HSSLIVE.IN

DIGESTION AND ABSORPTION

Introduction

- Food is one of the basic requirements of all living organisms.
- The major components of our food are **carbohydrates, proteins and fats**.
- **Vitamins and minerals** are also required in **small quantities.**
- Food provides energy and organic materials for growth and repair of tissues.
- The water we take in, plays an important role in metabolic processes and also prevents dehydration of the body.
- **Biomacromolecules** in food cannot be utilized by our body in their original form. They have to be broken down and converted into simple substances in the digestive system.
- The process of conversion of complex food substances to simple absorbable forms is called **digestion** and is carried out by our digestive system by mechanical and biochemical methods.

DIGESTIVE SYSTEM

- The human digestive system consists of the
  a)alimentary canal/Gut
  b) digestive glands

a)Alimentary canal

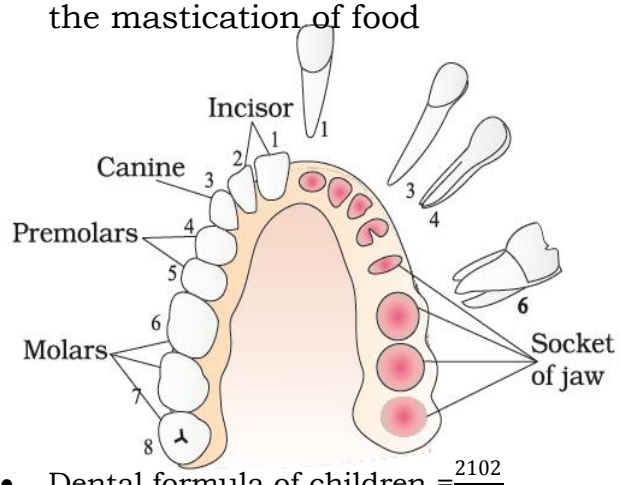
It is a long tube starting from mouth and ends in anus. The main parts of alimentary canal include Mouth, oral cavity, pharynx, Oesophagus, stomach, small intestine,large intestine.

Mouth and Oral cavity

- Mouth is a small slit like opening located between two lips.
- The mouth leads to the buccal cavity or oral cavity.
- The oral cavity has a number of **teeth** and a muscular **Tongue**.

Teeth

- **Thecodont**: Each tooth is embedded in a socket of jaw bone. This type of attachment is called **thecodont**.
- **Diphyodont :** Majority of mammals including human being forms two sets of teeth during their life, a set of **temporary** milk or deciduous teeth replaced by a set of **permanent or adult teeth**. This type of dentition is called **diphyodont**.
- **Heterodont :** An adult human has 32 permanent teeth which are of four different types (**Heterodont dentition**), namely,
  - Incisors (I),
  - Canine (C),
  - Premolars (PM)
  - Molars (M).
- **Dental formula :** Arrangement of teeth in each half of the upper and lower jaw in the order I, C, PM, M is represented by a dental formula which in human is $\frac{2123}{2123}$
- The hard chewing surface of the teeth, made up of **enamel**, helps in the mastication of food



- Dental formula of children $=\frac{2102}{2102}$

Tongue

- The tongue is a freely movable muscular organ attached to the floor of the oral cavity by the **frenulum**.
- The upper surface of the tongue has small projections called **papillae**, some of which bear **taste buds**.
- The oral cavity leads into a short pharynx

Pharynx.

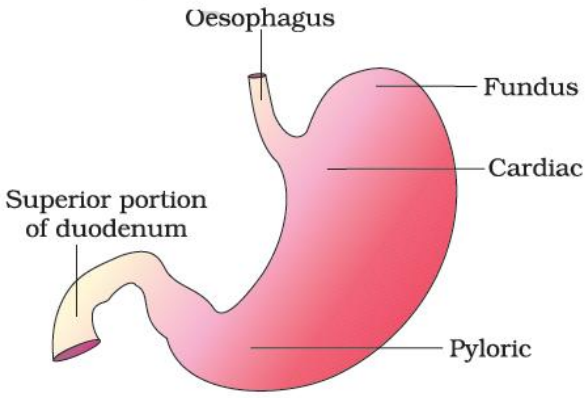
- Pharynx act as the common passage for **both food and air**.
- The oesophagus and the trachea (wind pipe) open into the pharynx.
- A cartilaginous flap called epiglottis prevents the entry of food into the glottis – opening of the wind pipe – during swallowing

Oesophagus

The oesophagus is a thin, long tube which extends posteriorly passing through the neck, thorax and diaphragm and leads to a **'J' shaped bag** like structure called stomach. A muscular sphincter (**gastro-oesophageal**) regulates the opening of oesophagus into the stomach

Stomach

- The stomach, located in the upper left portion of the abdominal cavity,
- It has three major parts –
  - **A cardiac** portion into which the oesophagus opens,
  - **A fundic** region and
  - **A pyloric** portion which opens into the first part of small intestine.
- The opening of the stomach into the duodenum is guarded by the **pyloric sphincter**
- The stomach stores the food about **4-5 hours**.

