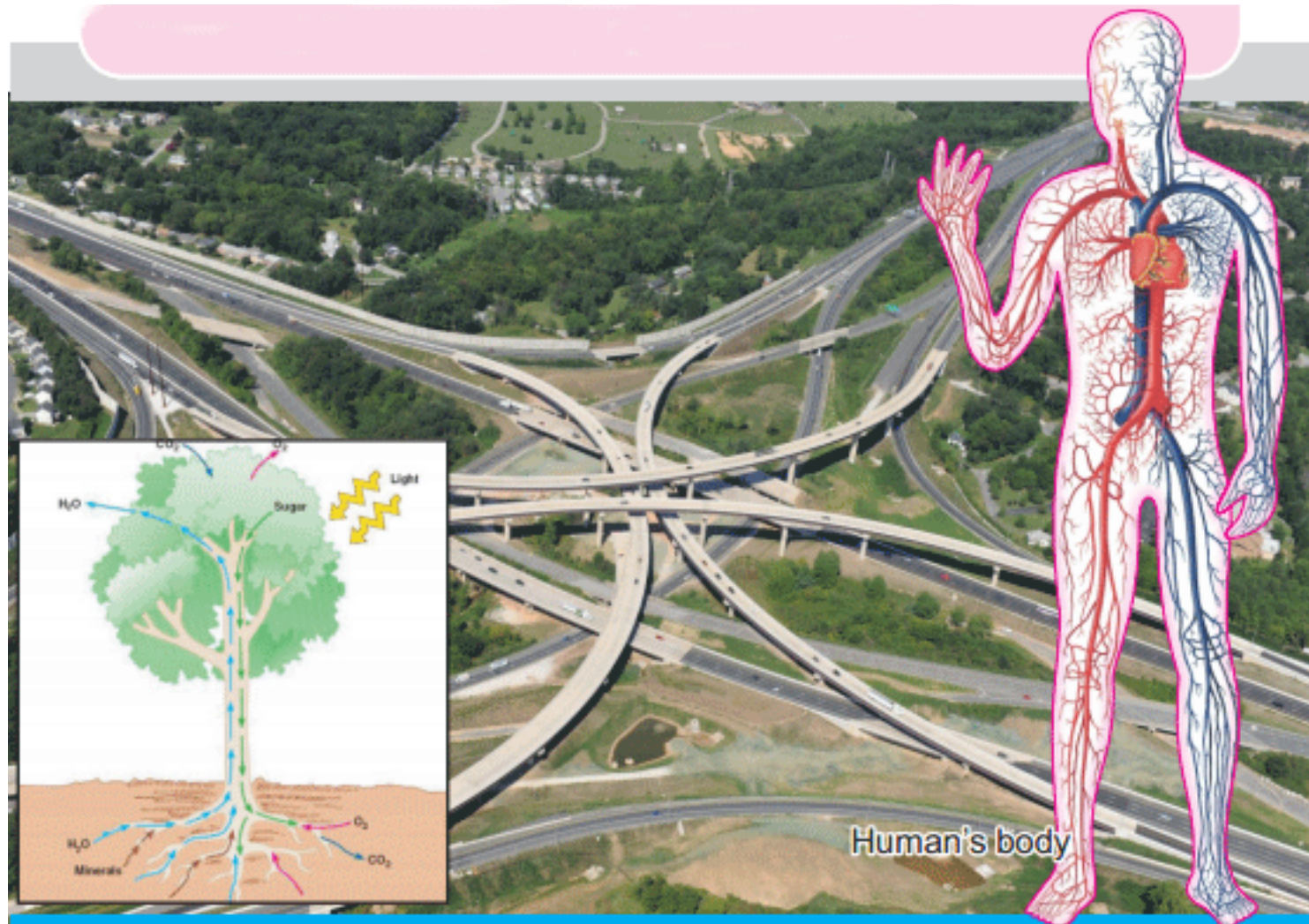


Students' Learning Outcomes

After completing this chapter, the students will be able to:

- Explain the transport system in humans.
- Describe the structure and function of heart and blood vessels.
- Explain the working of the circulatory system.
- Identify scientific developments that provide alternatives for dysfunctional body parts such as artificial tissues and organs, and their transplantation.
- Find out that some disorders in human transport system can be affected by diet.
- Describe the absorption of water in plants through roots.
- Explain how the structure of the roots, stem, and leaves of a plant permit the movement of food, water and gases.



