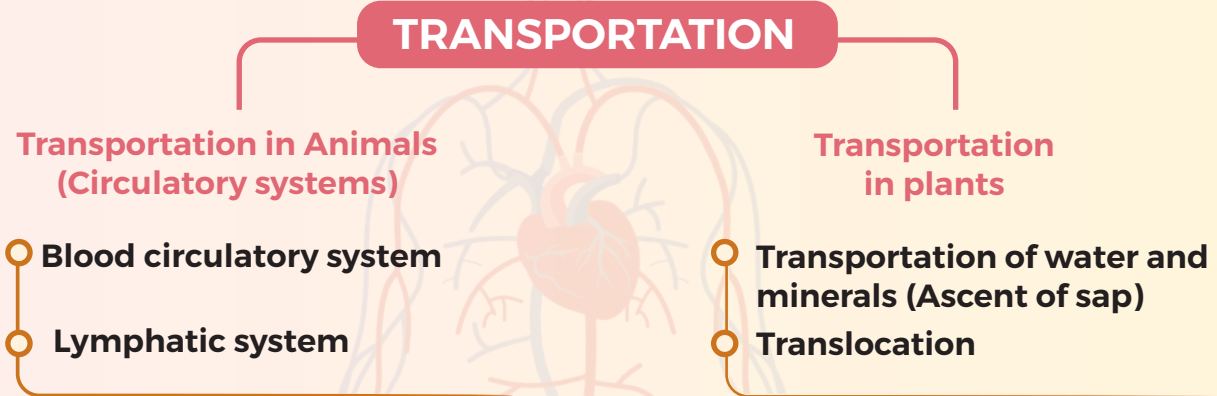


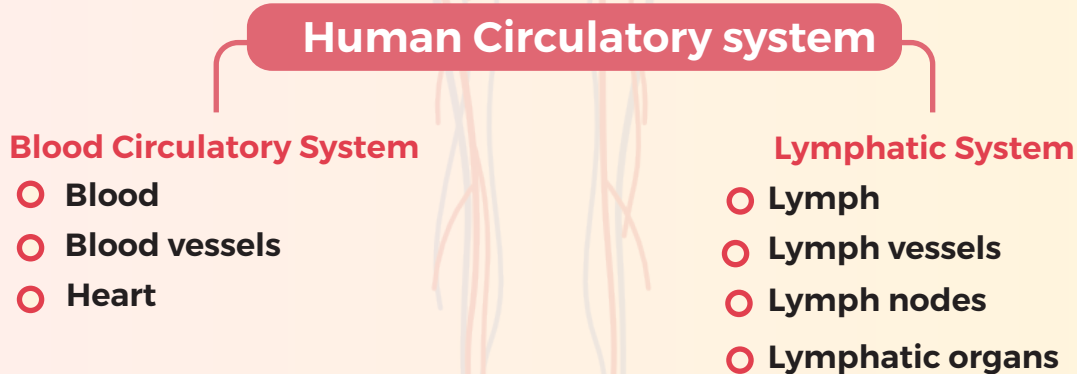
Key Points

“Transportation whether in plants or animals is the key to the efficient assimilation of the nutrients that the organisms synthesize, get from their environment or digest.”



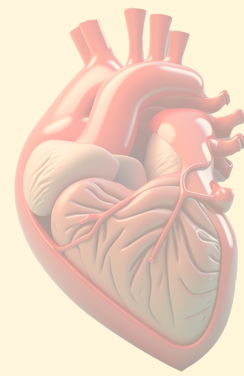
TRANSPORTATION IN HUMAN BEINGS

The process of transporting the absorbed food, water and waste products from one place to another in the body is called circulation.

