LIFE PROCESSES

Those things which are alive are called living things. All the plants and animals (including human beings are alive or living things.

The most important criterion to decide whether something is alive (or not) is the Movement. The movement in most of the animals are fast and can be observed easily but the movements in plants are usually slow and observed with difficulty. This is because plants are fixed in soil at a place, so they cannot move like animals from place to place. They can only move parts of their body such as leaves, flowers, etc. For example, leaves and flowers of sunflower move by bending towards the sun so as to face the sunlight. Various features of living things are as follows:-

(i) They can move by themselves.

(ii) They need food, air and water.

(iii) They can grow and respond to changes around them.

(iv) They can respire, excrete and reproduce.

What are LIFE PROCESSES?

The basic functions performed by living organisms to maintain their life on this earth are called Life Processes.

The basic life processes common to all the living organisms are as follows:

1. **Nutrition.** The process of nutrition involves the taking of food inside the body and converting it into smaller molecules which can be absorbed by the body.
2. **Respiration.** It is the process which releases energy from the food absorbed by the body.
3. **Transport.** It is the process in which a substance absorbed or made in one part of the body is moved to other parts of the body.
4. **Excretion.** It is the process in which the waste materials produced in the cells of body are removed from the body.
5. **Control and Coordination.** It is a process which helps the living organisms to survive in the changing environment around them.
6. **Growth.** It involves the change from a small organism to an adult organism.
7. **Movement.** The organism either moves from one place to another or moves its body parts while remaining at the same place.
8. **Reproduction.** The production of new organisms from the existing organisms of the same species is known as reproduction.

ENERGY - a basic requirement

All the living organisms need energy to perform various life processes. They get this energy from food. **Food is a kind of fuel which provides energy to all the living organisms.** Since life on earth depends on Carbon based molecules, most of these food sources are also carbon based. Energy is required by an organism even during sleep. This is because when we are asleep, a number of biological processes keep on occurring in the body which require energy.

NUTRITION

The process of taking in food (consuming food) and utilising it is called nutrition. The food taken in by an organism contains a large number of **nutrients** like Carbohydrates, fats, proteins, minerals, vitamins and water, etc. Carbohydrates are most common nutrient for getting energy. The simplest Carbohydrate is **Glucose** and complex Carbohydrate is **Starch** and **Glycogen**.

Modes of Nutrition

Depending on the mode (or method) of obtaining food, all the organisms can be classified into two groups:

1. **Autotrophic mode of nutrition.**
2. **Heterotrophic mode of nutrition.**

Autotrophic mode of nutrition

The word 'auto' means 'self' and 'trophe' means 'nutrition'. Thus, autotrophic means **'self nutrition'**. **Autotrophic nutrition** is that mode of nutrition in which an organism makes its own food from the simple inorganic materials like Carbon dioxide and water present in the surroundings. The organisms having autotrophic mode of nutrition are called **autotrophic organisms or Autotrophs**. For example, **Green plants, Autotrophic bacteria**.

Autotrophs contain the green pigment called **Chlorophyll**, which is capable of trapping sunlight energy. This trapped sunlight energy is utilised by the autotrophs to make food by combining inorganic materials like Carbon dioxide and water present in the environment by the process of **Photosynthesis**. Autotrophs are the producers of food.

Heterotrophic mode of nutrition

The word 'heteros' means 'others' and 'trophe' refers to 'nutrition'. Thus, heterotrophic means **'nutrition obtained from others'**. **Heterotrophic nutrition** is that mode of nutrition in which an organism cannot make its own food from simple inorganic material like Carbon dioxide and water, and depends on other organisms for its food. The organisms having heterotrophic mode of nutrition are called **heterotrophic organisms or heterotrophs.** For example, all **animals**, most **bacterias** and **fungi** and **non-green plants (like yeast)**.

Some plants also eat insects called as **insectivorous plants**. For example, **the pitcher plant** and **venus fly trap**.

Heterotrophic nutrition is of three types:-

1. **Saprotrophic nutrition.** Saprotrophic nutrition is that nutrition in which an organism obtains its food from decaying organic matter of dead plants, dead animals and rotten bread, etc. The organisms having saprotrophic mode of nutrition are called **saprophytes**. For example, many bacteria and fungi (like **bread moulds, yeast, mushrooms**).
2. **Parasitic nutrition.** The parasitic nutrition is that nutrition in which an organism derives its food

from the body of another living organism (called its **host**) without killing it. A **Parasite** is an organism which feeds on another living organism called its **host**.

For example, few plants like **Cuscutta** and some animals like **lice**, **Plasmodium and round worms** are Parasites.

3. **Holozoic nutrition.** The holozoic nutrition is that nutrition in which an organism takes the complex organic food materials into its body by the process of ingestion, the ingested food is digested and then absorbed into the body cells of the organism. The undigested and unabsorbed part of the food is thrown out of the body of the organism by the process of egestion.

Human beings and most of the animals like cat, dog, cattle, etc. have holozoic mode of nutrition.

Nutrition in plants

Green plants being autotrophic, synthesize their own food by the process of **Photosynthesis**. It is the process by which green plants make their own food (glucose) from Carbon dioxide and water by using sunlight energy in the presence of **chlorophyll**.

The process of photosynthesis can be represented as:

$$6CO_2 + 6H_2O + \text{Light energy} \xrightarrow[\text{(Chlorophyll)}]{\text{Photosynthesis}} C_6H_{12}O_6 + 6O_2$$

Carbon dioxide (from air)	Water (from soil)	(from sun)	Glucose	Oxygen

The process of photosynthesis takes place in the green leaves of a plant. The green pigment called **Chlorophyll** is present in green leaves that helps in absorbing energy from sunlight. This energy is required to carry out the chemical reactions involved in the preparation of food. The green colour of leaves is due to presence of **Chloroplasts** (which contain chlorophyll) in them.

The food prepared by the green leaves of a plant is in the form of a simple sugar called **Glucose**. The extra glucose is changed into another food called **Starch**, which is stored in the leaves of plant. Glucose and starch belong to a category of foods called carbohydrates. Similarly unused glucose is stored in the form of **Glycogen** in animals.

The photosynthesis takes place in the following three steps: -

1. Absorption of sunlight energy by chlorophyll.
2. Conversion of light energy into chemical energy, and splitting of water into hydrogen and oxygen by light energy.
3. Reduction of carbon dioxide by hydrogen to form carbohydrate like glucose by utilising the chemical energy (obtained by transformation of light energy).

These three steps involved in photosynthesis need not take place one after the other immediately. They can take place at different times. For example, **Desert plants** take up Carbon dioxide at night and prepare an intermediate product which is acted upon by the sunlight energy absorbed by chlorophyll when the sun shines during the next day.

The condition necessary or photosynthesis to take place are: -

1. Sunlight,

2. Chlorophyll,
3. Carbon dioxide, and
4. Water

The conditions necessary for photosynthesis are also the conditions necessary for autotrophic nutrition.

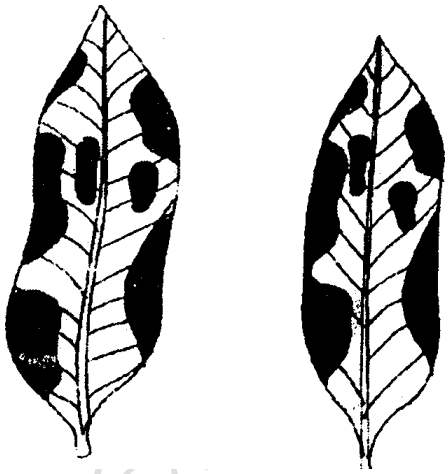
ACTIVITY - 1

AIM: ***To prove that chloropyll is essential for phtotosynthesis.***

MATERIAL REQUIRED: Plant with variegated leaves, boiling water, beaker containing alcohol, iodine solution, test tubes, sheet of paper water bath.

PROCEDURE:

1. A plotted plant with variegated leaves (money plant or **cotons**) is kept in a dark room for three days to make the leaves starch-free.



2. Keep the plant in sunlight for about six hours.
3. Pluck a leaf from the plant. Mark the green areas in it and trace them on a sheet of paper.
4. Dip the leaf in boiling water for a few minutes.
5. Immerse the leaf in a beaker contaning alcohol.
6. Place the above beaker in a water-bath and heat till the alcohol begins to boil.
7. Colour of the leaf and colour of the solution is observed.
8. Dip the leaf in a dilute solution of iodine for a few minutes.
9. Take out the leaf and rinse off the iodine solution.
10. Observe the colour of the leaf and compare this with the tracing of the leaf done in the beginning.

