

# BIOLOGY

## Standard

IX



Government of Kerala  
Department of General Education

Part - I

1/2



State Council of Educational Research and Training  
(SCERT), Kerala  
2019

### 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.

Dear Students,

Science is activity based. Its method is the unprejudiced investigation of truth, based on scientific evidence. If what is generally considered right today is scientifically proved wrong tomorrow, it would be accepted. This is how Science works. This rational method has to be employed in learning Science. Continuous observations, experimentations and analyses lead the scientific perspectives to new dimensions. Hence, you have to make use of every possible opportunity to observe and experiment.

The student's role is pivotal in the process of construction of knowledge. This Science textbook is only a resource in the learning process. Your teachers and supplementary materials will help you in the creation of knowledge. 'Samagra', the education portal and technology enabled Q R Code printed textbooks would definitely make your learning activity in classrooms easy and joyful.

The National Skills Qualifications Framework, the current relevance of Disaster Management and the possibilities of I.C.T. have also been considered in the textbook.

This book includes lessons which spread light on Photosynthesis, the basis of existence of the living world, the diverse Organ systems of the human body, the complex Life processes they perform, Cell division which leads to the growth of the body and the Science behind maintaining the uniqueness of living species.

The method of presentation adopted is centred in the life processes that would be conducive to the learner to achieve Life skills and Health habits. Learning experiences which provide knowledge and delight have been included here. We expect the textbook to be helpful in the further learning of Science.

Love and Regards,

**Dr. J.Prasad**  
Director  
SCERT, Kerala



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**Certain icons are used in this  
textbook for convenience**



**For further reading**  
(Evaluation not required)



**Let us Assess**



**Extended Activities**

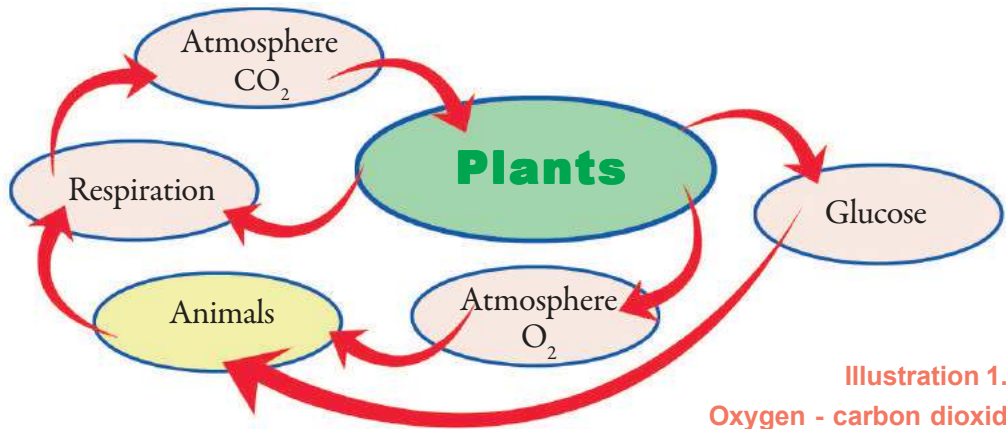


## Protectors of Biosphere



A poster designed by Sangeeth for a poster designing competition based on the message 'save earth from global warming', is presented above. What inferences can you formulate from this poster?

You have heard about global warming. It is a dangerous phenomenon which leads to the rise in earth's temperature. The main reason for global warming is the increase in the level of carbon dioxide in the atmosphere. Plants can resist this to a certain extent. Analyse illustration 1.1 given below based on the indicators and prepare notes in the Science diary.



**Illustration 1.1**  
Oxygen - carbon dioxide balance in atmosphere.

**Indicators**

- Why doesn't the level of oxygen in the atmosphere decrease?
- Why doesn't the level of carbon dioxide in the atmosphere increase?
- Which process in plants regulate the level of oxygen and carbon dioxide in the atmosphere?

Have you understood how plants control global warming?

List out the factors, other than carbon dioxide that are required for photosynthesis.

- Minerals and salts
- 

Where do plants acquire these factors from? Discuss.

