TRANSPORTATION

4.1 INTRODUCTION :

All living bodies need nutrients and oxygen in every cell of its various tissues to sustain life. The transport of different material and gases is essential both in plants and animals. Unicellular organisms e.g. Amoeba and Paramecium do not require the transport of any material. These are in direct contact with their surroundings from where they obtain these nutrients. These substances are distributed in the cytoplasm due to the streaming movements of cytoplasm called as **cyclosis. They** exchange gases from the external environment directly by diffusion due to the difference in the concentration in and outside their body. In higher organisms both plants and animals, digested food, oxygen, hormones, waste nitrogenous substances etc. are to be carried from one place to the other. So transportation of materials is essential. It is done through circulatory system.

4.1 (a) Transportation in Higher Plants :

The higher plants have specialized system for the transportation of materials inside the body. The transportation of material is carried out by means of vascular tissues of the plants. The vascular tissues act as pipes or vessels. Through these vessels or pipes, water, minerals, salts, food etc. are transported in the plant body. In plants the medium of transportation is water. Water and food flows through the xylem (tracheids and vessels are the constituents of xylem) and phloem (sieve tubes and companion cells) for various metabolic activities. Tracheids and vessels are nonliving parts of xylem while sieve tubes and companion cells from the living parts of phloem. The terrestrial (land) plants absorb water and mineral salts through their roots. The area of young roots where most of the absorption takes place is the root hair zone. Root **hair are the extensions of the epidermal cells.** Root hair are delicate and do not live more than two days. The root hair have sticky walls by which they adhere tightly to soil particles. The root hair absorb water from soil by the process of osmosis but take in mineral salts by diffusion. The water and mineral salts are transported from the roots to the leaves, flowers and other parts of the plant. The upward movement of cell sap (water and minerals) through the xylem is called **"ascent of sap".**

4.1 (b) Translocation :

Phloem Translocates the manufactured food (sugar) or starch from the leaves to the leaves to the different parts of the plant including the roots.

4.1 (c) Transpiration :

Most of the water absorbed is lost through the aerial parts of the plant into air by a process called **"transpiration". Two** percent of total water absorbed is used up in various metabolic activities in the plant body. Transpiration is the loss of water from the living tissues of the aerial parts of the plant in the form of water vapours. There are three types of transpiration :

(i) Cuticular transpiration (through cuticle)

(ii) Lentiular transpiration (through lenticels)

(iii) Stomatal transpiration (through stomata)

- **Importance of transpiration :**

(A) It controls the rate of absorption of water from the soil.

(B) It is responsible for ascent of sap.

(C) It regulates the temperature of the plant.

(D) Mostly water absorbed by roots is lost by transpiration without serving any purpose. The energy spent by the plants in transpiration is wasted. So transpiration is a necessary evil.

4.1 (d) Differences in Function of Xylem and Phloem :

	Xylem		Phloem
(i)	Functional xylem ells are dead.	**(i)**	Functional phloem cells are alive.
(ii)	It carries mineral salts, water and traces of organic molecules	**(ii)**	An organic solution of sugars and amino acids is translocated.
(iii)	The movement is only upward.	**(iii)**	The movement can be upward or downward.

4.2 TRANSPIRATION COHENSION THEORY :

The main loss of water is through stomatal transpiration. Turgor pressure in the mesophyll cells of the leaf forces water outwards through the cell wall. Water evaporates from the surface of the cells into the air spaces of the spongy tissues and then passes into the outer atmosphere through the pores or stomata. The cell sap of mesophyll cells becomes concentrated by losing water and causes ad drop in turgor pressure. As a result water is sucked from adjoining mesophyll cells and ultimately from vascular tissues. This tension is transmitted all the way down to the unbroken column of water through the stem to the absorbing parts of the root. The molecules of the water show cohesion (mutual attraction) and molecules of water and vessel wall show adhesion (affinity for water). Due to these adhesive and cohesive forces, water column does not break but pulled upward by the force called as **"transpiration pull". The** whole process can be compared with a person (transpiration pull) pulling a bucket full of water (forces on water column) from a well with a rope (column of water due to cohesion).

4.3 TRANSPORTAION IN HUMANS :

In humans there is a circulatory system that uses blood or lymph as carries of materials (fluid exchange medium) and the heart as the pumping organ to help in circulation. Circulatory system consists of blood vascular system (blood as carrier) and lymphatic system (lymph as carrier).

4.3 (a) Blood Vascular System :

The higher multicelluar animals with higher metabolic rates posses a well developed blood vascular system. This system helps in the quicker supply of nutrients and oxygen to the body tissues and also in the rapid disposal of toxics waste material and carbon dioxide. The blood acts as the circulatory fluid. Blood vascular system consist of blood, blood vessels and heart.

