



We have learnt that many of the objects around us are said to be alive while many others are not alive. Then, what are the differences between these living and non living objects ? If we see a grazing cow, a running cat, a man doing work, we know that these are alive. Even while they are sleeping we know that they are alive. Why ? Because they are respiring. So, all that are alive respire while those which are not alive do not respire. We also see that a calf grows up in size with the sucking of the mother's milk. A young plant also grows in size with time. Thus, all the living things grow in size with the consumption of food. We also see a cow giving birth to a calf, a hen laying eggs which later hatch to chicken. So the living organisms reproduce their own kind to continue their race.

In earlier classes, we have learnt that the living organisms possess well organised structures. They have organs, organs have tissues, tissues have cells, cells have smaller components in them and so on.

13.1. Processes required for living

The maintenance of the functions of the body go on continuously in living organisms. Even when they are not doing any work or even when they are asleep, these function go on continuously. The processes concerned with maintenance of life are **life processes**.

The life processes of the living body need energy. This energy normally comes from outside the body of the organism in the form of food. This energy from the food from outside the body of the organism is released inside the body by a process called **nutrition**.

Food, the outside sources of energy, may occur in varied forms. These food materials need to be broken down in the body and finally converted to a uniform source of energy that can be used for the various cellular functions necessary for maintaining life. A series of chemical reactions are necessary for this. Most common chemical reactions for breaking down molecules are oxidation-reduction reactions. For this, many organisms take in oxygen from

outside the body. This taking in of oxygen and breaking down of food materials inside the body for cellular need is known as **respiration**.

In most unicellular organisms, generally no specific organs or organ systems occur for taking in food, exchange of gases or removal of wastes, as the entire body surface is in contact with the environment. But, in case of multicellular organisms, most of the cells are not in direct contact with the surrounding environment. For them, various body parts have become specialised for performing these functions. These specialised structures or tissues also do the function of uptake of food and oxygen. But these are done only in the specialised parts of the body while every cell of the body needs these food and oxygen. Thus there arises a need for distribution of the food and oxygen to every cell by developing a transporting system.

When chemical reactions take place for the release of energy by using food materials and oxygen, by-products are released. Accumulation of these by-products beyond a permitted level is harmful to the body. So these are to be continuously removed from the body and discarded outside. This process is known as **excretion**. In multicellular organisms, a specialised system for excretion is present.

Now, let us discuss the various life processes, more in detail.

Let us answer these.

1. How can we know that something is alive ?
2. In which form the living organisms get energy from outside the body ?
3. What are life processes ?
4. No specific organ for gaseous exchange is needed in a unicellular organism. Why is it so ?

13.2. Nutrition

When we do some work or ride a bicycle, we are using up energy. Even when we are not doing any work or sleeping, we need energy to maintain a state of order in our body. We also need materials from outside the body in order to grow, to repair worn out tissues and also to synthesize protein and other substances needed in the body. The sources of energy and materials required come from the food we eat.

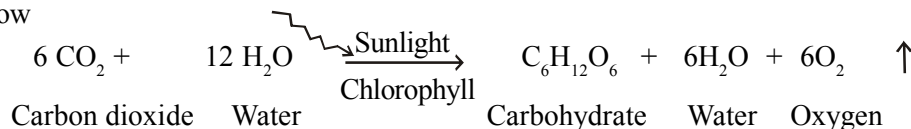
13.2.1. How do living things get their food ?

The requirement for energy and materials is common to all living organisms. But, it is fulfilled in different ways. Some organisms synthesize their food from simple inorganic components like carbon dioxide and water. These organisms, known as **autotrophs**, include green plants and some bacteria. Other organism, known as **heterotrophs**, utilise the food materials synthesized by the autotrophs. Thus, the heterotrophs depend directly or indirectly on autotrophs for their food. Heterotrophic organisms include animals, fungi and protists.

13.2.2. Autotrophic nutrition

Autotrophs take in simple substances from the outside and convert them into more complex forms of energy through a process called **photosynthesis**. In this process, carbon dioxide (CO_2) and water (H_2O) are converted into carbohydrates with the help of the light energy absorbed by the chlorophyll pigment of the green plants. Carbohydrates are utilized for providing energy to the plant and excess carbohydrates are stored in the form of starch.

During this process, oxygen (O_2) is evolved as a byproduct, as shown below



The following events occur during photosynthesis:

- (i) Chlorophyll of the plant traps the light energy.
- (ii) Conversion of light energy to chemical energy and splitting of water molecules into hydrogen and evolution of oxygen.
- (iii) Reduction of carbon dioxide to carbohydrates.

Activity 13.1.

