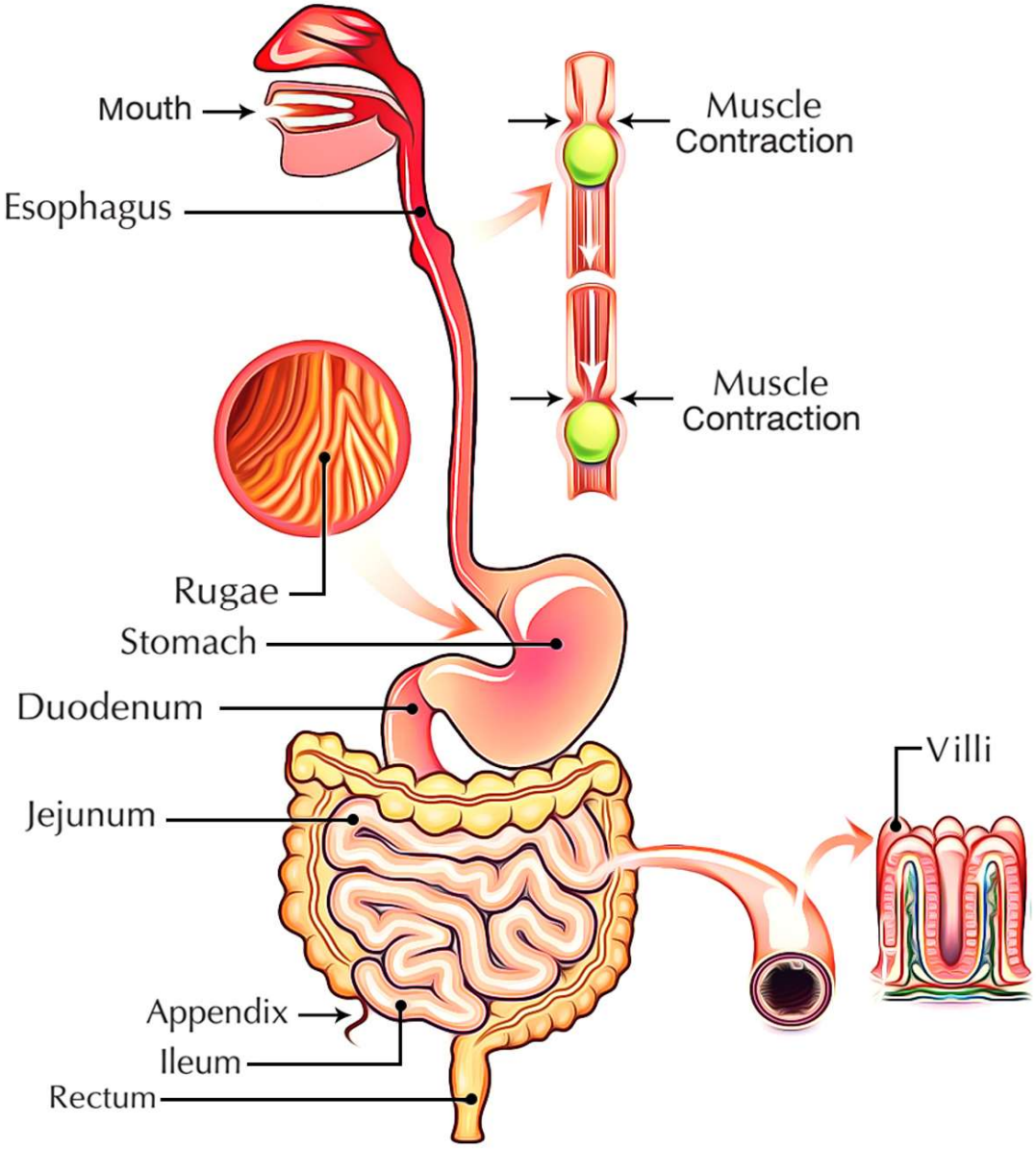
BIOLOGY

DIGESTION AND ABSORPTION

Digestion

The process in alimentary canal by which the complex food is converted mechanically and biochemically into simple substances suitable for absorption and assimilation in the body of animals/ organisms.



Digestive System

Alimentary canal begin with anterior opening mouth and opens out posteriorly through anus. It comprises of following parts:

Mouth: Mouth leads to oral cavity or buccal cavity which contains teeth and tongue.

Types of teeth

Papillae: Upper surface of tongue has small projections called Papillae, some of which contain taste buds.

Thecodont: Each teeth is embedded in socket of jaw bone (thecodont).

Diphyodont: Milk teeth is replaced by permanent or adult teeth, this type of dentition is called diphyodont.

Heterodont: Four different types of teeth (Heterodont) are incisors (I), canine (C), premolar (PM) and molar (M).

