UNIT - V

TRANSPORTATION AND CIRCULATION

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Dear pupil:

You may remember that in the previous Unit, you studied about different ways of nutrition in plants and animals. You know that for all Organisms whether autotrophs or heterotrophs, food forms the main source of energy for performing various life activities. But, the Question is, how do living organisms get energy from the food? To understand this you may have to recall what you have studied about respiration in your seventh standard. You have studied that during respiration, the digested food is 'burnt' with the help of oxygen taken in during breathing. The energy released during 'burning' is utilized for various life activities. Like food and oxygen, living organisms require many other substances for performing various life activities and to exist on this world. Not only this, they also have to throw away the metabolic wastes such as carbon-di-oxide (produced during respiration), ammonia, urea etc., from the body. Otherwise, the collection or accumulation of these wastes products will not only cause many diseases, but sometimes may lead to death of the organism. Take your own body as an example. You know that your body is composed of millions and millions of cells.

Every cell of your body should get food, oxygen and other substances which are needed for carrying out various physiological activities. And also, the metabolic wastes produced in the cells are to be removed from the body. Otherwise, these cells will simply perish due to starvation, and toxic nature of the waste products. Think for a moment as to how the food that is digested in the alimentary canal reaches the cells present at the tip of your finger, nose,or toe, and how the metabolic wastes from these cells are removed? What is the mechanism that operates in your body to supply each and every cell with food, oxygen etc., and remove waste products from them? Is it not interesting to know about such a mechanism?

This Unit provides answers to such Questions. In the first two parts of the Unit, you will study the mechanism of supplying food to each and every cell, and also the removal of waste products. At the end of these parts or sections, you will be in a position to answer questions such as:

-- How food, oxygen and other substances needed for performing life activities are transported to each and every cell in animals?

-- How waste products such as Carbon-di-oxide, ammonia, etc., are removed from the body of animals?

-- What are the different organs and tissues that take part in such a mechanism?

Think of the other Kingdom of living organisms,namely, plants. In plants also, water and mineral salts from the soil have to reach cells present at the tip of the leaves, stems etc. And in the same way, the manufactured food from the green parts have to reach cells present at the tip of roots, stem etc. You might have seen trees growing upto a height of 50 to 60 feet. Surely, you will be surprised to hear that there are trees 250-300 feet tall. How water, mineral salts, or food is transported in such plants?

Through the third Section of this Unit you will find answers to such Questions as:

-- How water and mineral salts are transported from soil to different parts of the plants?

-- How the manufactured food from green leaves is transported to non-green parts of the plant.

The learning material in the three parts of this a Unit are presented in different ways. How to study the material under each part has been explained at the beginning of each part.

P A R T - I

TRANSPORTATION AND CIRCULATION

Dear pupil:

As mentioned earlier, this part deals with the mechanism of transportation of food and other substances in animals. In this part, you would be learning the Concepts through projections and teacher's explanation. This way of learning is not new to you. You may recall how you learnt the topics of "Cell and Its Organelles" and "the Process of Digestion in Animals". You may remember, while learning these topics, you answered some questions in the work-booklet after a few projections and teacher's explanations* were over. In the same way, here also, you will answer a few questions after learning each Concept. These questions are provided mainly to make you understand the Concept better.

Hope you will enjoy this experience.

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*Transparencies have been presented at the end of "Teacher's Explanation" (Please refer after page no.324).

1. Look at the Diagram. It is the diagram of an amoeba with which you are all familiar.

You know that it is a single celled organism. In the previous unit, you have studied how this organism ingests, digests and absorbs solid food. You may recall the process of digestion in amoeba. You know that the process of digestion is intra-cellular.

In other words, the digestion of food takes place inside the cell.

2. Think now, how this digested food reaches all parts of amoeba.

To understand this, you may recall what you have learnt about molecular motion in your Chemistry classes this year. Suppose you keep little potassium permanganate crystals in a beaker containing water and allow it to stand for some time, what will happen?

Surely, from your knowledge of molecular motion, you would say that the particles of potassium permanganate will start spreading to other parts of water in the beaker. What reason can you think of for this spreading of particles? You may say that it is because of molecular motion.

3. You are right. The point where potassium permanganate crystals are dissolving is higher in concentration when compared to the rest of the regions of water in the beaker.

It is because of this difference in concentration, molecules of potassium permanganate start moving from the regions of lower concentration. This movement of molecules from a region of higher concentration to a region of lower concentration is called as diffusion (you will study more about this process in your Chemistry class this year in the Unit 'water').

4. Let us apply our knowledge about molecular motion to understand the process of distribution of food in amoeba.

You know that during digestion, food is broken into simpler substances such as sugar, amino acids, etc. These substances start dissolving in the cytoplasm. Hence, the point where the food is digested in the cytoplasm becomes higher in concentration than the rest. Owing to this difference in the concentration, the molecules of food start moving from the region of higher concentration to the region of lower concentration.

In other words, we can say that food diffuses from the point where it is digested to the rest of the parts of amoeba.

5. For a moment you think of the places where amoeba lives.

   You know that it lives in ponds, pools, etc. From the Diagram, you can easily make out that the complete body of amoeba is in direct contact with the outside pond water, which forms the environment for it.

6. Think, from where does amoeba get Oxygen for respiration.

   You know that the water that surrounds amoeba, is composed of hydrogen and oxygen. The outside pond water is rich in oxygen when compared to the Cytoplasm of amoeba. In other words, you can say that there is a difference in concentration in oxygen between the cytoplasm of amoeba and the outside pond water. Because of this difference in concentration, oxygen from the outside pond water (region of higher concentration) diffuses into the cytoplasm of amoeba (region of lower concentration).

7. The oxygen thus diffused into the cytoplasm of amoeba is utilized for burning of digested food.

   You know very well that during respiration, carbon-di-oxide is produced which increases the concentration of CO_2 in the Cytoplasm. This leads to difference in the concentration of CO_2 present in

Cytoplasm and outside pond water. Owing to this difference in concentration, CO_2 diffuses out into the pond water from the Cytoplasm of amoeba. Thus, the waste product viz., CO2 is thrown out. In the same way, the waste product, ammonia is also thrown out.

8. As in amoeba, in paramaecium also the digested food and oxygen are transported to different parts through the process of diffusion. The waste products such as CO_2, ammonia etc., produced during metabolic activities are thrown outside through the same process of molecular motion, that is, diffusion.

9. We shall take the example of another organism, namely, hydra.

You know that it is a multicellular organism and can be easily seen by the naked eye. What you see in the diagram is the longitudinal section of hydra. From the diagram you can make out that very little of the body is occupied by cells. Most of the interior of hydra is occupied by the gastro-vascular cavity.

Further, the surrounding body wall is composed of only two layers of cells. Therefore, every cell of hydra, as you can see from the diagram, is adjacent either to the outside pond water or to the water in the gastro-vascular cavity.

10. By looking into the diagram, you will get an idea as to how the digested food in hydra is transported to all parts.

The digested food from the gastro-vascular cavity diffuses first into outer layer of cells. Occasionally, the diffusion of food takes place sideways, that is, to the adjacent cells also. The arrows in the diagram will enable you to understand the process of diffusion of food in hydra.

For a moment think as to why there is no complex transportation system for distributing food in hydra, even though it is multicellular in nature.

11. You may say that since the cells of hydra are arranged in only two layers and are adjacent to each other, the distance to be travelled by the food is very small. Hence, there is no development of complex transportation system in hydra for transporting food.

12. As in the case of amoeba and paramaecium, in hydra also the surrounding pond water forms the environment.

Further, in hydra, the inner layer of cells are in contact with the water in the gastro-vascular cavity. Since each and every cell of hydra is in contact with either outside pond water, or water in the gastro-vascular cavity, exchange of gases takes place through diffusion.

13. In the diagram is shown a portion of the body wall of hydra cut open.

> You can see in the diagram, the process of diffusion of oxygen from the pond water and the diffusion of water in the gastro-vascular cavity into the cells. In the same way, the metabolic wastes such as carbon-di-oxide and ammonia diffuses out into the surrounding pond water or to the water in the gastro-vascular cavity.

14. Summarising what we have studied about hydra, we can say that since each and every cell of hydra is adjacent to each other, and is in direct contact with the outside environment (pond water) or inside environment (water in the gastro-vascular cavity), there is no development of complex transportation system for the transport of food and other substances.

15. So far we have studied about the mechanism of transportation of food and other substances in animals like amoeba, paramaecium and hydra.

> These organisms and other lower organisms can depend upon this way of transportation because; 1. they are smaller in size; and 2. the entire cell (as in amoeba) or cells of the organism are adjacent to each other (as in hydra) and are exposed to the environment. But, as we go higher and higher in the ladder of evolution,

the organisms become more and more complex. For example, earthworms are more complex than hydra and amoeba. Cockroaches have still more complex body. Human beings are the highly evolved and complex animals. They are complex because; 1. They are bigger in size; and 2. cells in these organisms are situated deeply in the body, having no direct contact with the outside environment or the digestive tract. Diffusion being a very slow process (as you wi all know from the potassium permanganate and water experiment), if food and other substances are to reach each and every cell through the process of diffusion, it will take months for some of the molecules of food to reach the cells situated deeply in the body.

Hence, higher animals cannot depend upon diffusion alone for the quick transportation of food and other substances. They have developed their own mechanism for this purpose.

16. Let us now take examples of higher animals and try to understand the mechanism of transportation in them.

First, we shall consider the case of earthworms. What you see in the diagram is the transverse section of earthworm. In the diagram, you can make out that some of the cells are deeply situated in the body, and are neither in contact with the digestive

cavity nor with the outside environment. Imagine as to how much time it may require for the food from the digestive tract to reach every cell by the process of diffusion. But, cells cannot wait for such a long time. The food has to be transported to these cells in a much faster way. This quick transportation of food and other substances is done by the circulatory system.

17. Let us see further what this system consists of, and how it performs the functions?

The diagram 17 will give an idea about the circulatory system of earthworm. Observe the diagram carefully. You will find that it consists of heart, blood vessels, and blood. You can also see in the diagram innumerable branches of blood vessels in each segment. These small branches, branch again and again to form small one capillaries which reach every part of the organism. The digested food and oxygen are picked up by the blood, and are supplied to every cell. The metabolic wastes viz., CO_2 and NH_3 diffuse back from the cell to the blood which takes them to the excretory organ from where it is thrown out of the body.

18. From the Diagram 18, you will get a better picture of circulation of blood in earthworms.

The vessel above the alimentary canal collects blood from different parts e.g., alimentary

canal, skin etc. and is pumpted to the ventral vessel through he arts. The ventral vessel supplies the blood (containing digested food) to all parts of the body. In the course of its supply, blood passes through extretary organs where waste products such as carbon-di-oxide and ammonia are removed.

19. Think as to whether blood is left free in the body cavity or enclosed in the blood vessels throughout its course?

Definitely you would say that blood in earth-worms is always enclosed in blood vessels. You are right. Since blood is always enclosed in the blood vessels, this type of circulation is called as closed circulatory system.

20. At this point, you may get a doubt, that is, can blood be left free in the body of an organism? You will get an answer to this shortly.

This is the diagram (20) of an insect namely Cockroach, with which you are all familiar. Like earthworm, Cockroach is also a complex organism, and some of the cells are situated deeply in the body. Hence, there is the development of complex transportation system. As in the case of earthworm, in Cockroach also blood does the function of transportation of food. Blood absorbs the digested food from the alimentary canal and supplies it to other parts of the body.

21. Look at the diagram (21). It is the diagram showing only heart of Cockroach.

You can make out from the diagram that it is a long and tubular organ sisuated in the centre. Observe the heart of Cockroach in the diagram closely. You will find that it is open in the head region, but is closed behind. In the heart, always, the blood (which is colourless) is pumped forwards towards the head region.

