

PPT

**DIGESTION
AND
ABSORPTION**

Nutrition is the science that interprets the interaction of nutrients and other substances in food in relation to maintenance, growth, reproduction, health and disease of an organism. It includes food intake, absorption, assimilation, biosynthesis, catabolism and

Basic steps of Holozoic Nutrition

Ingestion : Intake of food.

Digestion : Breaking down of complex organic food materials into simpler, smaller soluble molecules.

Absorption and assimilation : Absorption of digested food into blood or lymph and its use in the body cells for synthesis of complex components.

Egestion : Elimination of undigested food as faeces.

Digestion

Digestion – The process of changing food into simple components which the body can absorb

Digestive tract or Gastrointestinal tract- where digestion & absorption take place

Mouth->esophagus->stomach->small intestine->large intestine

DIGESTIVE SYSTEM

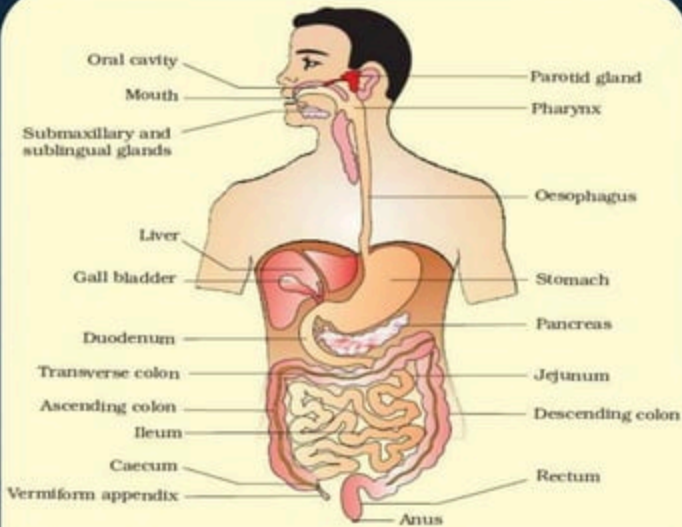


Figure 16.1 The human digestive system

ALIMENTARY CANAL

The alimentary canal begins with an anterior opening – the mouth, and it opens out posteriorly through the anus.

- Mouth leads to buccal cavity or oral cavity.
- Oral cavity has teeth and muscular tongue.
- Each tooth embedded in a socket of jaw bone: such attachment called thecodont.
- Diphyodont : human has two sets of teeth in their life time:
- Milk teeth or deciduous teeth
- Permanent teeth.
- Heterodont : teeth are of unequal shape and size.
- Incisor (I)
- Canine (C)
- Premolar (PM)
- Molar (M).

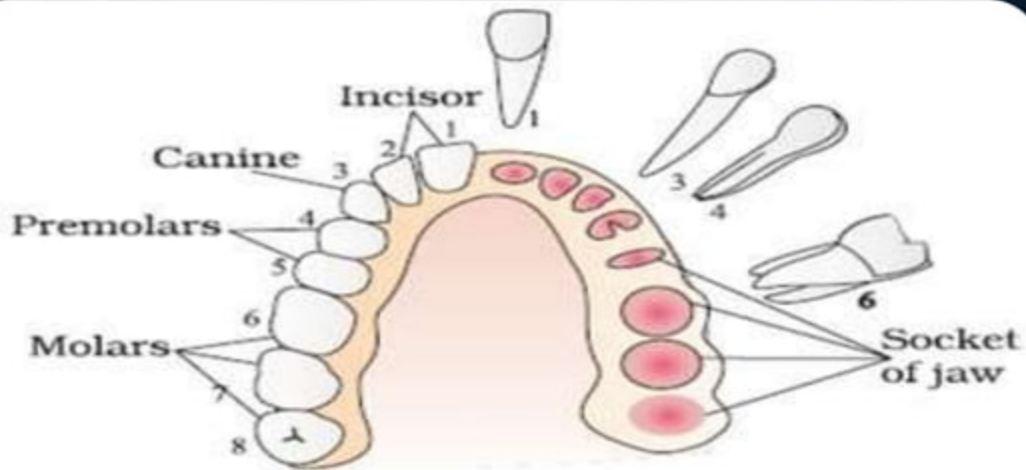


Figure 16.2 Arrangement of different types of teeth in the jaws on one side and the sockets on the other side

The hard chewing surface of the teeth made up of enamel.