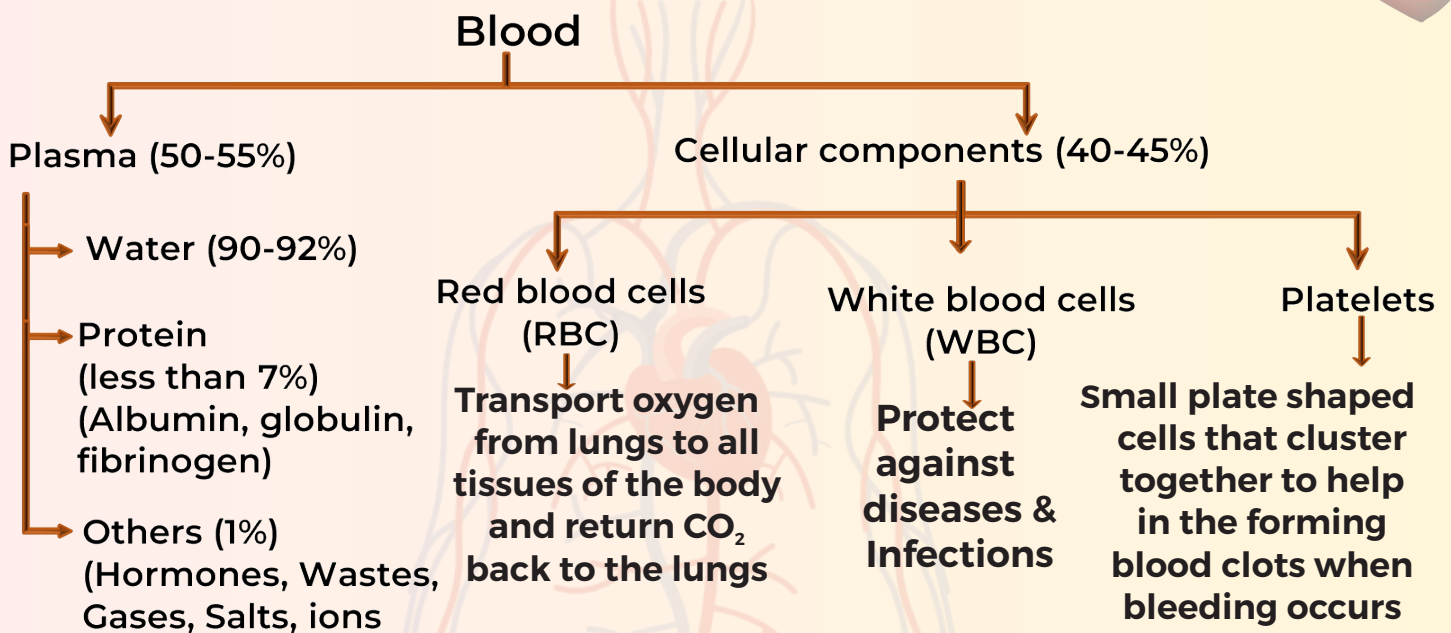


Blood

It is the fluid connective tissue and also called 'River of life'. It's pH ranges from 7.35 - 7.45 (slightly alkaline).



Composition of blood



Blood clotting or coagulation

Injured tissue release substances that attract the platelets. The contact of platelets with the injured cells causes release of thromboplastin that forms enzyme prothrombinase.

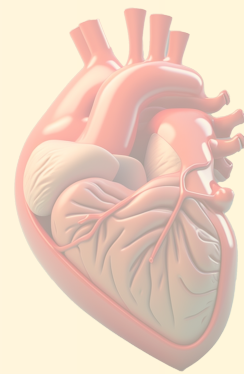


- Prothrombin and Fibrinogen are proteins which are synthesized in liver and are present in plasma.
- Serum is a watery fluid expelled from a contracting blood clot.

• Serum = Plasma - Clotting factors.

Special Point

Blood is thicker and slightly heavier than water. Its pH ranges from 7.35 to 7.45 (slightly alkaline).

