Digestive System

Introduction

The digestive system consists of organs that break down food, absorb its nutrients, and expel any remaining waste. The organs of digestive system make up the gastrointestinal (GI) tract. Food actually passes through these organs. The rest of the organs of the digestive system are called accessory organs. These organs secrete enzymes and other substances into the GI tract, but food does not actually pass through them.

The digestive system has three main functions relating to food:-

1. Digestion of food.
2. Absorption of nutrients from food.
3. Elimination of solid food waste.

Digestion:-

It is a process by which food is broken into simple chemical compounds that can be absorbed and used as nutrients or eliminated by body is called as digestion. There is degradation of the macromolecules (carbohydrates, proteins, fats) into the smaller molecules or components which are suitable for the absorption and assimilation. On the other hand, a few components in diet like water, inorganic salts, monosaccharide's, most of the vitamins are absorbed in the digestive tract without any chemical change.

The digestion is classified into three types:-

1)Intracellular digestion :-

The simplest example of intracellular digestion, which takes place in a gastro vascular cavity with only one opening. Most animals with soft bodies use this type of digestion, including Platyhelminthes (flatworms), Ctenophora (comb jellies), and Cnidaria (coral, jelly fish, and sea

anemones). The gastrovascular cavities of these organisms contain one open which serves as both a "mouth" and an "anus". Ingested material enters the mouth and passes through a hollow, tubular cavity. The food particles are engulfed by the cells lining the gastrovascular cavity and the molecules are broken down within the cytoplasm of the cells (intracellular).

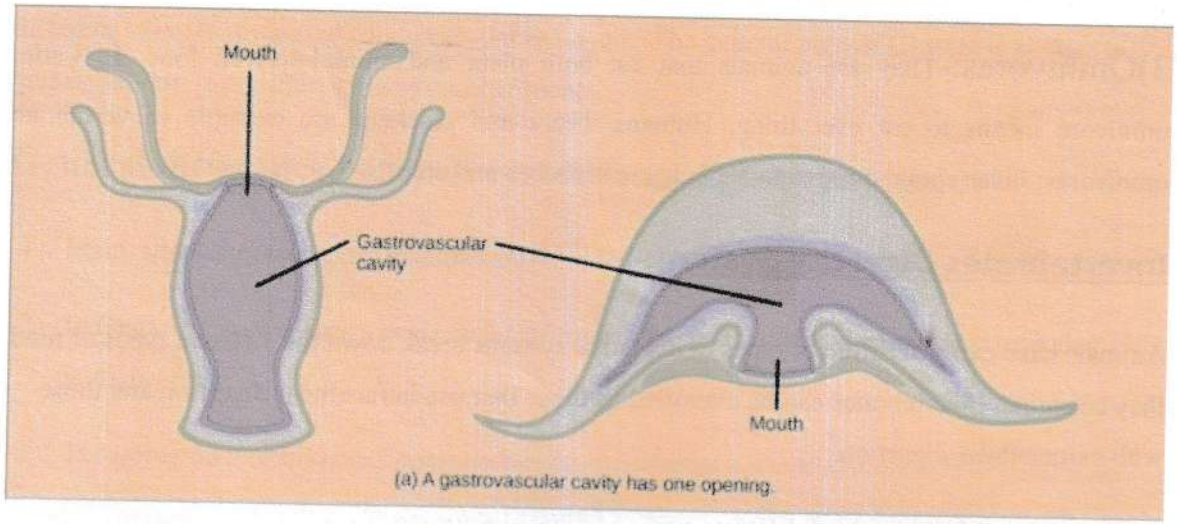
2)Contact Digestion:-

It occurs in some coelenterates (such as sea anemones) and falls between the intracellular and extracellular digestions. In this case, the digestion occurs in the gastro-vascular cavity and during the process, the filament of endodermal cells lining the coelenteron extend and are applied closely on to the surface of the large food particle and secret the digestive enzymes.