(i) Blood : The blood is a specialized kind of living connective tissue which is made to circulate, by the muscular pumping organ called as **the heart.** In adult human beings there is 5.5 to 6 liter of blood. The blood consists of fluid part, the plasma. The red blood corpuscles (RBSs), white blood corpuscles (WBCs) and blood platelets are present in the plasma. The formation of blood is called **"Hempieces".**

(ii) Plasma : The plasma consist of water (90% & above) inorganic substances. In the plasma RBCs, WBCs and blood platelets float. Inorganic salts (09%) are also present. The organic substances are glucose, amino acids, proteins, hormones, digested and waste excretory products. The blood proteins (7%) are **fibrinogen, albumin, globulin and prothrombin.**

NOTE : Serum is plasma from which fibrinogen is removed.

(A) Red Blood Corpuscles (RBCs) or Erythrocytes : The number of RBCs is about 5.5 million in 1 ml of blood. The total number of RBC is about 30 billion. Each RBC is a **biconcave disc-like structure devoid of nucleus.** The mammalian erythrocytes do not possess nuclei, mitochondria and endoplasmic reticulum. The erythrocytes contain hemoglobin. Hemoglobin consist of globin (protein) and F^{2+} porphyrin compels (haeme). 100 ml of blood contains 15 mg of hemoglobin. if the amount of hemoglobin in blood is less, the person suffers from anemia The hemoglobin carries oxygen to the different cells of the body and brings carbon dioxide from the cells. The life span of a RBC is 120 days.

(B) White Blood Corpuscles (WBCs) or Leucocytes : The number of leucocytes is comparatively fever i.e. one ml of blood contains 5000 - 10000 leucocytes in humans. The total number of WBCs is about 75 millions. The number of leucocytes increases in infections like **pneumonia, blood cancer** (Leukemia) etc. These are large in size and contain nucleus. White blood corpuscles are of two types :

• **Granulocytes :** In granulocytes the cytoplasm contains granules and the nucleus is multliobed. Bosophils, Eosinophils and Neutrophils are three different types of granulocytes. **Eosinophils** and **neutrophils** are phagocytic (engulf and kill harmful microbes) in nature and this process is called as **"phagocytosis".** The function of **basophils** is to release histamine and Heparin.

• **Agranulocytes :** Monocytes and lymphocytes are two different types of agraulocytes. **Lymphocytes** secrete antibodies which destroy microbes. The **monocytes** are phagocytic in nature.

(C) Blood platelets : These are small and without nuclei. Their number various from 0.15 to 0.45 million in 1ml of blood. Their normal life span is one week. These help in blood clotting at the site of injury by liberating **thrombosplastin.**

4.3 (b) Functions of Blood :

Blood performs the following functions :

• **Transpiration of nutrients :** The digested and absorbed nutrients like glucose, amino acids, fatty acids are first transported to the liver and then to all the tissues for their storage, oxidation and synthesis of new substance.

• **Transportation of respiratory gases :** The respiratory gases (oxygen, carbon-dioxide) are transported by the blood. Oxygen is transported from the respiratory surface (lung, skin and buccal cavity) to the tissues and carbon dioxide from the tissues is taken to the respiratory organ for its removal.

• **Transportation of excretory products :** Different wastes from the different parts of the body are

collected by the blood and then taken to the organs (kidneys, lungs, skin and intestine) from where they are exerted.

• **Transportation of hormones :** Hormones are produced by endocrine glands. These hormones have target organs (p lace to act). These are carried by the plasma of blood and bring about the coordination in the working of the body.

• **Maintenance of pH :** the plasma proteins act as buffer system and maintains required pH of the body tissues.

• **Regulation of body temperature :** The blood flows in all the parts of body, so it equalizes the body temperature. It carries heat from one place to another place in the body.

• **Transportation of metabolic intermediates :** The blood carries metabolic intermediates from one tissue to another for further metabolism. In the muscle cells due to anaerobic respiration lactic acid is produced. This lactic acid is carried to the liver for further oxidation.

• **Water balance :** The blood maintains water balance to constant level by distributing it uniformly in the body.

• **Protection from diseases :** The WBCs (eosinophils, neutrophils, monocyts) engulf the bacteria and other disease causing organisms by phagocytosis. The lymphocytes produce antibodies to neutralize the action of toxins produced by pathogens.

• **Clotting of blood :** Blood forms a clot at the site of injury and thus prevents the further loss of blood.

• **Support :** Blood flows under pressure in arteries. Due to this tissues become stiff as in the case of erection of nipples, clitoris and penis.

4.3 (c) Blood Clotting :

At the site of injury of the blood vessels, the platelets induce blood coagulation through the release of **thromboplastin** (thrombokinase). Thromboplastin changes prothrombin of blood plasma into thrombin. Thrombin converts soluble protein fibrinogen to insoluble fibrin. Fibrin forms a network which entangles RBCs and blood platelets to form plug or **clot** over the inured area. Blood clotting is usually completed within 2-3 minutes.

Injured tissue + Blodd platelets ⟶ **Thromboplastin released**

Prothrombin $\xrightarrow{\text{Thrombokinase}}$ **Thrombin**

Fibrnogen $\xrightarrow[\text{Thrombin}]{Ce^{++}}$ **Fibrin**

(soluble) **(Insoluble)**

Fibrin +Red blood corpuscles ⟶ Clot of blood

4.3 (d) Blood Groups :

Land Steiner discovered that blood of different individual did not match each other but there were biochemical differences. He discovered Antigens A and B and blood groups **(ABO systems).** Antigen (agglutinogen) is a glycoprotein present on RBCs. For each antigen there is a corresponding antibody. Thus there are two antibodies (agglutinin) a and b occurring in the blood plasma. There are four types of blood groups depending on the presence or absence of these antigens.