22. Since the heart is open at the head region, think as to what may happen to blood when it is pumped to head region?

Since the heart is open at the head region, blood comes out of the heart into the body cavity. In the body cavity (as you can make out in the diagram), blood absorbs digested food and other substances directly from the alimentary canal and supplies it to all other parts of the body.

After this supply, blood again enters the heart through small pores situated on it and is circulated once again. About the supply of oxygen and removal of waste products, you will study in the Unit Respiration, this year.

23. What you see in the Diagram (23) is the cross-sectional view of Cockroach.

From the diagram, you will get a better picture as to how blood in cockroach is left free in the body space. The arrows indicate the course of blood. If you trace the arrows, you will find that blood is not enclosed in the blood vessels, and it is left free in the body space.

24. Compare the type of circulation seen in Cockroach with that of earthworm.

In earth worm, blood is always enclosed in the blood vessels, whereas in Cockroach it is left free in the body space. This type of circulation of blood is called as open type of circulation. It is open because blood is left free in the body space, and is not enclosed in the blood vessels.

25. Let us summarise what we have studied about transportation of food in earthworm and cockroach.

1. In both earthworm and cockroach, transportation of food from the digestive tract to other parts of body takes place through the circulation of blood.
2. In earthworms, the type of Circulation of blood is of 'closed type', since blood is enclosed, always in the blood vessels.
3. In Cockroach, the type of circulation of blood is'open type', since blood is left free in the body space without being enclosed in the blood vessels.

26. Now let us take our own example, namely, that of human beings, and try to understand how food and other substances are transported to different parts of the body. In the case of human beings also there is the development of circulatory system for performing this function.

Till the year 1628, people were not knowing that there is a system like circulatory system in our body. It was in the year 1628, an English doctor, named William Harvey discovered that blood flows in the tubes present in our body, and is pumped to different organs by the heart. He noted that blood leaves the heart through some vessels and returns to heart through some other vessels. He named these vessels as arteries and veins. But, he did not know how arteries are connected to the veins. Malpighi, an Italian scientist, observed this a few years later with the help of a microscope. Like William Harvey and Malpighi, many more scientists worked to find out how blood flows in our body. It is because of their work, today, we know that the arteries branch into arterioles and still smaller vessels called capillaries. The capillaries are richly distributed in our body. It is because of this extensive distribution, a cut anywhere on the body makes the blood to come out. The diameter of a capillary is so small that blood cells must move slowly and in a single file.

Due to this slow movement of blood cells, the blood can effectively do its job of transporting or delivering the load of nutrients and oxygen

to the cells, and of removing waste products from them.

27. All organs related to the circulation of blood in our body together constitute the system, viz., the circulatory system. Let us try to understand more about this system.

The diagram makes you recall the different organs and tissues of human circulatory system. You know that circulatory system of human beings consists of heart, blood vessels and blood. You have studied that blood vessels are of two types, viz., arteries and veins. Arteries carry pure blood from the heart to different parts of the body, and veins collect impure blood from these parts and brings it back to heart. Thus, blood remains enclosed within the blood vessels throughout its course. What type of circulatory system is this? Is it open or closed? Surely, you would say that it is closed circulatory system.

28. This is the diagram of the longitudinal section of the human heart showing the path of blood. It will enable you to recall what you have studied about human heart in your 7th standard. You know that it has 4 chambers, namely, right auricle, right ventricle, left auricle and left ventricle.

The impure blood (deoxygenated) from upper and lower parts of the body enters the right auricle through superior and inferior venacava.

From the right auricle, blood flows into the right ventricle. The impure blood from right ventricle is pumped to lungs for oxygenation. During oxygenation, oxygen is taken up by the blood and carbondioxide is thrown out. (You will study more about this process of oxygenation of blood in your next unit namely "Respiration and energy formation"). The oxygenated blood from the lungs returns to left auricle, from there to the left ventricle. From the left ventricle, the oxygenated blood is pumped to all parts of the body through aorta and other vessels.

29. At this point, you may recall what you have studied about the process of absorption of food from small intestine in your earlier Unit.

The blood vessels present in the villi of the small intestine absorb the digested food from the small intestine and is taken first to the liver, where some of the food is stored. Later, it is taken to the heart, from where it is pumped along with blood to all parts of the body. (You will study more about this process of absorption of food in the second part of this Unit). Thus the digested food and oxygen are supplied to different parts of the human body.

30. For a moment, recall the course of blood in the heart. Think as to how many times it enters the heart, and how many times it leaves the heart.

First the impure blood enters the heart and leaves the heart to lungs for purification. In the second phase the purified blood from lungs enters the heart and leaves it again to supply all parts of the body. To put it in short form, blood enters and leaves the heart twice. Since, in human beings, blood enters the heart twice and leaves the heart twice, the type of circulation is called as'double circulation'.

31. Friends, so far, we have tried to understand the mechanism of transportation of food and other substances in lower as well as higher animals. We studied that in lower organisms, this takes place through diffusion and in higher animals like earthworm, cockroach, human beings etc., through the circulation of blood. Like earthworm, cockroach and human beings, in all higher animals, transportation of food and other substances takes place with the help of blood. Blood forms the main transportation service and supplies every part of the organism with food and other substances.

32. But, the question is how exactly the cells get nutrients from Blood? To understand this, we shall consider the same example of human beings:

You are familiar with the two types of blood vessels seen in the body of human beings, viz., ~~They are~~ arteries and veins. These vessels further branch into very small branches which reach almost every part of our body. So to say,

they reach the neighbourhood of almost every cell. The blood flowing in these capillaries is separated from the cells by capillary walls and also by small spaces. These small spaces are filled with a fluid known as lymph. You may think as to what this lymph is?

33. Lymph is that part of the blood which oozes out from the capillary walls to the space between capillary and cells. It is rich in digested food and oxygen. This fluid lymph bathes the cells. The cells that are thus bathed in lymph, absorb digested food and oxygen from the lymph and give out their metabolic wastes into it. This lymph, containing metabolic wastes, returns back to heart through veins.

34. By now, you might be clear about the transportation of food and other substances in lower as well as higher animals. Let us summarise what we have studied in this Section.

S U M M A R Y

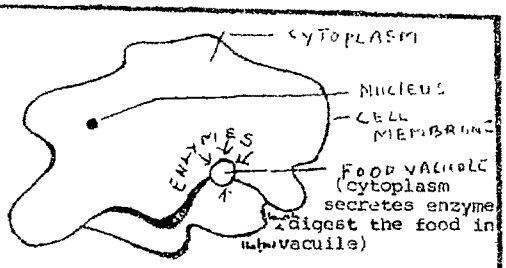
You remember that our main Question was how food, oxygen and other substances are transported to different parts in animals, and how waste-products are removed from them. To understand this, we took examples of amoeba, paramecium etc., which are lower organisms and noticed that transportation of food and other substances in these animals takes

place through diffusion. Later, we considered the examples of earthworm, Cockroach etc., and found that there is the development of a 'Circulatory System' in these animals which does the function of transportation of food and other substances.

Let us summarise what we have studied about transportation of food and other substances in human beings.

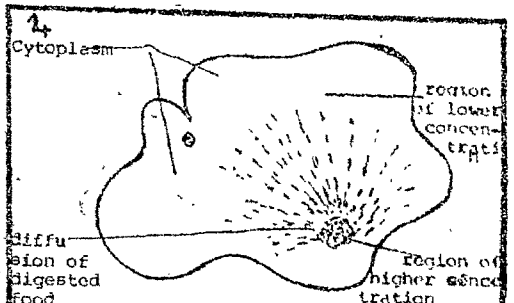
We studied that transportation of food and oxygen is done through the circulation of blood. The circulatory system consists of heart, blood vessels and blood. And, the nature of circulatory system is of closed type since blood remains enclosed in the blood vessels throughout its course. Further, we studied that circulation in human beings is of 'double circulation' in nature since blood enters the heart twice and leaves it twice.

1



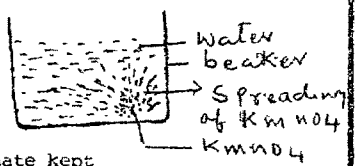
The process of digestion in amoeba is intra cellular in nature.

4



Transportation of food in amoeba takes place through diffusion

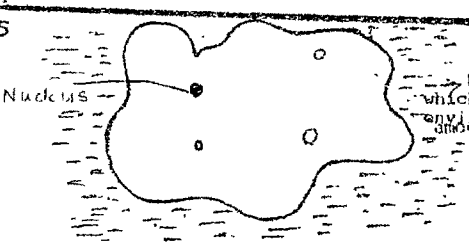
2



Potassium permanganate kept in a beaker containing water starts spreading because of the molecular motion.

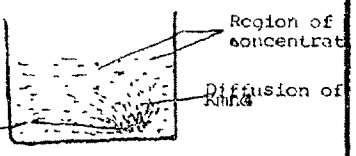
..... 5

5



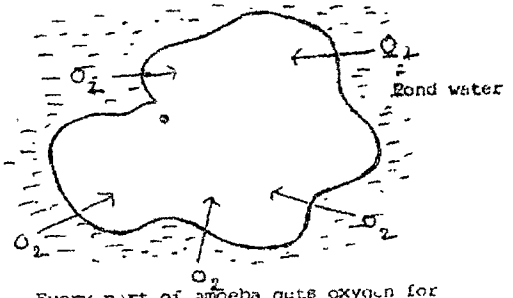
Every part of amoeba isin direct contact with the outside pond water, or the environment.

3



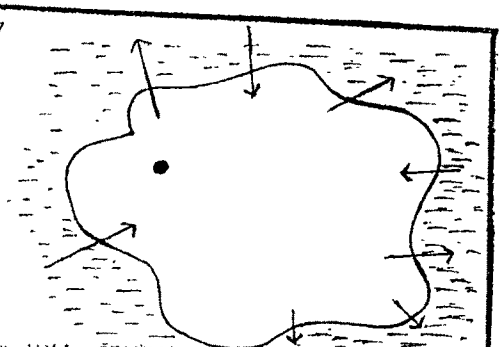
The movent of molecules from a region of higher concentration to a region of lower concentration.

6



Every part of amoeba gets oxygen for respiration from its environment through the process of diffusion. .....

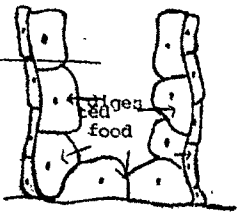
7



The waste products such as Co_2 and NH_3 are thrown out through the process of diffusion.

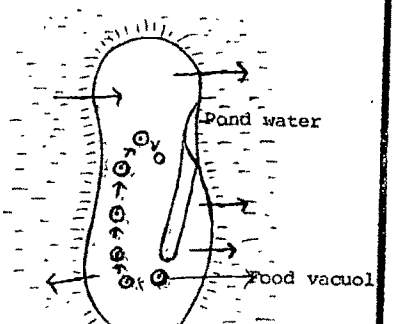
8

10



In Hydra , transportation of food takesplace through the process of diffusion.

8

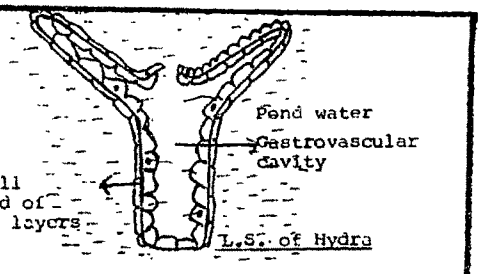


Distribution of digested food &exchange of ... takes place through of DIFFUSION.

11

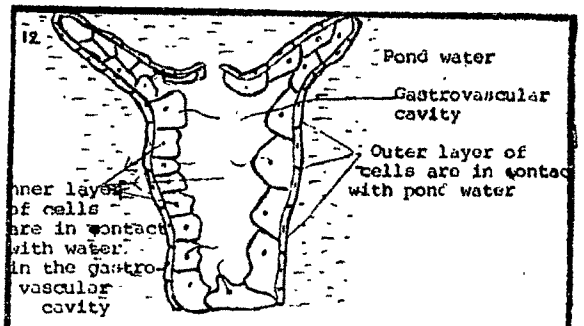
There is no development of complex transportation system in hydra. Transportation of food takes place through diffusion.

