

Life Processes

6.1 What are Life Processes?

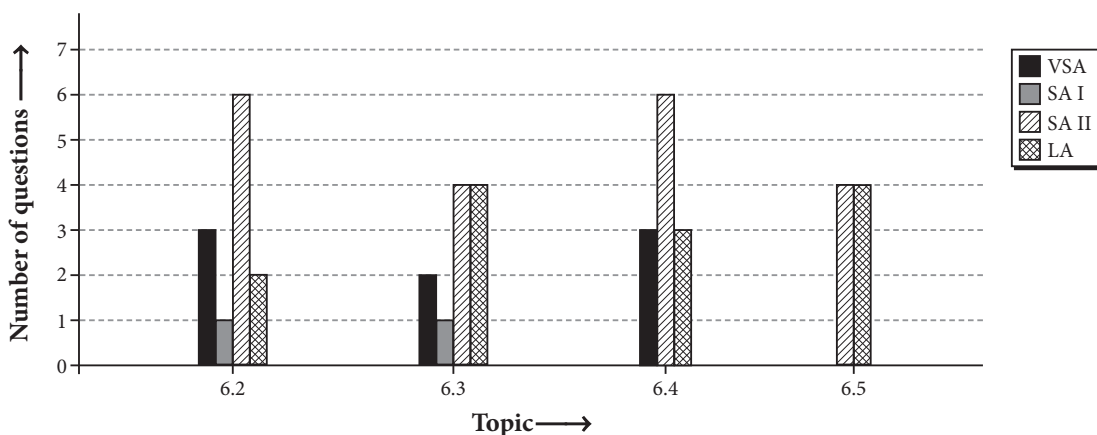
6.2 Nutrition

6.3 Respiration

6.4 Transportation

6.5 Excretion

Topicwise Analysis of Last 10 Years' CBSE Board Questions (2020-2011)

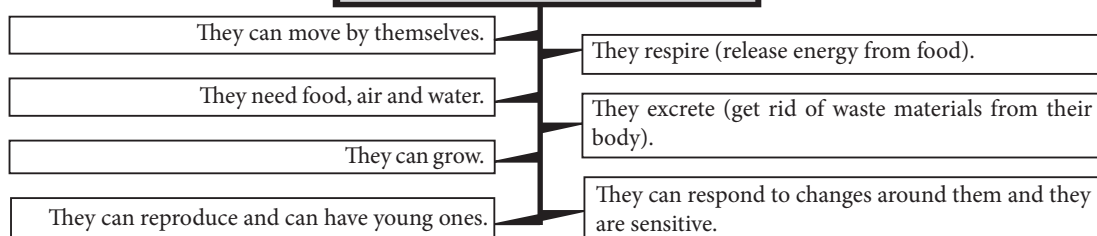


- ▶▶ Maximum weightage is of *Respiration and Transportation*.
- ▶▶ Maximum SA II type questions were asked from *Respiration and Transportation*.
- ▶▶ Maximum VSA type questions were asked from *Nutrition and Transportation*.
- ▶▶ Maximum LA type questions were asked from *Respiration and Excretion*.

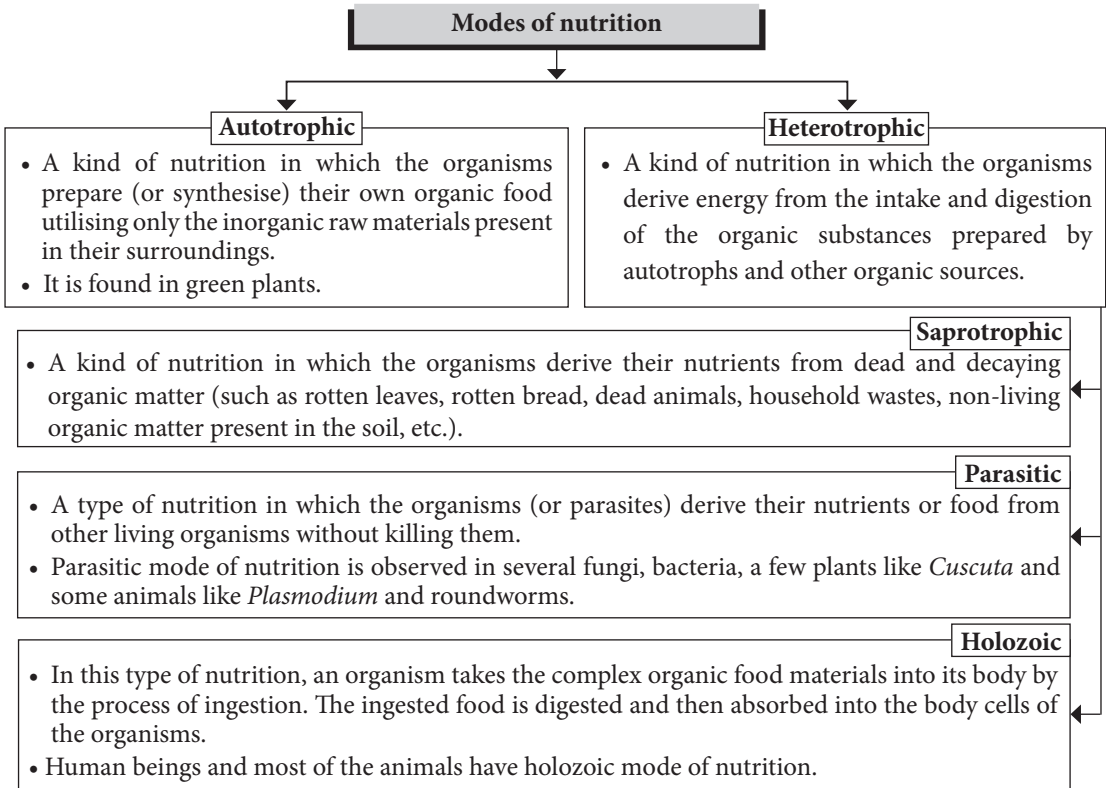
QUICK RECAP

- ▶▶ **Living organisms** : All the plants and animals (including human beings) are alive or living organisms. All living organisms have some common characteristics which make them different from non-living things.

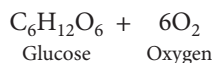
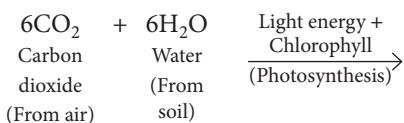
Characteristics of Living Organisms



- ▶▶ **Nutrition:** It is defined as the process of intake of nutrients such as carbohydrates, fats, proteins, etc., and their utilisation by an organism in various biological activities.



- ▶▶ **Nutrition in plants:** The process by which green plants make their own food (like glucose) from carbon dioxide and water by using sunlight energy in the presence of chlorophyll, is called **photosynthesis**. The process of photosynthesis can be represented as:



- ▶ The food prepared by the green leaves of a plant is in the form of a simple sugar called **glucose**. It is then sent to different parts of the plants. The extra glucose is changed into another food called **starch**. This starch is stored in the leaves of the plant. Glucose and starch belong to a category of foods called carbohydrates.
 - ▶ The plants take carbon dioxide required for photosynthesis from air through tiny pores called **stomata** present on the surface of leaves.
 - ▶ Water required for photosynthesis is absorbed from soil by the roots of plants.
 - ▶ **Mechanism of photosynthesis:** The first step of photosynthesis initiates when light falls on green leaves. The pigment chlorophyll present in the chloroplasts absorbs visible light and after absorption creates such condition that water breaks into hydrogen protons (H^+),
- ▶ The process of photosynthesis takes place in the green leaves of a plant because they contain green pigment called chlorophyll in special cell organelles called **chloroplasts**. Hence, site of photosynthesis in the leaves of green plants is chloroplast. They have green coloured **grana** embedded in liquid hyaline **stroma**.

electrons (e^-) and evolves molecular oxygen (O_2). This is called **photolysis**. This O_2 goes into the atmosphere. The electrons and protons released by the photolysis of water are used up in the production of **assimilatory power** in the form of **NADPH** and **ATP**. Photolysis of water, evolution of molecular oxygen (O_2) and synthesis of assimilatory power has been assigned as the **light reaction** of photosynthesis. This step occurs in the granum part of the chloroplast.

