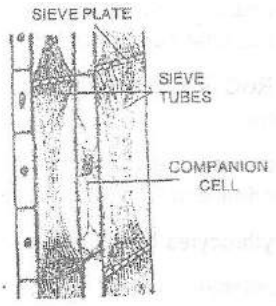
Transportation

Introduction

- All living bodies need nutrients and oxygen in every cell of its various tissues to sustain life.
- The transportation of different materials and gases is essential both in plants and animals.
  (a) Transportation In Plants:
- The higher plants have specialized system for the transportation.
- The transportation of materials is carried out by means of vascular tissues of the plants.
- The vascular tissue consists of xylem and phloem.
- Xylem: Xylem contains four type of cells
  (i) Xylem Tracheids (ii) Xylem vessels
  (ii) Xylem parenchyma
  (iv) Xylem sclerenchyma
- Function: It helps in transportation of water and minerals. It is called "ascent of sap".
- Phloem: Phloem consists of four types of cells
  (i) Sieve tubes
  (ii) Companion cells
  (iii) Phloem parenchyma
  (iv) Phloem sclerenchyma (fibre)
- Function: It helps in transportation of food.



Phloem

- **Translocation:**
- Phloem translocates the manufactured food (sugar) or starch from the leaves to the different parts of the plant including the roots.
- Transpiration: Most of the water absorbed is lost truough 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) Caticular transpiration (through cuticle)
(ii) Lenticular transpiration (through lenticles)
(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 eveil.

- Differences in Functioning of Xylem & Phloem:

S.No.	Xylem	Phloem
1.	Xylem parenchyma only living cells remaining cells are dead.	Phloem sclerenchyma only dead cells remaining all cells are living.
2.	It carries minerals, salts and water.	An organic solution of sugars is translocated.
3.	The movement is only upward	The movement can be upward or downward.

- Coheshion theory:
- The main loss of water is through stomatal transpiration.
- 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 a 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).

Transportation in Humans:

- In humans circulartory system consists of blood vascular system (blood as carrier) and lymphatic system (lymph as carrier).
- Functions of Circulatory System
- Transportation of nutrients like glucose, amino acids etc.
- Trasportation of nitrogenous wastes like urea, uric acid etc. Transportation of respiration gases between the organs of respiration and the body cells.
- Transportation of hormones from the endocrine glands to target organs.
- Transportation of lactic acid from muscles to the liver cells.
- Transportation of heat for homeothermy.

(a) Blood Vasular system:

- Occurrence. It is present in higher invertebrates from the annelids to the echinoderms and all the chordates. It is so because:

(A) These have thick body wall.

(B) These have higher metabolic rate.

- Three components:
  1. Heart is a thick, muscular and contractile organ which pumps the blood.
  2. Blood vessels are tubular vessels which conduct the blood e.g. arteries, veins and capillaries
  3. Blood is the red vascular connective tissue.
- Types of blood Vascular Systems:

(i) Open circulatory system:

- It is found in leeches, most of the mollusks and arthropods.
- It this, blood finally comes out of the blood vessels in open spaces called lacunae and sinuses. In arthropods and moliuscs, these sinuses join to form a body cavity with blood called the haemocoel.
- Blood flows at a very low velocity and at low pressure.
- There is a direct contact between the body cells and blood so there is direct exchange of materials.
- The respiratory pigment, when present, is dissolved in the plasma of the blood.
- Blood flow cannot be regulated.

(ii) Closed circulatory system:

- It is found in most of annelids (e.g. earthworm, Nereis) cephalopods among the mollusks and all vertebrates.
- It this, blood flows in blood vessels (arteries, veins and capillaries.)
- Blood is always at high pressure and high velocity.
- There is no direct contact. The exchange of materials between the blood and cells takes place through the tissue fluid.
- Significance: Closed circulatory system has two advantages over open circulatory system.

(A) It is more efficient as blood takes less time to complete one circulation.

(B) Blood supply to the organs can be regulated according to body needs.

(b) 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 (RBCs), white blood corpuscles (WBCs) and blood platelets are present in the plasma. The formation of blood is called “Haemopoisis”.