The highway system of a city helps to move food, water, petrol, garbage, and other goods. Similarly, the transport systems help to move food, water, gasses and wastes throughout our body and a plant's body.

We have learnt in the previous chapter that our body needs food and oxygen to produce energy. Wastes are also produced in our body. How do materials move in our body? The supply of food, water, oxygen, etc. and removal of wastes from our body is called **transportation**. The blood circulatory system in our body serves this purpose.

2.1: Human Blood Circulatory System

Our circulatory system comprises the heart, blood vessels and blood. Our heart is a pumping organ. It pumps the blood in blood vessels.

The Heart

Our heart is a muscular organ about the size of our fist. The heart is found in our chest. It pumps oxygen-poor blood (deoxygenated blood) to the lungs and oxygen-rich blood (oxygenated blood) to the body. There are four chambers in our heart; two upper chambers called **atria** (singular atrium) and two lower chambers called **ventricles** (Fig.2.1).

The ventricles of our heart are larger than the atria. Both atria contract at the same time, and so do the ventricles. The blood passes from the atria into the ventricles. There is a valve between each atrium and ventricle on the both sides of the heart. These valves keep the blood flowing in one direction. Deoxygenated blood from the body enters the right atrium and oxygenated blood from the lungs enters the left atrium of our heart. The right ventricle pushes the blood to the lungs and the left ventricle pushes the blood to the body.

