



NUTRITION IN HUMANS

- ❖ Humans are omnivores, they can eat plant-based food as well as animal-based food.
- ❖ Being more complex, humans have a very complicated nutrition system.
- ❖ The digestive system has an alimentary canal and associated digestive glands, which together function to nourish the body.
- ❖ There are five stages in human nutrition; Ingestion, Digestion, Absorption, Assimilation and Egestion.
- ❖ Four stages i.e. ingestion, digestion, absorption and egestion take place in the alimentary canal while assimilation of food takes place in the whole body.

ALIMENTARY CANAL

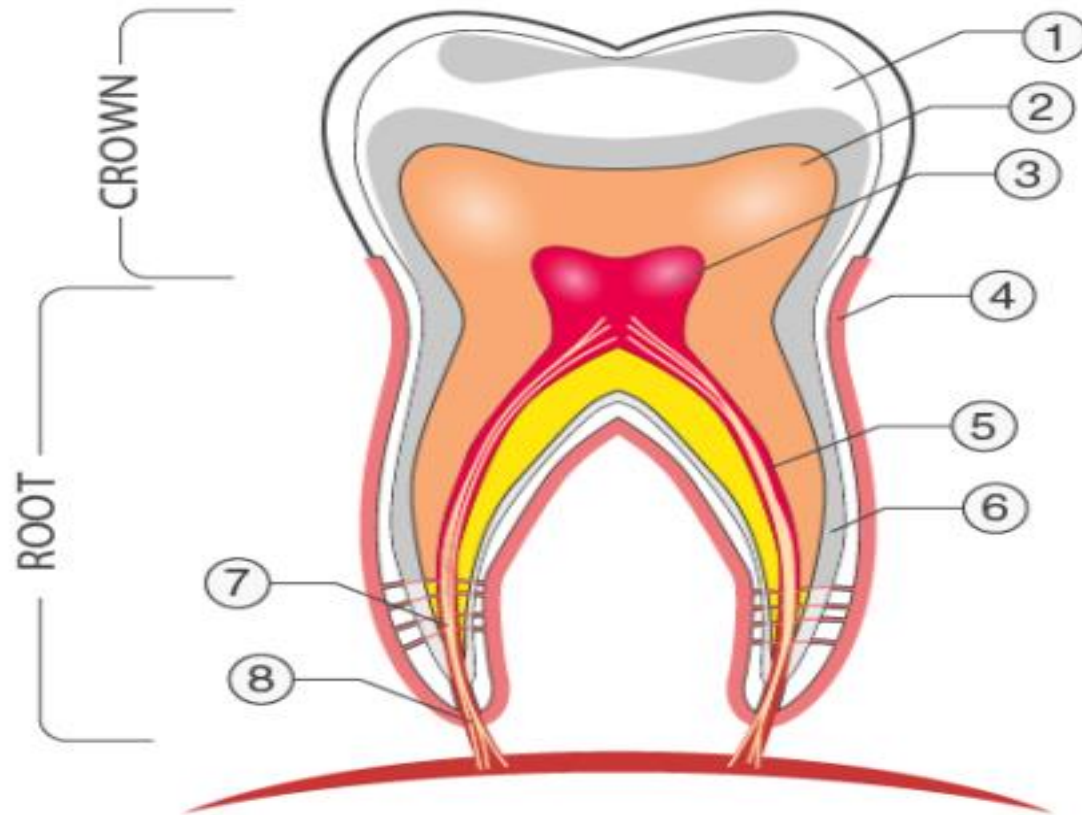
- ❖ Alimentary canal in humans is a long tube of varying diameter.
- ❖ It starts with the mouth and ends with the anus.
- ❖ Oesophagus, stomach, small intestine and large intestine are the parts of the alimentary canal.

MOUTH

- ❖ It is the opening of the alimentary canal and helps in ingestion of food.
- ❖ The buccal cavity which is present behind the mouth is also commonly referred to as the mouth.
- ❖ The buccal cavity has teeth and tongue.
- ❖ The set of teeth helps in the mastication of food.
- ❖ The tongue has taste buds on it and thus helps in tasting the food.
- ❖ The salivary glands open also in the buccal cavity and pour saliva which initiates the process of digestion.