9



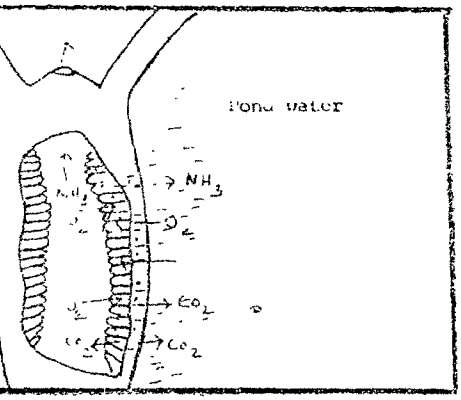
...ry cell of Hydra is exposed to the environment (either to the external environment or internal environment)

12



Every cell of Hydra is in contact with outside pond water or water in the gastrovascular cavity. Hence, exchange of gases takes place through the ... diffusion

15



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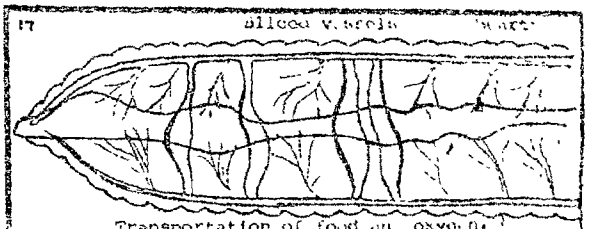
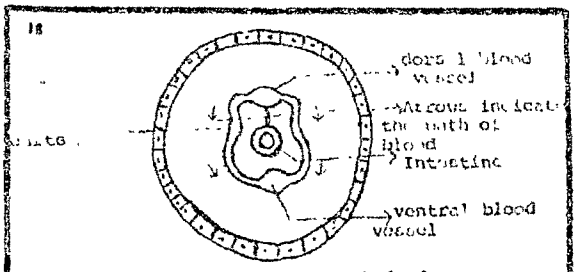


Transportation of food an oxygen removal of waste product such as CO_2 & NH_3 in earthworm is done through the circulation of blood.

14

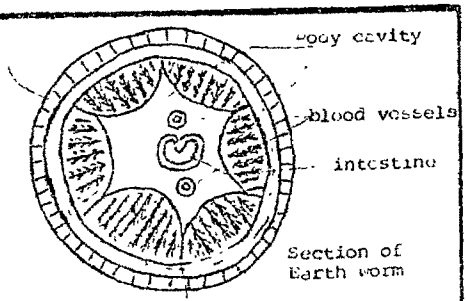
1. Each and every cell of hydra is in direct contact with the environment and are adjacent to each other.
2. Hence, there is no development of complex transportion system. Transportation is done through the process of diffusion alone.

18



Blood in earthworm is not left free in the body cavity.

16

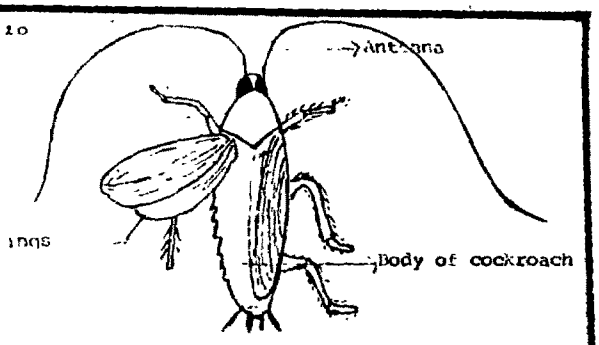


Cells are situated deeply in the body and are neither in contact with the digestive tract nor the external environment.

19

Closed type of circulatory system, wherein, blood remains always enclosed in the blood vessels.

20



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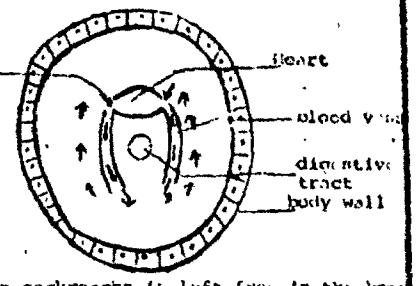
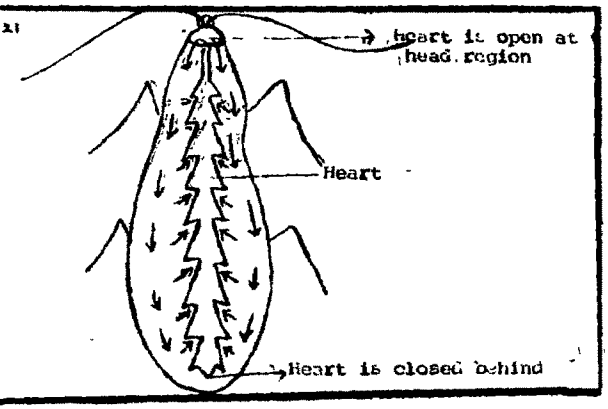


Blood in cockroachs is left free in the body space.

21



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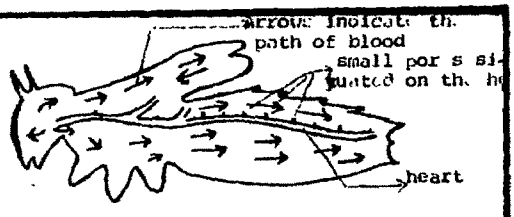
Open type of circulatory system is a type of circulatory system, wherein, blood is left free in the body space without being enclosed in blood vessels.

22

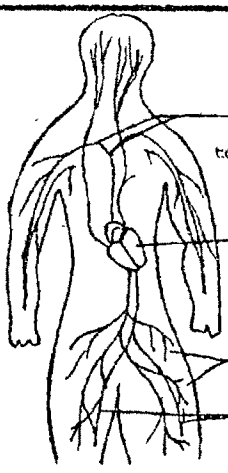


Transportation of food and other substances in cockroach is done by the circulation of blood.

25

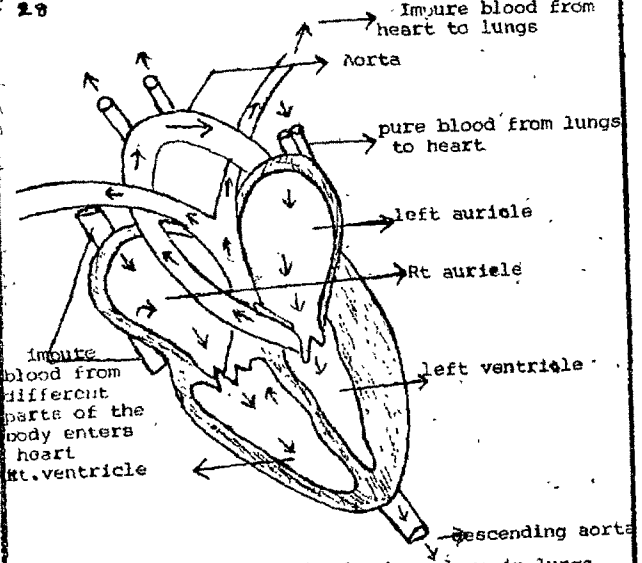
1. In both earthworm and cockroach transportation of food is done by circulation of blood.
2. Earthworm has a closed type of circulatory system.
3. Cockroach has an open type of circulatory system.

27



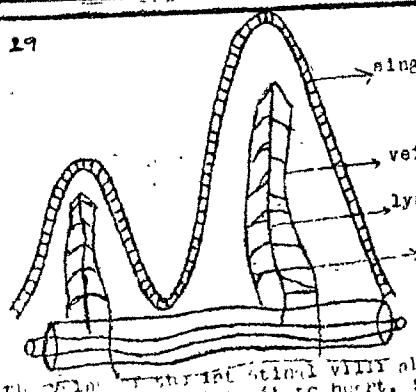
Human circulatory system consists of heart, blood vessels and blood.

28



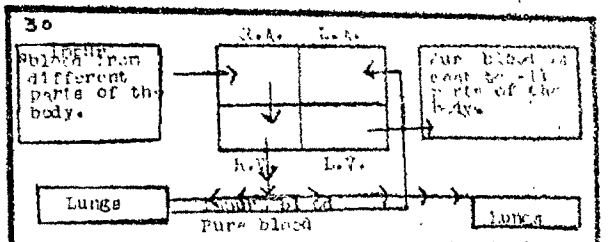
Oxygenation of impure blood takes place in lungs. During oxygenation, Co_2 of blood is given out and O_2 of air is taken in.

29



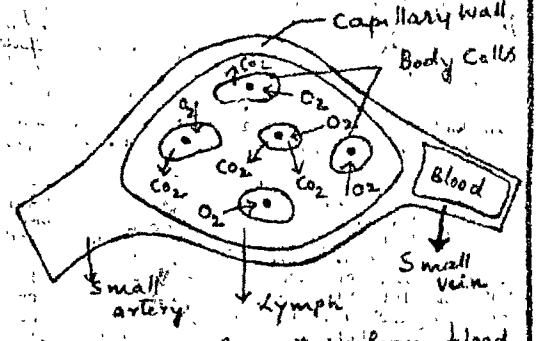
The villi of small intestine absorb the digested food & take it to heart, from where it goes to all parts of the body.

30



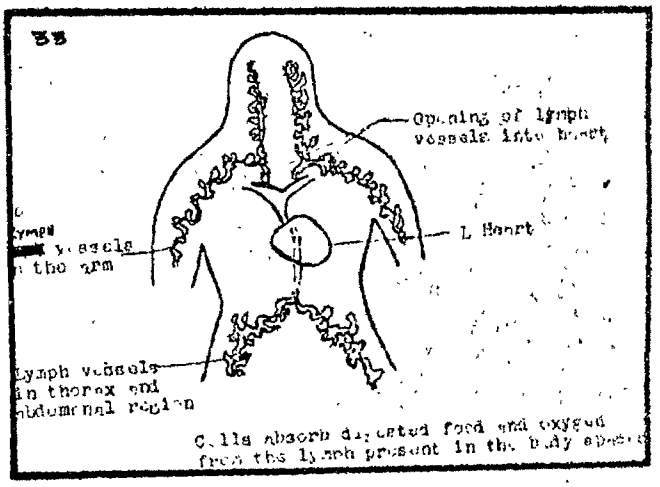
Double circulation is a type of circulation wherein blood enters and leaves the heart twice

32



Body cells are separated from blood by not only capillary walls, but also by lymph.

33



Cells absorb digested food and oxygen from the lymph present in the body

Work Booklet
Unit-V (Part-I)

1. The transportation of food and other substances in amoeba and paramaecium is done by the process of_____

2. Diffusion is a process in which molecules move from a region of_____ concentration to a region of _____ concentration.

3. Reason out as to why organisms such as amoeba,hydra and paramaecium can depend on diffusion alone for transportation of food and other substances,eventhough it is a very slow process?

