

## Transport of Materials in Plants and Animals

---

All plants need water. The wilted leaves recover when water is added to the soil, which means that water has been conducted upward into the leaves. You have also learnt that the leaves for photosynthesis need water. Likewise, the food produced in the leaves has to be transported to other parts of the plant including the stem, the roots flowers and fruits etc. All this transportation is the function of conducting tissues.

Similarly, in animals, the food absorbed by the gut has to be carried to all the body parts, oxygen absorbed in the lungs has to be transported to every cell of the body, the carbon dioxide produced in the cells has to be carried to the lungs for elimination, and the poisonous body wastes like urea has to be transported to the kidneys for elimination in urine, and so on. All such functions are the outcome of a transport system. You will read about these aspects of plant and animal life in this lesson.

### OBJECTIVES

After completing this lesson, you will be able to:

- explain the need for a system of transport in plants and animals;
- list and explain mechanism for movement of molecules such as diffusion, osmosis and active transport;
- explain the structure and function of xylem and phloem in plants;
- recognise the importance of blood as a medium of transport;
- explain the structure and function of human heart;
- describe the composition of blood;
- differentiate between arteries, veins, and capillaries;
- list the major blood groups and state the matching groups for blood transfusion;
- mention disorders of circulatory system.

### 26.1 MECHANISMS FOR MOVEMENT OF MOLECULES

Molecules move in and out of a cell through the cell membrane, which forms the boundary of each cell. The cell membrane is **selectively permeable** to substances, which means that it permits entry and exit of certain molecules only. The movement of molecules takes place by diffusion, osmosis, and active transport

---

### 26.1.1 Diffusion

Molecules move out from their region of higher concentration to the region of lower concentration. For example, during respiration, oxygen-laden air in lungs being at a higher concentration moves into blood capillaries having lower concentration of oxygen in them. Such movement of particles or molecules from a region of their higher concentration to a region of their lower concentration is termed **diffusion**.

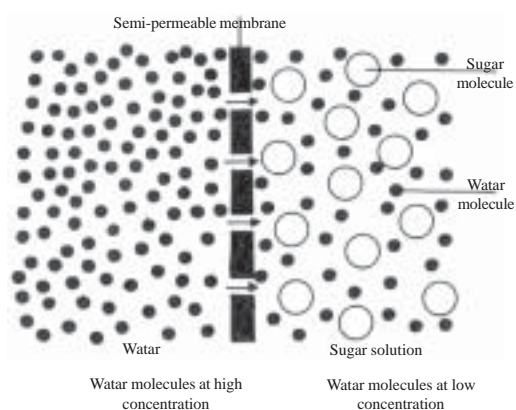


Fig. 26.1 The process of osmosis

### 26.1.2 Osmosis

Osmosis is the movement of water molecules from a region having more water molecules to a region having less water molecules when separated by a semipermeable membrane. Semipermeable membrane means a membrane, which allows some molecules (e.g. water molecules) to pass through it but not some other larger molecules (Fig. 26.1). No energy is spent during diffusion or osmosis.

### 26.1.3 Active transport

In active transport, molecules have to move (against concentration gradient) i.e., from a region of their lower concentration to a region of their higher concentration. Energy is required in active transport.

## 26.2 TRANSPORT OF MATERIALS IN PLANTS

### 26.2.1 Transport of water

Roots of plants take up water and minerals from the soil. How does this water move up from roots to leaves for needs like photosynthesis? You have already learnt about conducting tissues of plants – **xylem** and **phloem** in lesson 24. Tracheids and vessels (Fig. 26.2), which are non-living cells of xylem, transport water picked up by root hairs (Fig. 26.3) from soil to the leaves.

