All living things have an organized cellular structure with different levels of organization. An arranged and ordered structure with cells, tissues, organs, organ systems, etc is an important feature that distinguishes the living from the non - living. If this organization breaks down, an organism is no longer alive as organization is not only confined to external appearance but is present in the internal structure as well. Therefore, living things have to repair and maintain their structure through various processes.

Living Things and Life Processes

- The growth of a living organism starts with the division of its cells. When a cell divides, it forms two daughter cells from a single mother cell. The daughter cell divide and redivide to give rise to tissue and organs, Different life processes of an organism like growth and maintenance, require energy which is obtained from food by the process called ' nutrition'.
- Food is broken down into simpler forms by a stepwise oxidizing – reducing process known as 'respiration'. During this process, oxygen is commonly required by organism to release energy from the food for carrying out various life processes.
- In multicellular organism, all the cells are not in contact with the environment. So, food and oxygen have to be transported to all parts of the body. For the movement of food and oxygen from one part to other, there is transportation system. The carrying out of different life processes involves 'metabolism' (chemical reactions in organism) which produces harmful waste products that have to be removed from the bodies of living organism through the process of 'excretion'. In complex organism, specialized tissues system carries out excretion and specialized transportation system carries metabolic products to the excretory tissues.

Nutrition

- It is the process to transfer source of energy (food) from outside to the body for maintaining living structure of an organism.
- It provides nutrients to the body so that it can obtain energy to carry out the activities required to stay alive. 'Nutrients' are substances that give nourishment which provides energy to an organism. The digestive system of an organism breaks down complex food into simpler molecules, so that the cells can take them and use for survival, growth and reproduction.
- Nutrition promotes growth of the body, which involves the formation of new protoplasm. Nutrition meets the energy requirement of the body. It helps to synthesize a variety of substances like: proteins, carbohydrates, fats etc.

Modes of Nutrition

Plants and animals do not obtain food by the same process. Plants and some bacteria have the green pigment 'chlorophyll' to help synthesize food, while animals, fungi and other bacteria depend on other organisms for food. There are two modes of Nutrition:

1. Autotrophic Nutrition
2. Heterotrophic Nutrition

Autotrophic Nutrition

'Autotroph' means self nutrition. In autotrophic nutrition, an organism makes it own food from simple raw materials. E.g. green plants and some bacteria.

Photosynthesis

Green plants which are autotrophic, synthesize food through the process of 'photosynthesis'. It is the process by which green plants having chlorophyll, synthesize the simple sugar (glucose) from simple raw materials water and carbon dioxide using the energy from the sunlight. Oxygen is released in this process. The overall equation of photosynthesis is given.The sugar produced is stored in the form of starch in plants (in animals food is stored in the form of glycogen). Since autotrophic plants are able to produce food, they are also known as 'producers'.

$$6CO_2 + 12H_2O \xrightarrow[\text{sunlight}]{\text{chorophyll}} C_6H_{12}O_6 + 6O_2 + 6H_2O$$

Site of Photosynthesis

All green plants are capable of performing photosynthesis; the leaves are the most suitable organs for this process. The cells of the leaves contain special organelles called 'chloroplasts' which are the main sites of photosynthesis. These are plastids which contain light absorbing green pigment chlorophyll.

Requirements of Photosynthesis:

It requires chlorophyll, carbon dioxide, water and sunlight.

1. Chlorophyll: it is a green pigment, found in all photosynthetic organisms and is responsible for their green color. In plants, it is mainly found in leaves.
2. Carbon dioxide: air contains 0.03% carbon dioxide. Terrestrial plants use atmospheric carbon dioxide in photosynthesis. Aquatic plants use the carbon dioxide dissolved in water. Plants obtain carbon dioxide through pores called 'stomata' present on the surface of leaves. The opening and closing of these pores are regulated by guard cells.
3. Water: is an important raw material for photosynthesis. Plants absorb water from the soil through their root hairs and then transported up to the leaves through stem.
4. Sunlight: light energy is used in splitting water molecules into hydrogen and oxygen. The splitting of water in the presence of light is called 'photolysis'.
5. Other material: nitrogen, phosphorus, iron and magnesium are also required for photosynthesis and are taken up from the soil. Nitrogen is an essential element used in synthesis of proteins. It is taken up in the form of inorganic nitrates

Mechanism of photosynthesis

There are two stages in entire process: a) first stage dependent on light (light reactions) b) second stage does not dependent on light (dark reactions).