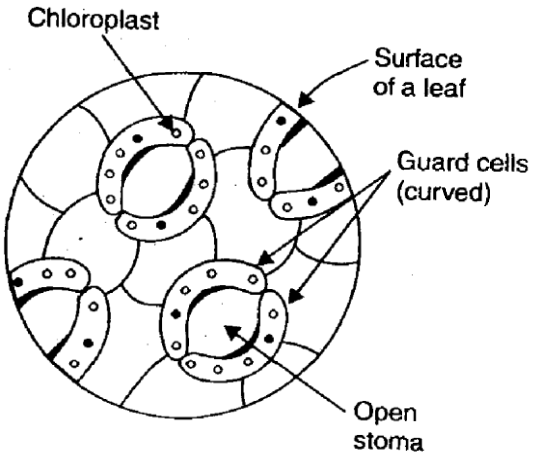
OBSERVATION: The portions of leaves which are devoid of chlorophyll **remain colourless whereas** the rest of the leaf turns blue black.

CONCLUSION: From the above experiment we come to conclusion that the rest of the leaf turns blue black due to the presence of starch.

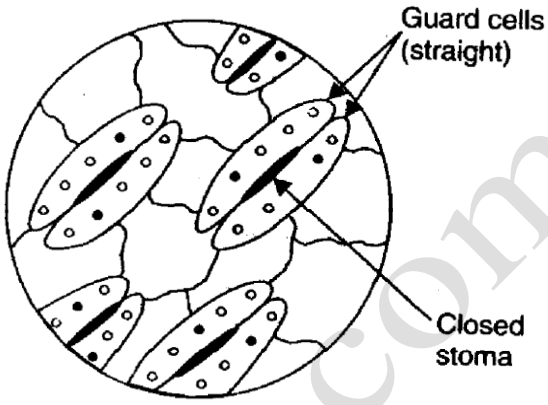
The raw materials for photosynthesis are:-

1. Carbon Dioxide. Green plants take CO_2 from air for photosynthesis. Carbon dioxide enters the leaves through stomata. **Stomata are the large number of tiny pores present on surface of the leaves of plants.**

Each stomatal pore (or stoma) is surrounded by a pair of **guard cells**. The opening and closing of stomatal pores is controlled by the guard cells. When water flows into the guard cells, they swell, become curved and cause the pore to open. On the other hand, when the guard cells lose water, they shrink, become straight and close the stomatal pore.



(*a*) Open stomata



(*b*) Closed stomata

A large amount of water is also lost from the cells of plant leaves through open stomatal pores. So, when the plant does not need carbon dioxide and wants to conserve water, the stomatal pores are closed. The oxygen gas produced during photosynthesis also goes out through the stomatal pores of the leaves. In this way, the **gaseous exchange in plants take place through the stomata in leaves**. The gaseous exchange also occurs across the surface of stems, roots and leaves.

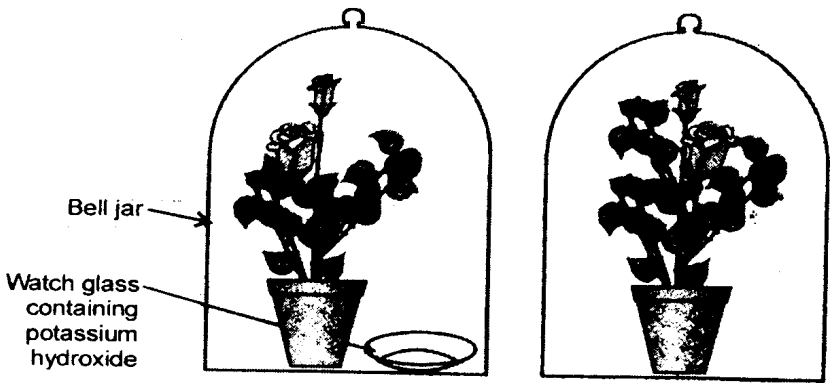
ACTIVITY - 2

AIM: ***To prove that carbon dioxide is essential for photosynthesis.***

MATERIAL REQUIRED: Two healthy potted plants, 2 glass plates, potassium hydroxide (KOH), 2 bell jars, watch glass, vaseline, iodine solution, H_2O and alcohol.

PROCEDURE:

1. Take two healthy potted plants of nearly the same size.
2. Keep the two pots in a dark room for three days.
3. Now place each plant on separate glass plates.
4. Place a watch-glass containing KOH by the side of one of the plants. KOH has the property to absorb carbon dioxide.

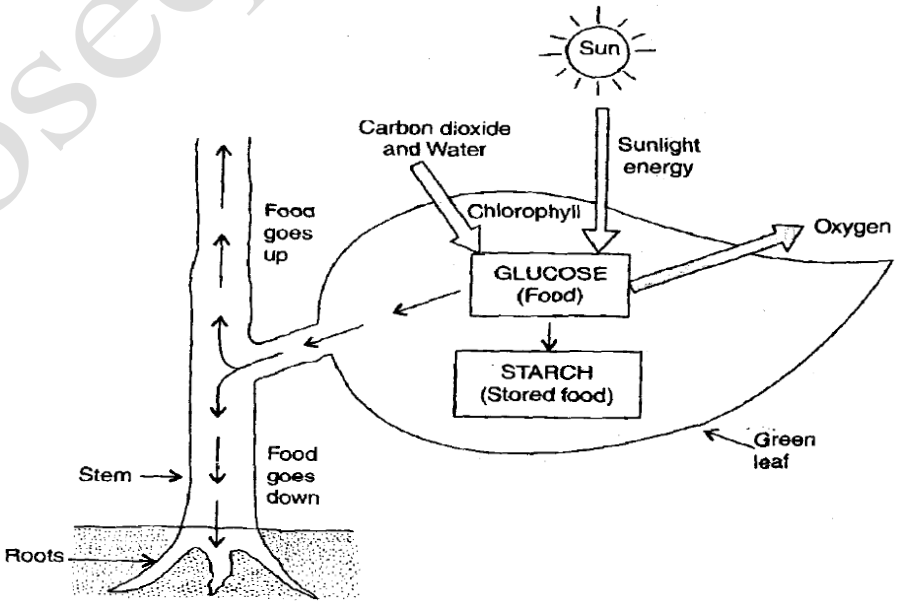


5. Cover both plants with separate bell-jars.
6. Use vaseline to seal the bottom of the jars to the glass plates so as to make the set up air-tight.
7. Keep the plants in sunlight for about two hours.
8. Pluck one leaf in sunlight for about two hours.
9. Perform starch test for both the leaves by decolorizing leaf first in water, then alcohol and finally testing with iodine solution.

OBSERVATION: Leaf which was within bell jar with KOH solution gives a negative test for starch whereas the other within the KOH solution gives a positive test.

CONCLUSION: This experiment proves that carbon dioxide is absolutely essential for photosynthesis. The part of the leaf whihc could not show iodine test positive (+)ve had all the requirements for photosynthesis except carbon dioxide (CO_2) which was absorbed by KOH in the bottle.

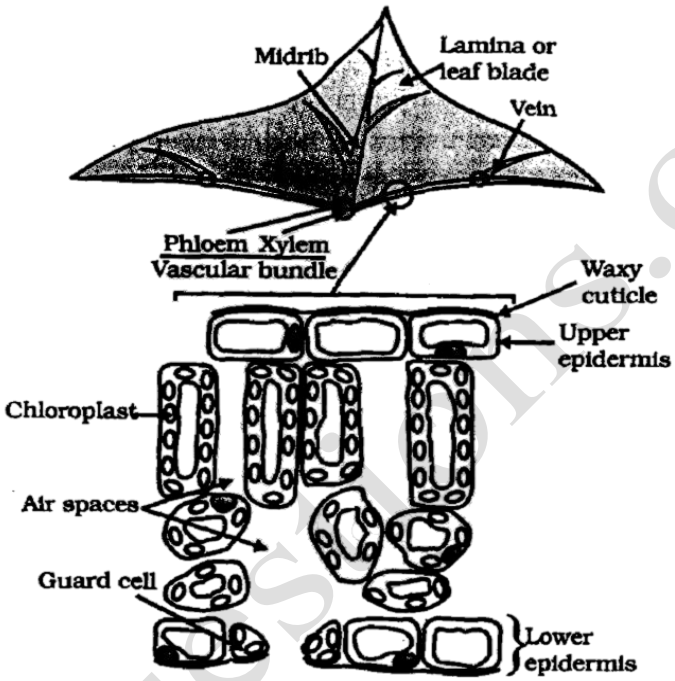
2. Water. The water required by the plants for photosynthesis is absorbed by the roots of the plants from the soil through the process of **osmosis**. The water absorbed by the roots of the plants is transported upward through the **xylem vessels** to the leaves where it is utilised in photosynthesis.



