

# NUTRITION

## 1 CHAPTER

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### ➤ NUTRITION

The process of intaking the food & utilization of food is called nutrition.

#### ◆ Nutrient :

- The different component of food that have distinct functions like providing energy, materials for body building, maintenance & regulation of metabolism are called nutrient.

For example - Proteins, Minerals, Vitamin, Carbohydrates, fats.

### ➤ TYPE OF NUTRITION

#### ◆ Autotrophic Nutrition :

- It is a mode of nutrition in which organisms are able to build up their own organic food from inorganic raw materials with the help of energy. The organism performing autotrophic nutrition are called

autotrophs. (Gk. *autos*-self, *trophe*-nourishment).  
*e.g.*, *Ferrobacillus* (iron bacterium).

#### ◆ Heterotrophic Nutrition :

- It is a mode of nutrition in which the organisms obtain readymade organic food from outside sources. The organisms that depend upon outside sources for obtaining organic nutrients are called heterotrophs. Heterotrophic nutrition is of three types - saprophytic, parasitic and holozoic.

### ➤ TYPE OF HETEROTROPHIC NUTRITION

#### 1. Saprophytic or Saprotophic Nutrition :

It is a mode of heterotrophic nutrition in which food is obtained from organic remains like dead organisms, excreta, fallen leaves, broken twigs, food articles, etc. Organisms performing saprophytic nutrition are called saprophytes.

#### 2. Parasitic Nutrition :

- It is a mode of heterotrophic nutrition in which a living organism flourishes by obtaining food from another living organism. The living organisms which obtain food and shelter from another organism is called parasite. The organism which provides food and shelter to a parasite is known as host. An external plant parasite is *Cuscuta* (Amarbel). It is a non-green plant that sends haustoria or sucking roots into host plant for obtaining food and water.

### 3. Holozoic Nutrition :

- It is a mode of heterotrophic nutrition which involves intake of solid pieces of food. Since solid food is taken in, holozoic nutrition is also called ingestive nutrition. The food may consist of another animal, plant or its parts. Depending upon the source of food, holozoic organisms are of three types – Herbivores, carnivores, omnivores.

#### ◆ Herbivores :

- (*L.herba*-plant, *vorare*-to eat). They are holozoic organisms which feed on plants or plant parts, e.g., Cow, Buffalo, Deer, Goat, Rabbit, Grasshopper, Elephant, Squirrel, Hippopotamus.

#### ◆ Carnivores :

- They are animals which feed on other animals. Carnivores are also called predators they hunt, kill and feed on their preys, e.g. Lion, Tiger, Leopard, Snake, Hawk.

#### ◆ Omnivores :

- (*L.omnis*-all, *vorare*-to eat). They are holozoic organisms which feed on both plant and animal materials, e.g. Cockroach, Ant, Pig, Crow, Rat, Bear, Dog, Humans.

#### ◆ Nutrition in Amoeba :

- Protozoan protists carry out holozoic nutrition through intracellular digestion.

##### (i) Ingestion :

Some protists can ingest food particle from any point on the surface (e.g., *Amoeba*) while others have fixed points for the same (e.g., *Paramecium*). Protozoans like *Amoeba* capture food with the help of temporary finger-like processes called **pseudopodia**. Protozoans like (*Paramecium* have small hair-like processes called cilia.) Beating of cilia creates current in water that pushes food particle through cytostome or cell mouth. The process of ingestion of solid food particle by a cell or unicellular organism is called phagocytosis.