- ▶ The assimilatory power, generated in the light reaction of photosynthesis, is used up in the next step where carbon dioxide (CO_2) of atmosphere is utilised in the production of carbohydrate.
- ▶ This step was discovered in detail by **Calvin, Benson** and **Bassam**. It is a cyclic process, which occurs in the stroma part of chlorophyll, that is totally enzymatic process and has been termed as the **dark reaction** of photosynthesis.
- ▶ The important factors which affect the process of photosynthesis are : light, temperature, carbon dioxide and water.
- ▶ **Nutrition in animals** : Depending upon the food habit, holozoic animals are classified into 3 categories :
 - ▶ **Herbivores**: These animals eat only algae or plant materials. The common herbivorous animals are cow, rabbit, goat, camel, deer, etc.
 - ▶ **Carnivores** : These animals eat only flesh of other animals. The common carnivorous animals are lion, tiger, frog, snake, etc.
 - ▶ **Omnivores** : These animals eat both plants and other animals as food. The common omnivorous animals are man, sparrow, crow, bear, etc.
- ▶ There are five steps in the process of nutrition in animals. These are :
 - **Ingestion** : The process of taking food into the body is called ingestion.
 - **Digestion** : The process in which the food containing large, insoluble molecules is broken down into small, water soluble molecules (which can be absorbed by the body) is called digestion.
 - **Absorption** : The process in which the digested food passes through the intestinal wall into blood stream is called absorption.
 - **Assimilation** : The process in which the absorbed food is taken in by body cells and used for energy, growth and repair, is called assimilation.
 - **Egestion** : The process in which the undigested food is removed from the body is called egestion.
- ▶ **Nutrition in Amoeba**: *Amoeba* shows holozoic mode of nutrition and obtains its food through phagocytosis. It engulfs the microscopic food particle by forming pseudopodia (temporary protoplasmic processes.) The food particle gets surrounded by pseudopodia to form **food vacuole**.
- ▶ **Nutrition in human beings** : Human beings are heterotrophic, holozoic, omnivorous organisms. The human digestive system consists of an alimentary canal and many digestive glands. The alimentary canal of human beings consists of following parts:
 - **Mouth** : Mouth gives passage for ingestion of food. It is guarded by two soft movable lips and opens into a chamber or cavity called **buccal cavity**.
 - **Buccal (Oral) cavity** : It is a large space bounded above by the palate, below by the throat and on the sides by the jaws. The throat supports the muscular tongue which forms the floor of this cavity and helps in ingestion of food. Both upper and lower jaws are provided with teeth. Each jaw has two pairs of incisors (I), one pair of canines (C), two pairs of premolars (P) and three pairs of molars (M). Thus, each jaw possesses total 16 teeth and a human adult has 32 permanent teeth. The full **dental formula** (arrangements of teeth) of humans is represented as – I 2/2, C 1/1, P 2/2, M 3/3. The **incisors** are sharp and have cutting edges. The **canines** are pointed and occur next to the incisors. The **premolars** and **molars** are called the grinding teeth. Teeth cut the food

into small pieces. The buccal cavity has three pairs of salivary glands located at different locations. The **parotid glands** lie on the sides of the face, **sublingual glands** lie under the front part of the tongue and **submaxillary glands** lie at the angles of the lower jaw. These salivary glands secrete saliva through their ducts. Saliva contains water, salts, mucin and an enzyme **ptyalin**. Ptyalin is salivary amylase which splits starch and glycogen into maltose.

- **Pharynx:** It is about 12 cm long funnel-shaped vertical canal which serves as a passage way for the food from the buccal cavity to the oesophagus.
- **Oesophagus:** This is a long and tubular structure which serves to carry the food from pharynx to the stomach. The wall of oesophagus is highly muscular. It exhibits **peristaltic movement**, *i.e.*, contraction and expansion movement of walls, so that the partially digested food is pushed forward in the tract.
- **Stomach:** This is a wide C-shaped or J-shaped muscular sac present on the left side of the abdomen. Partially digested food reaches the stomach from the buccal cavity through pharynx and oesophagus.
- The food is stored in the stomach for variable duration. Wall of the stomach undergoes periodic muscular contraction so that the food gets churned and mixes thoroughly with the gastric juice. Stomach possesses three types of glands which secrete hydrochloric acid, protein digestive enzyme and mucus. All these secretions are collectively called **gastric juice**. The hydrochloric acid makes the medium acidic. Protein-digesting enzyme **pepsin** acts in acidic medium which breaks down proteins into peptones. Gastric juice also contains some **gastric lipase** which partially breaks down lipids.
- **Small intestine:** This is the **longest part** of the alimentary canal. It is a narrow tube of about 6 metres which lies coiled in the abdomen. Partially digested and churned food from the stomach enters into the small intestine which receives secretions from the liver and pancreas, through a common duct. The **bile duct** carries bile secreted by liver and is stored in the gall bladder. Bile contains **bile salts (sodium glycocholate and sodium taurocholate)** which bring about the emulsification of fat. **Pancreatic duct** comes from the pancreas which is both an endocrine as well as exocrine gland. The exocrine region secretes sodium bicarbonate and many digestive enzymes whereas the endocrine region of pancreas secretes hormones, **insulin** and **glucagon**. The bicarbonate ions make the medium alkaline which is favourable for the action of pancreatic enzymes. The **pancreatic amylase** causes breakdown of starch, **pancreatic lipase** breaks down lipids and **trypsin** causes digestion of protein. The small intestine also secretes digestive juice which contains a mixture of several enzymes. All these enzymes act upon different types of food. Internally, the wall of small intestine is raised into numerous projections called the **villi**. The villi greatly increase the absorptive surface area of the inner lining of intestine. Presence of villi and blood capillaries in the absorptive surface enhance the capacity of absorption by the wall of the intestine. The absorbed food goes into the blood and moves along with the blood stream. This food reaches to the cells where it is utilised. Utilisation of food is also a part of nutrition and is termed as **assimilation**.
- **Large intestine:** It is arranged around the mass of small intestine in the form of a question mark. The greater part of large intestine is **colon** which is followed by **rectum**. The undigested food is collected as faeces in the rectum which leads to the anus.

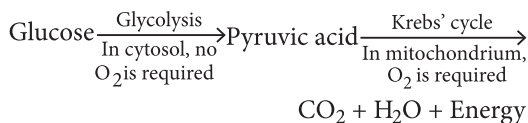
- The wall of large intestine absorbs most of the water from the undigested food making it almost solid. This undigested food is passed out from our body through anus as faeces. This act of expelling the faeces is called **egestion** or **defecation**.

▶▶ **Respiration:** Most living organisms need oxygen (of air) to obtain energy from food. This oxygen reacts with the food molecules (like glucose) present in the body cells and burns them slowly to release energy. The process of releasing energy from food is called **respiration**. Respiration is essential for life because it provides energy for carrying out all the life processes.

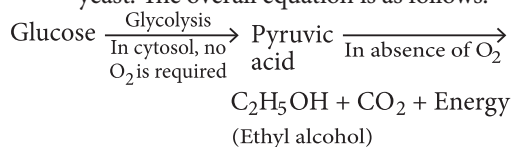
▶ **Breathing** is the process by which air rich in oxygen is taken inside the body of an organism and air rich in carbon dioxide is expelled from the body (with the help of breathing organs).

▶ **Cellular respiration** is much more complex process that occurs inside the living cells. It is the oxidation of respiratory substrate (mainly glucose) in the cells resulting in the release of carbon dioxide and energy (in the form of ATP). Cellular respiration may be of two types:

- **Aerobic respiration** : The oxidative breakdown of respiratory substrates with the help of atmospheric O_2 is known as **aerobic respiration**. During this process, the respiratory substrate is completely broken down into carbon dioxide and water by the process of oxidation. In most of the eukaryotic organisms, some part of aerobic respiration (glycolysis) occurs in the cytoplasm and the major part (Krebs' cycle) occurs inside the mitochondrion. In cytoplasm, the glucose is broken down to pyruvic acid (a three carbon compound) by the process called **glycolysis**. In presence of oxygen this pyruvic acid enters into mitochondrion where it is completely broken down resulting in the production of energy rich compound, ATP. The equation of aerobic breakdown of glucose is :



- **Anaerobic respiration:** Oxidation of respiratory substrates in absence of oxygen is termed as anaerobic respiration. It involves incomplete breakdown of respiratory substrates in which the end products like ethanol or lactic acid are formed and CO_2 is released. This respiration occurs in certain microorganisms such as bacteria and yeast. The overall equation is as follows:



▶▶ **Respiratory system in human beings** : The respiratory system in human beings includes external nostrils, nasal cavities, internal nostrils, pharynx, larynx, trachea and a pair of lungs which provide the surface for the exchange of gases.

- ▶ The air enters through the nostrils and reaches into a pair of nasal cavities, separated from the oral cavity by a bony palate and separated from each other by a nasal septum. The nasal cavities are lined with ciliated pseudostratified columnar epithelium rich in gland cells so that the inspired air gets warmed, moistened and becomes dust free. It is also lined with olfactory epithelium which acts as an organ of smell. The nasal chambers open into pharynx through internal nares.
- ▶ The **pharynx** is a short vertical tube located at the back of the buccal cavity which provides passage into which the internal nares and buccal cavity both open to pass the air into it. The pharynx provides passage into trachea or wind pipe through a slit-like aperture, called **glottis**. The glottis always remains open except during swallowing when the epiglottis (leaf like cartilagenous flap) closes it to check the entry of food into it.
- ▶ The **trachea** or wind pipe is a thin-walled tube that extends downward through the neck and divides into two major bronchi.

One enters the right lung, and the other, the left lung. Trachea has cartilaginous rings to prevent it from collapsing in between breathes.

- ▶ Lungs provide the surface for the exchange of gases. Each individual has a pair of **lungs**. The lungs lie in the thoracic cavity. The thoracic cavity is separated from the abdominal cavity by a muscular portion called **diaphragm**. Each lung is enclosed in two membranes, the **pleura**. Within the lungs, the major bronchi further divide into secondary bronchi which sub divide into smaller tertiary bronchi and finally into still smaller bronchioles. Each

bronchiole divides into alveolar ducts which enter the alveolar sacs. The alveolar sacs are also called **alveoli**. Alveoli have very thin walls composed of simple moist non-ciliated squamous epithelium. It is closely surrounded by a network of blood capillaries.