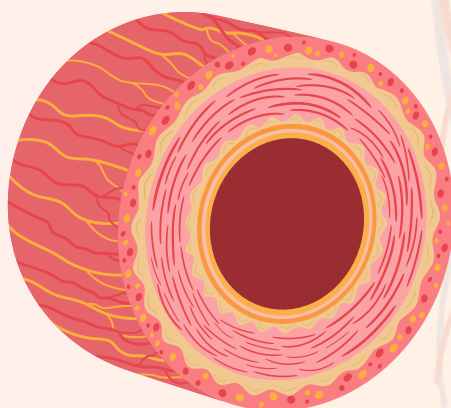


BLOOD VESSELS

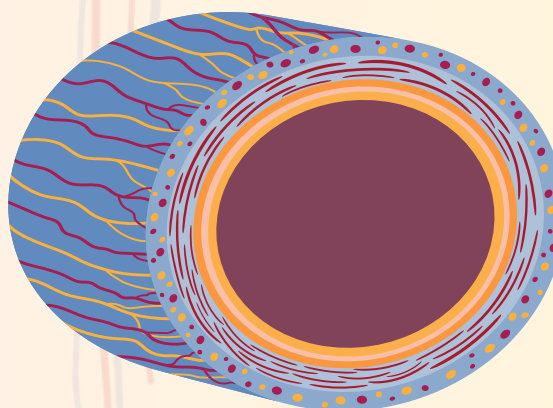


Comparative Study of Blood Vessels

S.N.	Features	Arteries	Veins	Capillaries
1.	Direction of blood flow	Take the blood away from heart to different parts of body.	Bring the blood towards the heart from various body parts.	Blood flows from arterioles to capillaries and then to venules.
2.	Kind of blood	Oxygenated blood except in pulmonary artery.	Deoxygenated blood except in pulmonary vein.	Blood changes from oxygenated to deoxygenated.
3.	Blood pressure	Pressure is high.	Pressure is low.	Pressure is extremely low.
4.	Blood flow	Blood flows rapidly with jerks.	Blood flows smoothly without jerks.	Blood flows smoothly without jerks.
5.	Lumen	Narrow	Wide	Very small
6.	Valves	Absent	Present	Absent
7.	Location	Mostly deep seated	Mostly superficial	Form a network all over the body and in the organs.



Artery



Vein

Special Point

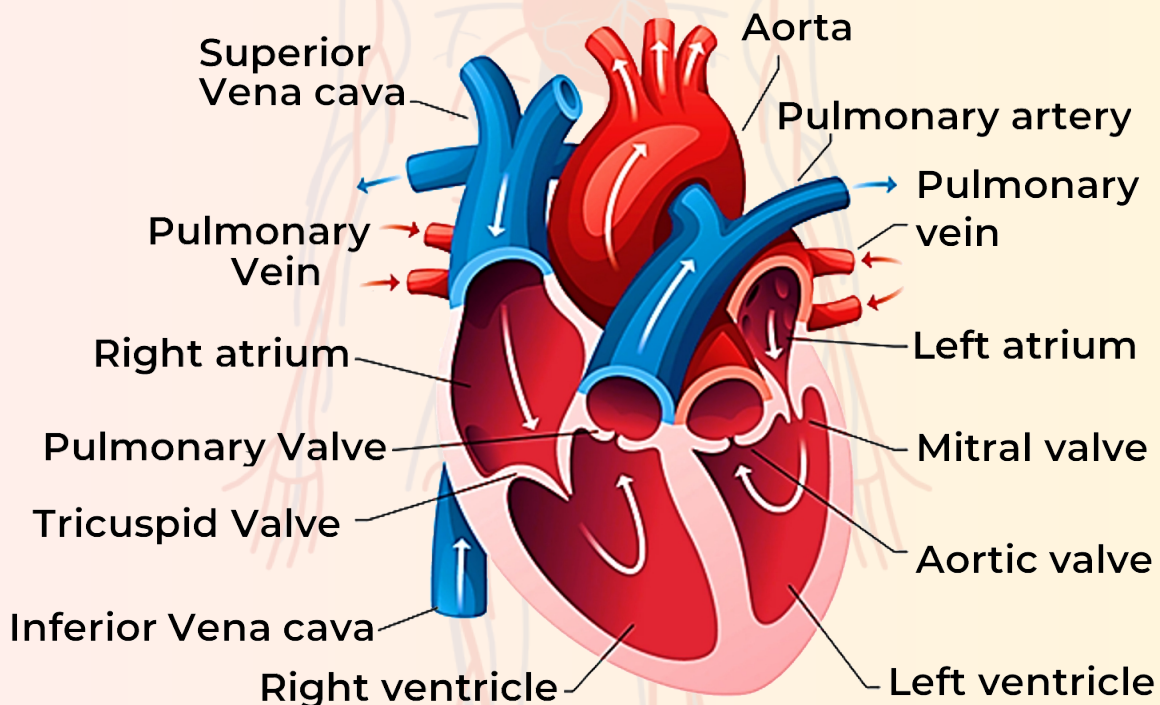
In humans RBCs are circular, biconcave and enucleated. The red colour of RBC is due to the presence of haemoglobin.