Canine: For tearing

Incisors: For cutting

Premolars: For grinding

Molars: For churning and grinding

Dental formula of man: (Permanent Teeth)

	I	C	PM	M	
32 = 2 ×	2	1	2	3	Upper Jaw
	2	1	2	3	Lower Jaw

Dental formula of man: (Milk Teeth)

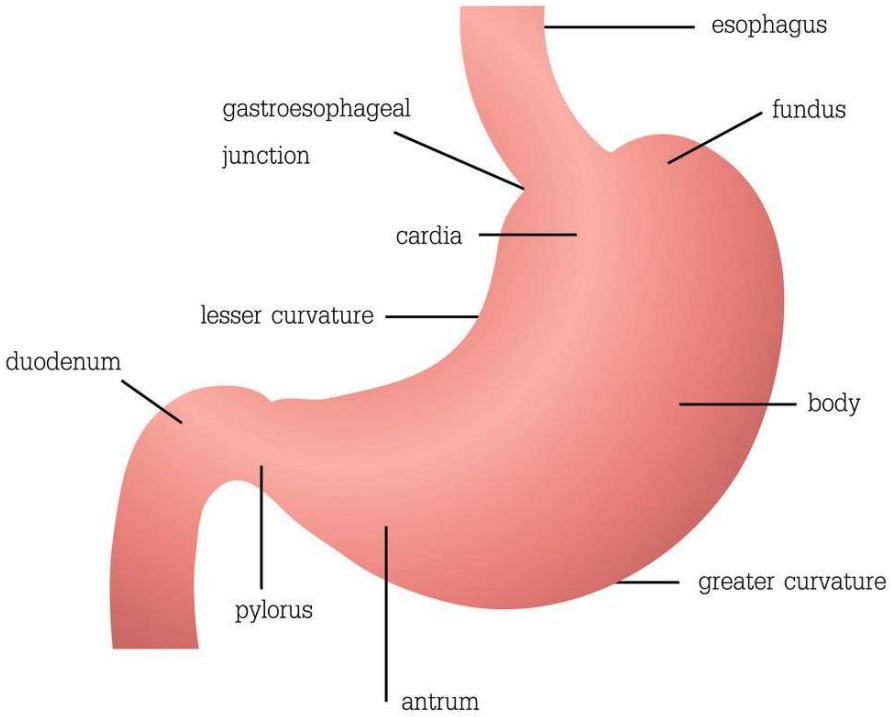
	I	C	PM	
20 = 2 ×	2	1	2	Upper Jaw
	2	1	2	Lower Jaw

Pharynx: Pharynx oral cavity opens into pharynx which acts as common passage for food and air. Cartilaginous flap called epiglottis prevents the entry of food into wind pipe (glottis) during swallowing.

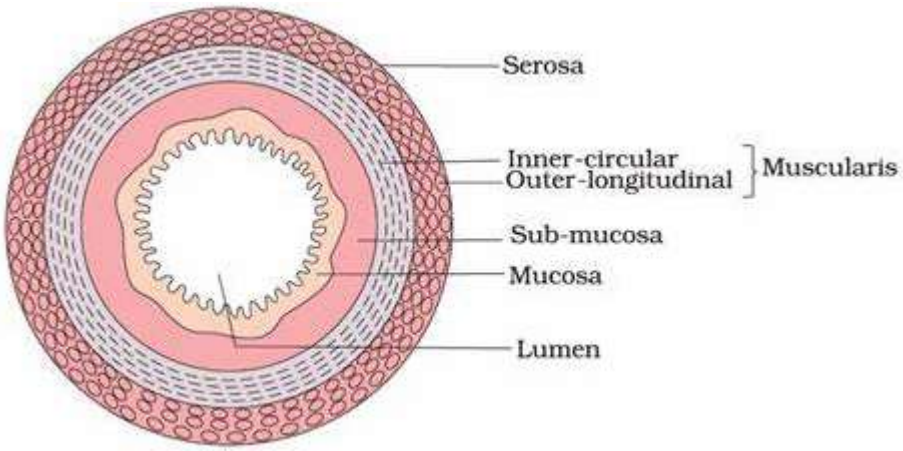
Stomach: Stomach Oesophagus leads to stomach. The opening of stomach is guarded by a sphincter (gastro-oesophageal). Stomach is divided into three parts- cardiac, fundic and pyloric.

Small intestine: Small intestine is the longest part of alimentary canal divided into duodenum, jejunum and ileum. Pyloric sphincter is present between stomach and duodenum.

Large intestine: Large intestine ileum opens into large intestine, which is divided into caecum, colon and rectum. Caecum is a blind sac which host microbes. Vermiform appendix arises from caecum. Rectum opens through anus.



Histology of Alimentary canal



The wall of alimentary canal from Oesophagus to rectum consists of four layers.

Serosa: Serosa it is the outermost layer made up of squamous epithelium and areolar connective tissue.

Muscularis: Muscularis it is composed of outer longitudinal and inner circular muscle fibres. Muscles fibers are smooth and have network of nerve cells.

Submucosa: Submucosa it consists of loose connective tissue richly supplied with blood and lymphatic vessels. Meissner's plexus is present between the muscular coat and mucosa that controls the secretion of intestinal juice.