- ▶ The pathway of air into lungs is as follows: External nares → Nasal cavities → Internal nares → Pharynx → Glottis → Larynx → Trachea → Bronchi → Bronchioles → Alveolar ducts → Alveoli.
- ▶ Breathing in humans involves the movements of rib cage and diaphragm. This happens as follows:

Mechanism of Breathing

Breathing in: When we breathe in (or inhale), then (i) the muscles between the ribs contract causing the rib cage to move upward and outward, and (ii) the diaphragm contracts and moves downward. The upward and outward movement of rib cage, as well as the downward movement of diaphragm, both increase the space in the chest cavity and make it larger. As the chest cavity becomes larger, air is sucked in from outside into the lungs. The lungs get filled up with air and expand.

Breathing out: When we breathe out (or exhale), then (i) the muscles between the ribs relax causing the rib cage to move downward and inward, and (ii) the diaphragm relaxes and moves upward. The downward and inward movement of rib cage as well as the upward movement of diaphragm, both decrease the space in our chest cavity and make it smaller. As the chest cavity becomes smaller, air is pushed out from the lungs.

Flow chart : Mechanism of breathing

- ▶ **Exchange of gases between alveoli and blood:** In this exchange, the blood takes up oxygen from the alveolar air and releases CO_2 to the alveolar air. Such an exchange occurs because the concentration of O_2 is more in alveolar air. The blood has higher concentration of CO_2 as compared to alveolar air. Thus, the CO_2 moves from blood to alveolar air due to simple diffusion. This exchange of gases results in the oxygenation of blood. The oxygenated blood then returns from the lung by pulmonary veins to the left side of the heart. The heart supplies the oxygenated blood to the body tissues.
- ▶ In tissues, the exchange of gases occurs between the oxygenated blood and the tissue cells. The concentration of O_2 is more in the blood and less in the tissue cells. So, the O_2 moves from blood to the tissues by the physical process of diffusion. Similarly, CO_2

concentration is more in tissues and less in the blood. So, the CO_2 moves from tissues to the blood. This process is called **internal respiration**.

- ▶ **Respiration in Fish :** The fish has special organs of breathing called '**gills**'. The fish uses the oxygen which is dissolved in water. It breathes by taking in water through its mouth and sending it over the gills. When water passes over the gills, the gills extract dissolved oxygen from it. The extracted oxygen is absorbed by the blood and carried to all the parts of the fish. Carbon dioxide produced by respiration is brought back by the blood into the gills for expelling into the surrounding water.
- ▶ **Respiration in other organisms :** Earthworm absorbs oxygen needed for respiration through its **moist skin** as it has good blood supply.

- ▶▶ *Amoeba* and *Paramecium* breathe through their **cell membranes**.
- ▶▶ In insects like grasshopper, cockroach, housefly and mosquito, the tiny holes called **spiracles** on their body and the air tubes called **tracheae** are the respiratory organs.
- ▶▶ **Respiration in plants** : Plants use oxygen of air for respiration and release carbon dioxide.

Respiration in plants differs from that in animals in three respects:

→ All the parts of a plant (like root, stem and leaves) perform respiration individually. On the other hand, an animal performs respiration as a single unit.

→ During respiration in plants, there is a little transport of respiratory gases from one part of the plant to the other. On the other hand, respiratory gases are usually transported over long distances inside an animal during respiration.

→ The respiration in plants occurs at a slow rate. On the other hand, the respiration in animals occurs at a much faster rate.

- ▶ Plants have a branching shape, so they have quite a large surface area in comparison to their volume. Therefore, diffusion alone can supply all the cells of the plants with as much oxygen as they need for respiration.

Diffusion in plants

Stem

→ The stems of herbaceous plants have stomata where the exchange of respiratory gases takes place.

Leaves

→ The leaves of plants have tiny pores called stomata. The exchange of respiratory gases in the leaves takes place by the process of diffusion through stomata.

Roots

→ The roots of plants take the oxygen required for respiration from the air present in between the soil particles by the process of diffusion.

- ▶▶ **Transportation** : It is a life process in which a substance synthesised or absorbed in one part of the organism is carried to other parts of its body.
- ▶▶ **Transportation in human beings** : In human beings, there are two circulatory systems

through which the materials are transported to relevant organs and tissues. They are: Blood vascular system and lymphatic system.

- ▶▶ **Blood vascular system** : A vascular system is that which has tubes full of fluid to be transported from one place to another. This system comprises of **heart**, the organ which pumps and receives the **blood**, and **blood vessels**, which are tubes through which the blood flows.

- ▶ **Blood** : Blood is a red coloured liquid (connective tissue) because it contains a red pigment called **haemoglobin**.

Main components of blood

Plasma

→ The liquid part of blood is called **plasma**. Plasma contains about 90 percent water and dissolved substances such as proteins, digested food, common salt, waste products (like carbon dioxide and urea) and hormones. Red blood cells, white blood cells and platelets are immersed in this liquid.

Red blood cells

→ Red blood cells are red in colour due to the presence of a red pigment called haemoglobin inside them. These cells carry oxygen from the lungs to all the cells of the body. It is actually the haemoglobin present in red blood cells which carries oxygen in the body. Red blood cells are circular in shape and lack nuclei.

White blood cells

→ White blood cells fight infection and protect us from diseases hence, they are called soldiers of the body. Some white blood cells can eat up the germs (like bacteria) which cause diseases. Other white blood cells make chemicals known as '**antibodies**' to fight against infection. These cells are irregular in shape. All the white blood cells have a nucleus though the shape of nucleus is different in different types of white blood cell.

Platelets

→ Platelets are the tiny fragments of special cells formed in the bone marrow. They do not have nuclei. Platelets help in the coagulation of blood (or clotting of blood) in case of cut or wound.

- **Blood clotting:** In the region of injury, the platelets rupture and release a substance called **thromboplastin**. It converts protein **prothrombin** into **thrombin**. **Vitamin K** is essential for the formation of prothrombin in liver. Thrombin then changes soluble **fibrinogen** protein into **fibrin**. The latter undergoes rapid polymerisation to form long fibres. The fibres form a network over the damaged (injured) region, entrap blood corpuscles and form a blood clot.

Functions of blood

→ Circulation of blood is responsible for transportation of soluble digested food from the small intestine to various parts of the body where they are stored or assimilated.

→ Blood carries soluble excretory materials, such as urea to organs of excretion.

→ Blood carries hormones from the endocrine glands to target organs.

→ Circulation of blood helps to maintain a constant body temperature by distributing the excess heat from the deeply seated organs.

→ Blood transports oxygen from the lungs to all parts of the body.

→ Blood carries carbon dioxide produced by the tissues to the lungs for breathing out.

→ Blood has a property of clotting which prevents excessive blood loss.

→ The white blood cells act as soldiers of the body by killing the bacteria and other germs.

→ The blood acts as a buffer and maintains a constant solute potential and pH.

- **Blood vessels :** There are three kinds of blood vessels in human body – arteries, veins and capillaries.

- (i) **Arteries** are the blood vessels which carry blood away from the heart for distribution to the body. The walls of arteries are thick that enables them to dilate but not rupture when the heart

contracts and forces blood into them. Thus, the blood passing through narrow lumen of arteries is aerated and has a considerable pressure.

- (ii) **Veins** are thin walled blood vessels which bring blood from the body back to the heart. They are larger and hold more blood than the arteries. The blood passing through wide lumen of veins is non-aerated (except in pulmonary veins) and has low pressure.

- (iii) **Capillaries** are thin walled and extremely narrow blood vessels which occur at the terminals of artery and vein. The wall of capillaries are permeable to water and dissolved substances so that the exchange of materials between the blood and body cells can take place.

- ▶ **Human heart:** The heart is a hollow, muscular organ, that contracts regularly and continuously pumps blood to various parts of the body. Its average weight is about 300 gm in males and about 250 gm in females. It is situated between the two lungs in the middle of the thoracic cavity. It is surrounded by a two layered sac, the **pericardium**. The pericardial fluid is secreted in the pericardial cavity between the pericardium and heart which reduces the friction between the heart wall and surrounding tissues when the heart is beating.

- **Structure of the heart:** The heart is divided by septa into two halves: the right and the left. Each half consists of two communicating chambers upper smaller or **atrium** and lower larger **ventricle**. Thus, the heart has four chambers: The two upper chambers, called atria and two lower chambers, called left and right ventricles. There are valves between left atrium and left ventricle and between right atrium and right ventricle. These valves provide one-way passage and prevent the return of blood. The walls of heart are composed of special muscles called **cardiac muscles**.

- One complete contraction (**systole**) and relaxation (**diastole**) of the heart is called a **heart beat**.

- The sequence of events which takes place during the completion of one heart beat is called the **cardiac cycle**.

Steps of cardiac cycle

Joint Diastole

During the time when the muscles of all four chambers of the heart are relaxed, the blood return to the heart under low pressure and enters the two atria. Blood from large veins, called **vena cava**, pours into right atrium. This blood comes from head, upper body parts and lower body parts where oxygen has been used up and the blood is free from oxygen, *i.e.*, deoxygenated. At the same time, the pulmonary vein from lungs pours oxygenated blood into the left atrium. Thus, **the oxygenated blood enters the left atrium.**

Atrial Systole

As the right and left atria fill with blood, pressure in them rises so that the valves between left atrium and left ventricle (**bicuspid valve**) and between right atrium and right ventricle (**tricuspid valve**) open and the atria contract. Atrial contraction forces pumping of deoxygenated blood from right atrium into the right ventricle through tricuspid valve and oxygenated blood from left atrium into left ventricle through bicuspid valve.

Ventricular Systole

Almost immediately the ventricles contract. This is called **ventricular systole**. During contraction of ventricles, the deoxygenated blood from right ventricle flows to the lungs through pulmonary artery and the oxygenated blood from left ventricle is distributed to all the parts of the body through the largest artery, called **aorta**.