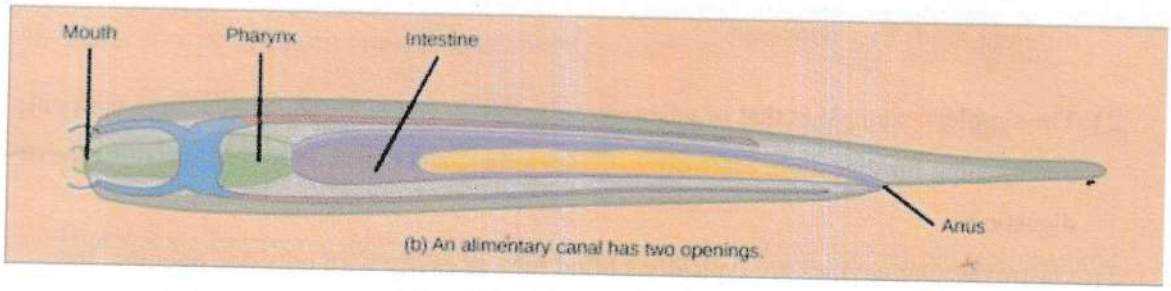
3)Extra-cellular Digestion:-

In animals, which take relatively large sized food particles (food in the form of chunks), this type of digestion is needed. The digestion of food in this case occurs in the alimentary canal. Such a type of digestion is characteristic of the higher animals. The alimentary canal is a more advanced digestive system than a gastrovascular cavity and carries out extracellular digestion. Most other invertebrates like segmented worms (earthworms), arthropods (grasshoppers), and arachnids (spiders) have alimentary canals. The alimentary canal is compartmentalized for different digestive functions and consists of one tube with a mouth at one end and an anus at the other.

Once the food is ingested through the mouth, it passes through the esophagus and is stored in an organ called the crop; then it passes into the gizzard where it is churned and digested. From the gizzard, the food passes through the intestine and nutrients are absorbed. Because the food has been broken down exterior to the cells, this type of digestion is called extracellular digestion. The material that the organism cannot digest is eliminated as feces, called castings, through the anus.



(a) A gastrovascular cavity has one opening.



(b) An alimentary canal has two openings.

Types of Digestive System:-

Animals obtain their nutrition from the consumption of other organisms. Depending on their diet, animals can be classified into the following categories: Plant eaters (herbivores), meat eaters (carnivores), and those that eat both plants and animals (omnivores).

Herbivores, Omnivores, and Carnivores

1)Herbivores:-They are the animals whose primary food source is plant-based. Examples of herbivores includes vertebrates like deer, some bird species, as well as invertebrates such as crickets and caterpillars. These animals have evolved digestive systems capable of handling large amounts of plant material.

2)Carnivores:-They are animals that eat other animals. The word carnivore is derived from Latin and literally means "meat eater. Tigers are examples of vertebrate carnivores, as are snakes and sharks, while invertebrate carnivores include sea stars, spiders, and ladybugs.

3)Omnivores:-They are animals that eat both plant and animal-derived food. In Latin, omnivore means to eat everything. Humans, bears and chickens are example of vertebrate omnivores; invertebrate omnivores include cockroaches and crayfish.

Invertebrates Digestive System:-

Animals have evolved different types of digestive systems break down the different types of food they consume. Invertebrates can be classified as those that use intracellular digestion and those with extracellular digestion.

1) Animals have evolved different types of digestive systems to aid in the digestion of the different foods they consume.

2) The simplest example is that of gastrovascular cavity and is found in organisms with only one opening for digestion. Flatworms, Comb jellies, and Coral, jelly fish, use this type of digestion.
3) Gastrovascular cavities are typically a blind tube or cavity with only one opening, the "mouth", which also serves as an "anus".
4) Ingested material enters the mouth and passes through a hollow, tubular cavity. Cells within the cavity secrete digestive enzymes that break down the food. The food particles are engulfed by the cells lining the gastrovascular cavity.
5) It consists of one tube with a mouth at one end and an anus at the other. Earthworms are an example of an animal with an alimentary canal.
6) Once the food is ingested through the mouth, it passes through the esophagus and is stored in an organ called the crop; then it passes into the gizzard where it is churned and digested.
7) From the gizzard, the food passes through the intestine, the nutrients are absorbed, and the waste is eliminated as feces, called castings, through the anus

Vertebrates Digestive System :-

Digestive System of vertebrates have more evolved complex digestive System to adapt their dietary needs. Some have single stomach where others have multi chambered stomach. The Vertebrate digestive system Consist of a tubular gastrointestinal tract which is modified in

different animals composed of a series tissue Layers. The general plan of GI tract is similar in vertebrates but taxa differs type of compartments.