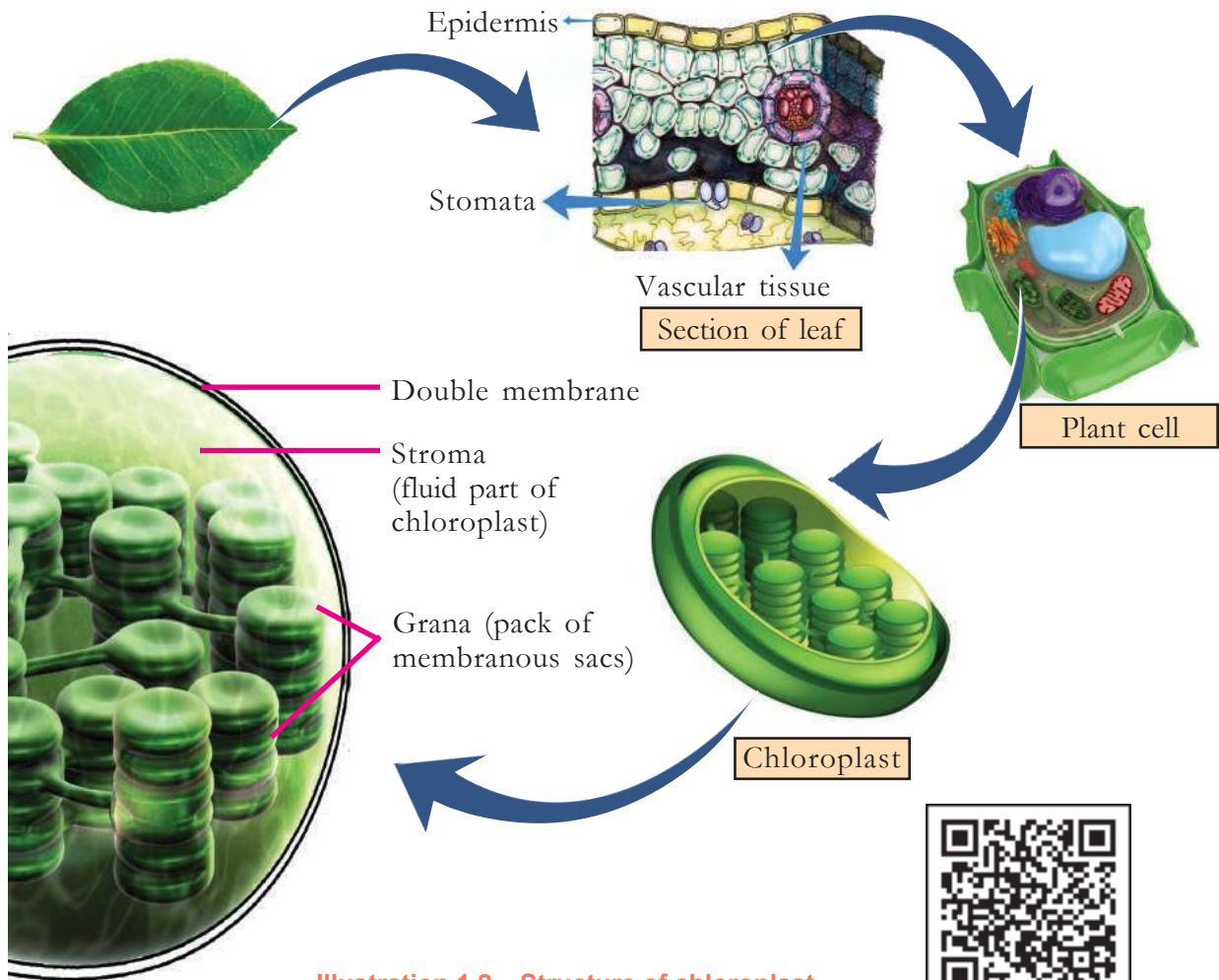


Have you noticed Thara's doubt? Visit the biodiversity park of your school and examine the validity of the doubt.

**Pigments in Leaves**

You know that chlorophyll imparts green colour to plant parts. With the help of your teacher, observe the section of a leaf through a microscope. Based on the indicators, analyse illustration 1.2 and description and formulate your inferences.





**Illustration 1.2** Structure of chloroplast

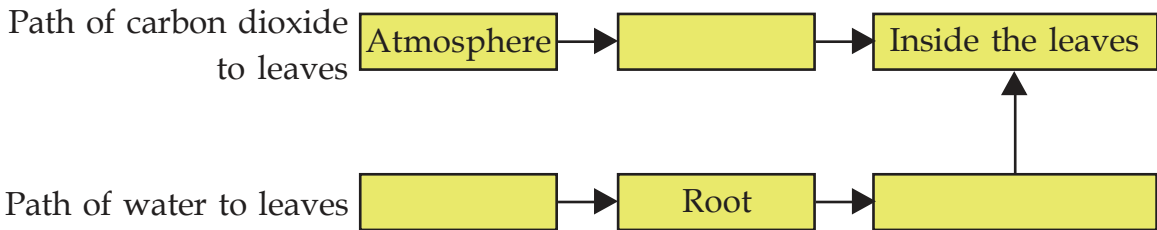


Photosynthesis takes place in chloroplast. It occurs not only in leaves, but in regions wherever chloroplast is present. Pigments that absorb sunlight are found in the grana of chloroplast. Chlorophyll a, chlorophyll b, carotene and xanthophyll are the pigments present in grana. All these pigments can absorb sunlight. 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

- Parts of chloroplast.
- Pigments in chloroplast.
- Role of pigments in photosynthesis.

Along with carbon dioxide, water should also reach the leaves for photosynthesis. How do they reach the leaves? Complete the work sheet.



### The Chemistry of Photosynthesis

How do plants produce food and oxygen through photosynthesis? Observe illustration 1.3, compare the two phases of photosynthesis and complete table 1.1.