(i) Plasma: The plasma consists of water (90% & above) inorganic and organic substances. In the plasma, RBCs, WBCs and blood platelets float. Inorganic salts (0.9%) 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 haemoglobin.
- Haemoglobin consists of globin (protein) and Fe^{2+} porphyrin complex (haem). 100ml of blood contains 15g of haemoglobin. It the amount of haemoglobin in blood is less, The person suffers from anaemia.
- The haemoglobin carries oxygen to the different cells of the body and bring carbon dioxide form the cells. The life span of a RBC is 120 days.

(B) White blood corpuscles (WBCs) or Leucocytes:

- The number of leucocytes is comparatively fewer 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 (Leukaemia) 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 multilobed. Basophils, Eoxinophil 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 agranulocytes. Lymphocytes secrete antibodies which destroy microbes. The monocytes are phgagocytic in nature.

(C) Blood platelets: These are small and without nuclei. Their number varies 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 thromboplastin.

(c) Functions of blood:

Blood performs the following functions:

- Transportation 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 substances.
- Transportation of respiratory gases: The respiratory gases (oxygen, carbon-dioxide) are transported by the blood. Oxygen in 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 waster from the different parts of the body are collected by the blood and then taken to the organ (kidneys, lungs, skin and intestine) from where they are excreted.
- Transportation of hormones: Hormones are produced by endocrine glands. These hormones have target organs (Place to act). These are carried by the plasma of blood and bring about the conordination 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, monocytes) 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.

(d) Blood Cloting:

At the site of injury of the blood vessels, the platelets induce blood coagulation through the release of thromboplastin (thrombokinease.) Thromboplastin changes prothrombin of blood plasma into thromtin. 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 injured area. Blood clotting is usually completed within 2-3 minutes.

Injuredtissue + Blood platelets $\xrightarrow{\text{released}}$ Thromboplastin

Prothrombin $\xrightarrow[Ca^{+2}]{\text{Thrombodinase}}$ Thrombin

Fibrinogen (Soluble) $\xrightarrow[\text{Thrombodin}]{\text{Thrombin}}$ Fibrin (Insoluble)

Fibrin + Red blood corpuscles $\xrightarrow{}$ Clot of blood

(e) Blood Groups:

Landsteiner discovered that blood of different individuals 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 or 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		
Blood group	Antigen present on RBCs	Antibody 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 ……. It can donate blood to any group (A.AB, B and O) but it can receive blood from O blood group. A B group is a universal recipient (receiver). It can receive blood from any group (A,B, AB, O) but it can donate to AB group only.

(f) 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 as "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 cross matched before transfusion to exclude any chance of incompatibility.
- When blood from a donor is added to blood of the recipient, without matching this causes clumping of RBCs. Thus antigen A in RBCs of group A individuals reacts with antibodies of plasma of group B individuals.

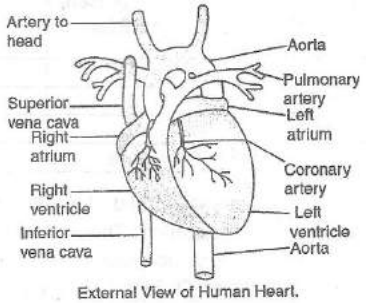
This phenomenon is called "agglutination".

Table: Human blood groups and transfusion

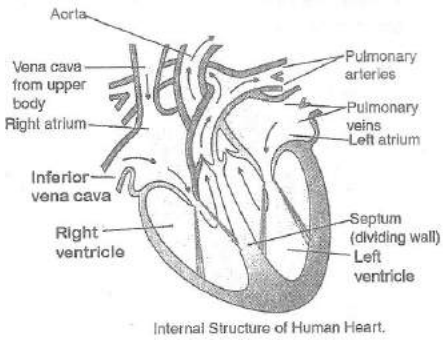
BLOOD GROUP OF RECIPIENT				
Blood group of Donor	**O**	**A**	**B**	**AB**
O	√	√	√	√
A	×	√	×	√
B	×	×	√	√
AB	×	×	×	√

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 1st 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.

Structure of heart



External View of Human Heart.



Internal Structure of Human Heart.

- Heart is the pumping organ to help in circulation.
- 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 to 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 in to 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 over" is present at interauricular septum having a depression called as fassa ovalis. If it remains after birth it results "a hole in the heart".