General difference between vertebrates digestive system:-

1) Many species posses extra chamber or modified region along the Gastrointestinal tract.
2) In Birds and bony fishes posses ceca that branch from GI tract and contain bacteria that aid in digestion.
3) The upper tract of birds has complex structure called as gizzard to crushed the food. Also consist crop which store the partially digested food.
4) Many species of Carnivorous animals have pointed teeth that lack flat grinding surface
5) By contrast the herbivores have large, flat teeth with complex ridges well suited for grinding.eg Cow, horse.
6) Humans are carnivores they eat both plants and animals so have specialized teeth having premolars, molars, incisors and canine.
7) In many vertebrates ingested food is fragmented through tearing or grinding action of specialized teeth.

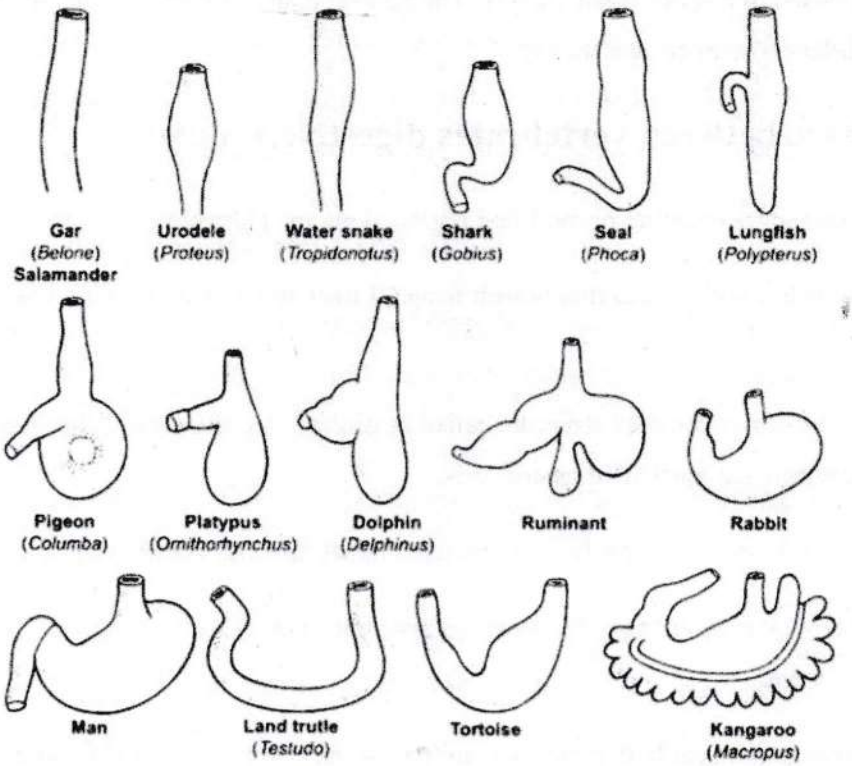


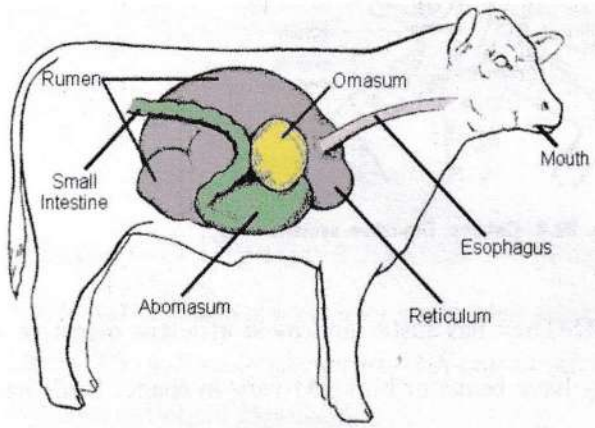
Fig. 43.10. Different shapes of vertebrate stomachs including human.

