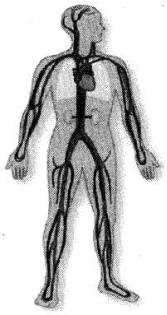
Transportation in Animals and Plants

Learning Objectives

1. Transportation in unicellular organisms
2. Blood circulation in humans
3. Excretory system in humans
4. Transportation in plats

INTRODUCTION

All living organisms need to take in air, water and nutrients and eliminate waste products out of their bodies. Oxygen from the air we breathe in is required by each cell of our body. Similarly, water and minerals absorbed by plant roots from the soil, must reach the leaves for preparation of food. This means, there must be some mechanism by which substances get transported within the body of plants and animals

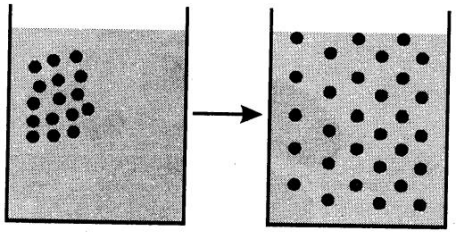


TRANSPORTATION IN UNICELLULAR ORGANISMS

In unicellular organisms, transportation of substances happens through diffusion and osmosis. Gases move in and out of the cell by diffusion. Other substances move by osmosis.

Diffusion

Random motion of particles in order to attain equilibrium of concentration is called diffusion. Diffusion can be observed in many aspects of day to day life. The aroma of food comes from the kitchen because of diffusion. A pleasant smell of flowers comes because of diffusion. Bad odour of garbage RE comes because of diffusion. Particles move from a region of higher concentration to a region of lower concentration.



Osmosis

Movement of water through a semi-permeable membrane from high water concentration to low water concentration is called osmosis. Osmosis is a type of diffusion. Cell membrane is a semi-permeable membrane. Substances move across the cell membrane because of osmosis. Seeds swell up; when soaked in water; because of osmosis.

CIRCULATORY SYSTEM IN HUMANS

Diffusion and osmosis can result in transportation of substances to short distances only. For bigger and complex organisms, there is a need of a more complex system for transportation of substances. The circulatory system in humans is composed of three main components, viz. heart, blood vessels and blood.

Do you know?

Blood surges out into the main arteries at a speed of 16 inches per second. If it were to pass through a hole the size of a pinhead at this speed and pressure it would spurt more than 10 feet.

Blood

Blood is a type of tissue which is responsible for transportation of substances. Blood works as the carrier of various substances. Blood performs many very important functions in the body

1. it transport oxygen and nutrients to the cells and takes waste products away from the cells
2. it carries hormones and chemicals to where they're needed in the body
3. it helps to maintain the body's temperature so that it doesn't get too hot or too cold
4. it's a vital part of the immune system

Blood composition

Blood is composed of four main substances:

1. plasma
2. red blood cells
3. white blood cells
4. platelets

Plasma

Blood plasma is a fluid in which red blood cells, white blood cells and platelets are transported. Plasma makes the liquid part of the blood. It makes the largest part of the blood. Plasma is pale in colour. However, plasma also transports a number of other important substances:

1. carbon dioxide from the organs to the lungs.
2. soluble products of digestion from the small intestine to the other organs.
3. the waste product urea from the liver to the kidneys.

Blood Cells

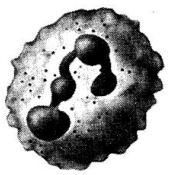
There are two main kinds of blood cells in the human blood, viz. Red

Blood Cells and White Blood Cells.

1. Red Blood Cells or Red Blood Corpuscles (RBC): These are in the shape of discs. They contain a pigment; called haemoglobin. Haemobglobin binds with oxygen and thus is mainly responsible for transportation of oxygen in the body Haemoglobin also transports some amount of carbon dioxide. The main component of haemoglobin is iron which is very good at carrying both oxygen and carbon dioxide. It's also the reason why red blood cells are red. In the lungs, the haemoglobin combines with the oxygen to form oxyhaemoglobin. When the oxygenated blood travels round the body the oxyhaemoglobin splits back up into haemoglobin and oxygen and the oxygen can then enter the cells. The shape of a red blood cell is a biconcave disc: this means that its surface to volume ratio is large so gases can diffuse in and out of it more quickly. Their small size and flexibility also mean that they can move through capillaries and get closer to the cells. Another interesting fact about red blood cells is the fact that they don't have a nucleus. In fact, they don't contain any organelles which mean that they have more room for haemoglobin.

Red blood cells

2. White Blood Cells or White Blood Corpuscles (WBC): These are present in various shapes. WBCs engulf foreign particles and harmful microbes. Thus, WBCs help in fighting the diseases. WBCs make the immune system of the body.



