Chapter 6
Life Processes

Life processes are the essential activities that living organisms carry out to maintain their life. These processes are crucial for the survival of all living organisms. In this chapter we will be studying about **Nutrition, Respiration, Transportation** and **Excretion.**

Nutrition

The process of taking in food and converting it into energy for the body is called nutrition. It includes ingestion, digestion, absorption, assimilation, and egestion.

Types of nutrition: Autotrophic and Heterotrophic.

Autotrophic nutrition: In this mode of nutrition an organism prepares its own food by the process of photosynthesis. For example: green plants and blue-green algae. Such organisms are called autotrophs.

Photosynthesis: The process by which green plants prepare their own food is called photosynthesis. During photosynthesis, carbon dioxide (CO_2) from the air and water (H_2O) from the soil are combined to produce glucose ($C_6H_{12}O_6$) and oxygen gas(O_2). Following events occur during photosynthesis:

- Absorption of light energy by chlorophyll.
- Conversion of light energy to chemical energy.
- Splitting of water molecules into hydrogen and oxygen.
- Reduction of carbon dioxide to carbohydrates.

$$6CO_2 + 12H_2O \xrightarrow[\text{Sunlight}]{\text{Chlorophyll}} \underset{\text{(Glucose)}}{C_6H_{12}O_6} + 6O_2 + 6H_2O$$

Stomata: Stomata are small openings on the surface of plant leaves that allow for gaseous exchange and transpiration. The opening and closing of stomata is controlled by specialized cells called guard cells. The guard cells swell when water flows into them from the surrounding cells causing the stomatal pore to open. Similarly, the pore closes if the guard cells shrink.

Heterotrophic nutrition: Heterotrophic nutrition is a type of nutrition where an organism obtains its food from other organisms. For example: deer, fungi, etc. Such organisms are called heterotrophs.

Types of heterotrophic nutrition: saprophytic, holozoic, and parasitic.

- **Saprophytic Nutrition**: Saprophytic nutrition is a type of nutrition in which an organism obtains its food by feeding on dead and decaying organic matter. The organism secretes digestive juices on the food material and then the digested food is ingested by the organism. Few examples are fungi like bread moulds, yeast and mushrooms.
- **Holozoic Nutrition**: In holozoic nutrition, the digestion happens inside the body of the organism after the food is ingested.
- **Parasitic Nutrition**: Parasitic nutrition is a type of nutrition in which an organism (parasite) feeds on another living organism (called the host). For example, cuscuta (amar-bel), ticks, lice, leeches and tape-worms.

Nutrition in Amoeba:

Amoeba is a unicellular organism that exhibits holozoic nutrition. Amoeba's nutrition is a combination of ingestion, digestion, absorption, assimilation and egestion of food.

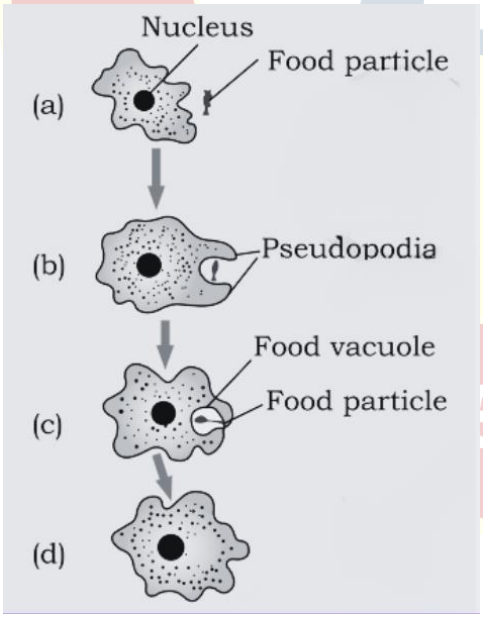
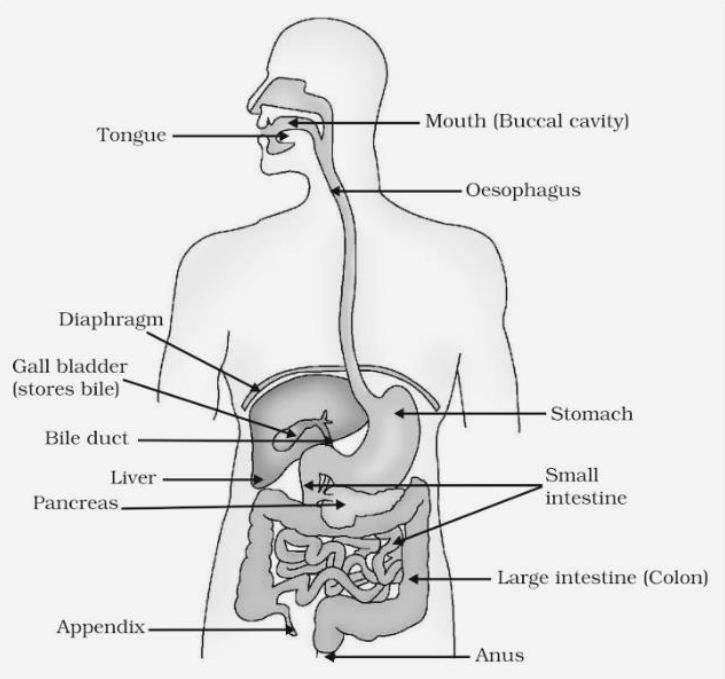