Ruminants:-

1) They are mainly herbivores(cows, sheep, goats).
2) They eat large amount of roughage or fibre.
3) They have evolved digestive system which helps in to digest vast amount of cellulose.
4) The stomach is multi chamberedie. 4 chambered which consist rumen, reticulum, omasum, & abomasum.
5) These chambers consist microbes that breakdown the cellulose and ferment the ingested food.

Pseudo Ruminants:-

- They have 3 chambered stomach that consist omasum, abomasum & reticulum. (e.g. Camels, alpacas).
- They eat lot of plant material and roughage.
- The microbes are present in the chamber to breakdown the cellulose.
- Cecum is pouched like organ present at beginning of large intestine containing many microorganisms that are necessary for digestion of plat material.



General characters of digestive system in different classes

1) Reptiles Digestive System:-The digestive system of modern reptiles is as similar as all higher vertebrates. It consist of mouth, pharynx, oesophagus, stomach, intestine, cloaca. Specialization in digestive system is the evolution of one pair of salivary glands into poison gland in the venomous snakes is most remarkable.

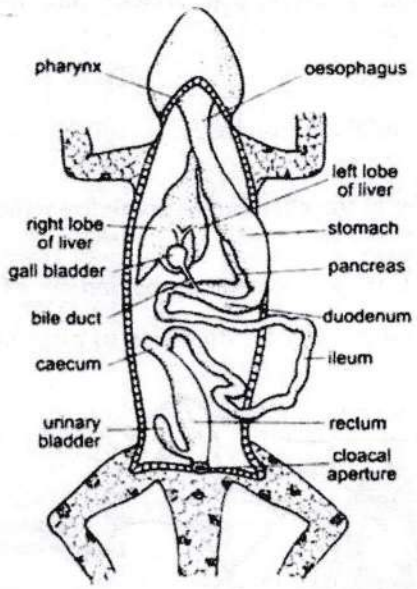
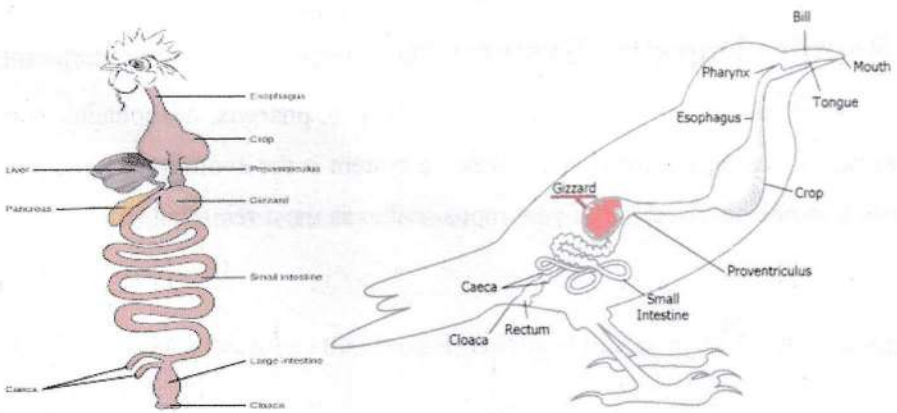


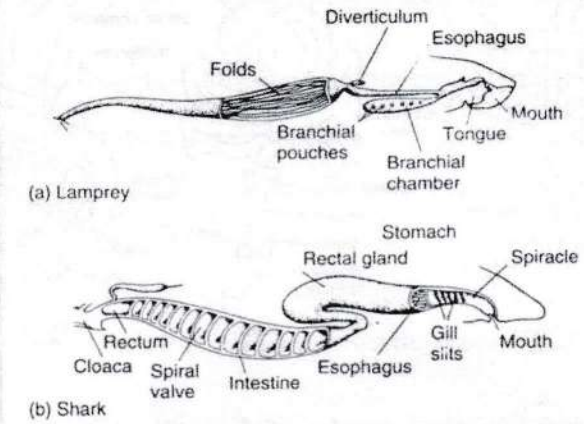
Fig. 22.2. *Calotes*. Digestive system.