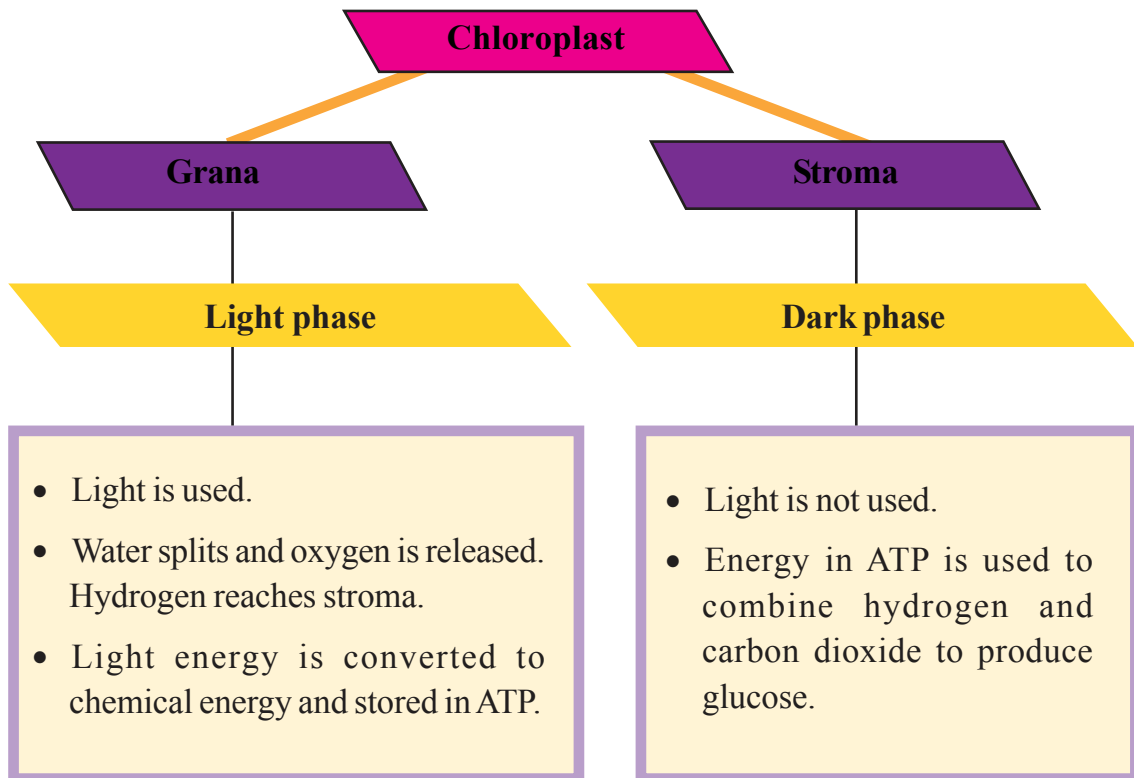


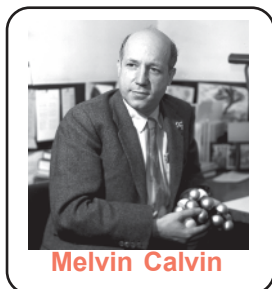
Illustration 1.3 Phases of photosynthesis

Indicators	Light phase	Dark phase
Location		
Action		
Products		
Necessity of light		
ATP	Formed	Utilized



Table 1.1

Dark phase follows the light phase. The cyclic chemical reactions in the dark phase were discovered by the scientist Melvin Calvin. Hence, this phase is known as Calvin cycle. He was awarded the Nobel Prize in 1961 for this discovery.



Now you have understood the chemical reactions in the process of photosynthesis. Based on this, complete illustration 1.4 given below.



Illustration 1.4

The complex process involved in photosynthesis was unfolded after long years of study and experimentation by many scientists. Photosynthesis remains an aspiring area of research even today. Prepare a Science edition by collecting information about research activities in this area.

### Energy currencies

Availability of energy must be ensured for continuous metabolic activities in the cells. ATP (Adenosine triphosphate) molecule is used for the continuous transfer of energy. The energy liberated during the break down of ATP into ADP (Adenosine diphosphate) and phosphate is used for the metabolic activities. ADP restores energy and gets converted back to ATP. Since such energy transaction is done by ATP, it is known as the energy currency of the cell.

### After Photosynthesis

If glucose is what all plants prepare, then how could we get starch, protein and fat from vegetable food items?



Isn't Beena's doubt genuine?

What happens to the glucose formed as a result of photosynthesis? Analyse the description and illustration 1.5 given below. Based on your analysis, prepare a note on the chemical changes of glucose in plants in the Science diary.

Since glucose is easily soluble in water it cannot 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. Starch is later converted to sucrose and is transported through phloem to various plant parts and stored there in different forms.