HEART

The heart is a muscular cone-shaped organ about the size of a clenched fist of the same person.

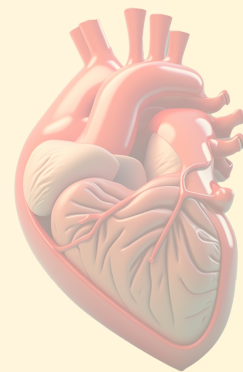
External structure

- Located in the middle of thoracic cavity between the lungs with its broad base facing upward and backward and its narrow apex facing downwards, forwards and pointing towards the left.
- Heart is covered by a tough, double walled sac, the pericardium.



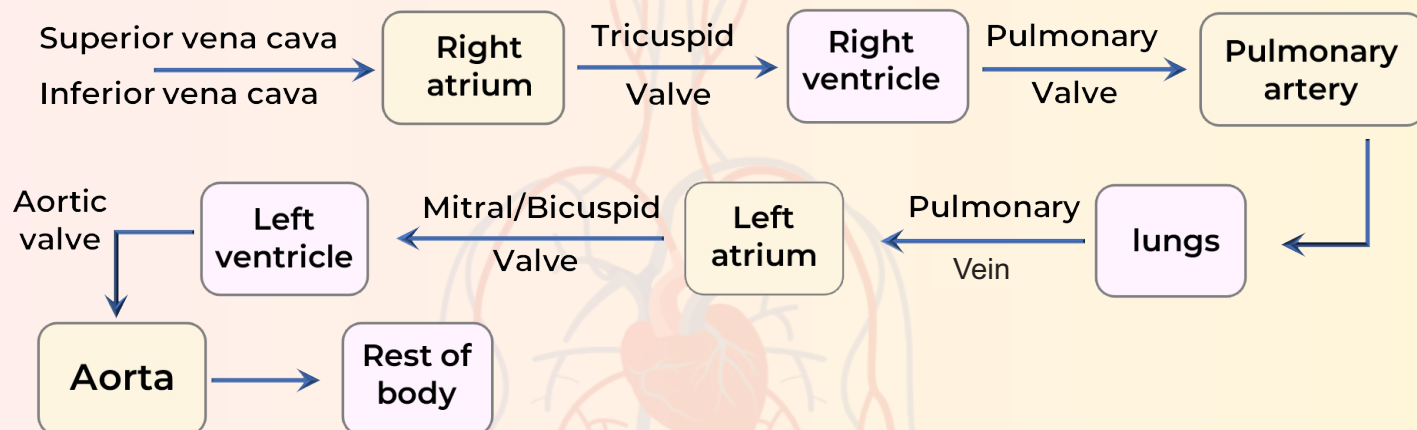
Internal structure

- **Right atrio-ventricular valve or tricuspid valve** separates right atrium from right ventricle. The right ventricle gives off a large blood vessel called pulmonary artery.
- **Semilunar valve** or pulmonary valve is present at the origin of pulmonary artery. It carries deoxygenated blood to the lungs for oxygenation.
- **Left atrio-ventricular valve or bicuspid valve (mitral valve)** separates left atrium from left ventricle. The left ventricle gives off a large blood vessel called the Aorta. Semilunar valve or Aortic valve is present at the origin of Aorta.