Table : Blood Group : Antigen and Antibody		
Body Group	**Antigen present on RBCs**	**Antbody in plasma**
A	**A**	**b**
B	**B**	**a**
AB	**AB**	**None**
O	**None**	**a,b,**

Blood is a life saving fluid. It is often needed during accident and operation. The transfusion of blood is only done when blood group is known. These groups are A,B,AB and O. Blood of O group is a universal donor i.e. it an donate blood to any group (a, AB, B and O) but it can receive blood from O blood group. A B group is universal recipient (receiver). It an receive blood from any group (A, B, AB, O) but it can donate to AB group only.

4.3 (e) Blood Transfusion :

The transfusion of blood from a healthy person to a patient suffering from blood loss due to injury or surgical operation is called a **"blood transfusion".** For this all major hospitals have **blood banks** where blood is collected from voluntary and professional donors. Before preservation the blood is tested for its blood group and Rh factor. Though theoretically a patient may be able to receive blood of two or more types, it is always advisable to have the donor blood of the same group as that of the recipient. Rather the blood of donor is always crossmatched before transfusion to exclude any change of incompatibility. When blood from a donor is added is added to blood of the recipient, it is necessary to avoid bringing together corresponding antigen and antibody. This causes clumping of RBCs. Thus antigen A in RBCs of group A individuals reacts with antibodies of plasma of group B individuals. This phenomenon is called **"agglutination".**

Table Human blood groups and transfusion

Blood group of donor	**Blood group of recipient**			
O	**O**	**A**	**B**	**AB**
	√	√	√	√
A	**x**	√	**X**	√
B	**x**	**X**	√	√
AB	**x**	**X**	**x**	√

√ Compatible

x Incompatible

Rh factor (in blood) can be genetically determined. Most of the people (more than 85%) are Rh positive (Rh^+) while a few are Rh negative (Rh^-). Both people lead normal life. If an Rh^- woman marries with an Rh^+ man then Its pregnancy is normal but in 2nd pregnancy the mother with Rh^- blood may lose the baby due to incompatibility of Rh factor. By new techniques and procedures now the child can be saved.

DAILY PRACTIVE PROBLES # 4

OBJECTIVE QUESTIONS

1. Osmosis is the movement of :

(A) solute particles from higher concentration to lower concentration

(B) solvent particles from higher water potential to lower water potential through a semi permeable membrane

(C) solute particles from higher concentration to lower concentration through a semipermeable membrane

(D) solvent particles from lower water potential to higher water potential.

2. The ultimate cause for the movement of water against the gravity in a tree is

(A) osmosis (B) transpiration (C) imbibitions (D) photosynthesis

3. Which one of the following is connected with transport of water in plants ?

(A) Phloem (B) Xylem (C) Epidermis (D) Cambium

4. Which of the following contributes most to transport of water from the ground to the leaves of a tall tree ?

(A) Breakdown of ATP (B) Capillary rise of water is xylem

(C) Cohesion of water and transpiration pull (D) Root pressure.

5. The process of transpiration in plants helps in

(A) opening of stomata (B) absorption of CO_2 from atmosphere

(C) upward conduction of water and minerals (D) absorption of O_2 from atmosphere

6. Opening and closing of stomata is due to

(A) pressure of gases inside the leaves (B) changes of turgor pressure in guard cells

(C) effect of hormones (D) their genetic constitution

7. The carbohydrates synthesized in the leaves are transported through sieve tubes most commonly in the form of

(A) glucose (B) starch (C) sucrose (D) cellulose

8. In a closed circulatory system, blood is completely enclosed with in

(A) sinuses (B) vessels (C) heart (D) skeleton

9. An artery is a vessel that carries blood

(A) with high concentration of oxygen (B) with high concentration of CO_2

(C) away from the heart (D) both A & C

10. Values are found in veins to check the backflow of blood flowing under

(A) low pressure (B) high pressure (C) no pressure (D) atmospheric pressure.

SUBEJCTIVE QUESTIONS

FILL IN THE BLANKS :

(i) ..... is the flow of water molecules from the region of higher water potential to the region of lower water potential through a semipermeable membrane.

(ii) The osmotic entry of water into a cell is called .....

(iii) Other name for blood platelets is .....

(iv) The process of production of erythrocytes is known as .....

(v) Heart is protected by a covering known as .....