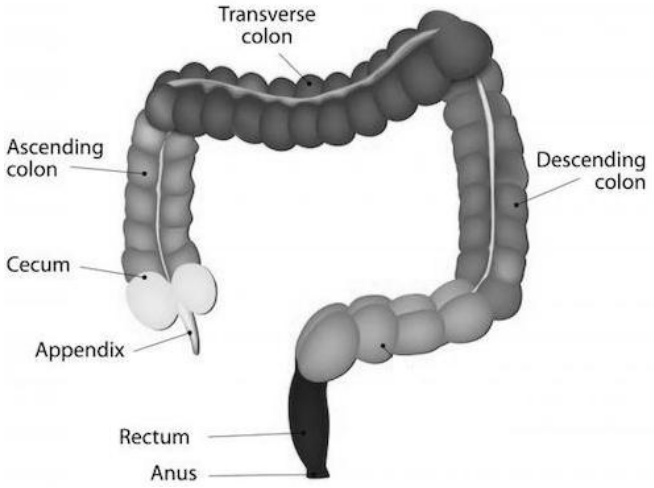


Small Intestine

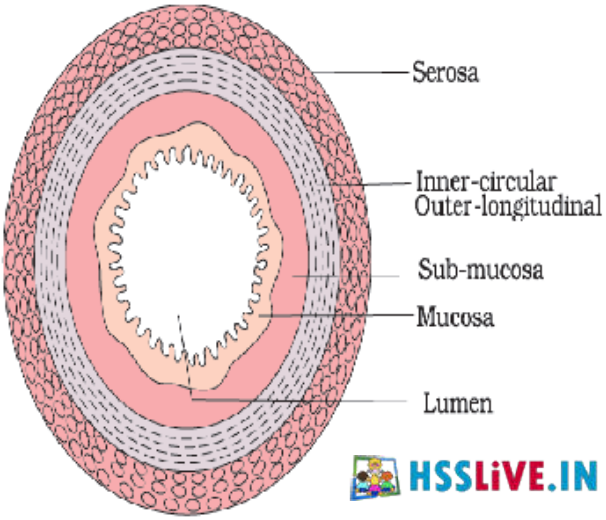
- Small intestine is distinguishable into three regions,
  - a **'C' shaped duodenum**,
  - a long coiled middle portion **jejunum** and
  - a highly coiled **ileum**.
- Ileum opens into the large intestine through **ileo-caecal valve.**

Large Intestine

- It consists of
  - **caecum,**
  - **colon**
  - **rectum**.
- Caecum is a **small blind** sac which hosts some symbiotic micro-organisms.
- A narrow finger-like tubular projection, the vermiform appendix which is a vestigial organ, arises from the caecum.
- The caecum opens into the colon. The colon is divided into three parts – an ascending, a transverse and a descending part.
- The descending part opens into the rectum which opens out through the anus



Transverse section of human Gut



The wall of alimentary canal from oesophagus to rectum possesses four layers namely **serosa, muscularis, sub-mucosa and mucosa**.

a) Serosa :

- It is the outermost layer
- It is made up of a thin **mesothelium** (epithelium of visceral organs) with some connective tissues.

b)Muscularis:

- it is formed by **smooth muscles** usually arranged into an **inner circular and an outer longitudinal layer**.
- An oblique muscle layer may be present in some regions.

c) sub mucosal layer :

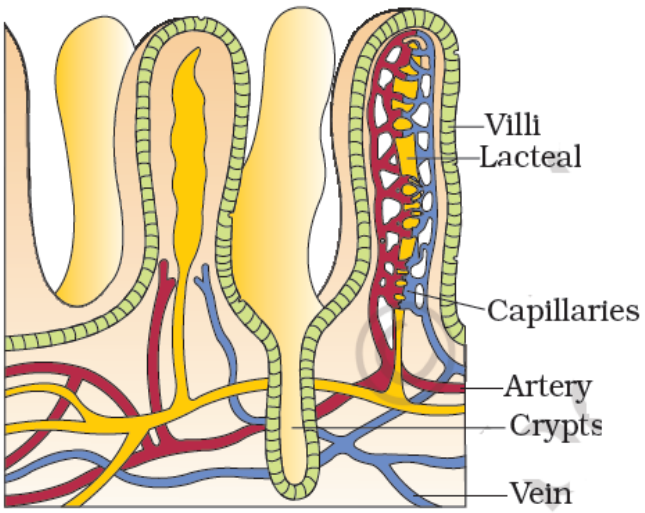
- it is formed of **loose connective tissues**
- It also contains nerves, blood and lymph vessels.
- In duodenum, glands are also present in sub-mucosa (brunner's gland).

d) mucosa layer :

- The innermost layer lining the lumen of the alimentary canal is the mucosa.
- This layer forms irregular folds in the stomach called **gastric rugae**.
- Mucosa layer also forms small finger-like foldings called **villi** in the small intestine.
- Mucosa forms glands in the stomach (gastric glands) and crypts in between the bases of villi in the intestine (crypts of Lieberkuhn).
- Mucosal epithelium has goblet cells which secrete mucus that help in lubrication of food while passing through gut.

Structure Of Villus

- Villuses are small finger like folding of intestine.
- The cells lining the villi produce numerous microscopic projections called **microvilli** giving a brush border appearance.
- These modifications increase the surface area enormously for the absorption of food.
- Villi are supplied with a network of capillaries and a large lymph vessel called the lacteal.