TEETH

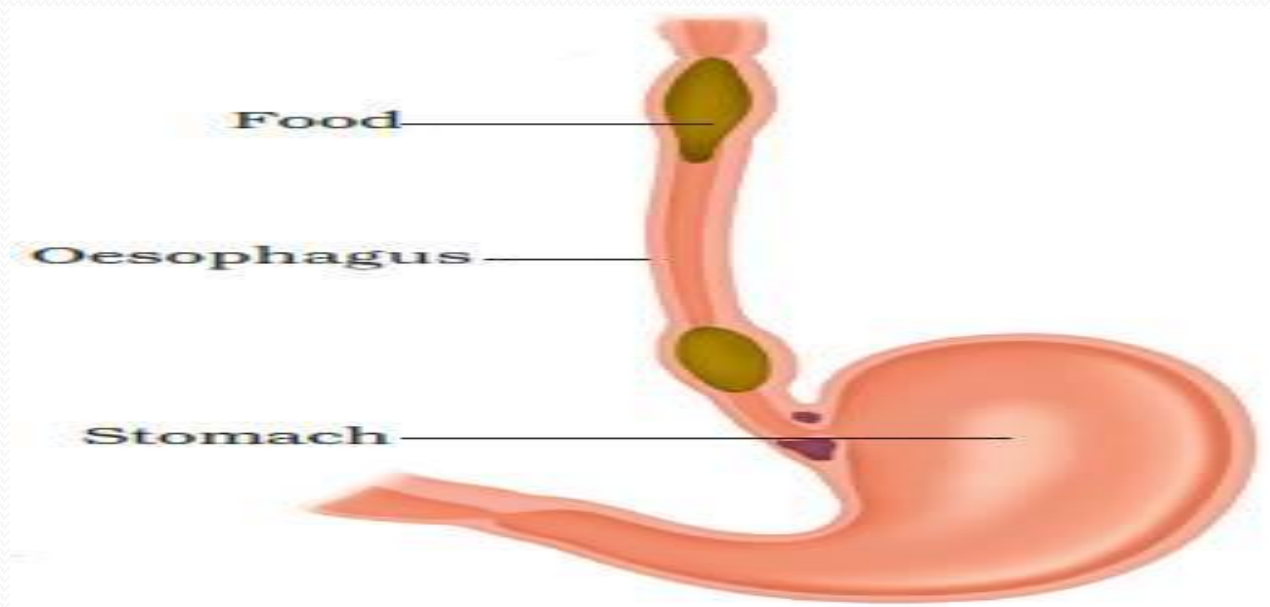
- ❖ Teeth are the hard structures present in the buccal cavity.
- ❖ They help us to cut, shear and masticate the food we eat.
- ❖ Vertical section of a tooth shows four layers as enamel, dentine, cement and dental pulp.
- ❖ Enamel is outermost, shiny, highly mineralized and hardest part of the human body.
- ❖ Dentine makes the bulk of the tooth and contains 70% inorganic salts.
- ❖ Cement is present at the lining of a tooth and bony socket.
- ❖ The dental pulp is the central soft part of a tooth and contains nerve endings, blood and lymph vessels along with connective tissue.
- ❖ There are four types of teeth in humans, Incisors, canines, molars and premolars, each with a specific function.
- ❖ Incisors cut the food, canines tear the food while molars and premolars crush it.
- ❖ The dental formula in adult humans is 2:1:2:3.



- | | | | |
|--------------|-----------------------|----------------------|--------------------|
| 1 Enamel | 2 Dentin | 3 Pulp chamber | 4 Gums |
| 5 Root Canal | 6 Supporting Ligament | 7 Nerves and Vessels | 8 Root end Opening |

OESOPHAGUS

- ❖ The swallowed food passes into the oesophagus.
- ❖ It is a muscular tube, about 25 cm long, with a sphincter (valve/opening) at each end.
- ❖ Its function is to transport food and fluid, after being swallowed, from the mouth to the stomach.
- ❖ Food is pushed down by peristaltic movements.