The plants also take other raw-materials like Nitrogen, phosphorus, iron and magnesium, etc. from the soil. The plants take up nitrogen from the soil in the form of inorganic salts called **nitrates** or in the form of organic compounds which are produced by bacteria from the atmospheric nitrogen.

Site of photosynthesis: Chloroplast

Chloroplasts are the organelles in the cells of green plants which contain chlorophyll and where photosynthesis takes place. In other words, **the site of photosynthesis in a cell of the leaf are chloroplasts**. In a cross-section of a leaf, chloroplasts can be seen as numerous disc-like organelles in the photosynthetic cells or mesophyll cells of the **palisade tissue**.



NUTRITION IN ANIMALS

Animals being heterotrophic depend on readymade food that is obtained from plants or other animals. Animals are divided into three groups on the basis of their food habits:-

(i) **Herbivores** Animals which eat only plants, e.g. **Goat, Cow**.

(ii) **Carnivores** Animals which eat only other animals, e.g. **Lion, Vulture**.

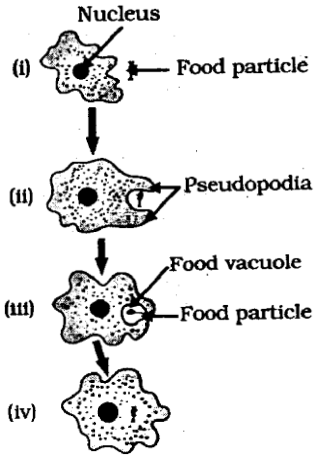
(iii) **Omnivores** Animals who eat both plants and other animals, e.g. **Man**.

Plants use the energy of sun to prepare food by photosynthesis and for maintaining their life. These plants are also eaten by herbivores and omnivores as food. And the carnivores eat herbivores as food. In this way, sun **is the primary source of energy** which provides food for plants, an animals.

Nutrition in Amoeba

Amoeba is a unicellular animal. The mode of nutrition in Amoeba is holozoic. The process of obtaining food by Amoeba is called phagocytosis. The various steps involved in the nutrition of Amoeba are:-

(i) **Ingestion** When a food particle comes near Amoeba, then it ingests this food particle by forming temporary finger-like projections called ***pseudopodia*** around it.



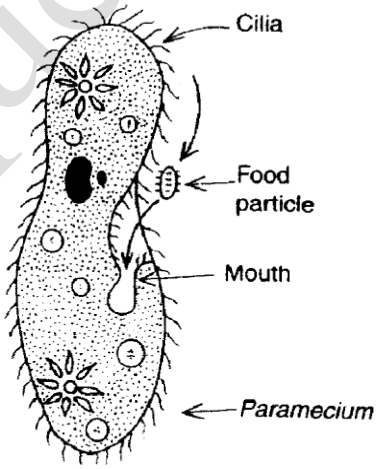
(ii) **Digestion** Food vacuole contains digestive enzymes that digest the food into small soluble molecules.

(iii) **Absorption** The digested food present in the food vacuole is absorbed directly into the cytoplasm by diffusion.

(iv) **Assimilation** The food absorbed in Amoeba cell is used to obtain energy through respiration and also help in growth of *Amoeba*.

(v) **Egestion** On accumulation of undigested food, cell membrane of Amoeba ruptures and undigested food is thrown out.

Paramecium is also a unicellular animal that uses its hair like structures called ***Cilia*** to sweep the food particles from water and put them into mouth.



Nutrition in human beings

The human digestive system consists of the Alimentary canal (or gut) and its associated glands. The ***human alimentary canal*** is a long tube running from mouth to Anus of a human being in which digestion and absorption of food takes place.

The various organs of human digestive system in sequence are:-

Mouth, Oesophagus (or food pipe), Stomach, Small intestine and large intestine.

The glands associated with digestive system of man are:-

Liver, Pancreas and salivary glands.

The various steps of nutrition in human beings are:-

(i) **Ingestion**. In human beings, food is ingested through the mouth.

(ii) **Digestion**.

- The digestion of food begins in the ***mouth*** itself. The ***teeth*** cut the food into small pieces, chew and grind it. So, teeth helps in **physical digestion**.
- ***The Salivary glands*** in the mouth produce **saliva**. Our tongue helps in mixing this saliva with food. Saliva being a watery liquid wets the food so that it can be swallowed easily. The watering of mouth is due to production of saliva.
- Saliva contains an enzyme called ***salivary Amylase*** which digests the starch present in food into sugar. However, the digestion is not complete.

ACTIVITY - 2

AIM: ***To study the action of salivary amylase on starch.***

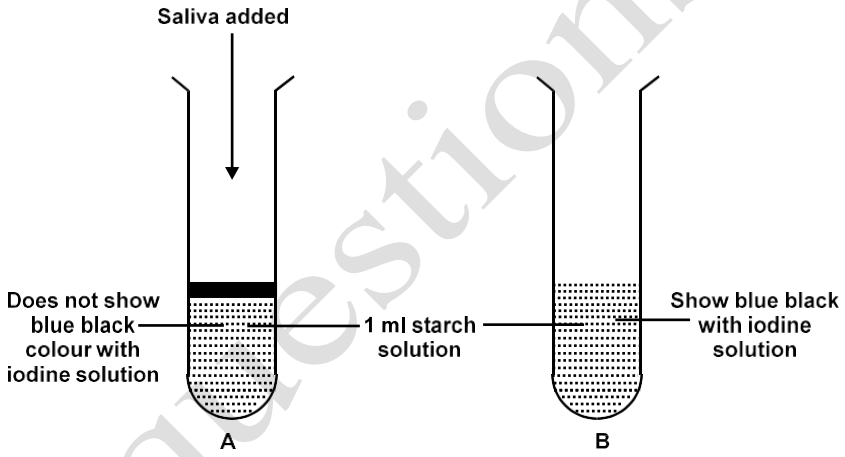


Fig. : Experiment to show actions of salivary amylase on starch solution

MATERIAL REQUIRED: Two test tubes (A and B), starch solution water, saliva, iodine solution.

PROCEDURE:

1. Take two test tubes A and B and put 1 ml of starch solution (10%) in both of these.
2. Add about 1 ml of saliva to test tube A.
3. Both the test tubes A and B are kept undisturb for 20-30 minutes.
4. Then add a few drops of dilute iodine solution to the both test tubes.
5. Observe the colour change.

OBSERVATION: The colour of starch solution in test tube B, in which no saliva was added turns **blue black** but in test tube A, come out to be negative.

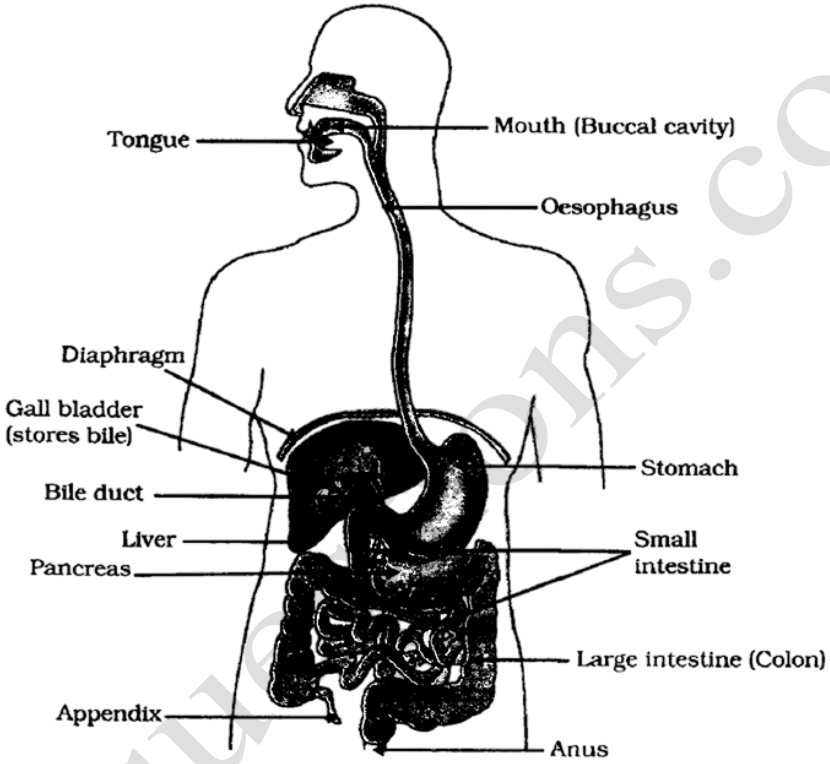
CONCLUSION: Starch solution gives blue colour with iodine, this experiment prove that in test tube A there was no starch. The starch was converted to something else due to the action of saliva.