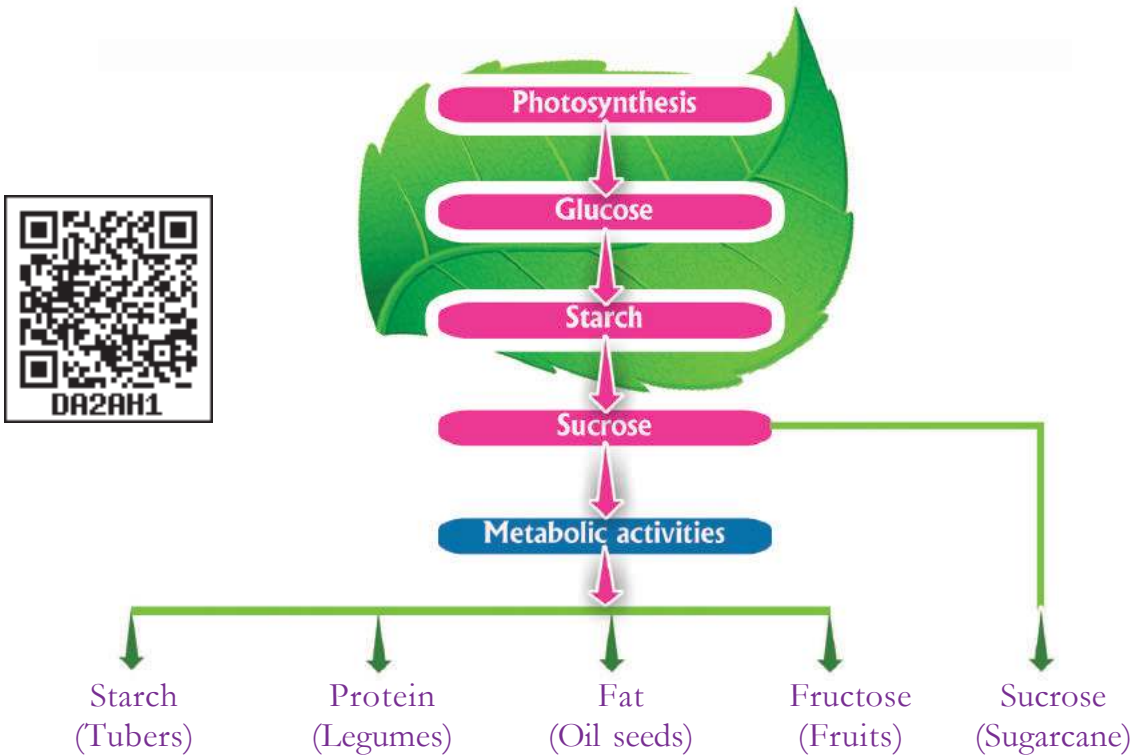


Illustration 1.5 Chemical changes in glucose

## Indicators

- Need of converting glucose to starch.
- Methods by which plants utilize starch.
- Storage of food in different parts of the plant.

Have you understood how various types of nutrients required for animals are obtained from plants?

Do plants provide only food and oxygen?

Observe the figures 1.1 given below and find more examples.

## 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 by breaking down chemical compounds. This process is called chemosynthesis.



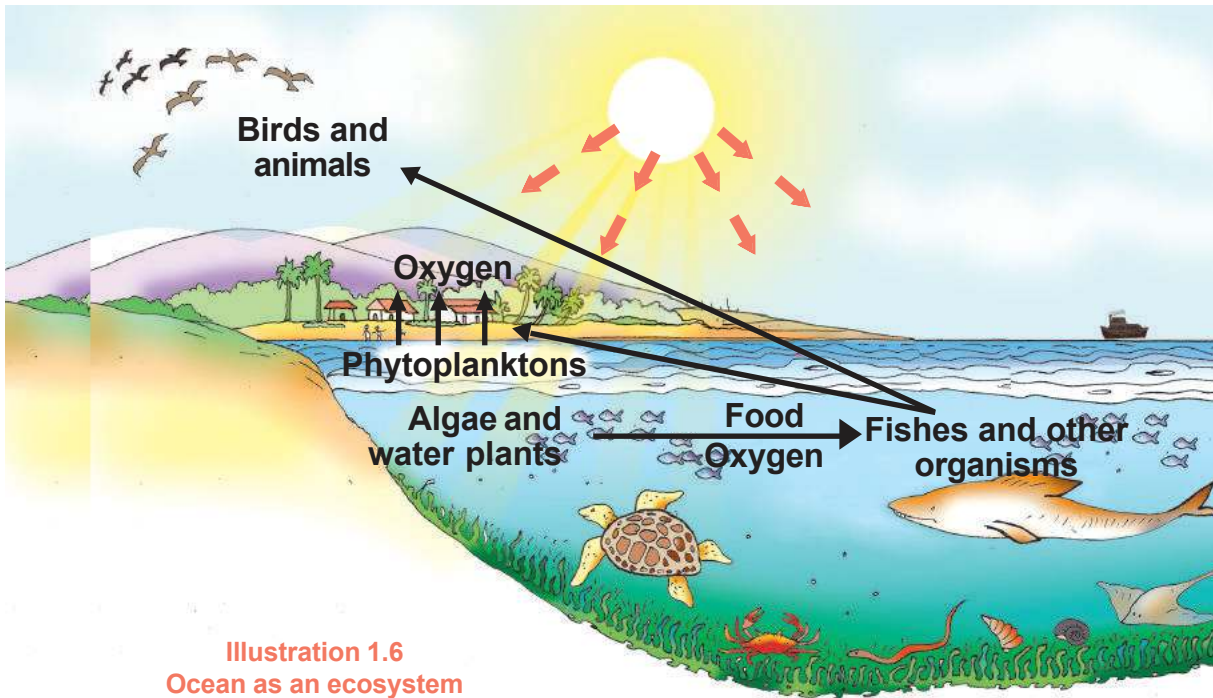
Figure 1.1 Products of economic importance.

Most plant parts have economic importance in one way or the other. A variety of value added products are made from them. The processing and marketing of these resources open doors to a wide range of job opportunities. With the help of your teacher collect information about economically important plant resources. Organize a discussion in your class on the job opportunities related to this area. Have you understood how diverse the plant world is?

