurs in the Inner mitochondrial membrane of cell

3. **Photophosphorylation** :-

occurs only in Chlorophyll Containing plant Cells or in Certain bacteria that Contain other Light-absorbing pigments.

Role of ATP :-

- Role of ATP in linking anabolic and Catabolic reaction.
- Active transport
- Cell Signaling
- Structural maintenance
- muscle Contraction
- Synthesis of DNA and RNA.

✱ Formation & Role of Creatinine Phosphate :-

- While muscle fiber are relaxed, they produce more ATP then they need for resting metabolism.
- The excess ATP is used to Synthesize Creatine phosphate, an energy-rich molecule that is found only in muscle fibers.
- The enzyme Creatine kinase (CK) Catalyzes the transfer of one of the high-energy phosphate groups from ATP to Creatine, forming Creatinge phosphate and ADP.

Note:- Creatine is a Small, amino acid-like Molecule that is Synthesized in the liver, kidneys, and pancrease and then transported to muscle fibers.

- Creatine phosphate Can be broken down into Creatinine, which is then excreated in the urine.

✱ BASAL Metabolic Rate :-

- The overall rate at which metabolic reaction use energy is termed the Metabolic rate.
- Some of the energy is used to Produce ATP, and Some is released as heat, Because many factors affect Metabolic rate.

- It is measured under standard conditions. with the body in a resting and fasting condition called the Basal rate.
- The measurment obtained under these condition is the basal metabolic rate (BMR).
- The most common way to determine BMR is by measuring the amount of oxygen used per kilocalorie of food metabolized.
- when the body uses 1 liter of oxygen to oxidize a typical dietary mixture of triglycerides, Carbohydrat and proteins, about 4.8 Cal of energy is released.

Thank you