3) Aves Digestive System:-They has faster and most efficient digestive system than those of other vertebrates. They have beaks or bills and vary in shape. Birds have two parts of stomach 1)Granular portion called as proventriculus. 2)Muscular portion called as gizzard which helps to grind the food. Crop is found only in seed eating birds which serves as food reservoir.



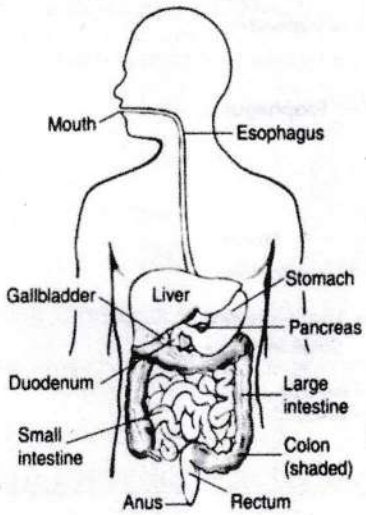
3) Pisces Digestive System:- It consist alimentary canal and its associated glands. It consist mouth, buccopharynx, esophagus, stomach, intestine, and rectum. The stomach

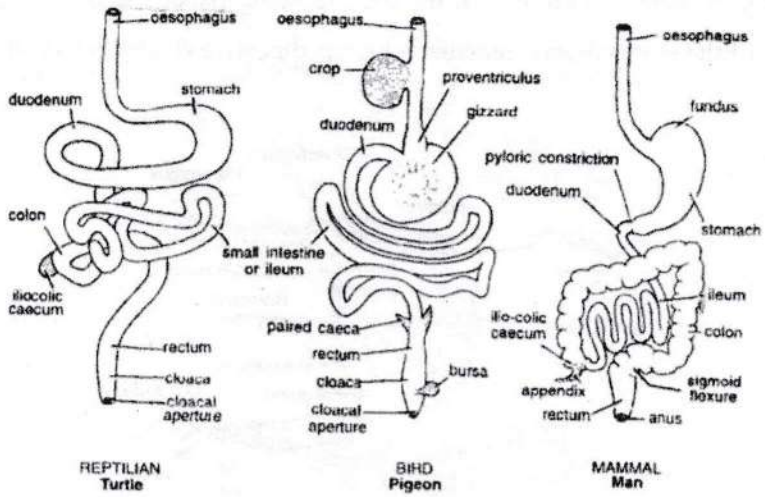
varies greatly in fishes depending on the diet. In some fishes the pyloric ceca is present at the junction of the stomach and intestine which is digestive & absorptive in function.



4) Mammals Digestive System:- The digestive system consist complete digestive tract & various accessory glands that secrets digestive juices into the canal through the ducts. The accessory glands are 1) A pair of salivary glands 2) The pancreas 3) The liver with its storage organ gall bladder.

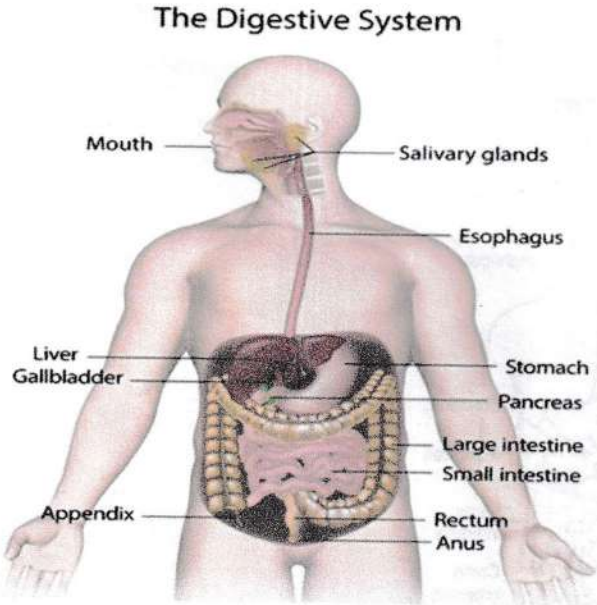
Human digestive system:





Comparative study of digestive system

Human Digestive System



The human digestive system consists of the gastrointestinal tract plus the accessory organs of digestion the (tongue, salivary glands, pancreas, liver, and gallbladder).Digestion involves the

breakdown of food into smaller and smaller component, until they can be absorbed and assimilated into body

The process digestion has three stages:- The cephalic phase, gastric phase, intestinal phase.