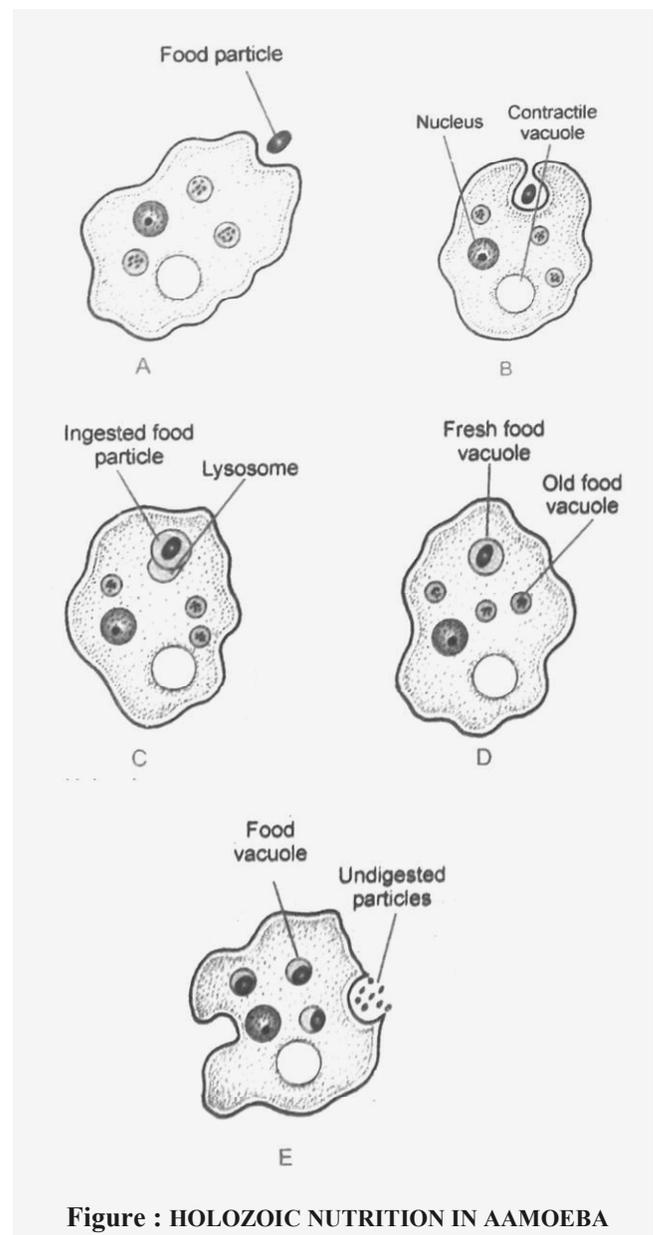


Figure : HOLOZOIC NUTRITION IN AAMOEBA

- As soon as *Amoeba* comes in contact with a food particle or prey, it throws pseudopodia all around the same. The tips of encircling pseudopodia fuse and the prey comes to lie in a vesicle or **phagosome**. This method of intake of food is called **circumvallation**. *Amoeba* can also ingest food by other methods like import, circumfluence and invagination.

#### ➤ DIGESTIVE SYSTEM OF HUMAN

Digestive system is a group of organs & associated digestive glands that take part in ingestion, digestive absorption of food & egestion of

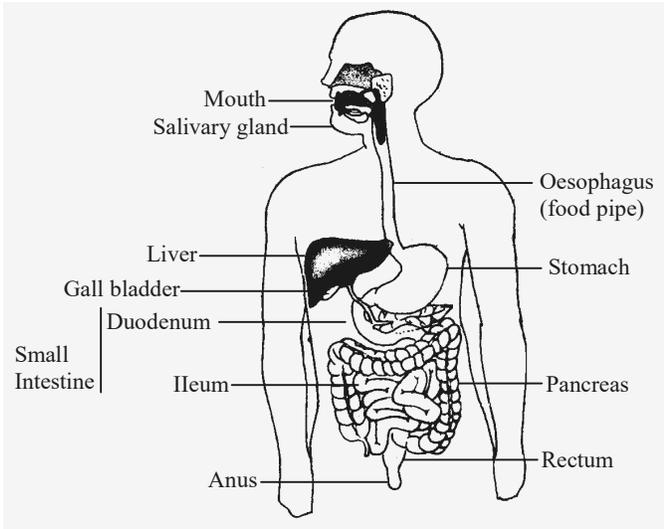
undigestible matter. Digestive organs form a continuous canal called alimentary canal.

**ALIMENTARY CANAL CONTAINS FOLLOWING PARTS**

Alimentary Canal in man is 9 metres long & consists of the following part

**Mouth :**

- Transverse slit like aperture.



**Oral Cavity :**

- It is bounded by lips & has cheeks, gums, teeth & tongue.
- The food taken inside oral cavity is masticated i.e. mechanically broken into smaller particles before being swallowed.
- The floor of the buccal cavity has a tongue bearing taste buds.
- Man possesses teeth on both the jaws, there are 32 teeth of four different types, namely incisors, canines, premolars & molars.

**Dental Formula :**

$$\times 2 = x$$

$$\frac{\text{No. of teeth in half part of upper jaw}}{\text{No. of teeth in half part of lower jaw}} \times 2 = x$$

- In Man  $\rightarrow I \frac{2}{2}, C \frac{1}{1}, Pm \frac{2}{2}, M \frac{3}{3} = \frac{8}{8} \times 2$   
= **Total 32 teeth**

**Pharynx :**

- It is short conical region that lies after the mouth cavity.