Fig: Nutrition in Amoeba

- When the amoeba encounters a food particle, it extends its pseudopodia around the food and engulfs it.
- The food is then enclosed in a food vacuole within the cytoplasm of the amoeba. Digestive enzymes are secreted in the food vacuole and digestion takes place.
- Digested food is absorbed by the cytoplasm and used for energy production, growth, and repair.
- After the digestion is complete, the undigested waste materials are eliminated from the cell through a process called exocytosis.

Nutrition in Human Beings

Human beings exhibit holozoic nutrition, which involves the ingestion of food followed by the digestion, absorption, and assimilation of nutrients. The human digestive system includes alimentary canal and several other organs, such as the salivary glands, liver, gallbladder, and pancreas, which produce and secrete digestive juices and enzymes that help in the digestive process.



- Alimentary canal comprises of mouth, oesophagus, stomach, small intestine and large intestine.
- The mouth has teeth, tongue and salivary glands. The tongue helps in tasting the food, mixing the food with saliva and swallowing the food.
- Teeth help in breaking down the food so that, swallowing becomes easier.
- Salivary glands secrete saliva. Saliva contains *salivary amylase* enzyme. Salivary amylase digests starch and converts it into simple sugar. Also, saliva makes the food slippery which makes it easy to swallow the food.
- Oesophagus (food pipe) takes food from mouth to stomach by peristaltic movement. Peristaltic movement is rhythmic contraction of muscles of the lining of the alimentary canal to push the food forward.
- Stomach is a large bag-like organ. The muscular walls of the stomach help in mixing the food thoroughly with digestive juices. Gastric glands present in the wall of the stomach release hydrochloric acid, *pepsin* (a protein digesting enzyme), and mucus.
- Hydrochloric acid makes the medium inside the stomach acidic which is necessary for *pepsin* enzyme to work. It also kills the germs present in food.
- The enzyme *pepsin* helps in digestion of proteins.
- The mucus, secreted by the walls of the stomach saves the inner lining of the stomach from getting damaged from hydrochloric acid.

- The small intestine is a long, narrow tube-like organ located in the lower part of the digestive tract. It is the longest part of the digestive system. Also, it is the site of the complete digestion of carbohydrates, proteins and fats. It receives bile juice and pancreatic juice for this purpose.
- Bile juice is produced by liver and stored in gall bladder. i) Bile neutralises the acidity of food coming from stomach. ii) A major function of bile is to break fat into fine globules for the action of *lipase* enzyme. Breaking of fat into fine globules is called emulsification of fats.
- Pancreas secretes pancreatic juice which contains *trypsin* for digesting proteins, *lipase* for breaking down emulsified fats and *pancreatic amylase* for digestion of carbohydrates.
- The walls of small intestine secrete intestinal juice which finally convert the proteins to amino acids, complex carbohydrates into glucose and fats into fatty acids and glycerol.
- The inner lining of the small intestine has numerous finger-like projections called villi which increase the surface area for absorption. The villi are richly supplied with blood vessels and they help in absorption of digested food.
- The undigested food goes into the large intestine. Absorption of water takes place in large intestine. After that, the undigested food goes to the rectum, from where it is removed from the body through the anus (egestion).

Respiration

Respiration is the process of releasing energy from food.