4. Give reasons as to why there is development of complex circulatory system in earthworm and cockroach.

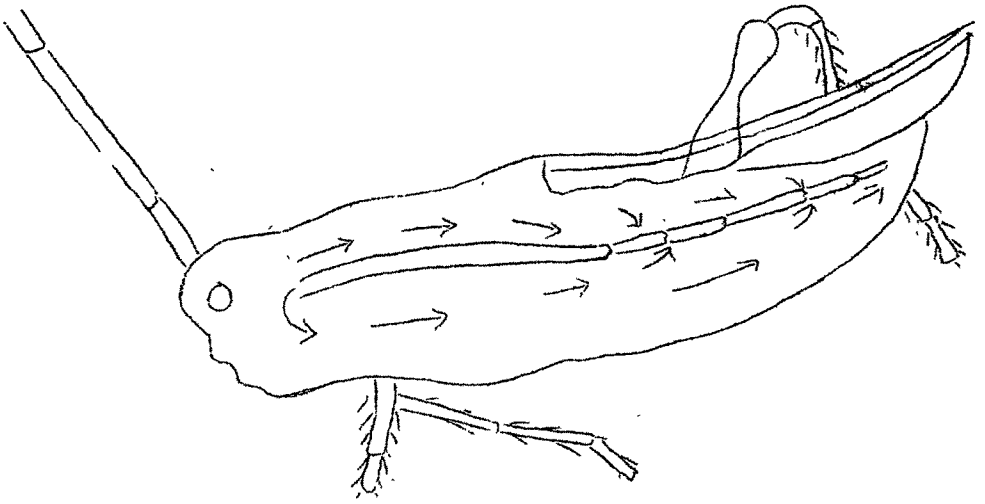
5. What is the difference between closed type of circulatory system and open type of circulatory system.

6. Can human beings depend on diffusion alone for the transpo_ rtation of food and other substances? - Yes/No.Give reasons

7. Name the different parts of human circulatory system.

8. What do you understand by double circulation?

9. What is lymph and what is its role in our body?

10. 

What you see in the diagram is the picture of a grasshopper with its heart exposed. Reason out as to whether the circulatory system is of closed type or open type?

PART - II

BLOOD AND ITS COMPOSITION

Dear pupil:

In part one of this unit you studied about the mechanism of transportation of food and other substances in lower as well as higher animals. You know that blood does this function of transportation in all higher animals. Having learnt this Concept, you might be interested in knowing the composition of blood and the different functions it performs in our body. In this part, you will be studying:

--- the nature of blood i.e., the Composition, colour, etc., and

--- the different functions performed by the blood.

You would be learning these concepts on your own. The learning material is prepared in such a way that you will be requiring very little help from your teacher. The information in this material is presented in small paragraphs, so that, you will easily understand it. As you read through the material, you will find at certain places some questions to answer and activities to perform at home. These questions and the activities to be carried out at home will enable you to understand the topic better. After answering the questions

you can check your answers with the correct answers given soon after the questions. Further, you can take note of the doubts that you get while going through the material, and discuss them with your teacher.

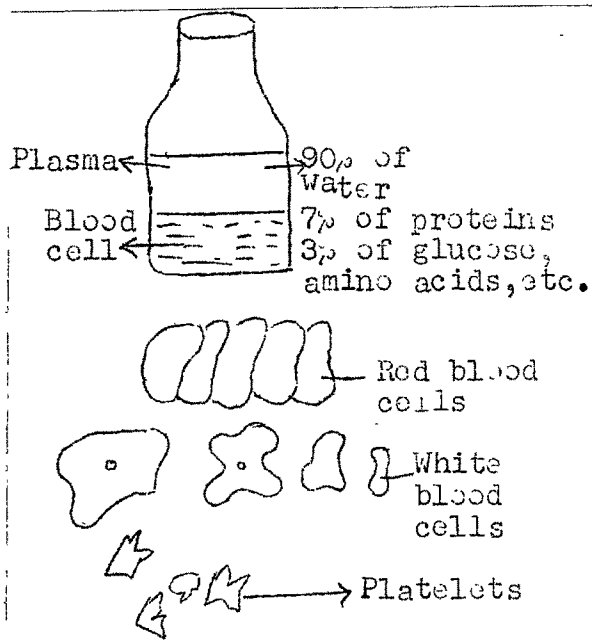
Hope this would be another enjoyable experience to you.

Nature of Blood:

All of you might have had small cuts on your fingers at one time or another. You might have noticed blood ~~ozzi~~ oozing out from the cut portion. You might have seen it coming out in the form of a red fluid. It is a liquid tissue present in our body. Suppose, you draw out 100 milli litres of blood from the cut portion and try to find out what it is composed of, you will find that about 45% of the volume is composed of cells. The remaining 55% is composed of a fluid called plasma. You might be curious to know what this plasma is composed of.

The plasma of blood is composed of 80% of water, 7% of proteins and 3% of other substances such as glucose, amino acids etc. In the plasma are suspended the blood cells.

About blood cells, you are already familiar with two types, namely, red blood cells or red blood corpuscles and white blood cells or white blood corpuscles. In addition to these two types, there is one more type known as platelets. Red blood cells out number the white blood cells by 500 to 1. It means, for every one white cell, there are 500 red blood cells. If you take one cubic millimeter of blood and count the number of red blood cells, white blood cells and platelets, you will find approximately 5 million red blood cells, 9000 white blood cells and 250,000 of platelets. You may think as to why blood contains such a large number of these cells. Definitely, you will be surprised to know that each of the blood cells have unique functions to perform. You will understand the functions performed by each type of blood cells as you go through the material.



About 55% of our blood is composed of plasma; the rest 45% is composed of blood cells. The blood cells are of three types, viz., 1. R.B.C., 2. W.B.C., and 3. Platelets.

Colour of the Blood:

Every one of us will think that blood will be always red in colour. But, this is not the case in all animals.

You may recall the colour of the blood of Cockroach. It is colourless. In the same way, in other insects like grasshopper, mosquitoes etc., blood is colourless. Have you heard of animals having bluish blood? Probably not. In animals like Oyster etc., blood is bluish in colour. If we take the example of frog, human beings, monkey, etc., (vertebrates, or animals having back-bone) you will find that the blood of these animals is red in colour. You might be thinking as to why is this difference in the colour of blood? It is because of the pigment present in them.

You may recall what you have studied in your seventh standard about the pigments present in the blood. You have studied about two types of pigments; 1. Haemoglobin, 2. Haemocyanin. Red colour of the blood is due to the pigment haemoglobin. In colourless and bluish blood, haemocyanin is present. But the question is, what is the difference between these two pigments?

Haemoglobin is an iron containing pigment, whereas haemocyanin is a copper containing pigment. But, as far as their functions are concerned, they are similar; both help in the transport of oxygen to different parts of the body. Haemoglobin has a very high attraction for oxygen and is present in red blood cells of vertebrates.

For a moment, think as to what may happen to a person if haemoglobin is very less in his blood. You may say that transportation of oxygen will be affected. Right. The body cells of such a person will not get sufficient oxygen. You can imagine as to what may happen to cells if they do not get sufficient oxygen. Food in the cells will not be burnt and hence energy will not be produced. It is because of this, the person becomes tired easily and will become short of breath readily. This condition of a person is called as ~~the~~ Anemia.

Let us summarise what we have studied so far:

S U M M A R Y

1. Blood is a liquid tissue present in the bodies of almost all animals, except lower organisms like amoeba, paramaecium etc.
2. It is composed of plasma and blood cells.
3. There are two types of blood pigments, namely, haemoglobin and haemocyanin.
4. Haemoglobin is an iron containing pigment, whereas Haemocyanin is a copper containing pigment. Both help in the transport of oxygen.
5. Less of haemoglobin in blood leads to a condition known as Anemia.

Before you proceed to the functions of blood, you may like to make sure of what you have studied so far. To do so, you may answer the following questions.

Questions:

1. Name the three types of blood cells present in our blood.
2. Why is human blood red in colour?
3. Name the two types of blood pigments you have studied.
4. What is the main property of haemoglobin?
5. What will happen to a person if the number of red blood cells in his blood decreases?

Answers:

1. The three types of blood cells present in our blood are: 1. red blood cells, 2. white blood cells and 3. platelets.
2. Human blood is red in colour because it contains a pigment known as haemoglobin.
3. The two types of blood pigments are: (a) Haemoglobin and (b) Haemocyanin.
4. Haemoglobin has high affinity for oxygen. Because of this reason, it helps in the transportation of oxygen.
5. You know that R.B.Cs. contain haemoglobin. If the number of red blood cells decreases, naturally, haemoglobin content of the blood also decreases. This leads to a condition known as anemia.

Activities to perform:

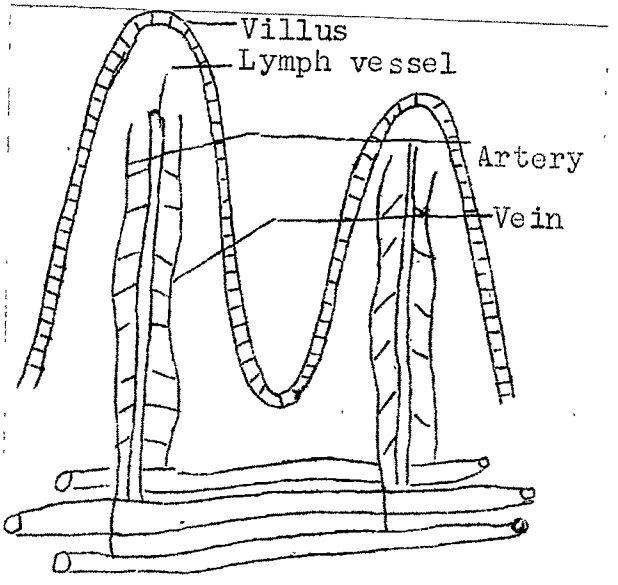
1. Try to catch hold of some insects and find out the colour of their blood. Basing your observation on the colour of the blood, hypothesise the type of pigment present in blood.

2. Go to a nearby hospital and find out as to how they preserve human blood in their blood banks. It will be a good essay for you to present before your friends in the Class.

Now you may proceed further to understand the functions of blood:

1. Transportation of Food:

You may recall what you have studied about the absorption of digested food in the small intestine, in your earlier unit. You know that the digested food is absorbed by the intestinal villi present in the small intestine. What you see in the diagram is the enlarged view of a villi. These villi are the small projections of the intestinal wall. From the diagram you can make out that there are three types of vessels

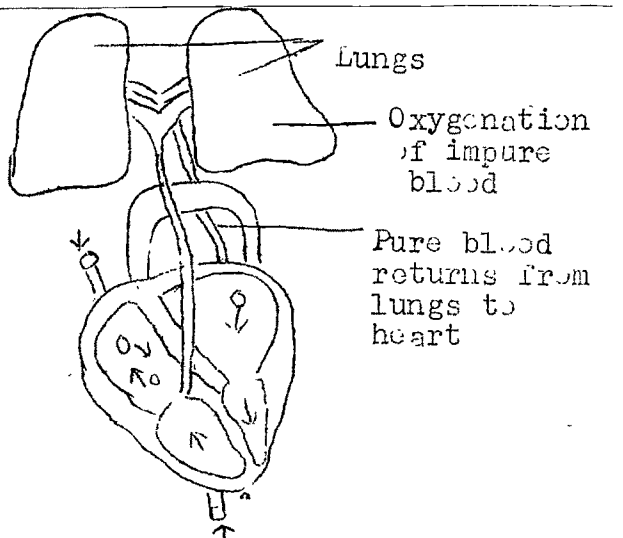


Veins of the villi absorb the digested food from the small intestine and distribute it to all parts of the body during circulation.

in each villus (villus is singular and villi is plural). The three types of vessels are: 1. artery, 2, vein, and 3. lymph vessel. The digested food from the intestine is absorbed by the blood in the veins of the villi and is carried first to liver and then to heart. From the heart, blood is pumped to all other parts of the body, where the digested food contained in the blood is utilized.