- **Pulse:** Every time the heart beats, blood is forced into arteries. This blood makes the arteries expand a little. The expansion of an artery each time the blood is forced into it, is called **pulse**. Each heartbeat generates one pulse in the arteries, so the pulse rate of a person is equal to the number of heartbeats per minute. The pulse rate of an adult person while resting is 70 to 72 per minute.

- **Blood pressure:** The pressure at which blood is pumped around the body by the heart is called **blood pressure**. The blood pressure of a person is always expressed in the form of two values called '**systolic pressure**' and '**diastolic pressure**'. The maximum pressure at which the blood leaves the heart through the main artery (aorta) during contraction phase, is called the **systolic pressure**. The minimum pressure in the arteries during the relaxation phase of heart is called the **diastolic pressure**. The normal blood pressure values are : Systolic pressure : 120 mm Hg, Diastolic pressure : 80 mm Hg. This is usually written as 120/80.
- The blood circulation in human heart is **double circulation**. One circulation involves the entry of blood into the heart from all body parts. This blood is deoxygenated which goes to lungs for oxygenation. The second circulation involves entry of oxygenated blood from lungs into the heart and then its distribution to all parts of the body. Double circulation is made possible because the human heart is divided into two halves. One half pumps deoxygenated blood to the lungs and the other half pumps oxygenated blood to the rest of the body.

▶ **Lymphatic system :** A system of tiny tubes called lymph vessels (or lymphatics) and lymph nodes (or lymph glands) in the human body which transport the liquid called lymph from the body tissues to the blood circulatory system is called **lymphatic system**. The lymphatic system consists of the following parts: (i) lymph capillaries, (ii) lymph vessels, (iii) lymph nodes (or lymph glands), and (iv) lymph.

- ▶ Lymph capillaries are tiny tubes which are present in the whole body (just like blood capillaries). Lymph capillaries are closed ended. Since the pores in the walls of the lymph capillaries are somewhat bigger, so even large protein molecules present in the tissue fluid can enter lymph capillaries. The lymph capillaries join to form larger lymph vessel. The lymph vessels have lymph nodes at intervals. The lymph nodes contain special

type of cells called **lymphocytes**. These cells are involved in the cleaning of lymph and protecting the body from disease. The lymph vessels are connected to large veins of the blood circulatory system. Lymph is a light yellow liquid which is somewhat similar in composition to blood plasma. It flows in only **one direction** - from body tissues to the heart. Since lymph is derived from the tissue fluid which remains outside the cells of the body, so it is also called **extracellular fluid**.

Functions of lymphatic system

Lymph takes part in the nutritive process of the body. For example, it puts into circulation large protein molecules by carrying them from the tissues into the blood stream (which could not be absorbed by blood capillaries due to their large size). Lymph also carries digested fat for the nutritive process.

Lymphatic system protects the body by killing the germs drained out of the body tissues with the help of lymphocytes contained in the lymph nodes and by making antibodies.

Lymph helps in removing the waste products like fragments of dead cells, etc.

▶ **Transportation in plants** : Transport system in plants is less elaborate as compared to animals. It is because plants are less active and require less supply of materials either from outside or synthesised by the plants themselves. There are two kinds of transportation in plants-

- (i) Transportation of water and minerals
- (ii) Transportation of food and other substances.

▶ **Transportation of water and minerals.**

The main water conducting tissue in higher plants is **xylem**. Xylem consists of vessels and tracheids. A xylem vessel is made of many hollow, dead cells (called **vessel elements**), joined end to end. The end walls of the cells are dissolved so that a long, open tube is formed. These vessels run from the roots of the plant right up through the stem and reach the leaves. These vessels do not contain cytoplasm or nuclei. Their walls are made of cellulose and lignin (a very hard and strong substance), so they also provide strength to the stems and help to keep the plant upright.

Tracheids are dead cells with lignified walls but they do not have open ends. They have pits in their thick cell walls. Pits are thin areas of the cell wall where no lignin has been deposited. Water flows from one tracheid to another through pits.

3 interconnected processes for transportation of water and minerals

Absorption of water and minerals

The water and minerals are absorbed by land plants from the soil where they are present in the form of soil solution. The main water absorbing organs are root hairs and mineral absorbing organs are root epidermal cells at root apex. The water is absorbed actively by water potential difference between soil solution and root hairs. Water molecules move from higher water potential to lower water potential and then migrate from cell to cell passing from epidermis to cortex, from cortex to endodermis and from endodermis to **xylem vessels** and **tracheids** from where they move upward by the process called ascent of sap.

Ascent of sap

According to root pressure theory, the roots absorb water and exert a pressure, the root pressure which pushes the water upward. The root pressure develops in the tracheary element of xylem as a result of metabolic activities of roots. The root pressure theory is applicable in small herbs but not in tall trees.

Transpiration

The loss of water in the form of vapours from the living tissues of aerial parts of the plant is termed as **transpiration**. It mainly occurs by the process of diffusion through stomata. The stomata are tiny pores present on the surface of leaf. Each stoma has two small, green-coloured, kidney-shaped guard cells which regulate the opening and closing of stomatal apertures. Loss of water through transpiration generates a transpirational pull. Transpiration pull and cohesion-tension theory explain the upward movement of water in tall trees. According to this theory, the main force responsible for upward movement of water is transpiration pull generated in the leaves which pulls the water column filled in the xylem tracheids and vessels.

- ▶ **Transportation of food and other substances** : The main food conducting tissue in plants is **phloem**. It is a complex permanent tissue, running parallel to the xylem strands. It consists of sieve tube elements and companion cells.
 - **Sieve tubes** are living cells which contain cytoplasm but no nucleus. The sieve tube cells do not have lignin in their walls. Each sieve tube cell has a companion cell next to it. The companion cell has a nucleus and many other organelles. Companion cells supply the sieve tubes with some of their requirements.
 - The sugars and other metabolites are transported through phloem. The phloem elements remain in close contact with the mesophyll cells of leaves. Soluble carbohydrates (food molecules) enter the phloem elements from mesophyll cells of the leaf. Once the food molecules enter the phloem, they are transported upward, downward in lateral directions.
 - The upward movement of organic solutes takes place from the leaves to developing buds, flowers and fruits for consumption and storage. The upward movement also occurs during the germination of seeds. The food materials, stored mainly in the cotyledons and endosperm, are translocated upward to the growing apex. The nutrients are transported in sieve tubes in a dilute aqueous solution. Such a transport of food from leaves to other parts of the plant is termed as **translocation** which takes place by utilising energy.
- ▶▶ **Excretion** : The two important homeostatic processes occurring in organisms which help to maintain the steady state are: excretion and osmoregulation. The biological process of removal of toxic wastes from the body of an organism is called **excretion**. **Osmoregulation** is a process that maintains the amount of water and proper ionic balance in the body fluids. It maintains a constant osmotic condition in the body by regulating the water content and solute concentration of body fluids, particularly of sodium, potassium and chloride ions.
 - ▶▶ **Excretion in animals**: The protozoans, lose waste matter by simple diffusion through the cell membrane into the surrounding water. Some excretion and osmoregulation occurs by way of contractile vacuoles.
 - ▶ In earthworm, the excretion and osmoregulation occurs through tubular structures constituting **nephridia**.
 - ▶ The insects, centipedes, arachnids and millipedes have **malpighian tubules** for excretion.
 - ▶ The molluscs and vertebrates have **kidneys** for excretion and osmoregulation.
 - ▶▶ **Excretion in human beings** : Excretory system in human beings consists of a pair of **kidneys**, a pair of **ureters**, a **urinary bladder** and a **urethra**. The two kidneys are located towards the back of the lower part of the abdominal cavity, one on either side of the backbone. Left kidney is slightly larger and placed a little higher than the right kidney. The blood from aorta enters into kidneys *via* renal arteries and returns to the posterior vena cava *via* renal veins. Urine formed in the kidneys passes by a pair of ureters to the bladder where it is stored until it is released *via* urethra.
 - ▶ Each kidney is made up of a large number of excretory units called **nephrons**. The 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 tubule. The Bowman's capsule and the tubule taken together make a nephron. One end of the tubule is connected to the Bowman's capsule and its other end is connected to a urine-collecting duct of the kidney.
 - ▶ The Bowman's capsule contains bundle of blood capillaries which is called **glomerulus** (plural glomeruli). One end of the glomerulus is attached to the renal artery which brings the dirty blood containing waste into it. The other end of glomerulus comes out of Bowman's capsule as a blood capillary, surrounds the tubule of nephron and finally joins a renal vein.

- ▶ The function of glomerulus is to filter the blood passing through it. Only the small molecules of substances present in blood like glucose, amino acids, salts, urea and water, etc., pass through the glomerulus and collect as filtrate in the Bowman's capsule. The large molecules like proteins and blood cells cannot pass out through the glomerulus capillaries and hence remain behind in the blood.
- ▶ The function of tubule of nephron is to allow the selective reabsorption of the useful substances like glucose, amino acids, salts and water into the blood capillaries. But the waste material like urea remains behind in the tubule. It does not get reabsorbed into blood capillaries.
- ▶ The condition when a person's kidneys stop working is called **kidney** or **renal failure**. Complete failure of the kidneys allows the urea and other waste products to build up in the blood. Even the amount of water in the body is not regulated. The best long term solution for kidney failure is the kidney transplant. If a kidney transplant is not possible due to some reasons, then the patient with kidney failure is treated periodically on a kidney machine by a procedure called **dialysis**.
- ▶ Dialysis is used for cleaning the blood of a person by separating the waste substance (urea) from blood. The blood from an artery in the patient's arm is made to flow into the dialyser of a dialysis machine made of long tubes of selectively permeable membrane (like cellulose) which are coiled in a tank containing dialysing solution. This solution contains water, glucose and salts in similar concentrations to those in normal blood. As the patient's blood passes through the dialysing solution, most of the wastes present in it pass through the selectively permeable

cellulose tubes into the dialysing solution. The clean blood is pumped back into a vein of the patient's arm.

