

Biology

Standard

IX



Government of Kerala
Department of Education

State Council of Educational Research and Training
(SCERT), Kerala
2016

The National Anthem

Jana-gana-mana adhinayaka, jaya he
Bharatha-bhagya-vidhata.
Punjab-Sindh-Gujarat-Maratha
Dravida-Utkala-Banga
Vindhya-Himachala-Yamuna-Ganga
Uchchala-Jaladhi-taranga
Tava subha name jage,
Tava subha asisa mage,
Gahe tava jaya gatha.
Jana-gana-mangala-dayaka jaya he
Bharatha-bhagya-vidhata.
Jaya he, jaya he, jaya he,
Jaya jaya jaya, jaya he!

Pledge

India is my country. All Indians are my brothers and sisters.

I love my country, and I am proud of its rich and varied heritage. I shall always strive to be worthy of it.

I shall give respect to my parents, teachers and all elders and treat everyone with courtesy.

I pledge my devotion to my country and my people. In their well-being and prosperity alone lies my happiness.

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Dear students

Many more new lessons and experiences are provided here for you who have already traversed across the variety of wonders of the living world from cell, the unit of life. You shall certainly like the photosynthesis which is the process of preparing food utilizing the energy from the sun, the various organ systems in human body, the complex life functions they perform, the cell division which leads to physical growth, science behind maintaining the uniqueness of living species etc.

Today's world of knowledge has been evolved out of continuous enquiries. Extended enquiries are decisive in tomorrow's scientific advancement. Continuous observations, experiments and assessments lead to the innovations in scientific views. Therefore, you need to make use of the opportunities given here to its maximum to observe and experiment. This will lead you to new findings.

We have to be careful in planting and preserving the plants which provide food and air to all living beings. We should be able to know the structure and the complex functions of the organ systems which perform the life activities. You can travel along the wonderful paths of science imbibing the importance of cell division which maintains the continuity of the living world and uniqueness of living species; we can share the joy of learning.

With loving wishes

Dr. P.A.Fathima
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A vertical table of contents on the right side of the page. It consists of seven horizontal bars, each with a colored tab on the left containing a white number. The bars are purple, blue, green, red, dark blue, orange, and pink. The text on each bar includes a chapter number, a title, and a page number. The background features a bamboo stalk on the left and a light green background with white circles on the right.

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Certain icons are used in this
textbook for convenience



For further reading
(Evaluation not required)



Significant learning outcomes



Let us assess



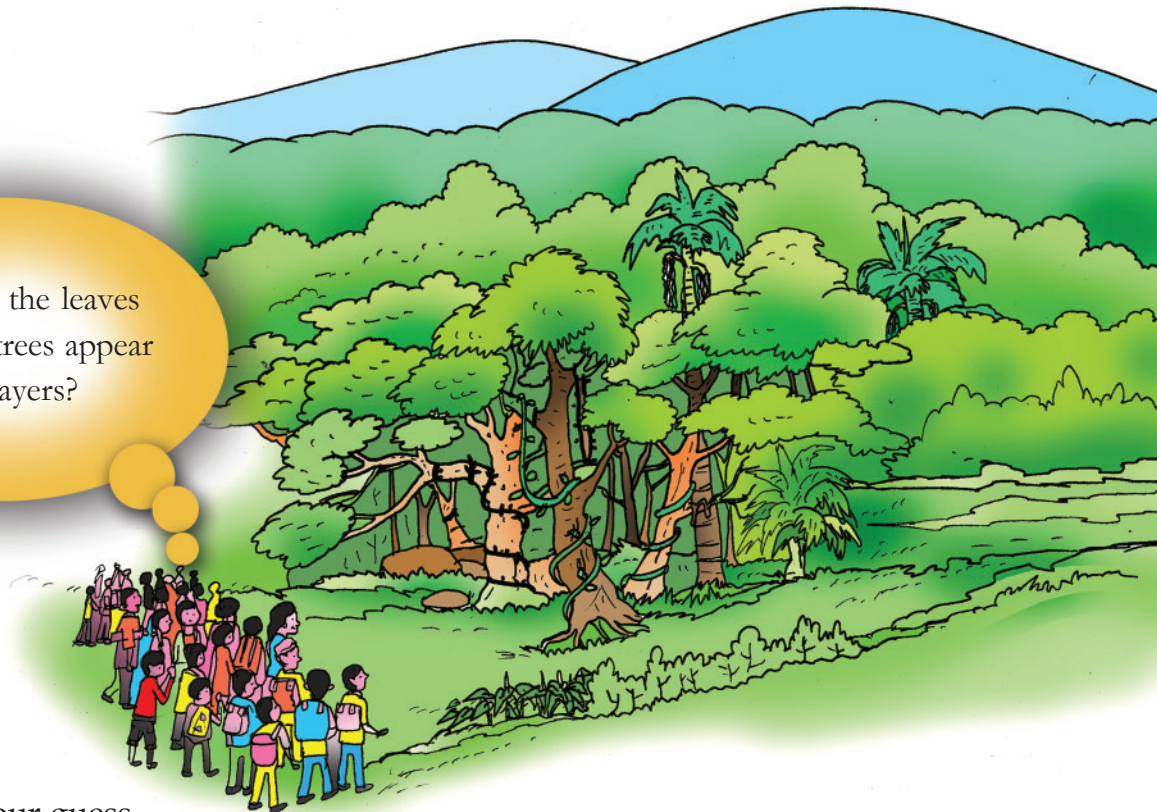
Extended activities



1

Food for the Living World

Why do the leaves of these trees appear as layers?



Note down your guess.
.....

Observe the arrangement of leaves in different plants.

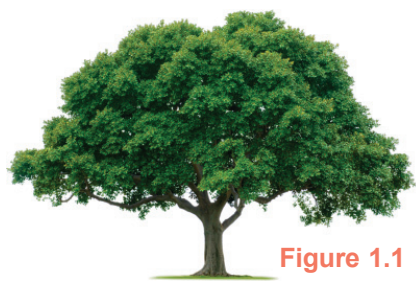


Figure 1.1

Indicators

- What could be the reason for the arrangement of leaves without one covering the other in bushes and palms?
- Is the length of upper branches and lower branches of a tree the same? What is its advantage?

Discuss and write down the inferences in your science diary.

Sunlight is inevitable for the existence of plants. All plants have arrangements for the leaves to get maximum sunlight.

Why is sunlight significant in plant growth? Write down your inference.

Analyse Illustration 1.1 and the description given below on the basis of the indicators. Examine the validity of your inference.

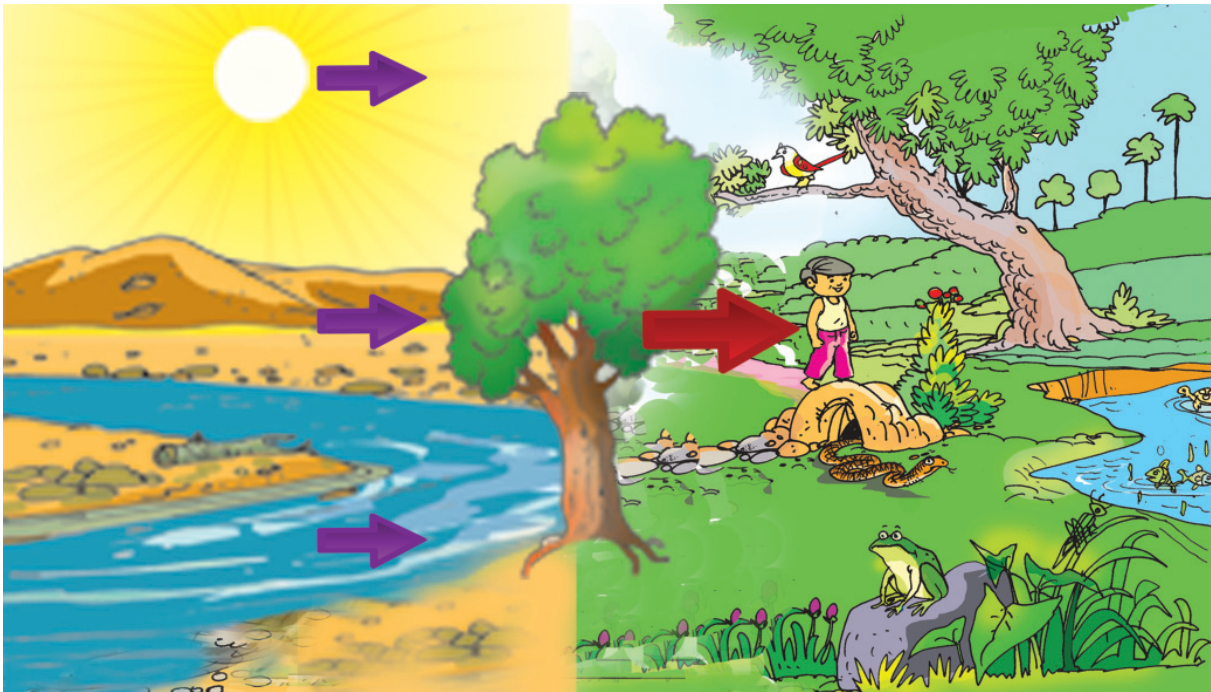


Illustration 1.1

Organisms need energy to perform life activities. Sunlight is the primary source of energy on the earth. The energy required for the sustenance of life on earth is obtained through photosynthesis. Plants convert solar energy to chemical energy through this process. Animals do not have the ability to use solar energy directly. They depend on plants, directly or indirectly, for energy. Thus photosynthesis can be said to be the pathway for energy to pass from the nonliving world to the living world.

Indicators

- Which group of living things can absorb solar energy directly?
- How does energy reach animals?
- What is the significance of photosynthesis?



Have you noticed Rita's doubt ? Analyse the description and Figure 1.2 given below and discuss on the basis of the indicators. Prepare a note.

Photosynthesis in green plants takes place mainly in leaves. You know that chloroplasts impart the green colour to leaves. There may be, at an average, 5 lakh chloroplasts in one square millimeter of a leaf. More number of chloroplasts are seen on the upper part of leaf than on the lower part.

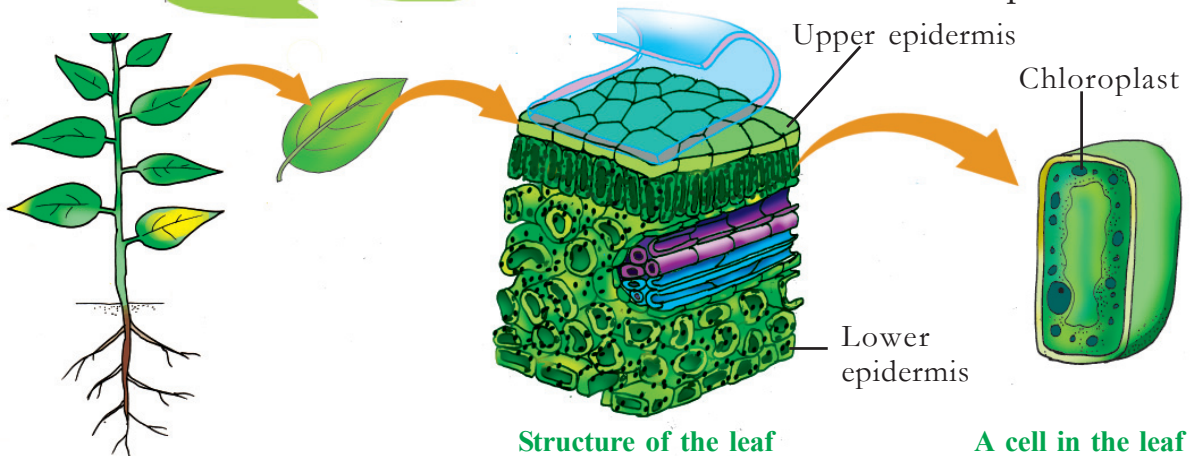


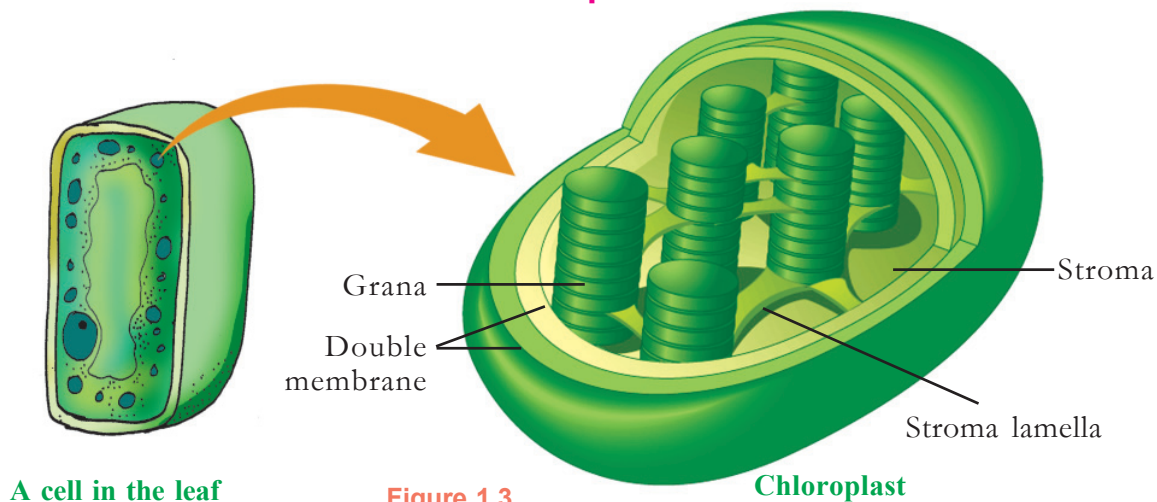
Figure 1.2 Internal part of the leaf

Indicators

- On which part of the leaf are chloroplasts seen more in number?
- Why is the lower part of a leaf less green in colour?

Doesn't photosynthesis take place in chloroplasts? How appropriate is the structure of the chloroplast appropriate for this? Analyse Figure 1.3 and the description given below. Based on the indicators, prepare a note in the science diary .

Structure of the Chloroplast



A cell in the leaf

Figure 1.3

Chloroplast

The chloroplast is an organelle with a double layered membrane. The fluid part of the chloroplast is the stroma. The membraneous sacs arranged one above the other, is the grana. The membrane bound structures joining the grana are the stroma lamellae. Pigments that can absorb sunlight are seen in the grana. Pigments like chlorophyll **a**, chlorophyll **b**, carotene and xanthophyll are seen in the grana. Chlorophyll **a** is bluish green, chlorophyll **b** is yellowish green, carotene is yellowish orange and xanthophyll is yellow in colour. All these pigments can absorb light. However only chlorophyll **a** can participate directly in photosynthesis. All other pigments absorb light and transfer it to chlorophyll **a**. Hence they are called accessory pigments.

Indicators

- What are the parts of the chloroplast?
- What are the pigments present in the chloroplast?
- What is the function of accessory pigments?

Green plants are the chief producers on the land. The ocean is much bigger than the land. There is an amazing diversity in oceanic ecosystem too. Who may be the chief producers in the ocean where living things from microorganisms to giant whales live? Observe Illustration 1.2. Discuss on the basis of the indicators, and write down your inferences in the science diary.

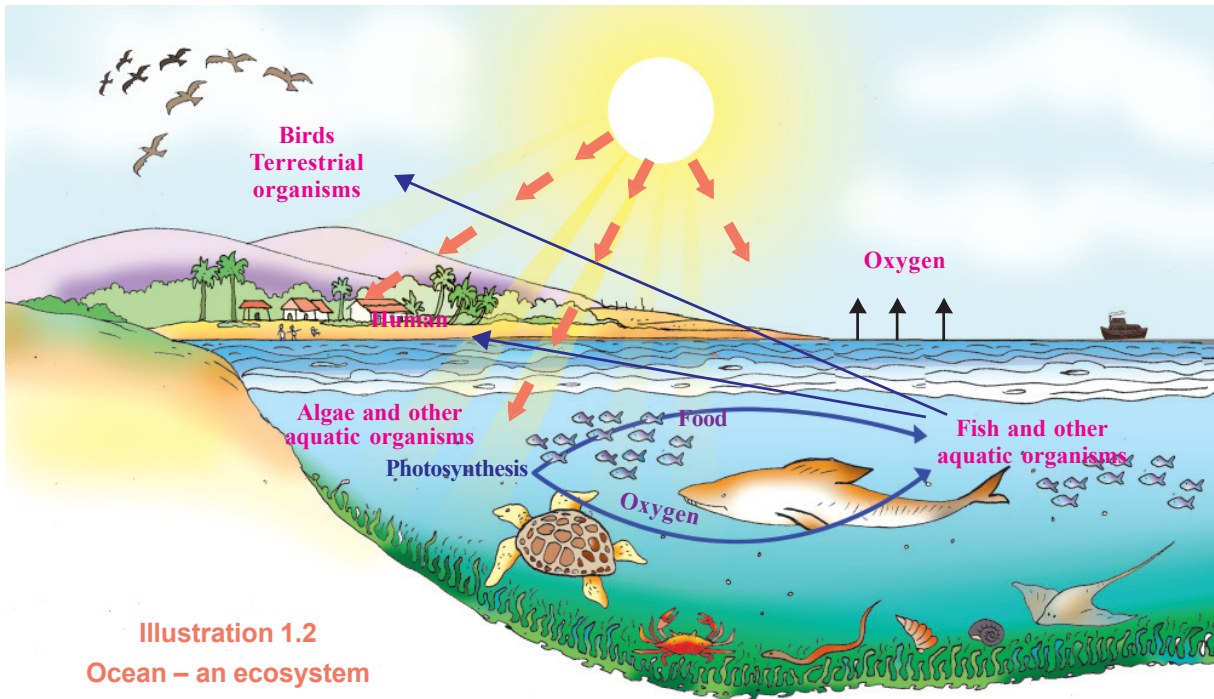


Illustration 1.2
Ocean – an ecosystem

Indicators

- Who are the chief producers of the ocean ecosystem?
- How does pollution in the ocean affect the organisms ?

Do we obtain only food from producers?



Did you notice the picture?

Sargasso Sea

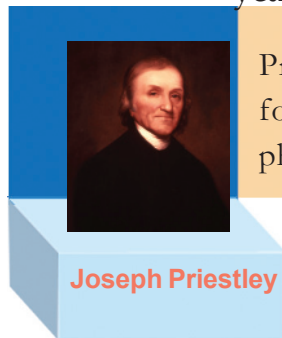


The world of algae is diverse. Based on the type of the main pigment present in the algae, they may be green, red or brown. Algae are diverse in their size too, from microscopic size to meters long. Sargassum is a large brown alga. The part of the northern Atlantic ocean where this alga grows abundantly is called Sargasso sea. This part is the habitat of organisms like fish, turtles, crabs etc. This is the only oceanic area where there is no sea route.

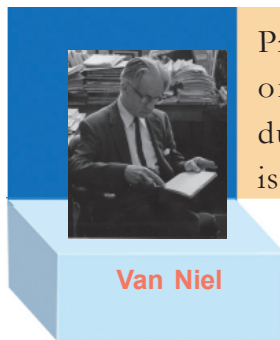


Oxygen is essential for the existence of organisms. You know that oxygen in the atmosphere is obtained through photosynthesis. About 70-80 percent of oxygen in the atmospheric air is contributed by algae in the ocean through the process of photosynthesis.

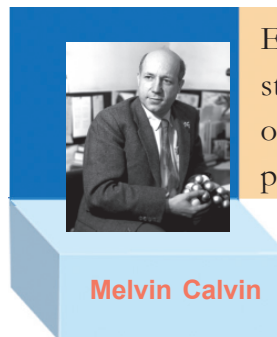
The process of photosynthesis became known to us following long years of study and experimentation by many scientists.



Proved that oxygen is formed as a result of photosynthesis.



Proved that the source of oxygen evolved during photosynthesis is water.



Explained the various stages of the formation of glucose during photosynthesis.

Collect information on other scientists who have made contributions in this area and prepare a science excerpt.

The Chemistry of Photosynthesis

How do plants produce food and oxygen through photosynthesis?

Do you know that water and carbon dioxide are essential for photosynthesis? This is a complex chemical reaction. Notice the equation of photosynthesis.



This reaction completes in two phases.

Analyse the description given below and complete the flowchart related to photosynthesis.

1. Light reaction

Light reaction occurs in the grana of chloroplast. During this phase, light energy is converted into chemical energy and stored as ATP molecules. Water that reaches the leaf, splits into hydrogen and oxygen in this phase. Oxygen evolved during this process is released by plants and hydrogen molecules are utilized in the second phase of photosynthesis.

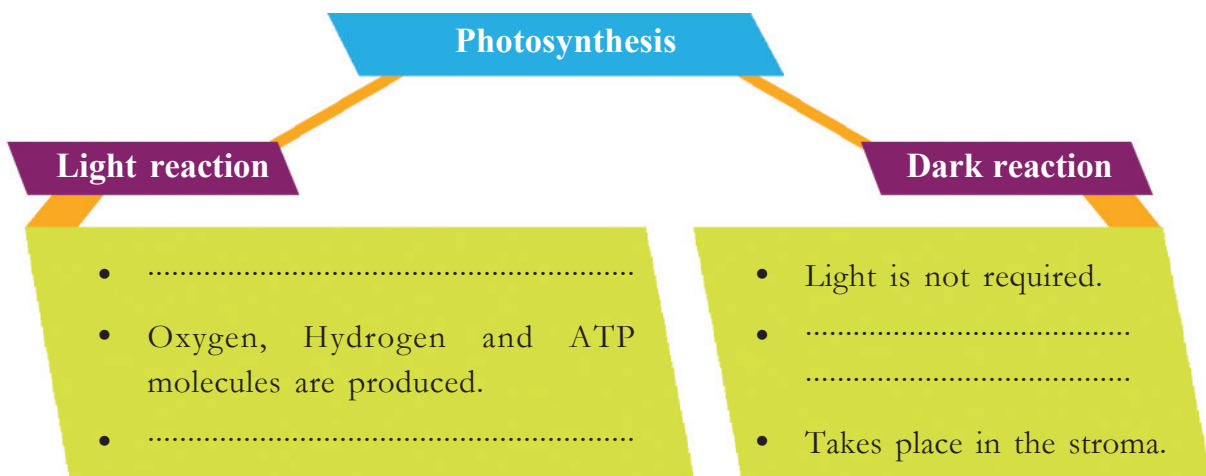
2. Dark reaction

Sunlight is not utilized in this phase that occurs in the stroma of chloroplast. During this process hydrogen is added to carbon dioxide to form glucose using the energy of ATP molecules. Dark reaction follows the light reaction. Light reaction stops when availability of light decreases. Hence dark reaction also stops. The reactions in dark reaction were discovered by the scientist Melvin Calvin. This phase is also known as Calvin cycle.

ATP- the energy currencies



Availability of energy must be ensured for continuous metabolic activities in the cells. ATP molecule is used for the continuous transfer of energy. Adenosine Tri Phosphate is the expanded form of ATP. These molecules are known as the energy currencies of the cell. Life activities like movement of muscles, chemical reactions in the cell etc., take place utilizing the energy released as a result of break down of ATP into ADP and phosphate.



We have learnt that oxygen is evolved during photosynthesis. Given in Figure 1.4 is an experimental set up to know more about it. Arrange this experiment in the classroom with the help of your teacher. Observe the difference in the evolution of the gas when sunlight falls directly and indirectly. Write down your inferences in the science diary.

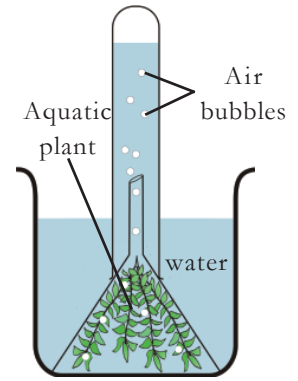


Figure 1.4

Chemical Changes of Glucose

Isn't Veena's doubt genuine?

What happens to the glucose formed as a result of photosynthesis? Analyse the description and Illustration 1.3 given below. Prepare a note, in the science diary, on the chemical changes of glucose in plants.

If all plants prepare glucose, how could we obtain starch, protein and fat from vegetable food items?



Since glucose is easily soluble in water it can't be stored in plant body. Therefore, plants store glucose in the form of insoluble starch in leaves. Plants utilize starch as a source of energy for life activities and to prepare substances required for growth. Moreover, starch is then converted to sucrose and is transported through phloem to various plant parts and is stored in different forms.

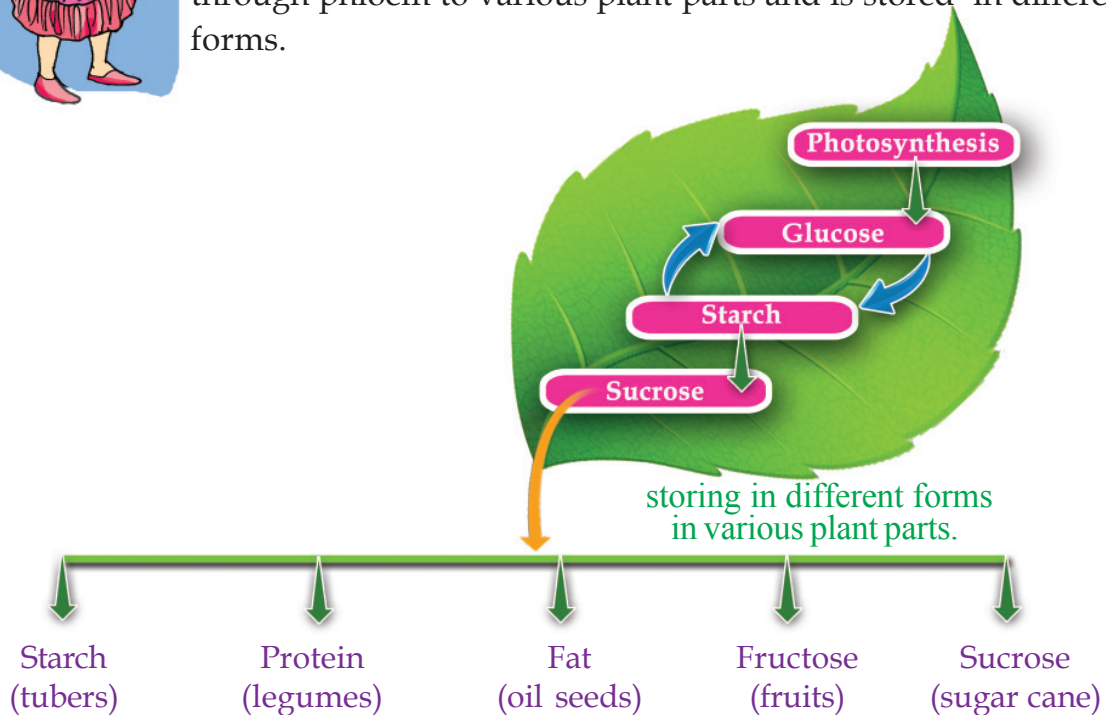


Illustration 1.3

Indicators

- In which form is starch transported to various parts of the plant body for storage?
- In which form is food stored in different plants?

Have you understood how various kinds of nutrients are obtained from different plants?

Plants – the Lungs of the Earth

The service provided by plants for the sustenance of the biological world is unique. Plants are the cheapest and effective natural mechanism for the purification of air. Plants offer great service to the biological world by absorbing carbon dioxide from the atmosphere and releasing oxygen. It is estimated that plants give out approximately 118 kilograms of oxygen when they use one tonne carbon dioxide. As the plant cover on the earth decreases, this recycling mechanism stops and air pollution becomes severe. Observe the pictures. Based on the indicators prepare a note on the importance of plants.

Indicators

- Plants, the lungs of the earth.
- Services offered by plants.

Chemosynthesis



All producers on earth do not depend on sunlight. The sulphur bacteria seen on land and in water are examples for this. They produce energy breaking down chemical compounds. This process is called chemosynthesis.



What can we do to protect forests?

Global warming is the result of deforestation, atmospheric pollution etc. Collect more information on the causes, consequences, remedial measures etc., of global warming, and organize a seminar on the topic 'Global warming and the survival of mankind'.





Significant learning outcomes

The learner

- observes and explains the peculiarities of leaves to perform photosynthesis .
- identifies and explains the structure of chloroplast.
- identifies the significance of photosynthesis in the ocean ecosystem and explains it.
- identifies and explains the stages of photosynthesis.
- organises the experiment to prove the evolution of oxygen as a result of photosynthesis.
- engages in plant protection activities identifying the importance of photosynthesis.



Let us assess

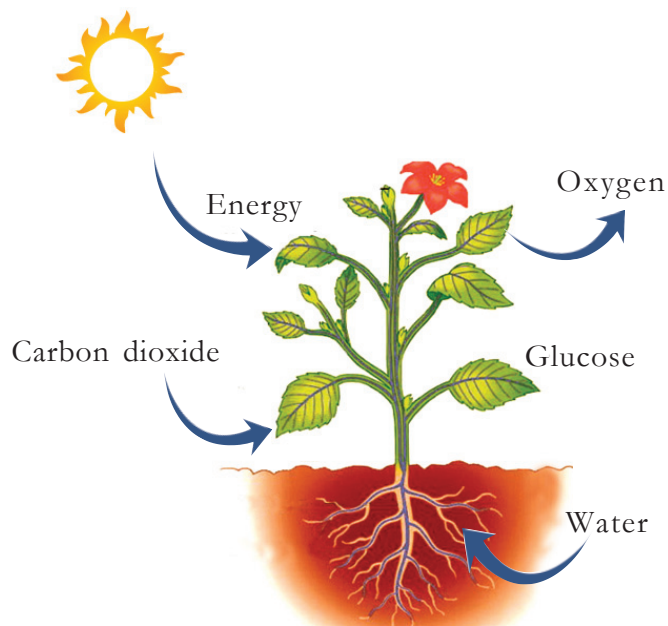
- Which of the pigments given below is the main pigment that performs photosynthesis?
 - Chlorophyll a
 - Chlorophyll b
 - Xanthophyll
 - Carotene
- Complete the equation related to photosynthesis.
 + $\xrightarrow{\text{Sunlight}}$ + 6O_2
- Complete the table.

Food item	Main nutrient
1. Pea	Protein
2. Oil
3. Rice



Extended activities

1. Collect the green alga named spirogyra. Observe it through the microscope with the help of your teacher and identify the shape of chloroplast.
2. Observe the illustration of photosynthesis. Prepare similar illustrations and exhibit them in the classroom.