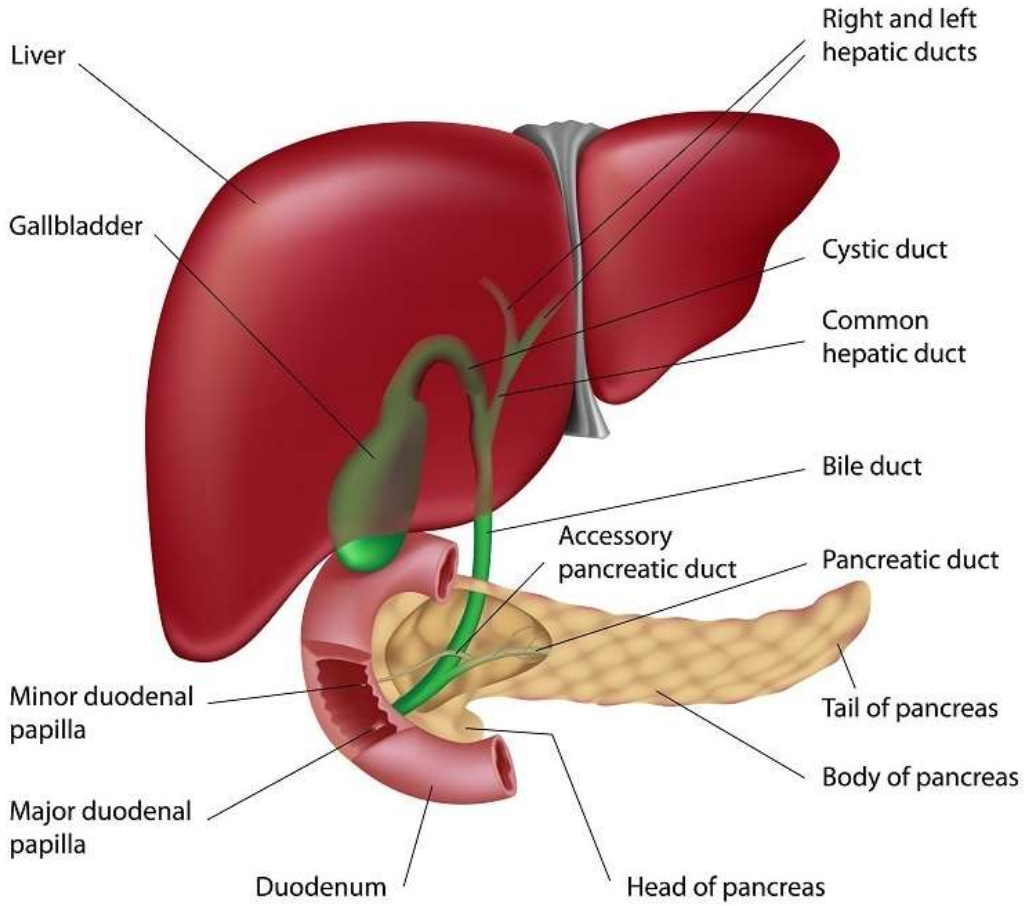
Mucosa: Mucosa is innermost layer lining the lumen of the alimentary canal. It has irregular folding in stomach called rugae and villi in small intestine. Mucosa forms glands in the stomach (gastric glands) and crypts in between the bases of villi in the intestine (crypts of Lieberkuhn).

Digestive Glands

- Salivary Glands
- Liver
- Pancreas

Salivary Glands: Salivary Glands secrete saliva in oral cavity. In human being's salivary glands are three pairs- parotid, sublingual, and submandibular.

Liver: Liver it is the largest gland in human body lies in upper right side of the abdominal cavity just below the diaphragm. Hepatic lobules, covered by Glisson's capsule, are structural and functional unit of liver made up of hepatic cells. The secretion is stored and concentrated in gall bladder. Bile duct and pancreatic duct open together in duodenum by common duct guarded by sphincter of Oddi.



Pancreas: Pancreas It is soft lobulated greyish pink gland which weighs about 60 gm., consists of exocrine and endocrine portion. The exocrine portion secretes alkaline pancreatic juice and endocrine secretes hormones insulin and glucagon.

Digestion of food

1. Carbohydrates, fats, proteins and nucleic acids occur in food in the form of large and complex insoluble macromolecules (polymers). These macromolecules are converted into small monomers by the action of enzyme.
2. In buccal cavity, teeth and tongue help in mastication and mixing of food. Mucus in saliva mix with masticated food to form bolus.
3. Bolus is passed to pharynx and Oesophagus by swallowing or deglutition.
4. Chemical digestion of food starts in oral cavity by the action of enzyme salivary amylase and lysozyme.
5. Lysozyme acts as antibacterial agent in mouth to prevent infection.
6. Salivary amylase breakdown starch into maltose
7. Mucosa of stomach have gastric glands having three types of cells- mucus neck cells that secrete mucus, peptic or chief cells that secretes proenzyme pepsinogen and parietal or oxyntic cells that secretes HCl.

8. Food mixes with gastric juice due to churning action of muscular wall to form chyme. HCl activates the pepsinogen to pepsin to digest protein into peptones and proteoses
9. Mucus and bicarbonates present in gastric juice play important role in lubrication and protecting inner wall of stomach from the action of HCl. Renin is a proteolytic enzyme found in gastric juice of infants to digest milk protein.
10. The Bile, pancreatic juice and intestinal juice are released in small intestine. Pancreatic juice contain inactive trypsinogen, chymotrypsinogen, procarboxypeptidases, amylases, lipases and nucleases.
11. Trypsinogen is activated by enzyme enterokinase in to trypsin, which further activates the other enzyme of intestinal juice.
12. Bile contains bile pigments (bilirubin and bil-verdin), bile salts, cholesterol and phospholipids which help in emulsification of fats.
13. Secretion of brush border cells of mucosa and goblet cells contain enzyme succus entericus, containing variety of enzymes to complete the process of digestion.