- ▶▶ **Excretion in plants** : The plants remove their waste products by different methods. The main waste products of plants are carbon dioxide, water vapour and oxygen. Carbon dioxide and water vapour are produced as wastes during respiration whereas oxygen is produced as a waste during photosynthesis. The gaseous wastes of respiration and photosynthesis in plants (carbon dioxide, water vapour and oxygen) are removed through the 'stomata' in leaves and 'lenticels' in stems and released in air.

Methods of disposal of plant wastes

Excess salt is removed through hydathodes along with guttation water.

Many breakdown products are recycled in the synthesis of new metabolic products.

Most of the toxic waste products are stored within dead permanent tissues such as **heartwood** (non functional part of xylem in the trunk and branches), leaves or bark which are removed periodically.

Some waste substances are eliminated through petals, fruits and seeds.

Some excretory products such as **latex, gums, essential oils**, etc., are stored in special type of tissues and glands. For example, laticiferous tissue collects latex (which is the source of natural rubber), resin ducts store resin (the resin of pine trees yields turpentine), mucilaginous ducts store mucilage, oil glands store essential oils, etc.

Previous Years' CBSE Board Questions

6.2 Nutrition

VSA (1 mark)

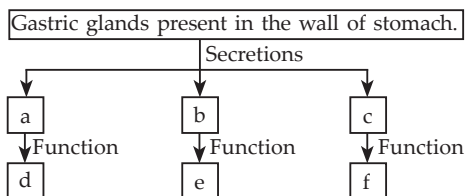
- Most of the digestion and absorption of the food takes place in the
 - small intestine
 - liver
 - stomach
 - large intestine. (2020)
- Mention the raw materials required for photosynthesis. (Board Term I, 2016)
- State the location and function of gastric glands. (Board Term I, 2014)

SA I (2 marks)

- Name the glands present in the wall of the stomach that release secretions for digestion of food. Write the three components of secretion that are released by these glands. (Board Term I, 2014)

SA II (3 marks)

- Complete the following flow chart as per the given instructions.



- (2020)
- State the role played by the following in the process of digestion :
 - Enzyme trypsin
 - Enzyme lipase
 - List two functions of finger-like projections present in the small intestine. (2020)
 - Explain the significance of photosynthesis. Write the balanced chemical equation involved in the process. (Board Term I, 2017)

- Differentiate between autotrophs and heterotrophs and give one example of each. (Board Term I, 2017)
- Explain with the help of neat and well labelled diagrams the different steps involved in nutrition in *Amoeba*. (Board Term I, 2015)
- What is peristaltic movement?
 - 'Stomata remain closed in desert plants during daytime'. How do they do photosynthesis? (Board Term I, 2013)

LA (5 marks)

- Why is nutrition necessary for the human body?
 - What causes movement of food inside the alimentary canal?
 - Why is small intestine in herbivores longer than in carnivores?
 - What will happen if mucus is not secreted by the gastric glands? (2020)
- State the form in which the following are stored:
 - Unused carbohydrates in plants.
 - The energy derived from food in humans.
 - Describe the process of nutrition in *Amoeba* with the help of diagram.

(Board Term I, 2016)

6.3 Respiration

VSA (1 mark)

- Anaerobic process
 - takes place in yeast during fermentation
 - takes place in the presence of oxygen
 - produces only energy in the muscles of human beings
 - produces ethanol, oxygen and energy. (2020)
- Diffusion is insufficient to meet the oxygen requirement of multicellular organisms like human. State reason.

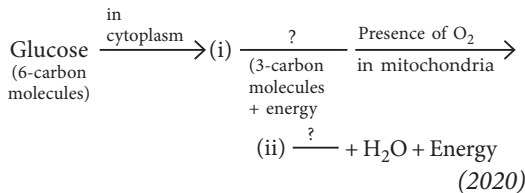
(Board Term I, 2017)

SA I (2 marks)

15. Write two different ways in which glucose is oxidised to provide energy in human body. Write the products formed in each case. (Delhi 2019)

SA II (3 marks)

16. (a) In the process of respiration, state the function of alveoli.
 (b) Rate of breathing in aquatic organisms is much faster than that in terrestrial organisms. Give reasons.
 (c) Complete the following pathway showing the breakdown of glucose.



17. Write three points of difference between breathing and respiration. (Board Term I, 2016)
18. Draw a flow chart to show the breakdown of glucose by various pathways. (Board Term I, 2016)
19. Write three points of difference between respiration in plants and respiration in animals. (Board Term I, 2014)

LA (5 marks)

20. (a) Why is there a difference in the rate of breathing between aquatic organisms and terrestrial organisms? Explain
 (b) Draw a diagram of human respiratory system and label – pharynx, trachea, lungs, diaphragm and alveolar sac on it. (2020)
21. (a) State reasons for the following:
 (i) Herbivores need a longer small intestine while carnivores have shorter small intestine.
 (ii) The lungs are designed in human beings to maximise the area for exchange of gases.
 (b) The rate of breathing in aquatic organisms is much faster than that seen in terrestrial organisms. (Board Term I, 2016)

22. Draw a flow chart showing the three different pathways involved in the breakdown of glucose in different organisms. Name the respiratory pigment present in human beings. State the function of rings of cartilage present in our throat. (Board Term I, 2015)
23. (a) Draw a diagram of human respiratory system and label: Trachea, Bronchi and Diaphragm.
 (b) Give reasons for the following:
 (i) Lungs always contain residual volume.
 (ii) Nostrils are lined with mucus. (Board Term I, 2013)

6.4 Transportation

VSA (1 mark)

24. Which one of the following statements is correct about the human circulatory system?
 (a) Blood transports only oxygen and not carbon dioxide.
 (b) Human heart has five chambers.
 (c) Valves ensure that the blood does not flow backwards.
 (d) Both oxygen – rich and oxygen – deficient blood gets mixed in the heart. (2020)
25. Name the vein which brings blood to left atrium from lungs. (Board Term I, 2017)
26. Define translocation in reference to plants. (Board Term I, 2016)

SA II (3 marks)

27. Write three types of blood vessels. Give one important feature of each. (Delhi 2019)
28. (a) Write two water conducting tissues present in plants. How does water enter continuously into the root xylem?
 (b) Explain why plants have low energy needs as compared to animals. (AI 2019)
29. Explain how the translocation of materials in phloem tissue in plants is achieved by utilising energy. (Board Term I, 2017)
30. What do the following transport?
 (i) Xylem (ii) Phloem
 (iii) Pulmonary vein (iv) Vena cava
 (v) Pulmonary artery (vi) Aorta (Board Term I, 2014)

31. Explain giving any three reasons the significance of transpiration in plants.
(Board Term I, 2014)
32. List in tabular form three differences between arteries and veins. (Board Term I, 2013)
- LA (5 marks)**
33. Give reasons:
(a) Ventricles have thicker muscular walls than atria.
(b) Transport system in plants is slow.
(c) Circulation of blood in aquatic vertebrates differs from that in terrestrial vertebrates.
(d) During the daytime, water and minerals travel faster through xylem as compared to the night.
(e) Veins have valves whereas arteries do not. (2020)
34. (a) "Blood circulation in fishes is different from the blood circulation in human beings". Justify the statement.
(b) Describe "blood circulation" in human beings. (2020)
35. (a) Mention any two components of blood.
(b) Trace the movement of oxygenated blood in the body.
(c) Write the function of valves present in between atria and ventricles.
(d) Write one structural difference between the composition of artery and veins. (2018)
- (i) Left kidney
(ii) Urinary bladder. (Board Term I, 2016)
38. Describe the structure and function of nephron with the help of diagram. (Board Term I, 2014)
39. (a) Name four types of metabolic wastes produced by humans.
(b) Name any two human excretory organs other than kidney. (Board Term I, 2013)
- LA (5 marks)**
40. (a) Name the organs that form the excretory system in human beings.
(b) Describe in brief how urine is produced in human body. (2020)
41. (a) Define excretion.
(b) Name the basic filtration unit present in the kidney.
(c) Draw excretory system in human beings and label the following organs of excretory system which perform following functions:
(i) form urine
(ii) is a long tube which collects urine from kidney
(iii) store urine until it is passed out. (2018)
42. (a) Draw a neat diagram of the human excretory system and label following parts:
(i) Urethra
(ii) Kidney
(iii) Ureter
(iv) Urinary bladder
(b) What are nephrons ? How is a nephron involved in the filtration of blood and formation of urine? (Board Term I, 2015)
43. (a) Draw a well-labelled diagram of structural and functional unit of kidney.
(b) Explain the mechanism of the urine formation. (Board Term I, 2013)

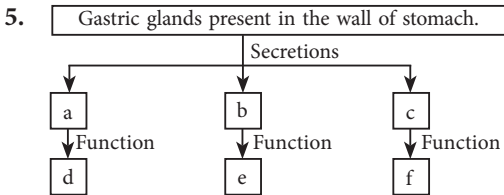
6.5 Excretion

SA II (3 marks)

36. Draw a diagram of human excretory system and label kidneys, ureters on it. (Board Term I, 2017)
37. Draw a neat diagram of excretory system of human beings and label on it:

Detailed Solutions

- (a)
- Raw materials required for photosynthesis are carbon dioxide (CO₂), water, light and chloroplast.
- Gastric glands are present in the wall of the stomach. They secrete gastric juices containing mucus, protein digesting enzymes pepsin, rennin and hydrochloric acid (HCl).
- Stomach's muscular wall contains gastric glands. These glands secrete gastric juices which contain dilute hydrochloric acid, mucus and two protein digesting enzymes rennin and pepsin.



a – Hydrochloric acid (HCl)

b – Protein digesting enzyme pepsin

c – Mucus

d – HCl makes medium acidic for the activation of an enzyme pepsin.

e – Pepsin acts in acidic medium which breaks down proteins into peptones.

f – Mucus protects the inner lining of stomach from corroding action of HCl.