- The slightly digested food is swallowed and goes down the ***food pipe*** called ***Oesophagus***. The contraction and expansion movement of walls of food pipe is called **Peristaltic movement**. This movement of food pipe pushes the slightly digested food into stomach.
- The glands present in the walls of ***stomach*** secretes ***gastric juice***. This juice contains three substances:-

  Hydrochloric acid: kills bacteria, provides acidity to the gastric juice and activates pepsin.

  Pepsin: Activated pepsin digest proteins into smaller molecules.

  Mucus: Protect stomach wall from acidity due to hydrochloric acid.



- The partially digested food then goes from stomach into the small intestine through **'sphincter muscle'**.
- The ***small intestine*** receives the secretions of two glands:-

  Liver – It secretes **bile**. Bile performs two functions.

  (a) makes the acidic food coming from stomach **alkaline** so that pancreatic enzymes can act on it.

  (b) Bile salts emulsify or break the fats present in the food into small globules making it easy for enzymes to act and digest them.

  Pancreas – They secrete **pancreatic juice** which contains digestive enzymes like ***pancreatic amylase, trypsin and lipase***

  (a) The enzyme amylase breaks down the starch.

  (b) Tryprin is an enzyme that digests the proteins.

  (c) Enzyme lipase breaks down the emulsified fats.

Enzymes are biological catalyst that carry out chemical digestion of food. Walls of small intestine contain glands which secrete ***intestinal juice***. The intestinal juice contains a number of enzymes which complete the digestion of complex carbohydrates into glucose, proteins into amino acids and fats into fatty acids and glycerol.

3. **Absorption.** The ***small intestine*** is the major region for the absorption of digested food. The inner surface of small intestine has millions of tiny, finger-like projections called ***Villi***, which gives inner walls of small intestine very large surface area.
4. **Assimilation.** The blood carries digested and dissolved food to all parts of the body where it becomes assimilated as part of the cells. This assimilated food is used by the body cells for obtaining energy as well as for growth and repair of the body.
5. **Egestion.** The undigested food passes from small intestine into ***large intestine***. The walls of large intestine absorb most of the water from the undigested food (with the help of villi). Then it is passed out or egested from the body through **Anus** as faeces.

DENTAL CARIES

- The formation of small cavities (or holes) in the teeth due to the action of acid forming bacteria and improper dental care is called ***Dental caries***.
- If the teeth are not cleaned regularly, they become covered with a sticky, yellowish layer of food particles and bacterial cells called ***'Dental plaque'***.
- Since plaque covers the teeth forming a layer over them, the alkaline saliva cannot reach the teeth surface to neutralize the acid formed by bacteria and hence tooth decay sets in.
- Brushing the teeth after eating food, removes the plaque before bacteria produce acids. This will prevent dental caries.

RESPIRATION

The digested food is assimilated into the body and is used as a fuel to get energy for various life processes. The process of releasing energy from food is called **Respiration**.

The process of respiration involves taking in Oxygen into the cells, using it for releasing energy by burning food, and then eliminating the waste products (Carbon dioxide and water) from the body.

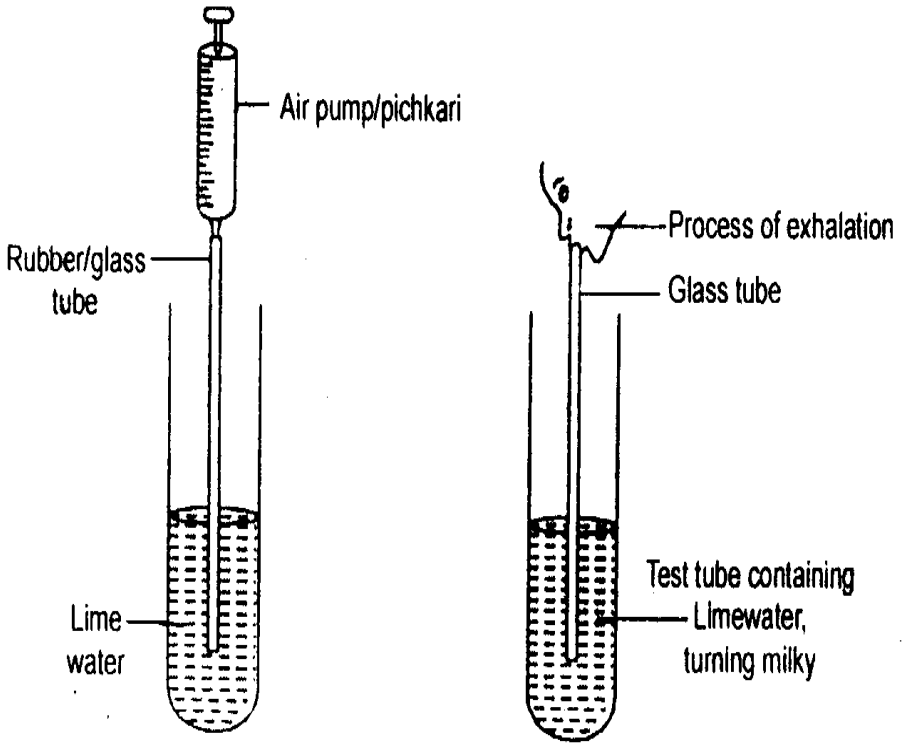
The process of respiration can be written in form of word equation as:

Food + Oxygen $\rightarrow$ Carbon dioxide + Water + Energy

There are two by products of cellular respiration: **carbon dioxide and water**. Out of these, carbon dioxide is a waste product because its accumulation in the body is harmful to organism. Water is beneficial for the body.

ACTIVITY - 3

AIM: ***To demonstrate the amount of carbon dioxide exhaled during the process of breathing.***



MATERIAL REQUIRED: Two test tube, lime water, syringe or pichari, glass tube, rubber tube.

PROCEDURE:

1. Take two test tubes labelled them as A and B.
2. Take some freshly prepared line water in both the test tubes.
3. Blow air with the help of the tube through the lime water in test tube B.
4. Note down time required to turn lime water milky in this test tube.
5. Use a syringe or pickkari to pass air through lime water taken in another test tube say A.
6. Note down time for turning lime water milky.
7. Compare time taken to convert lime water milky in both the test tubes A and B.

OBSERVATION: Time taken to turn lime water milky in test tube A is more than the time taken in test tube B.

CONCLUSION: Since the time taken to turn lime water milky in test tube A is more than test tube B, thus it is tells us that the amount of carbon dioxide in exhaled air is more than atmosphere air.

Breathing	**Respiration**
1. The mechanism by which organisms obtain oxygen from air and release carbon dioxide is called ***breathing***.	1. **Respiration** includes breathing as well as oxidation of food in the cells of organysim to release energy.
2. It is a ***physical*** process.	2. It is a ***physical*** as well as ***biochemical*** process.
3. This process involves the ***lungs***.	3. This process involves ***lungs*** and ***mitochondria***.

Photosynthesis	**Respiration**
1. It is an ***Anabolic*** process, i.e. food is synthesized.	1. It is an ***Catabolic*** process, i.e. food is broken down.
2. It utilizes carbon dioxide, water and sunlight energy.	2. It utilizes Oxygen.
3. In this process Oxygen is released.	3. In this process Carbon dioxide, water and energy is released.
4. It occurs only during day time.	4. It occurs during day time as well as at night.