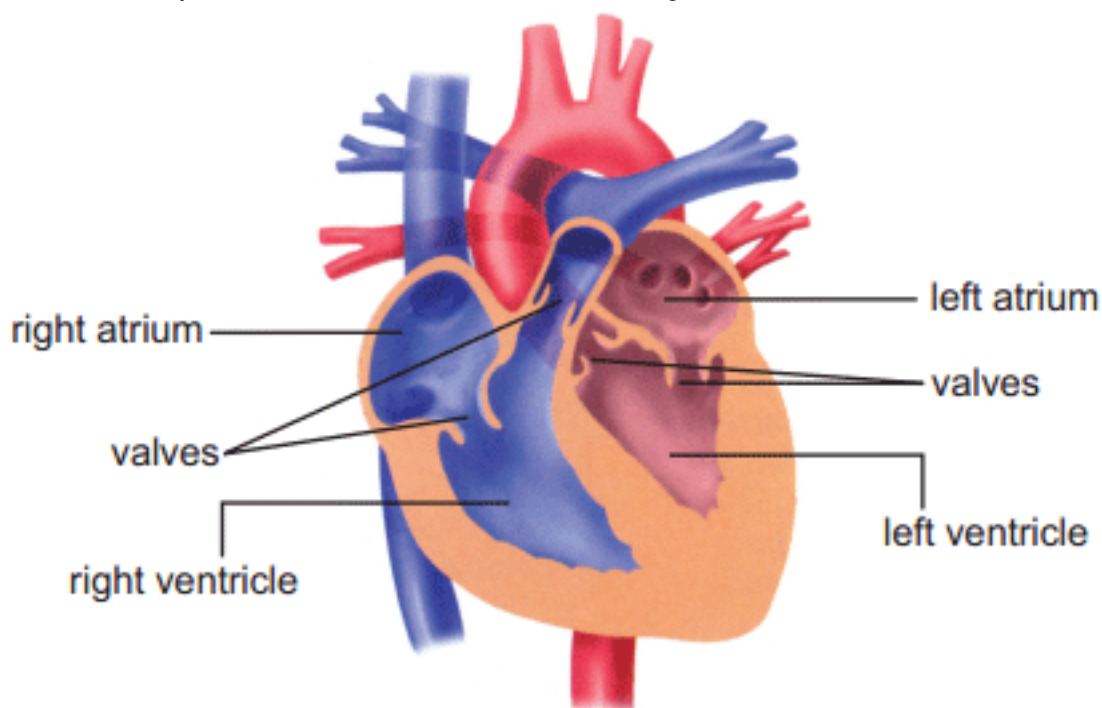


Fig. 2.1: Internal Structure of Human Heart

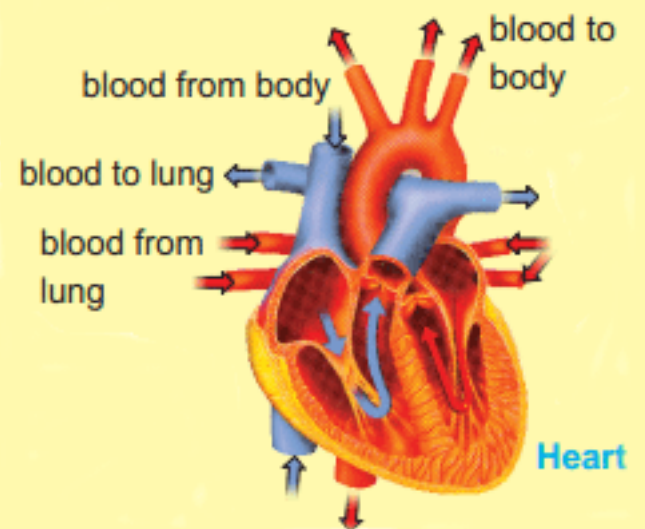
Extend Your Thinking

What do you think would happen if blood entering the heart is mixed with blood leaving the heart?

*Animation 2.2 : The whole Heart
Source & Credit : heartpoint*

How Does Our Heart Work?

Human heart acts as a double pump. Blood from lungs and other body parts enters the atria. The two atria contract at the same time and push the blood to ventricles. It is one pump. Now both ventricles contract at the same time and pump the blood to lungs and other body parts. It is the second pump. Our heart beats about 70 times a minute. We can feel our heart beat (pulse) while placing our fingers below the base of the thumb on the underside of our wrist.

**Blood Vessels**

The blood travels throughout the body through blood vessels (Fig.2.2). The three types of blood vessels are arteries, capillaries and veins.

Arteries

Arteries are the blood vessels that carry blood away from the heart (Fig.2.3). Arteries have thick and flexible walls. Most of the arteries carry oxygenated blood, but pulmonary arteries carry deoxygenated blood to the lungs. Arteries divide many times to smaller tubes, called **capillaries**.

Capillaries

Capillaries are the smallest blood vessels in the body (Fig.2.3). They are so small that red blood cells flow through them one cell at a time. Food and oxygen from the blood of capillaries diffuse into the cells. Waste materials and carbon dioxide from the cells diffuse into the blood of capillaries. Capillaries again join to form the larger blood vessels called **veins**.

Veins

Veins are the blood vessels that bring blood back to the heart (Fig.2.3). Most of the veins bring deoxygenated blood back to the heart, but **pulmonary veins** bring oxygenated blood from the lungs to the heart.