Working of heart

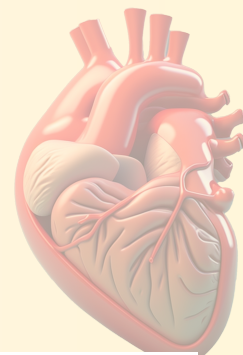
The heart of the human works like a pump.



- Four chambered heart ensures complete separation of oxygenated and deoxygenated blood, which is useful to animals with high energy needs (due to thermoregulation and higher metabolic activity) such as birds and mammals.
- Double circulation is an improvement over single circulation. The heart pumps both the types of bloods (oxygenated and deoxygenated) forcefully through the body.
- Double circulation = Systemic circulation + Pulmonary circulation.

Single and double circulation

Single Circulation	Double Circulation
Blood moves through heart only once during completion of whole circuit in the body.	Blood passes twice through heart during completion of full circuit.
Only deoxygenated blood flows through heart.	Both oxygenated and deoxygenated blood pass through heart.
Heart pumps blood only to the organ where oxygenation is to occur.	Heart pumps blood to both oxygenating organs and the rest of the body.
Pressure of blood flowing through the body is low.	Pressure of blood flowing through the body is high.
Metabolic rate is low.	Metabolic rate is high.
It is found in Pisces.	It is found in amphibian, reptiles, birds and mammals.



Pulmonary and systemic circulation

Pulmonary Circulation	Systemic Circulation
It is a shorter circulation	It is a larger circulation.
The circulation is in between heart and lungs.	The circulation is in between heart are remaining parts of the body except lungs.
Blood is pumped by right part of the heart and received by the left part.	Blood is pumped by the left part and received by right part.
It pumps deoxygenated blood into lungs.	It pumps oxygenated blood into different parts of the body.
It brings back oxygenated blood to the heart.	It brings back deoxygenated blood to the heart.

Special Points

Open circulation

Blood is pumped by heart into the body cavities where tissues are surrounded by blood. These cavities known as sinuses.
E.g. Arthropoda and Mollusca.

Close circulation

Blood is pumped by heart into vessels and does not come out to the body cavities.
E.g. Annelida, Echinodermata and Vertebrates.

- Heart in fishes is known as venous heart because only deoxygenated blood pass through the heart.