The first – step of Respiration, common to all organisms is **Glycolysis**. It is the breakdown of *Glucose*, a six-carbon molecule, into a three-carbon molecule called *Pyruvate*. This process takes place in **Cytoplasm**.

$$\underset{\substack{\text{(1 molecule)}\\ \text{(6 – Carbon)}}}{\text{Glucose}} \xrightarrow[\text{(in cytoplasm)}]{\text{Glycolysis (in cytoplasm)}} \underset{\substack{\text{(2 molecules)}\\ \text{(3 – Carbon)}}}{\text{Pyruvate}}$$

Types of respiration

The fate of pyruvate formed during respiration depends on whether oxygen is present in cells or not. On this basis, respiration is classified into two types:-

- Aerobic respiration
- Anaerobic respiration

1. Aerobic Respiration

The respiration which uses oxygen is called Aerobic respiration.

In Aerobic respiration, the glucose food is completely broken down into Carbon dioxide and water by oxidation. A considerable amount of energy is released. Aerobic respiration can be represented as

$$\text{Glucose} \xrightarrow{\text{Glycolysis (in cytoplasm)}} \text{Pyruvate} \xrightarrow{\text{Oxygen (mitochondria)}} \underset{\text{Carbon dioxide}}{6CO_2} + \underset{\text{Water}}{H_2O} + \text{Energy}$$

Mitochondria are sites of Aerobic respiration the cells.

2. Anaerobic Respiration

The respiration which takes place without oxygen is called Anaerobic respiration.

In Anaerobic respiration, the micro-organisms like yeast breakdown glucose into ethanol and carbon dioxide, and release energy. This respiration is called fermentation.

In this much less energy as compared with aerobic respiration is released.

Anaerobic respiration can be represented as:

$$\text{Glucose} \xrightarrow[\text{(Cytoplasm)}]{\text{Glycolysis}} \text{Pyruvate} \xrightarrow[\text{Oxygen Absent}]{\text{(yeast)}} 2C_2H_5OH + 2CO_2 + \text{Energy}$$

ACTIVITY - 4

AIM: ***To demonstrate the product formed during fermentiaton:***

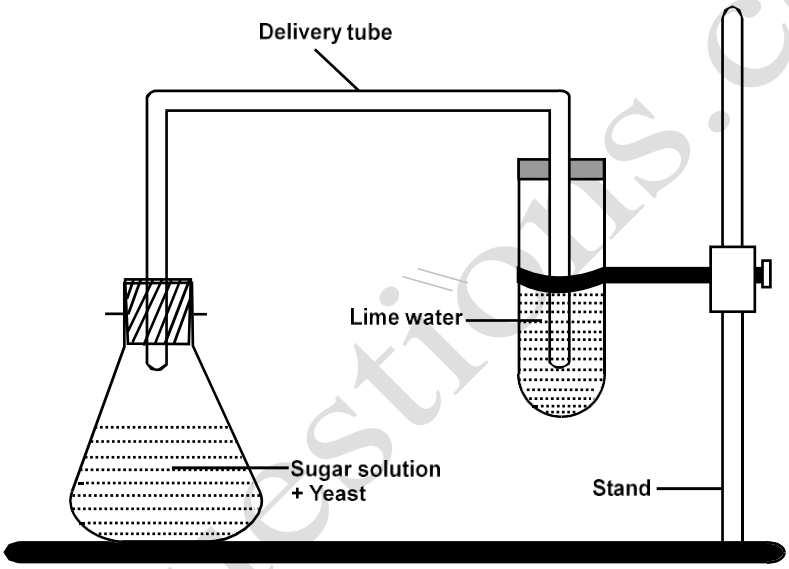


Fig. : Apparatus to demonstrate the products formed during fermentation

MATERIAL REQUIRED: Fruit juice, sugar solution, yeast, test tube fitted with a one-holed cork, conical flask, bent glass tube.

PROCEDURE:

1. Take some fruit juice or sugar solution in a conical flask.
2. Add some yeast to it.
3. Fix flask with one test tube fitted with a holed cork with a twice bend glass tube in it.
4. Take some lime water in the test tube.
5. Dig the free end of the glass tube into a test tube contanining freshly prepared lime water.
6. Leaves the apparatus for few hours.
7. Changes is observed.
8. Note down the time required to do so.

OBSERVATION: We observed that lime water turns milky.

CONCLUSION: In the above experiment yeast is respiring anaerobically as flask is covered with cork.

This process of respiration is called fermentation. This experiment shows that lime water turning milky, thereby concluding that CO_2 is released as result of fermentation.

$$\text{Sugar solution} \xrightarrow{\text{yeast}} \underset{\text{(Ethanol)}}{C_2H_5OH} + CO_2 + \text{Energy}$$

Human beings obtain energy by aerobic respiration. But anaerobic respiration can sometimes take place in humans.

For example, Anaerobic respiration takes place in our **muscles** during vigorous physical exercise when oxygen gets used up faster in muscle cells than can be supplied by the blood.

This breakdown of food during anaerobic respiration in muscles can be represented as:

$$\text{Glucose} \xrightarrow[\text{(Cytoplasm)}]{\text{Glycolysis}} \text{Pyruvate} \xrightarrow[\text{(muscle tissue)}]{\text{Oxygen absent}} \text{2 Lactic acid + Energy}$$

Aerobic Respiration	**Anaerobic Respiration**
1. It takes place in presence of Oxygen. 2. Complete breakdown of food occurs. 3. End product are Carbon dioxide and water. 4. It produces considerable amount of energy.	1. It takes place in absence of Oxygen. 2. Partial breakdown of food occurs. 3. End product are **ethanol** and **CO_2** (in yeast) or **Lactic acid** (in Animal muscles). 4. Much less energy is produced.

What happens to Energy produced?

- The energy released during cellular respiration is immediately used to synthesise a molecule called ***ATP***, which is used to fuel all other activities in cell.
- In these processes, ATP is broken down giving rise to a fixed amount of energy which can drive the endothermic reactions taken place in the cell.
- ATP is the ***energy currency*** for most cellular processes. The energy released during the process of respiration is used to make an ATP molecule from ADP and Pi.

  ADP + Pi $\xrightarrow{\text{Energy}}$ **ATP**

  ATP – Adenosine triphosphate

  ADP – Adenosine diphosphate

  Pi – Inorganic phosphate
- Endothermic processes in the cell then use this ATP to drive the reactions, when the terminal phosphate linkage in ATP is broken using water, the energy equivalent to 30.5 kJ/mol is released.

  ATP $\longrightarrow$ **ADP + Pi + Energy**

Respiration in Plants

- The respiration in plants involves the exchange of ***Oxygen*** and ***Carbon dioxide***. So, oxygen and carbon dioxide are called Respiratory gases.
- In plants all plants like roots, stem and leaves perform respiration individually.
- Oxygen required for respiration, reaches to all the cells of plants through **Diffusion**.

- Roots of a plant take the oxygen required for respiration from the air present in between the soil particles by Diffusion.
- The stems of herbaceous plants (herbs) have **stomata** for gaseous exchange. Whereas, woody stems has **Lenticels** for gaseous exchange.
- The exchange of respiratory gases in leaves takes place by the process of diffusion through stomata.
- In leaves, respiration occurs during day time and at night. Whereas, photosynthesis occurs only during the day time. The net gaseous exchange in leaves is as follows:-

  During day time:

  - Photosynthesis occurs and oxygen is produced.
  - Some of the oxygen is used for respiration and rest diffuses out into air.
  - Respiration occurs and carbon dioxide is produced.
  - This CO_2 is all used up in photosynthesis and even more CO_2 is taken in from air.
  - The net gas exchange is:

    O_2 diffuses out; CO_2 diffuses in

  During night time:

  - No photosynthesis occur, no oxygen is produced.
  - For respiration, oxygen from air diffuses into leaves.
  - CO_2 produced during respiration diffuse out.
  - The net gas exchange is: **O_2 diffuses in; CO_2 diffuses out**

Respiration in Animals

Different animals have different mode of respiration:

(i) Unicellular organisms like **Amoeba** respire by diffusion through their ***Cell membrane***.

(ii) Animals that live in soil like **earthworms** respire through their ***skin***.

(iii) Aquatic animals like **fishes, prawns,** etc. have ***Gills*** as their respiratory organs.

(iv) Insects like **grasshopper, cockroaches**, etc. respire through tiny holes called *spiracles* and air tubes called *trachea*.

(v) Land animals like **man, dog**, etc. has *lungs* as their respiratory organs.
Frog respire through both lungs and gills.