Function of large intestine

- Absorption of water, minerals, and certain drugs.
- Secretion of mucus for adhering of the undigested food and lubricating it for easy passage.
- Absorption of Digested Food:
- Absorption is the process by which nutrients pass from the alimentary canal into the blood and lymph through its mucous membrane.
- Amino acids, monosaccharide, fatty acids, glycerol, salts, vitamins, and water are to be absorbed. About 90% of absorption occurs in small intestine and rest 10% in stomach, mouth and large intestine.
- The passage of different absorbent depends upon concentration gradient for some substances like glucose and amino acids and electrolytes.

Absorption in different part of alimentary canal

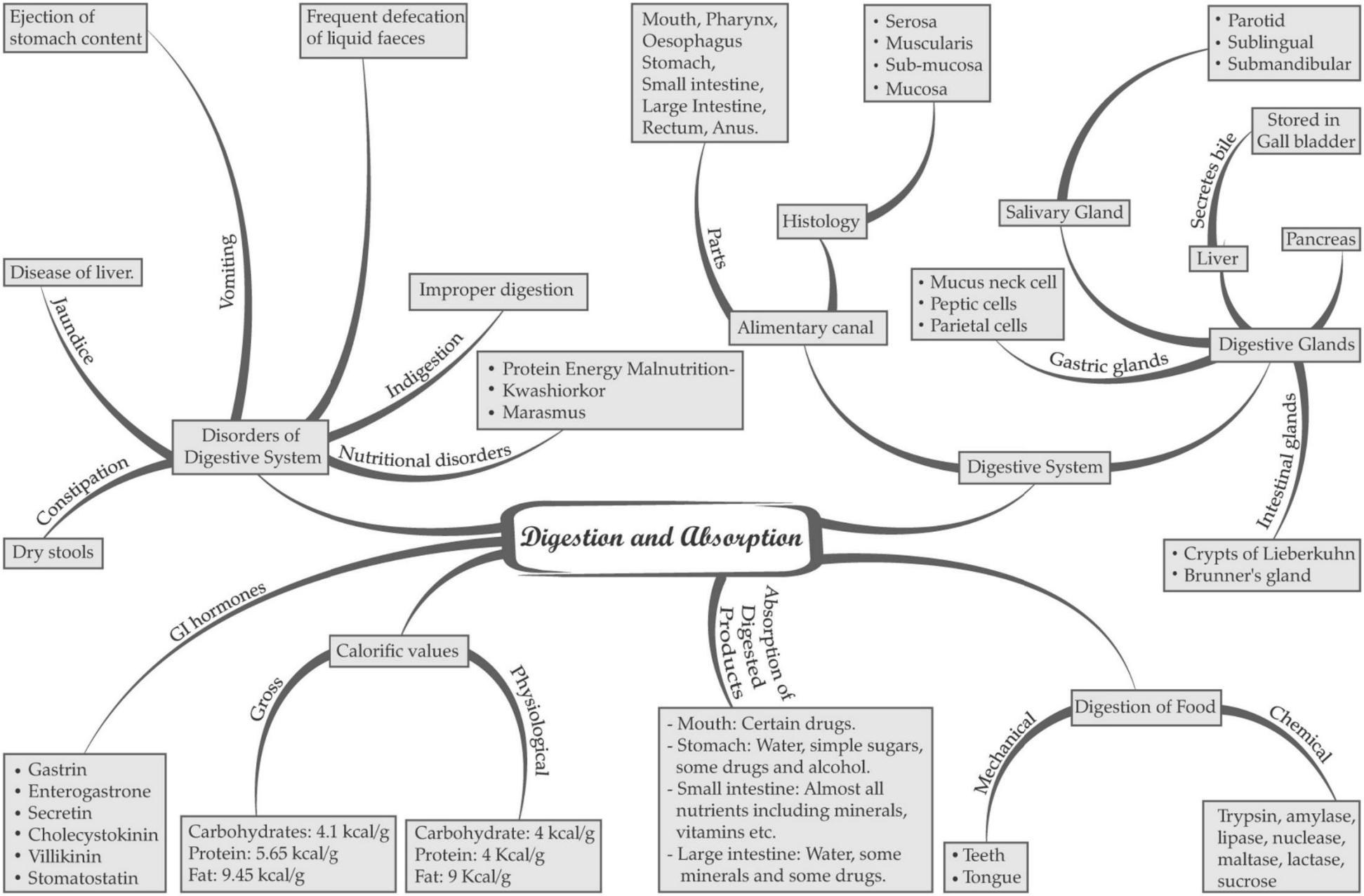
1. **Mouth:** Certain drugs coming in contact with the mucosa of mouth and lower side of tongue are absorbed into the blood capillaries lining them.
2. **Stomach:** Absorption of water, simple sugar and alcohol takes place.
3. **Small intestine:** Glucose, fructose, fatty acids, glycerol and amino acids are absorbed through the mucosa into the blood stream and lymph.
4. **Large intestine:** Absorption of water, some minerals and drug takes place.

Disorder of Digestive System

The inflammation of intestinal tract due to bacterial infection, fungal infection and parasitic infection caused by tapeworm, round worm, threadworm and pin worms.