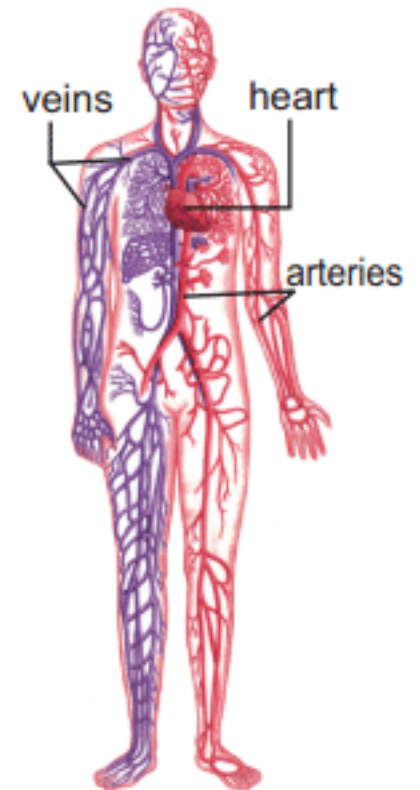


Fig. 2.2: Human Circulatory System

Extend Your Thinking

How is the structure of capillaries related to their function?

Activity 2.1

Exercise and Your Heart

1. Feel the pulse on your wrist while sitting on the chair. Using a watch, count the number of pulses for 15 seconds. Then multiply this number by 4 to find the number of heart beats in 1 minute.
2. Do jumping in place for 30 seconds and then stop. Count the number of pulses.
3. After taking rest for 5 minutes, count your pulse again.

Compare the heart beat rates in the two situations.

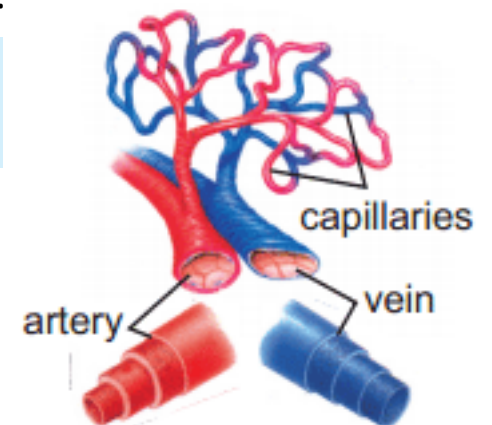


Fig. 2.3: Blood Vessels

Things to think

How did exercise affect your heart beat rate?

Extend Your Thinking

Explain how our circulatory system completes the work of our digestive and respiratory systems.

2.2: Diet Affects Our Circulatory System

Our diet and lifestyle affect our circulatory system and cause many diseases such as heart attack, blood pressure, diabetes, asthma, etc.

2.2.1: Heart Attack (Myocardial Infarction)

The heart is made of muscle cells. These cells, just like other cells in the body, must receive oxygen and food through circulatory system. The blood vessels which supply oxygen and food to the heart are called **coronary arteries**.

A hard substance called plaque can build up in the walls of coronary arteries. This plaque is made of fat and other cells. The coronary arteries may become narrow due to plaque. Sometimes a blood clot forms on the plaque and blocks coronary arteries. Due to this, the blood cannot reach a part of the heart. This part of the heart begins to die due to lack of oxygen and food. The death of a part of heart is called a **heart attack** or myocardial infarction. If too much heart muscle dies, the heart is unable to pump the blood and the person could die.

Heart attack symptoms may include: chest pain, shortness of breath, heavy sweating, etc. which is a medical emergency. Call 1122 or another ambulance.

Avoid Heart Diseases

Act upon the following tips and keep your heart and blood vessels healthy.

- Take foods high in fiber and low in fat.
- Take regular exercise to increase blood circulation throughout your body.
- Don't smoke. Smoking can increase your blood pressure.

Animation 2.3 : Human-Heart
Source and Credit: elearn.punjab



Fig. 2.4 : ECG report can help to diagnose heart attacks.



2.2.2: High Blood Pressure (Hypertension)

High blood pressure is a disorder of circulatory system. Blood pressure is the amount of force exerted by blood against the walls of the arteries.

If the blood pressure of a person remains above the normal value (120/80), the condition is called high blood pressure or **hypertension**.

The increased blood pressure can damage blood vessels and the result may be the failure of kidneys and heart. People with high blood pressure may have the symptoms such as, headache, fatigue, blurred vision, nosebleeds, etc. Foods high in fat, high salt intake, smoking, obesity, diabetes, lack of exercise, etc. raise the risk of high blood pressure.



