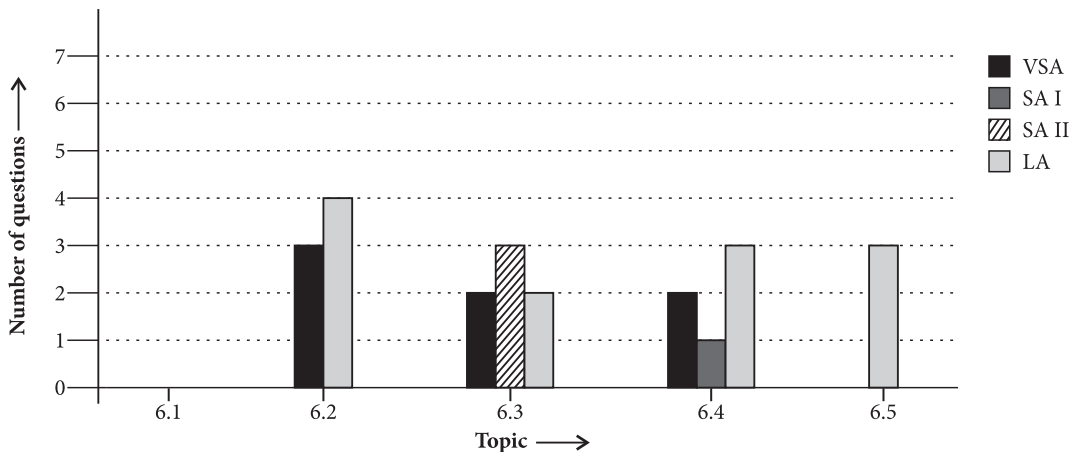
Chapter

6

Life Processes

Topicwise Analysis of 2010-2008 Years' CBSE Board Questions



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

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

- They can move by themselves.
- They need food, air and water.
- They can grow.
- They can reproduce and can have young ones.
- They respire (release energy from food).
- They excrete (get rid of waste materials from their body).
- They can respond to changes around them and they are sensitive.

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.

Modes of nutrition

Autotrophic

- A kind of nutrition in which the organisms prepare (or synthesise) their own organic food utilising only the inorganic raw materials present in their surroundings.
- It is found in green plants.

Heterotrophic

- A kind of nutrition in which the organisms derive energy from the intake and digestion of the organic substances prepared by autotrophs and other organic sources.

Saprotrophic

- A kind of nutrition in which the organisms derive their nutrients from dead and decaying organic matter (such as rotten leaves, rotten bread, dead animals, household wastes, non-living organic matter present in the soil, etc.).

Parasitic

- A type of nutrition in which the organisms (or parasites) derive their nutrients or food from other living organisms without killing them.
- Parasitic mode of nutrition is observed in several fungi, bacteria, a few plants like *Cuscuta* and some animals like *Plasmodium* and roundworms.

Holozoic

- In this type of nutrition, an organism takes the complex organic food materials into its body by the process of ingestion. The ingested food is digested and then absorbed into the body cells of the organisms.
- Human beings and most of the animals have holozoic mode of nutrition.

Flow chart: Modes of nutrition

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:

$$\underset{\text{Carbon dioxide (From air)}}{6CO_2} + \underset{\text{Water (From soil)}}{6H_2O} \xrightarrow[\text{(Photosynthesis)}]{\text{Light energy + Chlorophyll}} \underset{\text{Glucose}}{C_6H_{12}O_6} + \underset{\text{Oxygen}}{6O_2}$$

- 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**.
- 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^+),

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 (or 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, one pair of canines, two pairs of premolars and three pairs of molars. 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, Pm 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 stored in the gall gladder. 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 mitochondrium. 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 mitochondrium where it is completely broken down resulting in the production of energy rich compound, ATP. The equation of aerobic breakdown of glucose is :

$$\text{Glucose} \xrightarrow[\text{In cytosol, no } O_2 \text{ is required}]{\text{Glycolysis}} \text{Pyruvic acid} \xrightarrow[\text{In mitochondrium, } O_2 \text{ is required}]{\text{Krebs' cycle}} CO_2 + H_2O + \text{Energy}$$

  – **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:

$$\text{Glucose} \xrightarrow[\text{In cytosol, no } O_2 \text{ is required}]{\text{Glycolysis}} \text{Pyruvic acid} \xrightarrow{\text{In absence of } O_2} C_2H_5OH + CO_2 + \text{Energy}$$