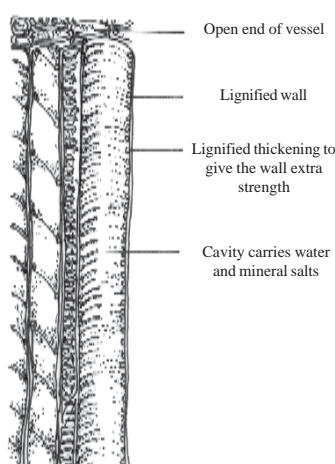


Fig. 26.2 Vessels in xylem

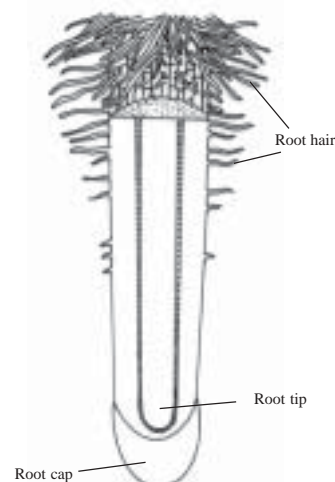


Fig. 26.3 Root hairs

The upward movement of water and minerals termed ‘ascent of sap’ is against gravity and is due to transpiration pull. Transpiration is the process in which a lot of water evaporates (as water vapour) from pores on the surface of leaf called **stomata** (Fig. 26.4). This evaporation creates a vacuum and pulls up water through the xylem.

### 26.2.2 Transport of food material

Sugars and other food molecules synthesised in the leaves are transported to other parts of the plant through phloem. Sieve tubes are living cells of the phloem, which transport food (Fig. 26.5).

Transport of food material from leaves to other parts of the plant is called **translocation**. This food may be stored in fruits, stem or roots.

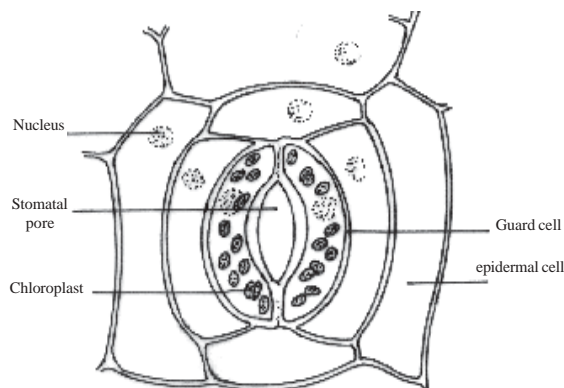


Fig. 26.4 Structure of stomata

### CHECK YOUR PROGRESS 26.1

1. In which type of molecular movement is energy required?
2. Define osmosis.
3. Name the two kinds of cells of xylem.
4. Which cells of phloem pass on food from one part of the plant to another?
5. Which out of the following are non-living parts: tracheids, vessels, sieve tubes?

### 26.3 TRANSPORT OF MATERIALS IN ANIMALS

In the body of majority of animals, substances are transported from one part of the body to another through blood. Thus blood is the “tissue for transport” and circulates throughout the body. Circulatory system consists of organs, which make blood circulate throughout the body. Blood transports nutrients, respiratory gases, hormones and waste material from one part of the body to another.

#### 26.3.1 Human circulatory system

Human circulatory system consists of

- (i) Centrally located muscular pump called **heart**, and
- (ii) **Blood vessels**, which are tube-like structures, connected to the heart (Fig. 26.6).

Blood vessels are of three kinds:

- **Arteries:** Carry blood from heart to various parts of body.
- **Veins:** Bring blood from various parts of body to the heart.
- **Capillaries:** Thin vessels between the artery and the vein. The capillaries allow the exchange of materials between blood and tissues.