- The tongue is a freely movable muscular organ attached to the floor of the oral cavity by the frenulum.
- The upper surface of tongue has small projections called papillae, some of which bears taste buds.
- The oral cavity leads into a short pharynx which serves as a common passage for food and air.
- Oesophagus and the trachea open into the pharynx.
- Opening of wind pipe or trachea called glottis, and that of oesophagus is called gullet.
- The cartilaginous epiglottis prevents the entry of food into the glottis during swallowing.
- Oesophagus connects pharynx with stomach.
- Opening of oesophagus is regulated by gastro-oesophageal sphincter.

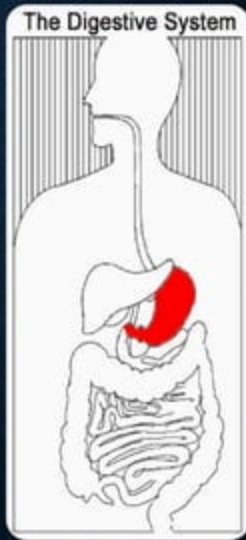
Stomach

J-shaped muscular bag that stores the food you eat, breaks it down into tiny pieces.

Mixes food with digestive juices that contain enzymes to break down proteins and lipids.

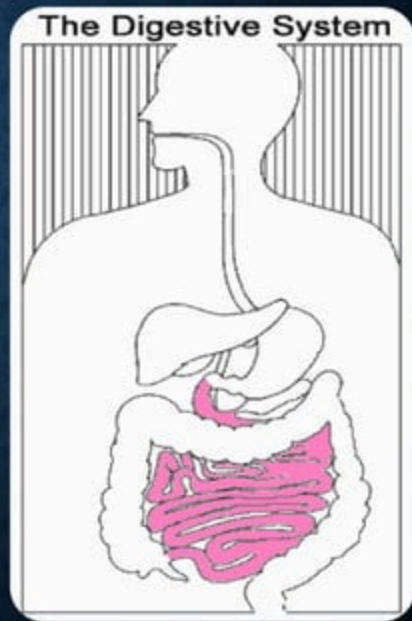
Acid in the stomach kills bacteria.

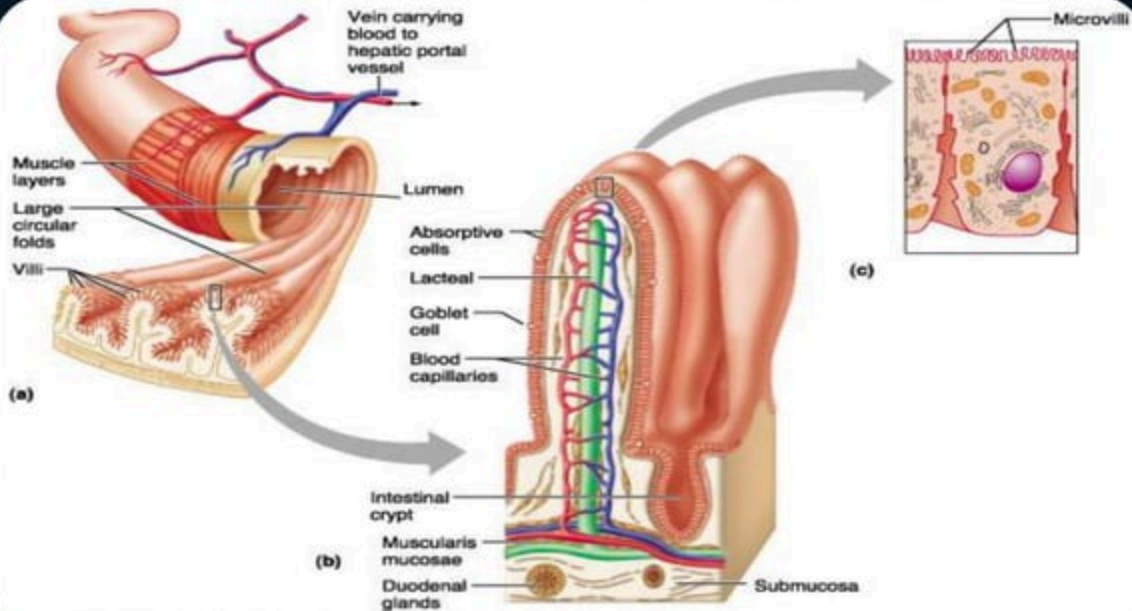
Food found in the stomach is called chyme.