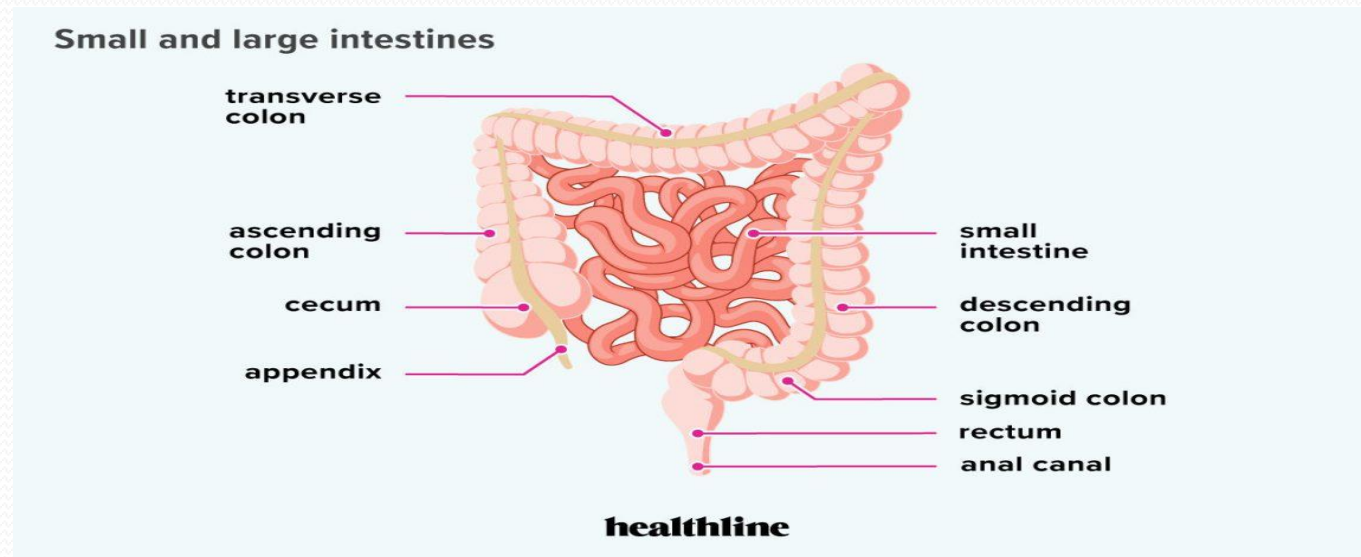


STOMACH

- ❖ The stomach is a thick-walled bag-like structure.
- ❖ It receives food from the oesophagus at one end and opens into the small intestine at the other end.
- ❖ The inner lining of the stomach secretes mucous, hydrochloric acid and digestive juices.
- ❖ Food is churned into a semi-solid mass in the stomach and is called chyme.
- ❖ Enzymes present in the gastric juice break down the food.
- ❖ Hydrochloric acid helps in partial digestion of proteins and also kills harmful bacteria.
- ❖ Mucus secreted by the wall of the stomach resists the action of HCl on itself.

SMALL INTESTINE

- ❖ The small intestine is the longest part of the alimentary canal, about 20 feet long in humans.
- ❖ It has regions, duodenum, the region which follows stomach, jejunum is the middle part and ileum is the later region which continues further into the large intestine.
- ❖ The internal surface of the small intestine is folded into finger-like projections called villi.
- ❖ A common pancreatic duct from pancreas and liver opens into the duodenum.
- ❖ Most of the chemical digestion and absorption takes place in the small intestine.