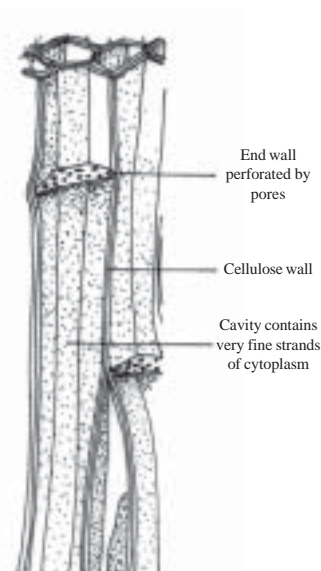


Fig. 26.5 Sieve tubes in phloem

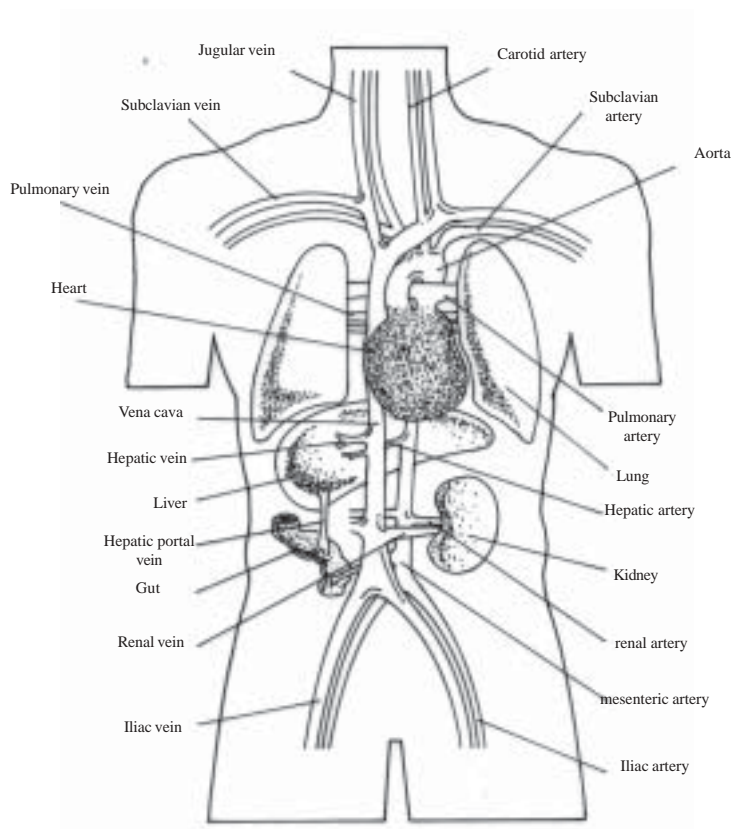


Fig. 26.6 Circulatory system in human beings

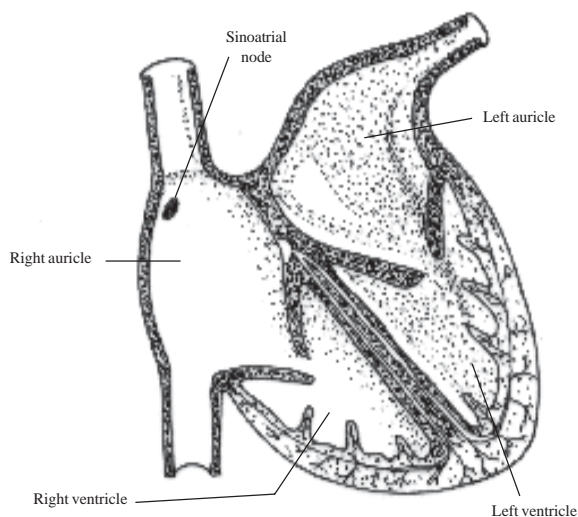


Fig. 26.7 The human heart

### 26.3.2 Heart

a) **Structure:** Heart is a powerful muscular organ lying between lungs in the upper part of thorax of our body. It is four-chambered- two (right and left) atria (*sing.* atrium, also called auricles), and two (right and left) ventricles. (Fig. 26.7).

The heart is made of specialised muscle cells (also called cardiac muscle fibers), which contract and relax all the time without getting tired. The contraction and relaxation follows a rhythm called **heartbeat** to pump blood into the vessels.

Rhythmic heart beat results in the proper transport of substances to the various organs. In one minute, normal human heart beats about 72 times. Abnormalities in heartbeat can be seen by taking **ECG** or **Electrocardiography** (Fig. 26.8).

---

- b) **Functions of heart:** A large vein, the vena cava collects impure or deoxygenated blood (blood low in oxygen and high in carbon dioxide) through veins from all parts of the body and empties into the right atrium. At the same time vein from the lungs brings oxygen-laden blood to left atrium. At this time all the four chambers of the heart are relaxed.

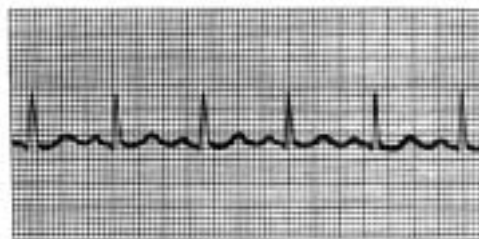


Fig. 26.8 Electrocardiograph

Then the atria contract and impure blood (blood full of carbon-dioxide) from right atrium enters the right ventricle and purified blood (blood full of oxygen) from left atrium enters the left ventricle. Valves within the heart prevent blood from flowing back.

Next, the ventricles contract while the atria relax. Blood to be purified is transported to the lungs from right ventricle through two pulmonary arteries. The oxygen laden blood from the left ventricle gets pumped into a large artery called aorta. It carries oxygenated blood to all parts of the body (Fig. 26.9).