Aquatic animals use the oxygen dissolved in water to carry out respiration. Since, the amount of dissolved oxygen in water is low as compared to the amount of oxygen in the air, therefore, **the rate of breathing in aquatic animals is much faster than in terrestrial animals (or land animals).**

ACTIVITY - 5

AIM: ***To compare the rate of breathing in fish and human being.***

MATERIAL REQUIRED: Aquarioum, stop watch.

PROCEDURE:

1. Observe in the aquarium, the position of gill slits or operculum which covers the gill slits behind the eyes of fish.

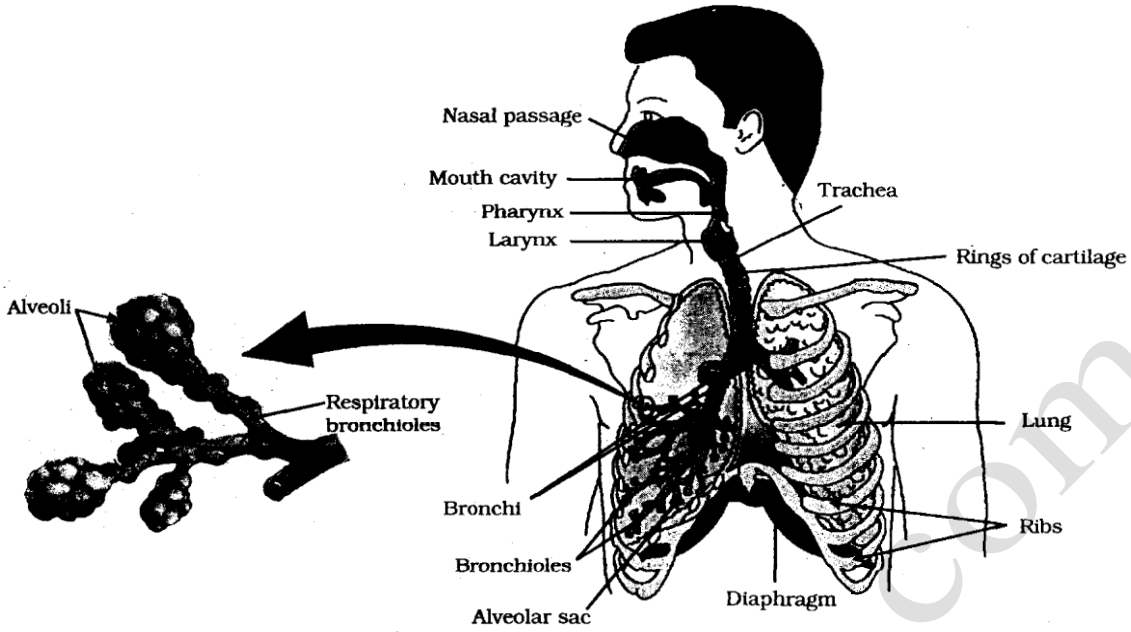
2. Also observe the opening and closing of mouth of fish in the aquarium.
3. Now count the number of times fish opens and closes its mouth, and the number of opening and closing of gill slits per minute.
4. Try to establish the relation in both the rates of opening and closing of mouth and gill slits.
5. Count the number of times you breathe in and out in a minute.
6. Compare the number of times you breathe in and out in a minute.

OBSERVATION: The rate of breathing in fish is much faster than the human beings.

CONCLUSION: Aquatic animals (fish) uses oxygen dissolved in water. Since the amount of dissolved oxygen in water is fairly low compared to the amount of oxygen in the air, the rate of breathing in fish is much faster than the human beings.

Human Respiratory System

- The main organs of human respiratory system are: ***Nose, Nasal passage (or Nasal cavity), Trachea, Bronchi, Lungs and Diaphragm***.
- Human respiratory system begins from **nose**. The air for respiration is drawn into our body through **nostril** present in the nose, from where it goes into **nasal passage**.
- Nasal passage is lined with fine hair and mucus.
  Nasal hair trap any kind of dust or impurity present in air
  Mucus also helps in this cleaning of air.
- From nasal passage, air enters into **pharynx** and then goes into the wind pipe (or **trachea**). Pharynx and trachea are together called throat. ***Rings of Cartilage*** are present in throat which ensures that air passage does not collapse.
- From throat, the air reaches ***Lungs***, within the lungs, the air passage divides into smaller and smaller tubes called **Bronchioles** which finally terminate in balloon like structures which are called ***Alveoli***.
- The Alveoli provides a surface where exchange of gases can take place, wall of Alveoli contain an extensive network of blood vessels. The presence of millions of alveoli in the lungs provides a very large surface area for the exchange of gases.
- When we breathe in air, the **diaphragm** of muscles attached to **ribs** contract due to which our chest cavity expands. Because of this, air is sucked into lungs and fills the expanded alveoli.
- The blood brings CO_2 from rest of the body for release into alveoli, and the O_2 in alveolar air is taken up by blood in alveolar blood vessels to be transported to all cells in body.
- During breathing cycle, when air is taken in and let out, the lungs always contain a **Residual volume** of air so that there is sufficient time for O_2 to be absorbed and for CO_2 to be released.



- When the body size of the animals increases, allowing the diffusion pressure alone to take care of reaching oxygen to all parts of the body becomes less efficient.
- Instead, in animals **Respiratory pigments** are present that take up the oxygen from the air in the lungs and carry it to tissues which are deficient in oxygen before releasing it.
- In human beings, the respiratory pigment is **Haemoglobin** which has very high affinity for Oxygen. This pigment is present in **Red Blood Corpuscles (RBCs)**.
- Carbon dioxide is more soluble in water and hence is mostly transported in dissolved form in our blood.

TRANSPORTATION

Transport is a life process in which a substance absorbed in one part of the body of an organism is carried to other parts of its body. Organisms need transport systems in their bodies to supply all their cells with food, oxygen, water and other materials.

HUMAN CIRCULATORY SYSTEM

The human circulatory system consists of the ***heart, arteries, veins, capillaries, and blood***.

BLOOD

Blood is a liquid called plasma with **red cells**, **white cells** and **platelets** floating in it. It is a red-coloured liquid which circulates in our body. The main components of body are:-

1. **Plasma** Plasma is a colourless liquid part of blood which consists mainly of water and certain dissolved substances such as proteins, digested food, common salt, waste products (like CO_2 and urea) and hormones. It carries all this dissolved substances from one part to another part in the body.
2. **Red Blood Cells (RBCs)** These cells are red in colour due to the presence of a red pigment called

haemoglobin inside them. RBCs carry oxygen from the lungs to all the cells of the body.

3. **White Blood Cells (WBCs)** WBCs fight infection and protect us from diseases. They are also called **as soldiers of the body**.
4. **Platelets** Platelets are the blood cells which circulates around the body and help in the **clotting of blood** in case of a cut or wound.

THE TUBES - BLOOD VESSELS

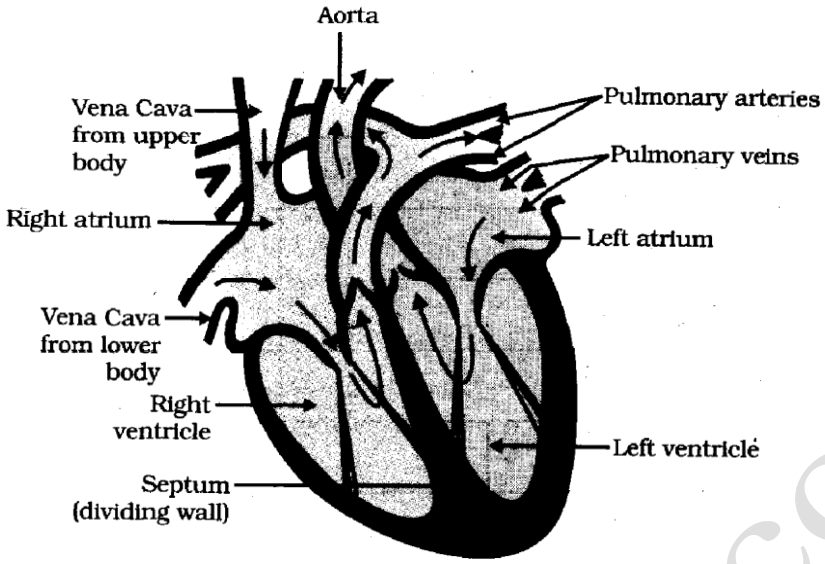
There are three types of blood vessels - Arteries, veins and Capillaries.