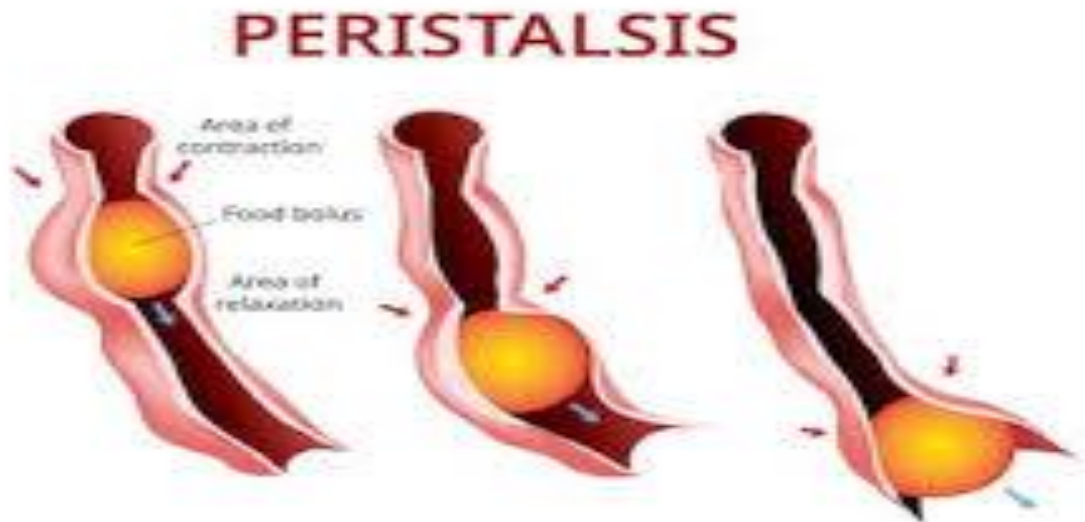


LARGE INTESTINE

- ❖ The large intestine in humans is about 5 feet long.
- ❖ It has two regions, colon (about 1.5 m) and rectum (10 cm in length in the adult).
- ❖ The region of large intestine after ileum is called colon while the last part is called the rectum.
- ❖ Colon has three regions as, ascending colon, transverse colon and descending colon.
- ❖ At the base of the ascending colon, a small finger-like out-growth is seen and is called an appendix.
- ❖ It houses many useful bacteria required for digestion of food.
- ❖ Rectum opens to outside by anus.
- ❖ The anus has internal and external anal sphincters.

PERISTALSIS

- ❖ A constant wave-like movement of the alimentary canal right from the oesophagus to the small intestine is called as peristalsis.
- ❖ Muscles present in the wall of the alimentary canal are responsible for peristalsis.
- ❖ This movement helps to push the food through the alimentary canal.

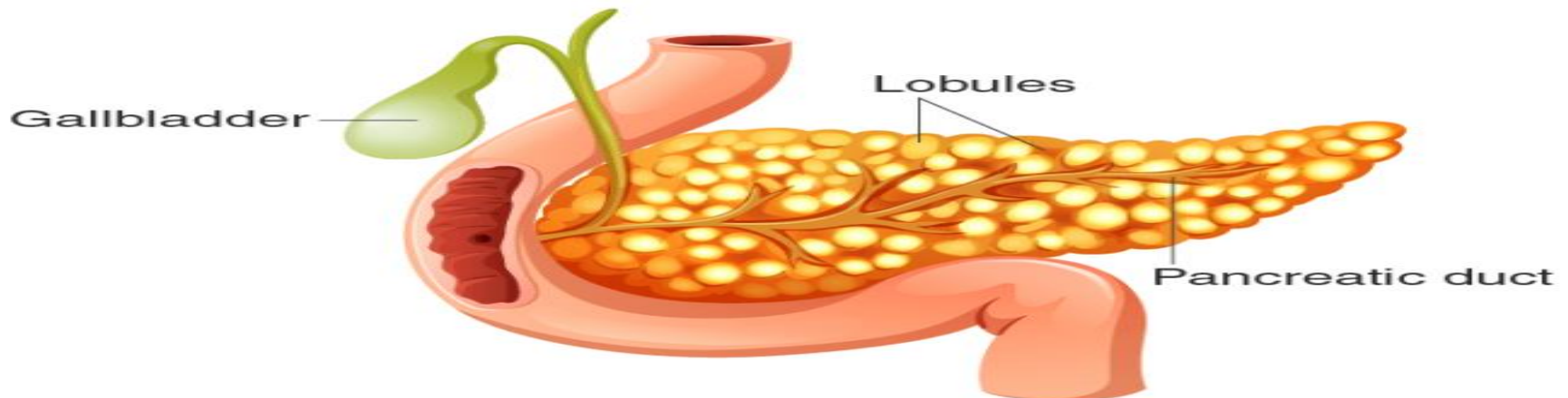


DIGESTIVE GLANDS

- ❖ Several glands produce digestive juices that help in digestion of the food.
- ❖ Salivary glands, Gastric glands, Liver, Gallbladder, Pancreas are few to name.
- ❖ Salivary glands secrete saliva which initiates digestion in the mouth itself.
- ❖ Gastric glands present in the wall of the stomach secrete hydrochloric acid and enzyme pepsin.
- ❖ The liver secretes bile which is stored in the gallbladder. Bile helps in digestion of fats.
- ❖ The pancreas secretes many digestive enzymes and its secretion is called as pancreatic juice.
- ❖ Enzymes like trypsin, chymotrypsin, lipase, amylase are present in the pancreatic juice.