2

Beyond the Sense of Taste



Which of the above is more suitable for a healthy life? Note down your answer.

What are the nutrients we get from food?

- carbohydrate
-
-

What are the functions performed by these nutrients in our body?

Complete Table 2.1.

Nutrient	Function
Carbohydrate	
Protein	
Fat	
Minerals	
Vitamins	
Water	

Table 2.1

You know that the food we eat is not absorbed by our body as such.

Digestion is the process of conversion of complex food materials into simple absorbable forms.

Examine Figure 2.1.

Identify and label the different parts of the digestive system.

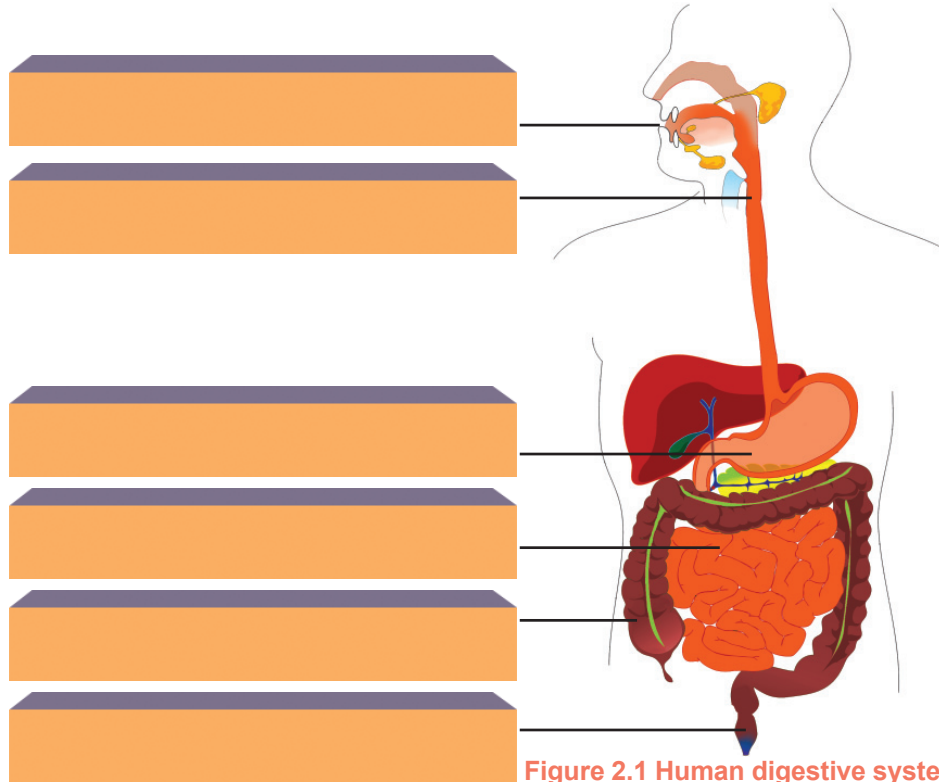


Figure 2.1 Human digestive system

Forming into bits

The process of digestion begins from the mouth. Here food is masticated and converted into smaller particles. The structure and arrangement of teeth are suitable for this. Complete Illustration 2.1 showing the arrangement of teeth in humans.

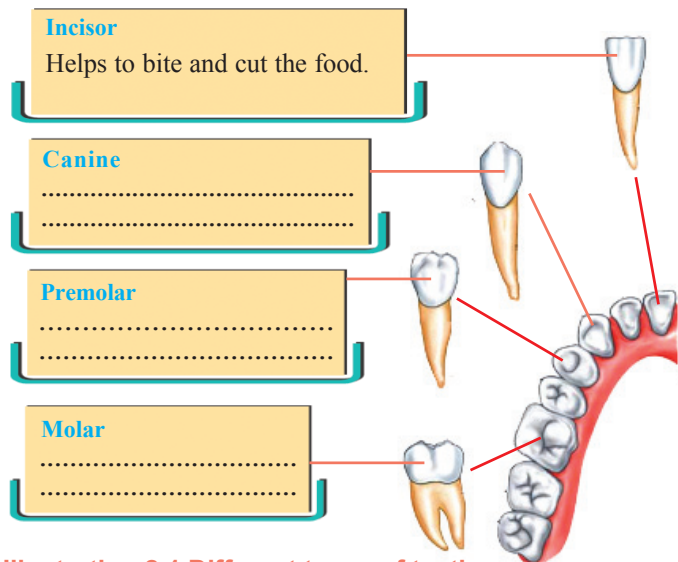


Illustration 2.1 Different types of teeth

Though teeth differ in their morphology and function, they show resemblances in their internal structure.

Analyse Illustration 2.2 and prepare a note on the internal structure of the teeth.

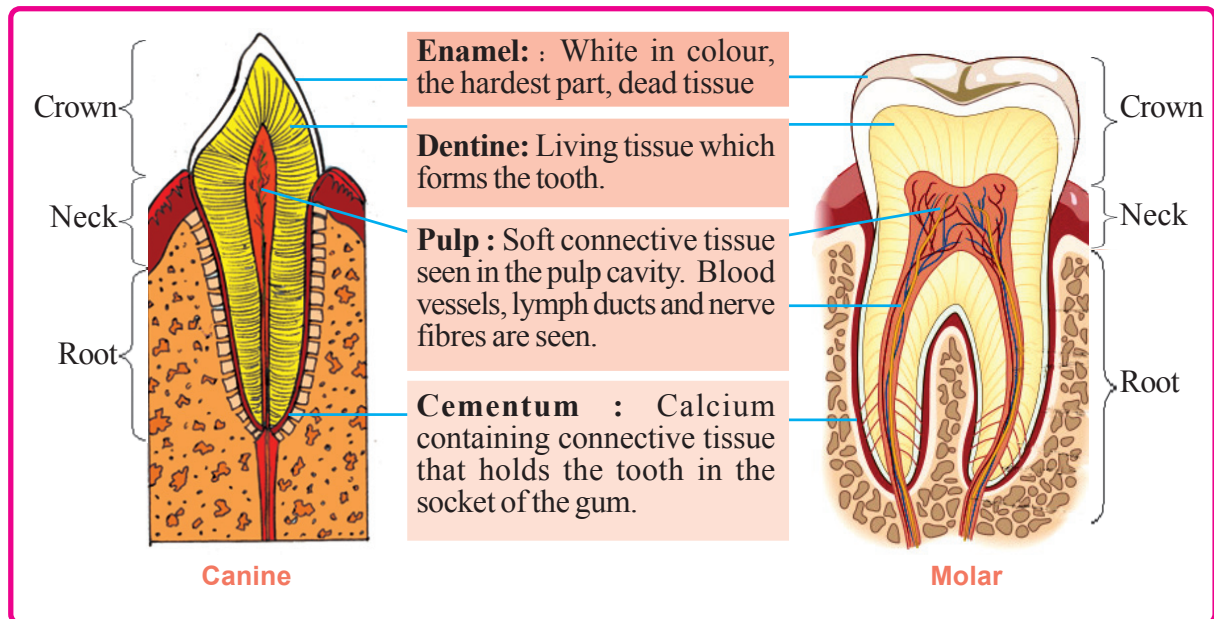


Illustration 2.2 Structure of a tooth

You now know how the structure of teeth is adapted to convert food into smaller particles. What is the role of the tongue in this process? The tongue mixes food items with saliva and helps the teeth to masticate it. The taste buds in the tongue also help us to sense taste.

Had there been no saliva?

Our mouth waters the moment we think of tasty food. Where is saliva produced? Does saliva play any role in the process of digestion?

Based on the indicators, analyse Figure 2.2 and the description given. Write a note on the significance of salivary glands in your science diary.

There are three pairs of salivary glands in the mouth. The saliva secreted from the salivary glands contains mucus and enzymes like

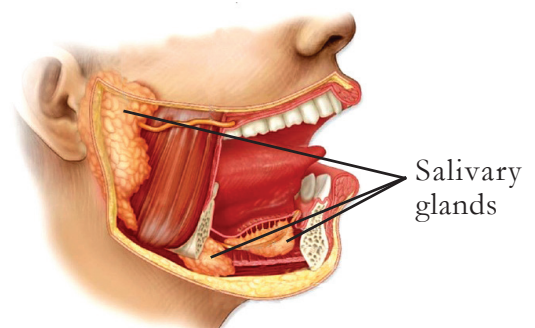


Figure 2.2 Salivary glands

salivary amylase and lysozyme. Mucus makes the food slimy, so that it can be swallowed. Lysozyme, to a great extent, helps to destroy the germs that enter the body through food. Salivary amylase partially converts starch to maltose, a form of sugar.

Indicators

- components of saliva.
- function of saliva.

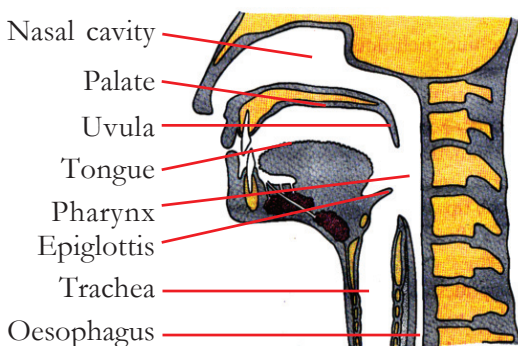
Perform the given experiment to test the action of salivary amylase, with the help of your teacher. Write about the experiment in your science diary.

Procedure

- Take 5 ml each of rice groel in two test tubes.
- Add a few drops of iodine solution in the first test tube and observe the colour change.
- Add 5 ml saliva to the rice groel in the second test tube and shake it well.
- After sometime, take some of it and add some iodine solution to it. Observe the colour change.
- Add 3 ml Benedict's Reagent to the remaining solution and heat it. Observe the colour change.

Hint: When iodine is added to starch, a blue colour appears. When the solution containing sugar like maltose is mixed with Benedict's Reagent and heated, one of the colours- green, yellow, orange or red is formed.

Haven't you now understood the chemistry behind the sweetness of rice when chewed for sometime without any curries?



Into the food pipe

Observe Figure 2.3 showing mouth and its associated parts. From the mouth, food enters the oesophagus through the pharynx. The trachea also begins from the pharynx.

Figure 2.3 Mouth and associated parts

How does the food we swallow enter the oesophagus properly without entering the trachea?

Based on the indicators, analyse Illustration 2.3 and complete the flowchart regarding the swallowing of food.

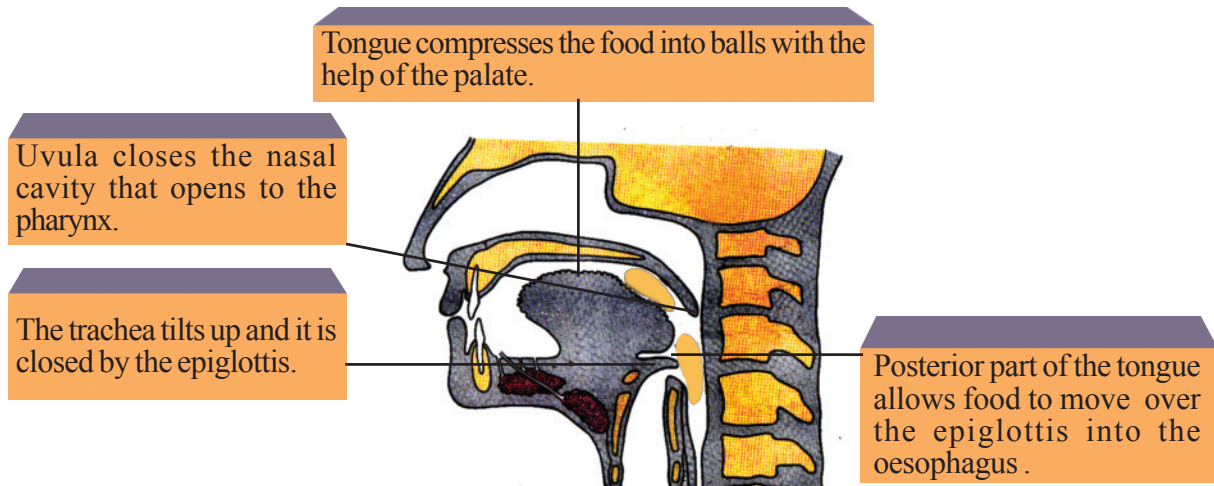


Illustration 2.3 Mode of swallowing of food



Into the Stomach

You know that food reaches the stomach by peristalsis, the wave like movement of the oesophagus..

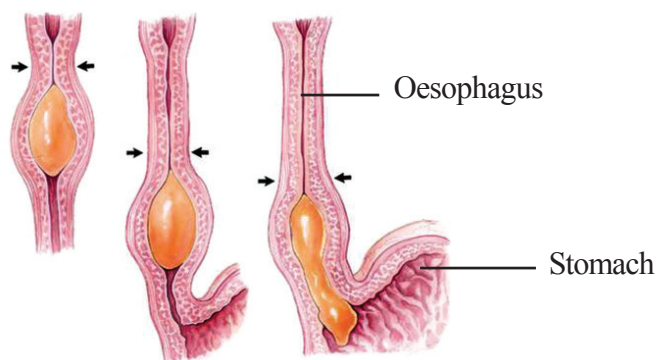


Figure 2.4 Peristalsis in the oesophagus

The partially digested food in the mouth reaches the stomach, where digestion takes place. On the basis of indicators, analyse Figure 2.5 and Illustration 2.4 on the digestive process in the stomach and prepare notes.

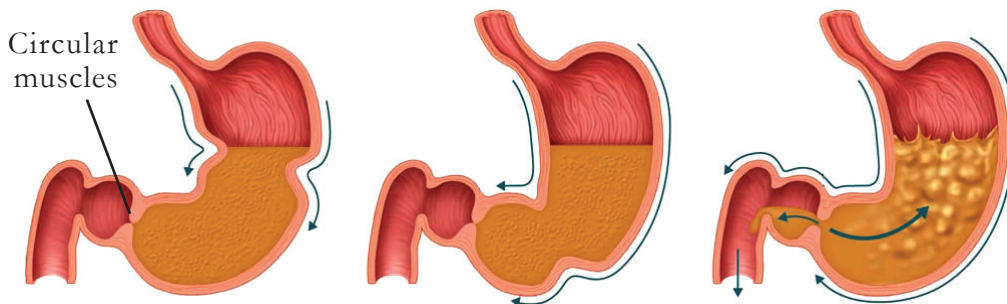


Figure 2.5 Peristalsis in the stomach

Peristalsis in the stomach converts food into a paste-like form. Special kind of circular muscles present in the posterior part of stomach retain food for a specific period. Different components in the gastric juice, secreted by the glands in the stomach wall also play a very important role in the process of digestion.

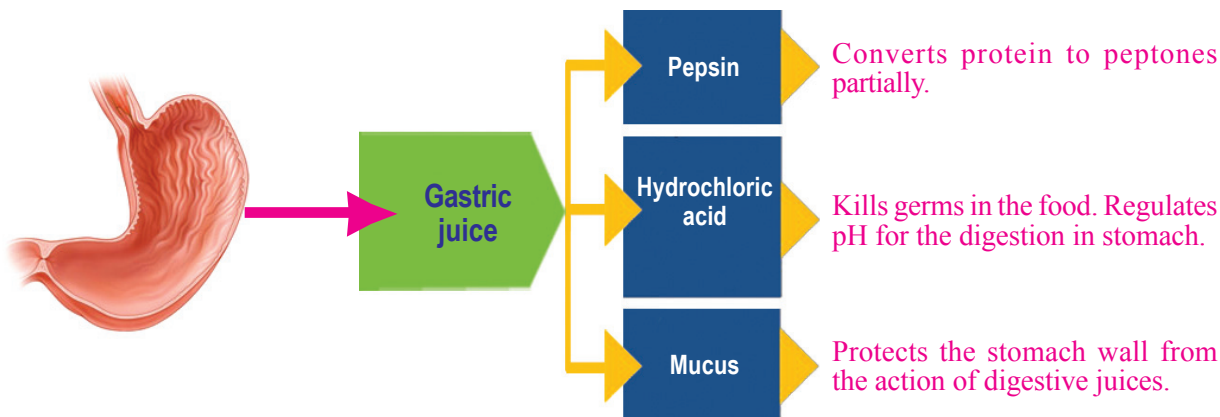


Illustration 2.4 Gastric juice - Components and functions

Indicators

- changes that happen to food while it is in the stomach.
- components in the gastric juice and their functions.

Into the Small Intestine

The digestion of food gets completed and the absorption of digested food takes place in the small intestine. From the stomach, the food in paste form enters the duodenum, the initial part of the small intestine. It reacts with the juices secreted by the liver and the pancreas and digestion continues. Analyse the process of digestion in the duodenum with the help of Illustration 2.5 and indicators and write notes in your science diary.

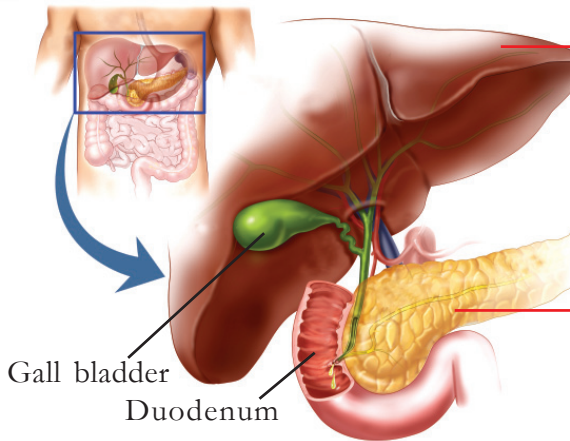


Illustration 2.5 Liver and Pancreas

Liver

The bile secreted by the liver converts fat into small particles and makes the food alkaline. The excess bile secreted by the liver is stored in the gall bladder.

Pancreas

Secretes pancreatic juice. Contains the enzymes - amylase, lipase, trypsin.

Starch	<u>Pancreatic amylase</u>	→	Maltose
Protein	<u>Trypsin</u>	→	Peptides
Fat	<u>Pancreatic lipase</u>	→	Glycerol + Fatty acid

Indicators

- role of pancreas in the process of digestion.
- role of liver in the process of digestion.

The food, almost completely digested, moves forward from the duodenum. With the help of the indicators, analyse Table 2.2 and prepare a note on further digestion within the small intestine.

The path shown by a bullet

Do you know that it was a bullet that helped us to get more information regarding the structure of the stomach and the action of the digestive system? When a bullet unexpectedly penetrated the stomach of Alexis Saint Martin, a shepherd, everybody thought that he would die. But an American doctor, Dr. William Beaumont was not ready to give up hope. He tried medicines and surgeries one after the other. Finally, the shepherd boy was saved. But a hole remained through which the stomach was visible from outside. Through this hole William Beaumont observed the stomach and conducted scientific studies about the stomach and digestion. This study helped us to know more about the digestive system.



Gland	Digestive juice	Enzyme	Action
Intestinal glands	Intestinal juice	Peptidase	converts peptides to amino acids.
		Disaccharidases	
		• Maltase	converts maltose to glucose.
		• Lactase	converts lactose to glucose and galactose.
		• Sucrase	converts sucrose to glucose and fructose.

Table 2.2 Intestinal juice and digestion

Indicators

- enzymes in the intestinal juice.
- digestion of peptides.
- action of disaccharidases.

Nutrients into the Blood

Which are the simple components formed by the digestion of protein, fat and carbohydrate?

Protein:

Fat :

Carbohydrate :

How far is the structure of the small intestine suitable for the absorption of these components? Analyse Illustration 2.6 and the description given. Prepare notes in your science diary.

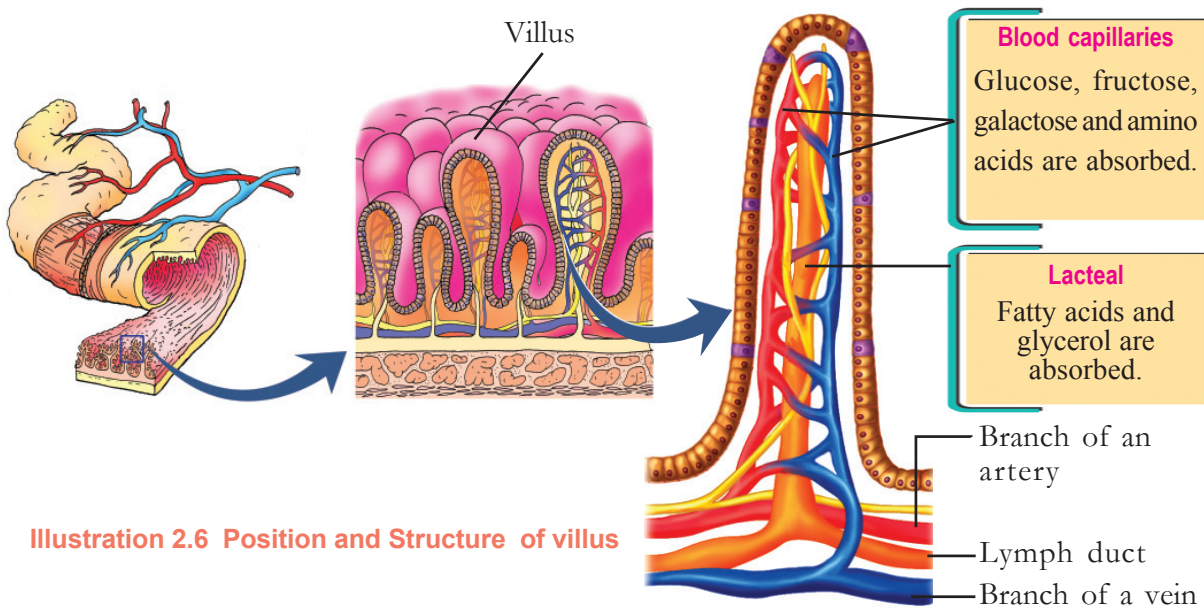


Illustration 2.6 Position and Structure of villus

The small intestine of humans is about 5-6 metres long. It is highly folded and forms a network in the abdominal cavity. So movement of food through the small intestine is very slow. Moreover many foldings are seen in the inner wall of small intestine. This helps in the process of digestion. Villi are small finger like projections seen in the walls of the intestine. These increase the area of absorption

of nutrients to a great extent within the small intestine. Villi are covered with a single layer of cells. They also contain blood capillaries and lacteals, the lymph capillaries. Absorption of nutrients and 90 percent of water absorption take place in the villi.

Indicators

- length of the small intestine.
- villi and the surface area of absorption.
- absorption of simple molecules into the blood capillaries.
- absorption of simple molecules into the lacteals.

Into the Large Intestine

The digestive wastes left after the absorption of nutrients move towards the large intestine. Salts and water left after the absorption in the small intestine, are absorbed in the large intestine. Certain bacteria residing in the large intestine produce substances like vitamin K. Absorption of these substances also takes place in the large intestine. After this, the wastes are stored in the rectum and are excreted out through the anus.

Through the Process of Absorption

You have understood that nutrients are absorbed by our body. Certain processes help in the transport of materials across the cells. Based on the indicators, analyse the following description and write down the facts in your science diary.

Diffusion

Observe Figure 2.6. Diffusion is the movement of molecules from a region of higher concentration to a region of lower concentration. By diffusion, molecules move across the cell through the cell membrane.

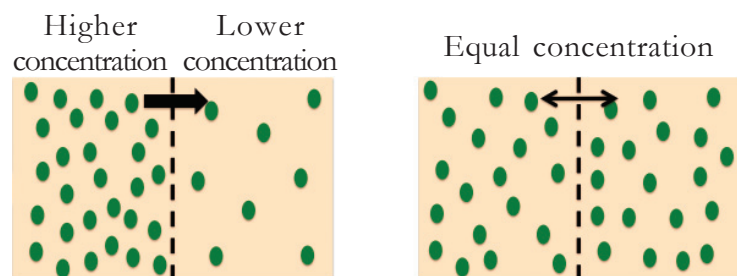


Figure 2.6 Diffusion

This process continues till the concentration becomes equal in both sides of the membrane. This process does not require any energy.

Eg: Absorption of fatty acids and glycerol into lacteals.

Osmosis

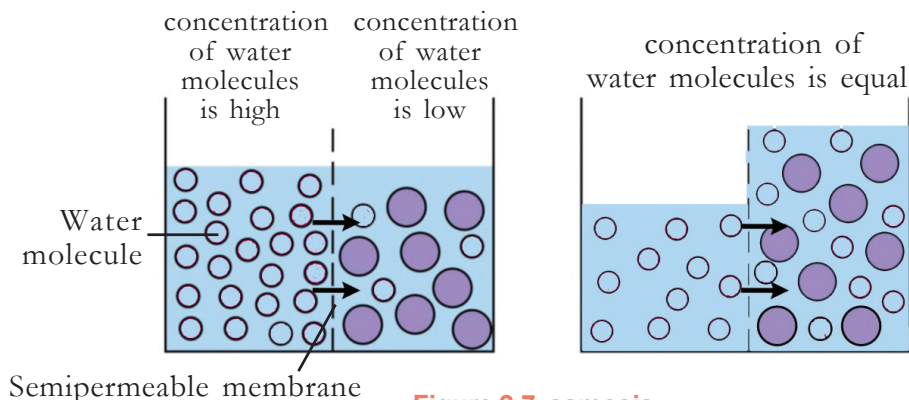


Figure 2.7 osmosis

Observe Figure 2.7. Osmosis is the movement of water molecules from a region of higher concentration to a region of lower concentration across a semi -

permeable membrane. This process continues till the concentration becomes equal. Energy is not utilized in this process.

Eg: Absorption of water in the small intestine and the large intestine.

Diffusion of certain molecules takes place with the help of protein molecules in the cell membrane. This process is called facilitated diffusion. Absorption of glucose, fructose, galactose and amino acids into blood capillaries is an example for facilitated diffusion.

At times, molecules are absorbed with the help of carrier proteins against the concentration gradient. This process utilizes energy and is called active transport. Absorption of glucose and salts is an example for this.

Indicators

- Which are the processes that help in the transport of substances in cells?
- What are the differences and similarities between diffusion and osmosis?
- How does diffusion differ from facilitated diffusion?
- What is the difference noticed in active transport in comparison to other processes?

The process of digestion is completed through many complex actions in the digestive tract. It requires about 4-5 hours. Hence it is necessary to arrange the intake of food accordingly. The nutrients derived from digestion maintains our health. If we choose food only on the basis of taste, we may not have an adequate intake of all nutrients. Regular use of cola drinks, fried foods, foods containing artificial colour and preservatives etc., are not good for health. We should cultivate a food habit that helps to maintain the health of the digestive system and its easy functioning.



Significant learning outcomes

The learner

- explains the structure and arrangement of teeth in relation to digestion.
- analyses and presents the changes that happen to food during digestion.
- recognises the role of various enzymes in digestion and explains their actions.
- explains how the structure of the small intestine helps in absorption.
- analyses and presents the importance of nutrients.
- explains various processes involved in material transport.
- identifies healthy food habits and practises them in life.



Let us assess

1. Identify the correct statements with regard to bile.
 - A) Secreted in liver
 - B) Enzymes are seen
 - C) Secreted into the stomach
 - D) Converts fat into tiny particles

2. Complete the table related to the process of digestion in humans.

Part of digestive tract	Enzyme	Action
Mouth	Starch → Maltose
.....	Pepsin
Small intestine	Maltose → Glucose
.....	Peptidase

3. How does the structure of the small intestine help in increasing the surface area of absorption?



Extended activities

- Making use of available materials, make a model of teeth showing its internal structure, and exhibit it in the class.
- Organise a debate on 'Traditional food and fast food' under the auspices of the School Health Club.

3

Tissue to Tissue

*Nutrients formed as a result of digestion reach cells.
How do they reach cells?*

Didn't you notice Deepu's doubt? What is your opinion? The energy required for carrying out metabolic activities is released from simple molecules formed as a result of digestion. This takes place in cells. Hence these nutrients must be carried to the cells. It is blood which performs this function. What are the other functions of blood? Observe Illustration 3.1. Prepare notes related to the functions of blood.

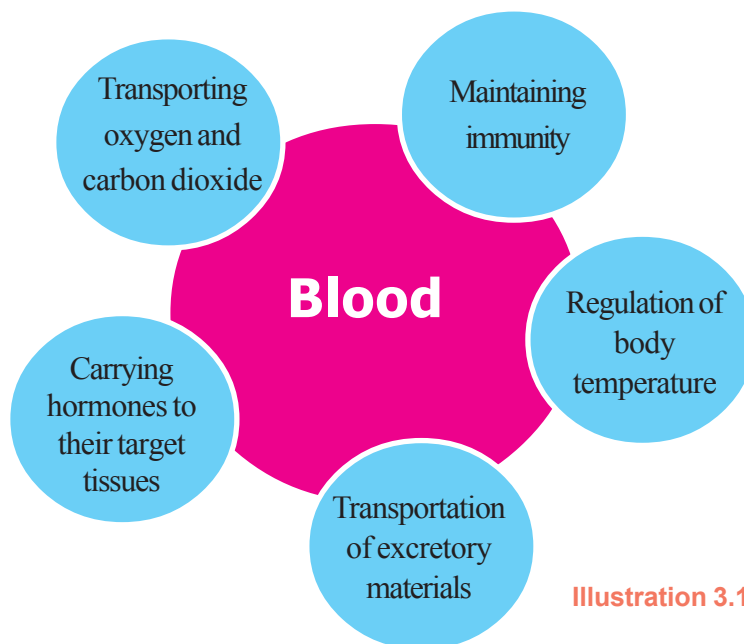
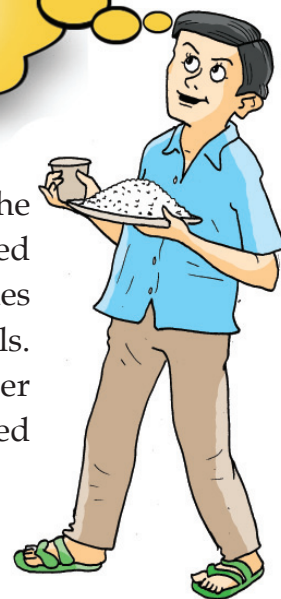


Illustration 3.1 Functions of blood

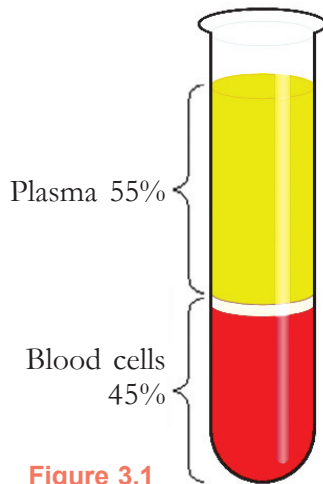


Figure 3.1
Components of blood

Haven't you understood the importance of blood? As blood performs so many functions, its loss will adversely affect the normal body activities. The composition of blood is suitable for performing various functions. Blood is a fluid connective tissue, which contains two parts- the fluid part named plasma and blood cells.