- ☞ Take a potted plant with variegated leaves e.g. *Coleus* or *Croton*.
- ☞ Keep the plant in a dark room for three days. Pluck a leaf from the plant and keep the leaf in a dark place.
- ☞ Now keep the plant in sunlight for about 6 hours.
- ☞ Again pluck another leaf from it.

- ☞ Dip both the leaves in a beaker containing alcohol. Carefully place the above beaker in a water bath and heat till the alcohol began boil.
- ☞ Transfer the leaves in a beaker containing dilute solution of iodine for starch test.
- ☞ Take out the leaves and rinse with clean water.
- ☞ Observe the colour of the leaves.

What can you conclude from the above experiment ?

Why the first leaf does not change its colour after starch test ?

Why the second leaf shows colouration only in various places ?

13.2.3. Let us see how CO₂ and chlorophyll are necessary for photosynthesis

A transverse section of a green leaf under the microscope (Fig. 13.1.) shows the presence of many cells containing green dot like cell organelles. These dot like organelles are the chloroplast which contain chlorophyll.

How do the plants obtain carbon dioxide ?

The stomata are the minute openings present on the epidermis of green leaves through which gases move in or out during photosynthesis. Water is also lost in the form of water vapour through these pores. Each stoma is surrounded by two specialised, kidney shaped **guard cells**. A few cells adjacent to guard cells are modified into **subsidiary cells**.

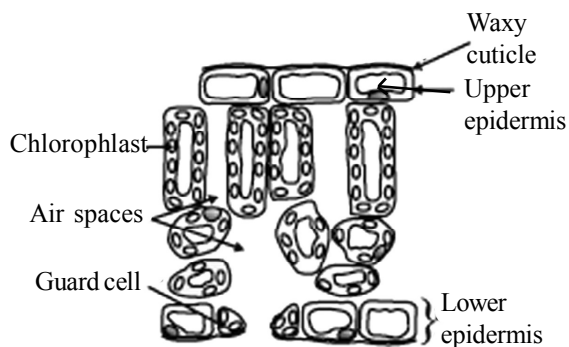


Fig. 13.1. Cross section of a leaf

These pores close when the plant does not need carbon dioxide for photosynthesis. The opening and closing of the stomata is brought about by the change in shape of the guard cells. The stomatal pore remains open when the guard cells swell due to the absorption of water and closed when the guard cells shrink (Fig. 13.2).

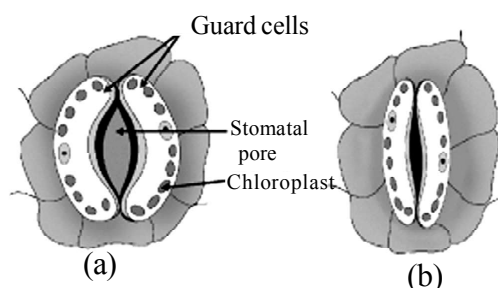


Fig. 13.2. (a) Opened stoma
(b) Closed stoma

The water used during photosynthesis is absorbed from the soil by the roots of land plants. Other nutrients like nitrogen, phosphorus, magnesium and iron etc. are also absorbed from the soil. Nitrogen is absorbed from the soil in the form of inorganic nitrates or nitrites or as organic compounds prepared by bacteria.

13.2.4. Heterotrophic Nutrition

Animals are heterotrophic organisms requiring readymade organic and inorganic compounds as food. These food substances are broken down, absorbed and used as a source of materials and energy.

Types of heterotrophic nutrition

- (i) Holozoic animals take in whole material and break it down inside their bodies. Protists like *Amoeba* and higher animals are important examples.
- (ii) Saprozoites like roundworms and flatworms feed on soluble organic matter in solution.
- (iii) Saprophytic fungi and bacteria break down the food materials outside the body and then absorb it.
- (iv) Parasitic organisms obtain their food from the body of other living organisms called the host. Examples are *Cuscuta*, Ticks, Leeches, etc.

13.2.5. Nutrition in Animals

In different animals, the food and the way it is obtained are different. So the digestive system is also different in different animals. In single celled organisms, the food may be taken in by the entire body surface. But, with the increase of complexity of the organism, different parts become specialised to perform different functions. In *Amoeba*, food is taken in by using pseudopodia which are temporary finger-like extensions of the cell surface and form a temporary food vacuole. Inside the food vacuole, complex substances are broken down into simple forms that are absorbed by the cytoplasm. The undigested material is thrown out of the body by moving to the surface. In *Paramoecium* which is also a unicellular organism, the cell body has a definite shape and food

is taken in at a specific spot. Food is driven to this spot by the action of the moving cilia which cover the entire surface of the body.

In higher animals, for example, in human beings, the alimentary canal is basically a long tube extending from the mouth to the anus. The tube has different regions specialised to perform different functions. The different types of food we eat are crushed into small fragments in the mouth with the help of teeth.