You must have noticed that veins bring impure blood to the heart and the arteries take the pure blood away from the heart. But here are two exceptions – the pulmonary artery carries impure blood and the pulmonary vein carries pure blood.

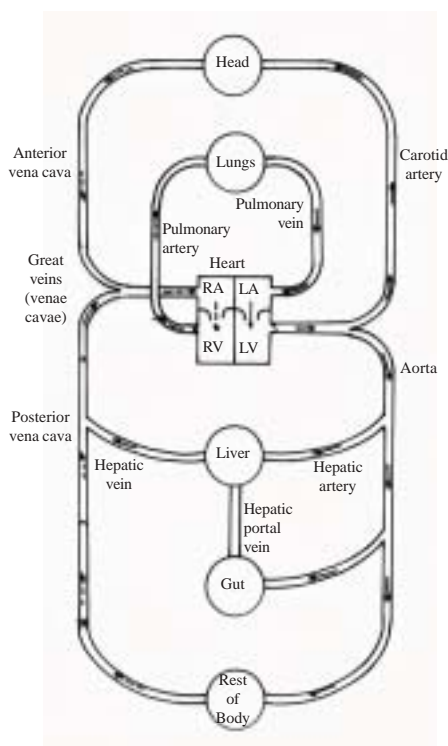


Fig. 26.9 General plan of the human circulatory system

### CHECK YOUR PROGRESS 26.2

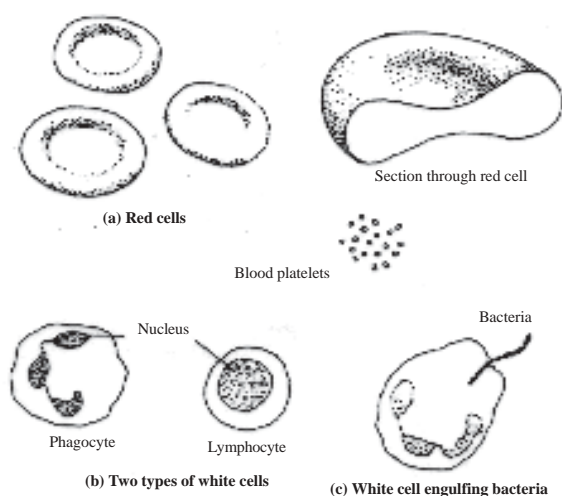
1. What are the different parts of human circulatory system?
2. What are capillaries?
3. In which category of blood vessels exchange of nutrients and respiratory gases occur between blood and tissues?
4. Name the kind of muscle fibres that make the heart?
5. What is the function of valves in the heart?

### 26.3.3 Blood

Blood is a connective tissue that circulates throughout the body. It is made up of a fluid medium called **plasma** in which float three types of **blood cells**, called red blood cells, white blood cells and blood platelets. Blood cells are manufactured in the bone marrow. (Fig. 26.10)

- a) **Red blood cells (RBC or Erythrocytes)**





- These are circular in shape, and contain a red coloured pigment called haemoglobin
- No nucleus is present in RBCs
- RBC carry oxygen to tissues and bring back carbon dioxide from tissues
- About 5 million  $\text{mm}^3$  erythrocytes occur in circulating blood

b) **White blood cells (WBC or Leucocytes)**

Fig. 26.10 Types of blood cells

- In the circulating blood 5000 to 7000  $\text{mm}^3$  WBCs are present
- Since they carry no pigments, therefore, they so are colourless
- WBC have irregular shape
- They prevent body from infections by eating up germs or by producing antibodies

c) **Blood platelets (Thrombocytes)**

- These are very small fragments of cells
- They have no nuclei
- They participate in clotting of blood

**Functions of blood:** Blood carries nutrients, oxygen, carbon dioxide, hormones and waste material to the relevant parts of the body. Some medicines when taken in the body are also distributed through blood.

## 26.4 BLOOD GROUPS AND BLOOD TRANSFUSION

You must have heard that blood has to be arranged for a person undergoing a surgery (operation) or in the case of an accident. This arrangement is to replace blood lost from the patient. Injecting blood into the body from outside is called **blood transfusion**. Blood transfusion is successful only when the blood of donor (who gives blood) and of the recipient (who receives blood) match. Unmatched blood transfusion causes agglutination (clumping together) of red cells due to which the recipient may even die.

Blood of all human beings belongs to one of four blood groups named A, B, AB and O. the blood group is inherited from parents. Table 26.1 shows the matching blood groups.