If you add chemicals like EDTA (Ethylene Diamine Tetra Acetic Acid) that prevents coagulation of blood, in a test tube that contains blood after sometime blood cells and the fluid part can be seen distinctly. Observe Figure 3.1 and identify the differences between these factors.

Plasma

Plasma is the straw yellow coloured fluid that constitutes 55% of blood. Blood cells are found in the plasma. The simpler molecules formed as a result of digestion, namely glucose, amino acids, fatty acids, glycerol etc., reach cells through the plasma. With the help of the indicators, analyse Illustration 3.2 given below on plasma.

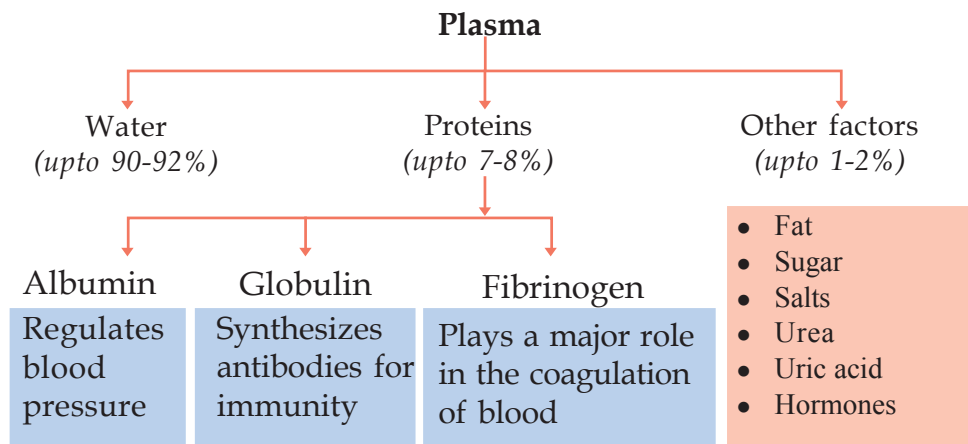


Illustration 3.2 Plasma-components

Indicators

- major components of plasma.
- functions of plasma.
- proteins in plasma.

Observe the permanent slide of blood cells through a microscope. Compare the observed picture with those in Table 3.1. Which are the blood cells you can identify? Complete Figure 3.2.

Analyse Table 3.1 and prepare notes regarding different types of blood cells in your science diary.

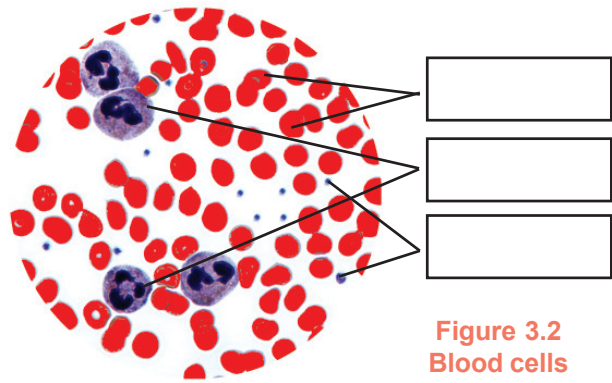


Figure 3.2
Blood cells

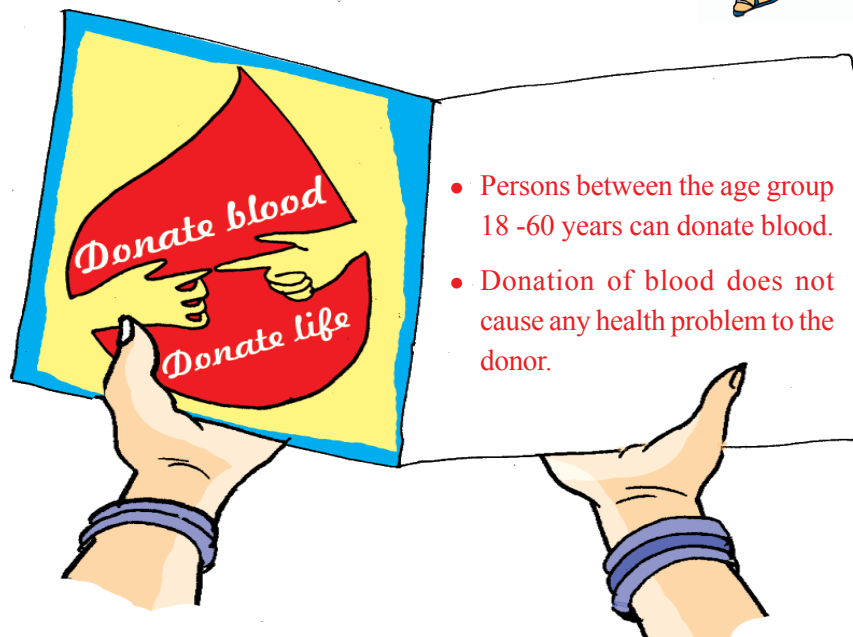
	Erythrocytes (RBC)	Leucocytes (WBC)	Platelets
Feature		<p>Basophil Neutrophil Eosinophil</p> <p>Lymphocyte Monocyte</p>	
Shape	Disc shaped	No definite shape	No definite shape
Nucleus	Absent	Different shapes	Absent
Colour	Red	Colourless	Colourless
Pigment	Haemoglobin	Absent	Absent
Normal count (per milli liter)	Between 45 to 60 lakh	Between 5000 to 10000	Between 2.5 to 3.5 lakh
Function	Transport of respiratory gases	Immunity	Blood clotting

Table 3.1 Blood cells- peculiarities

A healthy adult has 5 to 5.5 litres of blood in his body. Decrease in the amount of blood due to disease, bleeding etc., may lead to many complications. In such instances, another person's blood is required to maintain life.



Did you notice Mini's doubt?
Read the pamphlet given below.



"Donate blood-Donate life." Why is this so?

Prepare and exhibit a poster based on the greatness of blood donation.

Blood Vessels

You know that blood flows continuously through blood vessels all over the body. Blood vessels can be seen if you closely observe

your hands, feet, eyes etc. Are all blood vessels alike? Observe Illustration 3.3 to know more about blood vessels.

Vein

- carries blood to the heart.
- thin wall.
- valves are seen.
- transports blood in low speed and low pressure.

Artery

- carries blood from the heart.
- thick wall.
- no valves.
- carries blood in high speed and high pressure.

Capillaries

- thin vessels that connect veins and arteries together.
- wall is formed of a single layer of cells.
- minute pores on the walls.
- no valves.
- transports blood in low speed and low pressure.

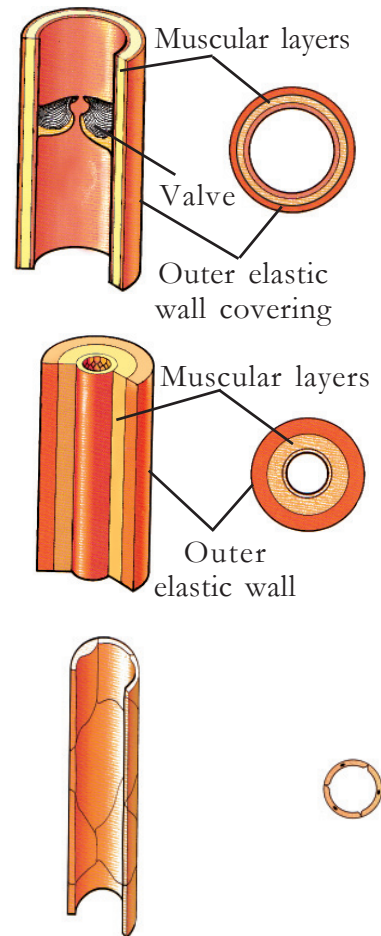


Illustration 3.3 Various kinds of blood vessels

Complete Table 3.2 listing the characteristics of different types of blood vessels.

Characteristics	Artery	Vein	Capillary
Wall			
Valves			
Blood transportation			

Table 3.2 Characteristics of blood vessels

Large arteries arising from the heart split into small arteries and these, in turn, split into capillaries. The capillaries unite to form small veins and these smaller veins unite to form larger veins and finally reach the heart.

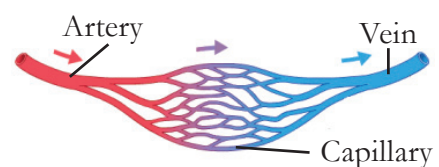


Figure 3.3 Blood vessels

From the Blood to the Cells

Blood flows only through blood vessels in human beings. If so, how do cells get oxygen, nutrients and other essential factors from blood?

Based on the indicators, analyse Illustration 3.4 and its description and write your inferences in the science diary.

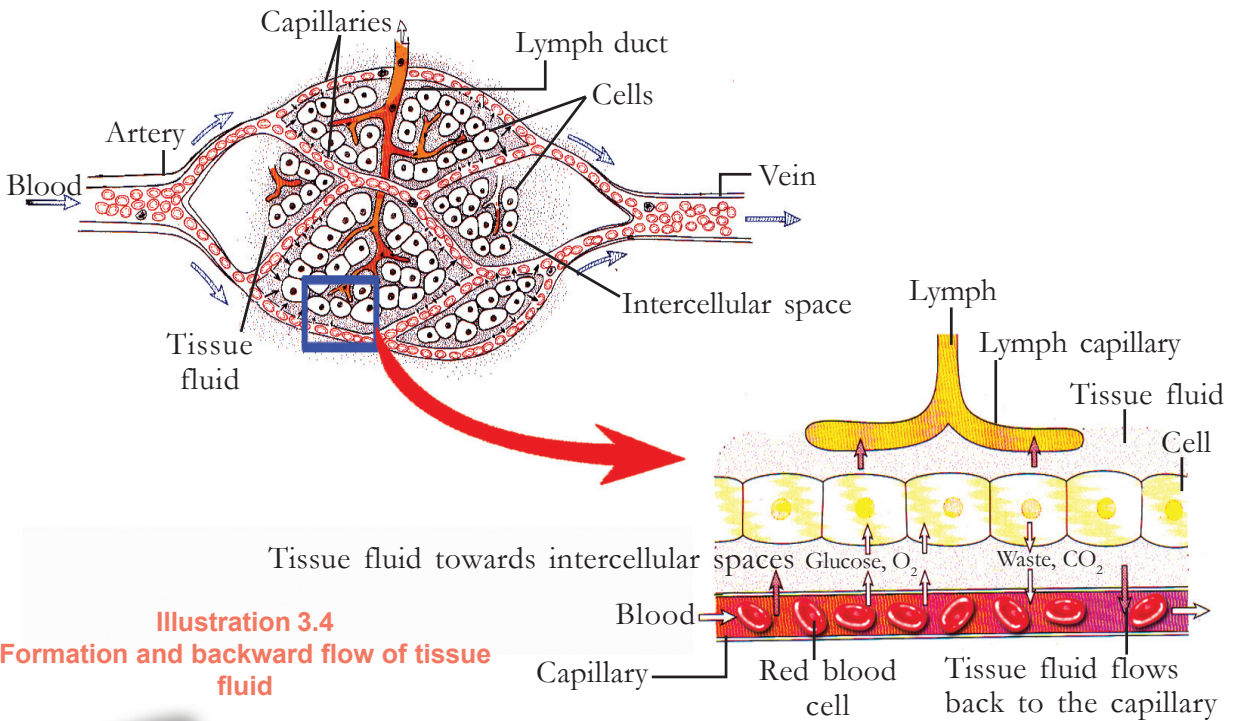


Illustration 3.4
Formation and backward flow of tissue fluid

Blood circulation - open and closed

Besides human beings, in many other organisms too blood flows through blood vessels. Here blood does not directly reach cells. This type of circulation is called closed circulation. But in organisms like cockroach, spider etc., a fluid similar to the blood, haemolymph is filled in body cavities. This fluid is in direct contact with tissues. This type of circulation is called open circulation.

When blood flows through capillaries the plasma oozes to the intercellular spaces through minute pores of the capillary wall. This fluid, formed in the intercellular space, is the tissue fluid. It does not contain RBCs and large protein molecules. Exchange of materials takes place between the tissue fluid and cells. Nutrients, oxygen and other essential factors are absorbed into cells. Carbon dioxide, and other wastes are given out from cells.

Indicators

- transportation of nutrients from blood.
- transportation of wastes from cells.
- formation of tissue fluid.

Conduction, through Lymph too

The lymphatic system is as important as the circulatory system in transporting nutrients and in providing immunity. Based on the indicators, analyse Figure 3.4 and its description and prepare a note on the lymphatic system.

Besides blood capillaries, small vessels with their one end closed are seen in intercellular spaces. These are the lymph capillaries. The major portion of tissue fluid in intercellular space returns to the blood capillaries. The remaining tissue fluid enters the lymph capillaries. The tissue fluid that reaches the lymph capillaries is called lymph. As in the tissue fluid, lymph also has no red blood cells or large protein molecules.

Lymph capillaries are united to form small lymph ducts. These small lymph ducts are united to form larger lymph ducts which open to the venacava. The lymphatic system consists of large and small lymph ducts, lymph nodes, lymph and spleen. Lymph helps to bring the tissue fluid back to blood. Besides, it helps in the absorption and transport of fatty acids and glycerols from the small intestine.

The lymph nodes seen at intervals in the lymph ducts are the major production centre of lymphocytes, a kind of white blood cells. When lymph passes through these nodes, the white blood cells destroy the pathogenic bacteria that are present in it. Thus lymphatic system participates itself in the defense mechanism of the body.

Indicators

- lymph capillaries and lymph.
- parts of the lymphatic system.
- functions of the lymphatic system.

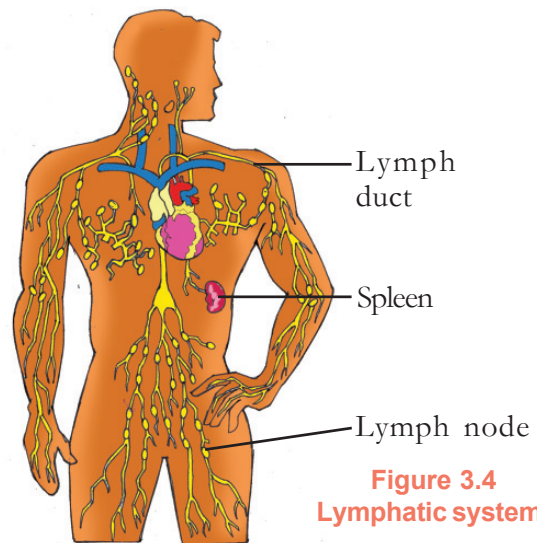
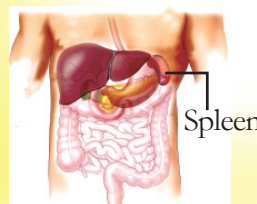


Figure 3.4
Lymphatic system

Spleen

Spleen is the largest organ in the lymphatic system. It is situated at the left side of the stomach in the abdominal cavity. Destruction of germs and inactive red blood cells is the main function of spleen. As it stores blood in small quantities, it is also known as the blood bank of the body.



What is the role of heart in blood circulation? Analyse the description related to the structure of heart and Figures 3.5 and 3.6 given below and complete Illustration 3.5.

Heart

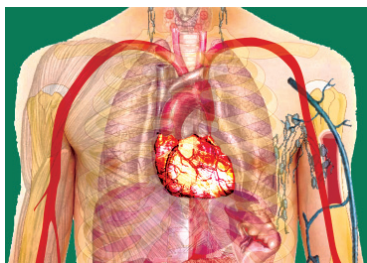


Figure 3.5
Position of heart

The human heart resembles two pumps placed side by side. As the heart works continuously like a pump, blood flows through blood vessels. The heart is situated slightly tilted towards left in between the two lungs behind the sternum in the thoracic cavity. The human heart is of conical shape. The size of one's heart is equal to the size of his/her fist. Pericardium is a double layered membrane that covers the heart. Pericardial fluid is filled in between the pericardial membranes. This fluid helps to reduce friction between the membranes during the heart beats.

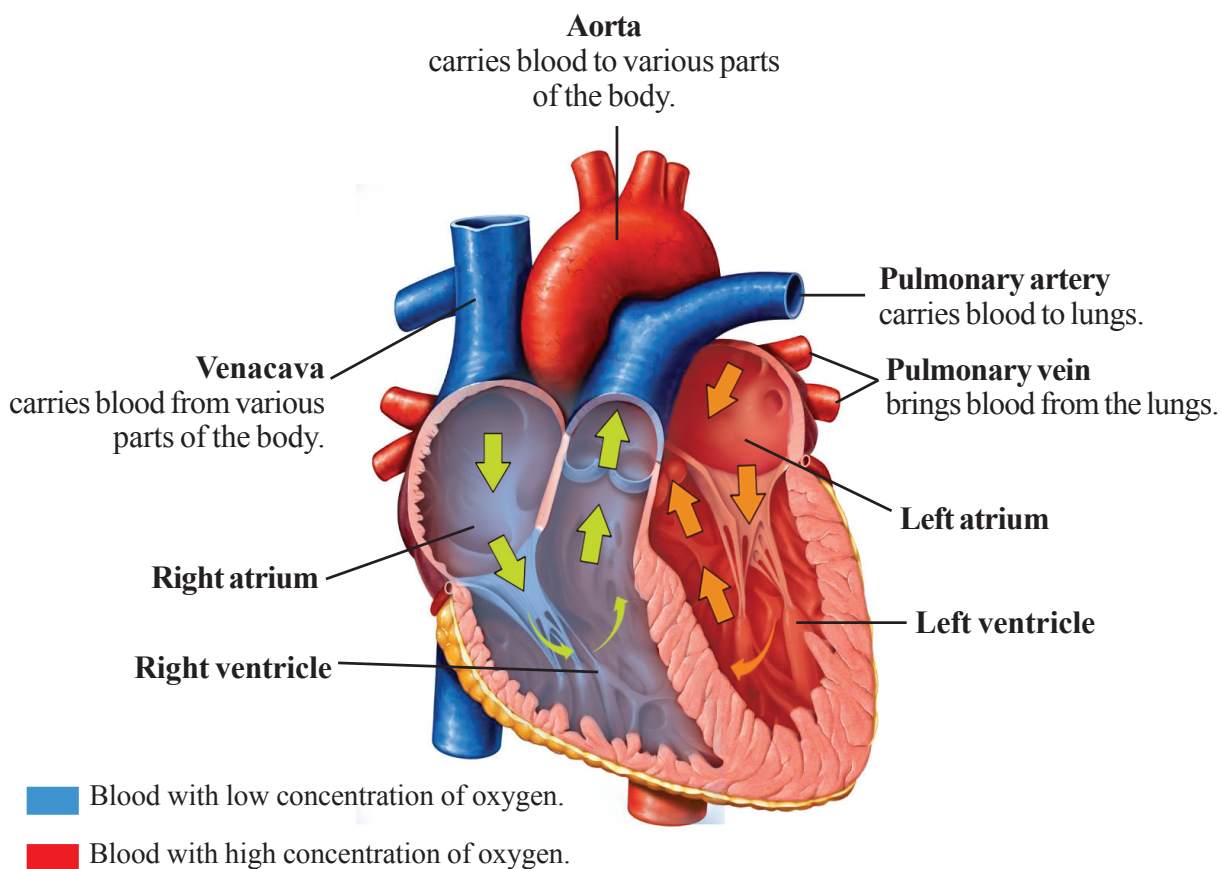


Figure 3.6 Longitudinal section of the human heart

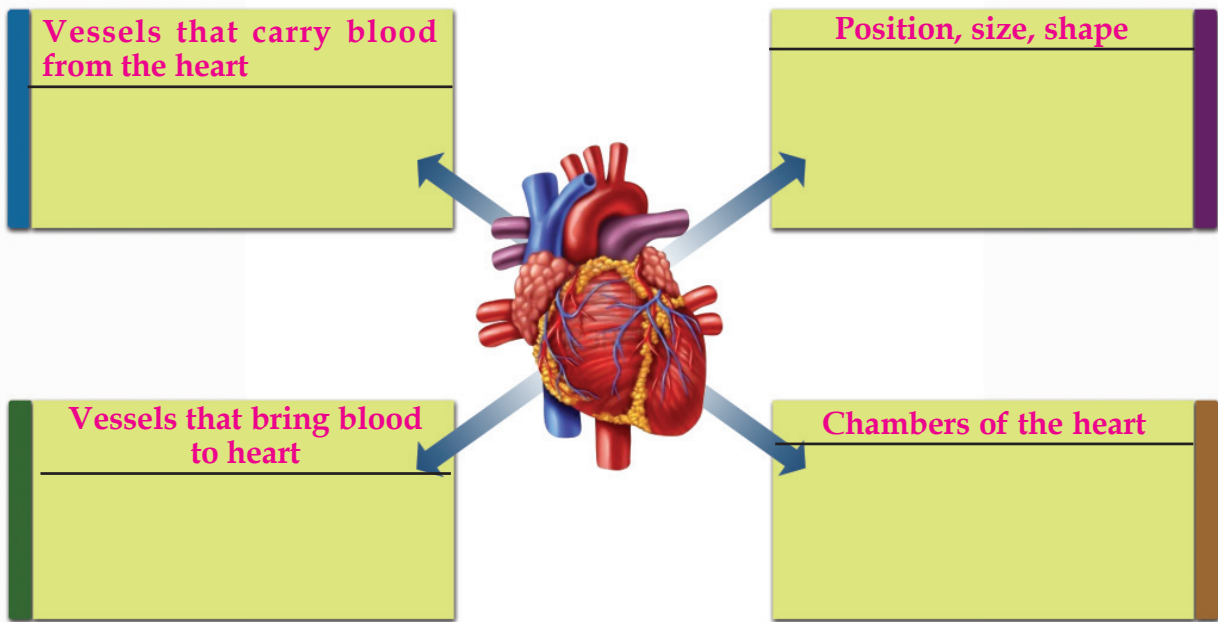


Illustration 3.5 Heart and related blood vessels

Chambers of the heart are separated from each other by muscular walls. The walls of ventricles are thicker than that of atria. The wall of left ventricle is the thickest one. What may be its reason?

Valves regulate the flow of blood through the heart.

Analyse Figure 3.7 showing the major valves of the heart and complete Table 3.3.

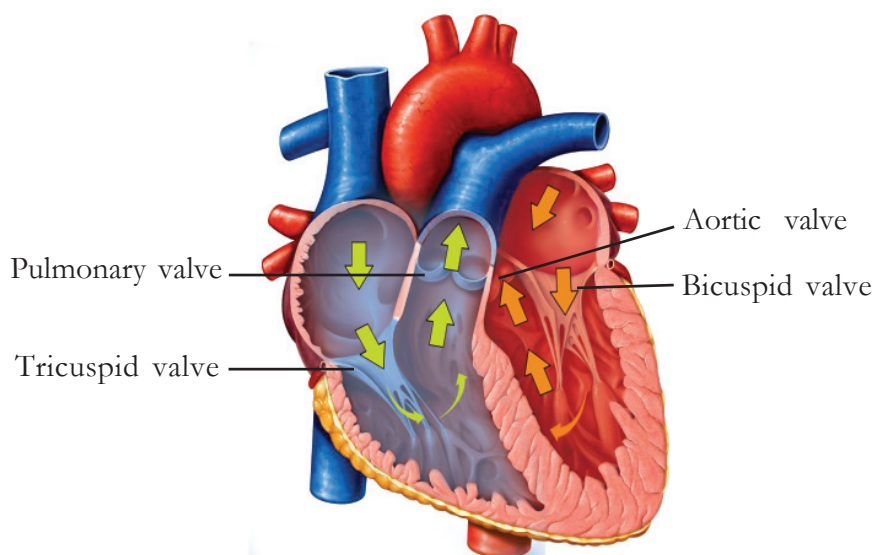


Figure 3.7 Valves in the heart

Valve	Position	Function
<ul style="list-style-type: none"> • Bicuspid valve 	<ul style="list-style-type: none"> • 	<ul style="list-style-type: none"> • Helps blood to enter the left ventricle from the left atrium. • Prevents the backward flow of blood from the left ventricle to the left atrium.
<ul style="list-style-type: none"> • 	<ul style="list-style-type: none"> • Between the right atrium and the right ventricle. 	<ul style="list-style-type: none"> • •
<ul style="list-style-type: none"> • Pulmonary valve 	<ul style="list-style-type: none"> • 	<ul style="list-style-type: none"> • Prevents the backward flow of blood from the pulmonary artery to the right ventricle.
<ul style="list-style-type: none"> • 	<ul style="list-style-type: none"> • Where the aorta originates. 	<ul style="list-style-type: none"> • Helps blood enter the aorta. •

Table 3.3 Valves of the heart

Continuous and rhythmic beating is a characteristic feature of the heart. Initiation of the contraction and relaxation of the heart and regulation of the heartbeat rate are carried out by the special muscles of Sino Atrial Node (SA node) at the anterior part of right atrium. This part is called pacemaker.

Stages of heartbeat

Analyse Illustration 3.6 and prepare a brief note on heartbeat in your science diary.

1. Blood reaches the atrium from the lungs and other parts of the body. Blood fills in atria. Atria dilate fully. Naturally blood flows from atria to the ventricles. Ventricles partially get filled with blood.

2. Atria contract. The remaining blood in the atria flows completely to the ventricles. Ventricles dilate fully.

3. Ventricles contract completely. Cuspid valves close. Blood flows out through aorta and pulmonary artery.

4. Atria and ventricles dilate simultaneously. One heart beat completes. First stage repeats.

Illustration 3.6 Heartbeat-stages

Contraction of the chambers of the heart is termed as systole. During this phase, blood flows from atria to ventricles and from ventricles to outside. Along with atria, ventricles also relax. This stage of relaxation is termed as diastole. In this phase, blood fills in the chambers of the heart. One systole and the subsequent diastole together constitute a heartbeat. It takes about 0.8 seconds.

About 70 ml of blood is pumped into the arteries during each heartbeat. The pressure exerted by this excess blood to the walls of the arteries is systolic pressure. It is about 120 mm Hg. When the heart dilates fully the same amount of blood enters the heart. A low pressure felt in the arteries, in this phase, is known as diastolic pressure.

It is about 80 mm Hg. The blood pressure of an individual is expressed in terms of these two pressures. Sphygmomanometer is the instrument used to measure blood pressure.

The heart beats at an average of 72 times/minute. The wave like movement formed due to the contraction and relaxation of the heart is felt throughout the walls of the arteries. This is called pulse. Rate of pulse is equivalent to that of the heartbeat. Let's check our pulse. Observe Illustration 3.7 and try it.



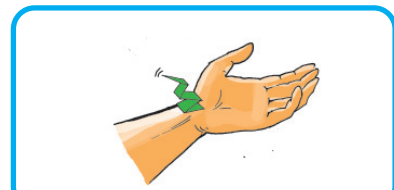
Figure 3.8
Sphygmomanometer



Cut a paper in a triangular shape. Fold it as shown in the figure



Identify the pulse point in your wrist.



Place the paper at that point. Observe the movement at the tip of the paper.

Illustration 3.7 Let us know our pulse

Note the number of pulses in a minute, by observing the movement of paper. After doing some exercise for a few minutes, take the pulse again. What difference do you notice? What is its reason? What are the other parts of the body where we can feel the pulse?

- both sides of the forehead.
-

Double Circulation of Blood

Carrying oxygen to cells is one of the major functions of blood. Oxygen is absorbed into the blood from the lungs. The oxygenated blood that reaches the heart through pulmonary veins, is supplied to all parts of the body through the aorta. Analyse Illustration 3.8 and the following description and complete the flowchart relating the circulation of blood.

