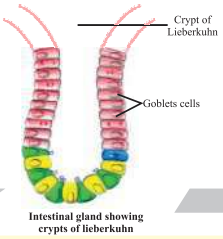


Intestinal gland showing crypts of lieberkuhn

Chapter - 16

Digestion and Absorption

Points To Remember

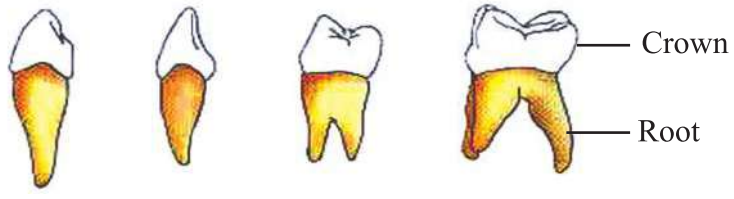
Digestion : The process in alimentary canal by which the complex food is converted mechanically and biochemically into simple substances suitable for absorption and assimilation in the body of animals/organisms.

Food : A substance which is taken and digested in the body to provide material for growth, repair & energy for reproduction and resistance from disease or regulation of body processes.

Thecodont : The teeth embedded in the sockets of the jaw bone, *e.g.,* in mammals.

Diphyodont : The teeth formed twice in life time *e.g.,* in mammals.

Heterodont : Different types of teeth. An adult human has 32 permanent teeth which are of four different types.



Incisor	Canine	Premolar	Molar
(for tearing)	(cutting)	(grinding)	(churning & grinding)

Different Types of Teeth

DENTAL FORMULA OF HYMANS

Milk Teeth		Permanent Teeth
I C PM M.		I C PM M.
$\left[\begin{matrix}2\ 1\ 2\ \ 0\\2\ 1\ 2\ \ 0\end{matrix}\right] \times 2 = \begin{matrix}10\\+\\10\end{matrix} = 20$	Upper half jaw Lower half jaw	$\left[\begin{matrix}2\ 1\ 2\ \ 3\\2\ 1\ 2\ \ 3\end{matrix}\right] \times 2 = \begin{matrix}16\\+\\16\end{matrix} = 32$

Peristalsis : The involuntary movement of the gut by which the food bolus is pushed forward.

Deglutition : The process of swallowing of food bolus. It is partly voluntary and partly involuntary.

Ruminants : The herbivours animals (*e.g.,* cow, buffalo etc.) which have symbiotic bacteria in the rumen of their stomach, which synthesize enzymes to hydrolyse cellulose into monosaccharides.

Diarrhoea : The abnormal frequent discharge of semisolid or fluid faecal matter from the bowel.

Vomiting : The ejection of stomach contents through the mouth, caused by antiperistalsis.

Dysentery : Frequent watery stools often with blood and mucus, along with pain and fever. Loss of water causes dehydration.

Chyme : The semifluid mass, into which food is converted by gastric secretion, which passes from the stomach into the small intestine.

Gastric : Anything associated with stomach is given a prefix 'gastric'.

Proenzyme : The inactive forms of enzymes.

Sphincter : A flap like structure at various junctions of the alimentary canal which facilitates one way traffic (movement of material) in the alimentary canal.

Bolus : The masticated food mixed with saliva.

Hepatic : Anything associated with liver is given a prefix 'hepatic'.

Goblet cells : The cells of intestinal mucosal epithelium which secrete mucus.

Glisson's capsule : The connective tissue sheath which covers the hepatic lobules of liver.