During crushing, the food is also mixed with saliva secreted by the salivary glands in the mouth. This makes the crushed food particles soft and facilitate swallowing. The saliva also contains an enzyme, ptyalin (salivary amylase) which initiates the digestion of starch to make simple sugars. The lining of the alimentary canal has muscles that contract involuntarily and rhythmically to push the food down the alimentary tract. This rhythmic movement is known as **peristalsis** and occurs all along the gut.

The food from the mouth comes to the stomach passing through the oesophagus. The stomach is a large bag like organ which expands when food enters into it. The muscular walls of the stomach which also performs peristaltic movement, help in mixing the food thoroughly with digestive juices secreted by the gastric glands of the stomach. The gastric glands secrete hydrochloric acid (HCl), pepsin (a protein digesting) enzyme and mucus. The HCl creates an acidic medium which facilitates the action of the enzyme pepsin. It also kills some of the micro-organisms entering the stomach along with the food materials. The mucus in the stomach protects the inner lining of the stomach from the action of HCl.

The stomach is followed by the small intestine. The passage of food from the stomach to the small intestine is regulated by a sphincter muscle. The small intestine is the longest part of the alimentary canal which is fitted into a compact space because of extensive coiling. The length of the small intestine varies in different animals depending on the type of food they eat. The small

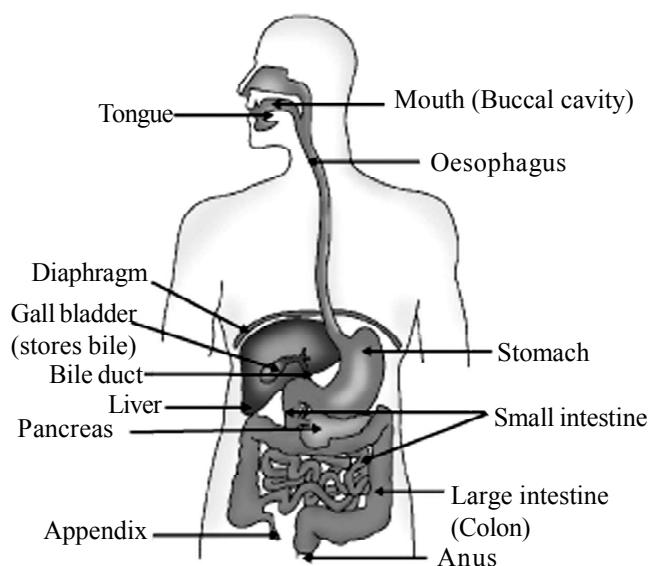


Fig.13.3. Human alimentary canal

intestine is very long in herbivores. This facilitates digestion of the cellulose of the plants by passing the food through a long distance. The small intestine is shorter in carnivores because it is easier to digest the animal tissues.

The digestion of carbohydrates, proteins and fats are completed in the small intestine. It receives the secretion of the liver, the bile and the secretion of the pancreas, the pancreatic juice. The food coming from the stomach is acidic as it is mixed with HCl. This acidic food has to be made alkaline since the pancreatic enzymes act in an alkaline medium. This change from acidic to alkaline medium is achieved with the help of bile. Bile salts also act on large fat globules and break them down to smaller globules thus helping in the digestion of fat. It is known as emulsification of fat.

The pancreatic juice contains enzymes such as trypsin for digesting proteins, lipase for digesting emulsified fats. It also contains the enzyme amylase for the digestion of carbohydrates. The walls of the small intestine also contain glands which secrete protein, carbohydrate and fat digesting enzymes. These enzymes finally convert the proteins to amino acids, complex carbohydrates into glucose and fats to fatty acids and glycerol.

The digested food is absorbed by the wall of the small intestine. The inner lining of the small intestine is provided with numerous, small, finger like projections called **villi** which increase the surface area of absorption.

The villi are richly supplied with blood vessels. The absorbed food is transported by blood to each and every cell of the body, where it is used for obtaining energy, building up new tissues and repair of damaged tissues.

The undigested and unabsorbed food is sent to the next part of the alimentary canal, the large intestine. Here most of the water is absorbed in the blood. After this the undigested portion of the food is removed from the body through the anus. The exit of undigested waste material is regulated by a sphincter muscle of the anus.

Let us answer these.

1. What are the differences between autotrophic and heterotrophic nutritions?
2. From where plants get the raw materials required for photosynthesis?
3. What are the different types of heterotrophic nutrition ?

4. Write the role of HCl in our stomach.
5. What are the functions of digestive enzymes ?
6. How does the small intestine designed to absorb digested food ?

13.3. Respiration

Activity 13.2.