6. (a) (i) Enzyme trypsin : This enzyme is produced by the pancreas in an inactive form called trypsinogen. Trypsin converts remaining proteins into peptones and the peptones into peptides and amino acids.

(ii) Enzyme lipase : It is secreted by pancreas and small intestine. Lipase converts fats into fatty acids and glycerol.

(b) Internally, the wall of the small intestine is provided with long finger-like projections called villi. Two functions of villi are :

(i) The villi greatly increase the absorptive surface area of the inner lining of small intestine.

(ii) The large surface area of small intestine helps in rapid absorption of digested food.

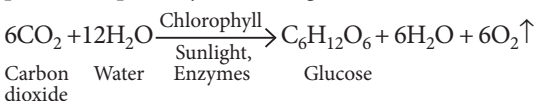
7. Photosynthesis is important for a number of reasons :

(i) Food : By photosynthesis, green plants synthesise food from simple raw materials like CO_2 and H_2O . Thus, it sustains life on earth.

(ii) Oxygen : Oxygen released during the process of photosynthesis is needed by animals and humans for respiration. It is also required for respiration of microbes. Oxygen also supports combustion of fuels.

(iii) Fuels : Fossil fuels like coal, oil and natural gas are forms of stored solar energy synthesised millions of years ago through photosynthesis.

Balanced chemical equation involved in the process of photosynthesis is given as :



8. Differences between autotrophs and heterotrophs are as follows :

S. No.	Autotrophs	Heterotrophs
(i)	These organisms are able to form organic substances from simple inorganic substances such as CO_2 , H_2S and water.	They cannot produce organic compounds from inorganic sources and therefore completely rely on consuming other organisms for its food requirement.
(ii)	They have chlorophyll to trap solar energy.	Chlorophyll is absent, so they cannot trap solar energy.
(iii)	They can be chemoautotroph and photoautotroph.	They can be saprophytic, parasitic and holozoic in mode of nutrition.
(iv)	Autotrophs are placed at the bottom of the food chain as producers.	Heterotrophs are placed above autotrophs in the food chain as consumers.
(v)	Green plants, some bacteria and some protists like <i>Euglena</i> are examples of autotrophs.	Mushrooms, <i>Euglena</i> , cow, goat, etc., are examples of heterotrophs.

9. The mode of nutrition in *Amoeba* is holozoic. The process of obtaining food by *Amoeba* is called phagocytosis.

(i) *Amoeba* ingests food by using its finger-like projections called pseudopodia.

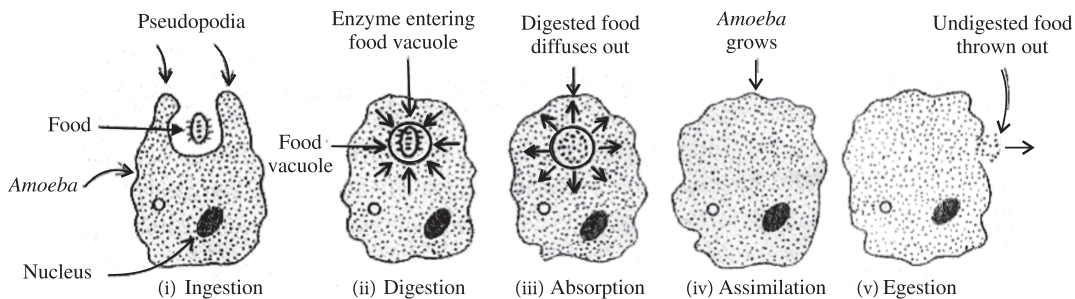
(ii) The food is engulfed with a little surrounding water to form a food vacuole inside the *Amoeba*. The food is digested inside food vacuole by digestive enzymes.

(iii) Food is absorbed directly into the cytoplasm of *Amoeba* by diffusion.

(iv) Food is used to obtain energy and growth of *Amoeba*.

(v) When considerable amount of undigested food collects inside *Amoeba* then its cell membrane ruptures at any place to throw out this undigested food.

Diagrammatic representation of different stages in the holozoic nutrition (feeding) of *Amoeba* is as follows :



10. (a) The involuntary contraction and relaxation of gut muscles to move the partially digested food downwards throughout the alimentary canal is called peristaltic movement.

(b) In desert plants, stomata open at night and take in carbon dioxide (CO_2). Stomata remain closed during daytime to prevent the loss of water by transpiration. They store the CO_2 in their cells until the sun comes out so that they can carry on with photosynthesis during the daytime.

11. (a) Human body continuously require energy for their life activities like respiration, circulation, excretion, etc. Energy is required even we are sleeping because a number of biological processes keep on occurring. All these processes require energy and this energy is obtained from nutrition. Nutrition is also needed for growth and repair of human body.

(b) The wall of alimentary tract contains muscles which can contract and expand alternately. The contraction and expansion movement of the walls of foodpipe is called peristaltic movement. The peristaltic movement moves the partially digested food in all the digestive organs throughout the alimentary canal.

(c) Herbivores eat plants which is rich in cellulose. Cellulose takes longer time for complete digestion by the enzymes present in symbiotic bacteria. Therefore, they have longer small intestine. Carnivores, feed on flesh which is easier to digest and do not contain cellulose also. Therefore, they have shorter intestine for digestion of food eaten by them.

(d) Gastric glands secrete HCl, mucus, rennin and pepsin enzymes. Mucus protects the inner lining of stomach from the action of HCl and enzymes. In the absence of mucus, there would be erosion of inner lining of stomach leading to acidity and ulcers.

12. (a) (i) Unused carbohydrates in plants are stored in the form of complex sugar known as starch. They are later broken down into simple sugars (glucose) when energy is needed.

(ii) The assimilated food molecules hold energy in their chemical bonds. Their bond energy is released by oxidation in the cell. This energy is trapped by forming bonds between ADP (adenosine diphosphate) and inorganic phosphate (Pi) to synthesise ATP (Adenosine triphosphate) molecules. These bonds are later broken by enzymatic hydrolysis and the energy released is utilised for cellular processes.

(b) *Amoeba* is a unicellular animal. *Amoeba* eats tiny (microscopic) plants and animals which float in water. The mode of nutrition in *Amoeba* is holozoic. The process of obtaining food by *Amoeba* is called phagocytosis. When a food particle comes close to *Amoeba*, it ingests the food particle by forming temporary finger-like projections called pseudopodia around it. The food is engulfed with a little surrounding water to form a food vacuole inside the *Amoeba*. The food is digested inside food vacuole by digestive enzymes and absorbed directly into the cytoplasm of *Amoeba* cell by diffusion. A part of absorbed food is used to obtain energy and the remaining part is utilised for growth of *Amoeba*. When considerable amount of undigested food collects inside *Amoeba* then its cell membrane ruptures at any place to throw out this undigested food. This process is called egestion.

Refer to answer 9 for figure.

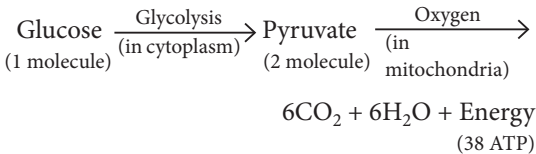
13. (a)

14. Due to higher metabolic rate and the volume of human body is so large that oxygen cannot diffuse into all cells of the body quickly as oxygen

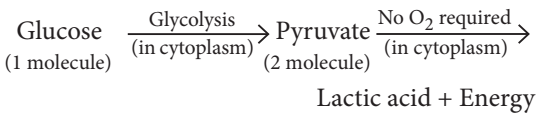
will have to travel large distances to reach each and every cell. So diffusion is insufficient to meet the oxygen demand of multicellular organisms.

15. The two different ways by which glucose is oxidised to provide energy in human body are :

(i) **Aerobic respiration** : The end products in aerobic respiration are carbon dioxide, water and energy.



(ii) **Anaerobic respiration** : The end products are lactic acid and energy.

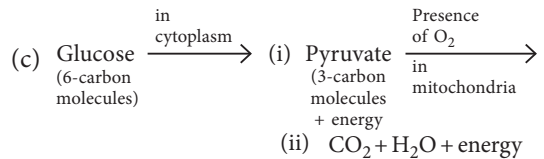


16. (a) Functions of alveoli are :

(i) They increase the surface area for exchange of gases.

(ii) The thin walls of alveoli facilitate rapid exchange of oxygen and carbon dioxide between alveolar air and blood.