VERY SHORT ANSWER TYPE QUESTIONS

1. Explain the importance of transportation.

2. Distinguish between diffusion and osmosis.

3. How does blood clot ?

LONG ANSWER TYPE QUESTIONS

4. Explain the composition of blood. Also give functions of all it's components.

5. Explain various components of xylem and phloem.

6. Comment upon :

(i) Translocation in plants **(ii)** Xylem

(iii) Phloem **(iv)** Excretion in plants

7. What is clotting of blood' ? Write a flow chart showing major events taking place in clotting of blood.

8. Name the constituents of blood. Why are white blood corpuscles called 'soldiers of the body ?

9. Draw a diagram of human heart and label the following on it

(i) Aorta (ii) Pulmonary trunk (iii) Superior vena cava (iv) Coronary arteries

10. **(a)** List any four blood groups found in human beings.

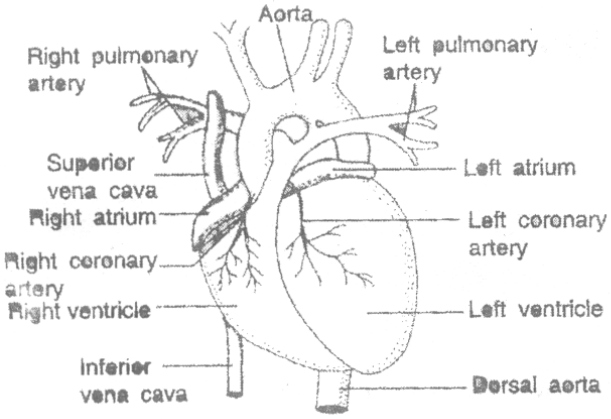
(b) People of which blood group can

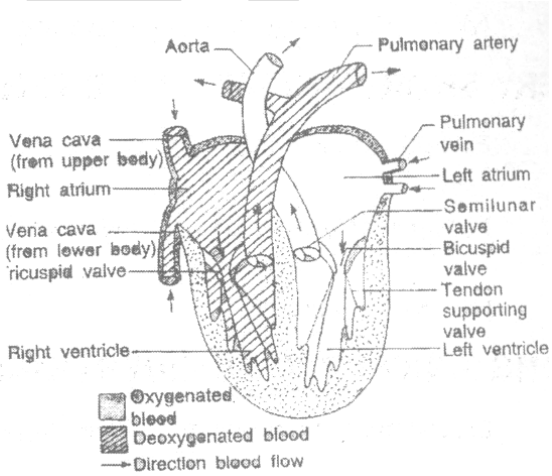
(i) donate blood to all groups ? **(ii)** receive blood from all groups ?

11. List two vital functions of the human kidney. Draw a labelled diagram of an artificial kidney

TRANSPORTATION

5.1 STRUCTURE OF HEART





- Heart is a hollow muscular organ that lies obliquely in the thoracic region in a cavity between the two lungs that is **pericardial cavity.** It is lined by 2 layers outer and inner pericardial membranes. These are filled with a fluid called **"pericardial fluid".** It protects the heart from shock and injury.
- Heart is made up of 4 chambers : upper 2 chambers are auricles and the lower 2 chambers are ventricles. Auricles are the receiving chambers and ventricles are the pumping chambers. Walls of ventricles are thicker as they have to pump the blood.
- Partition between right and left auricle is called "**interauricular septum"** and between right and left ventricles is **"inter ventricular septum".**
- Four pulmonary veins enter into left auricle, two from each lung bring oxygenated blood. There is one auriculoventricular aperture with a bicuspid or mitral valve in left auricles which opens into left ventricle.

- Left ventricle has aortic valve having 3 semilunar cusps for large artery i.e. dorsal aorta which takes the oxygenated blood to all body parts.
- Right auricle has openings for superior venacava that brings deoxygenated blood from head, neck and upper limbs, inferior venacava receives deoxygenated blood from rest of the body and lower limbs. Blood enters into right ventricle through tricuspid valve. A coronary sinus that drains venous blood from heart muscles.
- Right ventricle has pulmonary valve having 3 semilunar cusps for pulmonary artery carrying deoxygenated blood to lungs.
- The series of events which occur during one heart beat is called as cardiac cycle.
- **NOTE :** During foetal condition a flap valve called **"foramen ovale"** is present at interauricular septum having a depression called as **fossa ovalis.** If it remains after birth it results "a hole in the heart".

5.1 (a) Blood Pressure :

It is the pressure of the flow of blood in the aorta and its man arteries. The blood pressure varies according to the contraction and relaxation of the heart. In the condition of contraction or systolic phase (Lubb sound) it is about 120 mm of Hg. This is called **"systolic pressure".** In the relaxation or diastolic phase (Dub sound) it is about 80 mm of Hg and is called **"diastolic pressure".** The normal blood pressure of man (20 years) is 120/80. Fats and anxiety increase the blood pressure, the maximum normal blood pressure should into exceed 150 in males and 140 in females. The blood pressure is measured by **"sphygmomanometer".**

5.1 (b) Detection of Normalcy of Heart Beat :

The muscle fibres of heart are specialized at certain parts generate tiny electrical currents which cause the normal heart heats. The **"electrocardiograph" (E.C.G.)** is the device to record these electrical changes. Electrocardiogram is a record of electrical behaviour of heart and remains constant in a normal man. Doctors use the E.C.G. for detection of various heart diseases. Sometimes the sinoatrial node (SA node or pacemaker) gets damaged and fails to generate cardiac impulses at normal rate it becomes abnormally slow and irregular and ventricles fail to pump the required amount of blood. It can be corrected by the surgical grafting of an **artificial pacemaker instrument** in the chest of the patient. This instrument stimulates the heart electrically at regular intervals to maintain the beats.

