

Digestive System

Digestion, sequence by which food is broken down and chemically converted so that it can be absorbed by the cells of an organism and used to maintain vital bodily function

Types of digestion

There are two kinds of digestion: mechanical and chemical.

Mechanical digestion involves physically breaking the food into smaller pieces. Mechanical digestion begins in the **mouth** as the food is chewed.

Chemical digestion involves breaking down the food into simpler **nutrients** that can be used by the cells

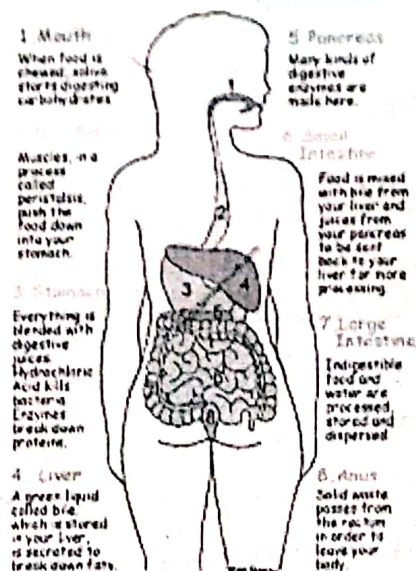
- The **digestive system** of man consists of a long coiled tube that extends from the mouth to the anus. The main parts in the direction of passage of food, are the oral or buccal cavity, esophagus, stomach, small intestine (duodenum, jejunum and ileum), large intestine (ascending colon, transverse colon, descending colon, caecum and rectum). Associated with the various regions are the glands, especially **salivary glands, liver and pancreas**. There are three sites of digestion in the digestive system of man - oral cavity, stomach and small intestine

Digestion in Oral Cavity

There are several functions of the oral cavity, the most obvious being the **(a) selection of food, (b) grinding or mastication (c) lubrication and (d) digestion.**

Selection of food: When food enters the oral cavity (the cavity bounded by palate, tongue, teeth and cheeks) it is tasted, smelled and felt. If the taste or smell is unpleasant or if hard objects like bone or dirt are present in the food, it is rejected. Oral cavity is aided in selection by the senses of smell, taste and sight. Tongue being sensory and muscular organ plays the most important role in selection of food through its taste buds.

Grinding or mastication: After selection, the food is ground by means of molar teeth into smaller pieces. This is useful because : (a) the esophagus



allows relatively small pieces to pass through and (b) small pieces have much more surface for the enzyme to attack.

Lubrication and digestion: These are the main functions of the oral cavity accomplished by saliva. Saliva is secreted by three pairs of salivary glands namely **sublingual glands** situated below the tongue; **submaxillary glands** behind the jaws and **parotid glands** in front of the ears. Saliva produced by these glands contains three important ingredients. i) **Water and mucus**, ii) **Sodium bicarbonate** and some other salts, iii) Carbohydrate digesting enzymes, **amylase or ptyalin**.

Water and mucus together make a slimy liquid which serves to moisten and lubricate the food so that it can be chewed efficiently and passed through the esophagus smoothly.

Sodium bicarbonate and some other salts are slightly antiseptic but their main function is to stabilize the pH of food. **Fresh saliva is alkaline with a pH nearly 8, quickly loses carbon dioxide and gets to pH 6.** **Ptyalin** is a carbohydrate - digesting enzyme, which digests starch and glycogen to maltose.

Swallowing: As a result of mastication, the softened, partly digested, slimy food mass is rolled into small oval lump called **bolus**, which is then pushed to the back of the mouth by the action of tongue and muscles of pharynx which ensure that the food does not enter the windpipe. Following are the events which occur during swallowing:

- i) the tongue moves upwards and backwards against the roof of the mouth, forcing the bolus to the back of the mouth cavity.
- ii) The backward movement of the tongue pushes the soft palate up and closes the nasal opening at the back. At the same time the tongue forces the epiglottis (a flap of cartilage) into more or less horizontal position thus closing the opening of the windpipe (the glottis).
- iii) The larynx, cartilage round the top of the windpipe moves upward under the back of the tongue.
- iv) The glottis is partly closed by the contraction of a ring of muscle.
- v) The food does not enter the partly open glottis, because the epiglottis diverges one side of the opening and safely down the esophagus. The first part of the swallowing action is voluntary, but once the food reaches the esophagus it is involuntary.

back of the mouth, swallowing becomes automatic. The food is then forced down the esophagus by peristalsis

Peristalsis These are characteristic movements of the digestive tract by which food is moved along the cavity of the canal. It consists of the wave of contraction of the circular and longitudinal muscles preceded by the wave of relaxation thus squeezing the food down along the canal. Peristalsis starts just behind the mass of food from the buccal cavity along the esophagus to the stomach and then along the whole alimentary canal. Occasionally, the movements are reversed, with the result food may be passed from the intestine back into the stomach and even into the mouth. This movement is called antiperistalsis, leading to vomiting. **Hunger contractions** are peristaltic contractions which are increased by low blood glucose levels and are sufficiently strong to create an uncomfortable sensation often called a "hunger pang". Hunger pangs usually begin 12 to 24 hours after the previous meal or in less time for some people.