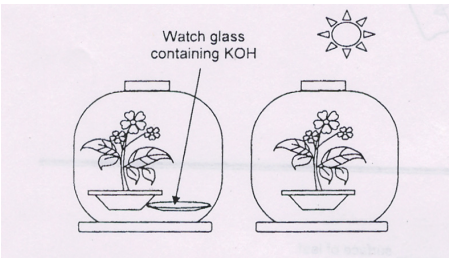
1. Absorption: light energy is absorbed by chlorophyll found in the chloroplasts.
2. Conversion: of light energy into chemical energy and splitting of water molecules into hydrogen and oxygen.
3. Reduction: carbon dioxide is reduced to carbohydrates.

Factors affecting photosynthesis:

1. Experiment to demonstrate that starch is formed during photosynthesis:

Pluck a healthy green leaf which was in the sunlight. Place it in a beaker containing boiling water for about two minutes. Now transfer the leaf to a beaker containing alcohol. Warm it over a water bath for a few minutes. You will observe that the leaf turns white, indicating that the chlorophyll has been removed. Now wash the leaf carefully in water without damaging it. Place the leaf in a dilute solution of iodine. This will turn the leaf bluish black. The changing of the leaf's colour to bluish black after it has been treated with iodine solution shows that the leaf contains starch.

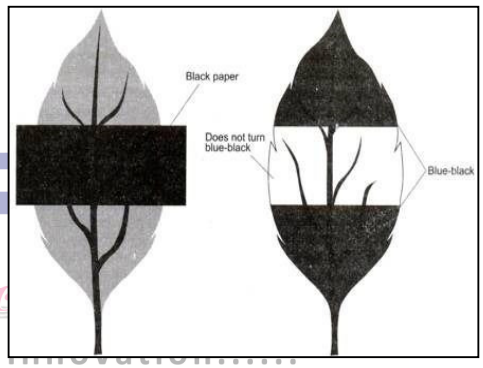
2. **Experiment to demonstrate that carbon dioxide is essential for photosynthesis:** Get two healthy potted plants of almost the same size and place them in the dark for 24 hours to de- starch leaves. Now place them on a glass plate. Cover the plants with separate bell jars. Keep some crystals of potassium hydroxide (KOH) in a petri dish and place it under one of the jars. Make the set up airtight by applying Vaseline at the bottom of the bell jars.



Keep the plants in sunlight for photosynthesis to take place. After 3 to 4 hours, pluck a leaf from each plant. Boil the leaves in water and subsequently in alcohol, using a water bath, to remove chlorophyll. Now use a few drops of iodine to test to starch in each leaf. Only one leaf turns blue black colour showing the presence of starch. This happens because KOH absorbs the CO_2 present inside one bell jar. As a result, the leaves do not get CO_2 for photosynthesis. Thus the process is inhibited and starch is not synthesized.