A section of small intestinal mucosa showing villi

b)Digestive glands

The digestive glands associated with the alimentary canal include the salivary glands, Gastric gland, the liver and the pancreas.

i) Salivary gland

- Saliva is mainly produced by three pairs of salivary glands,
  - ✓ the parotid gland (cheek),
  - ✓ the sub-maxillary/ sub-mandibular (lower jaw)
  - ✓ sublinguals gland(below the tongue).
- These glands situated just outside the buccal cavity secrete salivary juice into the buccal cavity.
- The saliva secreted into the oral cavity contains
  - ✓ electrolytes like Na+,K+,Cl-,HCO3-
  - ✓ enzymes-salivary amylase and lysozyme.
  - ✓ **Lysozyme** present in saliva acts as an **antibacterial agent** that prevents infections.
  - ✓ **Mucus** in saliva **helps in lubricating and adhering the** masticated food particles into a bolus

ii)Gastric gland

The mucosa of stomach has gastric glands. Gastric glands have three major types of cells namely -

(i) mucus neck cells which secrete mucus;

(ii) peptic or chief cells which secrete the proenzyme pepsinogen, Lipase and Pro Rennin

(iii) parietal or oxyntic cells which secrete HCl and intrinsic factor (factor essential for absorption of **vitaminB12**).

- The mucus and bicarbonates present in the gastric juice play an important role in lubrication and protection of the mucosal epithelium from excoriation by the highly concentrated hydrochloric acid.

iii)Liver

- ✓ Liver is the **largest gland** of the body weighing about **1.2 to 1.5 kg** in an adult human.
- ✓ It is situated in the abdominal cavity, just below the diaphragm
- ✓ it has two lobes.
- ✓ The hepatic lobules are the structural and functional units of liver containing hepatic cells arranged in the form of cords.
- ✓ Each lobule is covered by a thin connective tissue sheath called the **Glisson's capsule**.
- ✓ The bile secreted by the hepatic cells passes through the hepatic ducts and is stored and concentrated in a thin muscular sac called the gall bladder.
- ✓ The duct of gall bladder called cystic duct along with the hepatic

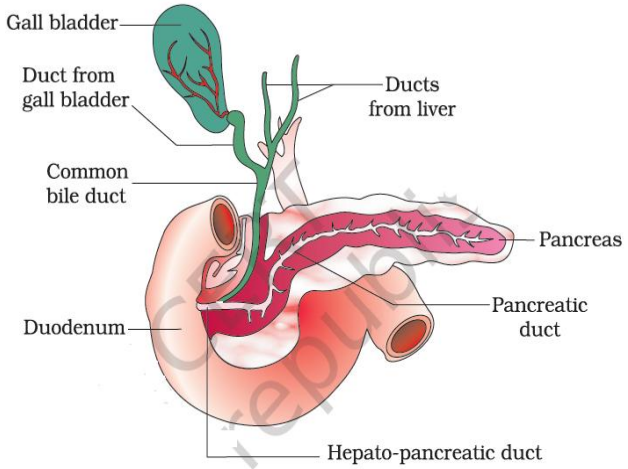
duct from the liver forms the common bile duct.

✓ The bile duct and the pancreatic duct open together into the duodenum as the common hepato-pancreatic duct which is guarded by a sphincter called the **sphincter of Oddi**

✓ The bile released into the duodenum contains

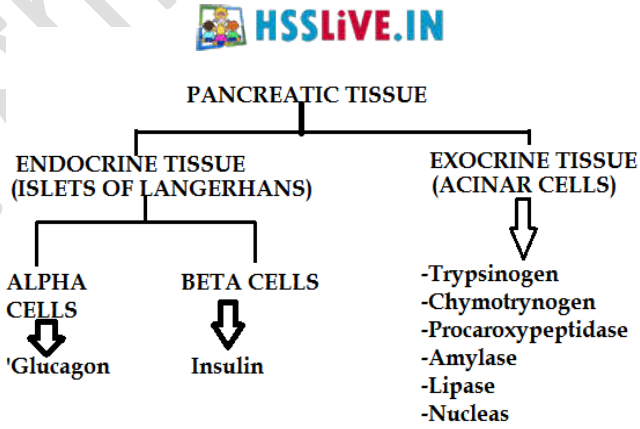
- Bile pigments (bilirubin and bili-verdin),
- Bile salts,
- Cholesterol
- Phospholipids
- But no enzymes.

The main function of bile is i)**emulsification of fats,** i.e., breaking down of the fats into very small micelles.
ii)Bile also **activates lipases.**



iv)Pancreas

- The pancreas is a compound or mixed gland or heterocrine gland (both exocrine and endocrine) elongated organ situated between the limbs of the 'U' shaped duodenum.
- The exocrine portion (Acinar cells)secretes an alkaline pancreatic juice containing enzymes and the endocrine portion(Islets of langerhans) secretes hormones, insulin and glucagon.
- Pancreatic juice and bile are released through the hepato-pancreatic duct.
- The pancreatic juice contains inactive enzymes –
  - **Trypsinogen**
  - **Chymotrypsinogen,**
  - **Procarboxypeptidases,**
  - **Amylases,**
  - **Lipases and**
  - **Nucleases.**



v) Intestinal gland

- These are simple microscopic digestive gland present in the mucosa of intestine.
- The intestinal glands secrete intestinal juice.
- The intestinal mucosal epithelium has goblet cells which secrete mucus.
- The secretions of the brush border cells of the mucosa alongwith the secretions of the goblet cells constitute the intestinal juice or **succus entericus**.