Digestion in stomach

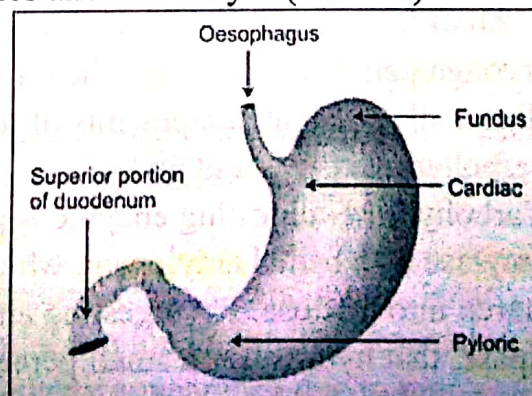
At the junction between esophagus and the stomach there is a special ring of muscles called **cardiac sphincter**. When the sphincter muscles contract, the entrance to the stomach closes and thus prevents the contents of the stomach from moving back into the esophagus. It opens when a wave of peristalsis coming down the esophagus reaches it.

Function

The stomach is situated below the diaphragm on the left side of the abdominal cavity. It is an elastic muscular bag that stores food from meals for some time, making discontinuous feeding possible. It also partly digests the food

Location

The stomach wall is composed of three principal layers: an outer layer of connective tissue; middle layer of smooth muscles and inner layer (mucosa) of connective tissue with many glands. The middle layer of muscles consists of outer longitudinal and inner circular muscles. These muscular layers help in churning and mixing the food with the stomach secretions. The mucosa of the stomach possesses numerous tubular gastric glands, which are composed of three kinds of cells;



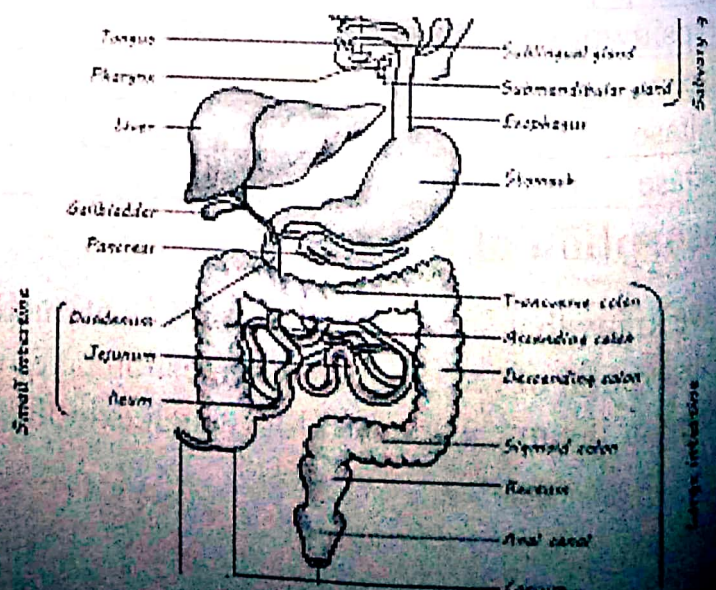
presence of numerous inger-like outgrowths called villi (Fig. 12.17 a & b). Each villus is richly supplied with blood capillaries and a vessel called lacteal of lymphatic system with a covering of epithelial cells. Electron microscope reveals that these cells have countless, closely packed cylindrical processes, microvilli

The total area of absorption becomes incredibly large due to the enfolding, villi and microvilli. Simple Sugars and amino acids are absorbed by difusion or active transport into the blood capillaries through the microvilli. Some of the fatty acids and glycerol are also absorbed into blood stream. However, a large proportion of fatty acids and glycerol enter the epithelial cells of villi, where they recombine into fats. These fats then enter the lacteals. Proteins present in lymph vessels combine with fat molecules to form lipoprotein droplets. These pass into blood stream via thoracic lymphatic duct. The lipoproteins are subsequently hydrolysed by blood plasma enzyme and enter body cells, where they may be used in respiration or stored as fat in the liver, muscle of under the skin.