1st stage:-Cephalic phase :- begins with secretion from gastric glands in response to sight and smell of food. The stage include mechanical breakdown of food by chewing, and chemical breakdown of food by digestive enzymes, this takes place in the mouth Saliva contains the digestive enzymes amylase, and lingual lipase, secreted by salivary and serous gland on the Tongue. Chewing in which the food is mixed with saliva, begins the mechanical process of digestion. This produce bolus which is swallowed down the esophagus to enter the stomach.

2nd stage:- It begins in stomach with the gastric phase. Here food is further broken down by mixing with gastric acid until it passes into the duodenum (the first part of small intestine).

3rd stage:-Intestinal phase It begins in the duodenum with the intestinal phase where partially digested food is mixed with a number of enzymes produced by the pancreas. Digestion is helped by chewing of food carried out by the muscle of mastication the tongue, teeth and also by the contractions of peristalsis. Gastric acid and the production of mucus in stomach, are essential for the continuation digestion.

- **Peristalsis** is rhythmic contraction of muscles that begin in esophagus and continuous along the wall of stomach and the rest gastrointestinal tract. This initially result in production of Chyme which when fully broken down in small intestine is absorbed as chyme into the lymphatic system.
- Most of digestion of food takes place in small intestine.
-Water and some minerals are absorbed back into the blood in the colon of large intestine.
-The waste product of digestion (fees) are diluted from the rectum via the Anus.

So as we all know digestion is process is by which food is broken down into simple chemical compounds that can be absorbed and used as nutrient or eliminated by body is called digestion.

The process of digestion includes 6 activities:-

1)Ingestion -Process of taking in food.

2)Propulsion-Movement of food along the digestive tract.

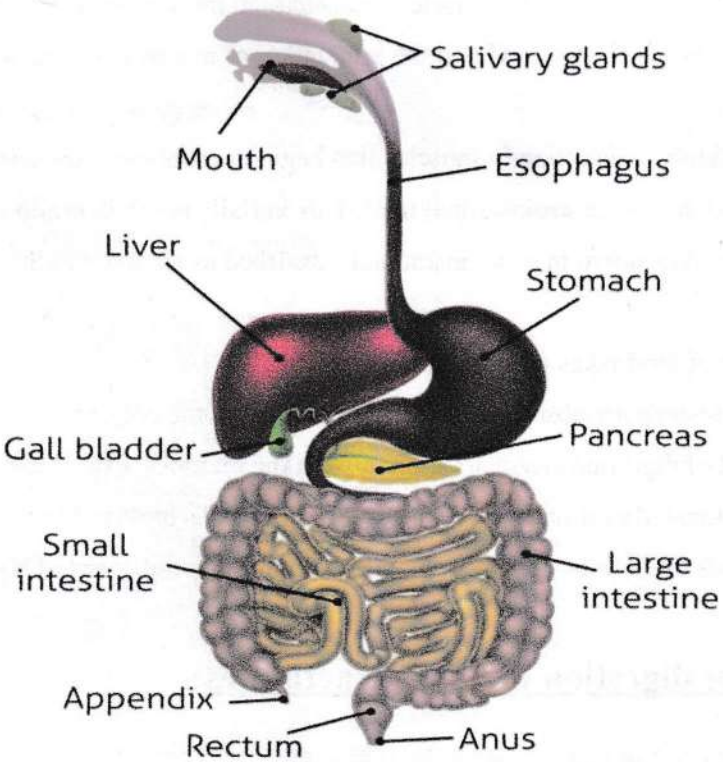
3)Mechanical digestion:- begins in mouth with chewing, thin churning in stomach and segmentation in small intestine.