- This juice contains a variety of enzymes like disaccharidases (e.g., maltase), dipeptidases, lipases, nucleosidases, etc.

Digestion of food

The process of **converting complex food material in to simpler asorable form is called digestion**. It is taking place in the alimentary canal.There are two types of digestion namely mechanical and chemcial digestion.

Digestion in the mouth

- The buccal cavity performs two major functions, **mastication of food and facilitation of swallowing**.
- The teeth and the tongue with the help of saliva masticate and mix up the food thoroughly.
- Mucus in saliva helps in lubricating and adhering the masticated food particles into **a bolus**.
- The chemical process of digestion is initiated in the oral cavity by the hydrolytic action of the carbohydrate splitting enzyme, **the salivary amylase**.
- About **30 %** of starch is hydrolysed here by this enzyme (optimum pH 6.8) into a disaccharide – maltose.

$$\text{Starch} \xrightarrow[\text{pH 6.8}]{\text{Salivary Amylase}} \text{Maltose}$$

- Then the bolus is then conveyed into the pharynx and then into the oesophagus by swallowing or deglutition.
- The bolus further passes down through the oesophagus by successive waves of muscular contractions called peristalsis.

- The **gastro-oesophageal sphincter** controls the passage of food into the stomach

Digestion in the stomach

- The stomach stores the food for **4-5 hours**.
- The food mixes thoroughly with the acidic gastric juice of the stomach by the **churning movements** of its muscular wall and is called the **chyme**.

- The proenzyme **pepsinogen, on exposure to hydrochloric acid gets converted into the active enzyme pepsin.**
- HCl provides the acidic pH (pH 1.8) optimal for pepsins

$$\text{pepsinogen} \xrightarrow[\text{pH=1.8}]{\text{HCl}} \text{Pepsin}$$

- Pepsin is the proteolytic enzyme of the stomach. Pepsin converts proteins into **proteoses and peptones (peptides).**

$$\text{Protein} \xrightarrow{\text{Pepsin}} \text{Proteoses+Peptones}$$

- Rennin is a proteolytic enzyme found in gastric juice of infants which helps in the digestion of milk proteins.
- Small amounts of **lipases** are also secreted by gastric glands

Function of HCl in the stomach

1. Conversion of inactive pepsinogen into pepsin
2. Killing the pathogens in the food
3. Stoppage of action salivary amylase

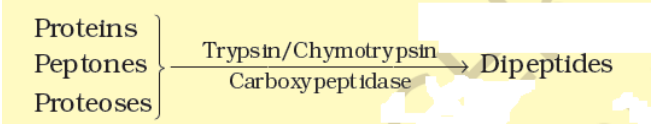
- After the about 4-5 hours the food enter into the first part of the small intestine called duodenum.

- A muscular sphincter (**gastro-oesophageal**) regulates the opening of oesophagus into the stomach

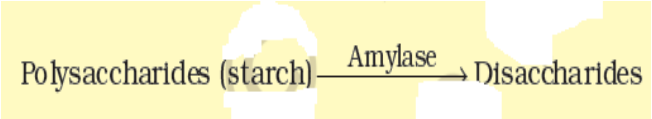
Digestion in the small Intestine

Various types of movements are generated by the muscularis layer of the small intestine. These movements help in a thorough mixing up of the food with various secretions in the intestine and thereby facilitate digestion.

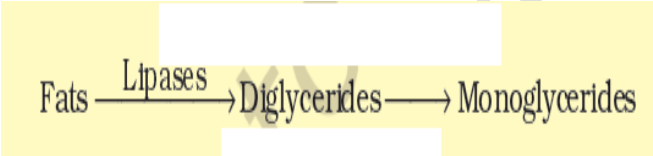
- The bile, pancreatic juice and the intestinal juice are the secretions released into the small intestine.
- Pancreatic juice and bile are released through the hepato-pancreatic duct.
- The pancreatic juice contains inactive enzymes – **trypsinogen, chymotrypsinogen,procarboxypeptidases, amylases, lipases and nucleases.**
- Trypsinogen is activated by an enzyme, **enterokinase, secreted by the intestinal mucosa** into active **trypsin**, which in turn activates the other enzymes in the pancreatic juice.
- Proteins, proteoses and peptones (partially hydrolysed proteins-they are formed as a result of the digestion by the enzyme pepsin in the stomach) in the chyme reaching the intestine are acted upon by the **proteolytic enzymes of pancreatic juice** as given below:



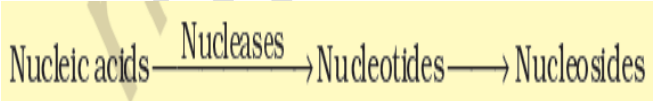
Carbohydrates in the chyme are hydrolysed by pancreatic amylase into disaccharides.