Fig: 2.5. A sphygmomanometer is used to measure the blood pressure.

Science, Technology and Society

Smoking can cause heart diseases. It has been found that a person who smokes is more likely to have heart problems than someone who does not smoke. A chemical in tobacco smoke causes blood vessels to become more narrow. The blood pressure of a smoker may increase. The heart works harder to pump blood through these narrow vessels. Heart patients are also asked not to smoke. Why cigarette brands should not be advertised?

2.2.3: Diabetes

Diabetes is a disease in which a person has high blood sugar, because his/her body does not produce enough insulin. Insulin is the chemical that is produced in our pancreas (Fig.2.6). Insulin helps to decrease blood sugar. Without insulin a person develops diabetes.

Loss of weight, frequent urination, excessive thirst and hunger, etc. are some of the symptoms of diabetes.

If the patient does not control the level of blood sugar, he/she may be at the risk of loss of eyesight and hearing, heart attack, gum disease, kidney disorder, etc.

A person can control his/her blood sugar level by taking medicines, eating proper diet and taking exercise.

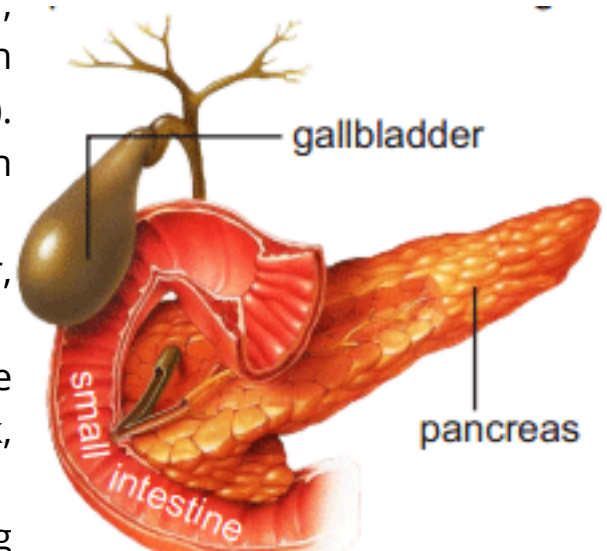


Fig: 2.6. Insulin is produced in the pancreas.

Carbohydrates have a big impact on our blood sugar level. Extra fats are not good. We need to take these foods carefully. Some vegetables and fruits are useful for a diabetic patient.

2.2.4: Asthma

Asthma is an allergy that causes the airways of the lungs to swell and narrow. A person with asthma may wheeze (a whistling sound when he or she breathes), cough, and feel tightness in the chest.

The things that can cause asthma are called **allergens**. Dust mites, pollen grains and some foods may cause asthma.

Symptoms of an asthma attack may be cough, shortness of breath, wheezing, extreme difficulty in breathing, chest pain, sweating and increased pulse rate. Severe asthma attack may lead to death.

It is not easy to cure asthma, but one can be normal and active even with asthma.

- Try to avoid the allergens of asthma.
- Use plenty of water, it will give you relief.
- On advice of a doctor, use medicines or inhaler (Fig.2.7).



Fig:2.7: An inhaler is used to relief asthma.

Transplantation

Sometimes an organ in the body of a person may stop its working because of a disease or injury. In the past, failure of a major organ resulted in the death of the patient. But, now scientists have found the solution of this problem.

An organ **transplant** replaces a failing organ with a healthy organ. A doctor removes an organ from a healthy person and places it in the patient's body. The patient again lives a normal life after transplantation.

Not all organs can be transplanted. Organs most oftenly transplanted are:

- **The kidney** because of diabetes or other kidney problems.
- **The liver** because of serious liver disorders.
- **The heart** because of heart failure.
- **The pancreas** because of diabetes.
- **The lung** because of serious respiratory disorders.