**Oesophagous :**

- It is a long narrow muscular tube which leads to the stomach. No digestive gland are present.

**Stomach :**

- It lies below the diaphragm on the left side of abdominal cavity is J-shaped.

**Small Intestine :**

- It is convoluted tube and differentiated into 3 regions, viz. **Duodenum** which is the first part of small intestine & is curved C-shaped; **Jejunum**, comparatively longer & more coiled and **Ileum**, which is the last part of small intestine whose inner surface is folded to form villi, which absorbs the products of digestion.

**Large Intestine :**

- It is much shorter & wider than small intestine & is differentiated into three regions viz;
- **Caecum** which is small rounded blind sac from which vermiform appendix arises;
- **Colon** is the inverted U-shaped tube
- The **rectum** opens to exterior through anus.
- No digestion takes place in large intestine, only absorption of water takes place.
- In herbivores like horse, rabbit digestion of cellulose takes place in caecum.

**Absorption :**

- In the small intestine (ileum) absorption of all digested materials takes place.

**Assimilation :**

- It is the process of utilisation of absorbed food for various body functions. The absorbed nutrients are utilised to resynthesise complex molecules like carbohydrates, protein & fats inside the cells.
- Man cannot digest cellulose.

◆ **Egestion :**

- It is the process of elimination of undigested food formed in the cells, or in the lumen of large intestine (colon & rectum) through the anus.

- Voluntary contraction of abdominal muscles help in egestion of faeces.

**TABLE : SUMMARY OF DIGESTION ENZYMES OF VARIOUS GLANDS WITH THEIR SECRETIONS AND END PRODUCTS OF DIGESTION IN MAN**

S.No.	Name of gland	Secretion	Site of action	Enzymes	Food acts upon	End product
1	Salivary glands	Saliva	Buccal cavity	Salivary amylase	Starch	Maltose
2	Gastric glands	Gastric Juice	Stomach	Pepsin	Proteins	Peptones & proteoses
				Renin	Casein of milk	Paracasein
		HCl	Stomach	—	Pepsinogen	Pepsin
3	Liver	Bile	Duodenum	—	Fats	Emulsification of fats
4	Pancreas	Pancreatic Juice	Duodenum	Amylase Trypsin Lipase	Starch & Glycogen Proteins Emulsified fats	Maltose & Isomaltose Peptones & peptides Fatty acids & glycerol
5	Intestinal glands	Intestinal Juice	Small intestine	Erepsin Maltase Sucrase Lactase Lipase	Peptones & Peptides Maltose Sucrose Lactose Triglycerides	Amino acids Glucose Glucose & fructose Glucose & galactose Monoglycerides & fatty acid
				Mucous	Large intestine	—

➤ **NUTRITION IN PLANTS**

◆ **Photosynthesis :**

- Photosynthesis is the primary mode of food production in green plant. " The process by which green plants synthesize food from simple substances carbon dioxide and water in the presence of sunlight is called **Photosynthesis**"
- The process of photosynthesis can be represented in the form of chemical reaction, as given below :  

$$6\text{CO}_2 + 12\text{H}_2\text{O} \longrightarrow \text{C}_6\text{H}_{12}\text{O}_6 + 6\text{H}_2\text{O} + 6\text{O}_2$$

Carbon    Water            Glucose            Water    Oxygen  
dioxide

◆ **Photosynthetic Pigment :**

- The light energy must be absorbed by a suitable pigment i.e. chlorophyll (green pigment).

- Chlorophyll is green colour pigment.

◆ **Mechanism of Photosynthesis :**

- Photosynthesis is divided in 2 main steps  
(A) light reaction            (B) dark reaction

◆ **Light reaction :**

- It is also called Hill Reaction.
- It occurs in grana of thylakoids.
- It is named as light reaction as it occurs only in presence of light.

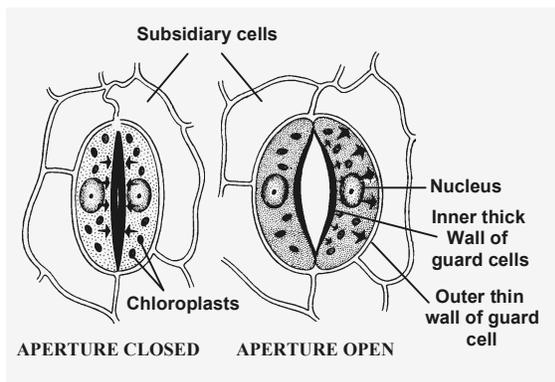
◆ **Major Step :**

- Absorption of light by chlorophyll.
- Photolysis of water.
- Reduction of CO<sub>2</sub> to Carbohydrates.