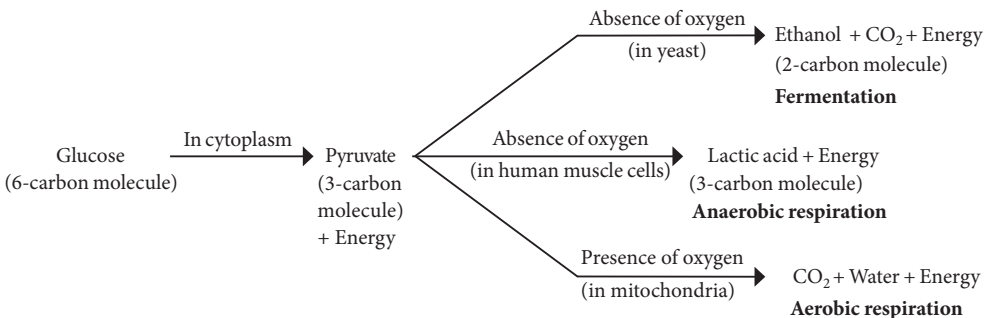
(b) Aquatic animals like fishes obtain oxygen from water present in the dissolved form through their gills. The amount of dissolved oxygen is quite small as compared to the amount of oxygen in the air. Therefore, to obtain required oxygen from water, aquatic animals have to breathe much faster than the terrestrial organisms.



17. Differences between breathing and respiration are as follows :

S. No.	Breathing	Respiration
(i)	It is a physical process. It involves inhalation of fresh air and exhalation of foul air.	It is a biochemical process. It involves exchange of respiratory gases and also oxidation of food.
(ii)	It is an extracellular process.	It is both an extracellular as well as intracellular process.
(iii)	It does not involve enzyme action rather two types of muscles are involved in this process.	It involves a number of enzymes required for oxidation of food.
(iv)	It does not release energy, infact it consumes energy.	It releases energy.
(v)	It is confined to certain organs only.	It occurs in all the cells of the body.

18. Breakdown of glucose by various pathways:

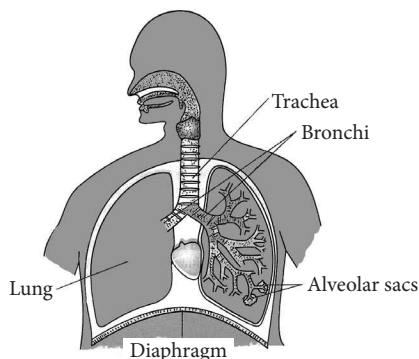


19. Differences between respiration in plants and animals are as follows:

S. No.	Plant respiration	Animal respiration
(i)	All parts of plants, like roots, stem and leaves, perform respiration individually.	Animal performs respiration as a single unit.
(ii)	There is little transport of respiratory gases from one part to the other during respiration.	Respiratory gases are usually transported over long distance inside an animal during respiration.
(iii)	Respiration occurs at a very slow rate	It is a fast process in animals.
(iv)	There is no special gas transport system.	Gases are transported by specialised blood vascular system.
(v)	Respiratory organ in plants are generally stomata in leaves, lenticels in stem and general surface of roots.	Respiratory organ in animals are generally lungs and gills.

20. (a) Terrestrial organisms inspire atmospheric oxygen, while aquatic organisms thrive on the dissolved oxygen present in water. Air contains about 21% of oxygen while water has less than 1% oxygen in dissolved state. Oxygen diffuses through water at a much slower rate as compared to air. A terrestrial organism has the advantage of utilising greater amount of oxygen at a faster rate with lesser effort whereas, aquatic organisms have to put more effort to obtain the same amount of oxygen, therefore breathing in aquatic organisms is much faster than the terrestrial organisms.

(b) The labelled diagram of human respiratory system is as follows :



21. (a) (i) Herbivores need a longer small intestine than that of carnivores because their diet is mostly grass and plants, that contains more fibres and cellulose which are hard to digest. Longer small intestine also hosts many small bacteria that process and break down cellulose into glucose which is a source of energy. Carnivores diet is not rich in cellulose so, they do not need to harbour bacteria for cellulose digestion.

(ii) Human lungs have a highly branched network of respiratory tubes. A primary bronchus divides into secondary bronchus, which in turn forms tertiary bronchus. Tertiary bronchus divides repeatedly into bronchioles which finally terminate into alveoli. Alveoli are small, rounded polyhedral pouches which are extremely thin-walled and possess a network of capillaries, for the exchange of gases. Due to vast surface area of alveoli, exchange of gases becomes a fast and effective process. Oxygen diffuses from alveoli into pulmonary blood capillaries and CO_2 diffuses out from capillaries into alveoli.

(b) Refer to answer 20(a).

22. Refer to answer 18.

Respiratory pigment present in human beings is haemoglobin.

Rings of cartilage are C in shape, stacked one on top of the other. These cartilaginous rings prevent the trachea from collapsing and blocking the airway.

23. (a) Refer to answer 20(b).

(b) (i) Lungs always contain residual volume so that during the breathing cycle, when air is inhaled and exhaled, there must be sufficient time for oxygen to be absorbed and for the carbon dioxide to be released. It is also important as it prevents the lungs from collapsing.

(ii) Mucus and hair present in nostrils help in filtration of inhaled air. It traps harmful substances and germs present in air.

24. (c)

25. Pulmonary vein carries oxygenated blood from lungs to left atrium of heart.

26. The transport of food prepared in the leaves, by the process of photosynthesis, to various parts (roots, stem, branches, etc.) of the plant is called translocation.

27. The three types of blood vessels in human body are: (i) arteries, (ii) veins and (iii) capillaries.

(i) Arteries are the blood vessels which carry blood from heart to various parts of the body. The walls of arteries are thick, elastic and muscular that enables them to dilate but not rupture when the heart contracts and forces blood into them.

(ii) Veins are thin walled blood vessels which bring blood from the body back to the heart. They are larger and hold more blood than the arteries. The lumen of veins are provided with valves to prevent the backflow of blood.

(iii) Capillaries are thin walled and extremely narrow blood vessels which occur at the terminals of artery and vein. The wall of capillaries are permeable to water and dissolved substances so that the exchange of materials between the blood and body cells can take place.

28. (a) Xylem tracheids and vessels are two water conducting tissues present in plants that help in rapid movement of water.

In xylem tissue, vessels and tracheids of the roots, stems and leaves are interconnected to form a continuous system of water conducting channels reaching all parts of the plant.

Minerals and water needed by the plants are absorbed by root hairs from the soil by the process of osmosis and take in minerals by the process of diffusion. Thus, a difference in concentration of ions is created between the roots and the soil which enables the water to enter into roots to compensate the difference in concentration. The water, alongwith dissolved minerals from root hairs, passes into xylem vessels through cells of the cortex, endodermis and pericycle and then ascent of sap (*i.e.*, upward movement of water and mineral salts from roots to the aerial parts of the plant against the gravitational force) takes place from xylem of the roots to the xylem of stem and leaves through vessels and tracheids. Evaporation of water molecules from the cells of leaves creates a suction pressure which pulls the water from xylem cells.

(b) Plants are autotrophic and do not have to move from one place to another in search of their food. Movements in a plant are usually at the cellular level and hence they required less amount of energy. Whereas animals are heterotrophic and locomote in search of food and other activities, hence require higher amount of energy than of plants.

29. The phloem cells transport the soluble food materials to all parts of plant. The transport of food from leaves to different parts of plant is termed as translocation. Components of phloem are sieve tubes, companion cells, phloem parenchyma and phloem fibres. The food is manufactured in the mesophyll cells (or photosynthetic cells) of a leaf. The manufactured food enters into sieve tubes of the phloem and is transported as a dilute aqueous solution either in upward or downward direction. Food is transported to all non-green parts of the plant for their growth and metabolic activities. Besides food molecules, phloem also transports amino acids, hormones synthesised in the shoot tips and root tips and other metabolites.

In this process, glucose is transferred to phloem tissue using energy from ATP. This increases the osmotic pressure of the tissue causing the water to move into it (endosmosis). Soluble material is then transferred from phloem tissue to other tissues which have less pressure than in the phloem. Thus, according to plant's requirement, the material is translocated from higher osmotic pressure areas to lower osmotic pressure areas.

30. (i) Xylem is a specialised plant conducting tissue that transports water and minerals from roots to all aerial parts of plants which occurs against gravitational force with the help of ascent of sap.

(ii) Phloem transports food that is prepared in the leaves, through photosynthesis, to various parts of plant. This process is called translocation. Phloem also transports amino acids, hormones synthesised in the shoot tips and root tips and other metabolites.

(iii) Pulmonary vein present in human circulatory system brings oxygenated blood from lungs to the left atrium of heart.

(iv) Vena cava transport deoxygenated blood collected by all veins of body except pulmonary vein and pass it to the right atrium of heart.

(v) Pulmonary artery transports deoxygenated blood from right atrium of heart to lungs for oxygenation.

(vi) Aorta transports oxygenated blood from left atrium to systemic arteries which further take the blood to various body parts and organs.

31. Significance of transpiration in plants :

- (i) The absorbed water is transported from roots to leaves through xylem vessels which is greatly influenced by transpiration pull.
- (ii) The water stream moving upwards carries dissolved minerals with it. Transpiration also helps in distributing these minerals throughout the plant.
- (iii) The evaporation of water during transpiration provide cooling effect to the leaves.