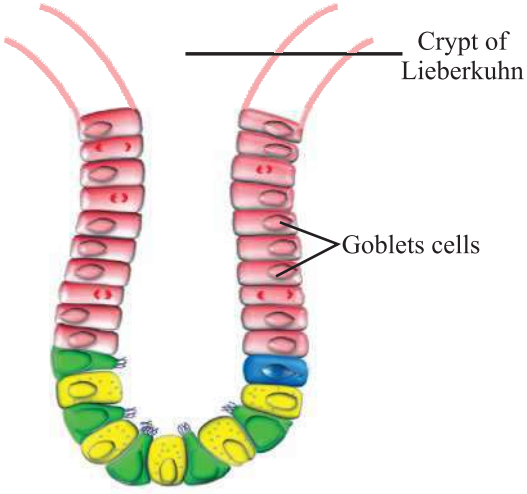
Hepatic lobules : The structural and functional units of liver containing hepatic cells which are arranged in the form of cords.

Sphincter of Oddi : The sphincter which guard the opening of common hepatopancreatic duct.

Villi : The small finger-like folding in the small intestine which increase the surface area for absorption of digested food.

Crypts of Lieberkuhn–pits of intestine/tubular intestinal glands.

Succus entericus—Intestinal juices, secreted in small intestine.



Intestinal gland showing crypts of lieberkuhn

Basic Steps of Holozoic Nutrition :

(1) Ingestion : Intake of food.

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

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

(4) Egestion : Elimination of undigested food as faeces :

Digestive glands : (A) Salivary gland—3 types are (i) Parotids (cheek)

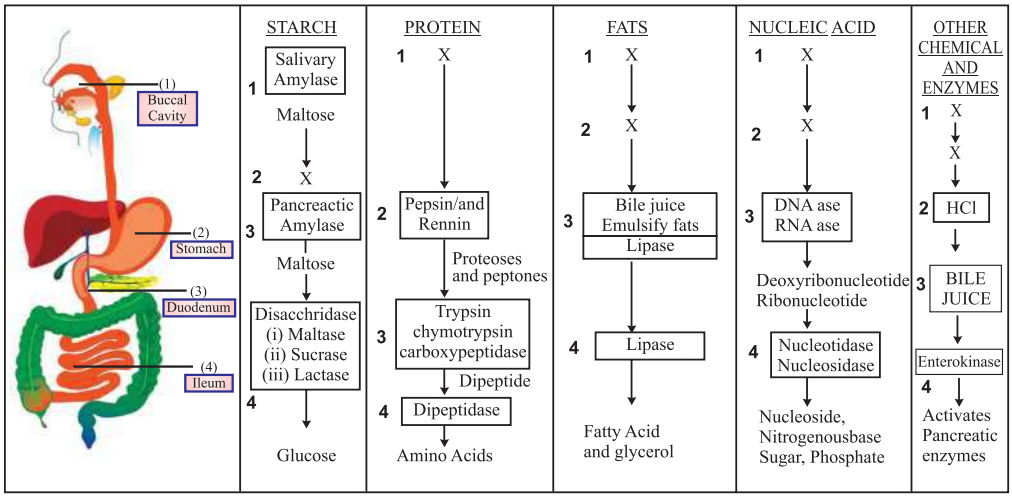
(ii) Sublinguals (Below the tongue) (iii) Submaxillary or submandibular (lower jaw) Secrete saliva which contains ptyalin (Salivary Amylase).

(B) Pancreas : A dual gland that secretes pancreatic juice and also secretes Hormones. Located between limbs of U shaped duodenum.

(C) Liver : In abdominal cavity (1.2–1.5 kg.)

2 lobed → Hepatic lobules → Hepatic cells (arranged as cords) → Secrete bile → Goes to hepatic ducts → bile stored in gall bladder.

COMPLETE PROCESS OF DIGESTION



ABSORPTION OF FATS

- Fatty acids and monoglycerides and Glycerol (insoluble).
- Micelles (tiny spheres with hydrophilic ends) formed.
- Absorbed by epithelial cells of small intestine (simple diffusion)
- They are reformed into very small protein coated fat globules called chylomicrons.
- Chylomicrons transported into lymph vessels (lacteals) in the villi.
- Lymph vessels release the absorbed substances into bloodstream
- **Malnutrition**—When a person is not getting enough food or getting unbalanced diet.