PANCREAS

- ❖ The pancreas is a long, flat gland present behind the stomach in humans.
- ❖ It is one of the major digestive glands and is of mixed nature i.e. endocrine as well as exocrine.
- ❖ As an endocrine organ, it secretes two hormones called insulin and glucagon which maintain the blood sugar level.
- ❖ As an exocrine gland, it secretes pancreatic juice which is nothing but a mixture of many digestive enzymes.
- ❖ The digestive enzymes secreted by the pancreas include trypsin and chymotrypsin and proteases which digest proteins.
- ❖ It also includes amylase which digests the starch content of the food.
- ❖ Pancreatic lipases are the pancreatic enzymes that help in digestion of fats.



HOLOZOIC NUTRITION

The mode of nutrition in which animals take their food as a whole is called as holozoic nutrition.

In holozoic nutrition, food passes through five steps as ingestion, digestion, absorption, assimilation and egestion.

PHYSIOLOGY OF DIGESTION

- ❖ Mechanical digestion of food takes place in the buccal cavity where teeth masticate the food, saliva gets mixed and it turns into a bolus.
- ❖ Digestion of starch starts in the buccal cavity itself, with the action of salivary amylase present in the saliva.
- ❖ Salivary amylase converts starch into maltose.
- ❖ In the stomach, the churning of food takes place due to the muscular contraction and relaxation of its wall. It breaks down the food into simpler substances.
- ❖ Digestion of proteins starts in the stomach with the action of pepsin. Proteins are broken down into smaller fragments called peptide by the action of pepsin.
- ❖ The bolus after mixing with gastric juice, turn into a fine soluble form known as the chyme.
- ❖ Chyme enters into the small intestine where complete digestion takes place due to the action of various enzymes present in the pancreatic juice, bile and intestinal juice.
- ❖ The digested food is completely absorbed by the villi and microvilli of the small intestine.
- ❖ Undigested food then enters into the large intestine.
- ❖ The colon is responsible for absorption of water and salts whereas rectum stores the undigested food temporarily before defaecation.

DIGESTIVE SYSTEM IN OTHER ANIMALS

- ❖ Digestive systems in different animals vary in structure and function.
- ❖ The structure of the digestive system depends on the food habits of the animal.
- ❖ Alimentary canal in herbivores is long as the cellulose content of their plant-based diet takes a long time to digest.
- ❖ On the other hand, the alimentary canal of carnivorous animals is comparatively shorter because meat gets digested faster.

ANATOMY OF DIGESTIVE TRACT

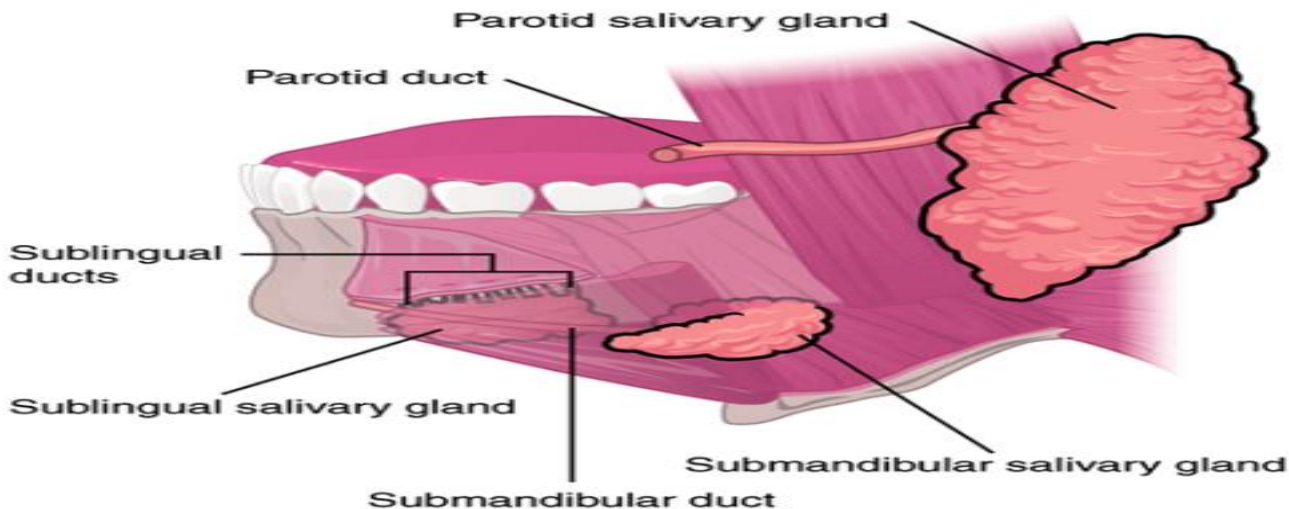
- ❖ The alimentary canal in humans is approximately 30 feet (9m) long.
- ❖ It starts with the mouth and ends in the anus.
- ❖ Between these two openings, the alimentary canal is the tube of varying diameter.
- ❖ Oesophagus, stomach, small intestine (divided into three regions as duodenum, jejunum and ileum) and large intestine(having two regions as colon and rectum) are the parts of the alimentary canal.
- ❖ Salivary glands, pancreas and liver act as major digestive glands.
- ❖ Glands present in the wall of the stomach and small intestine also contribute towards digestion of food.