Blood pressure

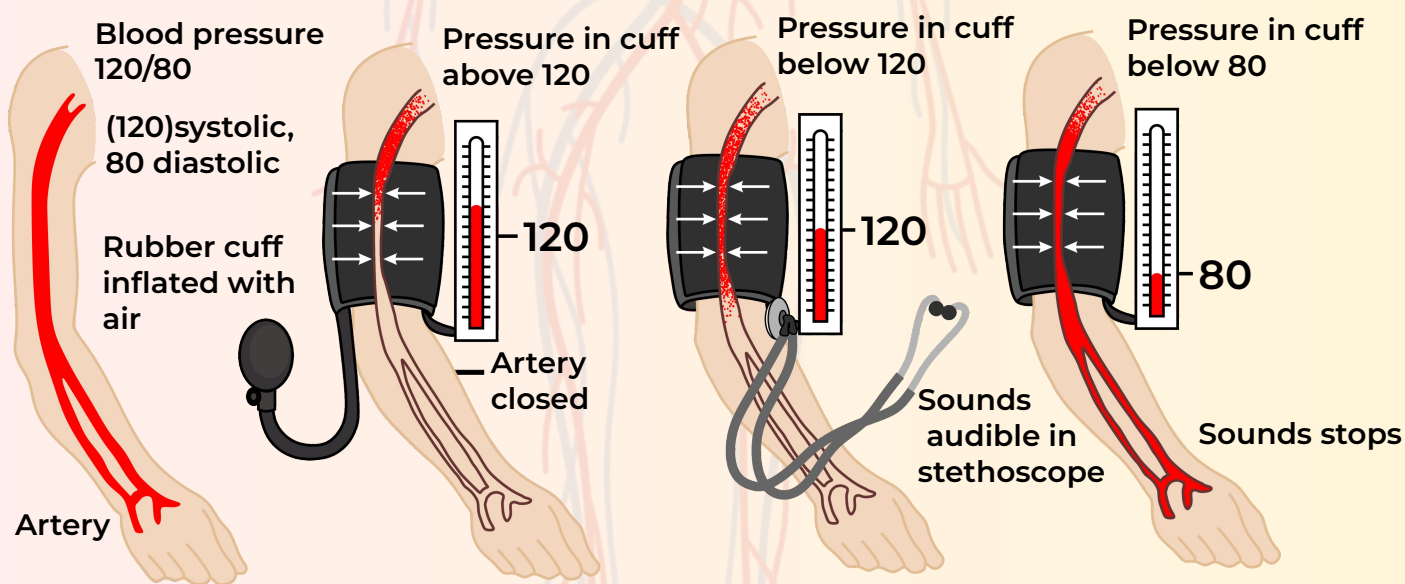
Pressure exerted by the flowing blood on the walls of arteries.



Characters	Systolic blood pressure	Diastolic blood pressure
Definition	Blood pressure at the time of maximum contraction of ventricles.	Blood pressure at the time of maximum relaxation of ventricles.
Value	120 mm Hg.	80 mm Hg.

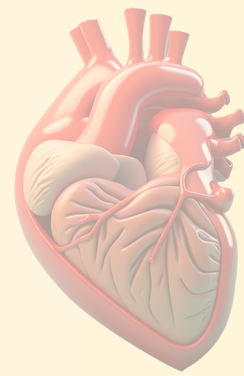
“The device used for measuring blood pressure is called sphygmomanometer.”

Measurement of blood pressure



Heart beat

- The heart shows regular contraction and relaxation. The rhythmic contraction followed by expansion constitutes a heart beat.
- The device that amplifies the sound of a person's heart beat is called a stethoscope.



Lymphatic system

- Lymphatic system is an open circulatory system.
 - It consists of lymphatic capillaries, lymphatic vessels, lymph nodes and lymphatic organs (Spleen and Thymus).
 - Lymph flows in one direction only i.e. from tissues to heart.
 - Blood capillaries have very fine pores through which blood plasma filters out and starts flowing into the inter cellular spaces. This fluid is called extracellular fluid. A part of this fluid enters into the lymph capillaries. The fluid inside the lymph capillaries is called lymph.
 - Lymph is clear, transparent fluid which contains blood plasma, except blood proteins, RBC and platelets.
- Labels in diagram: Lymph Nodes, Thymus, Spleen, Lymph vessels
- Lymphatic system in human
- Lymph enters into lymph capillaries which join together to form large lymph vessels. The lymph vessels finally drains lymph into large veins.
 - The lymphatic nodes occur at intervals in the course of lymphatic vessels. It contain lymphocytes, plasma cells and macrophages. The lymph filters through the lymphatic nodes. The macrophages remove microorganisms, cellular debris and foreign particles.
 - Lymph vessels finally drains lymph into large veins.
 - The lymphatic nodes occur at intervals in the course of lymphatic vessels. It contain lymphocytes, plasma cells and macrophages. The lymph filters through the lymphatic nodes. The macrophages remove microorganisms, cellular debris and foreign particles.