1. **Jaundice:** Jaundice it is a disease of liver. In jaundice the skin and the eyes turn yellow due to large quantities of bilirubin pigments in the extra cellular fluid.
2. **Vomiting:** Vomiting it is the ejection of stomach content through the mouth. This reflex action is controlled by the vomit Centre in the medulla.
3. **Diarrhea:** Diarrhea frequent defection of liquid faeces is known as Diarrhea. It reduces the absorption of food.
4. **Constipation:** Constipation in constipation the faeces are retained within the rectum as the bowel movements occur irregularly.
5. **Indigestion:** Indigestion incomplete digestion usually accompanied by one or more of the following symptoms- pain, nausea, vomiting, heartburn, acid regurgitation, accumulation of gas and escape of gas from the stomach.

CHAPTER : 16 DIGESTION AND ABSORPTION



Important Questions

➢ Multiple Choice Questions:

Question 1. Trypsin convert

(a) Fats into fatty acids

(b) Sucrose into glucose and fructose

(c) Proteins into peptones

(d) Starch and glycogen into maltose

Question 2. Liver cells secrete

(a) Trypsin

(b) Bile and no enzyme

(c) Amvlopsin

(d) Lipase

Question 3. Bilirubin and biliverdin mainly occur in

(a) Blood

(b) Bile

(c) Pancreatic juice

(d) Saliva

Question 4. Milk protein is curdled into

(a) Rennin

(b) Maltase

(c) Trypsin

(d) Lactase

Question 5. Amino acids are absorbed by

(a) Lacteals of villi

(b) wall of rectum

(c) Blood capillaries of villi

(d) Lacteals and blood capillaries of villi

Question 6. Glycogen is stored in

(a) Liver only

(b) Liver and muscles

(c) Muscles only

(d) Pancreas

Question 7. Renin is found is

(a) Gastric juice in stomach

(b) Pancreatic juice

(c) Kidneys

(d) Liver

Question 8. Digestion of fats, proteins and carbohydrates is completed in

(a) Large intestine

(b) small intestine

(c) stomach

(d) Liver

Question 9. Gastric juice contains

(a) Pepsin

(b) Rennin

(c) HCl

(d) All of these

Question 10. Which of these is a group of end product of carbohydrate digestion?

(a) Galactose, glucose, maltose

(b) Sucrose, galactose, maltose

(c) Glucose, galactose, fructose

(d) None of these

Question 11. Human digestive juices lack

(a) Amylase

(b) Nucleases

(c) Cellulase

(d) Lactase

Question 12. In alimentary canal maximum absorption of water occurs in

(a) Rectum

(b) Stomach

(c) Small intestine

(d) Large intestine

Question 13. Starch is hydrolysed by

(a) Lipase

(b) Pepsin

(c) Amylase

(d) Trypsin

Question 14. Chief function of bile is

(a) Emulsfication of fat

(b) Regulation of digestion

(c) Elimination of waste products

(d) Digestion of fat through enzymes.

Question 15. Gastric juice contains

(a) Pepsin, lipase and rennin

(b) Pepsin, trypsin and rennin

(c) Pepsin only

(d) Pepsin, amylase and rennin

➢ Fill In the Blanks:

1. The major components of our food are ……, …… and ……..
2. Food provides energy and ……. for growth and repair of tissues.
3. ……. in food cannot be utilised by our body in their original form.
4. Digestive system process of conversion of complex food substances to simple absorbale form is called …….
5. An adult human has 32 permanent teeth which are of four different types, namely ……, ……, ……. and ……
6. The stomach, located in the upper left portion of the abdominal cavity, has …… major parts.

➢ True or False:

1. In diarrhoea the skin and the eyes turn yellow due to the deposit of bile pigments.
2. The abnormal frequency of bowel movement and increased liquidity of the faecal discharge is known as jaundice.
3. The causes of indigestion are inadequate enzyme secretion, anxiety, food poisoing, over eating and spicy food.

4. Absorption of substances take place in different parts of the alimentary canal, like mouth, stomach, small intestine and large intestine.
5. Fatty acids and glycerol being insoluble, cannot be absorbed into the blood.
6. Small amounts of monosaccharides like glucose, amino acids and some of electrolytes like chloride ions are generally absorbed by a simple diffusion.

➢ Very Short Question:

1. How does pepsinogen become active in the stomach?
2. What is pancreatic amylase?
3. Name any animal starch.
4. Name the milk-coagulating enzyme.
5. Which enzyme is necessary for the digestion of fat?
6. Which part of the ruminant stomach secretes gastric juice?
7. Name the water-soluble vitamins.
8. State the function of ascorbic acid.
9. Which is the largest gland in our body?
10. Name the cobalt-containing vitamin.