(Ethyl alcohol)

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 pseudostraified 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 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 minium 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 Hg6, 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)

1. Name the green dot like structures in some cells observed by a student when a leaf peel was viewed under a microscope. What is this green colour due to? *(Delhi 2010)*

2. Where does digestion of fats take place in our body? *(AI 2009)*

3. How do autotrophs obtain CO_2 and N_2 to make their food? *(AI 2008)*

LA (5 marks)

4. Explain the process of digestion of food in mouth, stomach and small intestine in human body. *(Delhi 2010)*

5. (a) List the three events that occur during the process of photosynthesis. Explain the role of stomata in this process.

(b) Describe an experiment to show that "sunlight is essential for photosynthesis."

(Delhi 2010)

6. (a) Draw a diagram of human alimentary canal and label on it: oesophagus, gall bladder, liver and pancreas.

(b) Explain the statement, 'bile does not contain any enzyme but it is essential for digestion.' *(Delhi 2009)*

7. (a) Draw a diagram depicting human alimentary canal and label on it: gall bladder, liver and pancreas.

(b) State the role of liver and pancreas.

(c) Name the organ which performs the following function in human.

(i) Absorption of digested food

(ii) Absorption of water *(Delhi 2008)*

6.3 Respiration

VSA (1 mark)

8. State the basic difference between the process of respiration and photosynthesis. *(Foreign 2010)*

9. Name the intermediate and the end products of glucose breakdown in aerobic respiration. *(Foreign 2010)*

SA II (3 marks)

10. How are oxygen and carbon dioxide transported in human beings? How are lungs designed to maximise the area for exchange of gases? *(AI 2008)*

11. Write any three differences between aerobic and anaerobic respiration. *(AI 2008)*

12. (a) What are two different ways in which glucose is oxidised to provide energy in various organisms?

(b) Write any two differences between the two ways of oxidation of glucose in organisms. *(AI 2008)*

LA (5 marks)

13. Draw a neat and labelled diagram of human respiratory system. Explain in brief the role of lungs in the exchange of gases. *(Foreign 2010)*

14. (a) Draw a diagram of the human respiratory system and label on it: alveolar sac, bronchioles, larynx and trachea.

(b) How are the lungs designed in human beings to maximise the area of exchange of gases? *(Foreign 2009)*

6.4 Transportation

VSA (1 mark)

15. What will happen to a plant if its xylem is removed? *(Delhi 2009)*

16. Name the tissue which transports soluble products of photosynthesis in a plant. *(Delhi 2008)*

SA I (2 marks)

17. Write one function of each of the following components of the transport system in human beings.

(a) Blood vessels (b) Blood platelets

(c) Lymph (d) Heart *(AI 2008)*

LA **(5 marks)**

18. (a) Draw a sectional view of the human heart and label on it: pulmonary arteries, vena cava, left ventricle.

(b) Why is double circulation of blood necessary in human beings?

(AI 2009)

19. (a) Draw a schematic representation of transport and exchange of oxygen and carbon dioxide during transportation of blood in human beings and label on it: lung capillaries, pulmonary artery to lungs, aorta to body, pulmonary veins from lungs.

(b) What is the advantage of separate channels in mammals and birds for oxygenated and deoxygenated blood?

(Foreign 2009)

20. (a) Draw a sectional view of the human heart and label in it, aorta, right ventricle and pulmonary veins.

(b) State the functions of the following components of transport system.

(i) Blood (ii) Lymph

(Delhi 2008)

6.5 Excretion

LA **(5 marks)**

21. Draw a neat and labelled diagram of human excretory system. Describe in brief the function of kidneys, ureters, urinary bladder and urethra. *(Foreign 2010)*

22. (a) Draw a diagram of excretory system in human beings and label on it : aorta, vena cava, urinary bladder and urethra.

(b) List two vital functions of the kidney.

(Delhi 2009)

23. (a) Draw the structure of a nephron and label the following on it: glomerulus, Bowman's capsule, renal artery, collecting duct.

(b) What happens to glucose that enters the nephron along with filtrate? *(AI 2009)*

Detailed Solutions

1. The green colour of the leaves of the plant is due to the presence of tiny green coloured organelles called chloroplasts which contain green pigment chlorophyll.