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



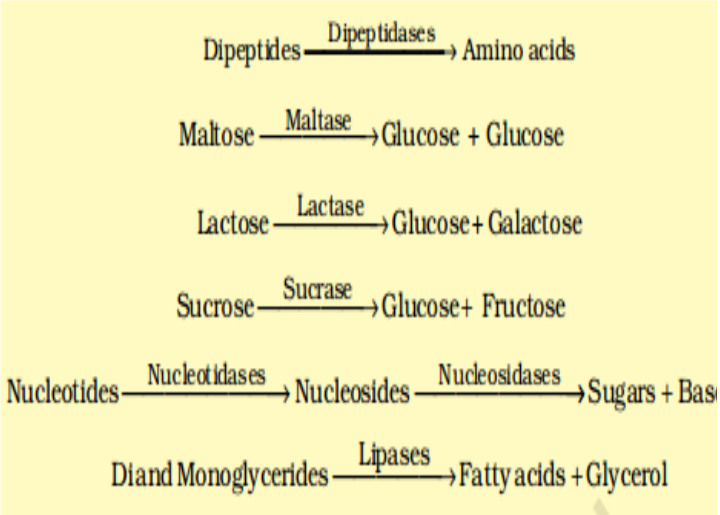
Nucleases in the pancreatic juice acts on nucleic acids to form nucleotides and nucleosides



The bile released into the duodenum contains bile pigments (bilirubin and bili-verdin), bile salts, cholesterol and phospholipids but no enzymes. Bile helps in **emulsification of fats,** i.e., breaking down of the fats into very small micelles. Bile also activates lipases.

The intestinal mucosal epithelium has goblet cells which secrete mucus. The secretions of the brush border cells of the mucosa alongwith the secretions of the goblet cells constitute the intestinal juice or succus entericus. This juice contains a variety of enzymes like disaccharidases (e.g., maltase), dipeptidases, lipases, nucleosidases, etc. The mucus alongwith the bicarbonates from the pancreas protects the intestinal mucosa from acid as well as provide an alkaline medium (pH 7.8) for enzymatic activities. Sub-mucosal glands (Brunner's glands) also help in this.

The enzymes in the succus entericus act on the end products of the above reactions to form the respective simple absorbable forms. These final steps in digestion occur very close to the mucosal epithelial cells of the intestine.



The breakdown of biomacromolecules mentioned above occurs in the **duodenum** region of the small intestine. The simple substances thus formed are **absorbed** in the **jejunum and ileum** regions of the small intestine. The undigested and unabsorbed substances are passed on to the large intestine

Digestion in the Large intestine

No significant digestive activity occurs in the large intestine. The functions of large intestine are:

i) absorption of some water, minerals and certain drugs;
ii) secretion of mucus which helps in adhering the waste (undigested) particles together and lubricating it for an easy passage.

- The undigested, unabsorbed substances called faeces enters into the caecum of the large intestine through **ileo-caecal valve**, which prevents the **back flow of the faecal** matter. **It is temporarily stored in the rectum till defaecation**

Regulation of digestion

- The activities of the gastro-intestinal tract are under neural and hormonal control for proper coordination of different parts.
- The sight, smell and/or the presence of food in the oral cavity can stimulate the secretion of saliva.
- Gastric and intestinal secretions are also, similarly, stimulated by neural signals.
- The muscular activities of different parts of the alimentary canal can also be moderated by neural mechanisms, both local and through CNS.
- Hormonal control of the secretion of digestive juices is carried out by local hormones produced by the gastric and intestinal mucosa

Gastro intestinal hormones

- Endocrine cells present in different parts of the gastro-intestinal tract secrete four major peptide hormones, namely
  - **gastrin,**
  - **secretin**,
  - **cholecystokinin (CCK)**
  - **gastric inhibitory peptide (GIP).**

Gastrin: it acts on the gastric glands and stimulates the secretion of hydrochloric acid and pepsinogen.

Secretin: it acts on the exocrine pancreas and stimulates secretion of water and bicarbonate ions.

CCK : it acts on both pancreas and gall bladder and stimulates the secretion of pancreatic enzymes and bile juice, respectively.

GIP: it inhibits gastric secretion and motility

ABSORPTION OF DIGESTED PRODUCTS

Absorption is the process by which the end products of digestion pass through the intestinal mucosa into the blood or lymph. It is carried out by passive, active or facilitated transport mechanisms.

- Small amounts of monosaccharides like glucose, amino acids and some electrolytes like chloride ions are generally absorbed by simple diffusion. The passage of these substances into the blood depends upon the concentration gradients.
- Some substances like glucose and amino acids are absorbed with the help of carrier proteins. This mechanism is called the facilitated transport.
- Transport of water depends upon the osmotic gradient.
- Active transport occurs against the concentration gradient and hence requires energy. Various nutrients like amino acids, monosaccharides like glucose, electrolytes like Na+ are absorbed into the blood by this mechanism.

ABSORPTION OF FAT

- Fatty acids and glycerol being insoluble, cannot be absorbed into the blood.
- They are first incorporated into small droplets called **micelles** which move into the intestinal mucosa.
- They are re-formed into very small protein coated fat globules called the **chylomicrons** which are transported into the lymph vessels (lacteals) in the villi.
- These lymph vessels ultimately release the absorbed substances into the blood stream.