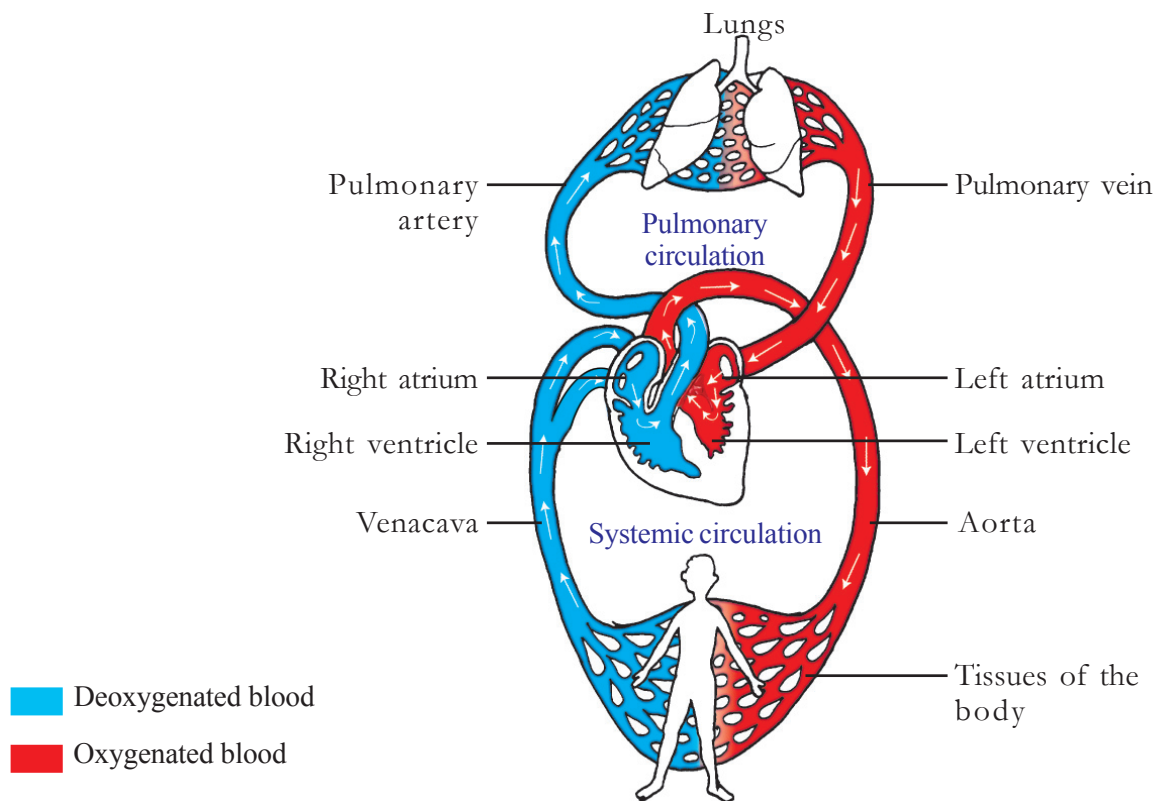
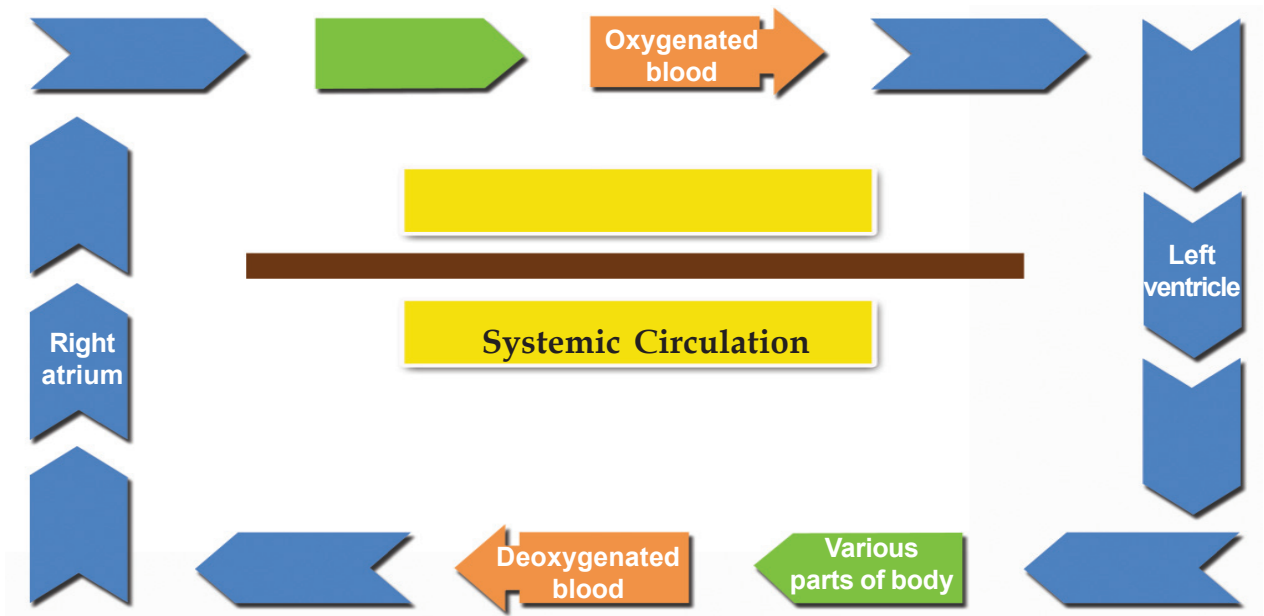


Figure 3.8 Double circulation of blood

It is clear from the illustration that the same amount of blood passes through the heart twice. This type of circulation is called double circulation. It includes pulmonary circulation and systemic circulation. The blood circulation that starts from the right ventricle to the lungs and from there to left atrium is called pulmonary circulation.

The circulation that starts from the left ventricle and ends in the right atrium after circulating throughout the whole body is called systemic circulation. Double circulation helps to maintain the level of oxygen in blood.



Portal Circulation

Veins are the vessels that carry blood from various organs to the heart. But certain veins do not reach the heart and they carry blood from organ to organ. These are called portal veins. They begin from one organ as capillaries and end in another organ as capillaries. Portal system is the system of circulation in which portal veins are included. The hepatic portal system is an example for it.

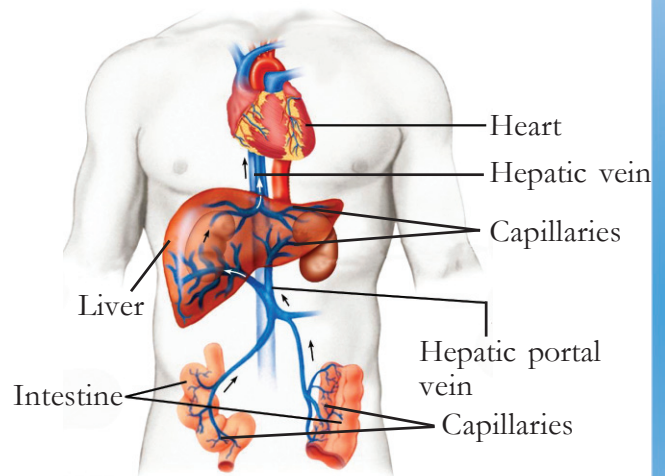
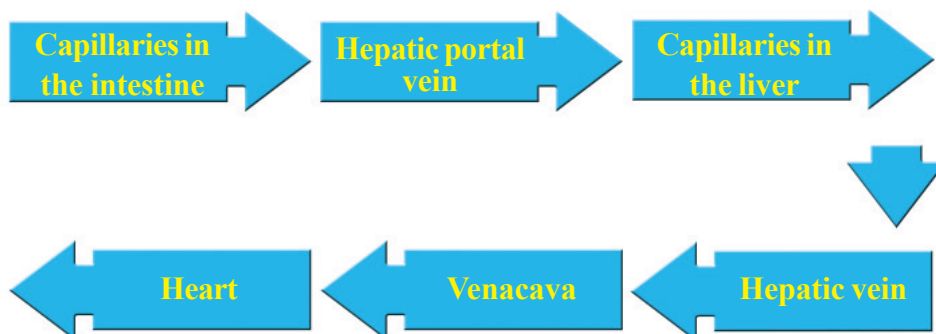


Figure 3.9 Hepatic Portal System

Observe Figure 3.9 and the flowchart given. Draw inferences with regard to the hepatic portal system.



Why do nutrients reach the liver?

Liver is the centre of metabolism. The nutrients that are formed by digestion undergo many changes in the liver. They include storing of glucose as glycogen, releasing of energy from fatty acids, producing cholesterol etc. Besides, specific defense cells in the liver destroy the pathogens that enter the blood from the digestive tract.

A Healthy Heart – Vital for Life

A day for healthy heart too! What is the significance of this day?



The number of people suffering from cardiac diseases is increasing day by day. Changing food habits, lack of exercise etc., are the factors that affect the health of the heart.

It is very important to protect the health of our circulatory system. Based on the indicators, analyse the given description on the health of heart and write a note in your science diary.

Consumption of excess fatty food leads to the accumulation of fat in the arterial walls. This condition is called atherosclerosis. As a result of atherosclerosis the inner diameter of the artery reduces. Moreover, the arterial walls become rigid, losing their elastic nature. When blood is pumped into the vessel that has lost its elasticity, the blood pressure increases. This increases the possibility of smaller arteries to break, which causes internal bleeding. Likewise, the accumulated fat roughens the inner wall of blood vessels. Here platelets and RBCs may clump together to form blood clots, named

thrombus. This condition is called thrombosis. Formation of thrombus in the coronary arteries which supplies blood to the heart, may cause heart attack.

Proper food habit and regular exercise play an important role in reducing the level of fat in blood. Thus we can maintain the health of the heart and the circulatory system.

Please don't reduce my life span and health.



Indicators

- causes and consequences of atherosclerosis.
- exercise and cardiac care.

Conduct a seminar on "Lifestyle and Cardiac health" collecting more information.

Transportation in Plants

As in animals, substances are transported in plants too. You have studied about the vascular tissues in plants. Complete the table of vascular tissues in plants and their functions.

Vascular Tissue	Function
Xylem	

Table 3.4 Vascular tissues in plants and their functions

Conduction – through Xylem

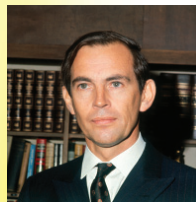
Vascular tissues in plants extend from the roots to leaves, in an interconnected manner. You know that the water and salts that roots absorb from the soil reach the leaves through xylem, the vascular tissue.

Transportation of water takes place through tracheids and vessels, the dead cells of xylem. The diameter of vessels is greater than that of tracheids. Vessels are arranged one above the other. As the cell walls between the vessels disintegrate, they look like long pipes.

Heart Transplantation



The life of a person with a critically damaged or diseased heart can be sustained by replacing it by a healthy donor heart. The first heart transplantation was done on 3rd December 1967 by Dr.Christian Bernard.



Dr.Christian Bernard

The donor hearts are procured from persons who are declared brain dead because of various reasons.

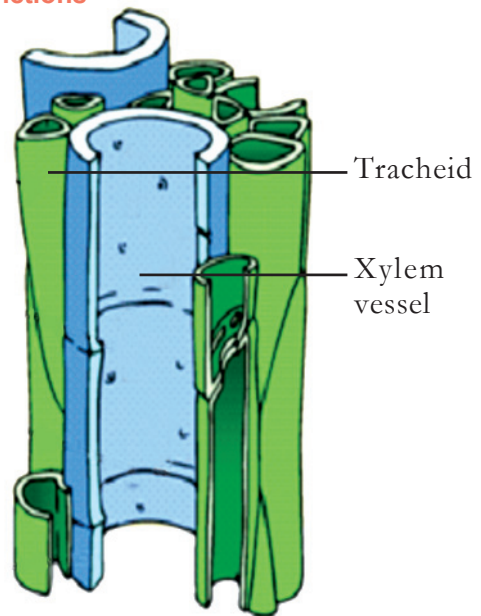


Figure 3.10 Xylem



Did you notice Aby's doubt?

How does water reach the tree-top through the xylem naturally? This happens due to the combined action of many processes. Let us examine these processes. Transpiration, root pressure, cohesion and adhesion are important among them.

Transpiration can be observed through a simple experiment. Take two potted plants. One with leaves and the other without leaves. Cover them using transparent polythene bags as shown in Figure 3.11.

Examine both the bags after sometime. What changes do you observe?

- Where did the water droplets come in the bag that covered the plant with leaves?

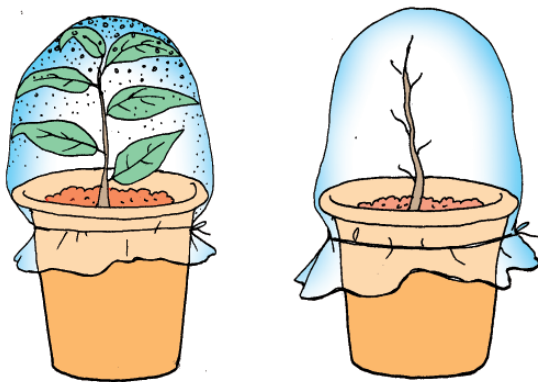


Figure 3.11

Only the bag that covered the plant with leaves contains water. It can be inferred from this, that the water comes from leaves. Water is expelled from leaves due to evaporation. This process is called transpiration.

What is the role of transpiration in transporting water absorbed by the roots to the leaves? Analyse Illustration 3.9 and the description given. Write a note on how water reaches leaves from roots in your science diary.

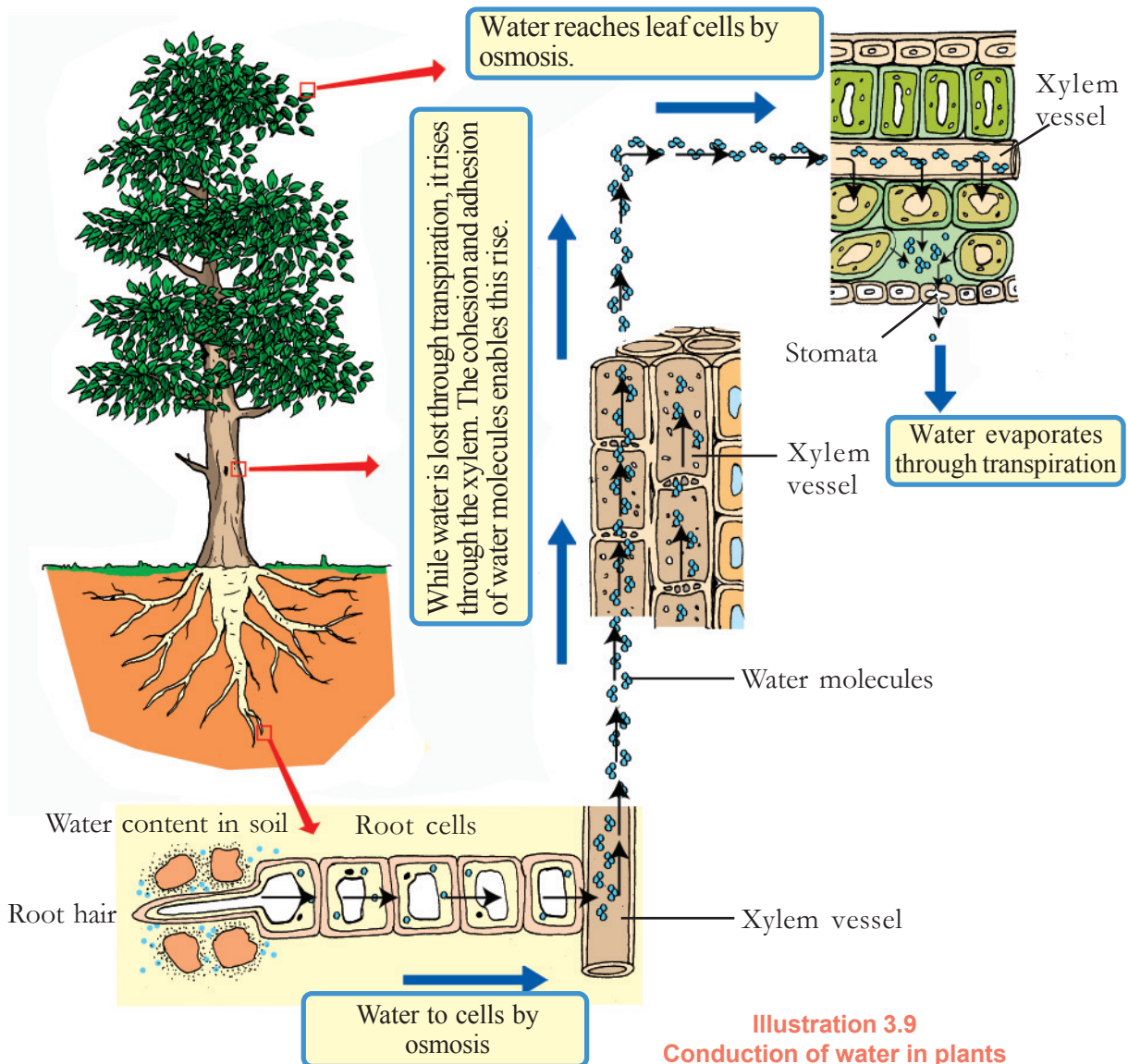


Illustration 3.9
Conduction of water in plants

Water is lost from the intercellular spaces of leaves through stomata by transpiration. It reduces the pressure in the cells of leaves. In order to compensate this pressure difference, water enters these cells from adjacent cells through osmosis. The transpiration pull developed due to transpiration helps to carry water to heights. Besides this, water molecules have the capacity to stick to themselves and with the walls of the vessels through which they move. These processes are known as cohesion and adhesion respectively. Along with these, the root pressure developed in the cells of root due to absorption of water also helps in raising water.

Phloem

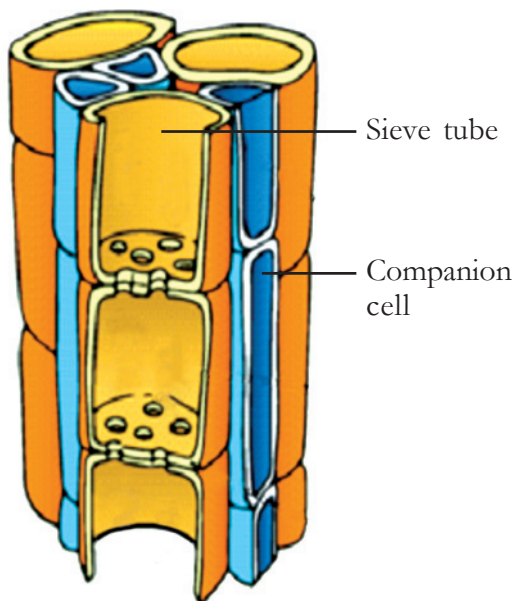


Figure 3.12
Phloem

Food is transported in the form of sucrose through the sieve tube, the main part of the phloem. Like xylem vessels, sieve tubes are also seen as pipes arranged one above the other. But differing from xylem vessels, pores are seen in their cross walls. Through these pores, the cytoplasm of sieve tubes are interconnected through which food molecules can travel. Companion cells are seen along with sieve tubes. They also help in the transportation of food.



Significant learning outcomes

The learner

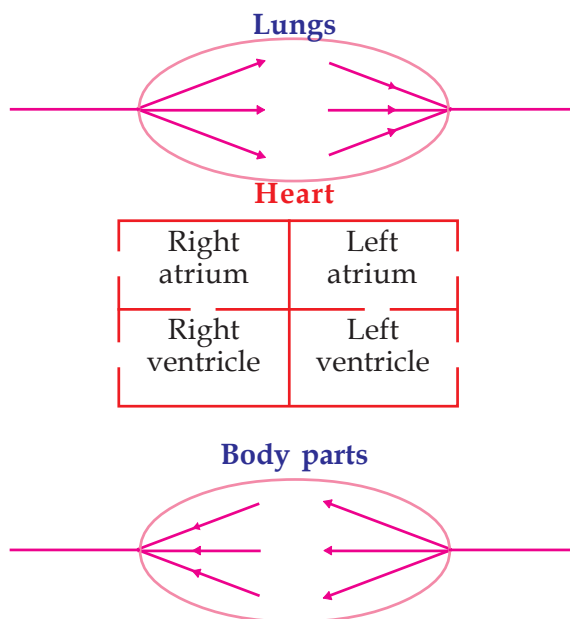
- analyses and presents clearly the role of blood in the transportation of various nutrients in the body.
- analyses and explains how the structure of blood is suitable for the transportation of various nutrients.
- develops positive attitude towards blood donation by recognising its greatness and participates in awareness programmes to motivate others for blood donation.
- identifies the structure and function of the circulatory system in humans and explains its importance in the transportation of materials.
- explains the structure of heart, arteries, veins and capillaries.
- identifies and explains the significance of the lymphatic system in the transportation of materials.

- identifies the importance of cardiac health, analyses and presents the need for adopting a healthy life style.
- identifies and explains the role of xylem and phloem in the transportation of materials in plants.
- analyses and presents the physical processes that help in the transportation of materials in plants.



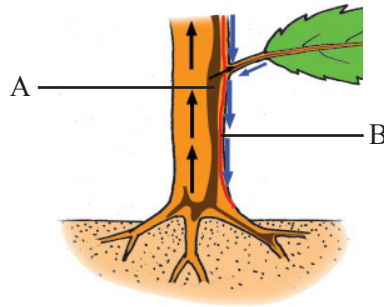
Let us assess

- Which of the following is not a characteristic of RBC?
 - Disc shape
 - Red colour
 - Nucleus of different shapes
 - Haemoglobin is seen
- Observe the illustration of the lungs, the heart and body parts.



Copy the illustration and connect the lungs and body parts to the heart using lines. Also show the route of blood flow.

3. Observe the figure showing the transportation of water and minerals plants.



- a. Identify the vascular tissues indicated by A and B.
- b. Name the processes that help water absorbed by the roots to reach the leaves.
- c. In some plants, the rate of transpiration is very high. Does it affect the availability of water in that locality? Why?



Extended activities

1. Construct a model of double circulation using coloured threads, thermocol etc. Direction of flow of blood also should be shown.
(Part where oxygenated blood is present - red colour
Part where deoxygenated blood is present - blue colour)
2. Prepare a science excerpt including information regarding care of Cardiac Health.



4

To Release Energy

Three young men in critical condition

Thiruvananthapuram: Three young men engaged in cleaning a well, were admitted to Medical College hospital yesterday. Rajiv, who went down the well first,

fainted and the other two friends went down to save him. The three found it difficult to breathe.....

Did you notice the news report? Why did the men who went down the well, feel suffocated? We know that the basic necessities to sustain life are air, water and food. We can live without food and water for some days. But is it possible to live without air?

Energy is not released only because nutrients from food reach cells. Oxygen is very much essential for releasing energy from nutrients. You have already learnt that oxygen from the atmospheric air is taken into the body through the respiratory system.

List the important parts of the respiratory system in humans.

-
-
-

The respiratory tract is the pathway which extends from the external nostrils to the internal alveoli.

Analyse Illustration 4.1 and prepare notes in your science diary on the parts of the respiratory system, based on the indicators given.

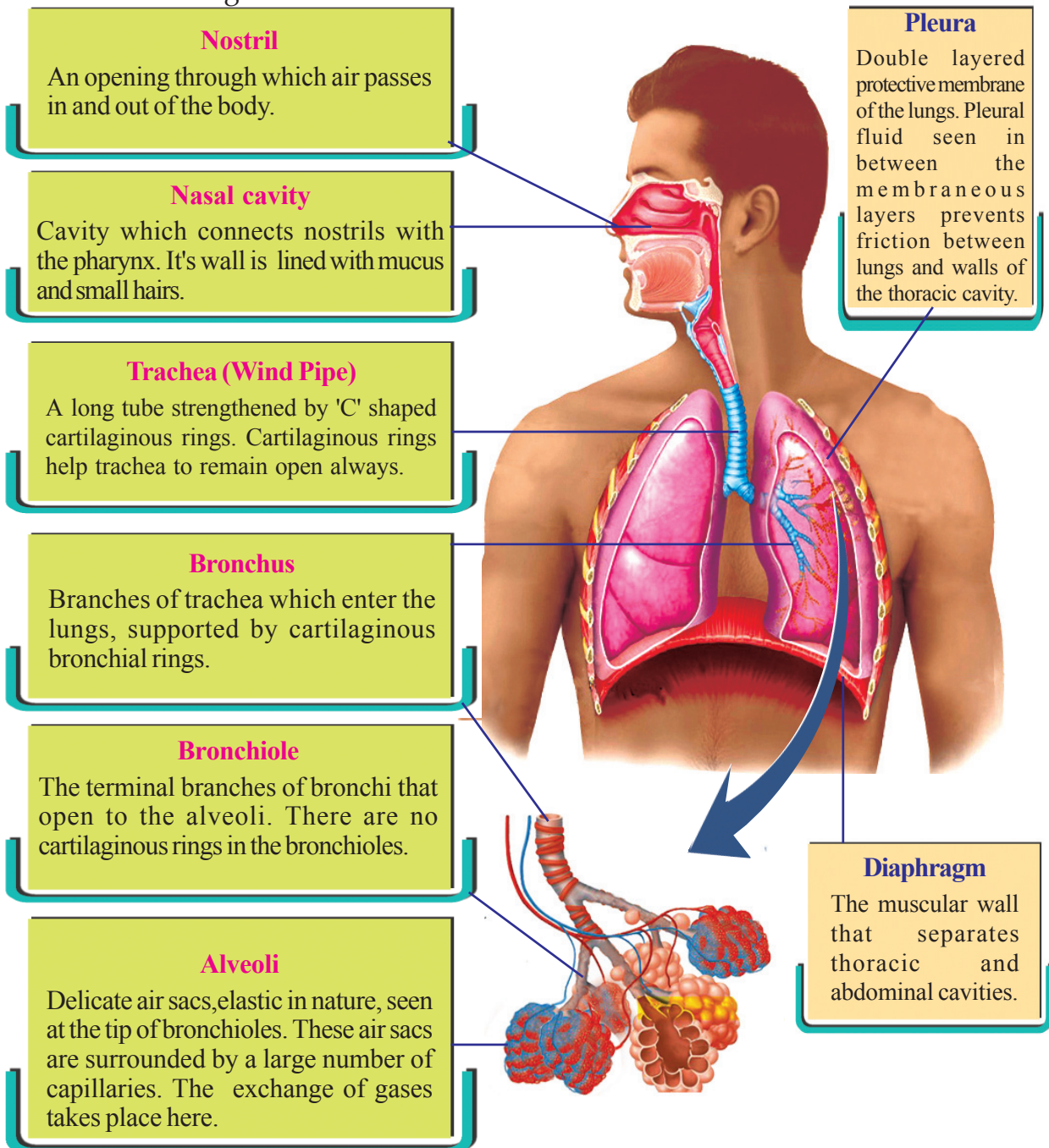
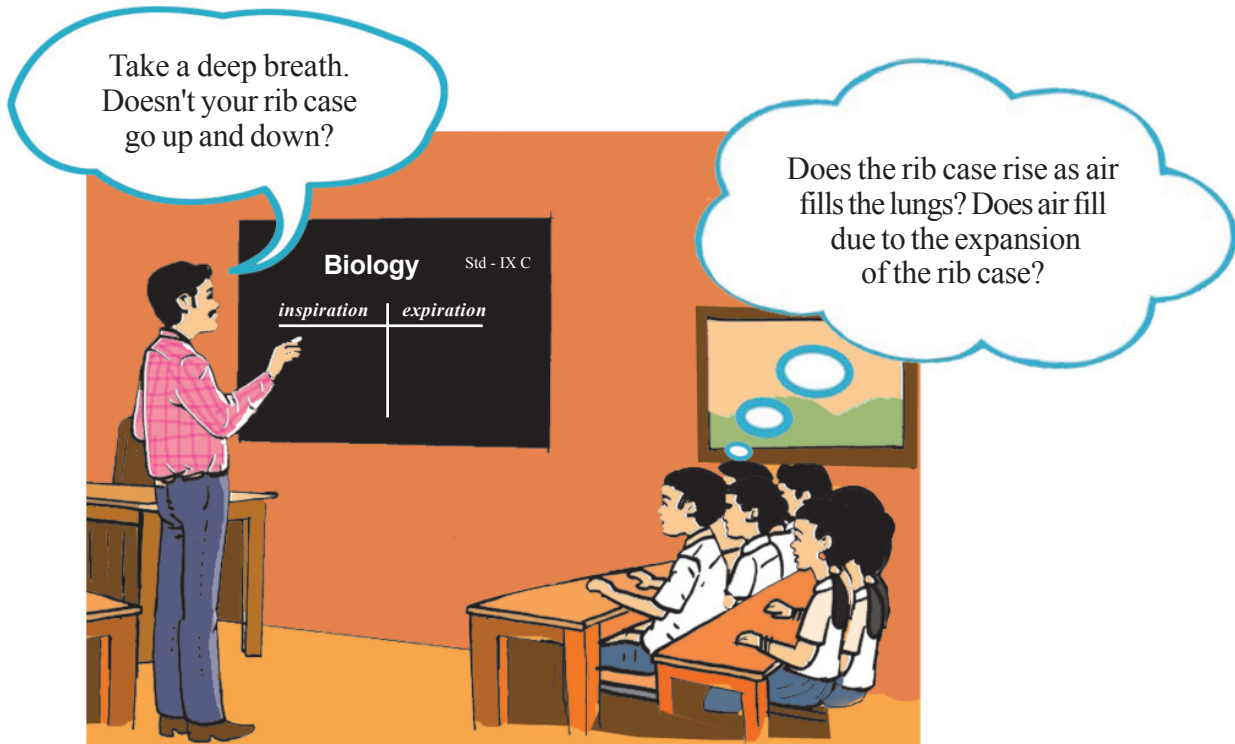


Illustration 4.1 Human respiratory system

Indicators

- path of the atmospheric air through the respiratory tract.
- importance of cartilaginous rings in respiratory tract.
- characteristics of alveoli.

Atmospheric air into the Lungs



Can you answer Raju's doubt?

The basis of respiratory movements is the expansion and contraction of the thoracic cavity. This repeats rhythmically.

Due to the increase in size of the thoracic cavity, air enters the lungs. This is called inspiration. Due to the contraction of the thoracic cavity, air is expelled out from the lungs. This is called expiration.

Let us now study how the thoracic cavity expands and contracts rhythmically. The combined working of intercostal muscles (muscles seen between ribs) and the diaphragm (muscular structure between the thoracic cavity and the abdominal cavity) help in increasing and decreasing the volume of the thoracic cavity.

Complete Table 4.1 by analysing the description and Illustration 4.2.

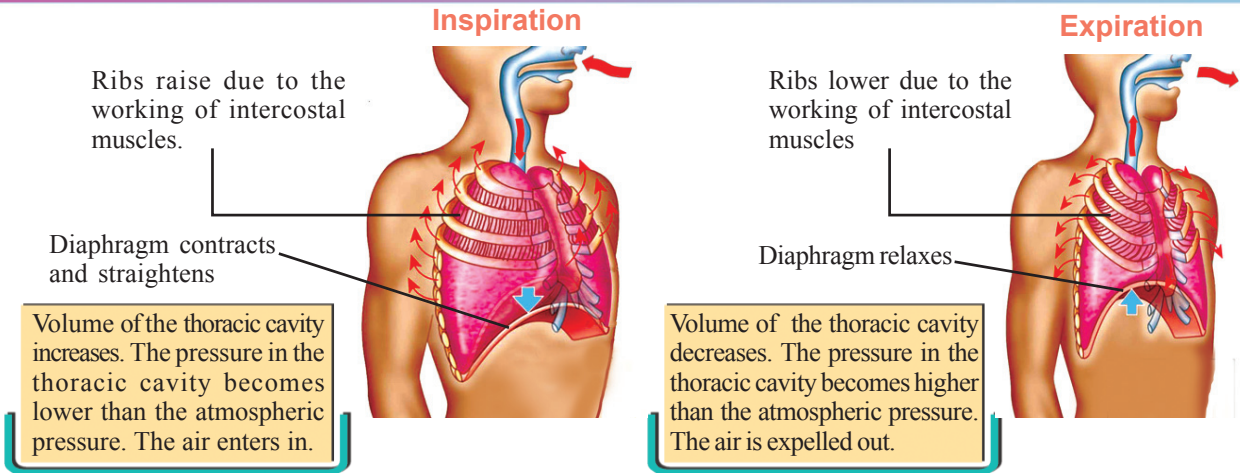


Illustration 4.2 Respiratory movements

Inspiration

- ⇐
- ⇐
- ⇐
- ⇐
- ⇐

- Diaphragm
- Ribs
- Volume of thoracic cavity
- Pressure in the thoracic cavity
- Air

Expiration

- ⇒
- ⇒
- ⇒
- ⇒
- ⇒

Table 4.1 Thoracic movements and breathing

Is the amount of air taken during each inspiration the same? Is it the same during expiration too?