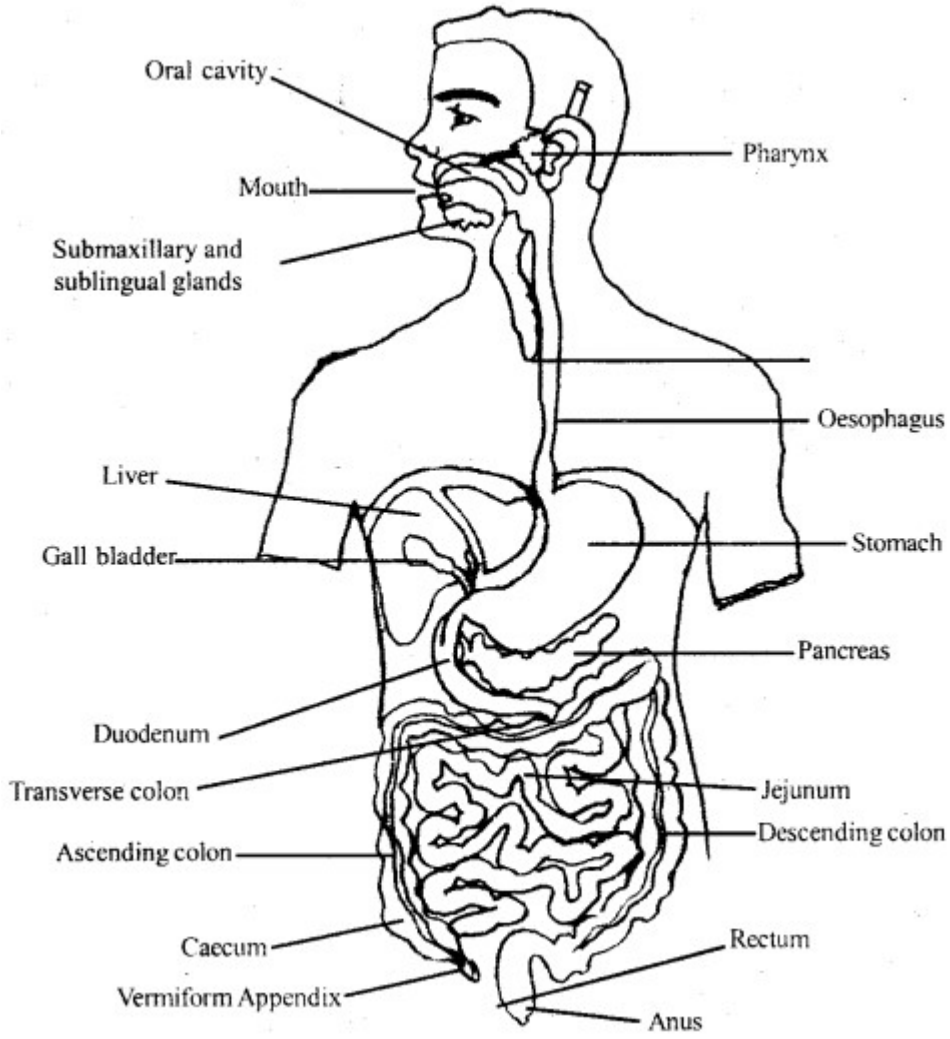
➢ Short Questions:

1. What is the passive absorption of food?
2. What do you mean by incomplete and complete type of digestive tracts?
3. What are wisdom teeth? Write the dental formula of permanent and milky teeth.
4. What is the role of
   (a) Enterogastrone
   (b) Cholecystokinin
   (c) Secretion
   (d) Duocrinn
   (e) Enterocrinin.
5. Name some of the symbiotic bacteria residing in a healthy human colon. What is the role of this bacteria?
6. Define chemotrophs and heterotrophs?
7. How does the gastrovascular cavity in the cnidarian help in digestion?
8. Crop, mid-gut-hepatic caeca, gizzard, buccal cavity, afraid gut- arrange these parts of the

alimentary canal of a cockroach in proper sequence in relation to digestion.

➢ Long Questions:

1. What are the accessory digestive organs of a human digestive system?
2. Discuss the five steps involved in the process of nutrition.



Digestive System

3. Where does the digestion of starch, proteins and fats take place and what is the role played by the associated glands?

Assertion Reason Question-

1. In these questions, a statement of assertion followed by a statement of reason is given. Choose the correct answer out of the following choices.

   (a) If both Assertion and Reason are true and Reason is the correct explanation of Assertion.

   (b) If both Assertion and Reason are true but Reason is not the correct explanation of Assertion.

   (c) If Assertion is true but Reason is false.

(d) If both Assertion and Reason are false.

Assertion: Thick layers of muscles are present in the wall of alimentary canal.

Reason: These muscles help in the mixing of food materials with the enzymes coming from different glands in the alimentary canal.

2. In these questions, a statement of assertion followed by a statement of reason is given. Choose the correct answer out of the following choices.

(a) If both Assertion and Reason are true and Reason is the correct explanation of Assertion.

(b) If both Assertion and Reason are true but Reason is not the correct explanation of Assertion.

(c) If Assertion is true but Reason is false.

(d) If both Assertion and Reason are false.

Assertion: Human beings have two sets of teeth during their life.

Reason: Human beings have thecodont dentition.

Case Study Based Question-

1. Rajni invited her friend Varsha for lunch. Being a working woman, Rajni could not make many dishes and the food was very simple with pulses, green vegetables, brown rice and chapatis. However, she did not forget to include salads in the menu, due to its health benefits.

   On the basis of above passage, answer the following:

   a. What is Salad?

   b. What are the benefits of eating salads?

   c. What values are displayed by Rajni?

2. Prabitha being a Biology teacher has to perform official visits concerned with her profession. Once, she had been to Kolkata and was roaming around Howrah Bridge, where she saw a beggar with his son. The little boy was too thin with wrinkled skin. She identified the symptoms of Marasmus and counselled his father regarding the boy's condition. She also gave him the address of government hospital where free treatment of his son will be ensured.

   On the basis of above passage, answer the following:

   a. What is Marasmus?

   b. Differentiate between Kwashiorkor and Marasmus?

   c. Write the values depicted by Prabitha.