4)Chemical digestion: The process where complex molecules like proteins, fats and carbohydrate are broken down into smaller pieces that your body can use. It requires special protein called enzymes.

5)Absorption :- The simple molecule, that result from chemical digestion pass through cell membrane of the lining in small intestine into the blood or lymph capillaries.

6)Defecation: The unwanted material which is no longer needed by the body passes as fees, means discharge of fees from the body.

Physiology of Digestion



1)Mouth/The Oral Cavity :- Digestion begin even before the food enters the mouth. When a person smells or thinks of food or eating. The salivary gland begin producing saliva. Once the food is inside the mouth saliva moisten it, the teeth and tongue break it down mechanically. An enzyme in the saliva, salivary amylase break it down into starch. Chewing and amylase digestion will convert the food into a small bolus, this enables a person to swallow it easily.

2)The Esophagus:-After swallowing, the bolus inter the esophagus where gravity and muscle contraction helps move it down to the stomach through a process called peristalsis. Peristalsis is slow contraction of smooth muscles along and around the digestive System.

3)The Stomach :- The bolus enter the stomach through a ring-like muscle called the lower esophageal sphincter.In stomach following process occurs:

The stomach stores the food temporary cell in stomach secrets gastric juices. This include with hydrochloric acid, which maintains the pH of stomach. These processes turn the food into a thick paste known as chyme. The stomach does not absorb many nutrients from the chyme into the bloodstreams, so the chyme enters the Small intestine through the pyloric sphincter. HCl is essential for :-

1)Destroying microorganism such as bacteria.
2)Breakdown protein and plant fibers and
3)Activating pepsin, an enzyme that help to digest proteins.

4)The Small Intestine :-

The Small intestine absorbs around 90% of nutrients from food into the bloodstreams.
There are three sections:
1)The duodenum - This receives chyme from stomach and digestive enzymes from the liver and pancreas.
2)The jejunum :- Most of chemical digestion and absorption occur here.
3)Ileum:-This contains ileucal valve a sphincter through which food passes to large intestine.
Once the food is fully broken down, the villi absorb the nutrients, which enter the bloodstream.

Villi are tiny, finger like projection that line the walls of small intestine. Within the villi are tiny capillaries called Lacteals. By increasing their surface area, the villi maximize their absorption of nutrients.

5)The Large Intestine:-Any unabsorbed food and nutrients now to pass the large intestine or colon. The material is now feaces.

The large intestine consists of :-

1)Cecum, a pouch through which food enters from small intestine.

2)Asceunding colon

3)Transverse Colon

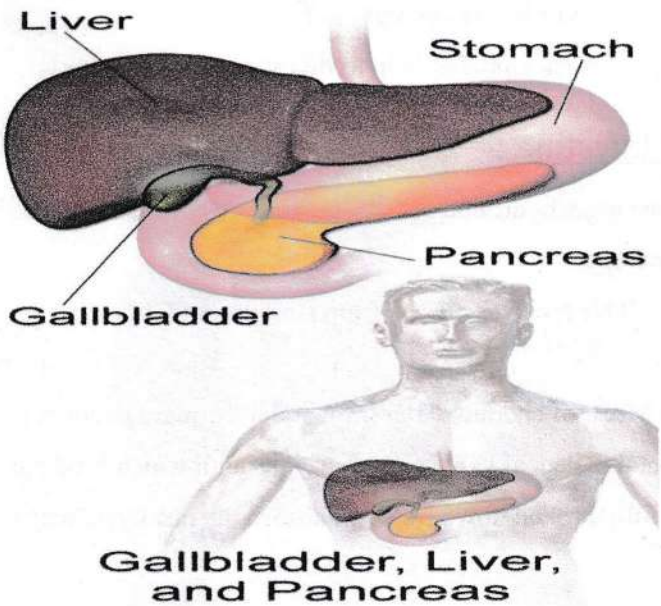
4)Discending colon

5)Sigmoid colon

Reabsorption of water takes place here. The undigested food moves towards rectum, to anus.