White blood cell

Platelets

Platelets are responsible for clotting or coagulation of blood. In case of an injury, the blood clots after some time. This prevents excess loss of blood. Clotting of blood is a defense mechanism in the body.

Do you know?

During a typical day the adult heart pumps out about 2000 gallons of blood. That would be enough blood to fill more than 50 bathtubs.

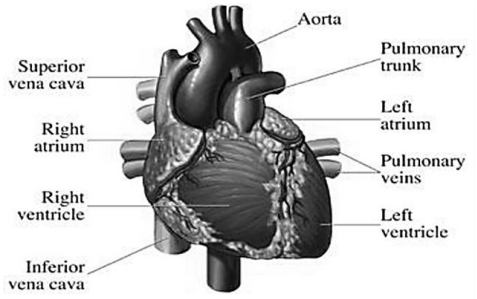
Blood Vessels

Blood vessels are of three main types, viz. arteries, veins and capillaries. Arteries: Arteries are made of thicker walls. Arteries carry oxygenated blood from the heart to different organs. Pulmonary artery is an exception, because it carries deoxygenated blood from the heart to the lungs. Veins: Veins are made of thinner walls. Veins carry deoxygenated blood from different organs to the heart. Pulmonary vein is an exception, because it carries oxygenated blood from the lungs to the heart. Capillaries: These are fine branches of arteries and veins.

ARTERIES	VEINS
Carries pure blood from heart to all other body parts	Carries impure blood from all other body parts to heart
Blood flows with great pressure	Blood flow is smooth
Have thick and elastic walls	Have thin and inelastic walls
Deep seated	Superficially located
Do not have valves	Have valves to prevent backflow of blood

HEART

The heart is a small muscular organ which is responsible for pumping the blood. The human heart has four chambers, viz. the right auricle, the right ventricle, the left auricle and the left ventricle. The upper chambers are called auricle or atrium. The lower chambers are called ventricle. The following flow chart shows the movement of blood through the heart (the blue colour shows deoxygenated blood and the red colour shows oxygenated blood):



Human Heart

From the body → Right Auricle → Right Ventricle → Pulmonary Artery → Lungs → Pulmonary Vein → Left Auricle → Left Ventricle → To the body

Do you know?

When we exercise the heart beat faster more than 150 times per minute.

Heart Beat

While pumping the blood, different chambers of the heart contract and relax in turns. The contraction and relaxation of different chambers produces a thumping sound. This sound can be heard as heart beat. One heart beat indicates one cycle of pumping action by all the four chambers. The heart of a normal human beats for 72 times in a minute. The heart pumps about 70 mL blood in one beat. This means that heart pumps a whopping 5 liter blood in a minute.

Pulse

A certain locations in the body, a pulse; similar to heart beat; can be felt. This happens because of blood rushing in with every heart beat. The pulse rate is same as the heart rate. Pulse can be felt near the wrist, neck, ankle, etc.

Stethoscope

This is a device which is used by doctors to listen to the heart beat and pulse. Stethoscope is composed of a long rubber tube, two ear pieces and a diaphragm.

EXCRETION

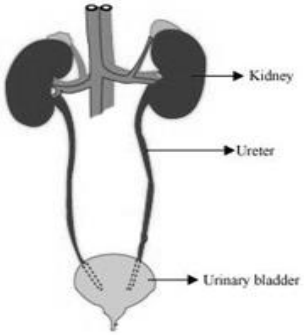
Various activities always go on inside the body of a living being. These activities are collectively called metabolism. Many harmful substances are created during metabolic activities. These substances can prove lethal if not removed from the body in time. Removal of waste from the body is called excretion.

Excretory System

The human excretory system is composed of a pair of kidneys, two tubes; called ureter and a urinary bladder.

Kidney

Kidneys are bean-shaped. They work like filters. Blood; laden with waste materials enters the kidney. The waste is filtered from the blood and the purified blood is sent to the normal circulation. The waste; along with water; is transferred to the urinary bladder through the ureters. The content of the ureter is called urine. Urine contains 95% water, 2.5% urea and 2.5% other wastes. Urine is expelled out from time to time. Type of waste and mode of excretion: Protein is made up of nitrogen. Metabolism of protein creates nitrogenous wastes in the body. The nitrogenous waste is the main waste in animals. The nitrogenous waste takes different forms in different animals. These are; ammonia, urea and uric acid. Based on the type of nitrogenous waste, animals can be divided into following categories:



Excretory system

Ammonotelic

Ammonia is the main nitrogenous waste in these animals. Lot of water is required for removal of ammonia. Ammonotelism is present in aquatic animals, e.g. fish, frogs, etc.