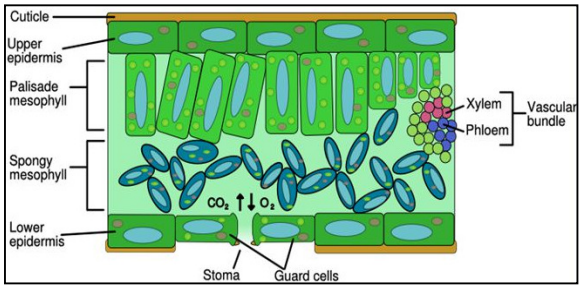
3. **Experiment to show that sunlight is essential for photosynthesis:**

Keep a potted plant in the dark for 24 hours. On one of the leaves, stick black paper strip (one below and one above the leaf) with the help of cello tape. Now, place this plant in sunshine for a few hours. Pluck the leaf and remove the black strips. Boil this leaf, first in water and then in alcohol, to remove chlorophyll. After washing the leaf with water, keep it in a petri dish. Add a few drops of iodine solution. The leaf turns blue-black except in the region that had been covered. This region did not receive light and hence no starch was formed. The uncovered region received light and starch was formed due to photosynthesis.



Cross Section of Leaf

A leaf contains the following parts:



1. Epidermis: outermost layer of the leaf and consists of two distinct parts: upper epidermis with no chloroplasts. It protects the internal leaf tissues by preventing excessive water loss through evaporation and lower epidermis, which contain stomata and helps in gaseous exchange in the plants.
2. Stomata: these are tiny pores, mostly found in the lower epidermis, which allows gases to enter and exit the leaf more rapidly between the plant and atmosphere.
3. Guard Cells: these are bean- shaped cells that frame the stomatal openings. They contain chloroplast and have cell well. Each pair of guard cells controls the opening and closing of the stomata. Hence, controlling the rate of diffusion of gases and water vapour into and out the leaf.

Exercise 1

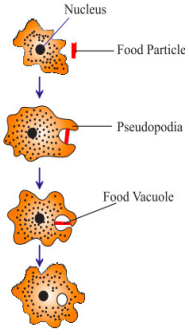
Q1. State the photosynthesis reaction and where does it occur.
Q2. What happens to the unused energy produced by plants?
Q3. Which organelle acts as the site of photosynthesis?
Q4. Name the raw materials which are essential to carry out the process of photosynthesis in plants?
Q5. Write the function of guard cells.

Heterotrophic Nutrition

'Heterotroph' means other nutrition. All heterotrophs depend on the other organism for their food, they are called consumers. All animals and non green plants like fungi come under this category. Consumers which consume herbs and other plants are called 'herbivores' and those which consume animals are called 'carnivores'. After taking complex organic materials as food, heterotrophs break them into simpler molecules with the help of 'enzymes' and utilize them for their own metabolism.

Depending upon the mode of living and mode of intake of food, heterotrophs may be parasitic, saprophytic and holozoic.

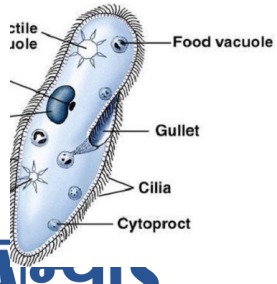
1. **Parasitic:** Parasitic organisms or parasites live on or inside other living organisms calls 'hosts' and obtain their food from them. The host does not get any benefit from the parasites. Different parasites, like cuscuta, cassytha, plasmodium, hookworms, tapeworms, leeches etc have different modes of feeding, depending upon habit, habitat and modifications.
2. **Saprophytic** Saprophytic organisms or saprophytes derive their food from dead organisms. They secrete enzymes that are released on food material outside their body. These enzymes break down complex food into simpler forms. Common examples: fungi (moulds, mushrooms, yeasts) and many bacteria.
3. **Holozoic:** In this mutation, complex organic substances are ingested (taken in) without their being degraded. After intake such food is digested by enzymes produced within the organisms. Digested food is absorbed into the body and the undigested food is egested (expelled) from the body. This kind of nutrition is found in non – parasitic animals like amoeba and human beings.



Nutrition in Amoeba

Amoeba is a unicellular, omnivore organism that does not possess specialized organ for the process of nutrition. The mode of nutrition in amoeba is 'holozoic' and taken place with the help of 'pseudopodia' (finger like extensions).