ROLE OF HCL

- ❖ Hydrochloric acid in the stomach is secreted by the gastric glands present in its wall.
- ❖ pH of the gastric acid is usually between 1.5 to 3.5
- ❖ This acid serves the following functions:
- ❖ Converts inactive pepsinogen and pro-rennin into active pepsin and rennin respectively.
- ❖ Provides acidic medium for protein digestion.
- ❖ Kills bacteria entered through food and prevents infection.
- ❖ Prevents putrefaction of food in the stomach.
- ❖ A thick layer of mucus secreted by the mucous glands of the stomach prevent itself from the action of the gastric acid.
- ❖ Excess acid damages gastric mucosa and causes gastric and duodenal ulcers.

SALIVARY GLANDS

- ❖ Salivary glands are the exocrine glands that secrete saliva and through a system of ducts, it is poured into the mouth.
- ❖ In humans, three major pairs of salivary glands are present, parotid, submandibular and sublingual.
- ❖ In healthy individuals between 0.5 to 1.5 litres of saliva is produced per day.
- ❖ Saliva serves the following functions in the oral cavity.
- ❖ It lubricates and protects the soft and hard tissues of the oral cavity
- ❖ It also gives protection from dental caries
- ❖ Saliva prevents microbial growth in the oral cavity.
- ❖ Saliva can encourage soft tissue repair by decreasing clotting time and increasing wound contraction
- ❖ Saliva contains the enzyme amylase that hydrolyses starch into maltose and dextrin. Hence saliva allows digestion to occur before the food reaches the stomach
- ❖ Saliva acts as a solvent in which solid particles can dissolve in and enter the taste buds located on the tongue.