Ureotelism

Urea is the main nitrogenous waste in these animals. Less water is required for removal of urea. Ureotelism is present in mammals.

Note: Some of the wastes are removed along with sweat. Carbon dioxide is an important waste which is removed through the lungs.

Urecotelism

Uric acid is the main nitrogenous waste in these animals. Removal of uric acid requires negligible amount of water. Urecotelism is present in reptiles and aves.

TRANSPORTATION IN PLANTS

For transportation in plants, there are two main tissues, viz. xylem and phloem. These are composed of narrow tube-like structures. Xylem is responsible for transport of water, while phloem is responsible for transport of food.

Transport of Water

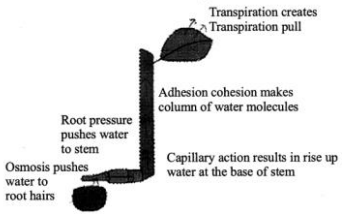
Plants take water from soil. Following are the main steps in transport of water in plants.

Do you know?

You make about 12000 gallons of urine during your lifetime which is enough to fill a swimming pool. That's a lot of trips to the bathroom.

In Roots

From soil, the water enters the root hairs because of osmosis. From root hairs water enters further because of root pressure.



Do you know?

Xylem is the woody material of a plant. When you cut down a tree and look at the tree trunks "rings" you can see the old xylem tissue. Every xylem ring depicts a year that a tree was alive.

In Stem

Various factors are at play during transportation of water through xylem in stems. The transport of water through xylem is also called 'Ascent of Sap'.

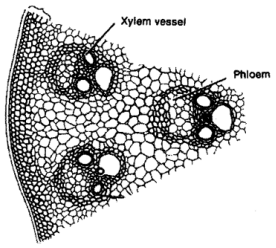
1. Root pressure is responsible for the rise of water to some height.
2. Capillary action pushes the water further up. The rise of liquid in a very narrow tube is called capillary action. Capillary action happens because of very small diameter of the tube.
3. Adhesion Cohesion: Water molecules stick to each other and make a continuous column inside the xylem tubes.
4. Transpiration pull: There are numerous small pores on the surface of leaves. These pores are called stomata. Water vapour is continuously removed through stomata during daytime. Removal of water vapour in plants is called transpiration. This creates a pull in the underlying xylem tissues. The pull is called transpiration pull. Transpiration pull creates a suction effect on the water column inside the xylem.

Do you know?

Xylem is the woody material of a plant when you cut down a tree and look at the tree trunks

Xylem

Xylem vessels are dead hollow tubes. The cell pathways are made from a substance called lignin which makes them waterproof. It also means that the vessels are very strong and stops them from collapsing under high pressure.

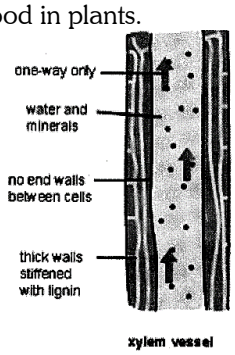


Xylem vessels also contain bordered pits. This allows water to move into them from the roots. The opening, or lumen, is very wide so that a lot of water can travel through it at once. Xylem vessels are like a long drain pipe. They are made from dead hollow cells, joined end to end without any end wall between them, forming long open tubes.

- Xylem vessels run from the roots of a plant, right up through the stem and spread out in every leaf.
- They carry water and minerals from the roots, up to the leaves

Transport of Food

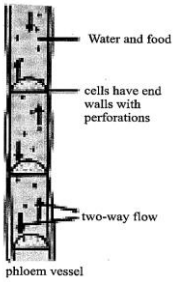
Food is prepared in leaves and needs to be transported to different plant parts for use and for storage. The transport of food takes place through phloem. Some biological force is used in transport of food in plants.



Phloem

There are four types of phloem cells in flowering plants all of which are living, unlike xylem cells. They can be found next to xylem in leaves. Phloem carries substances around the plant in a process called translocation.

These are made from living cells, joined end to end, with punctured end- plates so that materials can flow through. Phloem tubes carry food material in all the directions. This means, food prepared in leaves is carried to all parts of plant, including roots, by phloem tubes. Food is stored in different plant parts, such as carrot, radish potato, fruits. These are translocated through phloem tissue.



KEY WORDS

1. Diffusion ~ Movement of particles from a region of higher concentration to the region of lower concentration.
2. Hemoglobin - red pigment of the blood.
3. Xylem - connective tissue in plants that carry water and minerals up the stem.
4. Phloem - Connective tissue that carries prepared food to all parts of the plant body.
5. Auricle - Chamber of the heart with thin walls and pumps blood within the heart
6. Ventricle - Chamber of the heart with thick walls that pump blood away from the heart.

CONCEPT MAP