2. Transport of Oxygen:

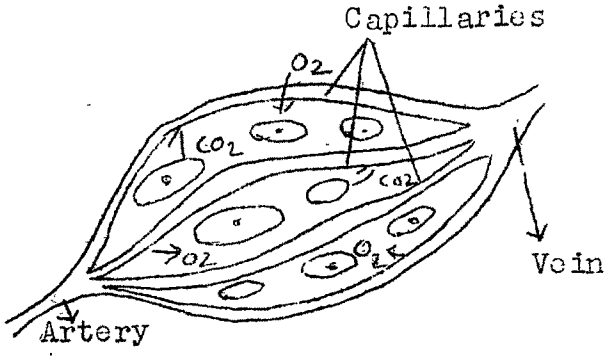
You are already fimiliar with this function of blood. You know that the pigment haemoglobin is mainly responsible for the transportation of oxygen. You may recall the nature of circulation in human beings. The diagram will help you in recalling this process. As you know, first, the impure blood received from all parts of the body is pumped to lungs by the right ventricles. In the lungs, the impure blood from the inhaled air and forms oxyhaemoglobin. Thus the impure blood gets purified(you will study as to how carbondioxide is given out under the next



Oxygenation of impure blood takes place in lungs. Blood combines with oxygen of air and gets purified. Purified blood returns to heart, from where it is pumped to all parts of the body.

heading, namely 'Transport and Carbondioxide" and waste products". This purified blood or oxygenated blood returns to heart. From the heart, it is pumped to other parts of the body through arteries by the left ventricle. Now the question is, how do body cells get Oxygen from the Oxygenated blood?

Observe the diagram carefully. You will find in the diagram, an artery, capillaries ,a vein and body cells. You know that capillaries reach almost the adjacent side of every cell. The blood flowing in capillaries is separated from tbe body cells only by capillary walls and small spaces. The percentage of oxygen present in the body cells is very less when compared to oxygenated blood in the Capillaries. Owing to this difference in concentration of oxygen, oxygen from blood diffuses into the body cells and carbondioxide from these cells diffuses back into the blood. Thus each and every cell gets oxygen from the blood. This is utilised by the cells for performing various metabolic activities.

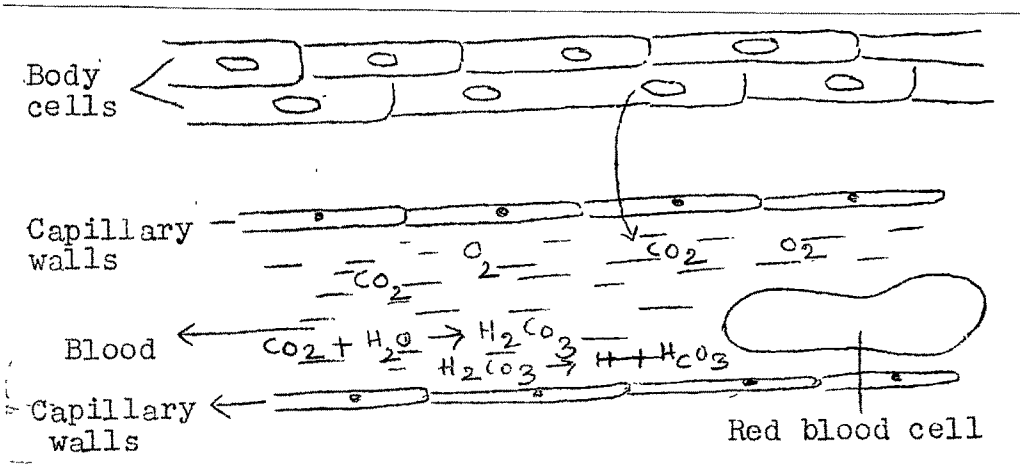


The percentage of O_2 present in the body cells is less when compared to oxygenated blood in the capillaries. Hence, diffusion of O_2 takes place from blood to body cells.

3. Transport of Carbondioxide and removal of Wastes:

You know already the different waste products produced during metabolic activities. They are carbon-dioxide, ammonia, urea, uric acid etc. The carbon-di-oxide produced during metabolic activities of the cells diffuse into the blood, and undergoes many changes. To understand these changes, you will have to make use of your knowledge of chemical equations, which you have studied in your Chemistry classes this year

In the diagram are represented the different changes that carbon-di-oxide undergoes in blood.

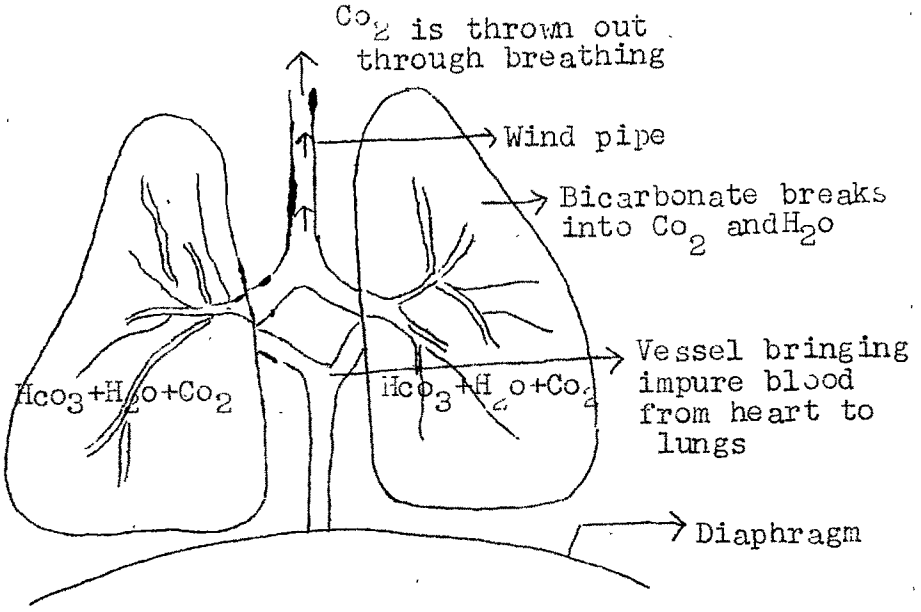


The Carbon-di-oxide that enters the blood combines with water of plasma and forms Carbonic acid.

$$CO_2 + H_2O \text{ ---- } H_2CO_3$$

(Carbonic acid)

The Carbonic acid thus formed, breaks immediately into Hydrogen and Bicarbonate. This impure blood containing bicarbonate is carried by veins into heart, from where it is pumped to lungs. In the lungs, the impure blood undergoes many changes to dispose of Carbon-di-oxide present in it. The following diagram will give you an idea of the different changes that take place in lungs.



In the lungs, bicarbonate present in the blood reconverts into Carbon-dioxide and water.

H_2CO_3 ----- H_2O + CO_2

Carbon-di-oxide is exhaled with water as vapour.

Thus, Carbon-di-oxide is transported from different parts of the body to lungs, from where it is thrown out. Of course, you might be thinking about other waste products such as ammonia, urea, etc. These waste products are carried to Kidneys through which they are thrown out of the body. (You will be studying more about this in the Unit "Excretion" this year).

Friends, you have studied about three functions of blood, namely, transportation of food, transportation of oxygen and transportation of metabolic wastes. Let us summarise what we have studied about these three functions of blood.

S U M M A R Y

Transport of Food:

The digested food from the small intestine is absorbed by the veins of the intestinal villi. This blood is first taken to liver and from there to the heart. From the heart, it is pumped along with blood to various parts of the body where it is utilized.

Transport of Oxygen:

The blood pigment, namely, haemoglobin combines with Oxygen of the inhaled air to form oxyhaemoglobin in lungs. This is carried to all parts of the body, where Oxyhaemoglobin breaks giving out oxygen. The liberated oxygen diffuses into cells having low concentration of oxygen.

Transport of Metabolic Wastes:

The metabolic wastes such as Carbon-di-oxide, Ammonia, Urea etc., are carried to different organs by blood; Carbon-di-oxide is taken to lungs from where it is thrown out and similarly, Ammonia and Urea are taken to Kidneys from where it is thrown out along with Urine.

Below are given a few Questions related to the functions of blood you have studied so far. You may answer them before proceeding further.

Questions:- (Fill in the blanks)

1. Oxygen from lungs is carried by blood to different parts of the body in the form of _____.
2. Oxygen of the blood in the Capillaries gets into the cells of the body through the process of _____.

3. The digested food is absorbed by the veins present in the villi of _____ intestine.(Large,small).

4. The Carbondioxide produced during metabolic activities combines with water present in blood to form _____ which later breaks into _____ and _____.

5. In the lungs, bicarbonate present in the impure blood breaks into _____ and _____.

6. The metabolic wastes such as ammonia and urea are removed through _____ along with urine.

Answers:

1. Oxyhaemoglobin
2. Diffusion
3. Small intestine
4. Carbonic acid, Hydrogen and bicarbonate
5. Carbon-di-oxide, water
6. Kidneys.

Now you may proceed further to understand a few other functions of blood.

4. Equalization of Body Temperature:

If you have recorded the temperature of your body, you must have noted that it is about 98.6°F in all seasons. It is same throughout the body. Blood does this function of equalising body temperature. You might be interested in knowing how blood performs this

function. Recall what you have studied about 'respiration' in your earlier standards. You know that during respiration, energy rich food substances such as Carbohydrates and fats are burnt or oxidised in the cells with the help of oxygen, and energy is released. In our body, liver and muscle cells release more energy when compared to other cells of the body. From the following equation, you will get an idea about the reaction that takes place during respiration.

$C_6H_{12}O_6 + 6O_2 \longrightarrow 6CO_2 + 6H_2O + 673$

(glucose) (Oxygen) (Carbon-di-oxide) (Water) (Calories of Heat).

About 40% of this energy is stored in the body as Adenosinetriphosphate (ATP) and is utilized for various activities. (In the Unit "Protoplasm and Its Composition", you have studied how body cells utilize energy contained in ATP by converting them into Adenosine diphosphate). The rest 60% of the energy is liberated as heat. This is picked up by the blood flowing in the surrounding capillaries. This warm blood, as it courses through the tissues, distributes heat to more superficial and cooler parts such as skin, tissues below the skin, etc., where cellular respiration

is comparatively low. Of course, as the blood is in constant circulation, blood from these superficial and cooler parts flows back to the regions where maximum heat is produced to become warm again. Thus, always an even temperature is maintained throughout the body.

5. Transportation of Hormones:

You are all familiar with certain endocrine glands present in our body, namely, pituitary, Adrenal gland, Gonads etc. They are ductless glands. Being ductless, they pour their secretions directly into the blood stream. Blood transports the hormones to different organs during its circulation.

6. Resistance against Diseases:

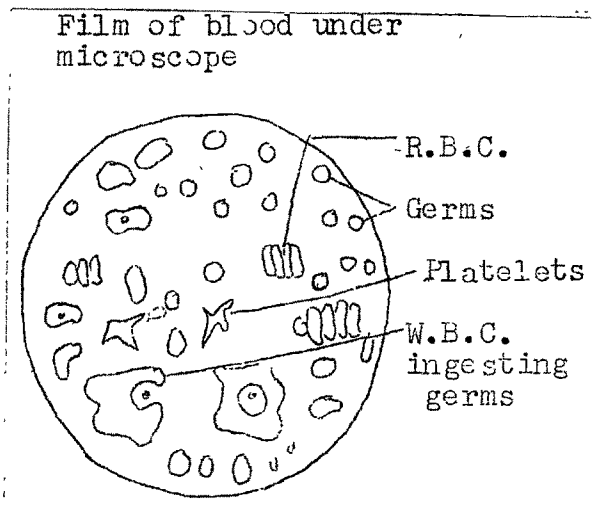
Living organisms are constantly threatened by agents of disease. Common examples of these agents are bacteria and viruses. In order to survive from this infestation (attack), organisms have developed various defense systems. For a moment, think as to how we survive this infestation. You may say that we rely on medicines. Right. It is only an external defense. Our body has internal defenses too to combat against the the disease producing organisms like bacteria, viruses, etc.

The white blood cells present in our blood are the key to our survival in the daily war against disease producing organisms. These white blood cells can move from place to place - from blood to surrounding tissues and cells - and prey upon bacteria and other germs. Their mode of ingestion is similar to that of amoeba.