- ☞ Take a clean test tube and fill about half of it with freshly prepared lime water.
- ☞ Blow air into this lime water by using a glass tube.
- ☞ Note how long it takes for the lime water to turn milky.
- ☞ Take another test tube and fill about half of it with freshly prepared lime water as before.
- ☞ Allow air to pass through the lime water using a syringe.
- ☞ Note in this case also how long it takes for this lime water to turn milky.

What does this tell us about the amount of CO₂ in the exhaled air ?

We know that during the process of nutrition food material is taken in the body of the organism. This food material is used in cells to provide energy for various life processes. Diverse forms of organisms do this in different ways. Some use oxygen to break down glucose completely into CO₂ and water, some use other pathways that do not use oxygen. The first step of the reaction for the liberation of energy in all cases is the break down of glucose, a six carbon molecule, into a three carbon molecule called **pyruvate** (Fig. 13.4.). This process takes place in the cytoplasm. Pyruvate may further be converted into ethanol and carbon dioxide. This takes place in yeast during fermentation. Since this process takes place in the absence of oxygen, it is called **anaerobic respiration**. Pyruvate may also be broken down by using oxygen in the mitochondria. In this process, the three carbon pyruvate is broken down to give three CO₂ molecules and water. Since this process takes place in the presence of oxygen, it is called **aerobic respiration**. The release of energy in the aerobic process is greater than in anaerobic process. There is another pathway for breakdown of pyruvate. This takes place when there is lack of oxygen in the muscle cells. In this pathway the pyruvate is converted to lactic acid which is also a three carbon molecule. The accumulation of lactic acid in our muscles during sudden activity causes **cramps**.

The energy released during cellular respiration is immediately used up to synthesize a molecule called ATP. All the energy required for different life processes are supplied in the form of ATP. During the process, ATP is broken down giving rise to a fixed amount of energy. This energy can drive the endothermic reactions taking place in the cell.

Being a living organism, plants also need energy. The energy is supplied by the process of respiration. The process of aerobic respiration is similar in

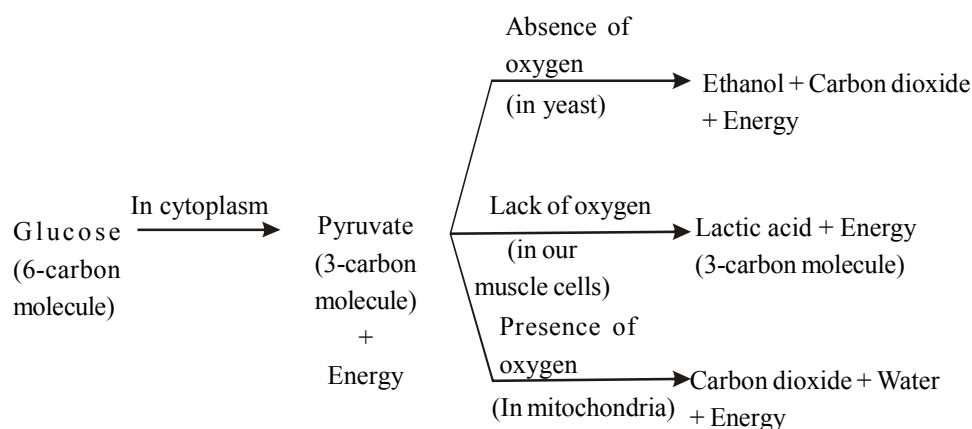


Fig. 13.4. Break down of glucose by various pathways

both plants and animals. The exchange of gases in plant takes place through the stomata and the large intercellular spaces ensure that all cells are in contact with air. The exchange of oxygen and carbon dioxide between the cells and atmosphere occurs by **diffusion**. The direction of diffusion depends upon the environmental conditions and the requirements of the plant. The CO_2 released by respiration during daytime is used up by photosynthesis, hence there is no CO_2 released but O_2 is released. At night, there is no photosynthesis, so CO_2 is eliminated as a byproduct. The unique feature in plant respiration is anaerobic respiration. This process does not occur in animals.

Various animals have developed different organs for taking in oxygen and giving out CO_2 . The terrestrial animals use atmospheric oxygen for breathing but the aquatic animals used oxygen dissolved in the water.

The amount of oxygen dissolved in water is very low when compared to the amount of oxygen present in the atmospheric air. So the rate of breathing in aquatic organisms is much faster than that in terrestrial animals. For breathing, fishes take in water through their mouths and force it to pass the gills where the dissolved oxygen is taken up by blood through diffusion.

Activity 13.3

- ☞ Observe some fishes in an aquarium. They open and close their mouths and gill slits or the operculum covering the gill slits also open and close. Are the timings of the opening and closing of the mouth and gill slits co-ordinated in some manner ?
- ☞ Count the number of times the fish opens and closes the mouth in a minute.
- ☞ Compare this to the number of times you breathe in and out in a minute.