Types of respiration: aerobic respiration and anaerobic respiration

Aerobic respiration

- happens in the presence of oxygen
- occurs in *mitochondria*
- carbon dioxide and water are formed
- more amount of energy is released

Anaerobic respiration

- happens in the absence of oxygen or lack of oxygen
- occurs in *cytoplasm*
- end products are alcohol or lactic acid
- less amount of energy is released

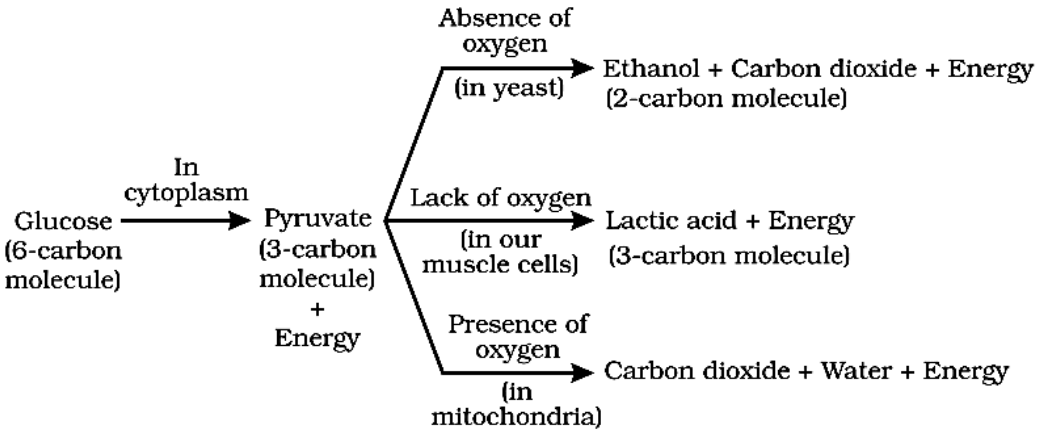


Fig: Break-down of glucose by various pathways

During heavy exercise, there is high demand for energy but the supply of oxygen to produce energy is limited. Therefore, anaerobic respiration takes places in the muscles cells to fulfil the demand for energy. and leads to the formation of lactic acid in muscles. The accumulation of lactic acid in muscles leads to **muscle cramps**.

Gaseous exchange during respiration

- For aerobic respiration, organisms need a continuous supply of oxygen, and carbon dioxide produced during the process needs to be removed from the body.
- Diffusion is the method which is used by unicellular and some simple organisms for intake of oxygen and removal of carbon dioxide. Plants also use diffusion for exchange of gases.
- Gills are the respiratory organs for fishes. Fishes take in oxygen which is dissolved in water through gills. The breathing rate of aquatic organisms is faster as availability of oxygen is less in the aquatic environment.
- Insects breathe through a system of tiny tubes called tracheae, which are connected to the outside through small openings on their body called spiracles.
- Terrestrial organisms have developed lungs for exchange of gases.
- Availability of oxygen is not a problem in the terrestrial environment so breathing rate is slower as compared to what it is in fishes.

Human Respiratory System

The human respiratory system is composed of a pair of lungs, nostrils, pharynx, larynx, trachea, bronchi, bronchioles and alveoli.

- The inner lining of the nostrils is lined by hair and remains wet due to mucus secretion. This helps to filter the air we breathe in, blocking dirt and dust from getting into our lungs.
- Pharynx is a tube-like structure which continues after the nasal passage.
- Larynx is the voice box.
- Trachea is composed of rings of cartilage. These rings prevent the collapse of trachea in the absence of air.
- Trachea divides into a pair of bronchi, with one bronchus going to each lung. A bronchus divides into branches and sub-branches inside the lung called as bronchioles
- Alveoli are balloon-like air sacs at the end of bronchioles. They provide a surface where the exchange of gases can take place. The walls of the alveoli contain an extensive network of blood-vessels where the oxygen mixes with the blood and carbon dioxide exits from the blood.