In the diagram is shown one white blood cell in the process of ingestion of bacteria. The ingested bacteria are killed in the cytoplasm of white blood cell and are digested. Usually, great number of these W.B.Cs gather in and around wounds, or wherever an infection has started. During their combat or fight with the germs, many of them get killed by the toxin (poisons) given off by the germs. You must have seen the formation of a yellow substance around the wound. This is nothing but the pus, and is composed of lymph, dead white blood cells and bacteria, and parts of dead tissue cells.

In attack of certain diseases like pneumonia, appendicities and tonsilities, the number of white blood cells in the blood increases greatly. By taking a sample of patient's blood, a doctor is often

able to detect the presence of an infection when no other symptoms indicate it.



W.B.C.s fight against germs by ingesting [illegible]

S U M M A R Y

To summarise what we have studied about the role of blood in animals, it helps in;

1. equalizing the body temperature;
2. transporting hormones; and
3. resisting against disease producing germs.

Blood maintains the same temperature throughout the body by carrying heat from more active tissues (tissues where rate of cellular respiration is high) to less active ones (tissues where rate of cellular respiration is low).

Blood conveys the hormones secreted by the endocrine glands to the tissues and organs through its constant circulation.

Following are a few questions which are related to the three functions of blood, namely, (i) Equalisation of body temperature; (ii) Transportation of hormones; and (iii) Resistance against diseases. You may answer them before you proceed further.

Questions:

1. It is a common experience that our hands become cold when we dip them in cold water. But, it again becomes warm after some time, when it is taken out from cold water. Give reasons as to why it happens so.
2. The gland thyroid, is one among different ductless glands present in our body. Write how the hormone produced by this gland is distributed to organs and tissues where it is needed.
3. Describe how white blood cells help in protecting our body from germs?
4. Why do we apply antiseptic cream when there is a cut or wound on our body?
5. Often you find some yellowish or whitish substance in wounds. What it is? How it is formed?

Answers:

1. The reason for the hands to regain its temperature after taking them out from cold water is mainly due to circulation of warm blood in our body. When we dip our hands in cold water, the warm blood flowing

in those parts loses heat and hence we feel our hands becoming cold. But after sometime, when the warm blood from other parts flows into hands they regain the original temperature.

2. Since thyroid gland is a ductless gland, the secretions are poured directly into the blood stream. As the blood circulates in the body, it distributes the hormones to organs where they are needed.

3. The white blood cells of our blood function as soldiers of our body. Whenever there is an infection, the white blood cells gather round the germs and ingest them. The ingested germs are killed and digested in the cytoplasm of white blood cells. Thus, they fight against disease causing germs and protect our body.

4. The main reason for applying an antiseptic cream when there is a cut or wound on our body is, it helps in killing the bacteria and other germs and in preventing the wound from further infection.

5. The yellowish or whitish substance formed in wound is a substance known as Pus. It is formed of lymph, dead white blood cells and germs, and dead cells of the body.

Activities to carry out at home:

1. Place your legs in a slightly warm water for sometime. You will start perspiring. Think of the reason for your perspiration.

2. Take a thermometer and note your body temperature by keeping it in your mouth. Do some heavy exercise, or run fast for sometime. Note the temperature once again. Find out whether there is any difference. Think of the reasons for this difference. (You can make use of the thermometer available in the biology laboratory, if you do not have it at home).

You can discuss your results with your teacher in the class.

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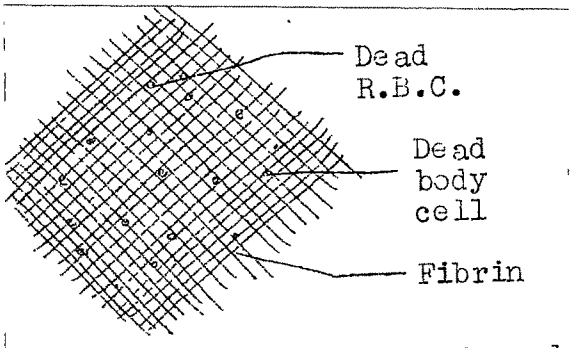
7. Clotting of Blood:

All animals with a blood system are faced with an interesting problem. The blood must always be in fluid state and under pressure, if it has to circulate in the blood vessels. At the sametime, all organisms are subject to injuries such as cuts and wounds, that break blood vessels containing blood. Since blood is a fluid circulating in the body under pressure, it would rapidly flow out of any hole in arteries or veins. Unless there are some ways of preventing loss of blood through wounds, an animal would be soon without blood. You can very well take your own example. All of you might have experienced small cuts at one time or other. Think, whether the blood flows out from the wound continuously? You would surely say 'no'.

Think, why it does not flow out continuously? You may say from your experience that a reddish substance is formed, which prevents further flow of blood. True. But, the questions that arise at this point are: (i) What is this substance? (ii) How is it formed?

The platelets present in our blood take an active part in the formation of the reddish substance, namely, the blood clot. These platelets liberate a substance known as <u>thromboplastin</u> which is needed for the formation of a substance known as <u>fibrin</u>. Fibrin is composed of fibre like substance and forms a net work. In this net work, dead red blood cells are captured forming the reddish substance that is <u>clot</u>, which blocks the opening of the cut or the wound. Thus, further flow of blood from the wound is prevented.



Fibrin is a substance formed during clotting. They are fibre like substance; forms a matrix, in which are embedded dead R.B.C.

Sometimes, blood clots inside the blood vessels, heart, etc., and thus obstructs the circulation of blood.

Many a time this leads to the death of the organism. Normally this does not happen, since plasma contains a substance known as heparin, which prevents clotting of blood inside the body. You might have read in newspapers that such and such a person died of heart attack. One of the reasons for this heart attack is clotting of blood in the heart and other vessels. In some persons, blood does not clot at all, or slots very slowly. This disease is known as haemophilia. And, the persons who suffer from such a disease are called as bleeders. In such persons, even if there is a small wound on their body, blood will continously flow from the wound. You can very well imagine the condition of such persons. Because of the excessive loss of blood they feel easily tired and suffer from anemia.

Summarising what we have studied about the clotting function of blood, - the platelets present in the blood produce a substance known as thromboplastin which helps in the formation of blood clot. This clot helps to block the wound, thereby preventing further loss of blood.

Now you may answer the following Questions to make sure of what you have understood about the clotting function of blood.

Questions:

1. What is the importance of platelets present in blood, and what will happen if the number of platelets in the blood reduces?
2. Name the substance produced by platelets during clotting.
3. Reason out as to what will happen if heparin is not produced adequately in the blood of humans.

Answers:

1. Platelets present in our blood helps mainly in the clotting of blood. If the number of platelets in the blood reduces, there will be less production of thromboplastin, a substance very much needed for clotting. Hence, blood will not clot easily.
2. The substance produced by platelets during clotting is thromboplastin.
3. If adequate amount of heparin is not produced in our body, then, chances for the blood to clot inside the body i.e., in the blood vessels, heart etc., will be more. This may lead to blocking of blood vessels thereby obstructing flow of blood, and leads to the death of the organism.

Activities to perform:

Stamp a Cockroach; blood comes out of the body of Cockroach. Wait and see whether blood of Cockroach clots or not.

Here is a Summary of what you have studied in this Part.

SUMMARY

In this part, namely, "Blood and Its Functions" of the Unit Transportation and Circulation, we studied that blood is a liquid tissue and is composed of blood cells and plasma. The blood cells are of three types, namely, red blood cells, white blood cells and platelets. About the functions of these cells, we learnt that red blood cells contain haemoglobin which help in transporting oxygen to different parts of the body. The white blood cells help in guarding the body against the disease causing bacteria and germs. The platelets present in our blood help in the process of clotting, when there is an injury to the body. In addition to these functions, we also learnt how blood does the function of transporting waste products, hormones secreted by endocrine glands, and also about the maintenance of even temperature throughout the body.

PART - III

TRANSLOCATION IN PLANTS

Friends,

In the first two sections of this unit, you studied about the mechanism of transportation of food and other substances in animals, and the different tissues and organs that are involved in such a mechanism. In this section, you would be studying the mechanism of transportation of water, mineral salts and the manufactured food in plants. In simpler terms, you would be finding answers to Questions such as:

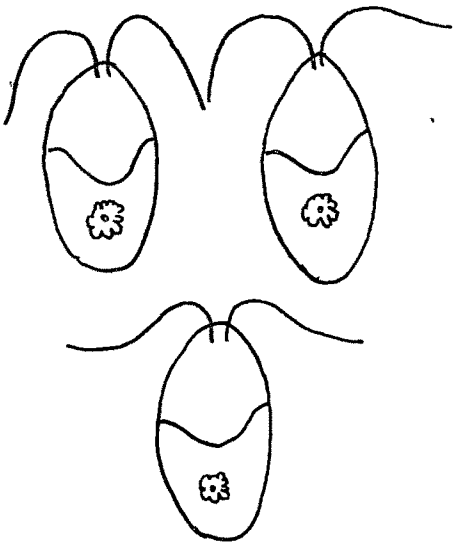
-- how water and mineral salts are transported from soil to different parts of the plant?

-- how the manufactured food from green leaves is transported to non-green parts of the plant?

This you would be learning in the same way as you learnt the topic "Factors needed for Photosynthesis", in the Unit "Autrophic Nutrition". You may remember that your teacher discussed the different factors needed for photosynthesis with the help of a few questions. In the same way, in this section also your teacher would discuss the topic by raising a few questions. Sometimes, you would be

observing certain experiments conducted by your teacher. After observing the experiments, you will have to make your observations and discuss them with your teacher. All these will enable you to understand how transportation of food and other substances take place in plants.

Teacher: Let us start our study about the mechanism of transportation of food and other subs-tances in plants by considering lower plants. What you see in the diagram is the plant body of Chlamydomonas, a lower plant. From the diagram, what can you say about the plant body of the Chalamydomonas?



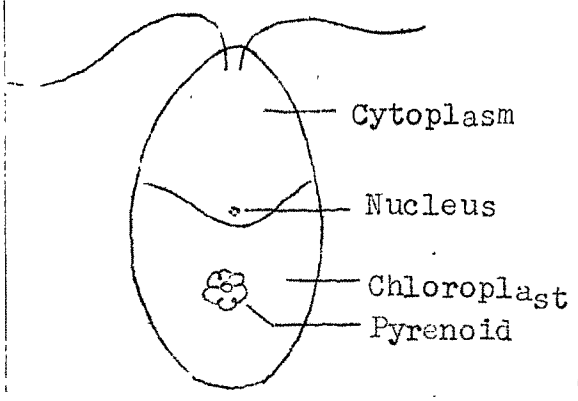
The plant body of Chlamydomonas is composed of only one cell, or it is unicellular in nature.

Ramesh: From the diagram, we can say that the plant Chlamydomonas is composed of only one cell.

Teacher: Correct. Chlamydomonas is usually seen in the pools and ponds. In the Diagram, you will find a cup shaped structure at the centre. It is known as

chloroplast. Think as to what may be the function of this chloroplast?

Suresh : Chloroplast helps in the manufacture of glucose or carbohydrates, since it contains a pigment known as chlorophyll.



Chloroplast contains chlorophyll, which helps in the manufacture of food(glucose).

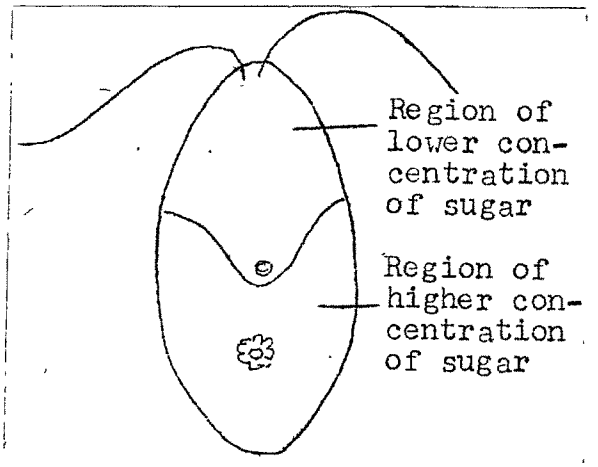
Teacher : Right. Chloroplast helps in the manufacture of glucose. Now the question is, how the food (glucose) manufactured in this chloroplast reaches every part of chlamydomonas.