2. Digestion of fats takes place in small intestine.

3. Green plants take carbon dioxide (for carbohydrates) required for photosynthesis directly from atmospheric air and nitrogen (for proteins) in the form of soluble nitrogen compounds present in the soil.

4. The process of digestion of food in mouth, stomach and small intestine in human body is as follows :

(i) Mouth : Food is chewed with the help of premolars and molars which increases the rate of action of salivary amylase. Food is mixed with saliva of salivary glands. Salivary amylase hydrolyses about 30-40% of starch into maltose and isomaltose at pH 6.8.

$$\text{Starch} \xrightarrow[\text{pH 6.8}]{\text{Salivary amylase}} \text{Maltose + Isomaltose}$$

(ii) Stomach : Food is mixed with gastric juice which contains mucus, hydrochloric acid, pepsin, rennin and a weak lipase enzyme. Mucus lubricates the food and protects the inner lining of the stomach from the action of acid. Hydrochloric acid stops the action of saliva in stomach, kills the bacteria present in the food and provides acidic medium (pH 1-2) of gastric juice so that pepsin gets active for protein digestion.

Pepsin hydrolyses proteins into proteoses and peptones, while gastric lipase enzymes hydrolyses small amounts of fats into fatty acids and glycerol. Curdling of milk is done by the enzyme rennin, which increases the period of action of pepsin on milk proteins.

$$\text{Proteins} \xrightarrow[\text{pH 1-2}]{\text{Pepsin}} \text{Proteoses + Peptones}$$

In addition to chemical digestion, food also undergoes mechanical churning inside the stomach.

(iii) Small intestine : Food is mixed with three digestive juices : bile juice of liver; pancreatic juice of pancreas and intestinal juice of intestinal glands. Bile juice neutralises the acidity of the food coming from the stomach and provides alkaline medium and emulsifies (breaks down with the help of bile salts) larger fat globules into smaller fat droplets but is a non-enzymatic digestive juice so has no chemical action on food.

Pancreatic juice contains a number of enzymes like trypsin, pancreatic amylase and pancreatic lipase, which digest the peptones, starch and fats into peptides, maltose, isomaltose and fatty acids respectively.

$$\text{Fats} \xrightarrow{\text{Lipase}} \text{Fatty acids + Glycerol}$$

Intestinal juice also contains number of enzymes like aminopeptidase, intestinal amylase, maltase, isomaltase and lipase enzymes which hydrolyse peptides to amino acids, starch to maltose, maltose to two glucose, isomaltose to two glucose and fats to fatty acids and glycerol.

So, small intestine is the site of the complete digestion of carbohydrates, proteins and fats.

5. (a) The three events that occur during the process of photosynthesis are :

(i) Absorption of light energy by chlorophyll : It takes place in grana region of chloroplast. During light reaction, radiant energy of sun is trapped by photosynthetic pigments like chlorophyll and accessory pigments. When exposed to light, chlorophyll molecule is excited and emits electrons.

(ii) Conversion of light energy to chemical energy and splitting of water molecule into hydrogen and oxygen : Emitted electrons from chlorophyll are channeled through electron transport chain in chloroplast. The energy absorbed by chlorophyll is responsible for carrying out three functions: (i) formation of ATP, (ii) photolysis of water and (iii) synthesis of NADPH (Reduced nicotinamide adenine dinucleotide phosphate).

(iii) Reduction of carbon dioxide to carbohydrate: Carbon dioxide is reduced to glucose (carbohydrate) by the hydrogen in NADPH and by utilising the chemical energy stored in ATP.

Stomata play an important role in photosynthesis,

as gaseous exchange in plants take place through the stomata. Stomata are tiny pores present on the surface of the leaves (also on other green parts like stem). Carbon dioxide required for photosynthesis enters the leaves of the plant through stomata. A large amount of water is also lost through stomatal pores and oxygen released as by product of photosynthesis goes out through stomatal pores of leaves.

(b) Experiment to show that sunlight is necessary for photosynthesis.

(i) Take a potted plant having green leaves and place it in a completely dark place for about three days to destarch its leaves.

(ii) Take a thin strip of aluminium foil (or black paper) and wrap it in the centre of one leaf on both the sides (while the leaf is still attached to the plant). The aluminium foil should be fixed tightly to the leaf by using paper clips so that sunlight may not enter it from the sides. The aluminium foil should cover only a small part of the leaf so that the remaining part of the leaf remains uncovered and exposed to sunlight.