Tidal volume is the volume of air we breathe in and out during a normal breathing. In humans, the tidal volume is about 500 ml.

Vital capacity is the volume of air that can be breathed out by forceful expiration after maximum or forceful inspiration. Vital capacity can be taken as an indicator of normal and healthy respiratory capacity and the strength of the muscles in the thoracic cavity. This is about 4.5 litres in male and about 3 litres in female.

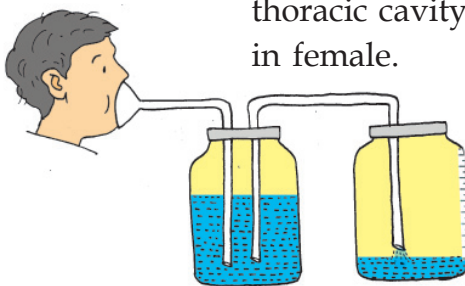


Figure 4.1 To measure vital capacity

Let's measure Vital Capacity

Arrange the plastic jars and tubes as shown in Figure 4.1. After a forceful inspiration, blow air forcefully into the first jar holding the funnel around the mouth. Measure the amount of

water that falls into the second jar. The volume of water will be proportional to the vital capacity. Compare the vital capacity of friends in your classroom.

Exchange of Gases in the Lungs

Atmospheric air reaches alveoli through the respiratory tract. How far is the structure of alveoli suitable for the exchange of respiratory gases like oxygen and carbon dioxide?

Based on the indicators, analyse Figure 4.2 and the description given and prepare notes in your science diary.

Terminal branches of bronchi which enter the lungs end in millions of alveoli. Alveoli increase the respiratory surface area in lungs. They are surrounded by numerous capillaries. The inner wall of the alveoli is always kept moist. The wall of the alveoli and capillaries are made up of a single layer of cells. In short, the surface that separates the blood in the blood capillaries and the air in the alveoli, has the thickness of two rows of cells only.

During inspiration, the concentration of oxygen inside the alveoli is higher than that of blood capillaries whereas the concentration of carbon dioxide in blood capillaries is higher than that of alveoli. As a result oxygen from the alveoli diffuses to the capillaries and the carbon dioxide from capillaries diffuses to the alveoli.

Larger than the skin!

The surface area of the skin that covers the entire body is only two square metres. Whereas the surface area of both the lungs together turn up to be at least 70 square metres. This is equivalent to the surface area of a tennis court! This large surface area help in the easy exchange of respiratory gases.

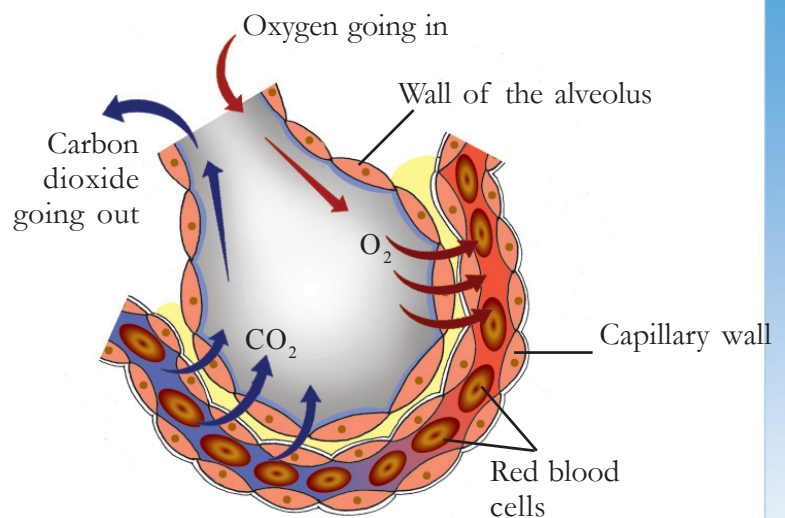



Figure 4.2 An alveolus

Indicators

- Alveoli and respiratory surface area.
- Peculiarities of the walls of the alveoli and blood capillaries.



Anaemia

The average amount of haemoglobin in a healthy man is 15 gm/ 100 ml and that of a woman is 13 gm/ 100 ml of blood. Anaemia is caused when the amount of haemoglobin in the blood decreases.

- Concentration gradient in respiratory gases.
- Exchange of gases in alveoli.

If Haemoglobin is not present

How does the oxygen reach cells which enters the blood by diffusion? Complete the flowchart after analysing Illustration 4.3 on the basis of the indicators given.

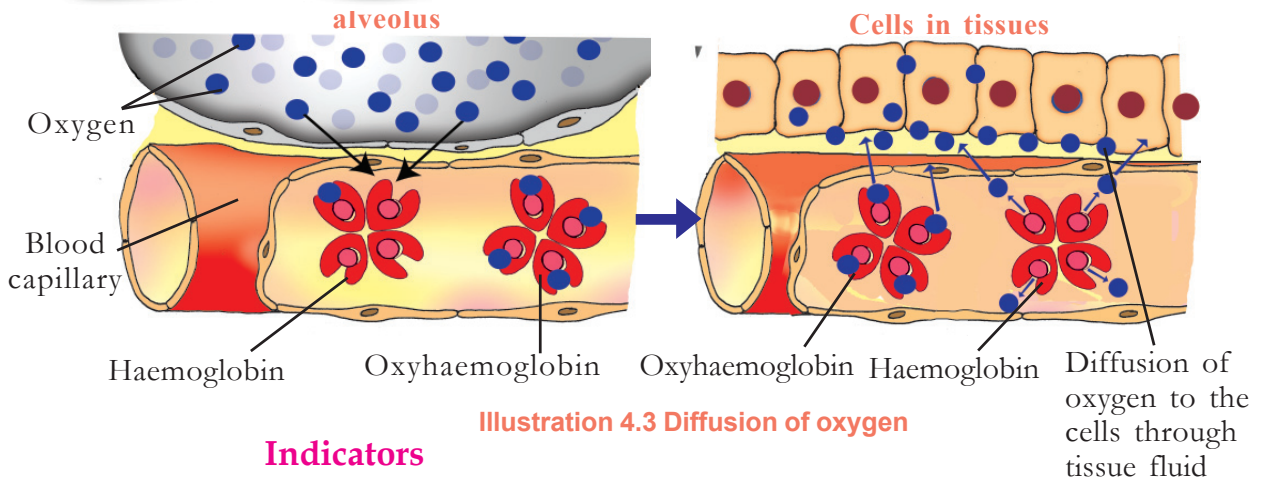


Illustration 4.3 Diffusion of oxygen

Indicators

- the factor in blood that carries oxygen.
- the maximum number of oxygen molecules, a haemoglobin molecule can transport.
- the compound formed by the combination of oxygen and haemoglobin.
- changes that occur in oxyhaemoglobin in the capillaries when it reaches tissues.



Iron molecules are essential for the synthesis of haemoglobin. Do you now understand the importance of food containing iron?

To release Energy

How does oxygen that reaches the cells help in releasing energy?

You know that energy is released mainly from glucose. The process by which energy is released from glucose in cells is called cellular respiration.

Cellular respiration occurs in two steps. Analyse Illustration 4.4 and complete Table 4.2 given below.

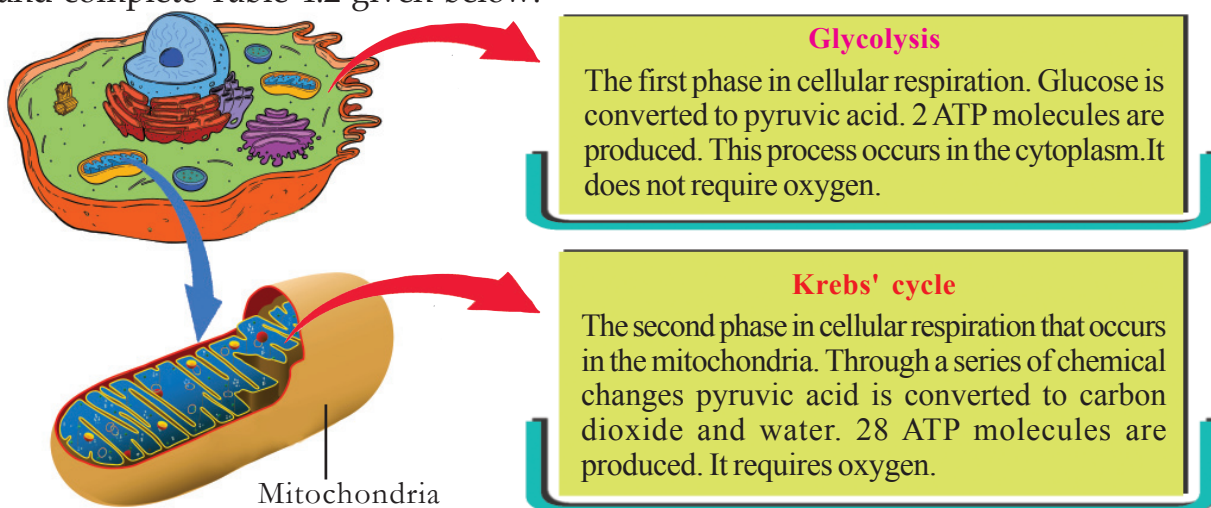


Illustration 4.4 Cellular respiration- stages

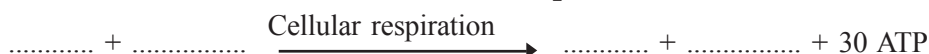
Indicators	Glycolysis	Krebs' cycle
Part where the cellular respiration takes place		
Need of oxygen		
Number of ATP molecules produced		
Products		

Table 4.2 Cellular respiration

You have understood how energy is released from glucose. Complete the chemical equation of cellular respiration based on the indicators given below.

Indicators

- Reactants of cellular respiration.
- Products formed in cellular respiration.



Haven't you understood the chemistry of respiration? Analyse the process of cellular respiration and find the relation between respiration and photosynthesis and complete Table 4.3.

Indicators	Photosynthesis	Respiration
Functions		
Phases of the reaction		
Substrates		
Products		

Table 4.3 Respiration and photosynthesis

Expulsion of Carbon dioxide

Carbon dioxide and water are the end products of respiration. Water is eliminated in the form of sweat and urine. But how is carbon dioxide, the major byproduct of respiration, eliminated from the cells? Discuss Illustration 4.5 on the basis of the indicators and note down your inferences in the science diary.

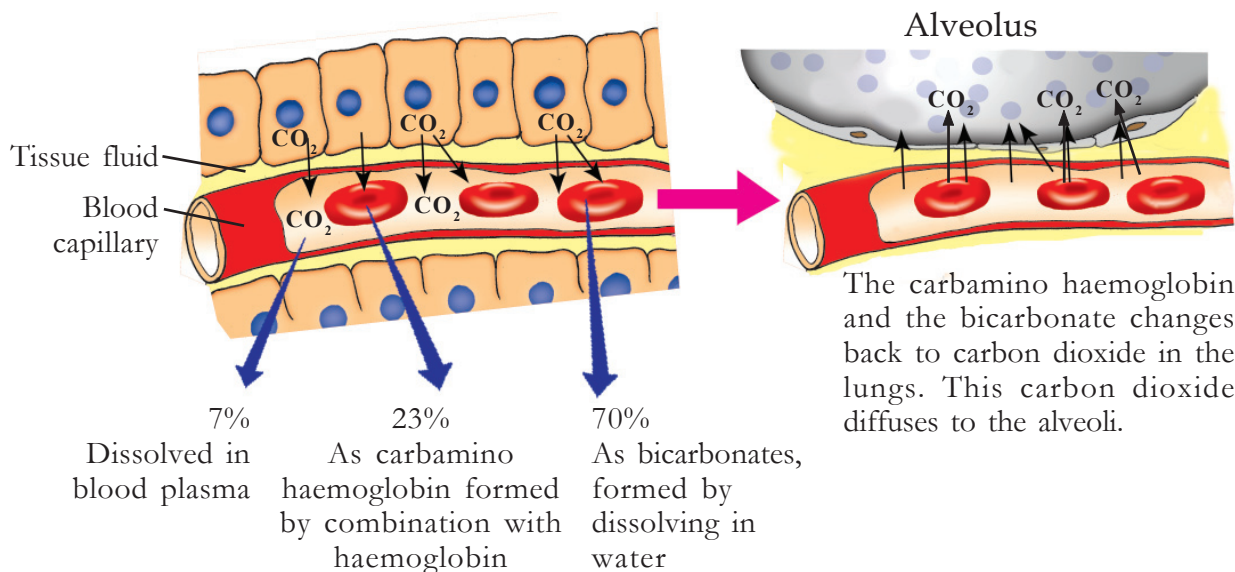


Illustration 4.5 Expulsion of carbon dioxide

Indicators

- diffusion of carbon dioxide through tissue fluids.
- transportation of carbon dioxide.
- elimination of carbon dioxide in the lungs.

Respiratory system and Maintenance of Homeostasis

What happens if excretory products like carbon dioxide are not eliminated from cells? Prepare notes in your science diary after analysing the details given below.

Various metabolic activities taking place in our body are the basis of life. As a result of these metabolic activities carbon dioxide water etc., are formed. When the level of products formed as a result of metabolic activities increases beyond the limit, the equilibrium of the body is disrupted and the very existence of life is in danger. For example, carbon dioxide formed by the cellular respiration combines with water present in and out of the cell to form carbonic acid and this increases the acidity in the body, which in turn changes the internal environment. In order to avoid such changes, the substances produced by metabolic activities are to be removed. Maintenance of internal equilibrium by removal of harmful materials is called homeostasis.

The respiratory system helps in the maintenance of homeostasis by eliminating carbon dioxide. A small amount of water is also eliminated from the body in the form of water vapour during respiration.

Indicators

- What is homeostasis?
- How does increased amount of carbon dioxide affect the internal environment of our body?
- What is the role of the respiratory system in maintaining homeostasis?

Respiration without Oxygen!

Many organisms like bacteria, yeast etc., can survive even in the absence of oxygen. If so, how do they get energy for their life processes? Based on the indicators given, analyse Illustration 4.6 and write your inferences in the science diary.

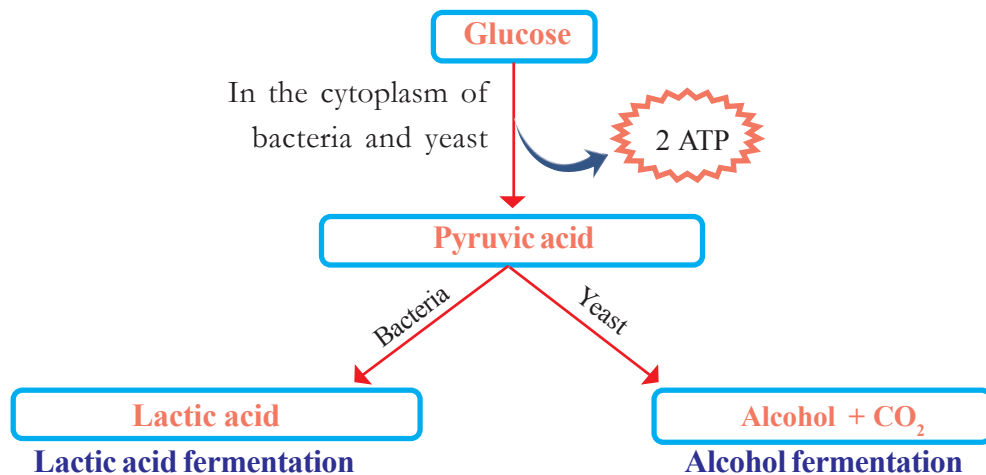


Illustration 4.6 Anaerobic respiration

Indicators

- chemical changes of pyruvic acid in bacteria.
- chemical changes of pyruvic acid in yeast.

Fermentation is the process of the production of lactic acid or alcohol from glucose by anaerobic respiration. In our daily life, we often make use of anaerobic respiration seen in microorganisms. Analyse Illustration 4.7 on the basis of the indicators and write your inferences in the science diary.

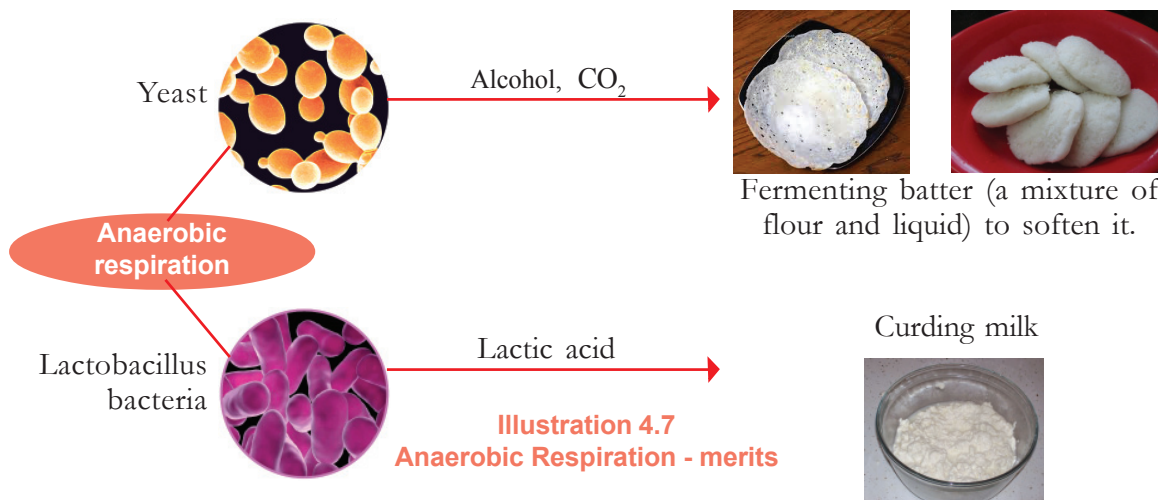


Illustration 4.7 Anaerobic Respiration - merits

Indicators

- Why does the nutritional quality of milk change when it becomes curd?
- How does batter become soft and puffy?

In certain circumstances anaerobic respiration also takes place in human beings. During strenuous exercise, energy utilization in muscles increase and the oxygen availability decreases. In such situations muscle cells produce energy by anaerobic respiration and lactic acid is formed in the muscle cells.

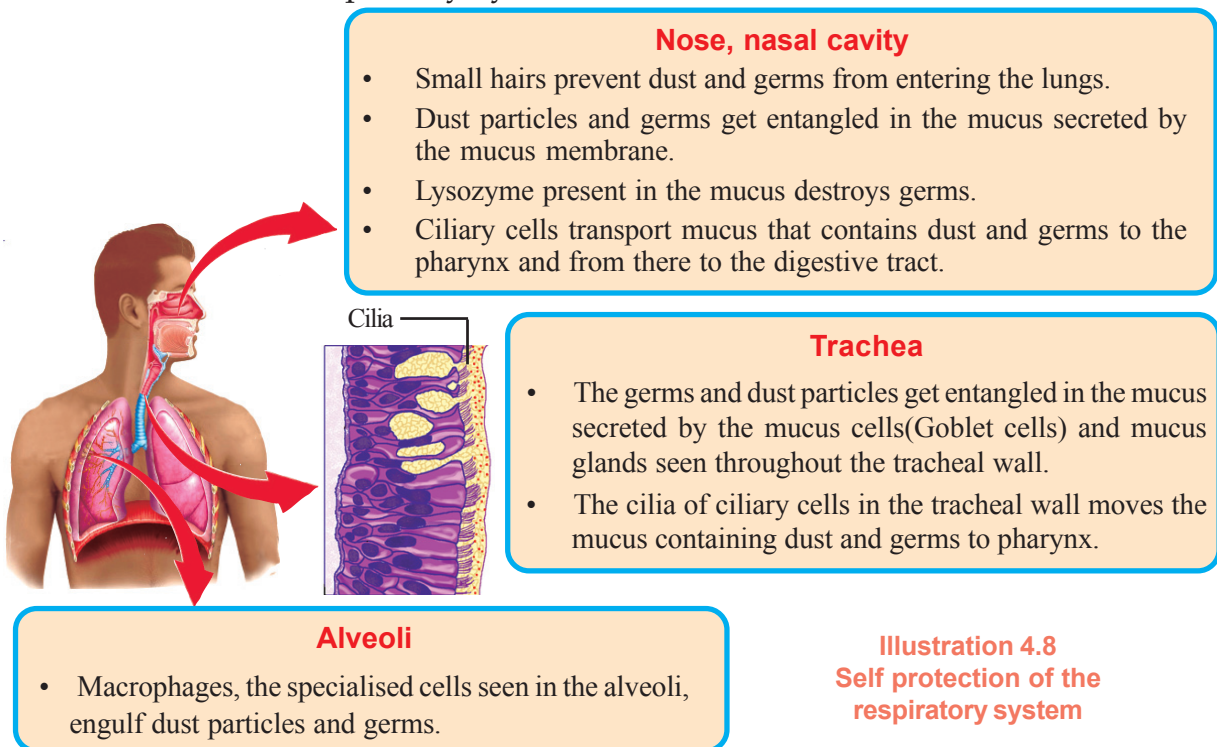
Lungs-with Care

What are the instances that are harmful to lungs?

-
-

Lungs can be damaged by dust, germs, chemicals etc., which are contained in the air we breathe in. The respiratory system itself has certain mechanisms to protect lungs from these hazardous instances.

Analyse Illustration 4.8 given below and find out the protective mechanisms of the respiratory system.



Nose, nasal cavity

- Small hairs prevent dust and germs from entering the lungs.
- Dust particles and germs get entangled in the mucus secreted by the mucus membrane.
- Lysozyme present in the mucus destroys germs.
- Ciliary cells transport mucus that contains dust and germs to the pharynx and from there to the digestive tract.

Trachea

- The germs and dust particles get entangled in the mucus secreted by the mucus cells (Goblet cells) and mucus glands seen throughout the tracheal wall.
- The cilia of ciliary cells in the tracheal wall moves the mucus containing dust and germs to pharynx.

Alveoli

- Macrophages, the specialised cells seen in the alveoli, engulf dust particles and germs.

Illustration 4.8
Self protection of the respiratory system

Discuss and write inferences on the healthy habits we need to adopt for protecting our respiratory system.

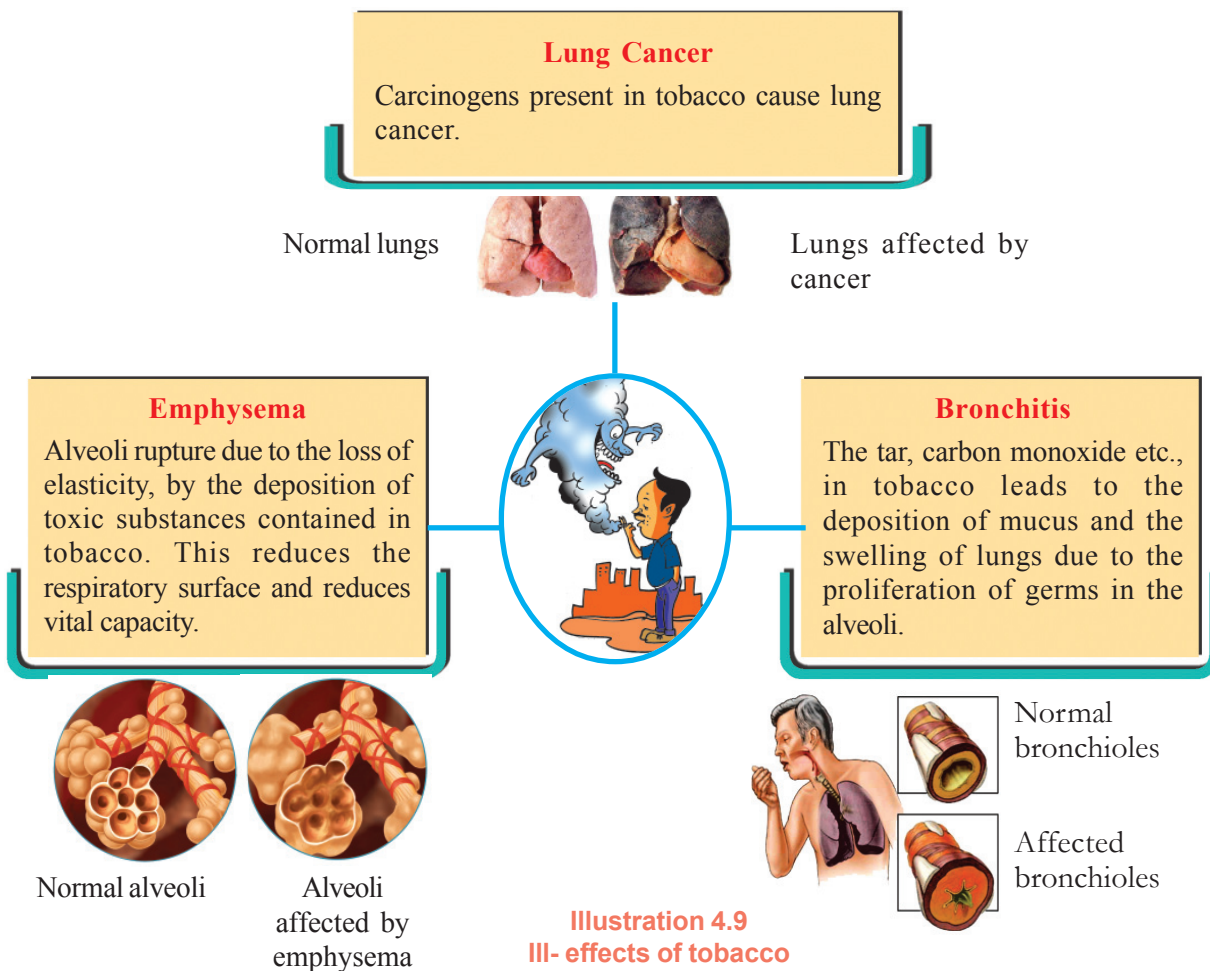
An army in the lungs!

In the alveoli, around 50 millions of macrophages are destroyed everyday in their encounter with dust particles and germs. But we do not know it.

Our Lungs... Don't Destroy them...

Smoking is a bad habit that harmfully affects the human race.

What are the respiratory disorders caused by smoking? Conduct a seminar in your class on the effects of smoking by analysing Illustration 4.9 and after collecting additional information.



Respiratory gases into plants

Do plants respire like animals? Discuss this on the basis of indicators and draw inferences about respiration in plants. Even though plants need less energy when compared to animals they also utilize glucose for the production of energy. The oxygen needed for the oxidation of glucose is also absorbed from atmospheric air. Plants have different mechanisms for the exchange of gases.

You already know about the stomata seen on leaves and green tender stems. These are the centres of exchange of gases in plants.

Did you notice the girl's doubt?

Observe the stem of mexican lilac (Sheemakonna) and moringa and the root of the jackfruit tree using a hand lens.

Can't you see small pores on the surface of stems and roots? These are called lenticels. Exchange of carbon dioxide and oxygen takes place in stems and roots through the cells of lenticels by diffusion. CO_2

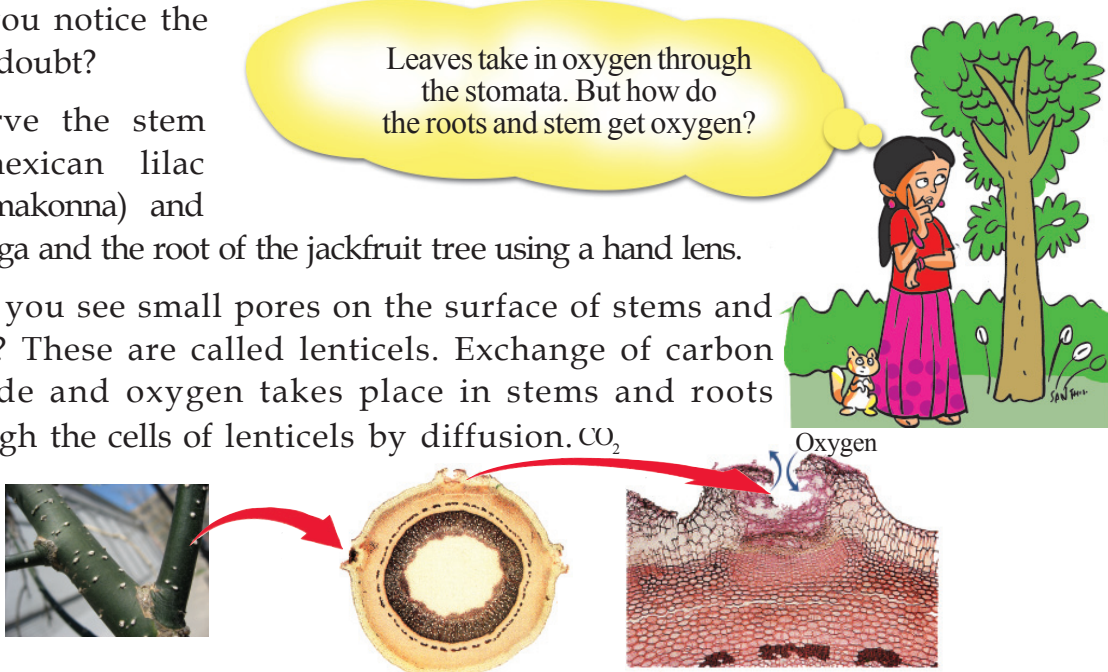


Figure 4.3 Lenticels

Oxygen is inevitable for the existence of all organisms. We know that plants play a very important role in producing sufficient oxygen in nature. But uncontrolled human interference in nature has increased the rate of pollution tremendously. Atmospheric pollution adversely affects the existence of life on earth. It is the duty of every human being to conserve and preserve nature with utmost care for the existence of life, in the years to come.



Significant learning outcomes

The learner

- illustrates and describes the structure of respiratory system in humans.
- identifies and describes the role of haemoglobin in the exchange of oxygen during respiration.
- analyses and presents the importance of oxygen in releasing energy from nutrients.
- lists the various stages of cellular respiration and products formed in each stage. Formulates the chemical equation of cellular respiration.

- identifies and describes the process and the need to eliminate CO_2 formed during cellular respiration.
- compares and describes anaerobic and aerobic respiration with examples.
- identifies the important measures to be taken to keep the respiratory system healthy and keeps them in life and engages in programmes to make people aware of it.
- analyses and describes the importance of lenticels and stomata in gaseous exchange in plants.