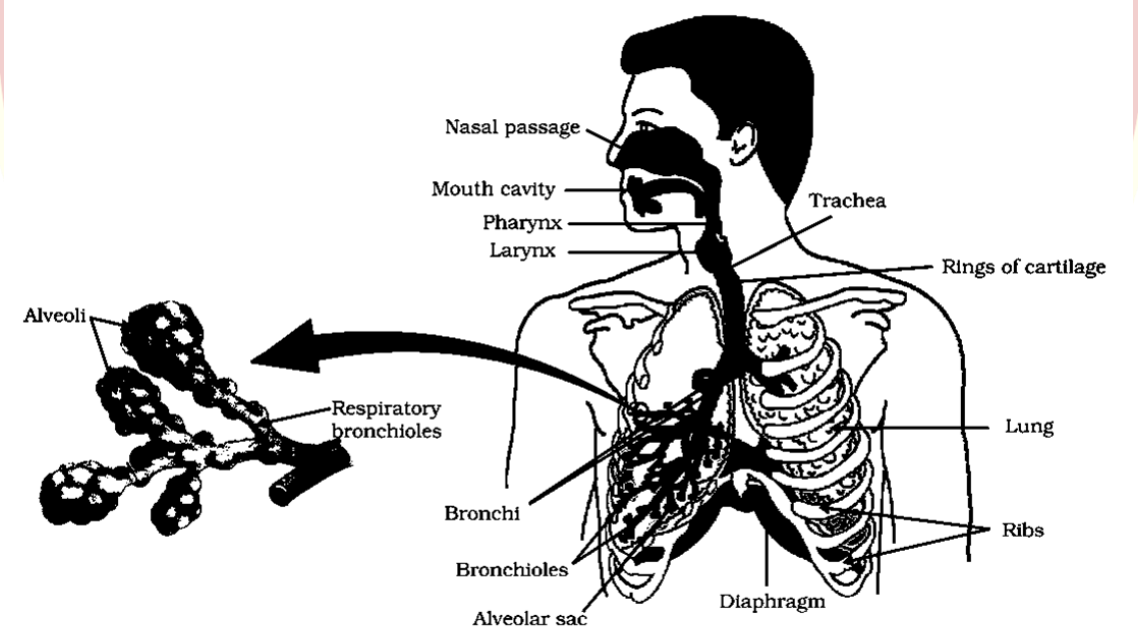


Fig: Human respiratory system

Transportation in Human Beings

Transportation in human beings refers to the process of moving substances such as oxygen, nutrients, hormones, and waste products throughout the body. Circulatory system is responsible for the transportation of the various substances. It is composed of the heart, arteries, veins, blood capillaries and blood.

- The heart is a muscular organ which is as big as our fist. It pumps blood throughout the body.
- Heart consists of four different chambers (two ventricles and two auricles) to prevent the oxygen-rich blood from mixing with the blood containing carbon dioxide.
- The pulmonary veins carry oxygen-rich blood from lungs to the left atrium. After that, the left ventricle contracts and pumps the oxygen rich blood to the rest of the body parts through aorta.
- The vena cava carries deoxygenated blood (carbon dioxide rich blood) from different body parts to the right atrium. The right ventricle contracts and pumps the deoxygenated blood back to the lungs via pulmonary arteries.
- **Arteries** are thick-walled blood vessels which carry oxygenated blood from the heart to different organs except pulmonary arteries. Pulmonary arteries carry deoxygenated blood from the heart to lungs.
- The arteries have thick and elastic walls as blood emerges under high pressure from the heart.
- **Veins** are thin-walled blood vessels which carry deoxygenated blood from different organs to the heart, except pulmonary veins because they carry oxygenated blood from lungs to the heart. Valves are present in the veins to prevent back flow of blood.
- The arteries divide into smaller and smaller blood vessels so that the blood reaches to all individual cells. Capillaries are smallest blood vessels that have single-celled walls.
- Platelets help in blood coagulation which prevents excess loss of blood in case of an injury.
- Red Blood Corpuscles (RBCs) are of red colour because of the presence of haemoglobin. Haemoglobin also helps in the transport of oxygen.
- **Lymph** is formed from a yellowish fluid which leaks from blood capillaries and goes to the intercellular space in the tissues. This fluid is collected through lymph vessels and finally returned to the blood capillaries (veins).
- Lymph also helps in killing germs and plays important role in the immune system.

Double circulation

- The blood passes through the heart twice in one complete cycle. This is called double circulation.
- Double circulation ensures complete separation of oxygenated and deoxygenated blood. This allows a highly efficient supply of oxygen to the body of warm-blooded animals, like birds and mammals, as they have high energy needs.
- Animals like amphibians or many reptiles have three-chambered hearts.
- Fishes have two-chambered heart. The blood is pumped to the gills, is oxygenated there, and passes directly to the rest of the body.