(iii) Keep this potted plant (with partially covered leaf) in bright sunshine for three to four days.

(iv) Pluck the partially covered leaf from the plant and remove its aluminium foil. Immerse this leaf in boiling water for a few minutes. This will break down the cell membranes of leaf cells and make the leaf more permeable to iodine solution. This leaf is now to be tested for the presence of starch. But before testing for starch, chlorophyll has to be removed from the leaf.

(v) Now put the leaf in a beaker containing some alcohol. Place the beaker containing alcohol and leaf in a water bath.

(vi) Heat the water in the bigger beaker. Then the alcohol in the smaller beaker will also get heated and start boiling soon. This boiling alcohol will extract (or remove) chlorophyll from the green leaf.

(vii) Boil the green leaf in alcohol till all its green pigment 'chlorophyll' is removed. The leaf will now become almost colourless or pale (and the alcohol will turn green).

(viii) Remove the colourless leaf from alcohol and wash it thoroughly with hot water to soften it and remove any chlorophyll which may be sticking to it.

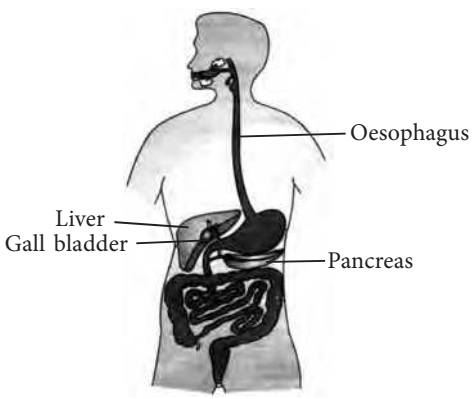
(ix) Place the colourless leaf in petri-dish. Drop iodine solution over the decolourised leaf with the help of a dropper. Observe the change in colour of leaf.

(x) The middle part of leaf which was covered with aluminium foil does not turn blue-black on adding iodine solution showing that no starch is present in this middle part of the leaf. This is because sunlight could not reach the covered 'middle part' of the leaf due to which the covered 'middle part' of leaf could not do photosynthesis to make starch.

(xi) The uncovered part of leaf which was exposed to sunlight turns blue-black on adding iodine solution showing that starch is present in this part of leaf.

(xii) Since the part of leaf which was covered and hidden from sunlight does not contain starch but the part of leaf which was exposed to sunlight contains starch, therefore, we conclude that sunlight is necessary for photosynthesis (to make food like starch).

6. (a) The diagram labelled of human alimentary canal is as follows:



(b) Bile is a dark green to yellowish brown fluid secreted by liver and stored as well as concentrated in the gall bladder. Bile does not contain any digestive enzymes like other secretions from gastrointestinal tract instead has salts which emulsify fats (that are in the form of complicated triglycerol) and breaks it down into small fat droplets that can easily be acted upon by fat digesting enzymes. This is actually a detergent like action of bile. Therefore, bile is essential for digestion though it does not contain any digestive enzyme.

7. (a) *Refer to answer 6(a).*

(b) Liver is the largest gland of the body that secretes bile juice. Bile juice neutralises acidity of food coming from stomach and provides alkaline medium and helps in digestion of fats in small intestine by bringing about fat emulsification (conversion of large fat droplets into smaller ones) making it easier for enzymes to act and digest them. Pancreas is a soft, lobulated greyish-pink gland which has both endocrine and exocrine parts. Cells of exocrine part secrete pancreatic juice which contains enzymes like pancreatic amylase, trypsin and lipase that help in digestion of starch, proteins and fats, respectively. The cells of endocrine part secrete hormones glucagon and insulin that take part in glucose metabolism.

(c) (i) The absorption of digested food takes place in small intestine.

(ii) Absorption of most of the water from undigested food takes place in large intestine.

8. Respiration involves breakdown of food (like glucose) by using oxygen and releasing carbon dioxide, water and energy whereas photosynthesis is synthesis of food (like glucose) by using carbon dioxide, water and sunlight and releasing oxygen. Therefore, respiration is just reverse of photosynthesis.

9. The intermediate product of glucose breakdown in aerobic respiration is pyruvate whereas the end products are carbon dioxide and water.