Different terrestrial animals have different organs to absorb atmospheric oxygen. All these organs have a structure that increases the surface area which is in contact with the oxygen rich air. Since the exchange of oxygen and carbon dioxide has to take place across this surface, it is very fine and delicate. Moreover, in order to protect the surface, it is lodged inside the body and so there have to be a passage that will take air to this area. A mechanism to move the air in and out of this area where the oxygen is absorbed is also developed.

Human beings take in the air into the body through the nostrils. The passage is provided with fine hairs and mucus to filter the air. From the nostrils the air comes to the lungs passing through the throat. The throat is provided with rings of cartilages. These ensure that the air passage does not collapse.

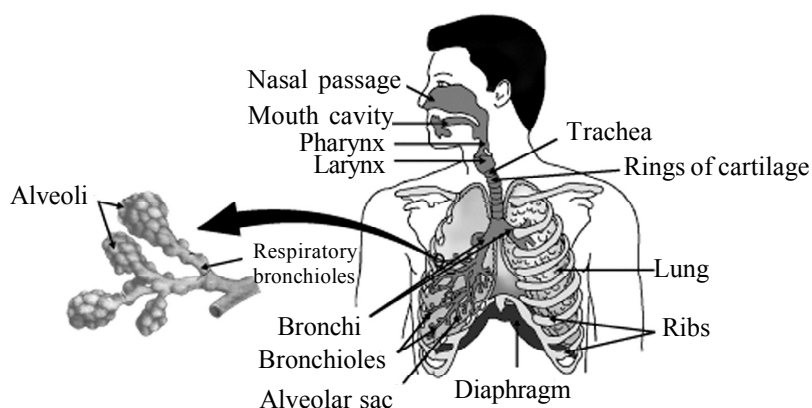


Fig.13.5. Human respiratory System

The wind pipe or air passage known as **trachea** divides into two **bronchi** leading each to each lung. In the lungs the bronchi divide into smaller branches called **bronchioles**. These bronchioles end in alveolar sac where the gaseous exchange takes place. The walls of the alveoli contain an extensive network of blood-vessels. When we breathe in the ribs are lifted and the diaphragm is flattened. As a result the chest cavity becomes larger. By doing so, the air is sucked into the lungs and fills the expanded alveoli. The blood in the alveolar blood vessels absorb the oxygen from the alveolar air and the carbon dioxide in the alveolar blood vessels diffuse out in the alveolar sac. The oxygen absorbed in the alveolar blood vessels is transported to all the cells of the body. During the 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 oxygen to be absorbed and for the carbon dioxide to be released.

When the body size of the animal is large, the diffusion pressure alone is not sufficient for supply of oxygen to all parts of the body. In addition there are respiratory pigments in the blood which take up oxygen from the air in the lungs. In human beings, haemoglobin is the respiratory pigment. It has very high affinity for oxygen. This pigment is present in the red blood corpuscles (RBC). Carbon dioxide is more soluble in water than oxygen. So, it is mostly transported in the dissolved form in our blood.

Do you know ?

- ⇒ *If the alveolar surface were spread out it would cover about $80m^2$. What is the approximate surface area of your body ? Consider how efficient exchange of gases carried out because of the large surface area available.*
- ⇒ *If diffusion were to move oxygen in our body, it is estimated that it would take about 3 years for a molecule of oxygen to get to our toes from our lungs. This does not happen due to the presence of haemoglobin.*

Let us answer these.

1. What advantage does a terrestrial animal get with regard to obtain oxygen during respiration over an aquatic animal ?
2. How is oxygen and carbon dioxide transported in human beings ?
3. “The human lungs are designed to have maximum surface area for exchange of gases”. Explain.

13.4. TRANSPORTATION

Transportation in Human beings

13.4 Activity

- ☞ Visit your local health centre and find out what is the normal range of haemoglobin content in human beings.
- ☞ Is it same for children and adults ?
- ☞ Is there any difference in the haemoglobin levels for men and women ?

In previous sections, we have seen that the blood transports digested food, oxygen, carbon dioxide, waste materials, etc. in our bodies. In previous classes also we have learnt that the blood is a fluid connective tissue. Blood consists of a fluid called plasma and cells suspended in it. Plasma transports digested food materials, carbon dioxide and nitrogenous wastes in dissolved forms. Oxygen is transported by red blood corpuscles. Many other substances like salts, hormones are also transported by the blood. Thus, for transporting various substances from one part of the body to another part, there is the necessity of a pumping organ to ensure a continuous flow of blood and a network of blood vessels to reach all the tissues.