Let us assess

- Reason for the diffusion of oxygen from alveoli to blood.
 - Low concentration of oxygen in blood
 - As the walls of the alveoli and blood vessels are thin
 - High concentration of oxygen in alveoli
 - All of the above.
- Observe the two reactions given below.

Reaction 1 $\text{C}_6\text{H}_{12}\text{O}_6 + 6\text{O}_2 \longrightarrow 6\text{CO}_2 + 6\text{H}_2\text{O} + \text{Energy}$

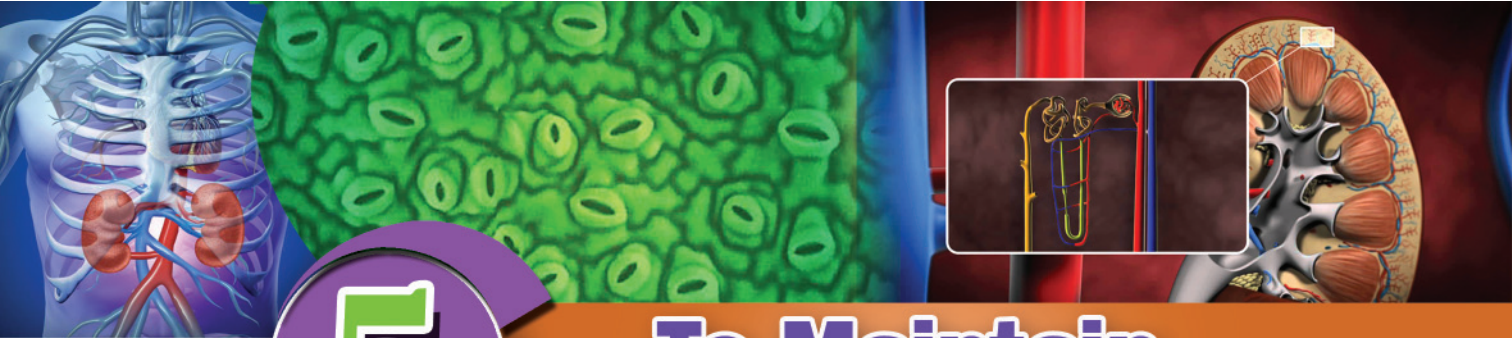
Reaction 2 $6\text{CO}_2 + 6\text{H}_2\text{O} \xrightarrow{\text{Light}} \text{C}_6\text{H}_{12}\text{O}_6 + 6\text{O}_2$

 - Identify the process occurring in plants and in animals.
 - Which is the process that takes place only in plants?
- Explain the role played by haemoglobin in the transportation of oxygen and carbon dioxide.



Extended activities

- Smoking is suicide and murder at the same time. Prepare a poster for the Health Club of your school based on the above statement.
- Interview a medical practitioner preparing a questionnaire on the topic 'Increasing Lung Diseases'.



5

To Maintain Homeostasis

Many excretory materials are formed in the body as byproducts of the metabolic activities that take place in cells. If these waste products are not eliminated from the body it will disturb homeostasis and life itself will be in danger.



Madam, how is it that our body maintains homeostasis by eliminating these waste products?

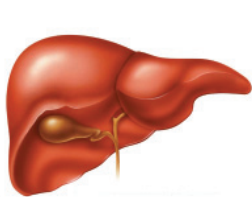


Note down what you have understood about how the body maintains homeostasis.

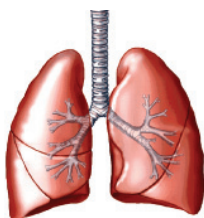
You know that different byproducts are formed as a result of many life processes in cells. It will be harmful if the level of byproducts increases beyond a certain limit.

The byproducts of respiration like carbon dioxide and water and the nitrogenous compounds formed during the metabolism of amino acids etc., are the main excretory products in human beings. They diffuse from cells to tissue fluid and from there to

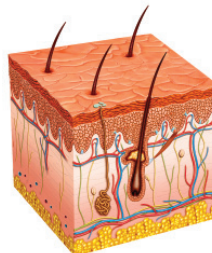
blood. Blood carries these materials to excretory organs. Name the main organs that remove waste materials from blood and maintain homeostasis? Observe Figure 5.1 and write your inferences.



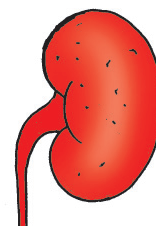
Synthesis of urea -
a nitrogenous
compound



Eliminates CO_2



Eliminates water and
minerals through sweat



Eliminates
urea and water

Figure 5.1 Main excretory organs

Now you have understood the major excretory organs and their functions in our body. Liver has a major role in removing wastes from body. It converts harmful substances entering the body and those produced inside the body into harmless substances. Synthesis of urea from ammonia is an example for this. How is urea synthesized in our body?

Synthesis of Urea

On the basis of the description and the indicators given, prepare notes on the synthesis of urea and present it in class.

Amino acids are formed by the breakdown of protein. These amino acids are used for the synthesis of various substances like proteins, enzymes etc., which are used for body building. By the metabolism of amino acids various nitrogenous byproducts are formed. The most harmful among these is ammonia. Hence ammonia is to be removed immediately from the body. The ammonia formed in tissues diffuses into blood through tissue fluids, and blood transports it to the liver. In liver with the help of certain enzymes ammonia combines with carbon dioxide and water to form urea.

Ammonia + Carbon dioxide + Water \rightarrow Urea

This process takes place in different stages. Urea is comparatively less toxic and dissolves in water easily.

Indicators

- products formed by the breakdown of protein.
- harmful products formed by the breakdown of amino acids.
- the change that happens to ammonia in liver.

Kidneys

Kidneys are vital organs which help in maintaining homeostasis by filtering waste products like urea, salts, vitamins, other harmful substances etc., from blood.

When blood passes through the kidneys, the waste materials present in it are filtered.

Observe Figure 5.2 and analyse the description given and complete Table 5.1 showing the details of the kidney and its associated parts.

Human beings possess a pair of kidneys, situated on both sides of the vertebral column adjoining the muscles in the abdominal cavity. They are bean shaped and are about 11 cm long, 5 cm broad and 3 cm thick. Each kidney is covered by a strong but soft membrane. Blood which is pumped into the aorta with high pressure, reaches the kidney through the renal artery. The filtered blood is pumped back into venacava through renal vein.

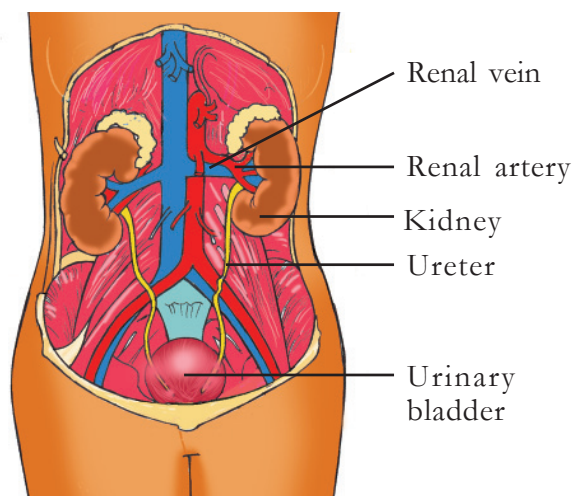


Figure 5.2 Kidneys and associated parts

Indicators	Feature/Part
Position and size of the kidney	
Blood vessel which supplies blood to kidneys	
Blood vessel which carries blood away from kidneys	

Table 5.1

How do the kidneys eliminate waste materials including urea?

Each kidney is comprised of about 12 lakh ultrafilters called nephrons. They are the structural and functional units of kidneys.

Analyse the given Illustration 5.1 and prepare note on the internal structure and the arrangement of nephron in kidneys.

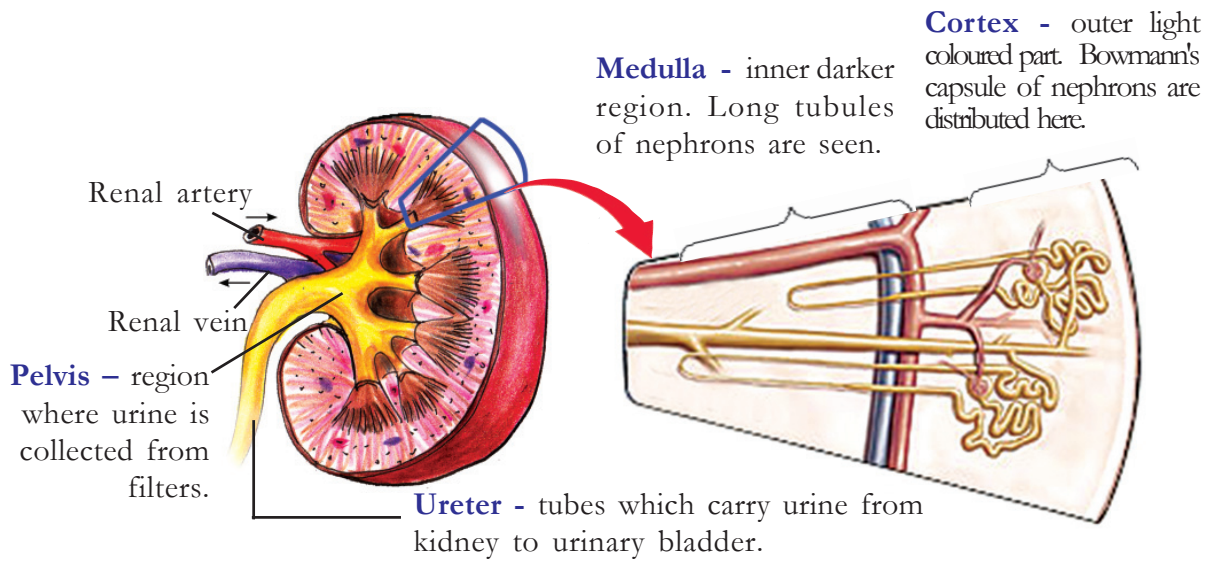


Illustration 5.1 Longitudinal section of the kidney

How far is the structure of the nephron suitable for filtering blood? Analyse Illustration 5.2 and complete Table 5.2 on the structure of nephron.

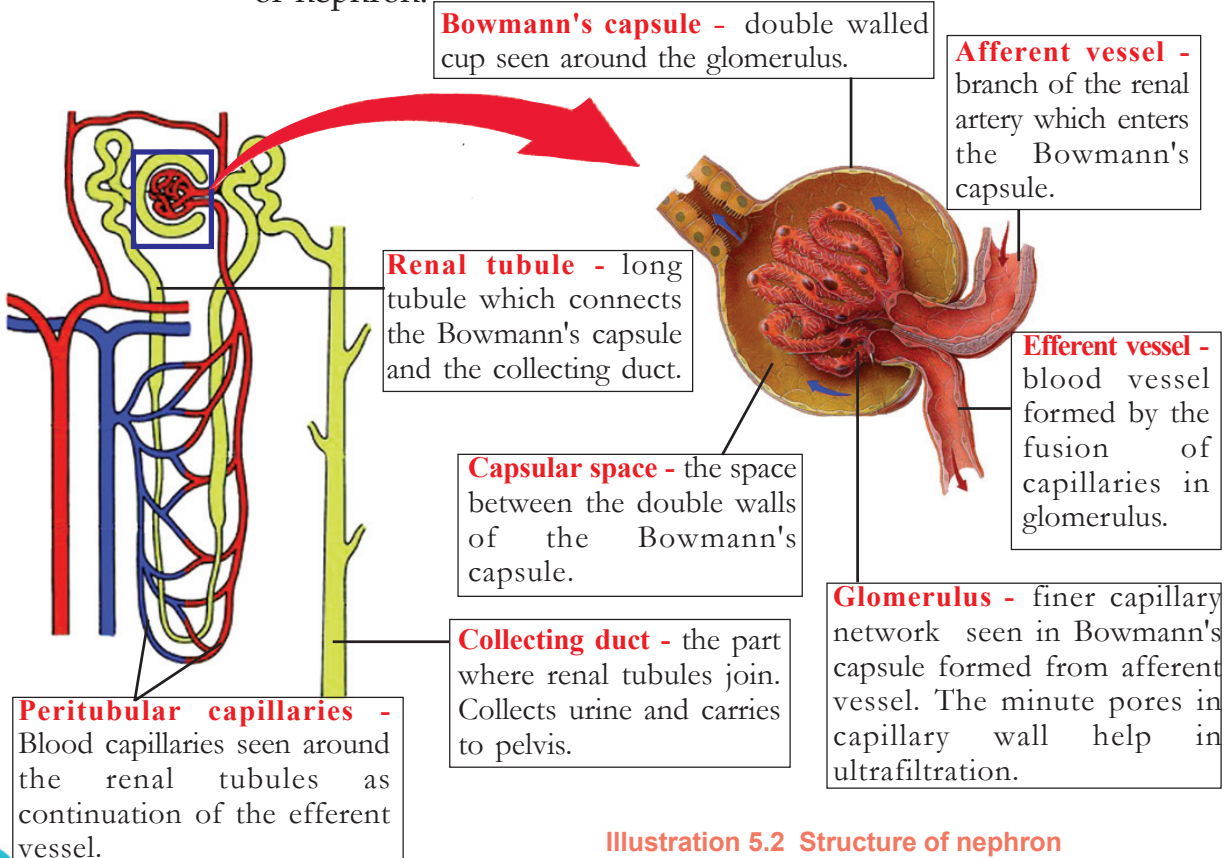


Illustration 5.2 Structure of nephron

Part of Nephron	Peculiarities
Bowmann's capsule	

Table 5.2 Parts of nephron and their peculiarities

How is urine formed?

You know that urine is formed in kidneys. Urine is formed in the kidneys in three major steps - ultrafiltration, tubular reabsorption and secretion and water absorption. Analyse Figure 5.3 and its description and prepare notes on the process of urine formation.

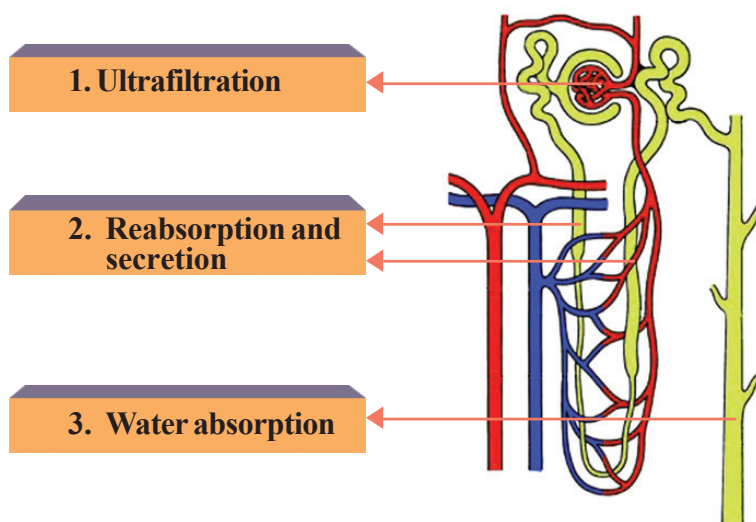


Figure 5.3 Nephron - stages in urine formation

1. Ultrafiltration

Blood undergoes filtration through the pores of the glomerulus. The pressure inside the glomerulus is very high as the size of the efferent vessel is less than that of the afferent vessel. This helps in filtration. The glomerular filtrate formed by the process of

ultrafiltration is collected in the capsular space. The composition of glomerular filtrate is similar to that of plasma. Following are the major components seen in the glomerular filtrate.

Components of glomerular filtrate

- water
- glucose
- amino acids
- ions of sodium, potassium and calcium.
- vitamins, urea, uric acid, creatinine etc.

2. Reabsorption and secretion

When the glomerular filtrate is transported from the capsular space to the collecting duct through the renal tubule, materials which are to be retained in the body like glucose, amino acids etc., are reabsorbed completely and sodium, potassium and calcium ions and water are reabsorbed partially into peritubular capillaries. Urea, potassium, hydrogen ions etc., which are seen in blood even after ultrafiltration is secreted from peritubular capillaries into the renal tubules.

3. Water absorption

Excess water seen in glomerular filtrate is absorbed in the collecting duct. As a result, the glomerular filtrate is changed into urine. Both the kidneys together produce about 127 ml of glomerular filtrate per minute out of which 126 ml is reabsorbed into the blood. The remaining part forms urine.

Indicators

- role of the afferent and efferent blood vessels in ultrafiltration.
- constituents of the glomerular filtrate collected in capsular space.
- role of the renal tubules in reabsorption.
- secretion from peritubular capillaries.
- reabsorption in the collecting duct.

Constituents of urine

Water	- 96%
Urea	- 2%
Uric acid, Creatinine, NaCl, KCl, phosphate , Calcium salts etc.	- 2%
Urochrome, the pigment formed by the disintegration of haemoglobin gives urine a pale yellow colour.	

Urine is transported from the collecting duct to the ureter through pelvis and is temporarily stored in the urinary bladder. When the urinary bladder is full, there is the sensation to urinate and urine is eliminated through the urethra.

Washing out of germs inside the urinary tract also takes place during the process of micturition (passing out of urine). It is advised to take 2 to 3 litres of water a day to prevent urinary tract infection. Holding urine for a long period may cause infection to the urinary tract because it prevents the washing out of germs inside the tract. The bacteria may cause infection in the inner membrane of the urinary bladder.

Role of Kidneys in Homeostasis

Kidneys play a major role in maintaining homeostasis. How do they maintain homeostasis? Analyse Illustration 5.3 and prepare notes on the role of kidneys in maintaining homeostasis.

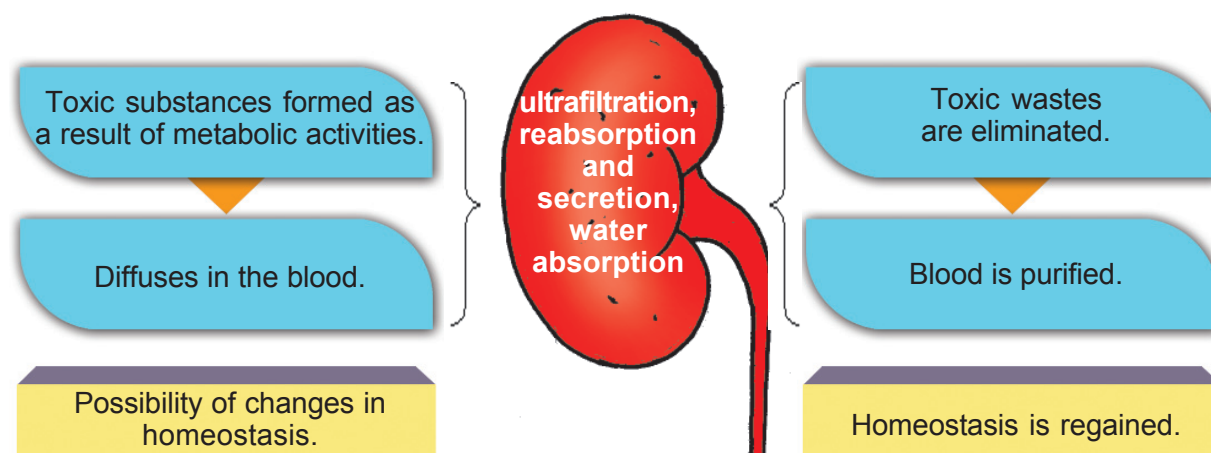


Illustration 5.3 Kidneys and homeostasis

To produce 1.5 litres of Urine



The blood in our body is completely passes the kidneys about 350 times a day. About 1800 litres of blood is filtered to form 170 litres of glomerular filtrate. 1.5 litres of urine is formed from 170 litres of filtrate.

Kidney Diseases

Bad health habits and lifestyle causes infection and often ill-health of kidneys. Analysing Illustration 5.4 and collecting additional information, prepare a pamphlet on diseases of kidneys.

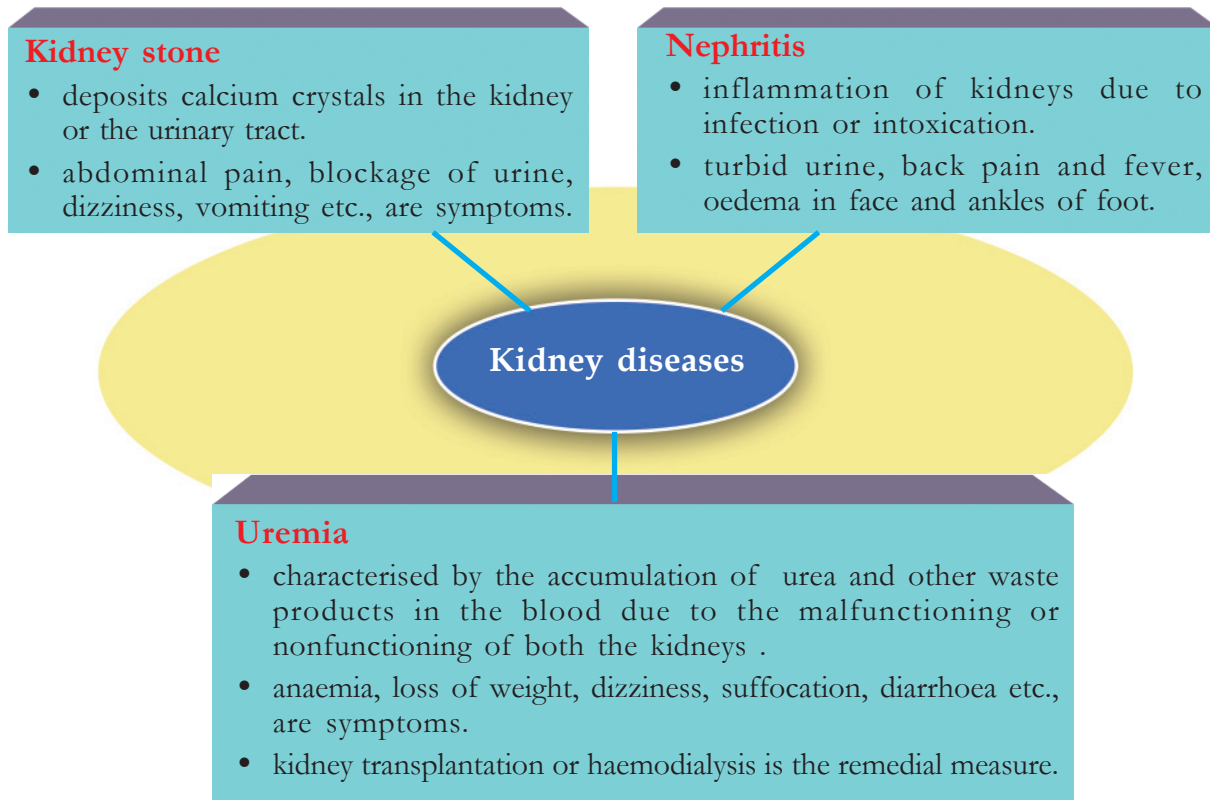
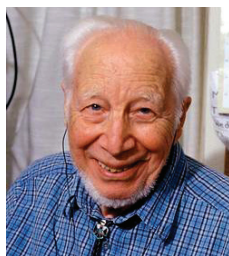


Illustration 5.4 Kidney diseases



William
Johann Kolff

Haemodialysis

Haemodialysis is the process proposed by modern medicine for the removal of wastes from the blood when both the kidneys become nonfunctional. In this process, blood is pumped into an artificial kidney called haemodialyser and is purified. The first artificial kidney was designed by the Dutch physician, William Johann Kolff in 1944.

Analyse Illustration 5.5 and write the steps of haemodialysis in your science diary.

1. Blood which contains wastes from the artery is pumped into the dialysis unit. Heparin is added to prevent coagulation.

2. Wastes from the blood are diffused into the dialysing fluid when it flows through the cellophane tube.

3. Purified blood is pumped back to the veins through another tube.

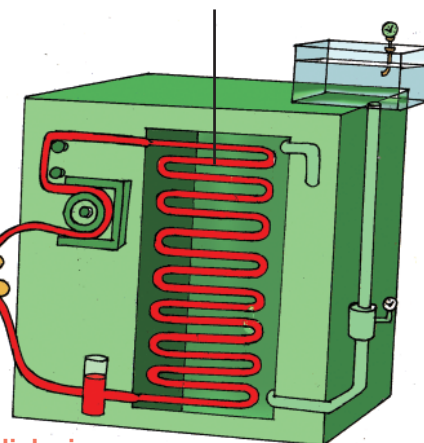
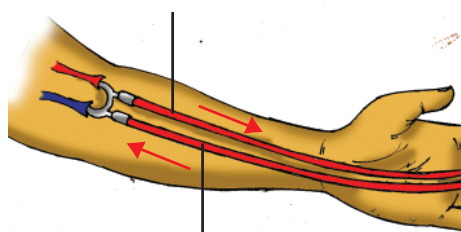


Illustration 5.5 Haemodialysis

Kidney Transplantation

One healthy kidney is enough for the purification of blood. But when both the kidneys fail we need to receive a functioning kidney from a donor. A kidney can be received from a healthy person or a person who dies in an accident, if the blood group of the donor and the recipient match. During transplantation, damaged kidneys are not removed. Instead a new kidney is connected below the nonfunctional kidney, with the recipient's renal tubule and renal vein as shown in Figure 5.4. The ureter of the transplanted kidney is also attached to the urinary bladder of the recipient. The transplantation of kidney is considered to be successful only when the donor's kidney is completely accepted by the recipient's body.

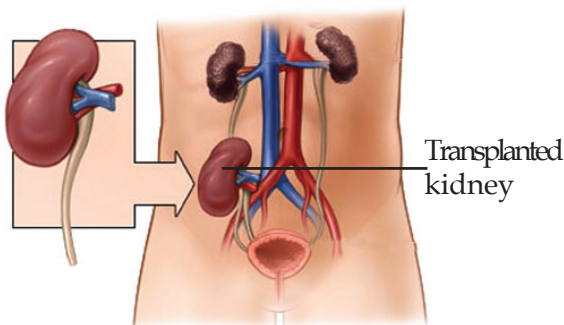


Figure 5.4.
Kidney transplantation



**Dr. Joseph
E. Murray**

**Conducted the
first kidney
transplantation
surgery**

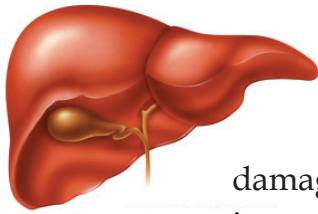
Notice the newspaper report given below.

Student extend a helping hand to their classmate

Aroor: Students extend a helping hand to their classmate whose both kidneys were damaged. A handsome amount was given to a student studying in the seventh standard by their friends. The mother of the student donated a kidney for the transplantation.

Can't we too develop such an attitude towards people who have damaged kidneys?

Liver



Liver is the main organ which detoxifies the toxins that enter our body. This process destroys the liver cells as a result of the continuous contact with toxins. But the largest gland in our body, liver, has the capacity to regenerate its damaged cells. However the destruction of liver cells higher than its regeneration power gradually leads to complete damage of the liver.

Figure 5.5 Liver



Hepatitis – different types

Hepatitis is the enlargement of the liver and the morbidity state thereby, due to many reasons. Hepatitis can be caused by virus, bacteria, toxic substances, drugs, alcohol etc. Hepatitis A, B, C, D and E are caused by virus. Consumption of contaminated food and water, unsafe sexual contact, use of unsterilized syringe and needle, transfusion of blood from patients etc., can be reasons for the spread of hepatitis. Hepatitis B is the most common and dreadful type of hepatitis.

Why is it said that alcohol consumption is a habit to be avoided?

Conduct a seminar in your class after analysing the details given and collecting additional information on the harmful effects of alcohol consumption.

The detoxification of alcohol in our body is done by liver cells. As a result liver cells become damaged. The same process occurs when we consume food with artificial chemicals. Have you understood the importance of taking healthy food and the need for avoiding alcohol?

**SAY NO TO
ALCOHOL**

Skin

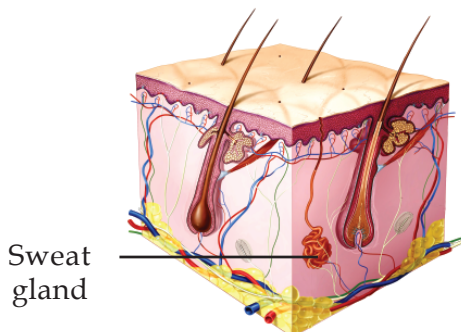


Figure 5.6 Skin

Another major organ which helps in excreting waste materials is the skin. It is the largest organ in the human body. The skin contains about 20 to 50 lakhs of sweat glands. Each sweat gland is a long coiled tube which opens to the surface of the skin. The lower portion of the sweat gland is rich in capillaries. When blood passes through

these capillaries excess water and minerals enter the sweat glands. This is eliminated as sweat through the body surface. Sweating also helps in regulating our body temperature.

Excretion in other Animals

Is there any mechanism in other organisms, as in human beings, to remove excretory wastes formed as a result of metabolic activities?

Analyse Table 5.3 and compare the excretory organs and excretory products of different organisms. Write your findings in the science diary.

Organism	Excretory product	Excretory organ
Amoeba	Ammonia, excess water in the body	No special excretory organ, contractile vacuoles function as excretory organs.
Earthworm	Urea, ammonia, water	Special structures called nephridia collect excretory products from body cavity and eliminate through pores in the body surface.
Insects	Uric acid	Malpighian tubules seen along with digestive tract. They separate excretory products and eliminates along with digestive wastes.
Fishes	Ammonia	Kidneys filter the wastes and eliminate directly to water.
Frog	Urea	Nitrogenous wastes filtered by kidneys are excreted in the form of urine.
Reptiles and birds	Uric acid	Kidneys filter waste products and eliminate alongwith digestive wastes.

Table 5.3 Diversity in excretion

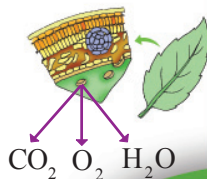
Excretion in plants

Plants also have a mechanism to eliminate excretory products formed as a result of metabolic activities. But plants do not have specialized excretory system. Plants have a lesser amount of waste products as they have a lower level of metabolic activities when compared to animals.

Analyse Illustration 5.6 and write your inference on excretory parts and the wastes formed in plants in the science diary.

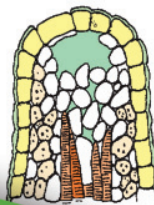
Stomata

Excretes photosynthetic byproduct oxygen and respiratory byproducts carbon dioxide and water.



Hydathodes

Excess water is eliminated through small pores (hydathodes) present at the tip of leaves in certain shrubs and grasses.