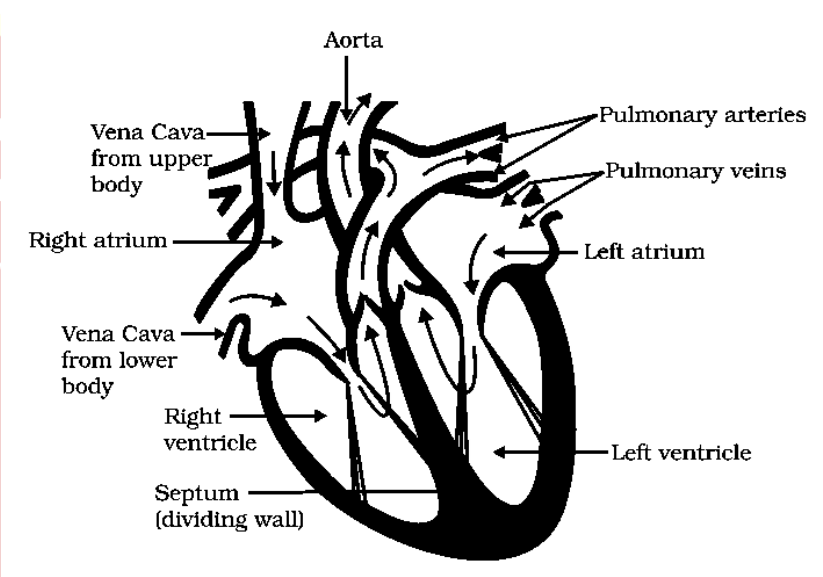


Fig: Sectional view of human heart

Transportation in Plants

- **Xylem** is responsible for transportation of water and minerals in plants.
- It carries water and minerals from the roots to the other parts of plant.
- The walls of cells of root hairs are very thin. Water from soil enters the root hairs because of osmosis. **Root pressure** and transpiration is responsible for movement of water up to the base of the stem.
- Loss of excess water through stomata in plants is called **transpiration**. Transpiration creates vacuum which creates a suction pull. Due to suction pull water is able to rise to great heights even in the tallest plants.

- **Phloem** is responsible for transportation of food in plants.
- It carries the food prepared during photosynthesis from leaves to the other parts of the plant. This process is known as **translocation**.

Excretion in Human beings

The process of removal of the harmful metabolic wastes from the body is called **excretion**. The excretory system of human beings includes a pair of kidneys, a pair of ureters, a urinary bladder and a urethra.

- Urine is produced in the kidneys.
- It passes through the ureters into the urinary bladder.
- It is stored in urinary bladder until it is released through the urethra.
- **Nephron** is the basic functional (filtration) unit of the kidney.

Structure of nephron

Nephron is a long tube-like structure composed of a cluster of very thin-walled blood capillaries called glomerulus. Glomerulus is enclosed in a cup-shaped structure known as bowman's capsule. Bowman's capsule is connected to a tubular part of nephron that collects the filtered urine. Tubes from all the nephrons converge into collecting duct, which finally goes to the ureter.

Functions of nephron

- **Filtration**: Nitrogenous wastes, glucose, water, amino acids and salts are filtered from the blood into bowman's capsule of the nephron.
- **Reabsorption**: Useful substances from the filtrate are reabsorbed back by the blood capillaries surrounding the tubules of nephron.
- **Secretion**: Extra water, salts are secreted into the tubule which opens up into the collecting duct and then into the ureter.

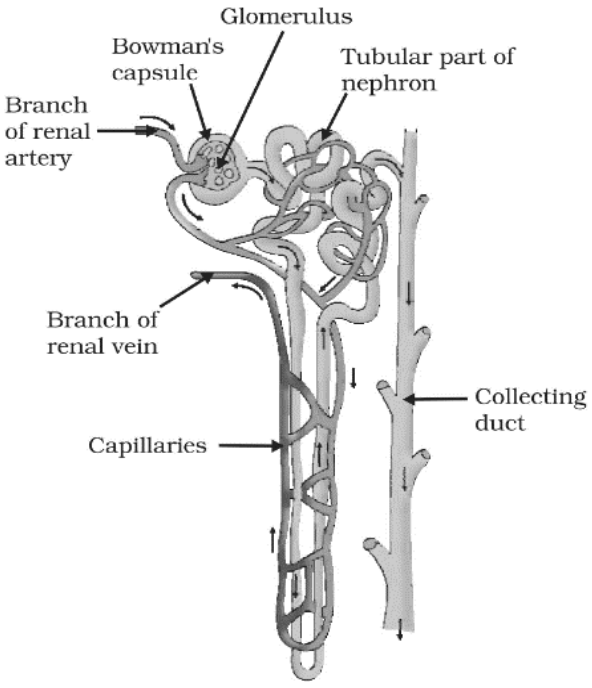


Fig: Structure of a nephron

Excretion in Plants

- Plants excrete waste through various organs, such as roots, leaves, stems, and reproductive organs. The main excretory products in plants include oxygen, water and carbon dioxide
- They can get rid of excess water by transpiration.
- Wastes stored in leaves, bark etc. fall off from the plant.
- Plants excrete some waste into the soil around them.