Small Intestine

Small intestines are roughly 7 meters long
Lining of intestine walls has finger-like projections called villi, to increase surface area.
The villi are covered in microvilli which further increases surface area for absorption.





Small Intestine

Nutrients from the food pass into the bloodstream through the small intestine walls.

Absorbs:

80% ingested water

Vitamins

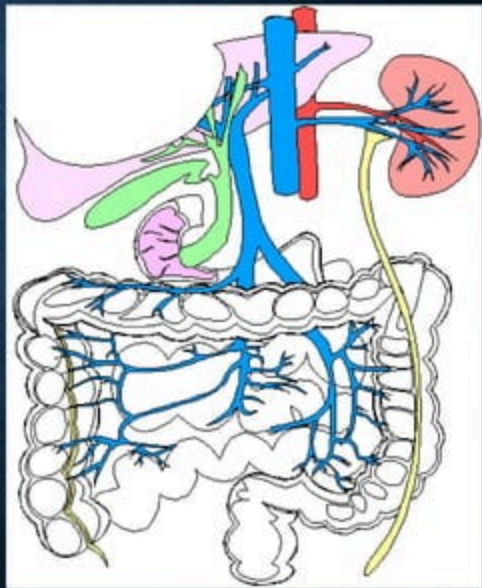
Minerals

Carbohydrates

Proteins

Lipids

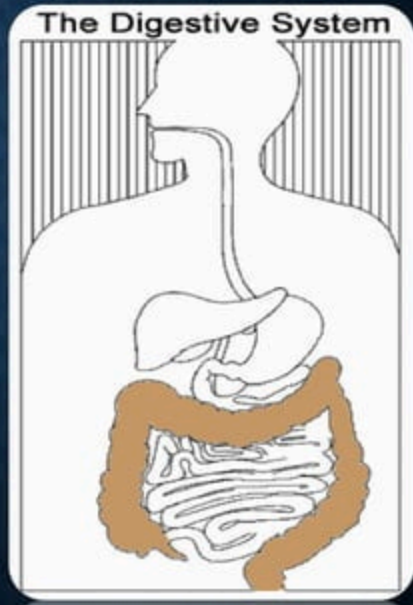
•Secretes digestive enzymes



Large Intestine

About 5 feet long
Accepts what small
intestines don't
absorb

Rectum (short term
storage which holds
feces before it is
expelled).



Large Intestine

Functions

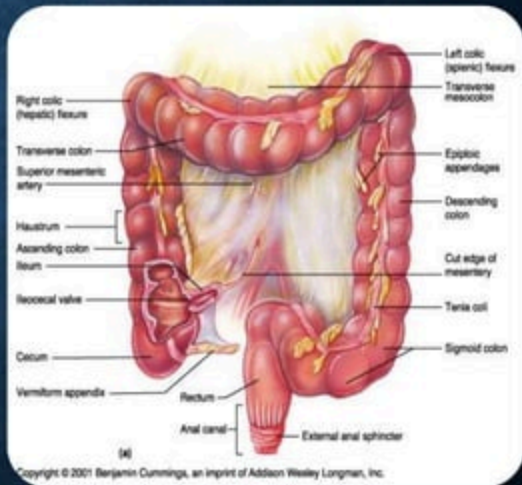
Bacterial digestion

Ferment carbohydrates

Protein breakdown

–Absorbs more water

–Concentrate wastes



Histology of alimentary canal :

Alimentary canal from oesophagus to rectum has four layers.