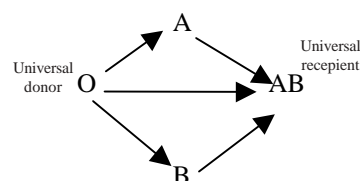
**Table 26.1 : Various blood groups in humans**

---

| Blood Group | Can donate to blood group | Can receive blood from blood group |
|-------------|---------------------------|------------------------------------|
| A           | A, AB                     | A, O                               |
| B           | B, AB                     | B, O                               |
| AB          | AB                        | A, B, AB, O                        |
| O           | A, B, AB, O               | O                                  |

The same may be depicted in a simple form as follows:

You must have noticed that persons with blood group O can donate blood to all and 'O' group is called **universal donor** and AB group can receive blood from all and is called **universal recipient**.



## 26.5 LYMPHATIC SYSTEM

Lymph is also a circulatory fluid and flows in the lymph vessels.

- It is light yellow in colour.
- It always flows only in one direction from tissues to heart.
- Cells called lymphocytes present in lymph eat up germs and prevent body from infections.
- Lymph carries digested fats from intestine to other parts.
- It returns proteins and fluid from circulation to tissues.

## 26.6 DISORDERS RELATED TO CIRCULATORY SYSTEM

1. **Heart attack:** Like all other organs, heart also needs food and oxygen. When arteries supplying the heart become thick due to age or faulty diet consisting of excessive fatty food, muscle cells of the heart cannot beat in the proper rhythm. Heart attack occurs which can be detected in an abnormal ECG and there are methods of treatment.
2. **Anaemia:** When haemoglobin level falls below a certain point the condition is called anaemia. It makes the person weak and look pale and inactive. Iron in the diet helps remove anaemia.
3. **Leukemia:** This is blood cancer. The bone marrow makes excessive WBCs at the cost of RBCs.
4. **Hypertension:** It is high blood pressure and leads to headache, dizziness and fatigue. Normal blood pressure is 120/80. High blood pressure is caused by anxiety also. Proper diet, exercise, medicines and tension free mind helps to cure high blood pressure.

## CHECK YOUR PROGRESS 26.3

1. What are the components of blood?
2. State one function each of RBC, WBC, and blood platelets.
3. Which category of blood cells do not have nuclei?
4. Which blood group is called "universal donor"?
5. In which direction does lymph flow?

**LET US REVISE**

- Molecules move in and out of cells by diffusion, osmosis or active transport.
- Diffusion is movement of molecules from region of their higher concentration to the region of their lower concentration.
- In osmosis, water molecules move from their region of higher concentration to that of their lower concentration.
- In active transport, molecules move against concentration gradient. Energy is required for active transport.
- In plants, water is absorbed from soil by root hairs and reach leaves and other parts through xylem vessels.
- Tracheids and vessels are cells of xylem. They are non-living.
- Ascent of sap is facilitated by transpiration pull.
- Food in plants is translocated by phloem.
- Sieve tubes, the cells of phloem are living structures.
- In most animals, blood circulates through heart and blood vessels to reach all parts of body.
- Blood flowing through the body transports food, nutrients, oxygen, hormones, metabolic waste and carbon dioxide.
- Heart in humans is four-chambered, two upper chambers are called atria and lower chambers are ventricles.
- Heart is made of cardiac muscle fibres.
- Heart pumps blood into blood vessels for transport by relaxing and contracting in a rhythmic manner called heartbeat.
- Heartbeat is recorded as ECG or Electrocardiogram.
- Of the blood vessels, artery carries blood away from heart, vein carries blood towards heart. Capillaries are thin blood-vessels between an artery and a vein.
- Blood is made of plasma, a fluid and three types of blood cells called RBC, WBC and blood platelets (cell fragments).
- RBCs are circular, non nucleated and carry respiratory gases. They contain a red pigment, haemoglobin.
- WBCs are colourless and of varied shape. They protect the body from infections.
- Blood platelets play a role in blood clotting.
- Blood transfusion can save life when blood loss occurs due to accident or surgery.
- Every human being belongs to one of four blood groups: A, B, AB and O.
- Blood transfusion can be between matching blood groups. O group is universal donor and AB blood group is universal recipient.
- Lymphatic system is made of lymph vessels in which a colourless fluid called lymph flows.
- Lymph flows only from tissues to heart and serves to transport proteins and digested fat.