13.4.1. Heart

The heart is the pumping organ which send blood to every part of the body. The human heart is a muscular organ which is as big as our fist. Since both oxygenated and deoxygenated bloods are to be transported by the heart, it has four separate chambers to check the mixing of the two types of blood.

The oxygen rich blood from the lungs comes to the left upper chamber of the heart known as the left atrium. It is a thin walled chamber. The left atrium relaxes when the blood enters into it. Then it contracts and the blood from this enters the thick walled left ventricle. When the left ventricle contracts the blood is

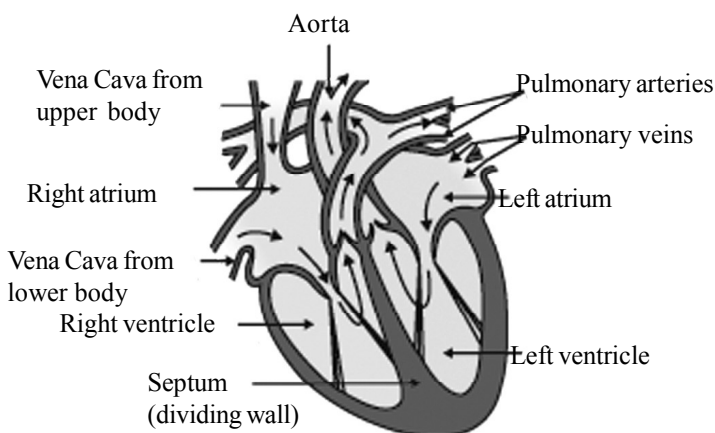


Fig.13.6. Sectional view of the human heart.

pumped out to the different parts of the body. Deoxygenated blood returning from different parts of the body enters the right atrium when it expands. As the right atrium contracts, the blood from here enters the right ventricle. When the right ventricle contracts in turn the deoxygenated blood from here is pumped to the lungs for oxygenation. The ventricles pump the blood to various organs, they have thick muscular wall while the atria have comparatively thinner walls. The back flow of the blood when the atria or ventricles contract is checked by the presence of valves.

The separation of the flow of blood in the right and left sides of the heart is useful in preventing the mixing of oxygenated and deoxygenated blood. This complete separation of the two types of blood gives a sufficient supply of oxygenated blood in the animals that have high energy needs. Such type of heart is present in birds and mammals which constantly use energy to maintain their body temperature. Animals like amphibians and many of the reptiles have only three chambered heart in which there is mixing of oxygenated and deoxygenated blood. In these animals the body temperature depends on the temperature of the environment. In fishes also the body temperature depends on the temperature of the surrounding environment. In these animals the heart is only two chambered. The deoxygenated blood collected in the heart is pumped to the gills for oxygenation. From the gills after oxygenation the blood is supplied to different parts of the body. So the heart in fishes contains only deoxygenated blood. Thus, in these animals the blood passes only once through the heart during one cycle of flow through the body. In other higher vertebrates, the blood goes through the heart twice during each cycle. Such condition is known as double circulation.

13.4.2. Blood vessels

The blood vessels which carry blood from the heart to various organs of the body are the **arteries**. These are thick walled because they are to carry the blood emerging under high pressure from the heart. The blood vessels which collect blood from various organs and return it to the heart are the **veins**. These are thin walled because the blood passing through them are not under high pressure. They possess valves which check the backflow of blood.

The artery divides into smaller and smaller vessels in the organs or tissues and the smallest vessels are known as **capillaries**. The capillary wall is of one-cell thickness and arranged in such a way that each and every cell is in contact with blood. Exchange of materials between the blood and surrounding

cells takes place across this thin wall. After supplying blood to the cell the capillaries join together to form veins and carry the blood from the organs or tissues and back to the heart.

13.4.3. Platelets

When there is an injury, bleeding starts. The leakage in the blood vessels would lead to a loss of pressure which would reduce the efficiency of the pumping system. To prevent it, there are platelets in the circulating blood which bring about the clotting of blood. Clotting prevents the loss of blood from the sides of injury.

13.4.4. Transportation in Plants

Plant transport systems involve the movement of raw materials from roots to the leaves for photosynthesis and synthesized food from leaves to the different parts of the plant. Movement of water and minerals is through the xylem and transport of photosynthetic products is through the phloem.

In lower plants, transport of water and other organic materials is done by different processes like simple diffusion, osmosis and active transport. Transportation of substances in algae and fungi take place across the cell membrane and within the cell cytoplasm by the above processes.

How the transportation takes place in vascular plant ? What types of forces are essential for transportation in higher plants.

In higher plants, the leaves can directly absorb carbon dioxide through diffusion for the process of photosynthesis. Other kinds of raw materials needed by the plant are taken in the form of solution through its root system. If the distance between the root system and chlorophyll containing parts are short, energy and raw materials can be easily diffused to all parts of the plant body. In trees the distance become long and simple diffusion processes is not sufficient. So a proper system of transportation is essential in such situation.