- In this process ADP changes to ATP & inorganic phosphate.
- Release of oxygen into atmosphere.

#### ◆ Opening and Closing Stomata :

- The opening and closing of stomata depend upon the turgid or flaccid state of the guard



cells. When guard cells are in turgid state the stomatal aperture opens and when guard cells are in flaccid state the stomatal aperture closes. The inner wall of guard cells (towards pore) is thick and outer wall (towards other epidermal cells) is thin. When the turgor pressure of the guard cells is increased the outer thinner wall of the guard cell is pushed out (towards the periphery) due to which a tension is created on the inner thicker wall thus pulling the inner thicker wall towards the periphery thus leading to the opening of stomatal aperture. On the contrary when the guard cells are in a flaccid state the outer thinner wall of guard cells returns to original position (moves towards pore) due to which tension on the inner wall is released which also returns to its original position and stomatal aperture gets closed again.

#### ◆ Dark Reaction :

- This reaction is not dependent on light. It is also known as calvin – Benson Cycle or C3 cycle as first stable product is phosphoglyceric acid (PGA) a 3 carbon compound.

#### ◆ C<sub>4</sub> Cycle or Hatch & Slakecycle :

- 4-C compound i.e. **oxaloacetic acid** (OAA).
- This cycle is found in many other tropical & subtropical monocots eg : Maize, Sorghum , Wheat, Oat, Pearl, millet etc.
- In dicots also many such plants are known eg : Amaranthus, Chenopodium, Atriplex, Euphorbia etc. In some families of dicots Compositae, Portulacaceae, Nyctaginaceae.

#### ◆ Crassulacean Acid Metabolism (CAM) :

- Certain plants, especially succulents which grow under extremely xeric (dry) condition, fix atmospheric CO<sub>2</sub> in dark.
- Since the process was first observed in the plants belonging to family crassulaceae (eg. Bryophyllum, kalanchoe etc.) It was termed crassulacean acid metabolism (CAM).
- The most characteristic feature of these plants is that their stomata remain open at night (in dark) but closed during the day (in light).
- Thus, CAM is a kind of adaptation in succulents to carry out photosynthesis without much loss of water.

# EXERCISE # 1

## A. Single Choice Type Questions

- Q.1** CO<sub>2</sub> and O<sub>2</sub> balance in atmosphere is due to  
(A) Photorespiration (B) Photosynthesis  
(C) Respiration (D) Leaf anatomy
- Q.2** During photosynthesis the oxygen in glucose comes from  
(A) Water  
(B) Carbon dioxide  
(C) Both from water and carbon dioxide  
(D) Oxygen in air
- Q.3** First stable compound in C<sub>3</sub> cycle is  
(A) Phosphoglyceraldehyde  
(B) Phosphoglyceric acid  
(C) Fructose-1-6 diphosphate  
(D) Glucose-6-phosphate
- Q.4** Dark reaction of photosynthesis occurs in the  
(A) Stroma of the chloroplast outside the lamellae  
(B) Space between the two membranes of the chloroplast  
(C) Membranes of the stroma lamellae  
(D) Thylakoid membrane of the grana
- Q.5** A specific function of light energy in the process of photosynthesis is to  
(A) Activate chlorophyll  
(B) Split water  
(C) Synthesis of glucose  
(D) Reduce CO<sub>2</sub>
- Q.6** Digestion within a digestive tract is  
(A) Incomplete  
(B) Extracellular  
(C) The same as absorption  
(D) An irreversible process
- Q.7** Dark reaction in photosynthesis is called so because  
(A) It does not require light energy  
(B) Cannot occur during daytime  
(C) Occurs more rapidly at night  
(D) It can also occur in darkness
- Q.8** Phloem always flows from a  
(A) Solar source to sugar sink  
(B) Sugar sink to sugar source  
(C) Leaf to the xylem to the phloem  
(D) Leaf to a root
- Q.9** With regards to natural eating habits, a human is  
(A) An herbivore (B) A carnivore  
(C) An omnivore (D) A Granivore
- Q.10** Muscular contractions of alimentary canal are  
(A) Circulation (B) Deglutition  
(C) Peristalsis (D) Churning
- Q.11** Which of the following regions of the alimentary canal of man does not secrete a digestive enzyme ?  
(A) Oesophagus (B) Stomach  
(C) Duodenum (D) Mouth
- Q.12** A digestive enzyme, salivary amylase, in the saliva begin digestion of  
(A) Protein (B) Nucleic acids  
(C) Fats (D) Carbohydrates
- Q.13** If you chew on a piece of bread long enough, it will begin to taste sweet because  
(A) Maltase is breaking down maltose  
(B) Lipases are forming fatty acids  
(C) Amylase is breaking down starches to disaccharides  
(D) Disaccharides are forming glucose
- Q.14** In the presence of lactase, lactose breaks down into molecules of  
(A) Glucose and galactose  
(B) Glucose and fructose  
(C) Galactose only  
(D) Glucose only
- Q.15** Saliva has the enzyme  
(A) Pepsin (B) Ptyalin  
(C) Trypsin (D) Rennin