- Serosa.
- Muscularis.
- Sub mucosa.
- Mucosa

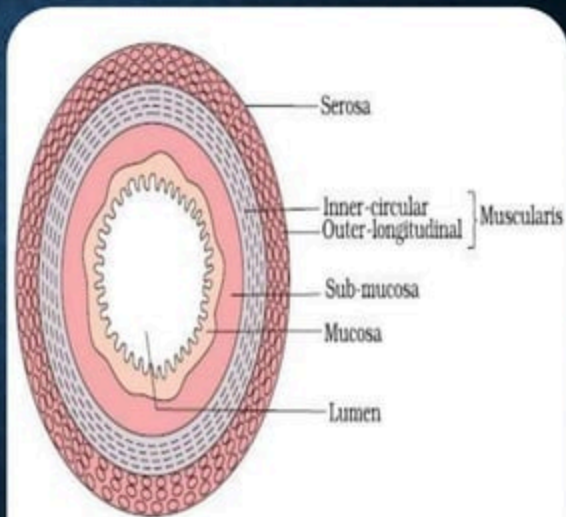


Figure 16.4 Diagrammatic representation of transverse section of gut

Mucosa forms irregular folds (rugae) in the stomach and small finger like folding called villi in the small intestine. □

The cells lining the villi produce numerous microscopic projections called microvilli giving a brush border appearance. □ These modifications increase the surface area for absorption. □ Villi are supplied with a network of capillaries and a central lymphatic vessel called lacteal. □

Epithelial cells of mucosa contain secretory cells which secrete digestive enzymes. □ Mucosa also forms glands in the stomach (gastric gland) □ Mucosa forms crypts in between the bases of villi in the intestine called Crypts of Lieberkuhn.

Small intestinal Mucosa Showing Villi

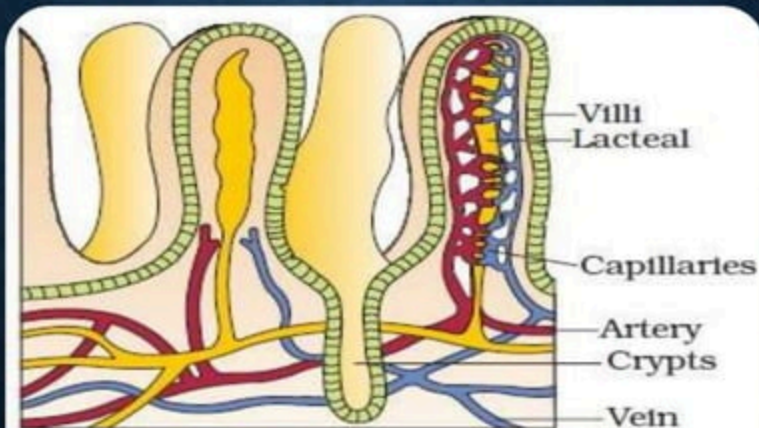


Figure 16.5 A section of small intestinal mucosa showing villi

Digestive glands

The digestive glands associated with the alimentary canal includes-

- Salivary gland
- Liver
- Pancreas
- There are three pairs of salivary gland present in the buccal cavity.
 - Parotid gland (below internal ear)
 - Sub-maxillary / submandibular (below lower jaw)
 - Sub-lingual (below tongue)
 - All salivary glands produce saliva into the buccal cavity.