People who have organ transplants must take medicines regularly the rest of their lives to stay healthy.

Sometimes artificial organs are also used to restore a function in the body of a person. An **artificial organ** is a man-made device that replaces a missing natural organ. Artificial legs, arms, bones, arteries, eyes, teeth and ears are common to transplant now-a-days. The scientists who design and build artificial body parts are called **biomedical engineers**.



2.3: Transportation in Plants

Plants do not have a circulatory system like humans and animals, but they too need to move water and food from one part to the other. How do plants transport materials? Plants transport water and minerals from roots to leaves through xylem vessels. Phloem transports prepared food from leaves to all other parts (Fig.2.8).

2.3.1: Absorption of Water in Plants Through Roots

The water enters the plant body through its roots. There are thousands of tiny root hairs on each root. The soil surrounding the roots has higher amount of water and minerals than inside the root cells. Water and dissolved minerals from the soil absorb into the root hairs by diffusion. Diffusion is the movement of a substance from where it is in large amount to where it is in small amount. As water in roots increases, a pressure is produced in the root cells to push water and minerals up in the plant. But this pressure of roots can only lift water up to a certain height. How does water reach in leaves of tall trees?

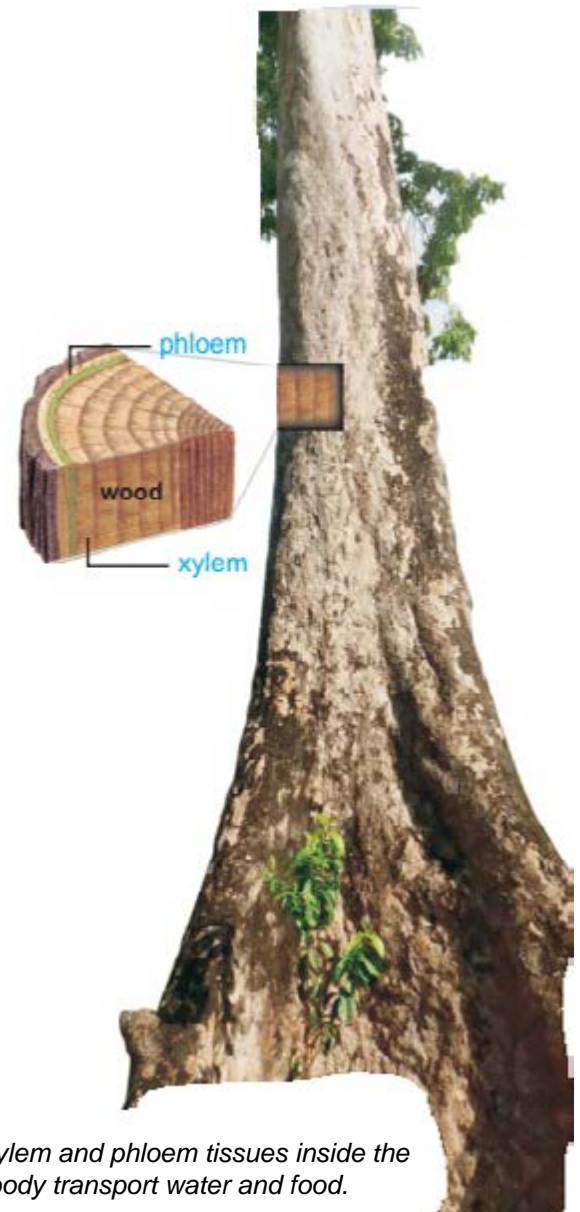


Fig: 2.8. Xylem and phloem tissues inside the plant body transport water and food.

2.3.2: Transpiration

In tall trees, water is pulled up through the xylem when it is evaporated from the leaves. Once in the xylem pipes, water forms unbroken columns from the roots, through stem and into the leaves. The loss of water by evaporation from plants is **called transpiration**. As water transpires, more water is drawn from the xylem. This movement of water exerts a pull on the water within the xylem. As water moves out of the leaves, more water moves up from the stem. Roots absorb more water from the surrounding soil to maintain the water column in stem and leaves.