6)Anus:-

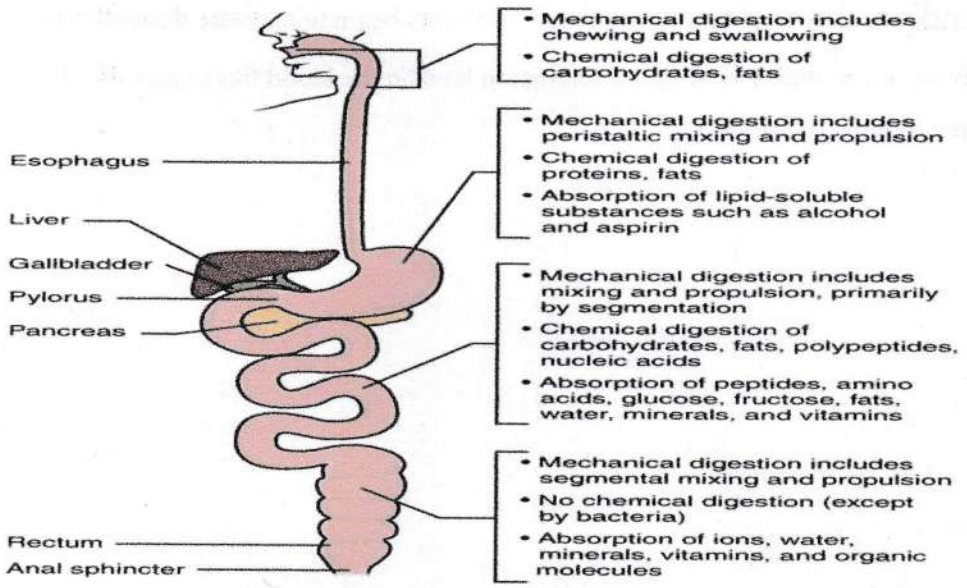
- The feaces is removed by defecation through Anus.
  -defecation involves involuntary contraction of muscles and rectum and relaxation of internal anal sphincter.
  -contraction of abdominal muscles and lowering of diaphragm increase the intra abdominal pressure and so assist the process of defecation.



Gallbladder, Liver, and Pancreas

Accessory organs involved in digestive system are:-

- Teeth - Breakdown food for swallowing further digestions
- Tongue - Moves food around your mouth to help you chew and swallow.
- Salivary glands - Screats saliva it has a cleansing effect on the teeth its moistens and lubricates the food during mastication and swallowing its begin the chemical digestions of starch through the action of amylase which breaksdown polysaccharide into disaccharide
- Liver - Secrets bile salts (bile is yellowish green fluid produced by liver cells) the main component of bile are water, bile salts, bile pigment, and cholestrols, bile salts act as emulsifying agent in the digestion and absorption of facts.
- Gallbladder- It is pear shaped sac that is attached to visceral surface of liver by the cystic duct the principle function of gallbladder is to serve as a storage reservoir for bile
- Pancreas - It consist of pancreatic acinar cells that secrets digestive enzymes into tiny ducts interwoven between the cells pancreatic enzyme includes amylase, trypsin, peptidase and lipase.



Disorders of Digestive System:-

It is mandatory to take adequate amount of nutrients in diet for proper & accurate functioning of the digestive system. Many infection related to bacteria, virus or other parasites may also cause disfunctioning of the gut.

Some common disorders of digestive system are:

1) Indigestion:-Condition of incomplete or improper digestion of food that leads to feeling of fullness. It may cause due to over eating , food poisoning, have spicy junk food etc.

2) Constipation:- A condition of difficult or irregular defecation during the feaces are retained within the rectum(large intestine) for longer time than the normal.

3) Diarrhea:- The condition of abnormal frequency of bowel movement (act of defecation) and increased liquidity of feaces. It is cause due to irritation in colon.

4) Vomiting:- The forceful ingestion of harmful contents of stomach through the mouth. It not due to reverse peristalsis of the stomach and esophagus. Instead the major thurst or force for expulsion is rom the contraction of diaphragm and abdominal muscles.

5) Jaundice:-The condition in which bile pigments begin to excreate through other parts of the body due to their increased accumulation level in the blood this occurs due to malfunctioning of the liver.

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Class Notes

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