Amoeba first identifies its food. It then throws out number of small pseudopodia also called 'false feet'. These pseudopodia enclose the food particle and prevent it from escaping. The food enclosed in the cell membrane forms a food vacuole. The complex food is broken down into simpler molecules with the help of digestive enzymes of the organelle called 'lysosomes'. The digested food is distributed in the cytoplasm and the undigested food is egested through the cell membrane.



Nutrition in Paramoecium

Paramoecium is a unicellular organism with a specific shape, food is ingested through a special opening the cytoplasm (cell mouth). Food is brought to this opening by the lashing movement of cilia that covers the entire surface of the cell.

Difference between the two modes of Nutrition

	Autotrophic Nutrition	Heterotrophic Nutrition
1	It occurs in green plants, some bacteria and in some plants.	It occurs in fungi and animals
2	Chlorophyll is necessary for trapping solar energy.	Chlorophyll is absent; as such they do not trap solar energy.
3	Food is self manufactured using CO_2 and water as raw material	Food is obtained directly or indirectly from autotrophs.
4	Digestion of food does not occur.	Digestion is required to convert complex organic substances into simpler form
5	They are placed at the bottom of the food chain as producers.	They are placed above producers in the middle of food chain as consumers.
6	e.g.: plants, blue – green algae	e.g.; animals including humans

Exercise 2

Q1. What type of nutrition occurs in fungi?
Q2. Write the steps involved in nutrition in amoeba.
Q3. How do parasitic organisms derive their nutrition?
Q4. How is heterotrophic nutrition different from autotrophic nutrition?

Peristaltic Movement

It is necessary to move the food in a regulated manner along the digestive tube so that it can be passed properly in each part. The lining of the canal has muscles that contract rhythmically in order to push the food forward. These rhythmic contractions are known as peristaltic movements.

Human Digestive System

The alimentary canal and the glands associated with digestion constitute the human digestive system.

Alimentary Canal: the alimentary canal is human beings measure about 8 to 10metres in length. It extends from the mouth to the anus. It has the following parts:

1. Mouth: it consists of oral cavity, through which food is ingested. It is bounded by lips and cheeks. It contains gums, teeth, a tongue and muscles.

- The tongue tastes the food and moves it to pharynx. Tongue is a highly muscular sensory organ present at floor of buccal cavity. It bears several taste buds and helps in mixing food with saliva. Teeth help in biting, cutting and chewing food. Teeth masticate the food. This makes it easier to swallow food and increases its surface area for various digestive secretions to act on.
- The four types of teeth are: incisors, canines, premolars and molars. Incisors help in cutting the food. Canines help in tearing of food. Molar and pre molar help in crushing, chewing and grinding of food. Our teeth are covered with a hard protective covering of 'enamel'. The enamel covers the dentine, which is a yellowish substance forming the bulk of the tooth.
- **Tooth Decay**: the condition of gradual softening of enamel. It begins when bacteria acting on sugar produce acids and soften or de- mineralise the enamel. Masses of bacterial cells together with food particles stick to the teeth to form 'dental plague'. Due to this, saliva fails to reach the tooth surface to neutralize the acid because plague covers the teeth. Brushing the teeth after eating removes plague before the bacteria produce acids.

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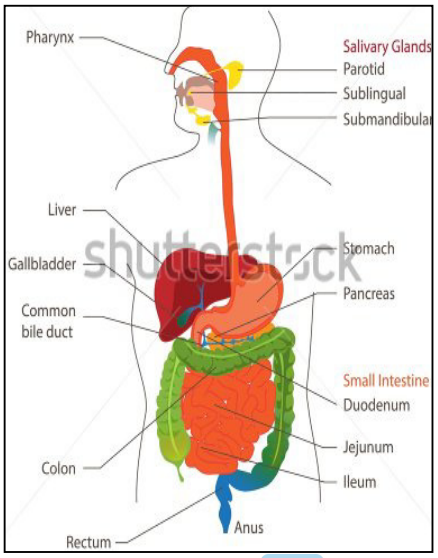
- When we eat sweets, chocolates and ice creams, bacteria act on sugars and produce acids which soften the protective covering. This cause 'dental caries'. If the teeth are not brushed properly after meals, bacteria may invade deeper into the teeth. This leads to infection and toothache.
- The presence of food on the mouth stimulates the three pairs of salivary glands to secrete 'saliva'. Saliva has mucin, which lubricates the mouth and food. Saliva also has 'salivary amylase', a digestive enzyme that breaks down starch and glycogen to maltose.