A single rye plant in four months of growth have 350 km of roots. There are approximately 13 million root tips possessing an estimate total of 14 billion root hairs.

13.4.5. Transport of water in vascular plant

The water conducting system of higher plant includes xylem tissues, like vessels and tracheids of the roots, stems and leaves are interconnected to form

a continuous system reaching all parts of the plant. The capacity of root cells to take up ions from the soil creates a difference in the concentration of these ions between the root and the soil. So, water moves from the soil into the root to stabilize this difference. Such a steady movement creates a pressure that can push the water upward. The root pressure is not enough to lift the water upto the height that we commonly see in a plant. Plants thus, have to use other strategies to overcome it.

13.5. Activity.

- ☞ Cut a leafy twig of Balsam plant (it has semitransparent stem) under water to avoid entry of airbubble through the cut end.
- ☞ Place the cut end in a beaker containing water coloured with eosin (a red dye) dissolved in it.
- ☞ After some time red lines will be seen moving upward through the stem.
- ☞ If a section of the stem is observed under microscope, only the xylem elements will be seen filled with coloured water.

In which tissues transport of water takes place ?

Can uplift of water takes place without root ?

What are the processes responsible for the uplift of water through stem ?

Water is lost in the form of water vapour from the aerial portion of the plant through the stomata of leaf. This loss of water is replaced by water from the xylem vessels in the leaf and also creates a suction which pulls water from the xylem cells of roots.

Thus the loss of water in the form of vapour from the aerial portions of the plant is called **transpiration**. It helps in the absorption and movement of water and minerals dissolved in it from the roots to the leaves. It also helps in temperature regulations. During night transportation of water is done by root pressure and by transpiration during daytime when the stomata are open. So transpirational pull is major driving force in the movement of water in the xylem.

13.4.6. Transport of food and other substances

The transport of soluble products of photosynthesis from the leaves and stem to the other parts of the plant through the phloem is called **translocation**. Phloem also transport amino acids and other substances. The upward and

downward translocation of food and other substances takes place through the sieve tubes with the help of companion cells of phloem tissue.

Unlike water transport, the translocation in phloem is performed by utilising energy from ATP. The transfer of substances like sucrose into the phloem tissue results in increase of osmotic pressure causing water to move into it. This pressure moves the material in the phloem tissues which have less pressure. In this way the materials are translocated by the phloem to all the parts of a plant, which need it for various activities and storage. During spring stored materials in root or stem tissue would be transported to the bud which need energy to grow.

Let us answer these.

1. Name the components of the transport system in human being. Write the functions of the components.
2. What are the advantages of separation of oxygenated and deoxygenated blood in birds and mammals ?
3. What are the components of the transport system in highly organised plants ?
4. How are water and minerals transported in plants ?
5. How is food transported in plants ?

13.5. Excretion

The removal of harmful metabolic waste from the body is known as **excretion**. The metabolic activities in the body generate nitrogenous materials. These nitrogenous wastes are harmful if accumulated in the body so these are to be removed. Different organisms use different devices for the removal of waste materials. Many unicellular animals remove these waste products by diffusion through the body surface to the surrounding water. Other multicellular organisms use specialised organs for the removal of the nitrogenous wastes.

13.5.1. Excretion in Animals

Different groups of animal have different organs for the removal of nitrogenous waste products.

Certain animals like platyhelminthes use structures called **flame cells** to remove the waste products. The Insects remove the nitrogenous waste by the help of structures called **Malpighian tubules**. The vertebrates have **kidney** for excretion. In human beings the excretory system consists of a pair of kidneys, a pair of ureters, a urinary bladder and a urethra.

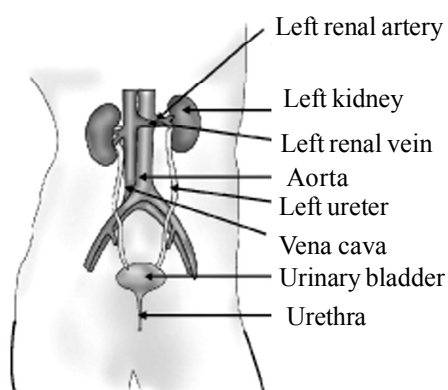


Fig. 13.7. Excretory system in human beings

Kidneys are located in the abdomen, one on either side of the backbone. Urine produced in the kidneys passes through the ureter and is stored in the urinary bladder. From the urinary bladder it is released through the urethra.