Excretion in plants

Formation of heartwood

Some waste products are accumulated in the older xylem cells seen at the centre and play a major role in the formation of heartwood.



Abscission of leaves

When leaves are about to fall, plants absorb all useful materials from them. Falling leaves contain only the waste materials.



Illustration 5.6 Excretion in plants

Our body exists as such due to various types of metabolic activities. Byproducts formed during these metabolic activities can alter the constant internal environment. But the process of excretion that goes on continuously maintains the homeostasis. Now you have studied the role of the liver, kidney and skin in maintaining the homeostasis of body. Let us be more cautious of keeping these organs healthy.



Significant learning outcomes

The learner

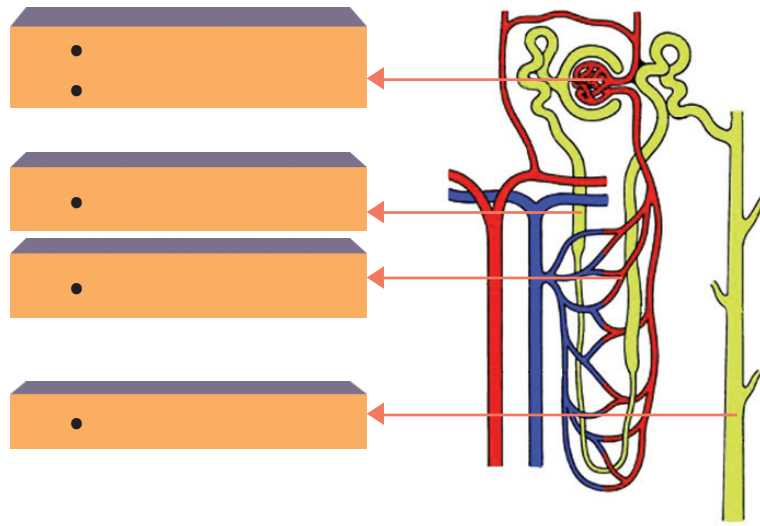
- explains the process of synthesis of urea in human body.
- analyses the structure of kidney and explains the process of purification of blood by filtering of excretory materials.
- identifies that the basic structural and functional unit of kidney is nephron. Explains its structure and function.
- describes the various steps in the formation of urine.
- explains the major diseases of kidney.
- explains the stages of haemodialysis.
- identifies the greatness of kidney donation and engages in awareness programmes.
- explains how alcohol consumption is injurious to liver.
- analyses the role of skin in excretion.
- explains the process of excretion in plants.



Let us assess

1. Water reabsorption in kidney takes place in the
 - A. Glomerulus
 - B. Renal tubules only
 - C. Efferent vessel
 - D. Renal tubule and collecting duct
2. The steps involved in the formation of urine are given below. Arrange them in the correct sequence.
 - Collects urine.
 - Ultrafiltration takes place.
 - Reabsorption of ions takes place towards this part from renal tubules.

- Collects glomerular filtrate.
- Excess urea is secreted here from peritubular capillaries.

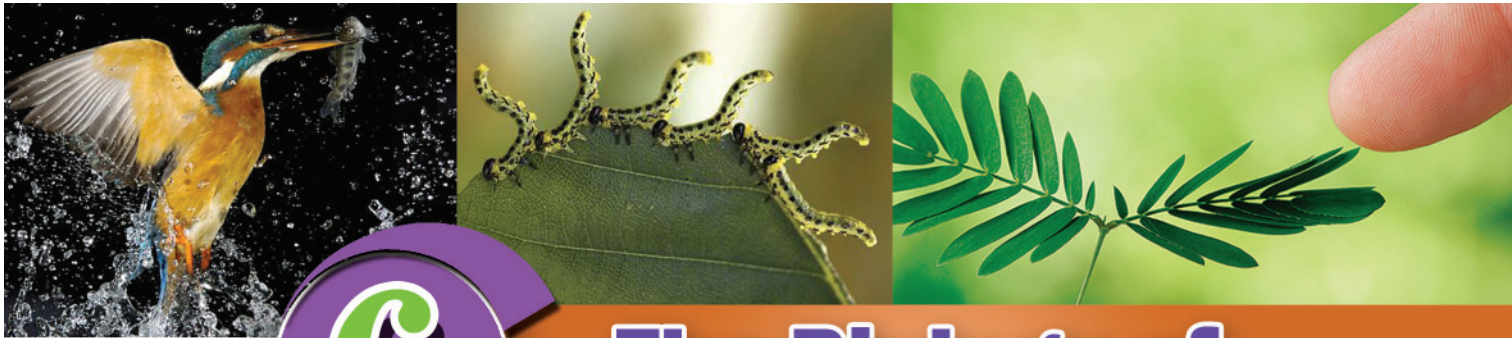


3. Why are blood cells and proteins not seen in the glomerular filtrate?



Extended activities

1. Conduct a seminar in the class on 'Lifestyle and kidney diseases'.
2. Collect newspaper cuttings on the topic 'Kidney donation and its glory' and prepare a collage and display it in the bulletin board.



6

The Biology of Movement



Observe the cartoon and evaluate the comment by the parent.

Are exercise and games necessary?


Why should we do exercise?

- to maintain cardiac health.
-
-

Importance of Exercise


Analyse Illustration 6.1. Discuss and prepare notes on how exercise is beneficial to the body.


Importance of Exercise



- Increases blood circulation all over the body.
- Cardiac muscles become strong.

- Stored fat is broken down thereby reduces obesity.
- Sweats more, and so more waste is eliminated through sweat.





- Exchange of respiratory gases becomes more effective.
- Vital capacity increases.

- More capillaries are formed in muscles.
- Increases the efficiency of muscles.




Illustration 6.1 Importance of exercise

Have you realised the importance of exercise? Do you exercise regularly? Our physical strength increases as we involve in interesting exercises such as games. Exercise reduces mental stress and helps us to work energetically.

Involuntary Movements

Body movements are enabled by muscles. List out our body movements.

- hand movements
- heartbeat
- movement of the tongue
-

Do all these movements occur according to our will?

Body movements can be classified into two - those which can be controlled by our will and those which cannot. The movement which occurs according to our will is called voluntary movement and the movement which is not controlled by our will is called involuntary movement. Tabulate the body movements you have already listed.

Voluntary movements	Involuntary movements

Table 6.1 Movements

Types of Muscles

Our body is made up of different types of muscles. Given below in Table 6.2 are the different types of muscles and their characteristics. Analyse the table based on the indicators given and prepare notes in the science diary.

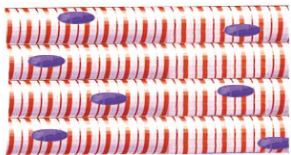
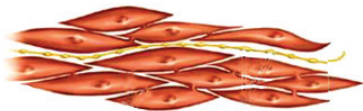
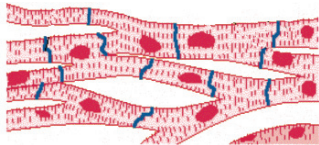
Muscles	Characteristics of muscle cells
Skeletal muscle (Striated muscle) 	<ul style="list-style-type: none"> • seen attached to bones. • cylindrical cells. • dark and light striations are seen. • make voluntary movements possible.
Smooth muscle (Nonstriated muscle) 	<ul style="list-style-type: none"> • seen in internal organs like the stomach, small intestine, and in blood vessels . • spindle shaped cells. • no striations. • make involuntary movements possible.
Cardiac muscle 	<ul style="list-style-type: none"> • seen on the walls of the heart. • branched cells • striations are seen. • make involuntary movements possible.

Table 6.2 Different types of muscles and their characteristics

Indicators

- How do skeletal muscles differ from smooth muscles?
- What are the characteristics of heart muscles?

Muscular tissues have the structural peculiarity that enables contraction and relaxation. Prepare notes on the structure of the skeletal muscle in your science diary by analysing Illustration 6.2 and the given description.

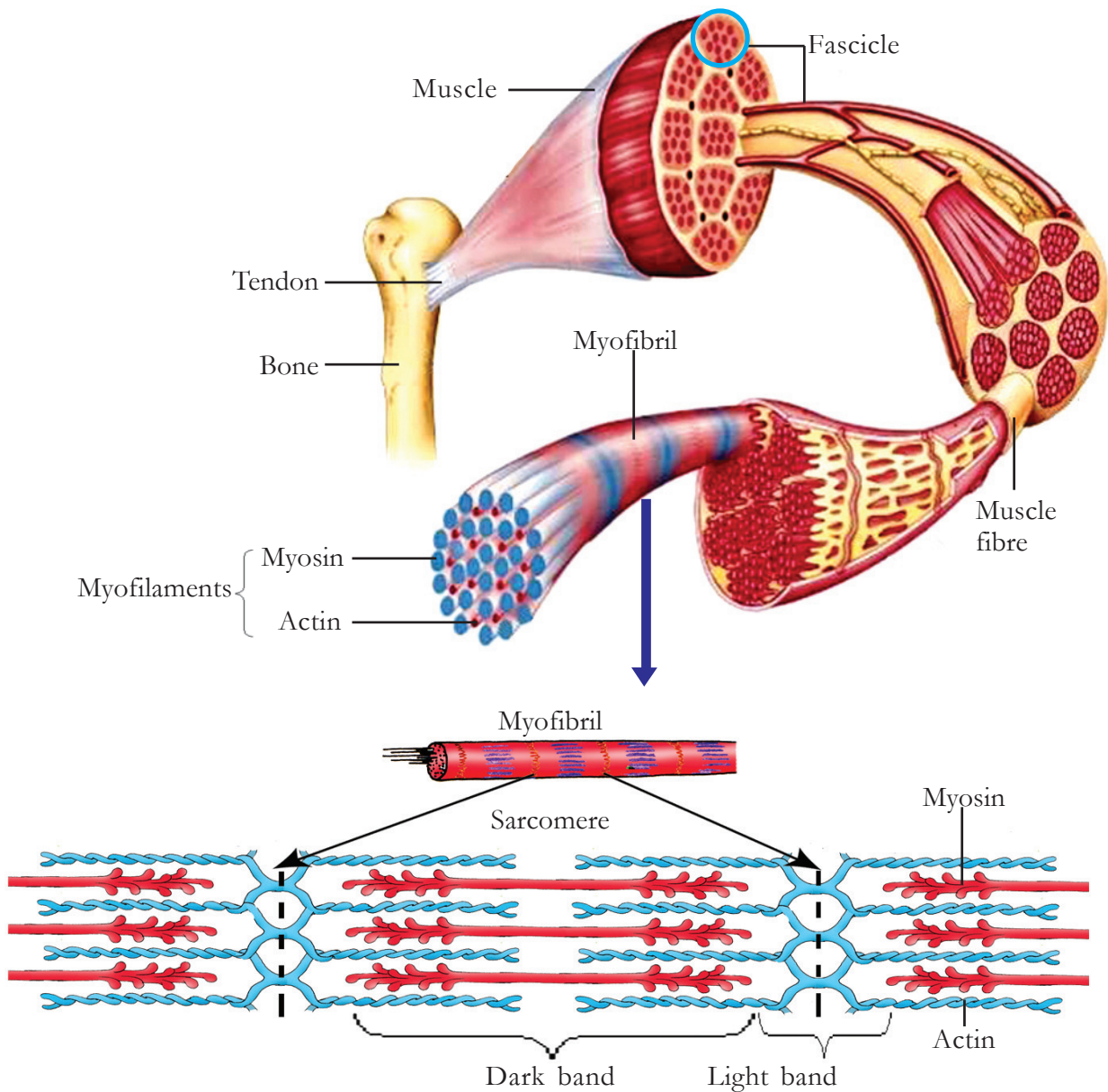


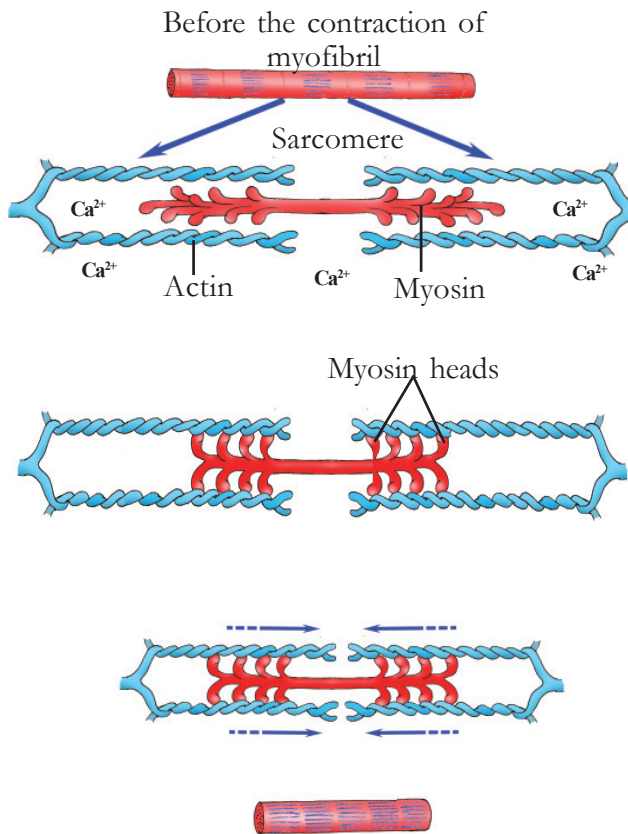
Illustration 6.2 Skeletal muscle - ultra structure

Muscle cells are the basic unit of muscular tissue. They are fine fibre like structures and are also called muscle fibres. Muscle fibres are seen in bundles in muscular tissue and are called fascicles. Each muscle fibre is composed of 4 to 20 myofibrils. Each myofibril is made up of filamentous protein fibres called myofilaments. There are mainly two types of myofilaments - thin actin filaments and thick myosin filaments. Myosin filaments and actin filaments are arranged alternately. This arrangement of myofilaments gives the striated appearance for the muscle fibre and thereby to skeletal muscles. The region where both myofilaments (actin and myosin) are present is seen as dark and is called dark band. The region where there is only actin filament is seen light and is called light band. A dark band and half of the two light bands seen on both its sides together constitute a sarcomere. A sarcomere is the basic contractile unit of a muscle fibre.

Indicators

- fascicle
- muscle cell
- myofibril
- myofilaments
- reason for the striated appearance of muscle fibres
- sarcomere

Analyse Illustration 6.3 showing the different stages of muscle contraction and prepare notes in your science diary.



After the contraction of myofibril

Illustration 6.3

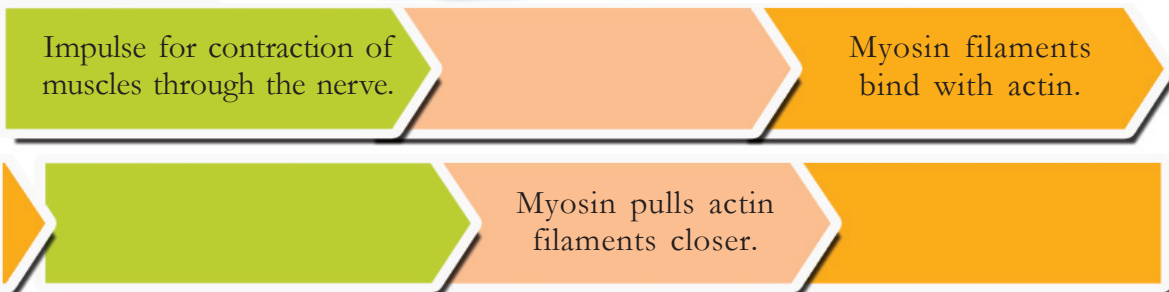
Different stages of muscle contraction

Indicators

- role of calcium in muscle contraction.
- source of energy for muscle contraction.
- role of actin and myosin filaments in muscle contraction.

Complete the flowchart on muscle contraction using the hints given in the box.

Muscle contracts, calcium ions become active, energy is released from ATP



The impulse for contraction reaches the muscle through nerves. Calcium ions are activated in the cytoplasm.

Calcium ions help in the binding of actin and myosin filaments. Actin binds with the head of myosin filaments.

Energy is released from ATP at the myosin head. Using this energy, myosin heads pull the actin filaments towards the centre of the sarcomere. Contraction of all sarcomeres results in the contraction of the muscle.

Muscle Fatigue

You have studied that when we are engaged in continuous and strenuous exercises, lactic acid accumulates in the muscles due to anaerobic respiration. This increases acidity in muscles and slows down the action of many enzymes associated with muscle contraction. As a result, muscles get exhausted and temporarily lose their power of contraction. This condition is called muscle fatigue. On taking rest, lactic acid is removed from the muscles and they regain their capacity for contraction.

Bones and Movement

In what all ways can you move your hands? Different types of movements are effected by the combined action of bones and muscles. The human skeletal system consists of 206 bones. Based on their position, the human skeleton can be divided into axial skeleton and appendicular skeleton. Observe Figure 6.1 of the human skeletal system. Complete Illustration 6.4 showing the number of bones in the axial and appendicular skeleton.

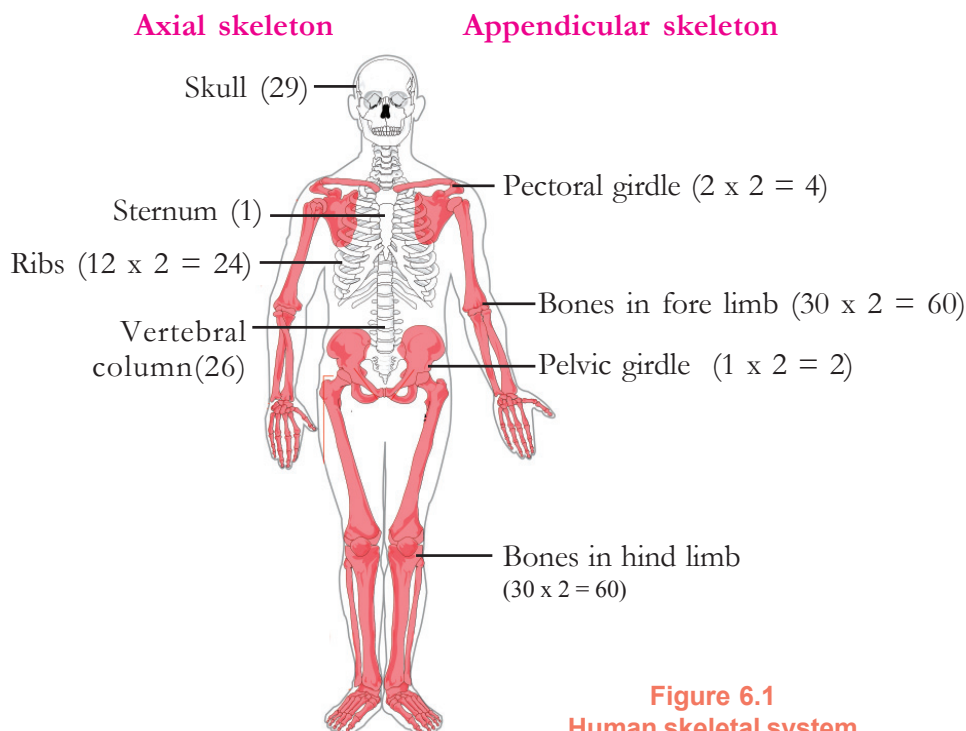


Figure 6.1
Human skeletal system

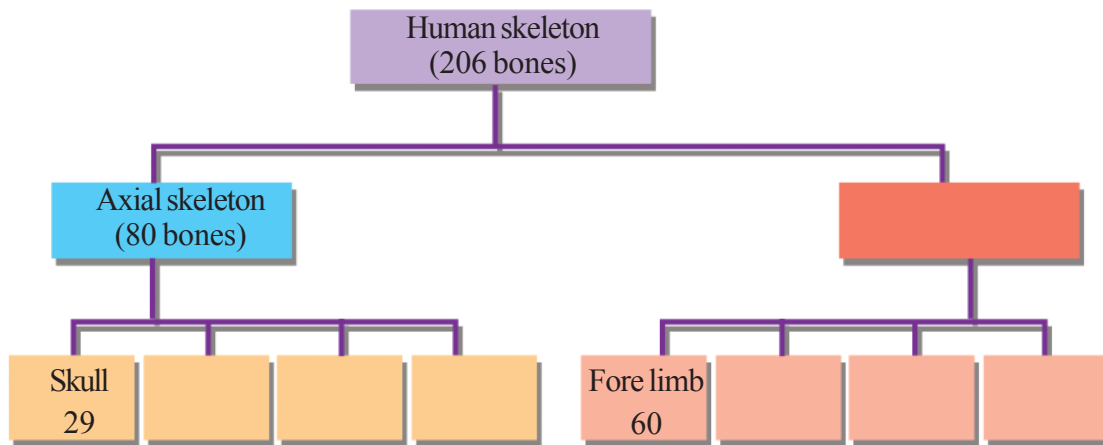


Illustration 6.4

Let us study how the combined action of bones and muscles facilitates variety of movements. We can understand this easily by observing the movement of muscles and bones in our hand. Observe Figure 6.2, discuss the given points and prepare notes in your science diary.

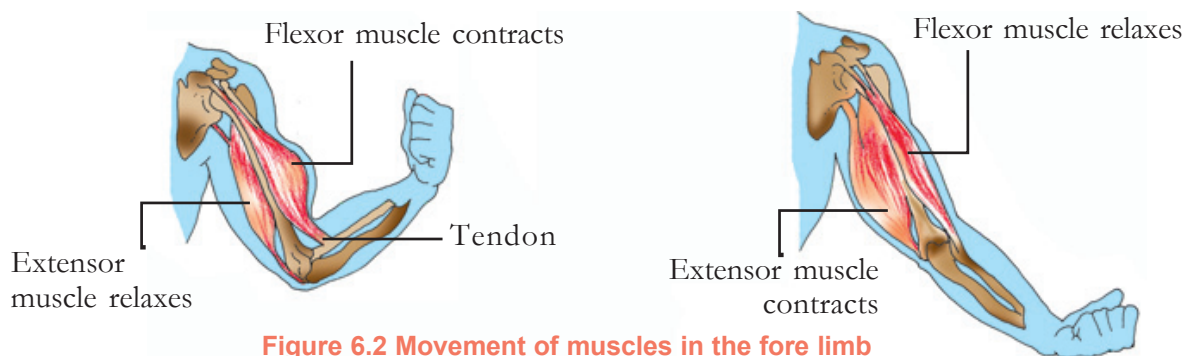


Figure 6.2 Movement of muscles in the fore limb

Indicators

- relation between muscles and bones.
- muscle which contracts on folding the forelimb.
- muscle which contracts on extending the forelimb.
- muscle which relaxes on folding the forelimb.
- muscle which relaxes on extending the forelimb.

A movement is effective and complete when muscles work in unison with bones. You have understood that in forelimb, when one muscle contracts the other muscle relaxes. These types of muscles which are opposite in action are called antagonistic muscles. The basis of almost all the movements of the body is the proper functioning of antagonistic muscles.

Joints and Movements

Joints are the meeting place of two bones. It helps in the movement of bones. Joints give more flexibility to bones to move. The nature of movements varies with the nature of joints. Observe Figure 6.3 of the human skeleton. Formulate inferences and complete Table 6.3.

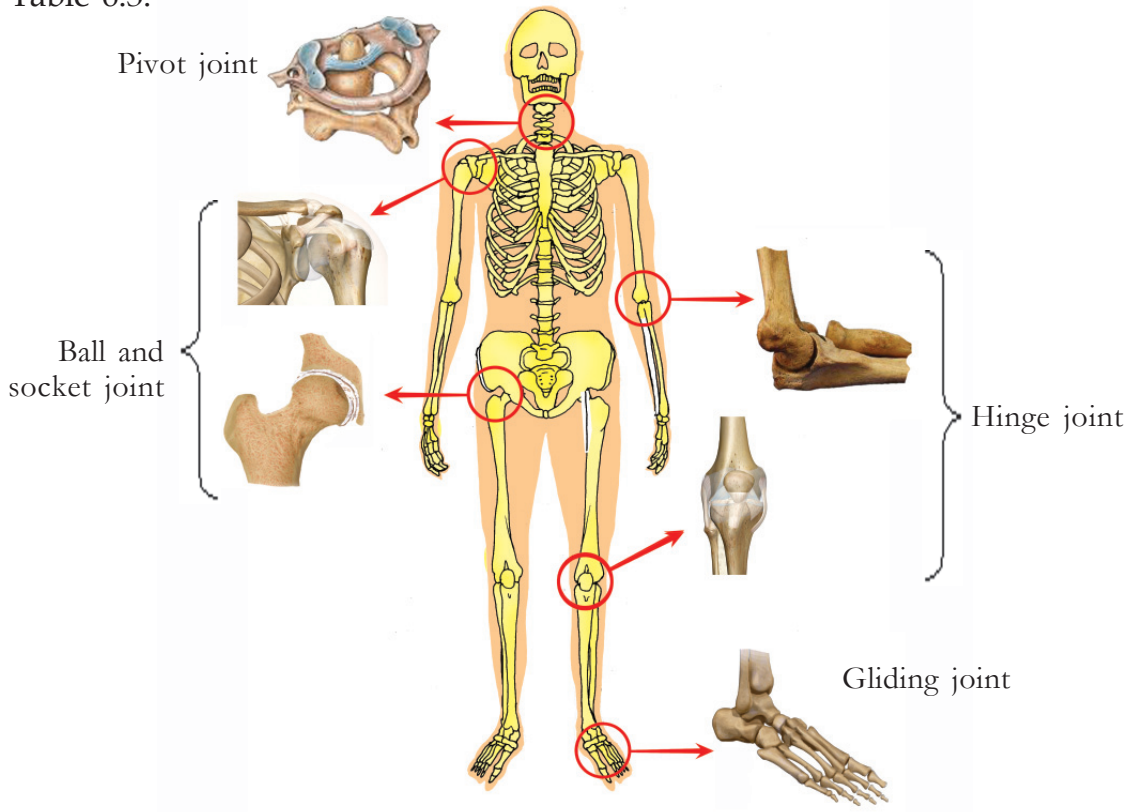


Figure 6.3 Human skeleton - joints

Types of Joint	Characteristics	Position in the body
		the point where the first vertebra joins the skull
	enables movement to one direction like a hinge	
Ball and socket joint		
Gliding joint		

Table 6.3 Skeletal joints

Let's examine the structure of a joint and how it is adapted for its function. Analyse Figure 6.4 of the synovial joint and write notes in your science diary on the basis of the indicators.

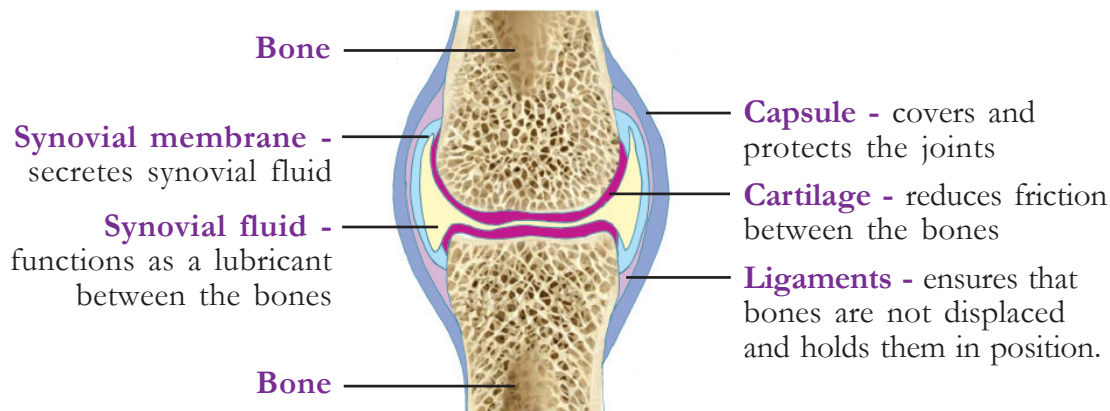


Figure 6.4 A typical joint

Indicators

- role of synovial fluid and cartilage in the smooth functioning of joints
- function of ligaments
- function of capsule

Facilitating movements is not the only function of the skeletal system in our body. List the other functions of the skeletal system.



Steroids and Muscles

Steroids are chemical substances which increase energy production in muscles. Some athletes usually depend on these types of chemicals for improving their performance. Continuous use of steroids may cause high blood pressure, cardiac problems etc. This also produces masculine feature in females and prevents the production of sex hormones in males.

- maintains posture
- helps in hearing
-

Various defects and diseases affect our bones and muscles. Prepare notes in your science diary regarding skeletal and muscular disorders, by analysing the description and collecting additional information.

Rheumatic Arthritis

- Caused by infection in joints, injuries, degenerative changes due to old age.
- Damage to cartilage.
- Severe pain, incapable of moving joints.

Dislocation

- Displacement of bones in joints.
- Damage to ligaments.
- Severe pain, oedema and difficulty in movements.

Sprain

- The stretching or breaking of ligaments.
- Severe pain and oedema.

How can we keep our bones and muscles in good condition? You are well aware of the importance of exercise. But we must be very careful to avoid fracture and damage to ligaments and joints, while playing and doing exercise. Nutritious food also has an important role in keeping our bones and muscles healthy.

Movement and Locomotion in other Animals

There are mechanisms for locomotion in other organisms too. Draw inferences on different types of locomotory structures in other organisms from the following description.

Paramecium

Cilia enable movement of paramecium in water. Cilia are small protein filaments.

Euglena

Locomotory structures of euglena are flagella. These are long whip like protein filaments.

Earthworm

The body of earthworm consists of 2 types of muscles. They are circular muscles and longitudinal muscles. Locomotion in earthworm is effected by the rhythmic contraction and relaxation of these muscles. Apart from these muscles, structures projected out from the body called chaetae also help in locomotion.

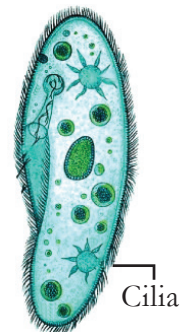


Figure 6.5
Paramecium



Figure 6.6
Euglena

Movement in Plants too



Did you notice Mini's doubt? What is your opinion?

Plants also exhibit movements in response to various stimuli. Light, gravity, water, touch, chemicals etc., are various stimuli which cause movements in plants. Observe Illustration 6.7 showing various plant movements.