2. **Pharynx**: the oral cavity opens into the pharynx. Pharynx is a small funnel shaped chamber located behind the oral cavity. The swallowing mechanism guides the masticated food through the pharynx, into a tube called oesophagus.
3. **Oesophagus**: it is a muscular, tubular part of the alimentary canal. The muscular walls of the oesophagus move in a rhythmic wavelike manner which carries the food down to the stomach. This muscular movement is called 'peristalsis'.
4. **Stomach**: it is J- shaped part of the alimentary canal, which is situated between the oesophagus and the small intestine, below the diaphragm. It serves as a storehouse of food where partial digestion takes place. The inner linings of the stomach have three pits. Each pit constitutes a gastric gland:

a) mucous cells(secreting mucus);
b) parietal cells (secreting hydrochloric acid)
c) chief cells (secreting the inactive enzyme propepsin)

- The hydrochloric acid in gastric juice converts propepsin to active pepsin and also kills bacteria ingested by gastric juice. About 3L of gastric juice is produced every day. Excess secretions of gastric juice, especially in an empty stomach. Erodes the inner lining of the stomach.
- This erosion causes 'ulcers' in the stomach walls. Digestion of protein begins in the stomach. Pepsin breaks down proteins into peptones. Gastric lipase partially breaks down lipids.

5. **Small intestine**: it is about 6metre in length and 2.5 cm in thickness. There are three divisions of the small intestine: 'duodenum', 'jejunum' and 'ileum'. Duodenum is the first part. It begins from the pyloric stomach and is C shaped. In the middle of the duodenum two different ducts open through a common aperture. One of the ducts is the common bile duct and the other is pancreatic duct. **'Bile'** is a yellowish green alkaline juice is poured into the duodenum through the common bile duct.
6. **Liver**: largest gland of the body. It performs many functions. It secretes bile, which helps in digestion. Bile juice is produced by the liver is stored in the 'gall bladder'. There are two functions of bile:

- It emulsifies fats by rendering them soluble and breaking them into small globules. In this form, fats are better exposed to the action of fat - hydrolyzing

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enzymes. (All digestive enzymes catalyze by breaking water molecule and are hence called hydrolyzing enzymes.)

- The acidic food (chyme) coming from stomach becomes alkaline (chyle) when it is mixed with bile. This is important as the intestinal enzymes catalyze the breakdown of food only in an alkaline medium.

7. **Pancreas**: they secrete pancreatic juice which is carried by the pancreatic duct into the duodenum. Pancreatic juice contains a number of digestive enzymes such as '**amylase**' for the splitting of polysaccharides, '**lipase**' for the breakdown of fats, and '**trypsin and chymotrypsin**' for the breakdown of proteins. These enzymes catalyze the breakdown of their substrates in an alkaline medium. But the catalysis does not completely break all the substrates into their simplest form.
8. Intestinal Glands: the complete digestion of the remaining food material takes place in the 'ileum' (the last part of the small intestine). There are numerous small glands in the walls of the small intestine. These glands secrete intestinal juices. The digestive enzymes in the intestinal juice break small pepsides into amino acids, disaccharides into monosaccharides, lipids into fatty acids and glycerol and nucleic acids into nucleotides.
9. **Large intestine**: the ileum passes into the large intestine. It can be divided into two parts: anterior (colon) and posterior (rectum). The colon has an **ascending** part, a **traverse** part and a **descending** part. The last part or the descending part open into the rectum. The terminal part of the rectum is called 'anal canal'. It opens through the anus, guarded by the 'sphincter muscles'.