## Ocean at par with Land

Ocean is far more extensive than land. Ocean too has an amazing diversity in its ecosystem. Small organisms to the giant whales live there.

Analyse illustration 1.6 and the description given below. On the basis of the analysis and the indicators provided, discuss and write down your inferences in the Science diary.



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 atmosphere is contributed by algae and phytoplanktons present in the sea.



### Algae and Phytoplanktons

The world of algae is diverse. Based on the quantity of the main pigment present in them, algae may be green, red or brown in colour. Algae are diverse in their size too; from microscopic size to metres long. Sargassum is a large brown algae. Phytoplanktons found in oceans are free floating microscopic organisms that perform photosynthesis. Desmids, golden algae and cyanobacteria are examples of phytoplanktons.

### Indicators

- Chief producers in the ocean ecosystem.
- Importance of photosynthesis in ocean.

Ocean gets polluted due to various reasons. Find its reasons and prepare a short note.

Like land pollution, ocean pollution also adversely affects organisms including human beings. What can we do to avoid this? Formulate suggestions.

### Plants - Earth's Wealth

The service rendered by plants for the sustenance of the living world is unique. Plants serve as the cheapest, effective and natural means for the purification of air. By absorbing carbon dioxide from the atmosphere and releasing oxygen, plants provide invaluable service to the living world. Plants also have a major role in the mitigation of natural disasters.

Mangrove forests help in controlling Tsunami to some extent. Bamboo forests, reed, vetiver, lemongrass etc. protect the river banks from collapsing during flood. Trees and bushes in mountains and hills prevent soil erosion and landslide.



It is not when natural calamities happen that one should think about nature conservation. Nature conservation should become part and parcel of everyone's life. Nature should be used wisely and preserved for the generations to come. Green plants are the protectors of biosphere. Hence for the conservation of nature, nurturing of plants should be considered as one's prime responsibility.

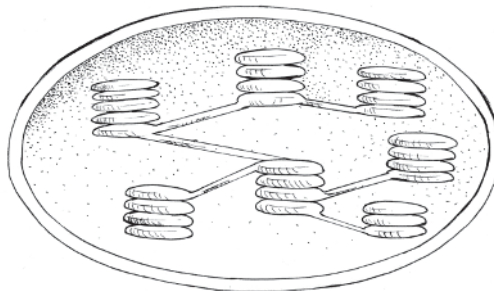


### Let us Assess

- Which of the pigments given below participate directly in photosynthesis?
  - Chlorophyll a
  - Chlorophyll b
  - Xanthophyll
  - Carotene
- Glucose formed as a result of photosynthesis gets stored in different parts of the plant in different forms through metabolic activities. Based on this, complete the table given below.

Plant part	Stored form of glucose

- Diagram showing the structure of chloroplast is given below. Redraw the diagram and label its important parts.



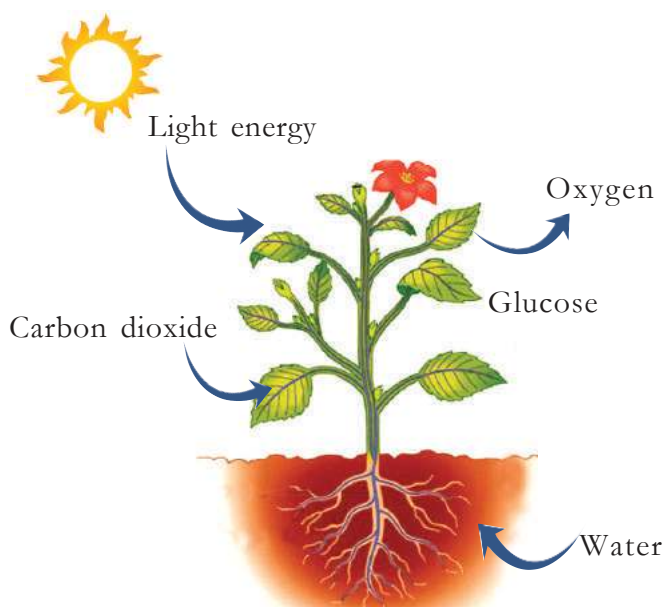


4. Correct the statements given below by replacing the underlined words alone, if found incorrect.
  - a. Oxygen is formed during photosynthesis by the splitting of carbon dioxide.
  - b. The dark phase of photosynthesis takes place in the stroma.
  - c. Glucose is transported through the phloem tube to various parts of the plant.
5. Plants are the lungs of earth. Assess the relevance of this statement and prepare notes.