Liver

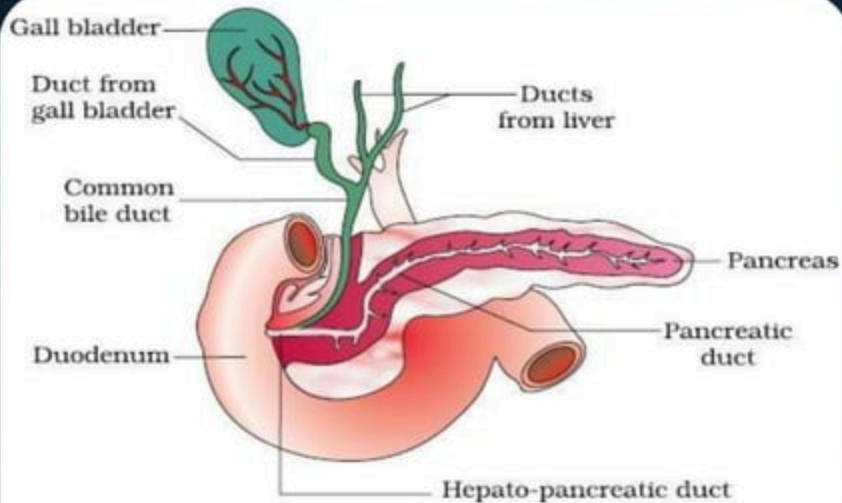
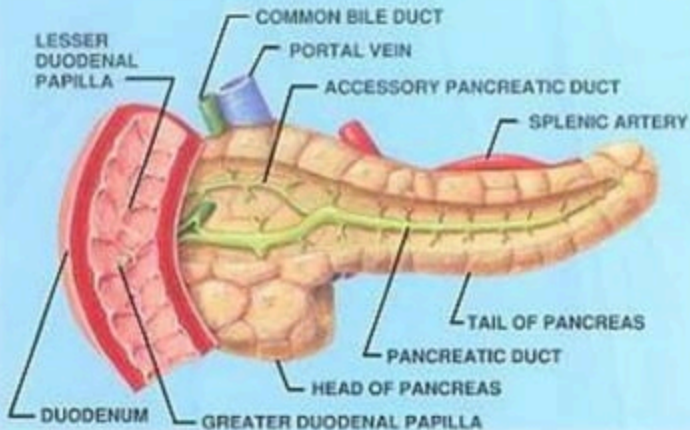


Figure 16.6 The duct systems of liver, gall bladder and pancreas

Largest gland of the body weighing about 1.2 to 1.5 kg in adult. □ Structural and functional unit of liver is the hepatic lobles. □ Hepatic lobules consist of hepatic cells. □ The bile secreted by the hepatic cells passes through the hepatic ducts and stored in the gall bladder in concentrated form. □ Bile from the gall bladder is transported by cystic duct. □ Cystic duct along with hepatic duct forms the common bile duct. □ Bile duct joined with pancreatic duct to form hepato-pancreatic duct which open into the duodenum. □ Hepato-pancreatic has a swelling portion called ampulla of Vater; the opening is guarded by sphincter of Oddi.

Pancreas

PANCREAS



Pancreas is a compound myxocrine gland (both exocrine and endocrine) elongated organ situated between the limbs of 'U' shaped duodenum. □ The exocrine aciner cells secrete pancreatic juice containing enzymes. □ The endocrine Islets of Langerhans secrete hormones like insulin and glucagon.

Digestive glands

(A) Salivary glands (found in mouth).

□ Three types are :

(i) Parotid,

(ii) Sublingual,

(iii) Submaxillary. Secrete saliva which contains ptyalin (Salivary amylase)

(B) Pancreas : Secretes pancreatic juice.

(C) Liver : Secretes bile.

(D) Gastric glands : Secretes gastric juice.

(E) Intestinal glands : Secretes intestinal juice or succus entericus.

DIGESTION OF FOOD

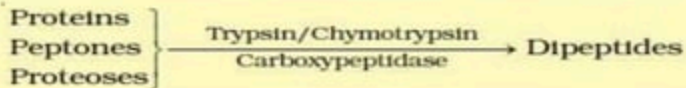
Digestion is accomplished by mechanical and chemical process.

- In the buccal cavity :
- Buccal cavity performs two major functions;
- Mastication of food.
- Facilitation of swallowing.
- The teeth and tongue with the help of saliva masticate and mix up the food.
- The saliva composed of ;
- Electrolytes (Na^+ , K^+ , Cl^- HCO_3^-)
- Enzyme- salivary amylase or ptyalin.
- Lysozyme.