The intestinal contents are pushed along the alimentary canal by normal peristaltic activity. At the end of ileum, there is an **ileocolic sphincter** that opens and closes time to time to allow a small amount of residue from the ileum to enter the large intestine.

Large intestine : The large intestine is composed of a caecum, colon and rectum. Caecum is a blind sac that projects from the large intestine between ileum and colon. From the blind end of the caecum there arises a inger like process called appendix. The appendix, some times gets inlamed due to entrapping and then puriication of food causing appendicitis, which has to be removed surgically in many instances

The material that passes from the small intestine to the large intestine contains a large amount of **water, dissolved salts and undigested material**. Water and salts are absorbed into blood, while undigested material is rejected as feces. The fecal matter contains a large number of bacteria, plant ibers, sloughed

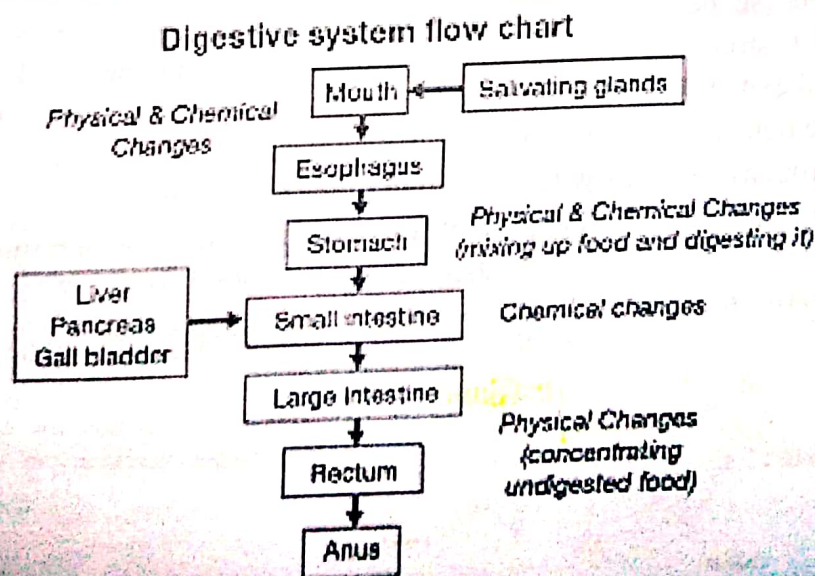


of mucosal cells, mucus, cholesterol, bile pigments and water. Large intestine also harbors a large population of useful bacteria that synthesize some vitamins especially vitamin K, which are absorbed in blood. If the absorption of water and salts does not take place due to infection, drug action or emotional disturbance, a condition known as **diarrhoea** occurs. If this condition is unchecked, dehydration develops that may prove to be fatal. The other extreme condition is **constipation**, which is caused by the excessive absorption of water. **Rectum** is the last part of large intestine, where feces are temporarily stored and rejected through anus, at intervals. Anus is surrounded by two sphincters, the internal is of smooth and outer of striped muscles. Under normal conditions, as the rectum is filled up with feces, it gives rise to defecation reflex. This reflex can be consciously inhibited in individuals other than infants. Gradually the child learns to bring this reflex under control

Treatment of food in the digestive system

The treatment of food in the digestive system involves the following seven processes:

1. **Ingestion** is the process of eating.
2. **Propulsion** is the movement of food along the digestive tract. The major means of propulsion is peristalsis, a series of alternating contractions and relaxations of smooth muscle that lines the walls of the digestive organs and that forces food to move forward.
3. **Secretion** of digestive enzymes and other substances liquefies, adjusts the pH of, and chemically breaks down the food.
4. **Mechanical digestion** is the process of physically breaking down food into smaller pieces. This process begins with the chewing of food and continues with the muscular churning of the stomach. Additional churning occurs in the small intestine through muscular constriction of the intestinal wall. This process, called **segmentation**, is similar to peristalsis, except that the rhythmic timing of the muscle constrictions forces the food backward and forward rather than forward only.
5. **Chemical digestion** is the process of chemically breaking down food into simpler molecules. The process is carried out by



enzymes in the stomach and small intestines.

6. *Absorption* is the movement of molecules (by passive diffusion or active transport) from the digestive tract to adjacent blood and lymphatic vessels. Absorption is the entrance of the digested food (now called nutrients) into the body.
7. *Defecation* is the process of eliminating undigested material through the anus