Extend Your Thinking

What would happen to a plant if its leaves were covered with waterproof petroleum jelly?

Activity 2.2

Transpiration in Plants

You will need:

- 4 Clear plastic glasses
- A leaf of water plant with a stalk
- Ice-cream stick
- Cardboard (2 pieces)

Procedure

1. Fill two of the glasses about two-third of water.
2. Make holes in the pieces of cardboard and pass the leaf stalk and ice-cream stick through them.
3. Place the cardboards with the leaf and ice-cream stick over the glasses of water.
4. Cover the glasses with leaf and ice-cream stick with empty glasses.
5. Place the glasses in sunlight for a day.

Observe it all the next day. The glass over ice-cream stick is still clear. The glass over plant leaf looks foggy because of transpiration.

Things to think

Why do people sit and relax under trees in hot summer days?



Animation 2.4: Transpiration
Source and Credit: elearn.punjab

2.4: Translocation

Plants prepare food in their leaves. The prepared food is carried by phloem to all parts of a plant. The movement of prepared food from leaves to those parts of plant body where it is needed is called translocation (Fig.2.9). How is solid food transported from one part of the plant to the other?

Pressure Flow Hypothesis

We can explain the movement of solid food through the phloem by “pressure flow hypothesis”. According to this hypothesis water from nearby xylem enters the phloem and mixes with the food forming a solution. This solution flows under pressure through the phloem. The pressure is created by the difference in amounts of water in phloem and nearby xylem.

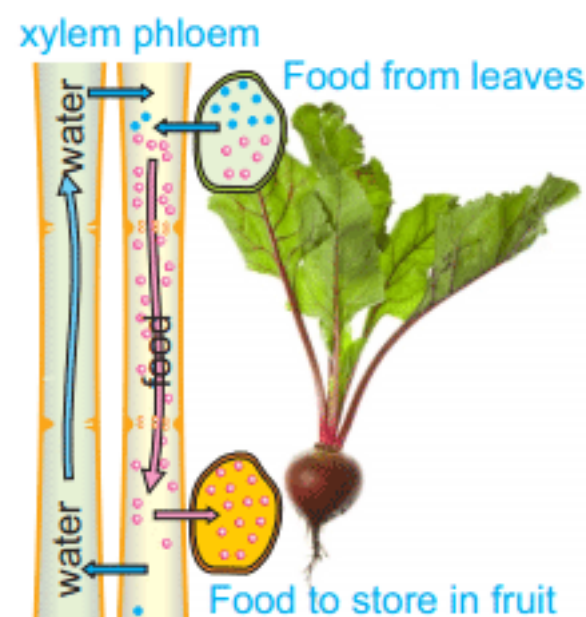


Fig: 2.9 Food moves through phloem in solution form.

2.4.1: Structures of Plant Parts and Transportation

Nature has made the plant parts in such a way that their structures permit the movement of materials.

Structure of Roots

From the moment a seed grows, its root starts to search water and minerals in the soil. Roots have branches that play an important role in absorption of water.

The root hair on the roots absorb water and minerals from the soil (Fig. 2.10). Roots have xylem tissues to move water and minerals from the soil up through the stems, to the leaves. Phloem tissues in roots help to transport food.

Structure of Stem

Many plants such as mustard (sarsoon) have a waxy layer cuticle around the stem to reduce water loss. Bark also reduces water loss in plants. Phloem tissues in the stem transport food made in leaves. Xylem tissues carry water from roots to the leaves.

Structure of a Leaf

Leaves are the food factories of plants. Upper layer of a leaf has a waxy layer cuticle to reduce water loss. Lower layer of a leaf has stomata. Exchange of gases and transpiration take place through stomata. Midrib and veins of a leaf have xylem and phloem tissues. These tissues transport water and food throughout the leaf (Fig.2.11).