5.2 LYMPHATIC SYSTEM :

The lymphatic system comprises the lymph, lymphatic capillaries (simply lymphatic), lymphatic vessels and nodes. Lymph severs as the middle man between the blood and organ for exchange of any material. The lymph is the tissue fluid present in the intercellular spaces in the tissues. So it is also called as **"extracelluar fluid".** The lymph resembles the blood except that the lymph is devoid of R.B.Cs, blood platelets and some plasma proteins. Lymphatic system runs parallel to the veins. The **lymphatic capillaries** are present in the form of network under epithelial surface. The ends of lymphatic capillaries are blind. The lymphatic capillaries unite to form lymphatic vessels and these vessels resemble with the veins. The lymphatic vessels posses the valves which prevent back flow of lymph. Neighboring body muscles help in the flow of lymph. The small lymphatic vessels unite to form large vessels. Larger lymphatic vessels unite to form large ducts i.e. **right lymphatic duct** and **thoracic duct.** Right lymphatic duct opens into right

subclavian vein and left thoracic duct open in to left subclavian vein. Before the lymph reaches the blood, it always passes through the **lymph nodes. The** lymph's nodes are enlargements of the lymphatic vessels. Lymphocytes and other plasma cells are present in the lymph nodes. The lympis is cleaned or filtered by lymph nodes. These cells also kill the germs and produce antibodies.

5.2(a) Functions of Lymph :

(i) It provides immunity through lymphocytes**.**
(ii) Fats are absorbed through lymph vessels in the intestine
(iii) It supplies digested food and oxygen to various parts of the body.
(iv) It helps in removal of waste products like parts of dead cells.
(v) It returns proteins and excess tissue fluid to the blood from the tissue spaces.

DAILY PRACTIVE PROBLEMS # 5

OBJECTIVE QUESTIONS

1. The phenomena non of uptake of water at the expense of energy by the cells and usually against the osmotic gradient is known as
(A) active absorption (B) passive absorption (C) osmosis (D) diffusion

2. Water will be absorbed by root hair when
(A) concentration of solutes in the cells sap in high
(B) plant in rapidly respiring
(C) they are separated from soil by a permeable membrane
(D) concentration of salts in the soil in high.

3. Root cap has no role in water absorption because
(A) it has no direct connection with the vascular system
(B) it has no cells containing chloroplasts
(C) it has no root hairs
(D) it has loosely arranged cells.

4. Which of the following is used in measuring transpiration ?
(A) Photometer (B) Cobalt chloride paper (C) Bell - jar (D) None of the above

5. Translocation of solutes primarily takes place through
(A) phloem (B) xylem (C) cortex (D) pith.

6. A mature human erythrocyte has the typical characteristic of
(A) a eukaryotic cell (B) a prokaryotic cell
(C) both eukaryotic and prokaryotic cell (D) neither eukaryotic nor prokaryotic cell

7. Removal of calcium from freshly collected blood will
(A) result in clotting (B) prevent clotting
(C) prevent oxidation of hemoglobin (D) cause hemolysis

8. In the cardiac cycle, diastole is

(A) the number of heart beats per minute

(B) the relaxation period after contraction of the heart

(C) the forceful pumping action of the heart

(D) the contraction period after relaxation of the heart.

9. One of the difference between blood and lymph is that

(A) blood has RBCs and WBCs while lymph has Lymphocytes.

(B) blood has RBCs while lymph has no WBCs

(C) blood has WBCs while lymph has RBCs

(D) blood has dissolved organic salts while lymph has no such inorganic salt.

10. Blood vessel carrying blood from lung to heart through

(A) Pulmonary artery (B) Pulmonary vein (C) Coronary artery (D) None of these.

SUBJECTIVE QUESTIONS

FILL IN THE BLANKS

1. The series of events which occur during one complete beat of the heart is known as ..... cycle.

2. Depression in the interauricular septum is known as .....

3. Normal blood pressure is .....

VERT SGIRT ANSWER TYPE QUESTIONS

1. Write short note on leucocytes.

2. Distinguish between open and closed circulatory system.

3. What is double circulation ?

4. Distinguish between arteries and veins.

5. Why AB+ blood group is considered as universal recipient ?

LONG ANSWER TYPE QUESTIONS

6. Explain the structure of human heart with the help of diagram.

7. Define cardiac cycle. Explain the changes occurring in heart during cardiac cycle..

8. What is lymph ? Explain its important functions. Write about its circulation.

9. Draw a diagram showing how blood in the capillaries, surrounding tissues exchange respiratory gases with

cells of the tissues. Label the following on this diagram :

(i) Red Blood Corpuscle (ii) Tissue Cell

10. Why is it essential to match the blood groups of the 'donor' and the 'receiver' persons before arranging transfusion of blood ? A person tests as 'universal donor'. which group of blood will be acceptable to him for receiving blood transfusion ?