Absorption of substances takes place in different parts of the alimentary canal, like mouth, stomach, small intestine and large intestine. However, maximum absorption occurs in the small intestine

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.

Assimilation

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

Elimination

The digestive wastes, solidified into coherent faeces in the rectum initiate a neural reflex causing an urge or desire for its removal. The egestion of faeces to the outside through the

anal opening (**defaecation**) is a voluntary process and is carried out by a mass peristaltic movement.

CALORIFIC VALUE

- Heat is the ultimate form of all energies.SoThe energy requirements of animals, and the energy content of food, are expressed in terms of measure of heat energy. This is often measured to as calorie (cal) or joule (J),
- One calorie or one Joule is the amount of heat energy required to raise the temperature of 1 g of water by 1 °C.
- One kilo calorie is the amount of energy required to raise the temperature of 1 kg of water by 1 °C.
- Nutritionists, traditionally refer to kcal as the Calorie or Joule (always capitalised).
- The amount of heat liberated from complete combustion of 1 g food in a **bomb calorimeter** (a closed metal chamber filled with O_2) is its **gross calorific or gross energy value.**
- The actual amount of energy combustion of 1g of food is the **physiologic value of food**.

Nutrient	Gross calorific value	Physiologic value
Carbohydrate	4.1 kcal/g	4.0 kcal/g,
Protein	5.65 kcal/g	4.0 kcal/g
Fat	9.45kcal/g,	9.0 kcal/g,

DISORDERS OF DIGESTIVE SYSTEM

- The inflammation of the intestinal tract is the most common ailment due to bacterial or viral infections. The infections are also caused by the parasites of the intestine like tapeworm, roundworm, threadworm, hookworm, pin worm, etc.

1. **Jaundice:**
   The **liver** is affected, skin and eyes turn yellow due to the deposit of bile pigments.
2. **Vomiting:**
   It is the ejection of stomach contents through the mouth. This reflex action is controlled by the vomit centre in the **medulla**. A feeling of nausea precedes vomiting.
3. **Diarrhoea:**
   The abnormal frequency of bowel movement and increased liquidity of the faecal discharge is known as diarrhoea. It reduces the absorption of food.
4. **Constipation:**
   In constipation, the faeces are retained within the rectum as the bowel movements occur irregularly.

5. **Indigestion:**
   In this condition, the food is not properly digested leading to a feeling of fullness. The causes of indigestion are inadequate enzyme secretion, anxiety, food poisoning, over eating, and spicy food.

6. Protein-energy malnutrition (PEM)

- Dietary deficiencies of proteins and total food calories are widespread in many underdeveloped countries of South and South-east Asia, South America, and West and Central Africa.
- Protein-energy malnutrition (PEM) may affect large sections of the population during drought, famine and political turmoil. This happened in Bangladesh during the liberation war and in Ethiopia during the severe drought in mid-eighties.
- **PEM affects infants and children to produce Marasmus and Kwashiorkar.**

a)MARASMUS

- ✓ Marasmus is produced by a **simultaneous deficiency of proteins and calories.**
- ✓ It is found in **infants less than a year in age**,
- ✓ This disorder is due to Replacement of mother's milk too early by other foods which are poor in both proteins and caloric value.
- ✓ This often happens if the mother has second pregnancy or childbirth when the older infant is still too young.

Symptoms

- ✓ Protein deficiency impairs growth and replacement of tissue proteins;
- ✓ Extreme emaciation of the body and thinning of limbs results,
- ✓ the skin becomes dry, thin and wrinkled.
- ✓ Growth rate and body weight decline considerably.
- ✓ growth and development of brain and mental faculties are impaired.

b)Kwashiorkar

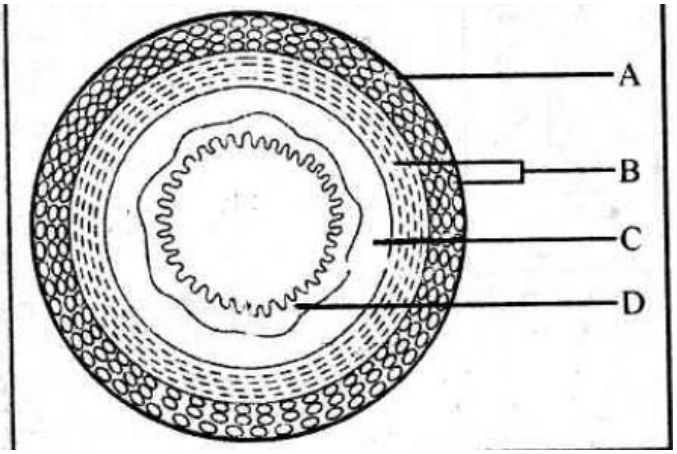
- ✓ It is produced by **protein deficiency unaccompanied by calorie deficiency**.
- ✓ It results from the replacement of mother's milk by **a high calorie low protein diet** in a child **more than one year** in age.