Sumita : The food manufactured in chloroplast reaches every part of chlamydomonas through the process of diffusion.

Teacher : Good. Can you explain in detail as to how glucose manufactured in chloroplast reaches every part of chlamydomonas through the process of diffusion?

Sumita : The glucose manufactured in the chloroplast dissolves in the cytoplasm. Due to this the concentration of glucose or sugar in that part of

cytoplasm increases. We know that molecules move from a region of higher concentration to a region of lower concentration. Since the concentration of glucose is high in the region of chloroplast, glucose molecules start moving from the region of chloroplast to the other regions. In other words, diffusion of glucose takes place from chloroplast to other regions.



Molecules move from a region of higher concentration to a region of lower concentration. In otherwords, diffusion takes place

Teacher : Correct. The manufactured food in Chlamydomonas is transported to other parts through the process of diffusion. Like amoeba and paramaecium, chlamydomonas is also a microscopic organism. And, since the area for the food to be distributed is small, it can solely depend upon diffusion.

For a moment, think as to how exchange of gases may take place in Chlamydomonas?

Kiran : Silence.

Teacher : You may recall what you have studied about exchange of gases in amoeba. You know that exchange of gases takes place between amoeba and outside environment (pond water) through the process of diffusion, since the entire body of amoeba is exposed to the outside pond water or the environment. Now try to compared chlamydomonas with amoeba as far as their environment and nature of the body is concerned.

Kiran : Both amoeba and chlamydomonas are unicellular organisms.

Teacher : Anything else?

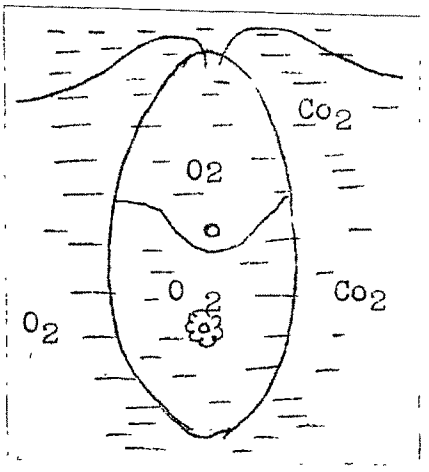
Hiren : The bodies of both the organisms are completely exposed to the outside pond water or environment.

Teacher : Well. Now can you tell me as to how exchange of gases take place in Chlamydomonas?

Kiran : As in the case of amoeba, in chlamydomonas also exchange of gases take place through diffusion, since the entire body is exposed to the surrounding environment.

Teacher : Good. Since each and every part of chlamydomonas is exposed to the surrounding environment, that is water, diffusion of gases takes place easily.

Because of the simplicity of the organism, there is no development of complex transportation system in chlamydomonas. ~~Like chlamydomonas~~ Like chlamydomonas, in other lower plants also transportation of food and other substances takes place through the process of diffusion.



Exchange of gases that is oxygen and carbon-di-oxide takes place through the process of diffusion.

Now, let us consider the case of higher plants such as herbs, shrubs and trees that are there in your environment. Think as to where the food is manufactured in them.

Rajesh : Food is manufactured in the leaves.

Priti : Food is manufactured in the green parts of the plants.

Teacher : Right. Food is manufactured in the green parts of the plant,namely, leaves, stem,etc. Sneha, can you tell me as to how this food is manufactured in leaves?

Sneha : Food is manufactured in theleaves with the help of water and carbon-di-oxide in the presence of sunlight and chlorophyll.

Teacher : Good. Think, what else they require for their living, besides food?

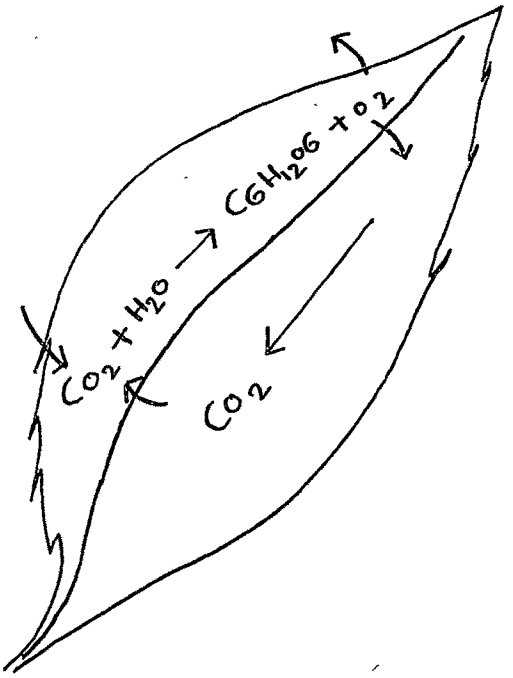
Rakesh : They also require oxygen and mineral salts for their living.

Teacher : Correct. So, plants require carbon-di-oxide, water, oxygen, mineral salts to exist on the world and thereby carry out various life activities. You already know as to how these things are absorbed by the plant body. Plants absorb water and mineral salts from the soil, and oxygen and carbon-di-oxide from the air. Carbon-di-oxide of air combines with water in the presence of chlorophyll and sunlight, and carbohydrates are manufactured. You may recall the mechanism of gaseous exchange that you have studied under photosynthesis. You have studied that most of the carbon-di-oxide produced during respiration is utilized for manufacturing food. A part of oxygen produced during photosynthesis is used for respiration and the rest is given out to the atmosphere. For a moment, think as to how the water and

mineral salts that are absorbed by the roots from the soil are taken to the leaves. Do you have any idea about such a mechanism.

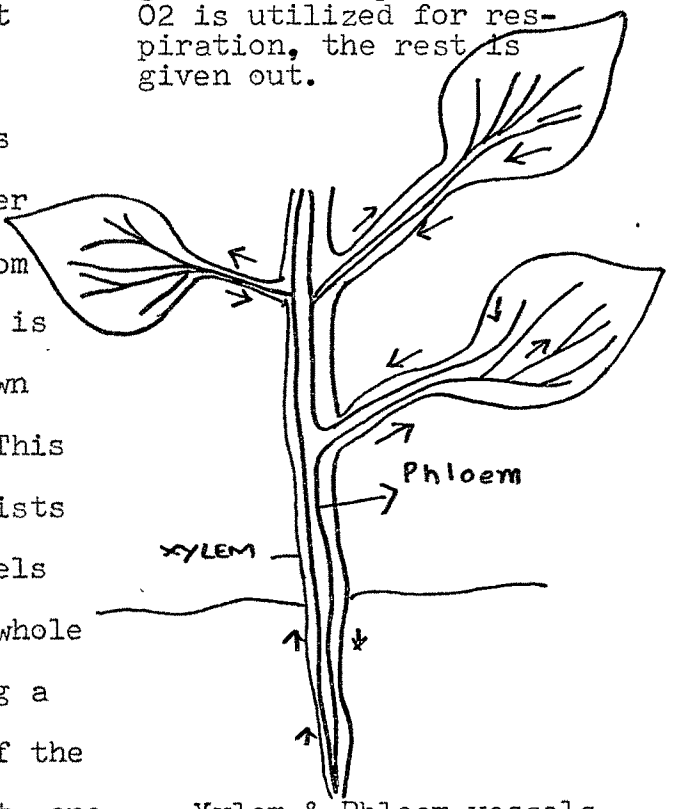
Saxena : Silence

Sharma : Silence



During photosynthesis CO2 is utilized & O2 is given out. A part of this O2 is utilized for respiration, the rest is given out.

Teacher : In all higher plants, this movement of water and mineral salts, in other words translocation of water and mineral salts from roots to other parts is done by a system known as vascular system. This vascular system consists of two types of vessels which run along the whole plant body. By taking a transverse section of the stem of a young plant, one



Xylem & Phloem vessels traverse the whole of the plant body and help in the transportation of water, mineral salts & food to all parts of the plant.

can get an idea about the location and the different types of cells that form these vessels.

Your teacher would take a transverse section of the Sunflower stem by proceeding in the following way and focus it under microscope. Observe the section and draw a neat sketch of what you observed.

Materials Needed:

1. Sunflower stem
2. Water
3. Razor blade
4. Eosin stain

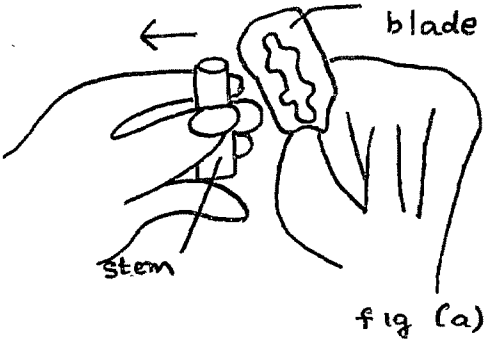
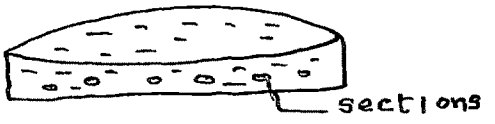


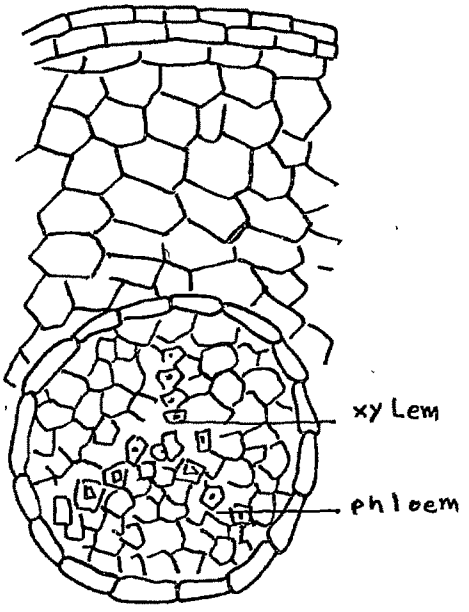
fig (a)

Procedure:

The material will be held firmly in the left hand between the thumb and the fingers in such a way that the thumb is always slightly lower than the first finger (fig.a). By passing the razor blade through the stem, thin sections of the stem will be taken. A good section will be selected and will be stained with Eosin and focussed under microscope.



Teacher : Recall what you have observed in the Sunflower section. The diagram will help you in recalling. You have observed the central hexagonal cells. They are called as the xylem cells. These cells form one type of vessels known as xylem vessels. The peripheral round cells are the phloem cells and form the vessel phloem. These two vessels together constitute the vascular system. Now the question is which of these two vessels help in translocating (transporting) water and mineral salts from the roots to other parts, and which conducts manufactured food from leaves to roots? Can you think of a way by which we can find an answer to this question?



The xylem cells are hexagonal cells, which constitute xylem vessels. And, the peripheral phloem cells which are polygonal in nature, and constitute phloem vessels.

Hiren : We can take two plants, and in one of them, xylem can be removed. Both the plants can be fed with water and mineral salts. The plants having a vessel which conducts or translocates water and mineral salts will be alive, and the other will die. This will tell us as to which vessel translocates water and mineral salts.

Teacher : You are correct. But, it is difficult to remove the vessels completely from the plant body. Hence, instead of removing the vessels, we can block xylem in one plant and phloem in another with the help of paraffin wax. Let us do the experiment and find out which vessel translocates water and mineral salts.

Your teacher would proceed in the following way to show you that xylem vessels conduct water and minerals upwardly. Make your observations and discuss it with your teacher.