✓ Answer Key-

➢ Multiple Choice Answers:

1. (c) Proteins into peptones
2. (b) Bile and no enzyme
3. (b) Bile
4. (a) Rennin
5. (c) Blood capillaries of villi
6. (b) Liver and muscles
7. (a) Gastric juice in stomach
8. (b) Small intestine
9. (d) All of these
10. (c) Glucose, galactose, fructose
11. (c) Cellulase
12. (a) Rectum
13. (c) Amylase
14. (a) Emulsfication of fat
15. (a) Pepsin, lipase and rennin

➢ Fill In the Blanks:

1. Carbohydrates, proteins, fat
2. organic materials
3. Bio macromolecules
4. digestion
5. incisors (I), Canine (C), Premolars (PM), molars (M)
6. three

➢ True or False:

1. False
2. False
3. True
4. True
5. True
6. True

➢ Very Short Answers:

1. Answer: Due to the presence of HCl.
2. Answer: The pancreatic juice contains a starch-digesting enzyme called pancreatic amylase.
3. Answer: Glycogen.
4. Answer: Chymotrypsin.
5. Answer: Pancreatic lipase.
6. Answer: Abomasum of the ruminant stomach secretes gastric juice.
7. Answer: Vitamin B-complex and vitamin C.
8. Answer: It is necessary for the proper development of teeth and gums.
9. Answer: Liver.
10. Answer: Vitamin Bp or Cobalamine.

➢ Short Answer:

1. Answer: It is the absorption of nutrients from higher concentration to lower concentration without the expenditure of energy. This requires the nutrients to be in higher concentration in the intestinal lumen than inside the cell. The diffusion of molecules would continue as long as the concentration difference persists.

   The diffusion is a slow process. Water is absorbed by osmosis from the interstitial lumen to the intestinal cells and then to blood as long as the solute concentration is higher in the blood than in the intestinal content.
2. Answer: The incomplete digestive tract has only one opening for intake of food and elimination of indigestible matter e.g. coelenterates planaria, liver fluke etc. Complete digestive tracts have a separate opening for intake of food and elimination of indigestible matter e.g. in man, frog, rabbit, etc.
3. Answer:
   - The last molar grown at maturity age in both upper and lower jaws on both sides are called wisdom teeth
   - The dental formula of permanent teeth = 2, 1, 2, 3/2, 1, 2, 3 = 32; milk teeth = 2, 1, 2, 0/2, 1, 2, 0 = 20
4. Answer:

   (a) Answer: Enterogastrone slows gastric contractions and stops the secretion of gastric juice.

   (b) Answer: Cholecystokinin of CCK causes the release of bile from the gall bladder and the release of enzymes in pancreatic juice.

   (c) Answer: Secretion causes the release of sodium bicarbonate in the pancreatic juice.

   (d) Answer: Duocrinin causes the release of mucus from Brunner's glands into the

intestinal juice.

(e) Answer: Enterocrinin brings the release of enzymes from crypts of Leiberkuhn into intestinal juice.

5. Answer: Escherichia coli and streptococcus Faecalis, this synthesise vitamins B and K and convert bile pigment into brown pigments to impart colour to the farces; prevent the establishment of pathogenic microorganisms in the intestine.

   Bile pigment contains water, mucin, lecithin, cholesterol, bile salts and bile pigments.

6. Answer: Organisms such as nitrifying bacteria e.g. Nitrosomonas and nitrobacteria, which capture the energy released during oxidation of inorganic chemical substances and prepare organic food with its help are called chemotrophs.

   Organisms such as animal, fungi, some protestants (Trypanosoma) and any kind of bacteria which cannot utilize sun energy but use chemical bond energy in the form of organic molecules or food synthesized by other organisms in building up their own organic molecules are called Heterotro

7. Answer: More organized animals, like cnidari&n (e.g. Hydra, Aurelia) have developed sac-like coelenteron or gastro Oscular cavity, which is lined by various types of endoderm cells. Gland, cells of the endoderm secrete their enzymes into the cavity and digest the food extracellularly. This kind of digestion outside cells within a cavity is extracellularly digestion. However in cnidarian, as soon as the food is, reduced to small fragments, the nutritive cells ingest them and complete the process of digestion intracellularly.

8. Answer: Buccal cavity, crop, gizzard, mid-gut, hepatic caeca, hindgut, are the parts of the alimentary canal of a cockroach.

➢ Long Answer:

1. Answer: The human digestive system has many accessory organs, the tongue, which is located in the buccal cavity is a muscular organ with bony attachments with the floor of the buccal cavity. Tongues are provided with gustatory receptors called taste buds.

   The accessory digestive glands include the salivary glands, the liver and the gall bladder and the pancreas. Humans have three pairs of salivary glands. Parotid glands in the cheek, submandibular and sublingual, opening into the floor of the mouth. The liver is situated in the right upper part of the abdomen. The gall bladder is a small end elongated muscular sac situated below the liver.

   The pancreas is an elongated gland, situated near the junction of the stomach and the duodenum. Both the liver and pancreas act as endocrine and exocrine glands, whereas the gall bladder acts as a storing organ. The duct system of these organs is shown below diagram.

2. Answer: Nutrition: Sum total of certain processes that enable a cell to utilize nutrients is called nutrition.

   The entire process of nutrition includes the following steps: ingestion digestion, absorption, assimilation and egestion.