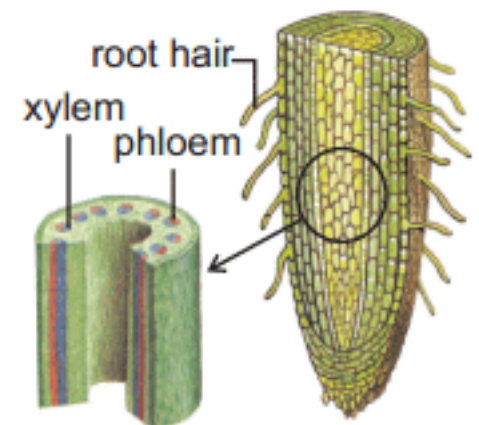


Fig: 2.10. The structure of root suits to the transport of materials.

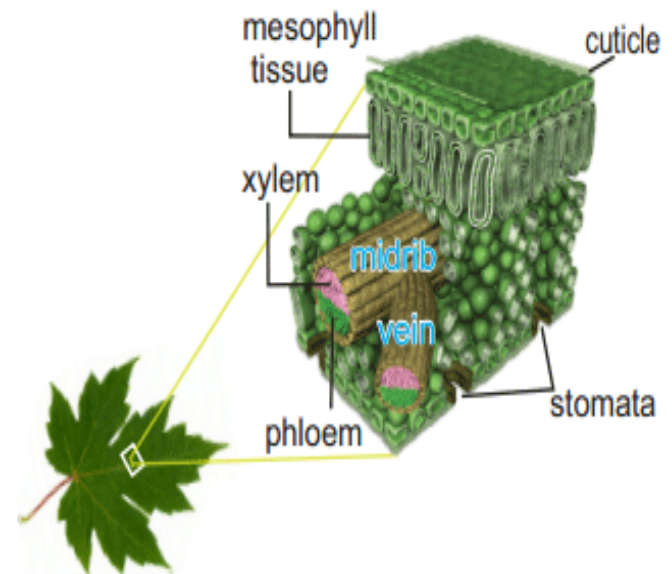


Fig. 2.11: Internal structure of a leaf supports the movement of materials.

Tidbit

Many stomata are present in the lower surface of each leaf. There can be as many as 200 stomata or more in an area equal to the size of the head of a pin.

Activity 2.3

Movement of Water in Plants

You will need • a clear plastic glass • celery stem • dropper • red ink • water

Procedure

1. Pour some water in the clear plastic glass. Add a few drops of red ink to water.
2. Take a celery stem, cut its edge and place it in the water.
3. Place the glass with celery stem in sunlight.

Observe the stem after 2 hours. You will see red lines in the leaves. If you cut a cross section of the stem you will also see the red colour inside it.

**Things to Think**

Through which tiny pipes does water move within the stem?

Key Points

- Our blood circulatory system delivers food and oxygen to our body cells and carries carbon dioxide and other wastes away from them.
- Human heart has four chambers, two atria and two ventricles. Heart pumps the blood into blood vessels, i.e. arteries, capillaries and veins.
- An organ transplant replaces a failing organ with a healthy one from another person. Organs transplanted more often are the kidney, heart, lung and liver.
- Our diet and lifestyle also affect our circulatory system and may cause some disorders, such as heart attack, high blood pressure, diabetes, asthma, etc.
- Tiny root hair on roots help to absorb water and minerals from the soil. Root pressure pushes water up the plant.
- Transportation in plants takes place through xylem and phloem.
- Structures of roots, stem and leaves of plants help in transportation of water, minerals and food.

Questions

1. Complete each of the following sentences by writing the correct term.

1. Blood vessels which carry blood towards heart _____
2. Blood vessels which supply blood only to the heart _____
3. Transports food in a plant body _____
4. Pores to exchange gases in plants _____
5. Transports water and minerals from roots to leaves _____