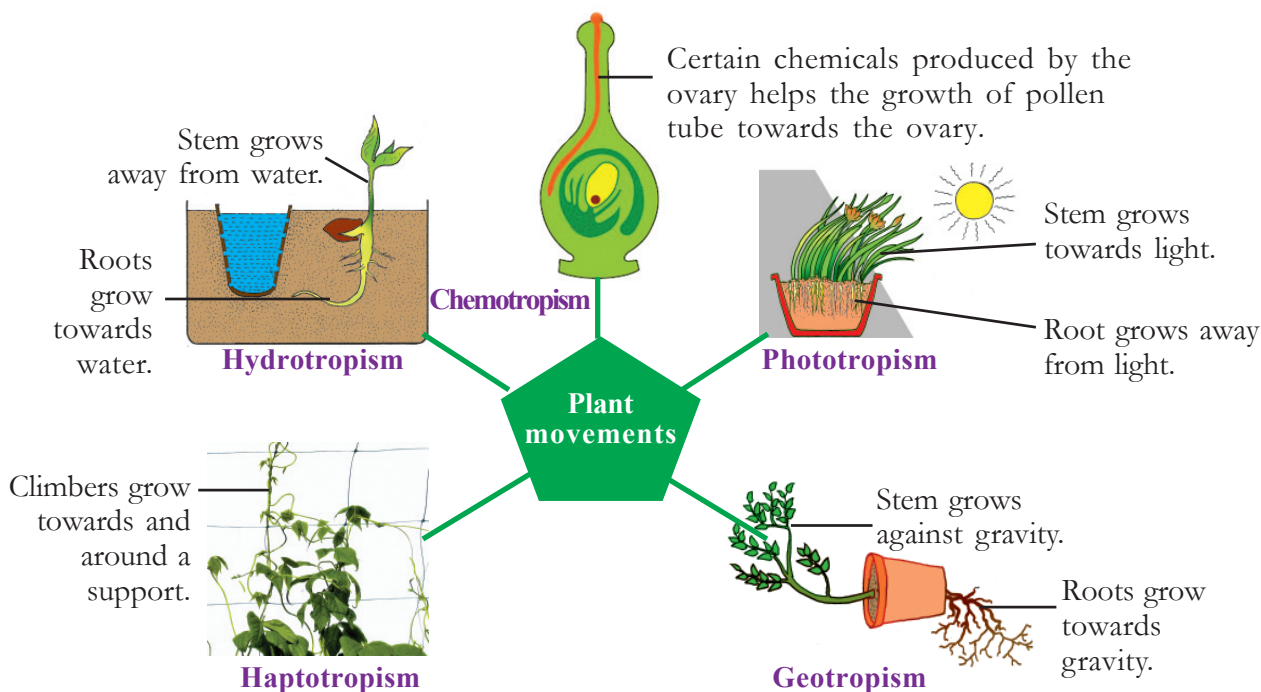


Illustration 6.7 Various types of plant movements

Did you notice any relation between stimulus and the direction of movement of plants in Illustration 6.7?

If the direction of plant movements is in accordance with the direction of stimulus it is called tropic movements.

Analyse Illustration 6.7 and complete Table 6.4.

Movement	Stimuli	Plant part that moves	Direction of movement
	light	stem	
		root	against the direction of the stimulus.
Geotropism		stem	
		root	towards the direction of the stimulus.
	water	stem	
		root	
Haptotropism	touch	stem	towards or around the object that causes stimulus.
Chemotropism	presence of chemicals	pollen tube	towards the direction of the chemicals produced.

Table 6.4

You are very much familiar with mimosa (touch-me-not). What is its peculiarity? Observe the figure.



Figure 6.7 Movement in touch-me-not plant

Is there any relation between stimulus and the direction of movement in mimosa?

If the direction of plant movement is not in accordance with the stimulus, it is called nastic movement. Collect more examples for nastic movements from your surroundings.

We have studied different types of movements in the human body. How many are the complex activities taking place in a split of seconds! The combined action of the skeletal system and the muscular system helps to maintain posture and movement of the body. Don't we need to protect these organ systems with utmost care.



Significant learning outcomes

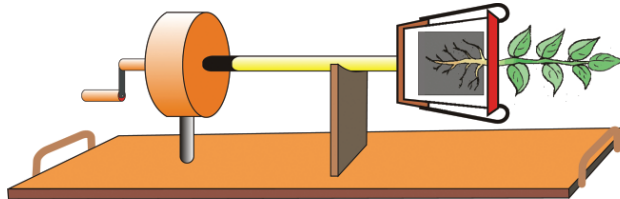
The learner

- recognises the importance of exercise in keeping a healthy body and avoiding lifestyle diseases. Practices the same in daily life.
- explains the structure and function of the muscular system in human beings.
- analyses and explains different types of muscles, their position and peculiarities in human beings.
- identifies and explains different stages in muscle contraction.
- describes the structure and function of the human skeletal system.
- identifies and describes the types of skeleton in human beings and identifies the number of bones in each section.
- describes different types of joints, their position and peculiarities.
- describes different defects of bones and joints and their causes.
- describes various adaptations that enable movements in certain animals.
- explains various plant movements with examples.



Let us assess

1. The basic contractile unit of a muscle cell
 - a. Fascicle
 - b. Muscle fibre
 - c. Sarcomere
 - d. Myofibril
2. Observe the figure and answer the following questions.

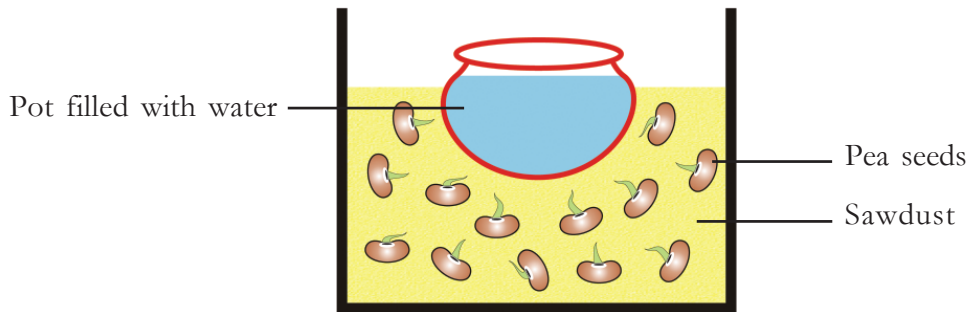


- a. What changes do you observe in the growth of root and stem in a plant, if it is kept stationary as shown in the figure for a few days. Why?
 - b. If the system is rotated continuously and slowly, what change would you observe in its root and stem?
3. Identify the odd one giving reason.
 - Coconut trees near a river bend towards the river.
 - Root of trees near a well grows towards the well.
 - Leaves of touch-me-not fold when we touch it.
 - Roots of plants grow towards gravity.



Extended activities

- Arrange sawdust and a pot filled with water in a box as shown in the figure. Then put pea seeds at different parts of the box.



Take out the pot carefully after a few days. Observe the direction of growth of the roots. Write your inference.

- Prepare and exhibit a poster showing the importance of exercise.

7

Division - for Growth and Reproduction



Did you notice the conversation between the children? Is the growth of a tree and that of a man of the same age similar?

What are the differences between the growth in plants and animals? List them.

- Plants grow throughout their life.
-

Plants grow due to the rapid division and differentiation of meristematic cells. Meristematic cells are special type of cells that have the capacity for continuous division. Plants can grow throughout out their life due to the presence of these cells.

Where are the meristematic cells seen in plants? Observe Illustration 7.1. Discuss this on the basis of indicators and prepare a note in the science diary.

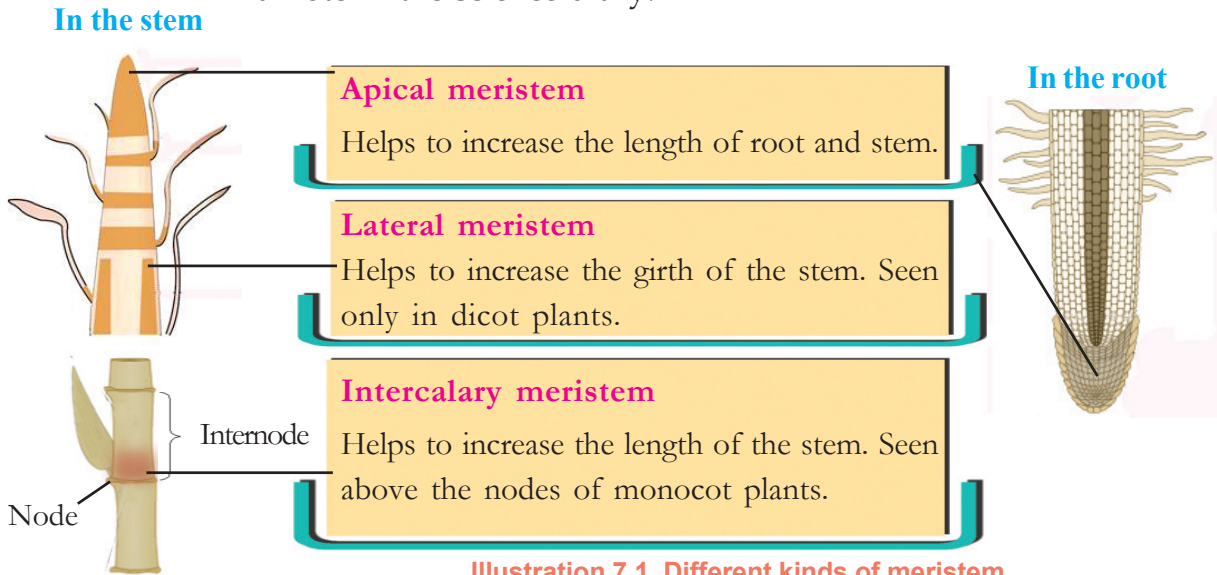


Illustration 7.1 Different kinds of meristem

Indicators

- Why is that growth in plants is localised only at certain parts?
- The stem of monocots increases in length faster than dicots. Why?
- The stem of monocots does not increase its girth beyond an extent. Why?

As in plants, growth in animals is also due to cell division and cell growth. Unlike plants, animals do not have localised centres of growth. Almost all body parts grow in animals during the growth phase.

Observe Illustration 7.2.

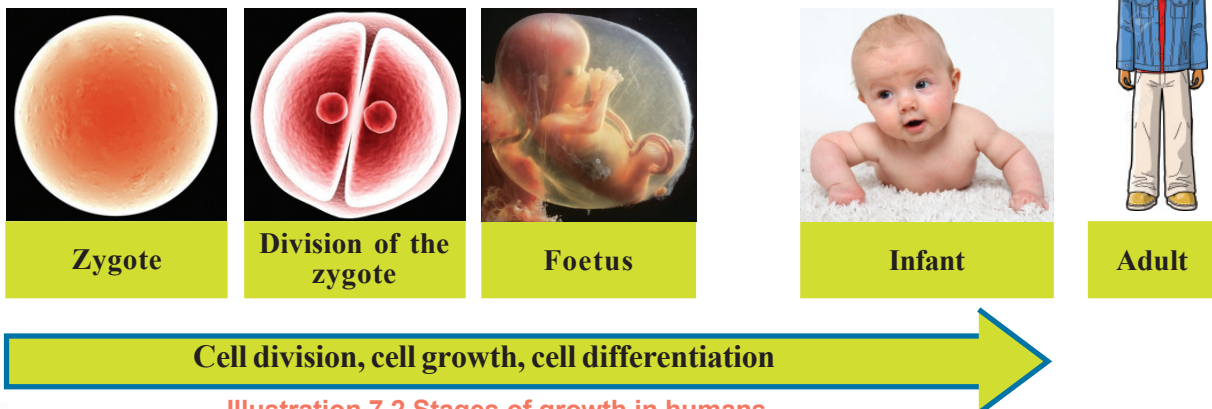


Illustration 7.2 Stages of growth in humans

Isn't it now clear that cell division is the main cause of growth. Cell division is mainly of two types. They are mitosis and meiosis.

Mitosis

The kind of cell division seen in eukaryotes is mitosis. In this process, a parent cell divides to form two daughter cells.

The phase at which a cell prepares for division is called interphase. The following are the main events that occur during this phase:

- duplication of genetic material in the chromatin reticulum of the cell.
- increase of cell organelles and cytoplasm.

Cell division begins after interphase. The changes that take place during this stage are as follows:

- division of the nucleus (Karyokinesis)
- division of cytoplasm (Cytokinesis)

Cytokinesis takes place after karyokinesis.

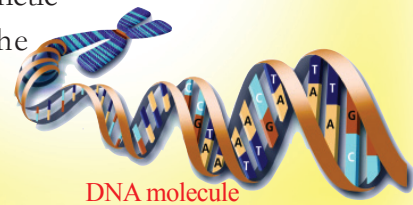
Division of the nucleus

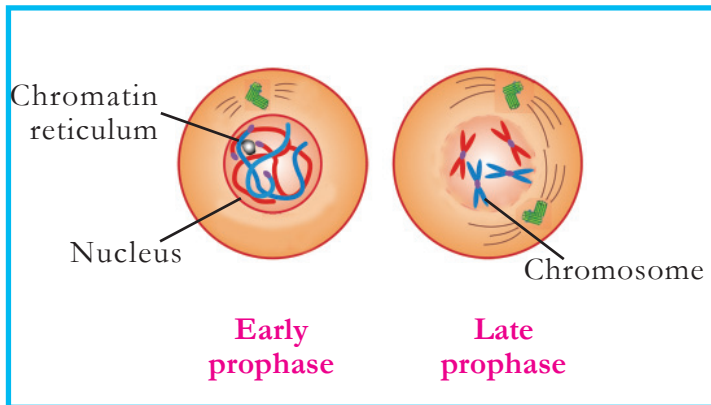
Based on the indicators, analyse Illustration 7.3 on the changes that take place in the nucleus during cell division, and formulate inferences.

The changes in nucleus take place in four stages. They are prophase, metaphase, anaphase and telophase. Let us familiarize ourselves with the changes that take place in each stage.

Genetic material in the chromatin reticulum

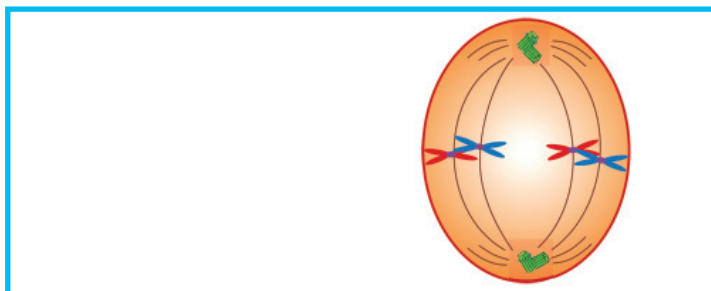
The chromatin reticulum in the cells of eukaryotes is made of different protein molecules and DNA (Deoxyribo nucleic Acid) molecules. Since the DNA contains genes that carry hereditary characters, DNA is the genetic material of the cell.





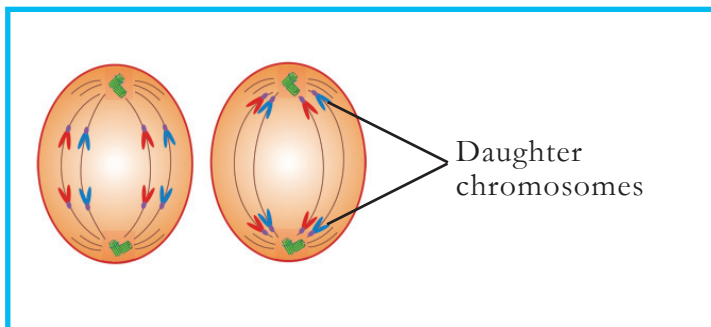
Prophase

- Chromatin reticulum condenses to form chromosomes.



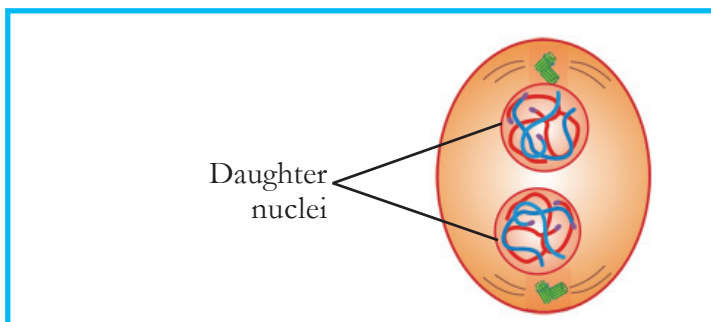
Metaphase

- Chromosomes get aligned at the equator of the cell.



Anaphase

- Chromatids of the chromosome separate.
- Daughter chromosomes with single chromatids move to each pole.



Telophase

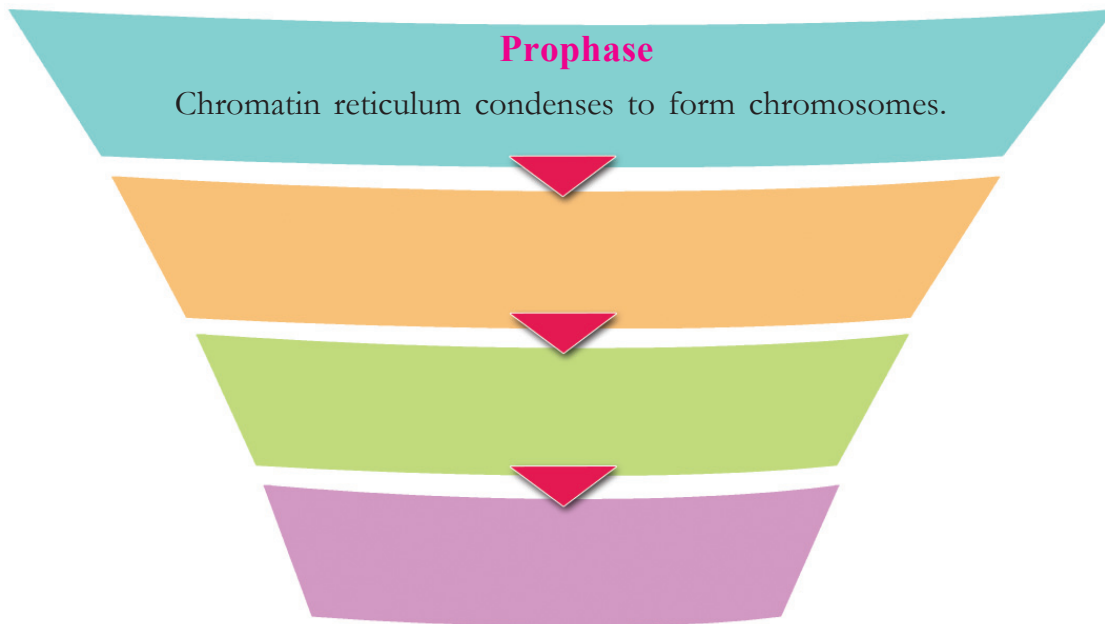
- Chromosomes that moved to the poles become chromatin reticulum.
- Daughter nuclei are formed.

Illustration 7.3 Stages of division of the nucleus

Indicators

- In which phase does the chromatin reticulum become chromosomes?
- What change occurs in telophase?

Based on the inference you have formulated, complete the flow chart by writing the stages of the division of nucleus and their peculiarities.



Division of the Cytoplasm

When the division of the nucleus is completed, two nuclei are formed in each cell. Cell division is complete only after the division of the cytoplasm. The stages of division of the nucleus in a plant cell and an animal cell are more or less similar.

But the division of the cytoplasm is entirely different. This is due to the presence of the cell wall in plant cell.

Observe the Illustration of cytokinesis in animal cell and plant cell (7.4, 7.5) and formulate inferences.

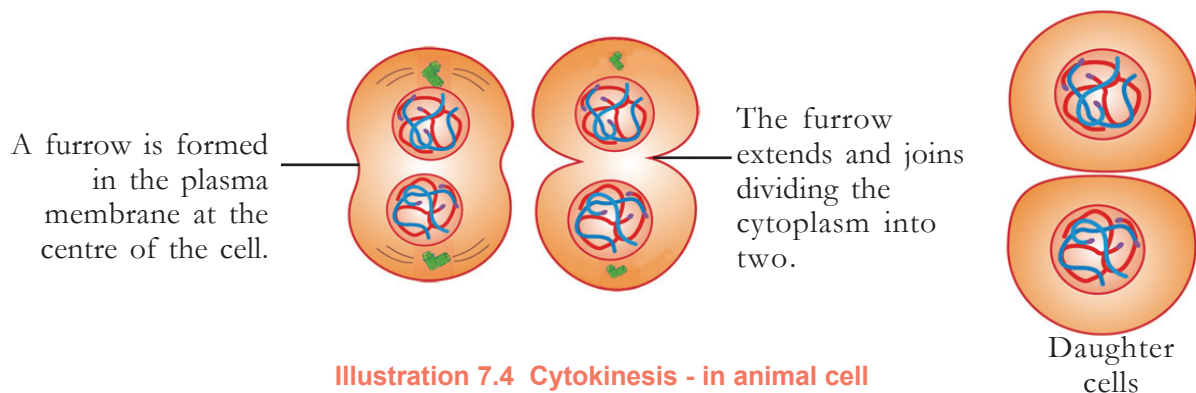


Illustration 7.4 Cytokinesis - in animal cell

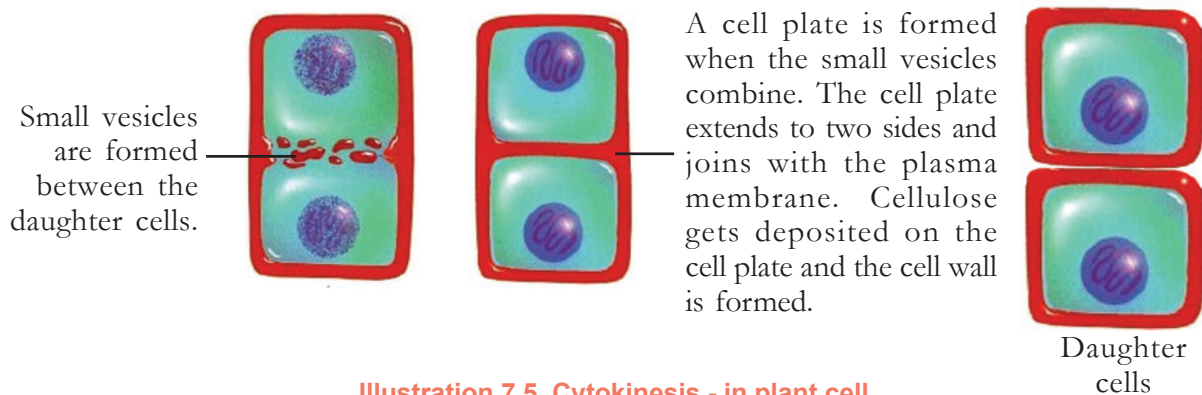


Illustration 7.5 Cytokinesis - in plant cell

Complete Table 7.1 suitably based on the inferences formulated on cytokinesis.

Cell	Peculiarities of cytokinesis
Plant cell	
Animal cell	

Table 7.1 Cytokinesis - peculiarities

Cell cycle

Through sequential changes, each cell grows and prepares for the next division. The changes that occur in each cell from one division to the next division is called cell cycle.

The daughter cells formed as a result of cell division grow and then divide. The significance of mitosis is that there is no change in the number of chromosomes.



Observe the permanent slides on the stages of mitosis and draw the diagrams in the science diary.

Significance of Mitosis

Analyse Illustration 7.6 on the significance of mitosis and prepare a note in the science diary.

For the repair of tissues.

Mitosis

For growth

Illustration 7.6 Significance of mitosis

Specific number of chromosomes are seen in the cells of each organism. It is this constancy in the number of chromosomes that maintains the genetic similarities of each species and enables them to exist on earth as one species.

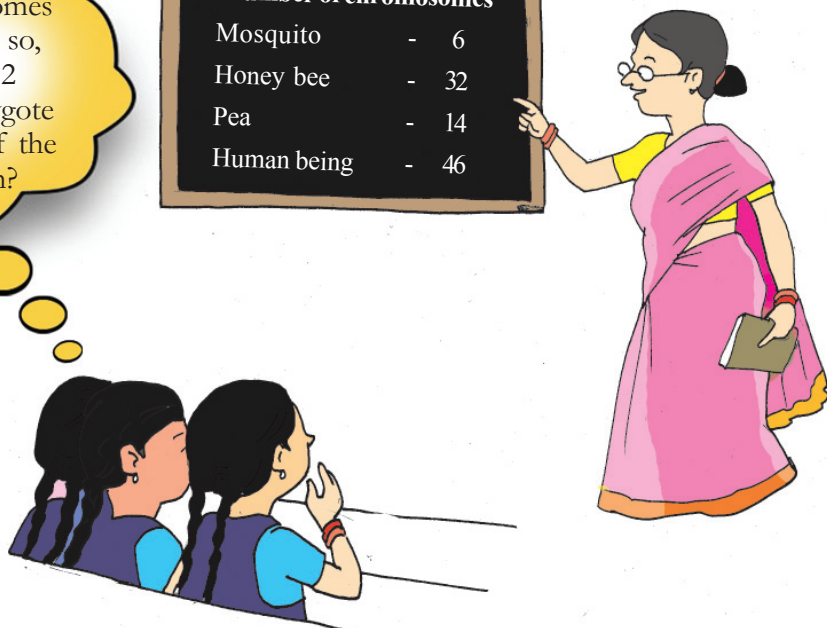
Cancer and cell division



Genes control cell division. When changes occur in these genes, cells divide in uncontrolled manner. The cells formed in this way are the cancer cells. They extend to other parts from the place of origin.

There are 46 chromosomes in the cells of man. If so, shouldn't there be 92 chromosomes in the zygote formed by the fusion of the sperm and the ovum?

Number of chromosomes	
Mosquito	- 6
Honey bee	- 32
Pea	- 14
Human being	- 46

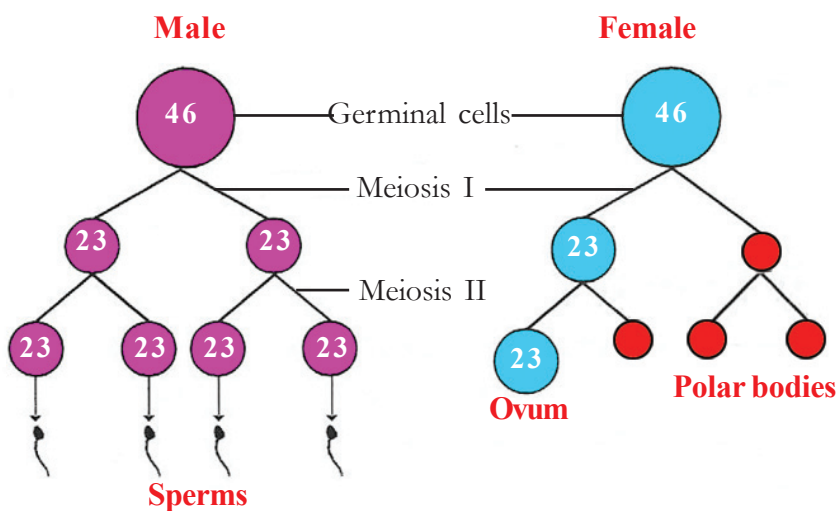


Do you have such doubts?

How does the chromosome number become half in the gametes of humans? Based on the indicators analyse Illustration 7.7 and description given below, and prepare a note.

Meiosis

Meiosis is the mode of cell division in which gametes are formed. Meiosis occurs in the germinal cells of the reproductive organs. Human beings have 46 chromosomes. Germinal cells with 46 chromosomes divide continuously two times. These divisions in meiosis are known as meiosis I and meiosis II. Two daughter cells with half the number of chromosomes (23 chromosomes) are formed in meiosis I. Each daughter cell again divides in meiosis II. There is no change in the chromosome number in this division. Hence meiosis II is similar to mitosis. As a result of meiosis, four daughter cells, each with 23 chromosomes, are formed from a germinal cell.



Polar body

When meiosis occurs in the female germinal cell, a large ovum and three small cells are formed. The smaller cells are the polar bodies. These sterile cells get destroyed.

Illustration 7.7 Stages of gametogenesis

Indicators

- What is the number of chromosomes in germinal cells?
- What is the number of chromosomes in the daughter cells formed after meiosis I?
- What is the peculiarity of meiosis II?
- Is there any difference in the number of sperms and ova formed after gametogenesis? What is the reason for this?

Have you understood that two kinds of cell division occur in sexually reproducing organisms? List the differences between mitosis and meiosis.

	Mitosis	Meiosis
In which kind of cell does it take place?		
The change in the number of chromosome.		
Number of daughter cells.		

Table 7.2 Mitosis and meiosis

You have already studied the different stages in the growth of human being. List them.

- Infancy
-
-
-

The adolescent period is around 10 to 19 years. The growth of a person completes at the beginning of the 20s. The body does not grow further.

Then the person moves towards old age. However, it takes a few more years for a person to show signs of old age. Old age is inevitable in life. Don't you think the aged who worked for the welfare of their family and society during their younger age deserve special consideration?

Observe the picture.

Have you ever helped anyone in this way?

Noticeable changes, quite different from other stages occur in old age.

What are the physical peculiarities of old age?

- rate of cell division decreases.
- availability of oxygen to the cells decreases.
- deterioration of cells increase.
- muscles shrink.
- production of energy decreases.
- efficiency of sense organs decreases.

Each of us will become old in future. How should we behave with elders? Do we offer them care and love? What should be our attitude towards them? Discuss in the class and implement your decisions.





Significant learning outcomes

The learner

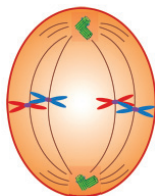
- identifies and explains various kinds of meristems responsible for plant growth.
- identifies and explains the features of the stages of cell division in eukaryotes.
- compares and identifies the difference between cytokinesis in plant cell and animal cell, and presents them.
- identifies and explains the significance of mitosis.
- explains how chromosome number is maintained in a species through meiosis.
- identifies features of old age and shows a positive attitude towards the aged.



Let us assess

1. The stage of karyokinesis at which daughter nuclei are formed.

A. Prophase	B. Metaphase
C. Anaphase	D. Telophase
2. Observe the figure.



- a. Which stage of mitosis is indicated in the figure?
 - b. What is the main change that occurs in this stage?
3. List the meristems in various parts of the plant and list their functions.



Extended activities

- Prepare a slide based on a story board on the reasons, symptoms and methods of treatment of cancer. Present it in the Health Club.
- Prepare models of various stages of karyokinesis using woolen threads of different colour, beads etc.