EXERETION

6.1 EXCRETION :

There are various metabolic activities which take place inside the living organisms. All these activities are chemical reactions. As a result in animal body several end products are formed which are of no use to the cells. These are called as **wastes.** These must be removed from the body for proper functioning of the body. The elimination of these waste nitrogenous products form the body is called as **excretion.** Waste material is ammonia, urea, uric acid, carbon dioxide, pigments, salts digestive wastes, excess of water etc. Ammonia, urea uric acid are waste nitrogenous products, The excretory produces are both volatile and non-volatile. These are removed from the body by different methods.

6.1(a) Excretion in Amoeba :

Amoeba is an ammonotelic organism since the principal excretory product is ammonia. Special excretory organelle in Amoeba is lacking. CO_2 and ammonia are exerted by diffusing is solution through plasma membrane. The concentration of ammonia is always higher in Amoeba than in the surrounding water. The water enters through plasma membrane by **"endosmosis".** Ammonia is formed in cytoplasm by metabolism. Surplus water enters contractile vacuole. This surplus water can rupture the animal's body. Thus size of contractile vacuole increases, when the contractile vacuole is fully expanded with water, it moves towards the periphery. As it comes in close contact with the plasma membrane, the contractile vacuole bursts. Thus excess of water (surplus water) is discharged in the surrounding water, this phenomenon of controlling the amount of water in the body is called as **"osmoregulation".**

6.1 (b) Excretion in Earthworm :

In earthworm, the excretory organs are **nephridia.** The internal funnel-like opening is called as **"nephrostome".** The waste material from body cavity (coelom) enters the nephridium through nephrosome. In the inner lining of nephridium, the cells absorb useful substances like glucose.

6.2S TRUCTURE OF A TYPICAL NEPHIRIDIUM :

A typical nephridium consists of three pars : nephrostome, body and terminal duct. The nephridium communicates with the coelom (body cavity) through internal nephrostome. Nephrostome is a ciliated funnel which leads into body of nephridium through the neck. The body of nephridium consists of short straight lobe, a long spiral lobe with narrow apical part. Spiral lobe consists of proximal limb and distal limb. Neck of the nephridium leads into proximal part of spiral lobe and terminal duct leaves the proximal limb. The tubule of the neck enters the body of the nephridium and leaves the body as terminal duct. These tubules have ciliated tracts inside. The number of ciliated tracts depends upon the number of coils of the tubules. The terminal duct may open outside by nephridiopore or into the gut (alimentary canal).

6.2 (a) Functioning of Nephridium :

Nephridia are highly vascular and extract nitrogenous wastes from the blood. The nitrogenous wastes and useful substances (glucose) enter the body of nephridium through internal neprostome in the fluid form. The cilia present in the tubule beat to move the fluid. Useful substances like glucose are reabsorbed by cells, lining the tubule and is passed into the blood. The remaining waste is discharged into the alimentary canal or to exterior through nephridiopore. According to the position of nephridia in the body of earthworm, nephridia are of three types :

(i) Septal nephridia are attached on septa. Nephridiopore is missing.

(ii) Integumentary nephridia are attached on inner side of the skin. Nephridiopore is present.

(iii) Pharyngeal nephridia are present as three p airs of groups of nephridia, on both sides of alimentary canal. Nephridiopore is absent. Septal and pharyngeal nephridia are endonephric as these open in the alimentary canal. Integumentary nephridia are ectonephric. Excretion is an adaptation to conserve water. Earthworm is ammonotelic (excrete ammonia) in excretion, in sufficient water while it is ureotellic (excrete urea) on land.

6.3 HUMAN EXCRETORY SYSTEM :

As a result of various metabolic process going on in our body a number of waste products are formed. These have to be eliminated as they are toxic to the body.

• **The waste products include :**

(i) Carbon dioxide which is liberated during respiration; and is eliminated by the lungs.

(ii) Nitrogenous metabolic wastes, such as urea and uric acid produced in the liver from excessive proteins.

(iii) Bile pigments : Bile pigments (**e.g., billrubin)** derived by the breaking down of hemoglobin of the erythrocyte.

(iv) Excess salts, water and vitamins : Concentration of these substance above the required level, is harmful to the body. Elimination of all metabolic nitrogenous wastes from the body is callers as **excretion.**

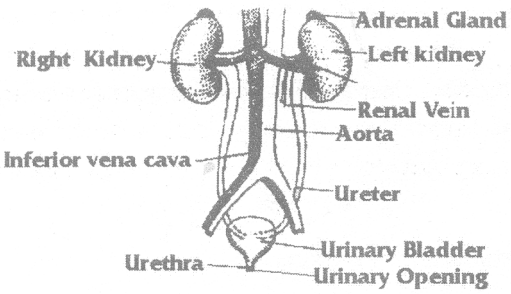
6.4 ORGANS OF EXCRETION :

(i) Lugs : Carbon dioxide produced by the oxidation of glucose or other food substances in the tissues is removed by the blood. This carbon dioxide is carried to the lungs through the blood vessels (veins) where it diffuses into the alveoli and out through the respiratory tract. Water vapour in small amount is also exhaled during expiration from the lungs.