- The large intestine allows the passage of residual food mass (faecal matter) which is egested through the anus. As the residue of the food mass passes along the large intestine, a considerable amount of water contained in the residue is absorbed into the blood through the intestinal walls. The specialized longitudinal muscle present in the colon wall regulates the passage of the faecal matter along the colon.

Digestive glands

Various glands associated with alimentary canal are:

1. Salivary glands: they secret salivary amylase which convert starch into sugar at the optimum pH of about 7. It is due to this gland that our mouth waters when we eat something we like.
2. Gastric glands: these are found in the walls of the stomach. They release digestive juice containing HCl, pepsin, mucous etc. HCl creates an acidic medium of pH 2, facilitating the action of pepsin enzyme which acts on proteins present in food. The mucus protects the lining of the stomach from the action of the hydrochloric acid produced under normal condition.
3. Liver: the largest gland secretes bile juice. They act on large fat molecules to form smaller globules increasing the efficiency of enzyme action. Gall bladder stores bile juice for further use.
4. Intestinal glands: walls of small intestine contain various glands that secrete intestinal juices containing **amylolytic, proteolytic and lipolytic** enzymes.
5. Pancreas: they secrete pancreatic juice which contains enzymes like **amylase, trysin and lipase**. This is connected to the small intestine through pancreatic duct.

Mechanism of Digestion of food

The food we eat contains various components like fats, carbohydrates, proteins etc. Various are type steps involved in digestion of these nutrients:

1. Ingestion: intake of food by mouth. Food is moistened by 'saliva', before swallowing, masticated by teeth to smaller particles.
2. Digestion: process of breaking down large organic molecules like carbohydrates into simple molecules like sugar is called digestion.
3. Absorption: absorption of completely digested food takes place in the ileum. The wall of the ileum has finger like projections called 'villi' that increase the surface area for absorption of digested food. The absorbed food is then brought into the blood capillaries, absorbed materials are transported by veins to the liver and then to the heart for distribution to different parts of the body.
4. Assimilation: intake of digested food by the cells of the body is called assimilation. It is used to obtain energy through the process of respiration; Excess monosaccharides are stored as glycogen. Amino acids are used in the synthesis of proteins. The glycerol and fatty acids either provide energy or gets converted into fats. The absorbed fats are also utilized for the formation of new cells and tissues, leading to growth and development of the body.
5. Egestion: the elimination of undigested food formed in the colon of the large intestine through anus is called egestion. Peristalsis gradually pushes the undigested food from small intestine to large intestine. The remaining material after re- absorption of water and ions is stored in the rectum for some time and is ultimately removed from the body through anus.

Exercise 3

Q1. What is the reason behind tooth decay?
Q2. Why carnivores have shorter small intestine?
Q3. Explain the role of HCl in digestion.
Q4. Where is bile juices produced? State its one function.
Q5. Explain the significance of peristalsis.

Worksheet 1

Q1. Draw a labeled diagram of cross section of a leaf.
Q2. How is required pH maintained in the stomach and small intestine?
Q3. Why is small intestine in herbivore longer than in carnivore?
Q4. Fill in the blanks:
a) Pepsin acts on proteins to convert it to_____ and _____.
b) Gastric Lipase converts fats into _____ and _____.
c) The pH of gastric juice is _____.
Q5. Why does a piece of bread start tasting sweeter after it is chewed for some time?
Q6. Define the terms 'nutrition' and 'nutrients'. List two differences between holozoic nutrition and saprophytic nutrition.
Q7. Describe the process of nutrition in amoeba.
Q8. In each of the following situations what happens to the rate of photosynthesis:
a) Cloudy day b) no rainfall in the area c) good morning in the area
Q9. Name the correct substrate for the following enzymes:
a) Trypsin b) amylase c) pepsin d) lipase
Q10. What is likely to happen if green plants disappear from Earth?

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