32. Differences between arteries and veins are as follows :

S. No.	Arteries	Veins
(i)	Arteries are the blood vessels which carry blood away from the heart for distribution to the body.	Veins are blood vessels which bring blood from the body back to the heart.
(ii)	Arteries walls are thick and valves are absent.	Their walls are thin and valves are present to prevent back flow of blood.
(iii)	Blood passing through narrow lumen of arteries is mostly oxygenated and has a considerable pressure.	The blood passing through wide lumen of veins is deoxygenated (except in pulmonary veins) and has low pressure.
(iv)	More elastic and placed deeply.	Less elastic and superficially placed.

33. (a) Since ventricles have to pump blood into various organs with high pressure, they have thicker walls than atria.

(b) Transport system in plants is less elaborate than in animals, as plants are less active, so their cells do not need to be supplied with materials so quickly.

(c) The aquatic vertebrates like fish have gills to oxygenate blood. The flow of blood in a fish is single circulation because the blood passes through the heart only once in one complete cycle of body. The terrestrial vertebrates like birds and humans have double circulation as the blood travels heart twice in one complete cycle of blood and they have lungs for oxygenation of blood.

(d) It is because during daytime rate of transpiration is higher.

(e) The lumen of veins have valves, which allow the blood in them to flow in only one direction. Thus prevent back flow of blood.

34. (a) Fishes have only two chambers in their heart, the blood is pumped to the gills to get oxygenated blood and from there it passes directly to rest of the body. Thus, the blood goes only once through the heart during one cycle of passage through the body. This type of circulation is termed as single circulation.

In human beings, during circulation blood travels twice through the heart in one complete cycle of the body and is called double circulation. The pathway of blood from the heart to the lungs and back to the heart is called pulmonary circulation and the pathway of blood from the heart to the rest of the body and back to heart is called systemic circulation.

(b) Deoxygenated blood from the body tissues is poured into right atrium. Contraction of heart forces it into right ventricle. From right ventricle, deoxygenated blood flows to the lungs through pulmonary artery. Oxygenated blood from lungs is returned into left atrium and then into left ventricle. The left ventricle forces the oxygenated blood to the whole body. Thus, for making one complete round or circulation circuit around all body parts, the blood passes through the heart twice. This is known as double circulation of blood.

35. (a) Two components of blood are blood plasma and blood corpuscles.

(b) Deoxygenated blood gets oxygenated in the lungs, from there it moves to heart and pumped to different parts of the body. Its path can be traced out as

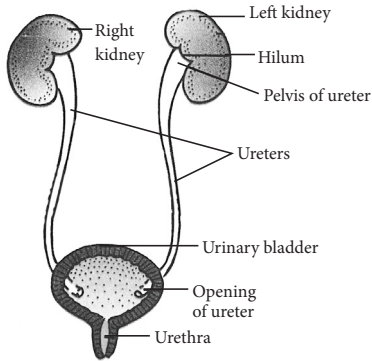
Lungs → Pulmonary veins → Left atrium of heart → Aorta → Arteries → Body parts

(c) When blood is pumped, valves prevent back flow of blood between ventricles and atria. They open and allow the right amount of blood to flow from one chamber to the other.

(d) Structural difference between veins and arteries is as follows:

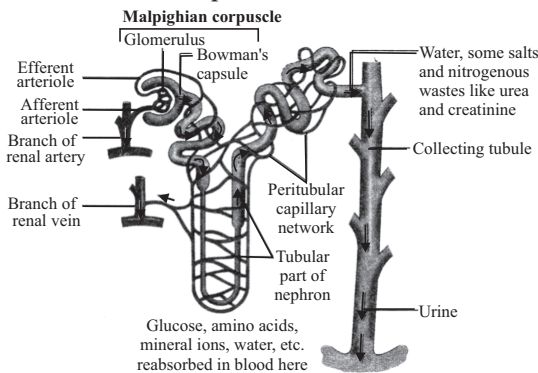
Veins	Arteries
Veins have thin, less elastic and less muscular walls. They have valves to prevent back flow of blood.	Arteries have thick, elastic and muscular walls with no valves.

36. Diagram of human excretory system is as follows :



37. Refer to answer 36.

38. Structure of nephron is as follows :



The function of nephron is filtration of blood and elimination of waste material from it. Blood is filtered from the blood capillaries into Bowman's capsule and pour the filtrate into the renal tubule. In this part, large amount of water and useful substances like glucose, amino acid, minerals ions, etc., are reabsorbed. Nitrogenous waste along with little amount of water is sent to the urinary bladder, which later expels the urine to the outside through urethra.

39. (a) Four types of metabolic wastes produced by human are urea, carbon dioxide, water and salts.
(b) Two human excretory organs other than kidneys are:

- (i) Lungs : They help to eliminate carbon dioxide.
- (ii) Liver : It is an excretory organ as it converts harmful amino acids to harmless urea and haemoglobin of worn out RBCs to bilirubin and biliverdin that can be excreted out of the body.

40. (a) Excretory system (Urinary system) in human beings consists of a pair of kidneys, a pair of ureters, urinary bladder and urethra.

(b) In the kidney, the wastes are converted to urine by three processes :

(i) Ultrafiltration : In it, large amount of water along with certain harmful substances like urea, uric acid, K^+ , ammonium salts, creatinine, etc., and certain useful substances like glucose, amino acids, Na^+ , etc., pass through glomerular capillaries and glomerular membrane into cavity of Bowman's capsule of nephrons under pressure. The filtrate so formed is called nephric filtrate which is moved towards ureter.

(ii) Selective reabsorption : In it, large amount of water and sodium, whole of glucose and amino acids and small amount of urea are passed back from nephric filtrate into blood capillaries. It occurs either by back diffusion (*i.e.*, water and urea) or active transport (*i.e.*, Na^+ , glucose and amino acids). It generally occurs in PCT (Proximal convoluted tubule) of nephrons.

(iii) Tubular secretion : In this, certain harmful chemicals like uric acid, creatinine, K^+ , etc., are passed from blood capillaries surrounding the nephron into nephric filtrate by active transport. It generally occurs in DCT (Distal convoluted tubule) of nephrons.

Now, the fluid is termed as urine and is excreted out of the excretory organs.

41. (a) The biological process involved in the removal of wastes, produced during various metabolic activities in the body from the body of an organism is called excretion. The wastes are non-gaseous nitrogenous wastes like ammonia, urea, uric acid, etc., along with excess of water, salts and pigments.

(b) Basic filtration unit present in kidney is nephron.

(c) Refer to answer 36.

- (i) Kidney
- (ii) Ureter
- (iii) Urinary bladder

42. (a) Refer to answer 36 for figure.

(b) Nephrons are the functional unit of kidney. Each kidney has about one million nephrons. Each nephron consists of a cup-shaped structure called Bowman's capsule containing a bunch of capillaries called glomerulus. Bowman's capsule leads into tubular structure which ultimately joins the transverse collecting tubule.

Filtration of blood and formation of urine in nephron involves the following steps:

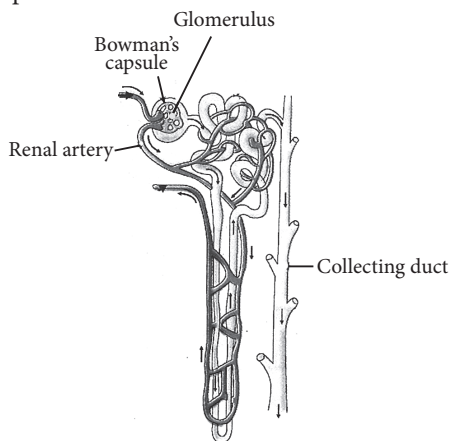
(i) The blood along with waste and excess water is brought to kidney by renal arteries. Blood is filtered from the blood capillaries into Bowman's capsule.

(ii) As the nephric filtrate passes through the tubular part of nephron, useful substances like glucose, amino acid, mineral ions, water, etc., are reabsorbed by blood capillaries surrounding the nephron.

(iii) Tubular secretion occurs mainly in the renal tubule and the collecting duct of the nephron where additional wastes are excreted from the blood stream into the filtrate.

(iv) The fluid that flows through collecting tubule is urine which consists of water, urea, uric acid, mineral ions like sodium, potassium, chloride, phosphates, etc.

43. (a) Structural and functional unit of kidney is nephron. Its structure is as follows:



(b) Main function of nephron is to form urine. The three main processes involved in the urine formation are :

(i) Ultrafiltration : It is the filtration of body fluids and solutes from the blood, out of the glomerular capillaries into the Bowman's capsule due to the pressure of the glomerulus. All substances from the blood are filtered out except the large protein molecules and blood corpuscles. This fluid in the glomerular capsule is called glomerular filtrate. It consists of water, urea, salts, glucose and other plasma solutes.

(ii) Selective reabsorption : Glomerular filtrate contains a lot of useful materials like water, glucose and salts such as sodium. These substances are reabsorbed by blood capillaries surrounding the nephron from the renal tubule at various levels and to various extents.

(iii) Tubular secretion : This occurs mainly in the renal tubule and the collecting duct of the nephron. It is a process performed by the cells of the cuboidal epithelium lining the tubules which excrete additional wastes from the blood stream into the filtrate by active transport. In this process substances like potassium, hydrogen, creatinine and certain drugs like phenol, penicillin, etc., are directly excreted by the tubular cells from the blood. The fluid which now flows through collecting tubule is urine which consists of water, urea, uric acid, mineral ions like sodium, potassium, chloride, phosphates, etc.