10. In gaseous 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 and O_2 moves from higher concentration to lower concentration due to the process of diffusion. The blood has more 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.

In times, 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 and CO_2 moves from tissues to the blood. The blood now becomes deoxygenated.

Heart receives this oxygen rich blood from lungs through pulmonary vein and distributes it to all body parts through arteries and collect carbon dioxide rich blood from all body parts through veins and takes it to lungs through pulmonary artery for oxygenation. Deoxygenated carbon dioxide rich air moves out from blood capillaries into the alveoli and is finally breathed out.

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. Exchange of gases takes place in alveoli and hence an alveolus is called a miniature lung.

The alveoli provide a vast surface area where exchange of gases can takes place. Oxygen diffuses from alveoli into pulmonary blood capillaries and CO_2 diffuses out from capillaries into alveoli.

11. Differences between aerobic and anaerobic respiration are as follows:

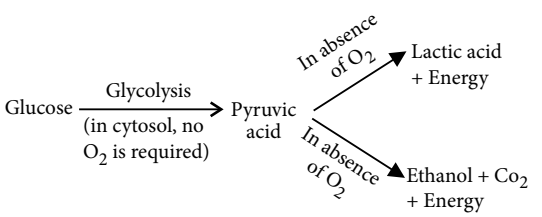
	Aerobic respiration	**Anaerobic respiration**
(i)	Aerobic respiration occurs in presence of oxygen.	Anaerobic respiration occurs in absence of oxygen.
(ii)	Glucose is completely broken down to release the end products in the form of carbon dioxide and water.	Glucose is incompletely oxidised to release the end products in the form of ethanol or lactic acid.
(iii)	Energy is released in larger amount.	Energy is released in lesser amount.
(iv)	It takes place in cytoplasm and mitochondria.	It takes place in cytoplasm. The mitochondria is not involved.

12. (a) Oxidation of food (glucose) within cell may be of two types depending upon the availability of atmospheric oxygen : aerobic respiration and anaerobic respiration.

(i) 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 (glucose) is completely broken down into carbon dioxide and water by the process of oxidation and large amount of energy (38 ATP) is produced. Aerobic respiration includes glycolysis which is common to both aerobic and anaerobic respiration. The pyruvic acid (pyruvate) molecules formed during glycolysis are carried to the mitochondria where they completely break down to CO_2 and H_2O with the evolution of a large amount of energy.

$$\text{Glucose} \xrightarrow[\text{Cytoplasm}]{\text{Glycolysis}} \text{Pyruvic acid} \xrightarrow[\text{Mitochondria}]{} CO_2 + H_2O + \text{Energy}$$

(ii) 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, such as ethanol or lactic acid are formed and small amount of energy is released. It involves glycolysis, during which glucose is degraded into pyruvate. Further breakdown of pyruvic acid in absence of oxygen result in the production of ethanol or lactic acid. Anaerobic oxidation of glucose in microorganisms formed ethanol and CO_2 and in muscle cells of humans, glucose is anaerobically metabolised into lactic acid.



(b) *Refer to answer 11.*

13. The labelled diagram of human respiratory system is as follows:

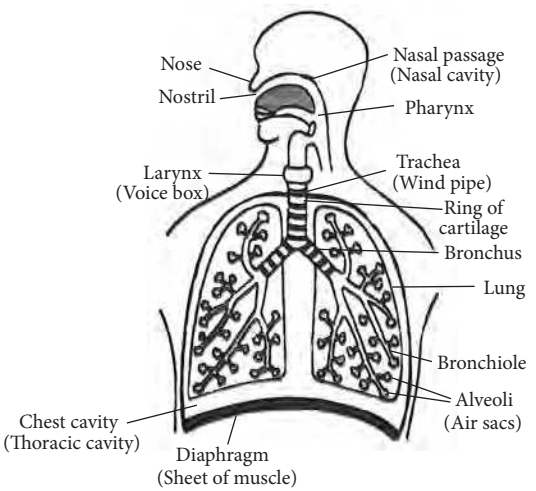


Fig.: Human respiratory system

The primary organs of the respiratory system are lungs, which function to take in oxygen and expel carbon dioxide as we breathe. During the exchange of gases at the respiratory surface (alveoli) of the respiratory organs (lungs) and the oxygen enters the blood and combines with haemoglobin (respiratory pigment) of red blood corpuscles to form oxyhaemoglobin. The oxygenated blood from the lungs is carried to left atrium of heart by pulmonary veins. The heart pumps and distributes the oxygenated blood to the body tissues by arteries where second exchange of gases occurs between blood and body cells. Blood gives oxygen to the body cells and takes carbon dioxide. Inside the cells, oxygen is utilised for oxidation of simple nutrients to produce energy, carbon dioxide and water. Body cells give carbon dioxide to blood and deoxygenated blood is pumped to right atrium of heart from where pulmonary artery carries deoxygenated blood to lungs.