Arteries	Veins
1. They carry blood away from the heart to various organs of the body except pulmoary artery. 2. Arteries have thick elastic walls 3. They do not have valves.	1. They collect the blood from different organs and bring it back to heart. except pulmonary vein. 2. Veins have thin, non-elastic walls. 3. They have valves that ensure that the blood flows only in one direction.

- On reaching an organ or tissue the arteries divide into smaller and smaller **vessels** to bring the blood in contact with all the individual cells.
- The smallest vessels have walls which are one-cell thick and are called **Capillaries**. Exchange of material between the blood and surrounding cells takes place, across this thin wall.
- The capillaries then join together to form veins that convey the blood away from the organ or tissue.

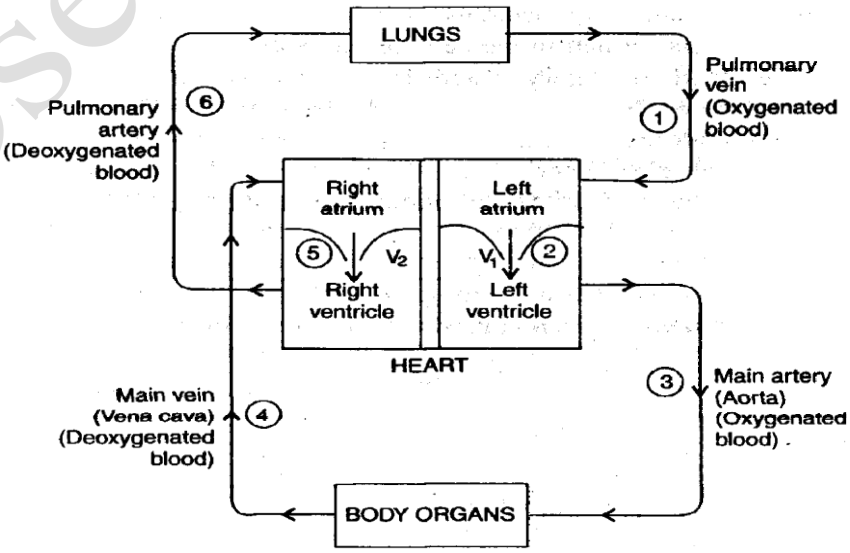
HEART

- The heart is a muscular organ that acts as a **pump** to push out blood. It is as big as our fist.
- Because both oxygen and carbon dioxide have to be transported by the blood, the heart has different chambers and prevent the oxygen-rich blood from mixing with the blood containing CO_2.
- There are four chambers in the heart; the upper two chambers of heart are called ***Atria***, and the lower two chambers are called ***Ventricles***.
- Carbon dioxide rich blood ***(deoxygenated blood)*** reach the lungs where CO_2 is removed from it and the oxygen rich blood ***(oxygenated blood)*** is brought back to the heart, from where it is pumped to rest of the body.



The circulation of blood in the human body occurs in following steps:-

1. When the muscles of all the four chambers of the heart are relaxed, the ***pulmonary vein*** brings the oxygenated blood from the lungs into **left atrium** of heart.
2. When the left atrium contracts, the oxygenated blood is pushed into the **left ventricle**.
3. When the left-ventricle contracts, the oxygenated blood is forced into main artery called ***'Aorta'***, which carries blood to all the organs of the body.
4. The deoxygenated blood from the body organs enters into the **Right Atrium** of the heart through main vein called ***Vena Cava***.
5. When the right atrium contracts, deoxygenated blood is pushed into the **right ventricle**.
6. And when the right ventricle contracts, the deoxygenated blood is pumped into the lungs through the ***pulmonary artery*** for oxygenation.
7. The blood goes twice through the heart during each cycle **(Double Circulation)**.



Since ventricles have to pump blood into various organs, they have thicker muscular walls than the atria do. **Valves** are also present in heart that ensure blood does not flow backwards when the atria or ventricles contract.

Animals that have high energy needs, such as birds and mammals *(including human beings)*, constantly use energy to maintain their body temperature and have **four-chambered heart**.

The animals such as amphibians and many reptiles do not need energy to maintain their body temperature and hence their requirement of energy is less. They have **three-chambered hearts**, and tolerate some mixing of oxygenated and deoxygenated blood streams.

Fishes have **two chambered hearts**, and the blood is pumped to the gills, where it is oxygenated and directly reaches to rest of the body. Thus, blood goes only once through heart in fishes during one cycle of passage through the body.

LYMPH

- Lymph is a tissue fluid which helps in transportation.
- Through the pores present in the walls of capillaries some amount of plasma, proteins and blood cells escape into intercellular spaces in tissues to form tissue fluid or **lymph**.
- Lymph is colourless and contains very less proteins.
- Lymph drains into lymphatic capillaries from intercellular spaces, which join to form large **Lymph vessels** that finally open into larger veins.
- Lymph carries digested and absorbed fat from intestine and drains excess fluid from extra cellular space back into blood.

BLOOD PRESSURE

- The force that blood exerts against the wall of a vessel is called ***Blood pressure***.
- The pressure of blood inside the artery during ventricular contraction is called ***systolic pressure***.
- Pressure of blood in artery during ventricular relaxation is called ***Diastolic pressure***.
- Normal systolic pressure is ***120 mm of Hg***.
- Normal Diastolic pressure is ***80 mm of Hg***.
- Blood pressure is measured using ***sphyganometer***.
- High blood pressure is called ***hypertension***. It is caused by constriction of arterioles, which results in increased resistance to blood flow.

TRANSPORT IN PLANTS

- Plants get O_2 and CO_2 directly from the air by diffusion. Other substances which are to be transported in a plant are water and minerals.
- For plants, soil is the nearest and richest source of raw materials like Nitrogen, phosphorus and other materials.
- Plants do not move, and plant bodies have a large proportion of dead cells in many tissues. As a result, plants have low energy needs, and can use relatively slow transport systems. The plants have two transport systems:-

(i) **Xylem** which carries water and minerals.

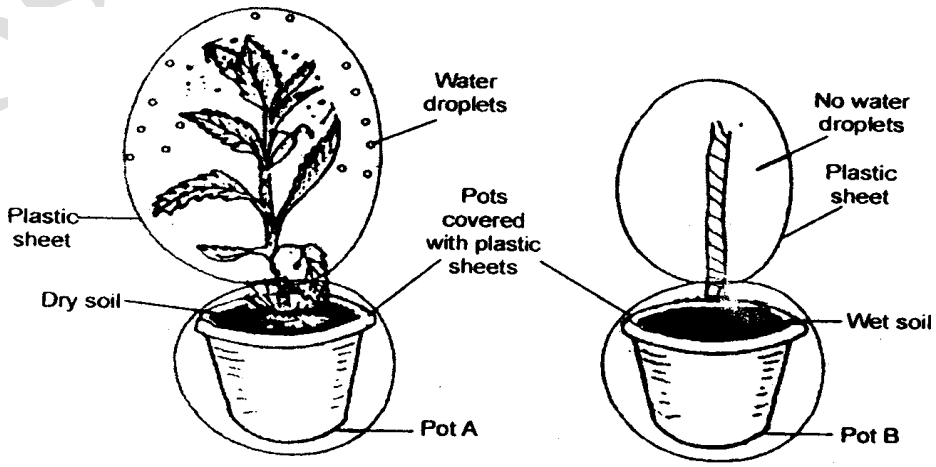
(ii) **Phloem** which carries the food materials which the plant makes.

Transport of water and minerals

- **Xylem** tissue has two kinds of elements – **Xylem vessels and tracheids**. The vessels and tracheids of roots, stem and leaves are interconnected to form a continuous system of water conducting channel reaching all parts of the plant.
- At the roots, the cells which are in direct contact with soil actively absorb minerals. Due to this, a difference in concentration of ions between the root and soil is created. To eliminate this difference, water moves from the soil into the root.
- Thus, there is a steady movement of water into the root xylem, that creates a column of water which is steadily pushed upwards. This is known as **Root pressure**.
- This root pressure helps in transport of water only in smaller plants it is not efficient in case of taller plants. In taller plants **suction pressure** helps in transport of water.
- In plants, lot of water from the leaves keep on evaporating into air through stomata. **This loss of water in the form of water vapours from the aerial parts of plant is known as Transpiration.**
- The water which is lost through stomata is replaced by water from the **Xylem vessels** in the leaf. This reduces the effective pressure at the top of Xylem vessels, so water flows up into them (from soil).
- Thus, continuous evaporation of water (or **Transpiration**) from the cells of leaf creates a kind of **Suction** which pulls up water through Xylem vessels. Transpiration also helps in water regulation.
- The effect of root pressure in transport of water is more important at night. During the day, when stomata are open, transpirational pull becomes the major driving force in the movement of water in the Xylem.