(a) Blood Pressure:

- It is the pressure of the flow of blood in the aorta and its main 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 120/80mm of Hg.
- The blood pressure is measured by "sphygmomanometer".

(b) Detection of Normalcy of Heart beat:

- The muscle fibres of heart are specialized at certain parts generate tiny electrical currects which cause the normal heart beats. 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 stimulater the heart electrically at regular intervals to maintain the beats.

Lymphatic System

- The lymphatic system comprises the lymph, lymphatic capillaries (Simply lymphatics), lymphatic vessels and nodes.
- Lymph serves 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 tissues, So it is also called as "extracellular 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 possess the valves which prevent back flow of lymph. Neighboring body muscles help in flow of lymph.
- The small lymphatic vessels unite to form lage vessels. Larger lymphatic vessels unite to form large ducts. i.e. right lymphatic duct and thoracic duct.
- The lymph nodes are enlargements of the lymphatic vessels.
- Lymphocytes and other plasma cells are present in the lymph nodes.
- The lymph is cleaned or filtered by lymph nodes.
- These cells also kill the germs and produce antibodies.

(a) Function 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.

- Hear: of cockroach is tubular and 13-chambered (Three in thorax and ten in abdomen) and lies in pericardial sinus.
- Each chamber has a pair of inlets, called ostia, guraded by valves. First heart chamber continues into head as anterior aorta.
- Blood circulation is completed in 5-6 minutes.
- Types of circulation:

(i) Singe circulation: Blood passes once through the heart to supply once to the body. It is fount in fishes which have two- chambered (one auricle and one ventricle), venous and branchiai heart.

(ii) Double Circulation: In double circulation, the blood passes twice through the heart to supply once to the body.

EXERCISE

1. The clotting of blood requires
(A) Vita. K and Calcium
(B) Vita. K and Potassium
(C) Calcium and Potassium
(D) None of the above

2. A pacemaker or S-A node is found in
(A) Heart (B) Kidney
(C) Liver (D) Stomach

3. Which helps in blood clotting?
(A) Sodium (B) Fibrinogen
(C) Bilirubin (D) None of the above

4. Heart disease is a
(A) Infectious Disease
(B) Communicable disease
(C) Degeneration Disease
(D) Deficiency disease

5. Which blood vessel in mammals would normally carry the largest amount of urea?
(A) Dorsal aorta
(B) Pulmonary vein
(C) Renal artery
(D) Pulmonary artery

6. Both erythrocytes and leucocytes are formed in-
(a) Thymus (b) bone marrow
(c) lymph nodes (d) arterial walls

7. In which of the following tissue food is transported?
(a) Xylem (b) Tracheieds
(c) phloem (d) Vessels

8. Which of the following organs act as both blood bank and graveyard of R.B.C's?
(a) Liver (b) Bone marrow
(c) Pancreas (d) Stomach

9. Single blood circulation occurs in-
(a) Fishes (b) Frogs
(c) Reptiles (d) Man

10. Anticoagulant of fresh water leech is-
(a) Hirudin (b) Heparin
(c) Sodium citrate (d) Chelating agent.

11. A sudden Increase in the number of white blood cells in the blood is a sign of
(a) Deficiency disease
(b) Better health
(c) Bacterial disease, Infection
(d) Mental tension

12. The cardiac pacemaker in a patient fails to function normally. The doctor finds that an artificial pacemaker is to be grafted in him. It is likely that it will be grafted at the site of
(a) Atrioventricular bundle
(b) Purkinje system
(c) Artiroventicular node
(d) Sinoatrial node

13. Osmosis is defined as the process in which-
(a) Water diffuses from higher concentration to lower of the solution.
(b) Solutes diffuse from lower concentration to higher concentration
(c) Active transport of ions takes place
(d) Passive transport of ions takes place

14. Water available to plants is
(a) Run off water
(b) Gravitational water
(c) Hygroscopic water
(d) Capillary water

15. Transpiration is helpful in-
(a) Increase of temperature
(b) Loss of Salt
(c) Ascent of sap
(d) Loss of nutrients

ANSWER KEY

TRANSPOTRATION

Q.	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
A.	A	A	B	C	C	B	C	A	A	A	C	D	A	D	C