14. (a) *Refer to answer 13.*

(b) *Refer to answer 10.*

15. Xylem is the main water conducting tissue of plant. If it is removed then water and minerals absorbed by plant roots will not be able to reach different plant parts and plant will wilt and ultimately die.

16. The phloem is a vascular tissue that transports soluble products of photosynthesis (food or sugar) to all the parts of plants.

17. (a) : The blood vessels are tubes that transport blood throughout the body. There are three kinds

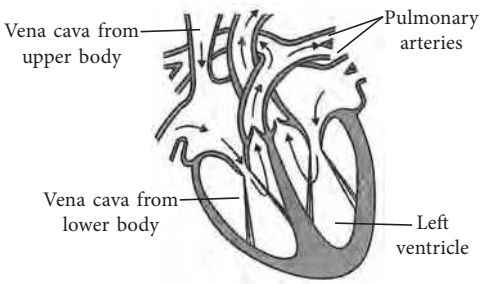
of blood vessels in human body; arteries, veins and capillaries.

(b) Blood platelets are irregular disc shaped cytoplasmic fragments that assist in formation of blood clot at the site of injury and prevent excessive loss of blood.

(c) Lymph is a mobile connective tissue and acts as 'middle man'. It takes part in nutritive process as it carries protein molecules from tissue into the blood stream. It also helps in removing waste products like fragments of dead cells, germs, etc.

(d) Human heart is a muscular organ that pumps blood throughout the body *via* the circulatory system, supplying oxygen and nutrients to the tissues and removing carbon dioxide and other wastes from the same.

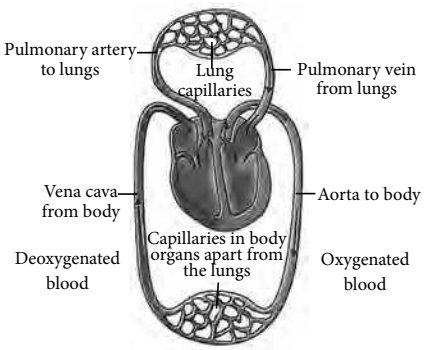
18. (a) The sectional view of human heart is as follows:



(b) The blood passes through human heart twice for one supply to the body. One circulation involves the transport of deoxygenated blood from all body parts into the heart. This blood is transported to lungs for oxygenation. The second circulation involves entry of oxygenated blood from lungs into left side of the heart from where it is distributed 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.

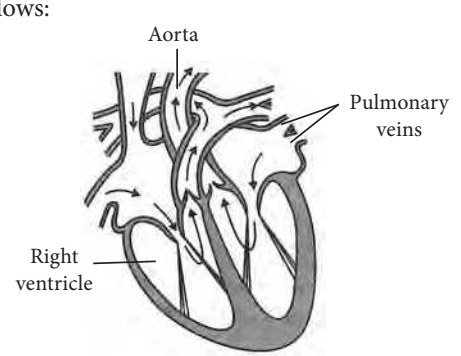
Double circulation prevent any mixing of oxygenated and deoxygenated blood in the body ensuring maximum supply of oxygen to all body parts. This is necessary for humans who need a lot of energy to maintain their constant body temperature against any external temperature fluctuations. The rich oxygen supply enables optimum oxidation of glucose in body cells to release the required energy.

19. (a) The schematic representation of transport and exchange of oxygen and carbon dioxide is as follows:



(b) In mammals and birds the two circulatory system (oxygenated blood and deoxygenated blood) become fully separate sending low pressure pumping to lungs and high pressure flow of blood to rest of body. This prevents any mixing of oxygenated and deoxygenated blood ensuring maximum supply of oxygen to all body parts. This allows optimum oxidation of glucose to release energy required by these animal groups to maintain their body temperature making them homeothermic.