- Q.16** Pepsin digests  
(A) Proteins in stomach  
(B) Carbohydrates in duodenum  
(C) Proteins in duodenum  
(D) Fats in ileum
- Q.17** Curding of milk in the stomach is due to the action of  
(A) Pepsin                      (B) Renin  
(C) HCl                         (D) Tenin
- Q.18** Chief function of HCl is  
(A) To maintain a low pH to prevent growth of micro-organisms  
(B) To facilitate absorption  
(C) To maintain low pH to activate pepsinogen to form pepsin  
(D) To dissolve enzyme secreted in stomach
- Q.19** If the stomach did not produce any hydrochloric acid, which enzyme will not function ?  
(A) Ptyalin                      (B) Trypsin  
(C) Pepsin                      (D) Collagenase
- Q.20** Chief function of bile is  
(A) To digest fat by enzymatic action  
(B) To emulsify fat for digestion  
(C) To eliminate waste product  
(D) To regulate process of digestion
- Q.21** Where is bile produced ?  
(A) In gall bladder  
(B) In blood  
(C) In liver  
(D) In spleen
- Q.22** Ileum is  
(A) First part of the small intestine  
(B) Middle part of the small intestine  
(C) Last part of the small intestine  
(D) Not a part of the small intestine
- Q.23** Largest gland in human body is  
(A) Liver                      (B) Pancreas  
(C) Pituitary                      (D) Thyroid
- Q.24** The specific function of liver is  
(A) Excretion  
(B) Digestion  
(C) Histolysis  
(D) Glycogenesis and glycogenolysis
- Q.25** The original function of the vertebrate stomach was  
(A) Storage  
(B) Digestion  
(C) Enzyme secretion  
(D) Absorption

## EXERCISE # 2

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### A. Very Short Answer Type Questions

- Q.1 Define heterotrophic nutrition.
- Q.2 What are heterotrophs ?
- Q.3 Which types of organisms are called consumers ?
- Q.4 What is saprophytic nutrition ?
- Q.5 Define saprophyte.
- Q.6 Define a herbivore.
- Q.7 What is carnivore ?
- Q.8 Which type of animal is called omnivore ?
- Q.9 Define digestion.
- Q.10 What is ingestion ?
- Q.11 Define egestion.
- Q.12 What is the mode of nutrition in *Amoeba* ?
- Q.13 What type of digestion occurs in *Paramoecium* ?

### B. Short Answer Type Questions

- Q.14 Differentiate between autotrophic and heterotrophic nutrition.
- Q.15 Distinguish saprophytes from parasites.
- Q.16 Differentiate between photosynthetic and holozoic nutrition.
- Q.17 How do saprophytic organisms obtain their nourishment ?
- Q.18 What is the importance of saprophytes ?
- Q.19 What is the action of hydrochloric acid of gastric juice ?

Q.20 Name a digestive juice that has no enzymes. What is the role of this juice ?

Q.21 Name the various parts of large intestine. What is the role of large intestine ?

### C. Long Answer Type Questions

Q.22 Explain the mechanism of nutrition of *Amoeba* with the help of suitable diagram.

Q.23 Describe the various types of heterotrophic nutrition.

Q.24 Briefly describe the digestive system of humans.

Q.25 What happens to food in the small intestine ?

Q.26 Why chlorophyll is needed for photosynthesis.