Symptoms

- ✓ Easting of muscles,
- ✓ Thinning of limbs,
- ✓ Failure of growth
- ✓ Brain development.
- ✓ Unlike marasmus, some fat is still left under the skin;
- ✓ Extensive oedema and swelling of body parts are seen.

Previous years question paper

1. Observe the diagram of transverse section of human gut : (HSE-July-2019)(2)



a)Label A,B,C and D

b) Write any two structural modifications of mucosa at different parts of gut'

2. a) Name the following : (HSE-March-2019)(2)

i) The carbohydrate splitting enzyme present in human saliva.

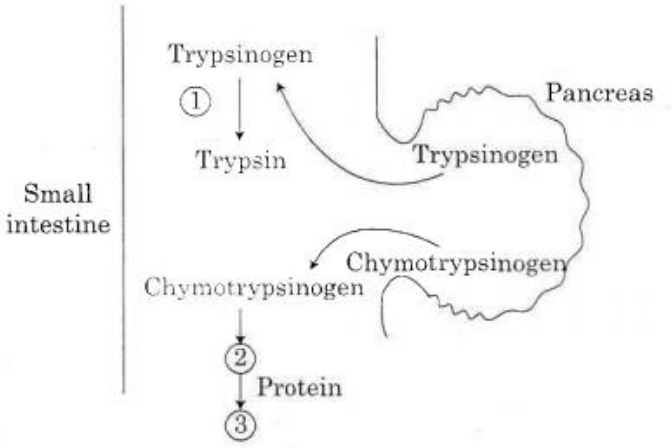
ii) The anti bacterial enzyme present in human saliva.

b) In which region of the alimentary canal does the following reaction occur?

i) Proteins, Peptones, Proteoses $\xrightarrow[\text{Carboxypeptidase}]{\text{Trypsin / Chymotrypsin}}$ Dipeptides

ii) Proteins $\xrightarrow{\text{Pepsin}}$ Proteoses + Peptones

The following diagram shows the action of protein digesting enzymes of Pancreas.



(HSE-Model-2019)(2)

3. (a) Label the number 1. 2 and 3.
   (b)Endocrine part of pancreas is known as .....
4. Give one word for the following.
   a) Presence of 2 sets of teeth in the life time. (HSE-Aug-2018)(2)
   b) Teeth are present in socket of Jaw bone
5. Name the following (HSE-March-2018)(2)
   a) The antibacterial enzyme present in the saliva of man which helps in prevention of infection.
   b) The digestive enzyme present in saliva.
6. Protein digestion by proteolytic enzymes is given below (HSE-March-2018)(3)

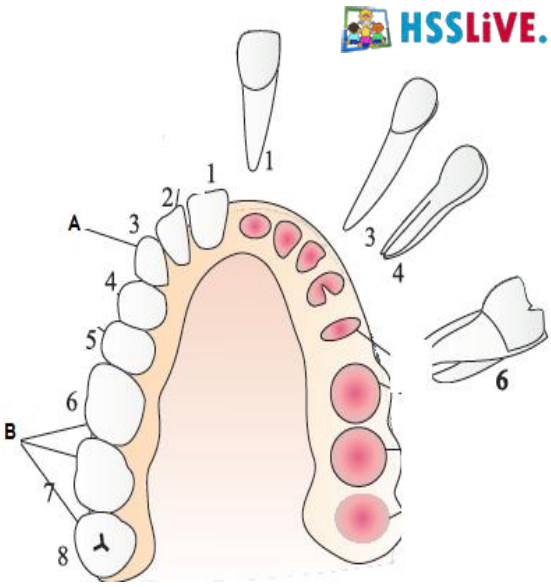
Proteins, Peptones, Proteoses $\xrightarrow[\text{Enzyme 'B'}]{\text{Trypsin/Enzyme 'A'}}$ Dipeptides

a) Name the enzymes marked as A and B
b) identify the gland which , secrete these enzymes.
c) Write the inactive form of the enzymes A and B

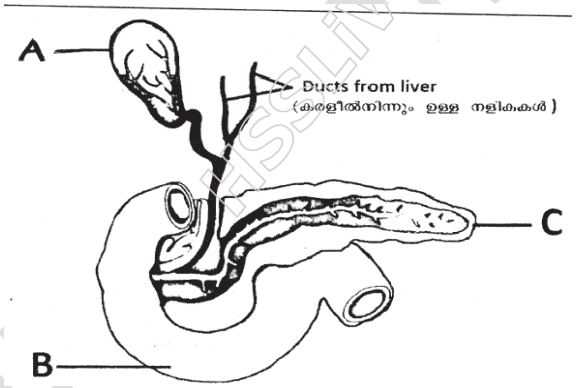
7. Certain indicators regarding the layers in the wall of alimentary canal are given. Name the layer against the indicator (HSE-Model-2018)(2)
   a)Formed of loose connective tissue containing nerves and blood vessels
   b)Inner most lining forms the ruge in the stomach
   c)Formed by smooth muscles
   d)Outermost layer made up of mesothelium
8. Complete the following table which shows digestive glands and their enzymes in an adult man ?
   (HSE-July-2017)(2)

Digestive gland	Enzymes	Functions
Gastric gland	……a…….	Protein digestion
Salivary gland	Salivary amylase	……b……..
…..c…….	Nuclease	Nucleic acid digestion
Pancreas	Lipases	…..d…….