PEM—Protein Energy Malnutrition

Kwashiorkar	Marasmus
The word means 'rejected child'	Word marasmus means wasting away
• It is a disorder found in children 1-5 years of age, where child is weaned off mother's milk very early.	• Child remaining under-nourished suffer from marasmus. Usually found in children below the age of 1 year.
• Children get low protein and low carbohydrate diet are affected.	• It is caused by deficiency of protein & carbohydrate & fat.

DIGESTION AND ABSORPTION					
Part of alimentary canal	Name of glands	Enzymes/ secretion	Substrate	End Products	pH
Buccal cavity	Salivary glands	Salivary amylase	Starch	Maltose	Slightly acidic
oesophagus	–	–	–	–	–
Stomach	Gastric glands (mucosal)	Gastric Juice HCL	Activates pepsinogen	Pepsin	Highly Acidic
		Pepsin	Protein	Peptone	
		Renin (in calves & infants)	caesin (milk protein)	Ca++ & paracaesinate	
		Mucus (protects stomach walls)			
Small intestine. (duodenum)	Liver (through duct)	Bile Juice	Fats	Emulsify fats	Alkaline
	Pancreas (through duct)	Pancreatic Juice			Alkaline
		Trypsin	Proteins	Peptones/ polypeptides	
		Carboxypeptidase	Milk proteins/ peptides	Dipeptides or amino acids	
		Amylase	Starch	Glucose	
		Lipase	Lipids	Fatty acids & Glycerol	
		Nucleases	RNA, DNA	nucleotides	
	Intestinal mucosa	Succus entericus			Alkaline
		Enterokinase	Trypsinogen	Trypsin	
		Dipeptidase	Dipeptides	Amino acids	
		Lipase	Lipids	Fatty acids + Glycerol	
		Maltase/sucrase/ lactase	Maltose/ sucrose/lactose	Glucose/ Fructose/ Galactose	
		Nucleotidase/ Nucleosidase	Nucleotides/ Nucleosides	Nucleoside/free base	
Small Intestine (lleum)	ABSORPTION OF DIGESTED FOOD				
	Passive diffusion	Active Diffusion		Facilitated Diffusion	
	Movement of molecules as per conc. gradient	against concen. gradient		Diffusion of some ions and polar molecules	
	No ATP utilised	ATP used		membrane proteins required	
	glucose, amino acids, chloride ions	amioacids, glucose, sodium		Fructose and some amino acids	

Symptoms

Kwashiorkar	Marasmus
1. Stunted growth	1. Low body weight
2. Dry & scaly skin	2. Wasting of muscles
3. Odema (retention of water in tissues)	3. Prominent ribs
4. Match stick legs	4. Sunken eyes
5. Protrude Belly	5. Lean body with thin limbs
	6. Mental retardation

Cure

Feeding the child with protein rich diet including milk, soyabean, egg etc.	Child should be given protein diet with enough quantity of carbohydrates & fats.

Calorific Value : Amount of heat energy released by 1 gm of substrate after complete oxidation.

Calorific value of Carbohydrates is 4.1 k.cal/g = 17.1 kj/g

Protein is 5.6 kcal/g = 23.4 kj/gm

Fats is 9.4 kcal/g (app.) = 39.2 kj/gm

Questions

(SRT) Select Response Type Question (1 mark each)

1. The hardest substance in the body is:
   (a) Keratin (b) Enamel
   (c) Collagen (d) Fibrin
2. Choose the correct option for lacteal and its function
   (a) Lymph vessel of villi, absorption of protein
   (b) Lymph vessel of stomach of protein
   (c) Lymph vessel of villi, absorption of vitamin
   (d) Lymph vessel of villi, absorption of fats
3. Smallest projection of tongue is:

(a) Goblet cells
(b) Serosa
(c) Papillae
(d) Appendix

Very Short Answer Questions (1 mark each)

4. Mention the function of epiglottis.
5. Write the names of major parts of stomach.
6. Name the enzyme that digest fats. Mention the end products of fat digestion.
7. In which part of alimentary canal absorption of water, simple sugars and takes place ?
8. Why are proteases generally released in inactive form ?
9. Trypsinogen is an inactive enzyme of pancreatic juice. An enzyme, enterokinase, activates it. Which tissue/cell secrete this enzyme ? How is it activated ?
10. What is the role of insulin ?
11. Name any one country where children affected from PEM are found more.

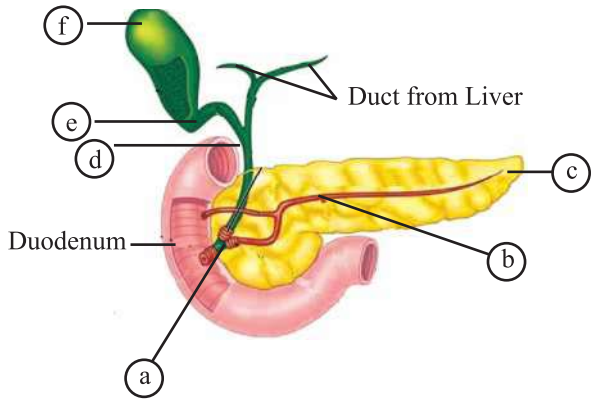
CONSTRUCTED RESPONSE TYPE (CRT)

Short Answer Questions-I (2 marks each)

12. What is emulsification ? Where and how does it occur ?
13. Name three parts of large intestine. Which vestigial organ arises from the first part of it ?
14. Name the digestive gland which acts as both exocrine and endocrine. Also name the products which are secreted by it.
15. The wall of alimentary canal is made up of four layers. Give the names of these four layers.
16. Hydrochloric acid is found in our stomach. What purpose does it serve in alimentary canal ?
17. In which part of the digestive system the absorption of following substances takes place ?
    (a) Certain drugs
    (b) Glucose, fructose and fatty acids
    (c) Water, some minerals and drugs
    (d) Simple sugar and alcohol
18. Differentiate between chylomicron and micelles.

Short Answer Question-II (3 mark each)

19. In the following diagram of duct system of liver, gallbladder and pancreas, label a, b, c, d, e and f :



20. Give a diagrammatic representation of transverse section of gut.
21. Draw the sketch of anatomical regions of human stomach and label any four parts in it.
22. How does the nervous system control the activities of gastro-intestinal tract ?

Long Answer Question (5 marks each)

23. Draw a labelled figure of digestive system of human.
24. Give a summary of cause and symptoms of following disorders of digestive system :
    (a) Jaundice
    (b) Vomiting
    (c) Diarrhoea
    (d) Constipation
    (e) Indigestion

Answers

(SRT) Select Response Type Question (1 mark each)

1. (b) Enamel
2. (d) Lymph vessel of villi, absorption of fats
3. (c) Papillae, Some Papillae have taste buds.

CONSTRUCTED RESPONSE TYPE (CRT)

Very Short Answer (1 mark each)

4. Prevent the entry of food into the glottis.
5. Cardiac, fundic, pyloric.
6. Lipase, fatty acids and glycerol.
7. Large intestine, small intestine and stomach respectively.
8. If released in active form, without the presence of food they will start digesting the membranes and muscular walls of the alimentary canal.
9. Intestinal Mucosa.

$$\underset{\text{(In active)}}{\text{Trypsinogen}} \xrightarrow{\text{Enterokinase}} \underset{\text{(Active)}}{\text{Trypsin}} \rightarrow \text{Proteins} \rightarrow \text{Peptides}$$

10. Metabolism of sugar.
11. African countries– Somalia & others.

Short Answer Questions–I (2 marks each)