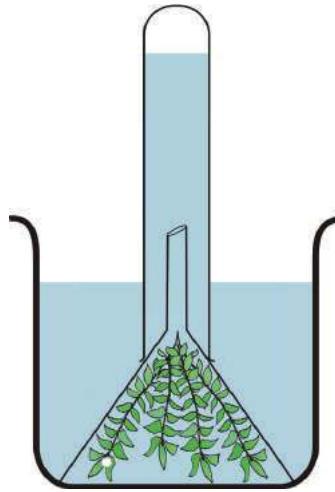


### Extended Activities

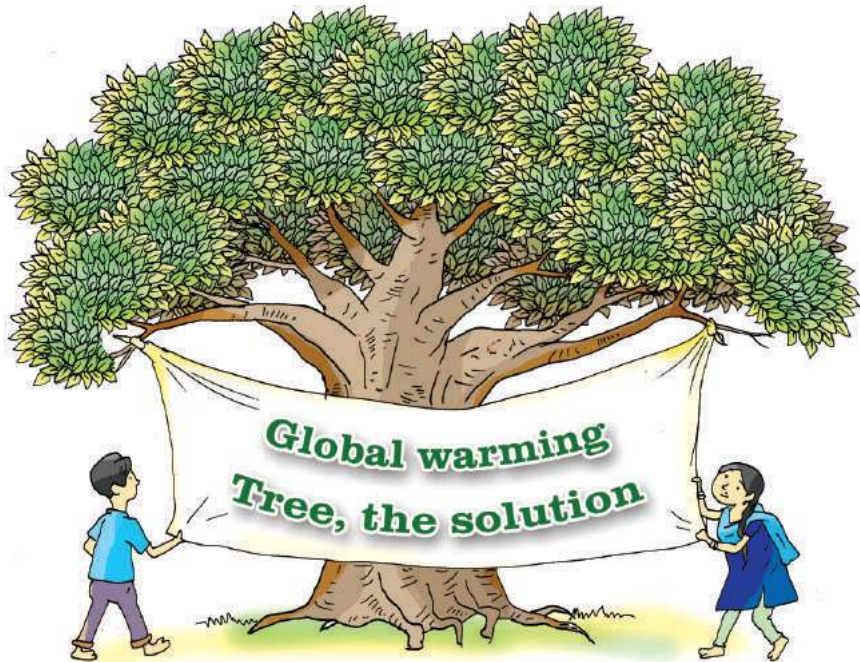
1. Collect the green algae named Spirogyra. Observe it through the microscope with the help of your teacher and identify the shape of chloroplast.
2. Observe the illustration of photosynthesis. Prepare similar illustrations and exhibit them in the classroom.



3. Arrange an experimental set up as shown in the figure. Observe the difference in the evolution of gas when sunlight falls directly and indirectly and write your inferences in the Science diary.



4. Analyse the illustration given below. Collect information regarding the reasons for global warming, its consequences and remedial measures, and with the help of a presentation conduct a seminar in the classroom.





# 2

## Food Through Digestive Tract

*Plants which prepare and use food by themselves do not have a digestive system. Then why do we, who receive food from plants have a digestive system?*



Adithyan is reading a question from the doubt box maintained by the Science club. What reply can you give? Write in the Science diary.

We get nutrients required for life activities from the food we eat. Complete table 2.1 by including their functions.



Nutrient	Function
Carbohydrate	
Protein	
Fat	
Minerals	
Vitamins	
Water	

Table 2.1

You know that the food materials we eat are not absorbed as such by our body. Digestion is the process of converting complex food materials into simple absorbable forms.

Examine figure 2.1. Identify and label the parts of the digestive system.



\_\_\_\_\_

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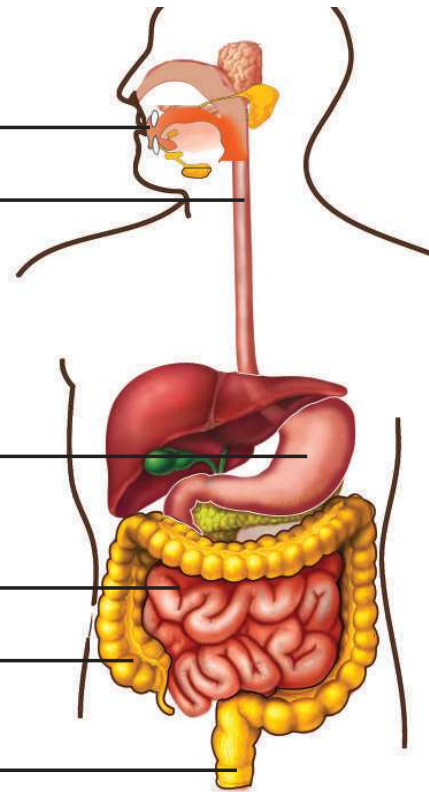


Figure 2.1 Human digestive system

**Food inside Mouth**

What changes happen to food inside the mouth?

- 
- Mixes with saliva.

The structure and arrangement of teeth is suitable to masticate the food we eat. Complete the missing areas in illustration 2.1 regarding the arrangement of teeth.

Eventhough teeth vary in their morphology and function, they show similarities in their internal structure.

Compare the completed illustration 2.1 and 2.2, analyse and prepare notes on the internal structural similarity and functional difference of teeth.