Functions of lymph

- Takes up excess fluid that has diffused out from the blood capillaries and puts it into blood.
- Lymphocytes which fight against germs and bacteria and produce antibodies to fight against infections.
- It absorbs and carries digested fats from the intestinal villi.

Transportation in plants

In plants, transportation is done by a specialized vascular system which is present in the root, stem and leaves.

Vascular system is made up of two types of vascular tissues:

(I) Xylem

(ii) Phloem

1. Transport of water and minerals [Ascent of sap]

The plants require water and minerals for making food and performing other functions.

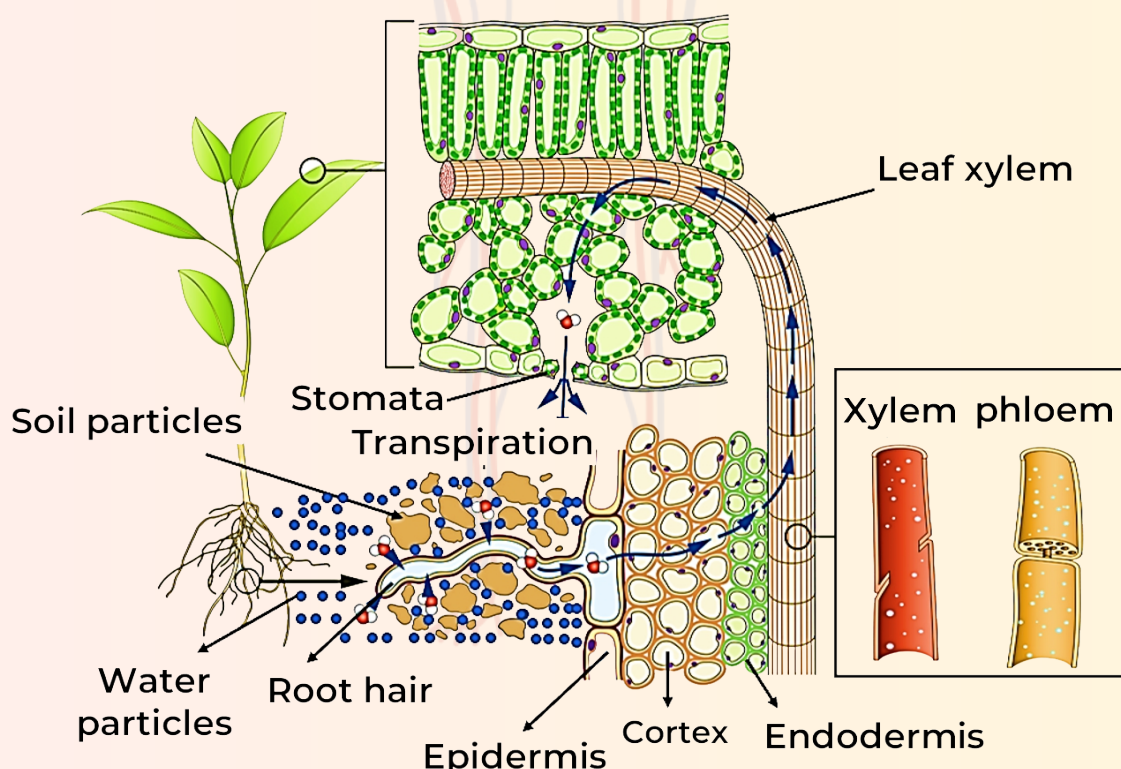
- Plants absorb water from the soil through the roots. Thus, water has to be transported upwards to the other parts of the plant. This upward movement of water is called ascent of sap. It is called the sap as it contains many dissolved minerals.
- Ascent of sap is carried out by xylem tissue which consists of :-

(i) Xylem vessels

(ii) Xylem tracheids

(iii) Xylem fibers

(iv) Xylem parenchyma



Tracheids and vessels

- Dead cells of xylem, transport water picked up by root hairs from soil to the leaves.
 - In flowering plants xylem vessels and tracheids conduct water and minerals upwardly.
 - In non flowering plants, vessels are absent, so tracheids are the only conducting cells.