Material Needed:

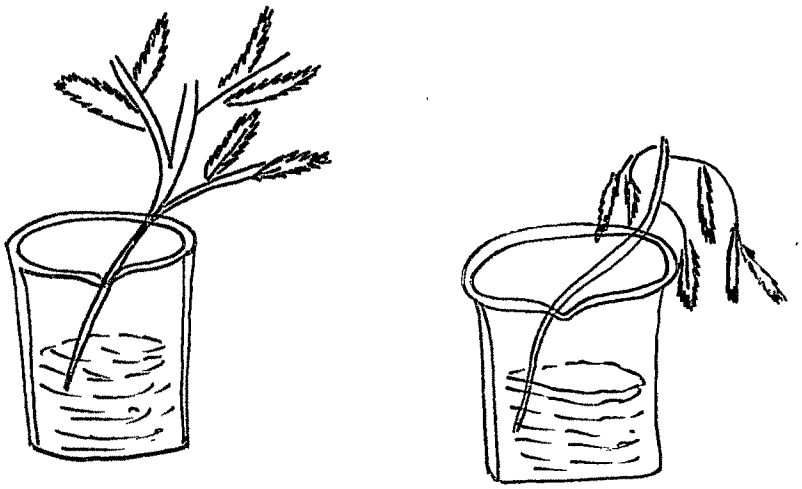
1. Two Beakers
2. Two balsom plants
3. Eosin stain
4. Water
5. Paraffin wax.

Procedure:

Two healthy balsom plants will be selected, and will be cut an inch above the ground. Ineone plant, xylem vessels will be blocked and in the other phloem. Both the plants will be kept in separate beakers containing eosin water (eosin stain with water) and left for some time.

Discussion:

Teacher : What change did you observe in the plants kept in separate beakers?



The plant in which Xylem is blocked shows drooping of leaves, whereas the plant in which phloem is blocked, leaves remained fresh. This shows that water and mineral salts are conducted upwardly through xylem.

Sharma : In one plant leaves drooped soon, whereas in the other, leaves remained fresh.

Teacher : Correct. What may be the reason for drooping of leaves in one plant?

Kiran : Probably water might not have been conducted in that plant to leaves. Hence, leaves drooped.

Teacher : Good. What may be the reason for this non-conduction of water in the plant?

Ramesh : Xylem vessels are blocked in that plant, hence there was no conduction of water, whereas, in the other where xylem vessels were not blocked, the leaves remained fresh.

Teacher : What can you infer from this experiment?

Ramesh : We can infer that xylem vessels conduct water and dissolved mineral salts to leaves upwardly.

Teacher : Correct. Now can you think of any other way by which we can confirm this?

Ramesh : We can confirm that xylem vessels conduct water and mineral salts in an upward direction by taking a cross-section of the stem in which xylem vessels are intact and observing it under miscroscope.

Teacher : Good. Let us take a cross-section of the stem and observe it under microscope.

Discussion:

Teacher : What did you observe in the section?

Deepak : Xylem cells were red in colour because of the eosin stain, whereas, there was no change in the phloem cells.

Teacher : Correct. Since the eosin water had moved in the xylem vessels, the xylem cells could absorb the eosin colour from the water and thus had become red. What can we confirm from this experiment?

Deepak : We can confirm that xylem vessels help in the upward translocation of water and mineral salts.

Teacher : Yes. We can confirm that upward translocation of water and mineral salts takes place through xylem vessels.

You know that xylem vessels traverse the whole of the plant body. They reach tips of leaves, stem etc. In the leaves, food is manufactured with the help of water and carbon-di-oxide. The manufactured food from the leaves is translocated or moved to all other parts. But, the question is how the manufactured food from leaves is transported to other parts of the plant body.

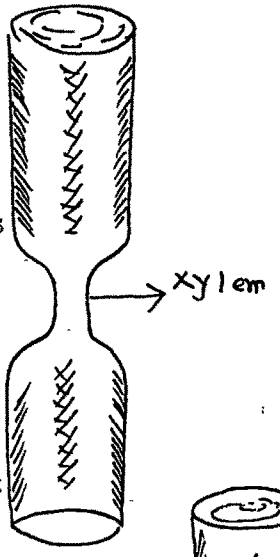
The same question was there in the minds of scientists who were working with plants. Scientists in the early 1800's believed that food manufactured in the leaves is translocated to other parts of the plant through the same vessels in which water and mineral salts are transported. However, a few scientists became very much interested and thought of finding whether xylem vessels translocate food materials downward also, i.e., from leaves to roots and stem. You might be interested in knowing the experiments they did.

They made a guess that if xylem vessels were to transport food materials, then even after removing all the tissues except xylem the plant should grow well. Can you think as to how they might have tested their guess.

Sunil : They might have tested their guess by removing all tissues except xylem and observing the plant.

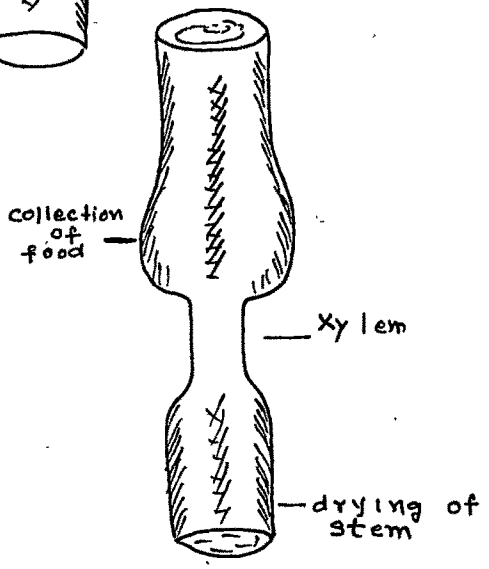
Teacher : Correct. They took a healthy plant and removed all tissues around xylem in a portion of stem. You will get a better picture of the experiment from the diagram. They observed the plant

for some days. They noticed that the stem below the ring dried, whereas the portion above the ring remained fresh. From this experiment what conclusions they might have drawn/ arrived at?



Ramesh : They might have concluded that xylem is not the vessel that conducts manufactured food downward.

Teacher : Good. From the experiment they concluded that the manufactured food from leaves is not translocated to stem and roots through xylem. This generated interest in other scientists working in the same area. Two more scientists by name Le Comte (1889) and Czapek (1897) also did this experiwith various plants and came to a conclusion that



When all the tissues around a stem except xylem are removed, there will be collection of food above the ring.

downward translocation of food does not take place through xylem. All these scientists concluded from their experiments that xylem vessels do not help in the downward translocation of food. They did not find out as to which vessel does this work of translocating food from leaves to other parts.

It was in the year 1928-29, a group of scientists found out that it is the phloem vessels that translocate manufactured food from leaves to other parts by doing chemical analysis. This they found out by analysing the chemical constituents of phloem cells, and the cells in the leaves. (you will study more about this in your higher classes).

Well friends, so far we have tried to understand how food, water and other substances are transported to different parts in lower as well as higher plants. Let us summarise what we have studied so far.

Here is a Summary of what you have studied in this Section.

S U M M A R Y

You have studied that in lower plants, transportation of food and exchange of gases take place through the process

of diffusion. In the case of higher plants, transportation of food and other substances takes place through vascular system. Water and mineral salts are translocated or moved upwards through xylem vessels. The manufactured food from leaves is translocated to all parts of the plant through phloem vessels.

UNIT TEST V

Name: _____

I. Instruction:

Here are given a few incomplete statements. Under each incomplete statement, you will find 3 or 4 alternatives with which you can complete that statement. You have to choose that alternative which is most appropriate and which completes the statement. Encircle the serial number of the alternative you have selected.

(1) The process by which substances are transported from one part of the body to another in higher animals is called as: K

(a) digestion (c) excretion

(b) circulation (d) respiration

(2) In amoeba, hydra, paramaecium, which are all lower organisms, the transportation of digested food takes place through: K

(a) Osmosis, (b) Circulation of blood (c) diffusion.

(3) In higher organisms say like earthworm, cockroach, man etc., since the cells are deeply situated in the body and are not in direct contact with the environment, transportation of food and other substances takes place through: K

(a) Circulation of blood

(b) circulation of water (c) diffusion.

(4) In an organism say "A", the blood always remains enclosed in blood vessels and is not left free in the body space. Then such a circulatory system is of: C

(a) Open type (c) Both

(b) Closed type (d) None of these

17 (5) In frogs, the blood leaves the heart, passes through the blood vessels and again returns to heart. Hence, the circulatory system in frogs is: K

(a) Closed type (c) Both

(b) Open type (d) None of these

(6) In monkeys, the circulation of blood is of double circulation type. It means: C

(a) blood enters and leave the heart twice

(b) blood enters and leaves the heart once.

(c) blood enters the heart once, but leaves the heart twice.

(d) blood enters the heart twice, but leaves it only once.

(7) The digested food from the small intestine is absorbed by the blood flowing in the _____ of the villi: K

(a) arteries (b) veins (c) lymph vessel.

(8) Blood helps in the removal of metabolic wastes such as urea, uric acid, etc. In other words, it helps in the process of:

(a) Respiration (c) Nutrition

(b) Excretion (d) Digestion

II. Fill up the Blanks:

(1) _____, _____, and _____ are the three types of cells present in the blood of humans. K

(2) In cockroach, the colour of the blood is & odourless and of bluish type. It is because, the pigment present in the blood is _____. C (Haemocyanin, Haemoglobin)

(3) In plants, the manufactured food from green parts is transported to other parts with the help of _____(Xylem vessels, Phloem vessels).

18 (4) Haemoglobin contains _____ compound, whereas Haemocyanin contains _____ compound. K
(Iron, Copper, Silver, Gold).

III.

(1) What would have happened to man, if there was no haemoglobin in the blood? A

(2) In some diseases, blood will not clot, that is, if there is a small cut or wound, blood will be continuously flowing. Which type of blood cell, you think, is absent in such blood? A

(3) There are two organisms; viz., organism 'A' and 'B'. Blood of organism 'A' contains W.B.C., whereas, blood or organism 'B' does not contain W.B.C. Which organism is likely to be infected by germs easily? Why? A

(4) Write the names of the organs and tissues that form the circulatory system of man. K

(5) Here are given a few steps that take place in the process of removal of CO_2 from out body. They are not in sequence. Arrange them in sequence. C

(a) CO_2 diffuses from cells and tissues to the blood.

(b) CO_2 forms carbonic acid in the blood.

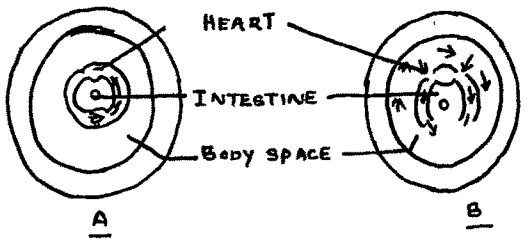
19 (c) Carbonic acid immediately changes into sodium Carbonate.

(d) The impure blood is carried to the lungs.

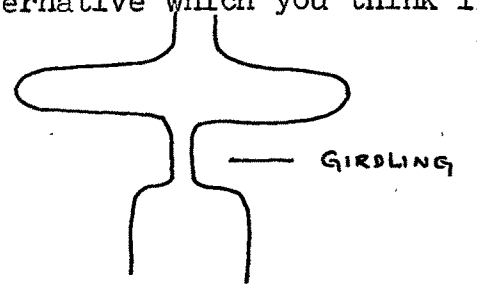
(e) Sodium Carbonate decomposes and CO_2 is released.

(f) CO_2 is released is exhaled.

(6) Below are the diagrams of cross-section of two organisms 'A' and 'B'. Think and write as to which one is having open type of circulatory system and which one is having closed type. C



(7) Below is given the diagram of a plant in which girdling has been done. Reason out as to which part of the stem has been removed. Encircle the alternative which you think is most appropriate.



Stem of a plant showing girdling:

(a) Xylem vessels are removed.

(b) Phloem vessels are removed.

(c) Both Xylem and Phloem vessels are removed.

(d) Cambium is removed.