(a) Ingestion and Digestion: The process of taking in food through the mouth is called ingestion. The digestion of food starts from the mouth and ends in the intestines.

i. Mouth: The food is ingested through the mouth, carbohydrates, such as starch, are broken down or digested to form sugar. The saliva contains the enzyme salivary amylase that helps in the digestion of starch into sugar. The saliva also helps in lubricating the food and making it easier for swallowing. The tongue helps in rolling and pushing food into the oesophagus.

$$\text{Starch} \xrightarrow{\text{Salivary amylase}} \text{Maltose}$$

ii. Oesophagus: TSie oesophagus or the food pipe helps in pushing the food into the stomach. The expansion and contraction of muscles of the oesophagus are called peristalsis or peristaltic movement.

iii. Stomach: The stomach is a highly muscular organ. The gastric glands present in its walls secrete gastric juices and help in the digestion of food. These juices contain hydrochloric acid (HCl) and enzymes like pepsin. HCl created an acidic medium for the activation of enzymes and kills bacteria. These enzymes break down the proteins into smaller fragments called peptones. The muscles of the stomach help in churning the food so that it is properly mixed with the digestive juices.

$$\text{Proteins} \xrightarrow{\text{Pepsin}} \text{Peptones (partly digested proteins)}$$

$$\text{Milk proteins} \xrightarrow{\text{Pepsin}} \text{Calcium Paracareinate}$$

iv. Small intestine: The food moves from the stomach to the duodenum. Here emulsification of fat takes place with the help of the bile juice secreted by the liver. The bile juice is stored in the gall bladder. The pancreas secretes trypsin, amylase and lipase which are poured into the duodenum.

The food moves to the ileum, which is the lower part of the small intestine. The inner surface of the ileum contains thin finger-like projections called villi. Villi are responsible for the absorption of digested food. Blood then carries the absorbed food to a different part of the body and undigested food is pushed into the large intestine.

$$\text{Peptones} \xrightarrow{\text{Trypsin}} \text{Amino acids (completely digested proteins)}$$

$$\text{Maltose and sugars} \xrightarrow{\text{Amylase}} \text{Glucose}$$

$$\text{Fats} \xrightarrow{\text{Lipase}} \text{Fatty acids + Glycerol}$$

v. Large intestine: This part of the body absorbs water from the undigested food and solid waste is lubricated to form the faeces. The faeces pass on to the lower part of the large intestine, called the rectum, and thrown out of the body through the anus.

3. Answer: Starch: Digestion of starch takes place in the mouth. Carbohydrates are broken down or digested to form sugar. The saliva contains an enzyme salivary amylase that helps in the digestion of starch into sugar.

$$\text{Starch} \xrightarrow{\text{Salivary amylase}} \text{Maltose}$$

Proteins: The gastric glands present in the stomach secretes gastric juice which contains (HCI) hydrochloric acid and enzymes like pepsin. These enzymes breakdown the proteins into smaller fragments called peptones. Pepsin

$$\text{Proteins} \xrightarrow{\text{Pepsin}} \text{Peptones (partly digested proteins)}$$

$$\text{Milk proteins} \xrightarrow{\text{Pepsin}} \text{Calcium Paracareinate}$$

Fat: Fat is digested in the duodenum (small intestine) with the help of the bile juice secreted by the liver. The bile juice is stored in the gall bladder. The pancreas secretes trypsin, amylase and lipase which are poured into the duodenum.

$$\text{Peptones} \xrightarrow{\text{Trypsin}} \text{Amino acids (completely digested proteins)}$$

$$\text{Maltose and sugar} \xrightarrow{\text{Amylase}} \text{Glucose}$$

$$\text{Fats} \xrightarrow{\text{Lipase}} \text{Fatty acids} + \text{Glycerol}$$

Assertion Reason Answer-

1. (d) If both Assertion and Reason are false.

   Explanation: Thick layers of muscles are present in the alimentary canal. These muscles facilitate the movement of food particles through alimentary canal. Large food particles are broken down into small, semi liquid particles by the action of these muscles. Later, these help in the forward flow of food materials and mixing of enzymes coming from different glands related to alimentary canal.

2. (b) If both Assertion and Reason are true but Reason is not the correct explanation of Assertion.

   Explanation: Majority of mammals including human beings possess two sets of teeth during their life, a set of permanent or adult teeth. This type of dentition is called diphyodont. Human beings also have thecodont dentition, i.e., teeth are embedded in the sockets of the jaw bones.

Case Study Answer-

1. **Answer:**

a. Salad is a mix of uncooked/ raw fibre rich vegetables and fruits like lettuce, tomato, cucumber, radish, carrot, onion etc..usually seasoned with oil, vinegar etc..

b. Salad provides minerals like calcium, iron, potassium, phosphorus. It is the best source of Vitamins . Fibres help in bowl movement, water retention and prevent constipation.

c. Scientific aptitude and food science applications, besides being caring and hard working.

2. Answer:

a. Severe form of Protein calorie malnutrition (PEM/PCM) in infants, caused due to chronic loss of fat, muscles and other tissue of body.

b. Marasmus is like Kwashiorkor only, but it also includes loss of energy along with protein.

c. Scientific aptitude, keen observer, leader, sympathetic to mankind