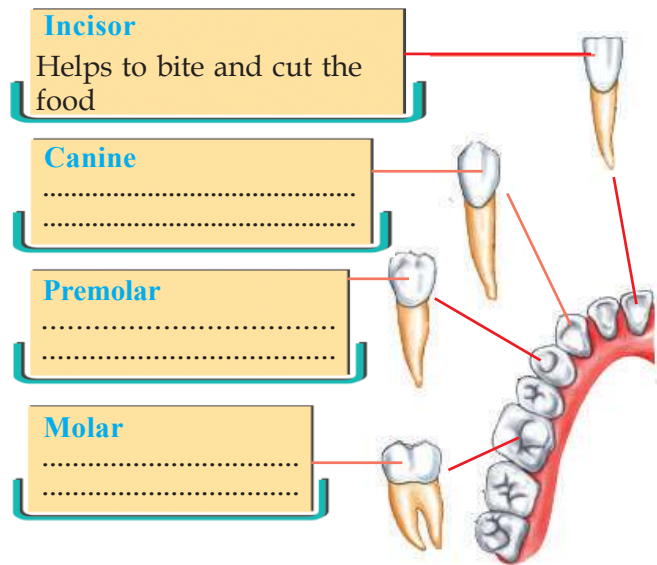


Illustration 2.1 Different types of teeth

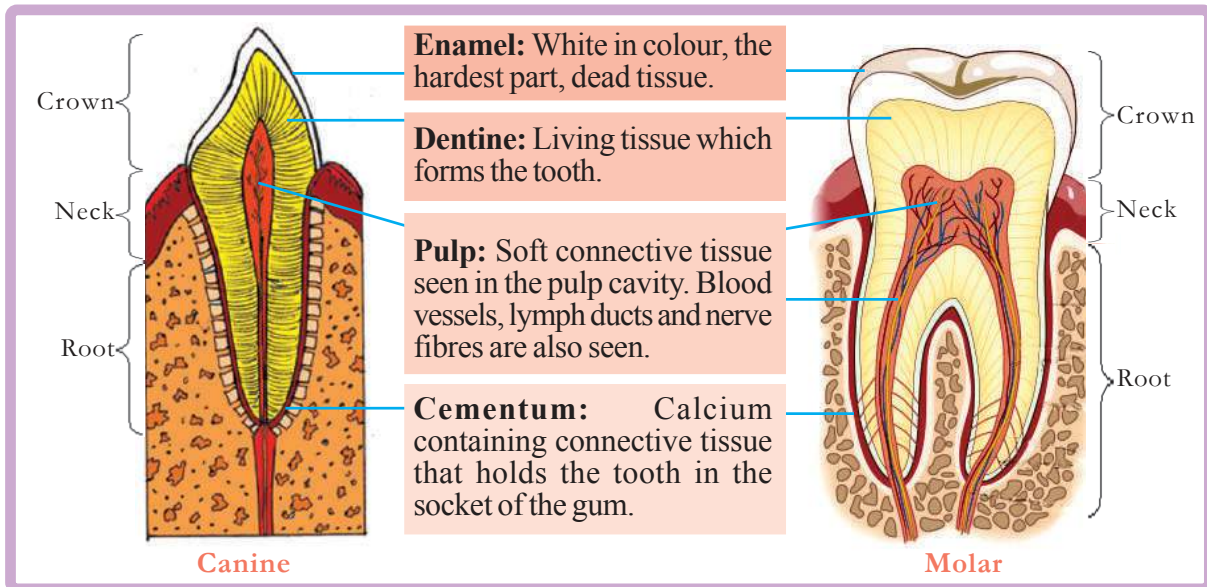
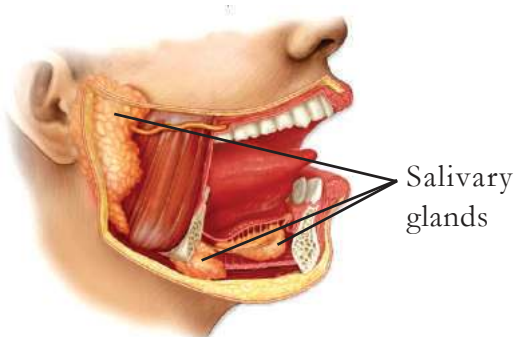


Illustration 2.2 Structure of molar tooth.

You have understood how the structure of teeth is suitable to break down food materials to smaller particles. What is the role of tongue in this process?

The tongue helps teeth to masticate food materials and mix them with saliva. The taste buds in the tongue help in the sensation of taste. Now you have understood the necessity of protecting teeth and tongue which help in masticating and moving food into the food pipe. Discuss the habits for achieving this and prepare a note on the same.