---

### TERMINAL EXERCISES

---



**A. Multiple choice type questions.**

1. Which cells of conducting tissues of plants are dead?
  - a) Sieve tubes
  - b) Tracheids
  - c) Stomata
  - d) Phloem
2. Which kind of muscle fibres is found in the human heart?
  - a) Striated
  - b) Unstriated
  - c) Cardiac
  - d) Voluntary
3. What is a lymph?
  - a) A fluid which flows in one direction only
  - b) A fluid which carries material from heart to tissues
  - c) Another name for blood
  - d) A fluid with red coloured cells
4. What happens when the atria contract?
  - a) Blood from left ventricle flows into aorta.
  - b) Blood from right ventricle flows into pulmonary artery.
  - c) Blood from pulmonary vein enters left atrium.
  - d) Blood which is almost without oxygen flows from right atrium to right ventricle.
5. Pulmonary artery carries carbon dioxide laden blood while all other arteries carry oxygenated blood. It is still called an artery because,
  - a) its structure is like that of a artery
  - b) it carries blood away from heart
  - c) it transports blood towards the heart
  - d) it brings blood from lungs to heart

**B. Descriptive type questions.**

1. Name the three kinds of blood cells.
  2. How many chambers does the human heart have? What are the lower chambers called?
  3. Name the two kinds of cells of xylem.
  4. Through which pores on the leaf does transpiration occur?
  5. Mention one point of distinction between  
(a) artery and vein (b) vein and capillary
  6. What happens to blood when  
(a) right atrium contracts (b) left ventricle contracts
  7. From donor of which blood group can a person with blood group O receive blood?
  8. State two functions of lymph.
  9. In plants, where is food synthesised and through which tissue is it translocated?
  10. What does “ascent of sap” mean?
-

11. Describe the events in the heartbeat.
12. Make a flow chart to show the flow of blood from one chamber of heart to the other and to the lungs and other parts of the body.
13. Draw a simple labelled diagram of the internal structure of human heart.
14. Write a note on lymph.
15. Write a note on composition of blood.
16. Name two disorders related to the circulatory system and write a note on any one of them.

**C. Difficult but try**

Rahul's blood group is A, Gita's blood group is AB and Ravi's blood group is O. Who can donate blood to whom in case of an emergency?

**ANSWERS TO CHECK YOUR PROGRESS**

**26.1**

1. Active transport
2. Net movement of water molecules from a region of higher concentration of water to a region of lower concentration of water.
3. Tracheids and vessels.
4. Sieve tubes
5. Tracheids, vessels

**26.2**

1. Heart and blood vessels like artery, vein and capillaries
2. Thin walled blood vessels through which exchange of material takes place. Capillaries connect artery to vein.
3. Capillaries
4. Cardiac muscle fibres
5. To permit blood to flow only in one direction / to prevent back flow of blood.

**26.3**

1. Plasma and blood cells like RBC, WBC and blood platelets.
2. RBC – To carry oxygen to tissues from lungs / carbon dioxide from tissues to lungs.  
WBC – To eat up foreign particles, to produce antibodies, to fight against disease  
Blood platelets – Factor required for blood clotting
3. RBC
4. Group O
5. From tissues to heart

**GLOSSARY**

---

**Selectively permeable:** That membrane which permits transport of only certain molecules through it and not others.

**Diffusion:** Process of movement of molecules from the region of their higher concentration to the region of their lower concentration.

**Osmosis:** Process of movement of molecules of water from region of their higher concentration to a region of lower concentration of water.

**Active transport:** Movement of molecules, with consumption of energy against the concentration gradient that is from a region of their lower concentration to that of their higher concentration.

**Transpiration pull:** Ascent of water against gravity because of pull exerted by transpiration of water from leaves.

**Translocation:** Transport of food materials in plants from leaves to other parts.

**Atria:** Upper chambers of the human heart.

**Ventricles:** Lower chambers of the human heart.

**Blood transfusion:** Introduction of blood from one person into another.

**Universal donor:** A blood group in whose case blood can be donated to all other groups. Blood group O is considered as the universal donor.

**Universal recipient:** A blood group in whose case blood from any other group can be received during blood transfusion.

**Heart attack:** A condition of the muscles of heart in which rhythm of heartbeat becomes abnormal.

**Leukemia:** Blood cancer in which the number of WBCs increase in blood beyond normal number.

**Hypertension:** High blood pressure.

---