20. (a) The sectional view of human heart is as follows:



(b) (i) Blood is a mobile connective tissue composed of a fluid, plasma and blood corpuscles.

Functions of blood are as follows:

— Blood takes part in transportation of respiratory gases (carbon dioxide and oxygen), nutrients and waste material in the body.

— White blood cells help to fight infection and protect from various pathogenic diseases.

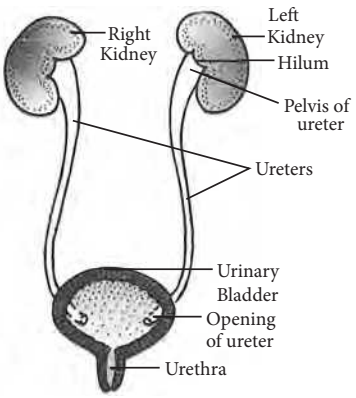
— Lymphocytes of blood produce antibodies and provide immunity against various diseases.

— When an injury is caused, the blood platelets release certain chemicals which help in clotting of blood.
— Blood plasma helps in maintenance of blood pH and uniform distribution of heat in the body.
— Blood carries hormones from endocrine glands to the target organs.

(ii) Lymph is a mobile connective tissue comprising of lymph plasma (fluid) and lymph corpuscles (cells).

— Lymph acts as 'middle man', takes part in nutritive process of body. It transport protein molecules from tissue into blood stream.
— Body cells are kept moist by lymph.
— It absorbs and transports fat and fat soluble vitamins from intestine.
— Lymph drains excess fluid from extra cellular spaces back into blood.

21. The labelled diagram of human excretory system is as follows:



Functions :

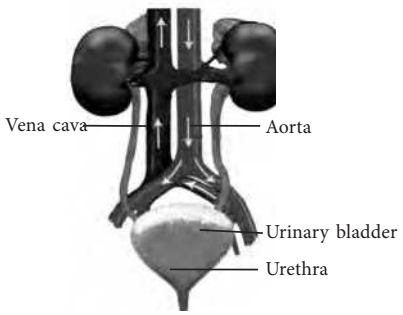
(i) Kidneys : These are main or primary excretory organs present as one pair of large-sized, reddish-brown coloured and bean shaped structure in the upper part of abdomen. The function of kidneys is to remove the poisonous substance, urea, other waste salts and excess water from the blood and excrete them in the form of a yellowish liquid called urine.

(ii) Ureters : These are a pair of long, narrow, thin-walled and tubular structures which conduct the urine from the kidneys to urinary bladder.

(iii) Urinary bladder : It is a thin-walled, elastic, pear-shaped and distensible sac which temporarily stores the urine. Its wall is lined with smooth (involuntary) muscles.

(iv) Urethra : It is a muscular and tubular structure which carries the urine from urinary bladder to the outside.

22. (a)



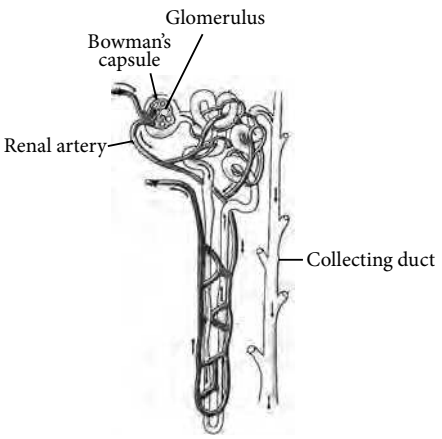
(b) Two vital functions of kidneys are:

(i) The most important function of kidneys is filtration of blood to excrete the waste products of metabolism. If these waste products, mainly nitrogenous waste such as urea and uric acid, are not removed from the blood, they will start accumulating to unbearable toxic levels.

(ii) Osmoregulation : Kidneys maintain water balance in the body and removes excess water.

Besides filtering out the waste products, the kidneys perform other functions such as secretion of erythropoietin, enzyme-renin, homeostasis and conversion of inactive form of vitamin D to the active form.

23. (a) The structure of a nephron is as follows:



(b) Glomerular filtrate present in Bowman's capsule contains glucose. This filtrate when enters proximal convoluted tubule of kidney then, much of it is reabsorbed back here (65%). Glucose is almost completely reabsorbed in the kidney tubule and is not excreted out.