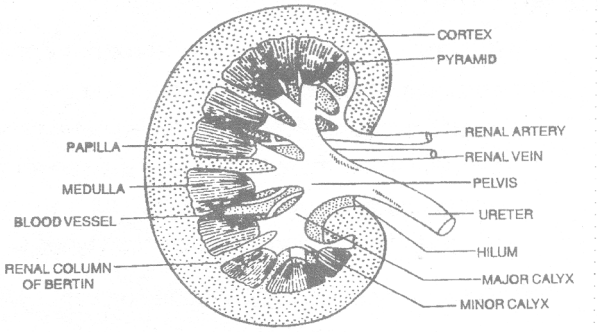
(ii) Skin : Substances like soluble food mater, oxygen, water dissolved mineral salts, traces of urea and uric acid diffuse from the thin walls of capillaries into the walls of the sweat glands. Oxygen and food substances are used for metabolic activities of the cells of seat glands but the remaining metabolic wastes are excreted out of the gland through the sweat duct which opens on the surface of the skin through sweat pore. Sweat contains 99% water, traces of urea and uric acid. However, after heavy exercise, lactic acid forms a major constituent of seat. Profuse sweating may lead to sodium deficiency, leading to muscle

cramps. An adaptation of prevention of water loss is the impermeability of our skin to water. However, in aquatic animals, skin is the major excretory organ. They excrete ammonia through their skin by diffusion as ammonia is highly soluble in water.

6.5 INTERNAL STRUCTURE OF KIDNEY :



Excretory system



L.S. of Kidney

(i) Bowman's capsule : It is a single-cells thick, double walled cup-shaped structure present in the cortex region of the kidney. The cup-shaped capsule contains a network of capillaries called **Glomerulus's.** Glomerulus's and Bowman's capsule are together called as **Renal corpuscle.**

(ii) Proximal convoluted tubule (PCT) : It starts after the Bowman's capsule and is greatly twisted. The whole PCT lies in the cortex region.

(iii) Henle's loop : Henle's loops is a U-shaped tubule located in the medulla region. it consists of

(A) a thin-walled descending limb in the medulla

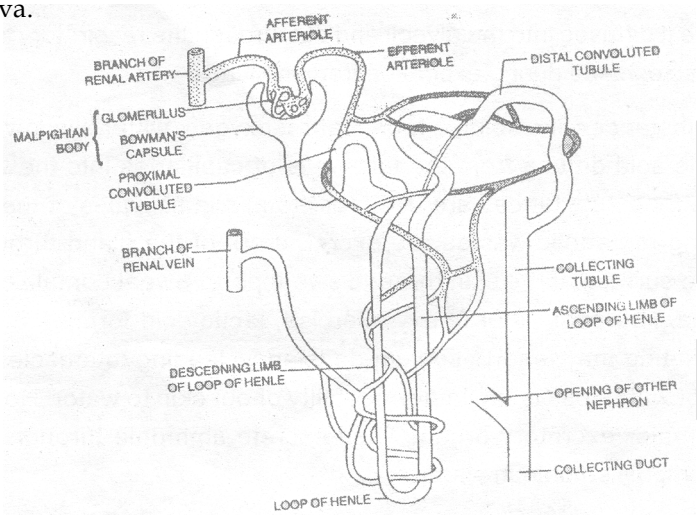
(B) a thick-walled ascending limb in the cortex. Henle's loop is long in those animals which pass hypertonic urine.

(iv) Distal convoluted tubule : The ascending limb continues into the distal convoluted tubule which forms several coils in the cortex.

(v) Collecting duct : Collecting tubule receives distal tubules of several uriniferous tubules. Several such tubules unite to form a large collecting duct. The collecting ducts are held together and converge to form a **pyramid.** The pyramid opens into the pelvis which leads into the ureter.

6.6 BLOOD SUPPLY TO NEPHTRONS :

Inside the kidney, the renal artery branches into a number of renal arterioles. A branch from a renal arteriole enters each Bowman's capsule, and is called the **afferent arteriole.** It breaks up into a network of capillaries which reunite to form a **efferent arteriole.** (Glomerulus is a mass of network of capillaries in the Bowman's capsule). The efferent arteriole after emerging from the Bowman's' capsule runs a short distance and breaks up into a capillary network which surrounds the renal tubule and rejoins to form a vein. By reuniting again and again with other veins of the kidney it forms the renal vein which drains into the posterior venacava.



Functional unit of kidney -nephron

6.7 CHEMICAL COMPOSITON OF URINE :

Normal human urine consist of about 95% water and 5% of solid wastes. Besides the normal constituents , certain hormones and medicines like the antibiotic and excess vitamins are passed out with urine. Organic compounds (gm/l): Urea - 2.3; Creatinine - 1.5; Uric acid - 0.7; Ammonia - 0.6 Inorganic Compounds (gm/l) Nacl - 19.0; KI - 12.5; H_2SO_4 - 1.8; NH_3 - 0.6. Normally a man excretes 1000 - 170 ml of urine daily, depending upon the water intake, diet, climate, mental state and physiological condition. Tea, coffee, alcohol and other beverages increases the formation of urine.