ACTIVITY - 6

AIM: ***To demonstrate the process of transpiration in plants.***



MATERIAL REQUIRED: Two small pots of same size, soil , one plant, another plant with stick of same size of first plant, plastic sheets.

PROCEDURE:

1. Take two small pots of approximately of same size.
2. Put same amount of soil in them.
3. Fix a plant in pot - A.
4. Place a stick of the same height as the plant in the other root - B.
5. Cover the soil in both pots with a plastic sheet so that moisture cannot escape by evaporation.
6. Cover both the sets, one with the plant and the other wtih the stick with plastic sheets.
7. Keep both the sets in bright sunlight for half an hour.
8. Observe the difference in both the sets.

OBSERVATION:

1. Soil of pot A will have less moisture than soil of pot B.
2. Water droplets observed in plastic sheet converting plant in pot A and no such observed in pot B.

CONCLUSION: As water has been lost by transpiration in the soil of the pot A the soil have less mositure content, while the soil of pot B was still wet as no transpiration occured. Water droplets are also observed due to the process of transpiration.

In both the case, loss of water through evaporation was not possible because they were covered with plastic sheets.

Transport of food and other substances

- Food made in the leaves of plant has to be transported to all parts of the plant like branches, stem and roots, etc.
- **The transport of food from the leaves to other parts of the plant is called translocation** and it occurs in the part of vascular tissue known as ***Phloem***.
- Besides the products of photosynthesis, the phloem transports amino acids and other substances. These substances are especially delivered to the storage organs of roots, fruits and seeds and to growing organs.
- The translocation of food and other substances takes place in the **sieve tubes** with the help of adjacent **Companion cells** both in upward and downward directions.
- **The movement of food in phloem (or translocation) takes place by utilising energy**. This happens as follows: - Sugar like sucrose is transferred into phloem tissue using energy from ATP.
- This increases the osmotic pressure of tissue causing water to move into it. This pressure moves the material in the phloem to tissues which have less pressure.
- This allows the phloem to move material according to the plant's needs.

EXCRETION

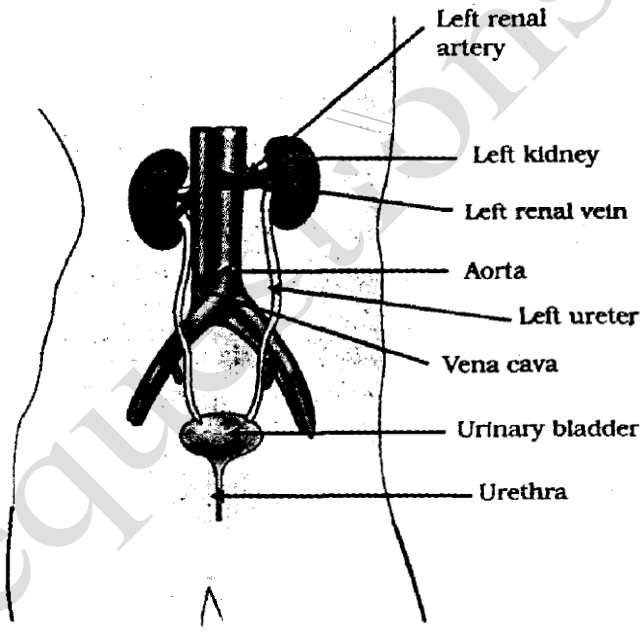
Metabolic activities in animals generate nitrogenous material (like urea) which are needed to be removed. The biological process involved in the removal of these harmful metabolic wastes from the body is

called **excretion**.

Different organisms use different strategies for excretion. In unicellular organisms like Amoeba, wastes are removed by ***simple diffusion*** from the body surface into the surroundings.

Excretion in human beings

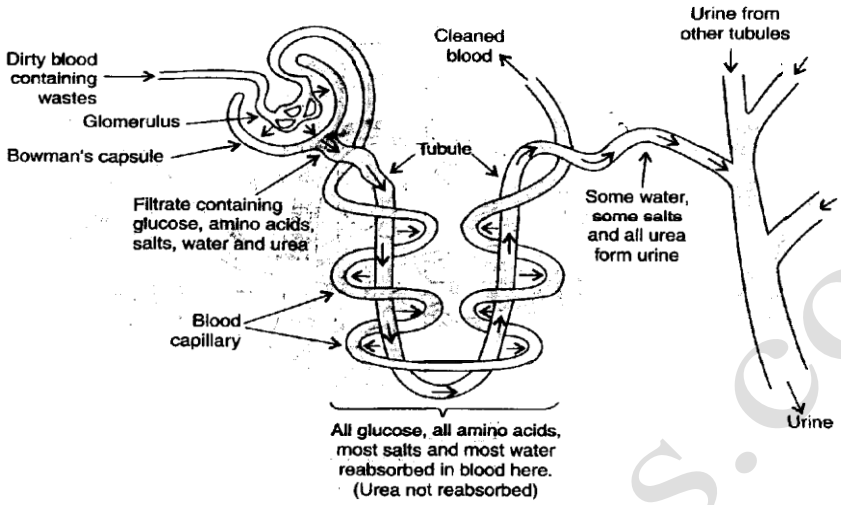
- Human body has different organs for the removal of wastes. These are ***lungs*** *and* ***kidneys***. Our lungs excretes **CO_2** and kidney excrete **urea** and **uric acid**.
- The main excretory system in humans include – ***two kidneys, two ureters, urinary bladder and urethra***.
- Kidneys are **bean-shaped** organs located in the abdomen. The function of kidneys is to remove the poisonous substances urea or uric acid other waste salts and excess water from the blood and excrete them in the form of yellowish liquid called **Urine**.
- Urine produced in the kidneys, passes through the ureters into the urinary bladder where it is stored until it is released through the urethra.



- Each kidney is made up of large number of basic filtration or excretory units called ***Nephrons***.
- Nephron has a cup-shaped bag at its upper end which is called ***Bowman's capsule***. The lower end of Bowman's capsule is tube shaped and it is called a ***Tubule***.
- Bowman's capsule contains a bundle of blood capillaries which is called ***Glomerulus***.
- The tubule of nephron selectively reabsorb useful substances like glucose, amino acids, salts and water into the blood capillaries. But, the waste material like urea remains behind in the tubule.
- The amount of water reabsorbed depends on how much excess water there is in the body and on how much of dissolved waste in to be excreted ***(Osmoregulation)***.
- The urine forming in each kidney eventually enters a long tube, the ***Ureter*** which connects the

kidneys with the ***Urinary bladder***.

- Urine is stored in urinary bladder until the pressure of expanded bladder leads to the urge to pass it out through the Urethra.
- The urinary bladder is under nervous control. As a result, we can usually control the urge to urinate.



ARTIFICIAL KIDNEY (HEMODIALYSIS)

- Several factors like infections, injury or restricted blood flow to kidneys reduce the activity of kidneys.
- This leads to accumulation of poisonous wastes in the body, which can even lead to death.
- In case of kidney failure, ***Artificial kidney*** can be used. It is a devise to remove nitrogenous wastes from blood through dialysis.
- Artificial kidneys contain a number of tubes with a semi-permeable lining, suspended in a tank filled with dialysing fluid. This fluid has the same osmotic pressure as blood, except that it is devoid of nitrogenous wastes.
- The patient's blood is passed through these tubes. During this passage, the waste products from the blood pass into **dialysing fluid** by diffusion.
- The purified blood is pumped back into the patient. This is similar to kidney function, but it is also different in that there is no re-absorption involved.

EXCRETION IN PLANTS

- Plants can get rid of excess water by **transpirtation**.
- Many plant waste products are stored in ***Cellular vacuoles***.
- Waste products may be stored in dead cell or leaves that fall off.
- Other waste-products are stored as ***resins and gums***, especially in old Xylem.
- Plants also excrete some waste substances into the soil around them.