12. The process of breakdown of large fat droplets into smaller ones. It occurs in duodenum of small intestine. It is brought about by bile salts through reduction of surface tension of large fat droplets.
13. Caecum, colon and rectum. Vermiform appendix.
14. Pancreas. Exocrine secretion is pancreatic juice containing enzymes and endocrine secretions are hormones : Insulin and glucagon.
15. Serosa, muscularis, submucosa and mucosa.
16. (i) Killing of germs present in food
    (ii) Conversion of inactive pepsinogen into active form pepsin.
17. (a) Mouth & large intestine (b) Small intestine
    (c) Large intestine
    (d) Stomach
18.

Chylomicron	Micelles
1. Protein coated water soluble fat droplets released into the lymph.	Formed by combination of fatty acid, monoglycerides and bile salts.
2. In this form fats lipids are put into circulation	In this form digested fats are absorbed in intestinal cells in alimentary canal.

Short Answers Questions–II (3 marks each)

19. NCERT Text Book, XI Biology.
20. NCERT Text Book, XI Biology.
21. NCERT Text Book, XI Biology.
22. (a) Sight/smell of food → secretion of saliva.
    (b) Neural signal → gastric intestinal secretion.
    (c) CNS and local control over muscular movement.

Long Answers (5 marks each)

23. NCERT Text Book, Class XI Biology.
24. NCERT Text Book, Class XI Biology.

Case-based/Value based questions :

26. When I do not sleep... then the metabolic activities of my body get affected badly. Various food components once ingested, voluntarily by me are passed on to my oesophagus. This proces now is an involuntary action which is now called peristalsis. My stomach works hard to grind the food which was chewed up by my mouth, it also secretes HCl to make surroundings acidic, so as to help in protein digestion. My liver gets filled up by the toxicity from the proteins (ammonia), which were completely digested in the small intestine. My hard working liver also converts fats into an energy source for the body. My intestines look forward to the much-needed rest they need, after their villi have absorbed the final products of digestion and passed it over to my blood. My pancreas screams for help as the Insulin secreted by it, unable to control the increase of the glucose in my blood.. My brain starts getting electrocuted by constantly responding to the huge variety of stimuli being fed into my system continuously... thus increasing my stress. So dear eyes close yourself on time and sleep peacefully. This much needed sleep on time, provides the much-needed rejuvenation to the metabolism of our body!

1. What is the end product of the digestion of proteins in the intestines, which is passed on to the blood?
   (a) Monosaccharides (b) Amino acids
   (c) Fatty acids (d) Nucleosides
2. Define metabolism.
   (a) Sum total of catabolic processes

(b) Sum total of anabolic processes
(c) Sum total of catabolic and anabolic processes.
(d) None of the above

3. Which hormone is secreted by the pancreas?
   (a) Salivary amylase
   (b) Insulin
   (c) Glucagon
   (d) Insulin and glucagon
4. Why sleeping on time is essential for the body?
   (a) To have a perfect circadian rhythm
   (b) To rejuvenate metabolism
   (c) To pass time
   (d) Both (a) & (b)

Assertion reasoning questions: Select Response Type-II Question (1 Mark each)

DIRECTIONS, a statement of assertion (A) is followed by a statement of the reason (R). Mark the correct choice as :

(a) If both (A) and (R) are correct and (R) is the correct explanation of (A)
(b) If both (A) and (R) true, but (R) is not the correct explanation of (A)
(c) If (A) is true but (R) is false
(d) If both (A) and (R) are false

27. **Assertion :** The innermost layer lining the lumen of the small intestine is mucosa and is called villi.
    Reason : It increases the surface area of the small intestine.
28. **Assertion :** The teeth help in the mastication of food.
    Reason : The hard chewing surface of the teeth is made up of enamel.

Solutions :

26. 1. (b)
    2. (c)
    3. (d)
    4. (d)
27. (a)
28. (a)