Lateral transportation

- At the roots, cells in contact with soil actively take up ions (actively means by energy expenditure). This creates a difference in concentration of these ions between the root and the soil. Water therefore moves into the root from the soil. Hence, there is steady movement of water into root xylem, creating a column of water that is steadily pushed upwards, from cortex to endodermis and from endodermis to xylem vessels and tracheids.
- Main forces which play a role in ascent of sap are:

Root pressure

- The pressure with which the water is pushed up by the xylem of the roots is called the root pressure that is developed in the xylem due to metabolic activity of the root cells. Root pressure explains the transport of water to the leaves and other parts in the case of short plants like the herbaceous plants.

Transpiration pull and cohesion-tension theory

- The main force responsible for upward movement of water in tall trees is transpiration pull generated in the leaves which pulls the water column filled in the xylem tracheids and vessels.
- Transpiration pull and cohesion-tension theory was given by Dixon and Jolly in 1894 to explain ascent of sap.
- Cohesion is the property of a liquid to stay together. It is mutual attraction between water molecules. During day period cohesion force (attractive force between water molecules) and transpiration pull helps in the upward movement of sap from roots to leaves.

Transpiration

- The loss of water in the form of water vapours from the aerial parts of plant is known as transpiration.
- Transpiration mainly occurs through stomata (about 80% to 90%) but it may also occur through cuticle (9%) and lenticels (1%).
- More transpiration occurs from the lower surface of dorsiventral leaf as compared to upper surface. This is because of the fact that more stomatal openings are present on the lower surface.

Functions of transpiration

- It helps in absorption and upward movement of water.
- It helps in temperature regulation. The plants are protected from the burning due to transpiration. Evaporation of water through stomata produces cooling effect.

2. Transportation of food and other substances

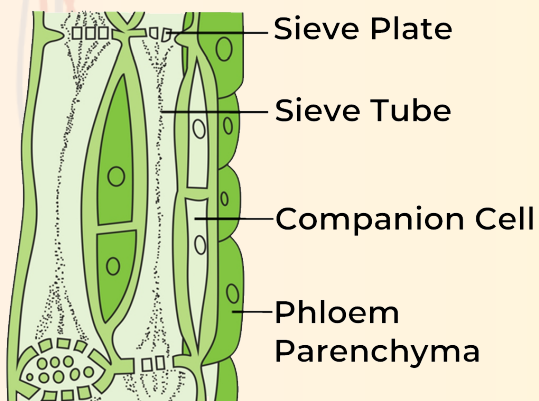
- Transport of food from leaves to different parts of plant is termed as translocation.
- Translocation may be in upward or downward direction depending on the need of the plant.
- Sugar, amino acids and other substances are translocated from site of synthesis to the site of storage through the phloem.
- Phloem tissue consist of four components:

(I) Sieve tubes

(ii) Companion cells

(iii) Phloem parenchyma

(iv) Phloem fibers



- Translocation of food takes place in the sieve tubes with the help of adjacent companion cells.

Mechanism of translocation

- Sugar made in leaves is loaded into the sieve tubes of phloem by using energy from ATP. It increases the osmotic pressure of sieve tubes.
 - Water now enters into sieve tubes containing sugar by the process of osmosis.
 - Soluble material is then transferred from phloem tissue to other tissues which have less osmotic pressure than in the phloem. Thus, according to plants requirement, the material is translocated from higher osmotic pressure to lower osmotic pressure areas.
 - **Osmotic pressure** : Osmotic pressure of a solution is equivalent to the pressure which must be exerted upon it to prevent the flow of solvent into it across a semipermeable membrane.
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