6.7 (a) Working of Nephron :

Main function of nephron is to form urine. There are three main process involved in the urine formation :

(i) Glomerular ultrafiltration : If is the filtration of body fluids and solutes from the blood, out of he glomerular capillaries into the Bowman's capsule due to the pressure in the glomerulus. All substances from the blood are filtered out except the large protein molecules. This fluid in the glomerular capsule is called as **glomerular filtrate.** It consists of water, urea, salts, glucose and other plasma solutes. Blood coming out of the efferent arteriole is therefore thick.

(ii) Tubular reabsorpiton : Glomerular filtrate contains a lot of useful materials like glucose, salts such as that of sodium and water. These substances are reabsorbed from the renal tubule at various levels and in varies proportions. **Glucose** is reabsorbed completely from the proximal convoluted tubule. More than 85% of **water** is reabsorbed from the proximal, distal and even in collecting tubules. **Sodium chloride** is

reabsorbed in the proximal and distal tubules. **Potassium** and **phosphate** is completely reabsorbed from the proximal tubule. Other substances reabsorbed are uric acid, sulpahtes, vitamin C, amino acids etc.

(iii) Tubular secretion : This occurs mainly in the distal convoluted tubule and the collecting duct of the nephron. It is an active, vital process performed by the cells of the cuboidsl 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, penciling etc. are directly exerted by the tubular cells from the blood. The fluid which now flows through the last parts of the tubule is urine which consist of water, urea, uric acid, mineral ions like sodium, potassium, chlorides, phosphates etc.

6.8 ARTIFICIAL KIDNEY :

In case of loss or damage of one kidney, the other kidney performs the function of both the kidneys and the person can lead a normal life. But the failure of both the kidneys leads to death. Artificial kidney is a **dialysis** machine which cleans blood of waste products, thus acting like a kidney. The patients' blood is led from the radial artery of the arm through the machine where urea and other salts are removed and pure blood is returned to vein in the same arm. In case of permanent damage to the kidneys, dialysis has to be performed for about twelve hours, twice a week. Patients with chronic kidney failure have been recorded to survive for more than 12 years on dialysis. Now a days, diseased kidney may be replaced with healthy one by **kidney transplantation.** To lead a normal life, one healthy kidney is more than enough. Therefore, a healthy person can donate his one kidney to patient who has both kidneys impaired.

DAILY PRACTIVE PROBLESMS # 6

OBJECTIVE QUESTIONS

1. Which of the following parts of a kidney contains the lowest concentration of urea ?

(A) Lop of Henle (B) Branches of renal vein

(C) Bowman's capsule (D) Glomerulus

2. Uriniferous tubules of a kidney are concerned with formation of

(A) glucose (B) amino acids (C) hormones (D) urine

3. Excretion is removal of

(A) CO_2 (B) harmful and useless ingredients

(C) extra water (D) metabolic wastes

4. Main function of kidney is

(A) passive absorption (B) ultrafiltration

(C) selective reabsorption (D) Both B and C

5. Ammonia is converted into urea in

(A) kidney (B) spleen (C) liver (D) nephron

6. Function of loop of Henle is

(A) conservation of water (B) formation of urine

(C) filtration of blood (D) passage of urine

7. Urea is transported through

(A) RBCs (B) WBCs (C) Plasma (D) All of the above

8. Major function of contractive vacuole is

(A) excretion (B) circulation (C) osmoregulation (D) all the above

9. Which one is a accessory excretory organ

(A) Liver (B) Stomach (C) Intestine (D) Heart

SUBJECTIVE QUESTIONS

VERY SHORT ANSWER TYPE QUESTIONS

1. Name of excretory organs of amoeba.

2. How wastes diffuse out from body of Sponge and Hydra ?

3. Flame cells are excretory organs of which group of animals.

4. Name the major excretory product of human beings.

SHORT ANSWR TYPE QUESTIONS

5. What is meant by excretion and osmoregulation ?

6. How excretion takes place in amoeba ?

7. Draw a diagram of nephron and label its various parts.

8. What is meant by osmoregulation ? How it is achieved in different groups of animals ?

LONG ANSWER TYPE QUESTIONS

9. Name the excretory organs of earthworm.

10. Draw diagram of human excretory system, label its pars.

11. Draw a labelled diagram of nephron and explain how urine is formed.

ANSWERS

DAILY PRACTIVE PROBLEMS # 4

Qus.	1	2	3	4	5	6	7	8	9	10
Ans.	B	B	B	C	C	B	C	B	D	B

DAILY PRACTIVE PROBLEMS # 5

Qus.	1	2	3	4	5	6	7	8	9	10
Ans.	A	A	C	A	A	D	B	B	A	B

DAILY PRACTIVE PROBLEMS # 6

Qus.	1	2	3	4	5	6	7	8	9
Ans.	B	D	D	D	C	A	C	C	A