9. A)Observe the diagram and label A and B
   (HSE-March-2017)(2)

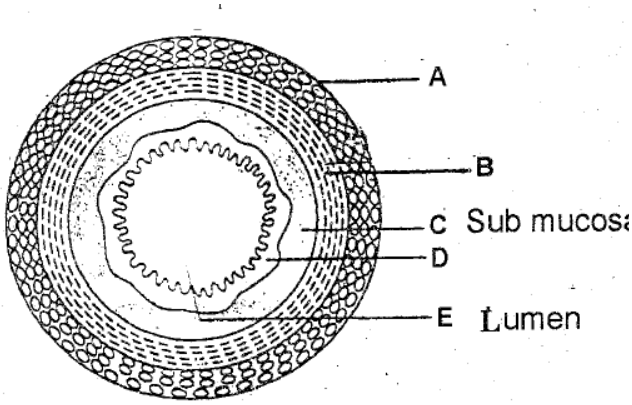


   b)Dental formula of permanent teeth in man is……
   i)2122/2122
   b)2123/2123
   c)2102/2102
   d)2122/2122
10. a)Observe the given diagram and identify the parts noted as A,B and C
    b)write the role of secretion stored in part A (HSE-Sept-2016)(2)



11. From the following list, pick out the enzyme, that takes part in carbohydrate digestion
    (HSE-march-2016) (1)
    (Salivary amylase, peptidase, lipase, carboxy peptidase)
12. In human dentiton is heterodnt.this condition means..(HSE-march-2016) (1)
    a)Presence of two types of teeth
    b)presence of two sets of teeth
    c)presence of diferent types of teeth
    d)teethes are palced in socket of jaw bone
13. Construct a flow chart to demonstrate the digestion of proteins in the different part of alimentary canal ?
    (HSE-September -2015)(2)
14. Observe the following diagram

(HSE-march-2015)(2)



a)Name the figure?

b)Label part A,B and D

15. Identify the odd one and write the common features of other items (Caecum,colon,rectum,renin)

(HSE august-2014)(1)

16. Proenzyme pepsinogen is a protein digesting enzyme (Inactive form) of the human digestive system

a)Name the digestive gland which secrete this enzyme?

b)How does the pepsinogen change into its active form, pepsin?

c)Complete the following sentence

Pepsin converts protein into proteoses and …… (HSE august-2014)(2)

17. Sketch an outline (or a flow chart) of protein digesting taking place in your alimentary canal ? (HSE march-2014)(3)

18. Read the features of cell layers in the wall of human intestine

(HSE,september-2013)(2)

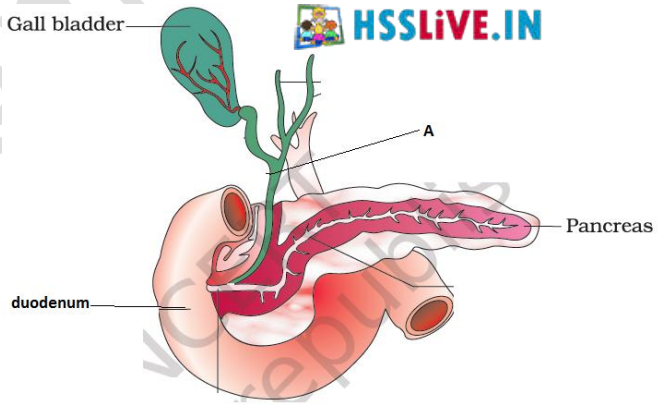
- It consist of circular and longitudinal smooth muscle
- Outer thin layer is formed of mesothelium
- A layer formed of loose connective tissue and nerves
- Epithelium with goblet cells to secrete mucus

Identify the cell layers and arrange them from inside to outside as seen in the section of intestine

19. Bile contain no digestive enzyme, so bile is not needed for digestion . Do you agree with this statement?Justify your answer ?(HSE-september 2012)(2)

20. Observe the given diagram and answer the following question?

(HSE-march-2012)(2)



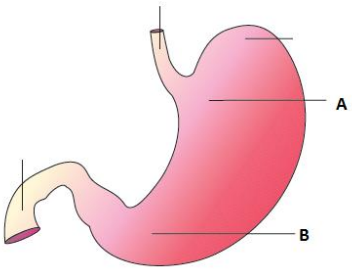
a)Identify the duct laelled A and the secretion it pours into the duodenum

b)Mention any two function of secretion in digestion?

21. "The end product of fat digestion are not absored directly into blood stream". Justify (HSE-MARCH-2011)(2)

22. Observe the diagram

(HSE-MARCH-2010)(2)



a)Label the parts A and B

b)Even though concetrated HCl is stored in the stomach, It willnot generally damage the stomach wall why?

23.The following reactions are catalysed by the enzymes produced from the digestive gland . Rewrite the reaction and write the correct enzyme above the arrow mark (HSE march-2009)(2)

Proteins, Peptones, Proteoses → Dipeptides

Polysaccharides → Disaccharides

Fats → Diglycerides + Monoglycerides

Nucleic acids → Nucleotides + Nucleoside