Nitrogenous waste products collected by the blood from different organs of the body are filtered in the kidney. Such compounds like urea or uric acid are removed from the blood. Like

in the lungs, clusters of very thin walled blood capillaries are present in the kidney. Each capillary cluster in the kidneys is associated with the cup-shaped end of a tube that collects the filtered urine. Each kidney has large numbers of these filtration units called **nephron** packed closed together. Some substances

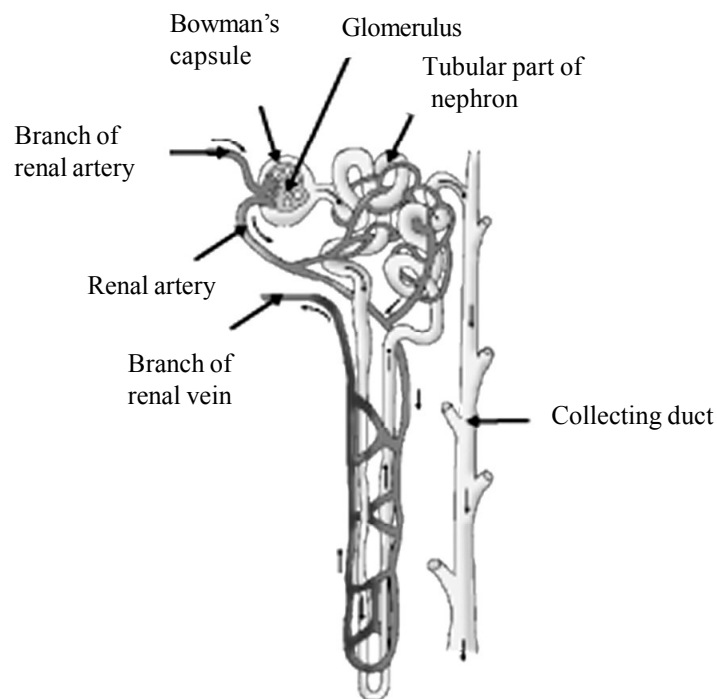


Fig. 13.8. Structure of a Nephron

like glucose, amino acids, salt and major amount of water are selectively re-absorbed as the urine flows along the tube. The urine forming in each kidney enters a long tube, the ureter, which connects the kidneys with the urinary bladder. From the urinary bladder the urine passes out of the body through the urethra.

13.5.2. Excretion in plants

Plants give out oxygen during photosynthesis and carbon dioxide during respiration. Water is released as vapour during day time and in liquid form during night. Roots also exude waste materials into the soil. All mineral salts absorbed in the form of ions are not essential in plants. The excess minerals are deposited in the leaves that fall off. Other waste products are stored as resins and gums specially in old xylem.

Let us answer these.

1. What are the methods used by plants to get rid of excretory products ?
2. Which organs are responsible for excretion in platyhelminthes and insects ?

POINTS TO REMEMBER

- ⇒ All living organisms respire.
- ⇒ The maintenance of life requires processes like nutrition, respiration, transport of materials within the body and excretion of waste products.
- ⇒ Autotrophic nutrition involves the manufacture of complex high energy organic material from simple inorganic materials by using solar energy.
- ⇒ Heterotrophic nutrition involves the intake of complex material prepared by other organisms.
- ⇒ In human beings the food eaten is broken down by various steps along the alimentary canal and the digested food is absorbed in the small intestine to be sent to all cells in the body.
- ⇒ Respiration provides energy in the form of ATP by broken down complex organic compounds such as glucose. ATP is the source energy for other reactions in the cell.
- ⇒ Respiration may be aerobic or anaerobic. Aerobic respiration produces more energy available to the organism.

- ⇒ In human being, the transport of materials such as oxygen, carbon dioxide, food and excretory products is the function of the circulatory system. The circulatory system consists of the heart, blood and blood vessels.
- ⇒ In highly differentiated plants, transport of water, minerals, food and other materials is a function of the vascular tissues which consist of xylem and phloem.

EXERCISES

1. What is the function of xylem ?
2. Which part of the alimentary canal absorbs the digested food ?
3. In which part of the cell the three carbon compound pyruvate is broken down to give CO_2 , H_2O and energy.
4. What is the function of kidney ?
5. Describe the structure and function of nephrons.
6. Describe double circulation in human being.
7. How are the alveoli designed to maximise the exchange of gases ?
8. What is the role of saliva in the digestion of food ?
9. How does the small intestine designed to absorb digested food ?
10. What are the differences between the transport of materials in xylem and phloem?
11. What are the differences between aerobic and anaerobic respiration ? Name some organisms that use the anaerobic mode of respiration.
12. What are the necessary conditions for autotrophic nutrition and what are its byproducts ?
13. What would be the consequences of a deficiency of haemoglobin in our bodies ?
14. Compare the alveoli in the lungs and nephrons in the kidneys with respect to their structure and function.
15. Draw and label the sectional view of the human heart.