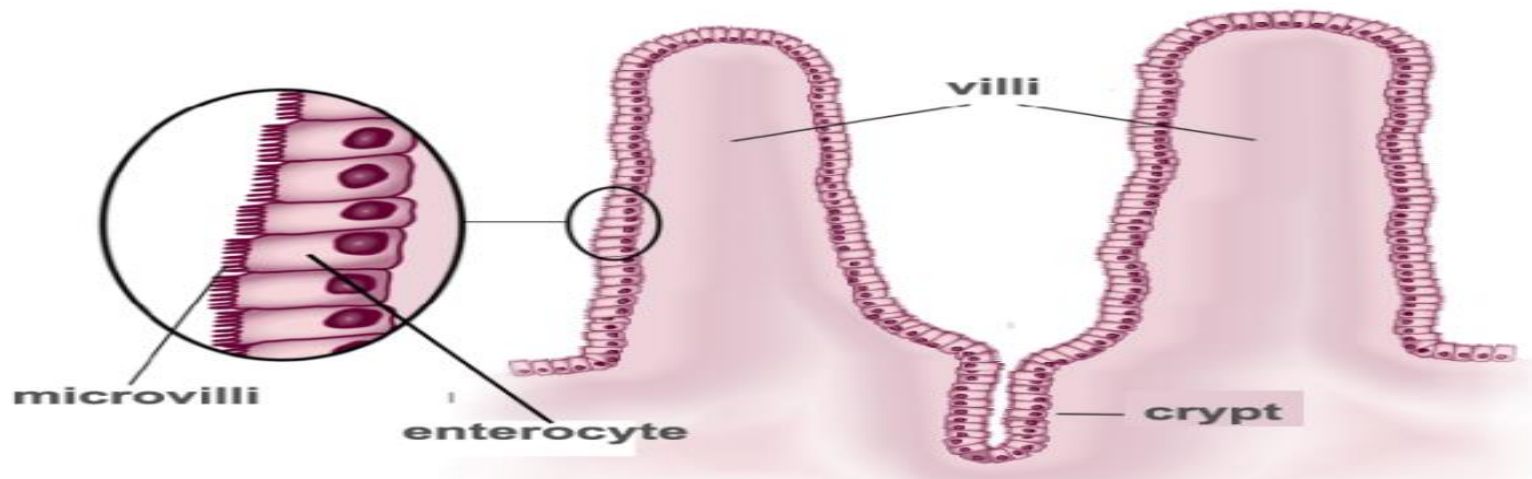


GLANDULAR EPITHELIUM

- ❖ Many small glands present in the inner layer of the stomach and intestine take part in the digestion of food.
- ❖ These glands are present in the epithelial lining of the stomach and intestine.
- ❖ The glands present in different regions of the stomach are called gastric glands.
- ❖ They are responsible for the secretion of mucus, hydrochloric acid and enzymes like pepsinogen.
- ❖ The glands present in the epithelial lining of the small intestine and large intestine are called intestinal glands.
- ❖ Glands of the small intestine are responsible for the secretion of intestinal juice also called succus entericus.
- ❖ Intestinal juice contains hormones, digestive enzymes, alkaline mucus, substances to neutralize hydrochloric acid coming from the stomach.
- ❖ Intestinal juice completes the digestion started by the pancreatic juice.
- ❖ Glands of the large intestine are associated with absorption of water and electrolytes.

VILLI AND MICRO VILLI

- ❖ Complete digestion and absorption of food take place in the small intestine.
- ❖ Pancreatic juice coming from the pancreas, bile from the liver and intestinal juice secreted by the intestinal glands complete the digestion of food material.
- ❖ All the digested nutrients are absorbed by the long finger-like projections present in the ileum of the small intestine.
- ❖ These small finger-like projections of the inner wall of intestine are called as villi (singular: villus).
- ❖ Each villus has its cell membrane of the lumen side again folded into microscopic processes, called microvilli.
- ❖ Villi increase the internal surface area of the intestinal walls making available a greater surface area for absorption.
- ❖ Digested nutrients pass into the semipermeable villi through diffusion.
- ❖ Villi also help in chemical digestion of food by secreting digestive enzymes.



LIVER

- ❖ The liver is the largest and major digestive gland of humans
- ❖ Liver, in humans, is located in the upper right-hand portion of the abdomen.
- ❖ This organ is dark reddish-brown in colour due to an extensive blood supply.
- ❖ Some of the important functions of the liver are as follows:
- ❖ It secretes bile that helps in digestion.
- ❖ It filters the blood coming from the digestive tract before passing it to the rest of the body.
- ❖ It detoxifies various metabolites and drugs
- ❖ The liver makes proteins important for blood clotting and other functions.
- ❖ It stores and releases glucose as needed.
- ❖ It processes haemoglobin, from the dead and worn out RBCs, for the iron content (the liver stores iron).
- ❖ Conversion of harmful ammonia to urea takes place in the liver.

DIGESTIVE JUICES

- ❖ Pancreatic juice, bile and intestinal juice (succus entericus) are collectively called as digestive juices.
- ❖ A common duct from digestive glands pours the secretions into the duodenum.
- ❖ Chyme enters into the small intestine where complete digestion takes place due to the action of various enzymes.
- ❖ In the duodenum, the acidity of chyme is turned to alkalinity by the action of bile coming from the liver. This is necessary for pancreatic enzyme action.
- ❖ Bile also emulsifies the fats into smaller globules.
- ❖ Pancreatic and intestinal amylases break down the carbohydrates into glucose.
- ❖ Trypsin and chymotrypsin are the proteases responsible for the breakdown of proteins finally into amino acids.
- ❖ Lipase is the enzyme which acts on the emulsified fats and breaks them down into glycerol and fatty acids.

WATER ABSORPTION IN LARGE INTESTINE

- ❖ The large intestine is not involved in the digestion of food or absorption of nutrients.
- ❖ The major function of the large intestine is to absorb water from the remaining indigestible food matter and make the stool solid.
- ❖ The large intestine also helps in absorption of vitamins made by bacteria that normally live in the large intestine.
- ❖ The innermost layer of the large intestine also acts as a barrier and protects from microbial infections and invasions.
- ❖ Rectum stores the undigested food temporarily until defaecation.

thank
you