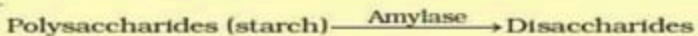
About 30% of starch is hydrolyzed into disaccharide (maltose) by salivary amylase in optimum pH 6.8).

- Lysozyme acts as antibacterial agent preventing infections.
- Mucus in the saliva helps in lubricating and adhering the masticated food particle into a bolus.
- The bolus is then passed into oesophagus through pharynx by swallowing or deglutition.
- By peristalsis the bolus from the oesophagus passed into the stomach.

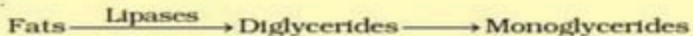
Digestion in small intestine



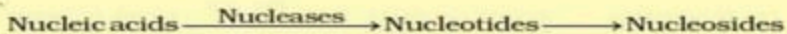
Carbohydrates in the chyme are hydrolysed by pancreatic amylase into disaccharides.



Fats are broken down by lipases with the help of bile into di- and monoglycerides.



Nucleases in the pancreatic juice acts on nucleic acids to form nucleotides and nucleosides



Funcion of succus entericus

Functions of succus entericus :

Dipeptides $\xrightarrow{\text{Dipeptidases}}$ Amino acids

Maltose $\xrightarrow{\text{Maltase}}$ Glucose + Glucose

Lactose $\xrightarrow{\text{Lactase}}$ Glucose + Galactose

Sucrose $\xrightarrow{\text{Sucrase}}$ Glucose + Fructose

Necleotides $\xrightarrow{\text{Nucleotidase}}$ Nucleosides $\xrightarrow{\text{Nucleosidases}}$ Sugars + Bases

Di and monoglycerides $\xrightarrow{\text{Lipases}}$ Fatty acids + Glycerol

ABSORPTION OF DIGESTED PRODUCTS

Absorption is the process by which the end product of digestion passes through the intestinal mucosa into the blood or lymph.

- Absorption is carried out by passive, active or facilitated transport mechanism.
- Glucose, amino acids and electrolytes are absorbed by simple diffusion into the blood in the concentration gradient.
- Fructose and some amino acids absorbed with the help of carrier ions like Na^+ . This is called facilitated diffusion.
- Active transport of digested food and electrolytes takes place against the concentration gradients.

Absorption of fatty acid and glycerol.

Fatty acids and glycerol being insoluble cannot be absorbed into blood.

- They are transported into mucosal epithelium and triglycerides are formed.
- Triglycerides are covered by a protein coat to form small fat globules called chylomicron, which are incorporated into the lacteal in the villi.
- These lymphatic vessels ultimately release the absorbed substances into the blood stream later on.

Assimilation and egestion

The absorbed substances finally reach the tissues which utilize them for their activities. This process is called assimilation.

□ The digestive wastes, solidified into coherent faeces in the rectum and removed to outside periodically by the process called defaecation.

DISORDERS OF DIGESTIVE SYSTEM

Jaundice : □ Affected organ is the liver.

□ Skin and eyes turn yellow due to deposition of bile pigments.

Vomiting : □ Ejection of stomach contents through the mouth.

□ It is controlled by the vomit centre in the medulla oblongata.

□ A feeling of nausea precedes vomiting.

Diarrhoea : □ Abnormal frequency of bowel movement and increased liquidity of the faecal discharge.

□ It reduces the absorption of food.

Constipation : □ The faeces are retained in the rectum as the bowel movements occurs irregularly.

Indigestion : □ The food is not properly digested leading to a feeling of fullness.

Summary

TABLE 16.1 The Summary of Absorption in Different Parts of Digestive System

Mouth	Stomach	Small Intestine	Large Intestine
Certain drugs coming in contact with the mucosa of mouth and lower side of the tongue are absorbed into the blood capillaries lining them.	Absorption of water, simple sugars, and alcohol etc. takes place.	Principal organ for absorption of nutrients. The digestion is completed here and the final products of digestion such as glucose, fructose, fatty acids, glycerol and amino acids are absorbed through the mucosa into the blood stream and lymph.	Absorption of water, some minerals and drugs takes place.

Thanking YOU