**Figure 2.2 Salivary glands**

### Saliva and Digestion

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

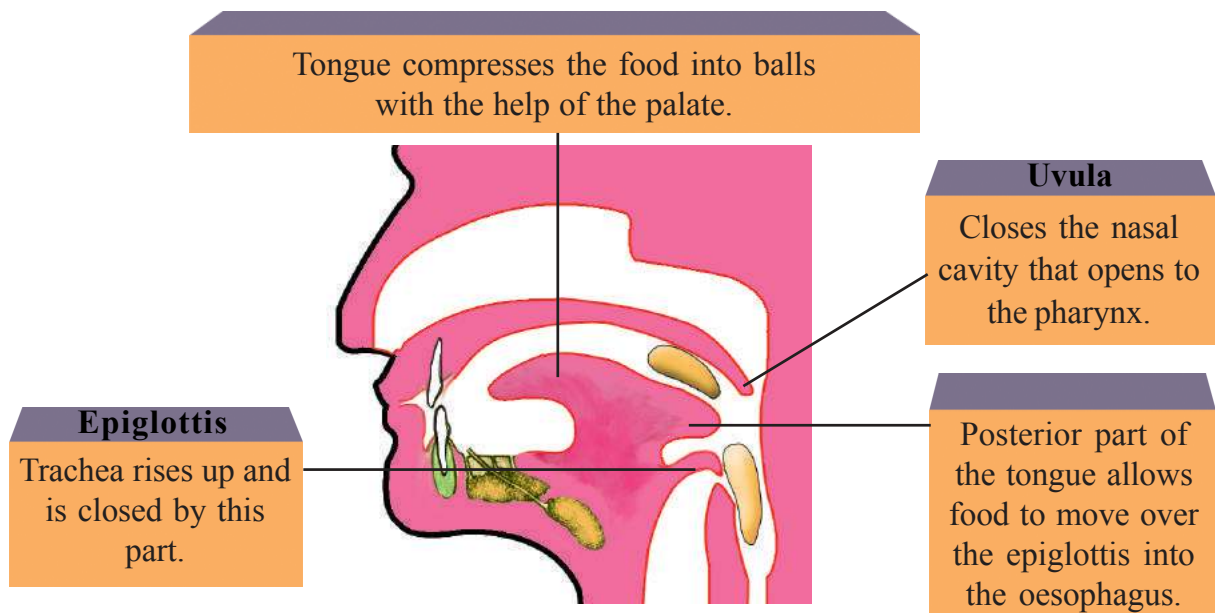
There are three pairs of salivary glands in the mouth (Figure 2.2). The saliva secreted from the salivary glands contains mucus and enzymes like salivary amylase and lysozyme. Mucus makes the food slimy, so that it can be swallowed. Lysozyme, to an extent, helps to destroy the germs that enter the body through food. Salivary amylase partially converts starch to maltose, a form of sugar.

So you have understood the chemistry behind the sweet taste while chewing rice for a certain time without adding curry.

### Food through Oesophagus

Partially digested food enters oesophagus through the pharynx. You know that trachea also begins from pharynx.

How does the food that we swallow enter exactly into the oesophagus without entering the trachea? Analyse illustration 2.3 and prepare a note.



**Illustration 2.3 Mode of swallowing food**

Have you understood the relevance of the saying that one should not talk while having food?

You know that food reaches the stomach by the wave like movement of the walls of the oesophagus. These movements are called peristalsis.

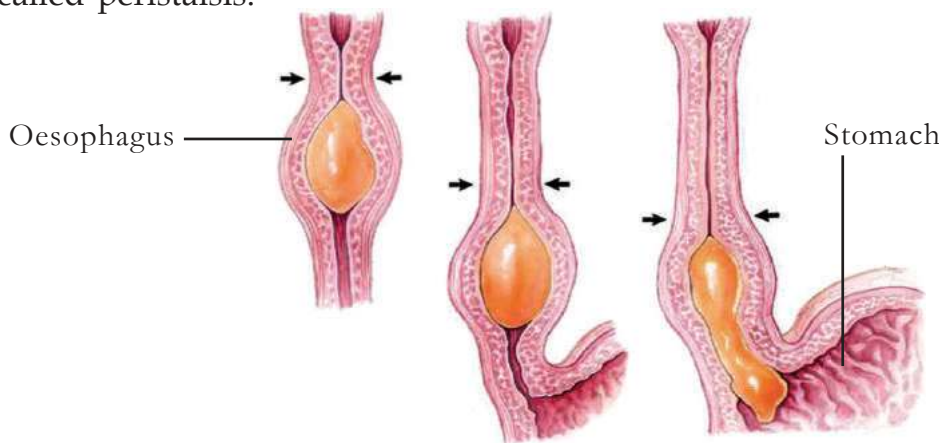


Figure 2.3 Peristalsis in the oesophagus

### Food inside the Stomach

The slightly digested food in the mouth reaches the stomach, where further digestion takes place. On the basis of indicators, and the description, analyse figure 2.4 and illustration 2.4 and prepare notes on the digestive process in the stomach.

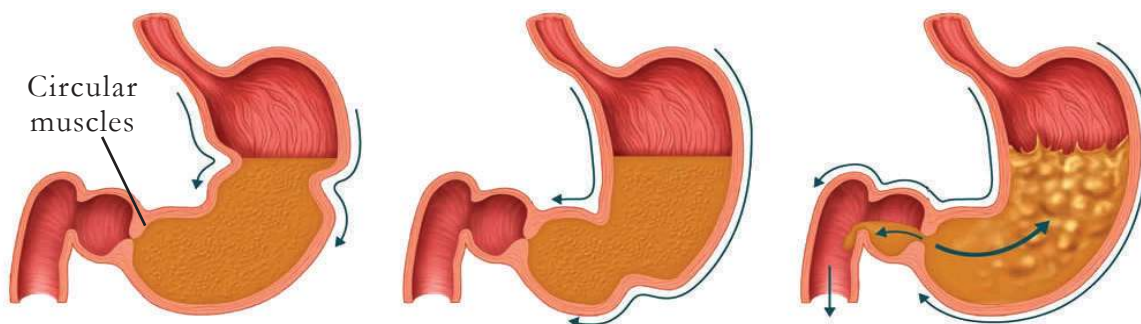
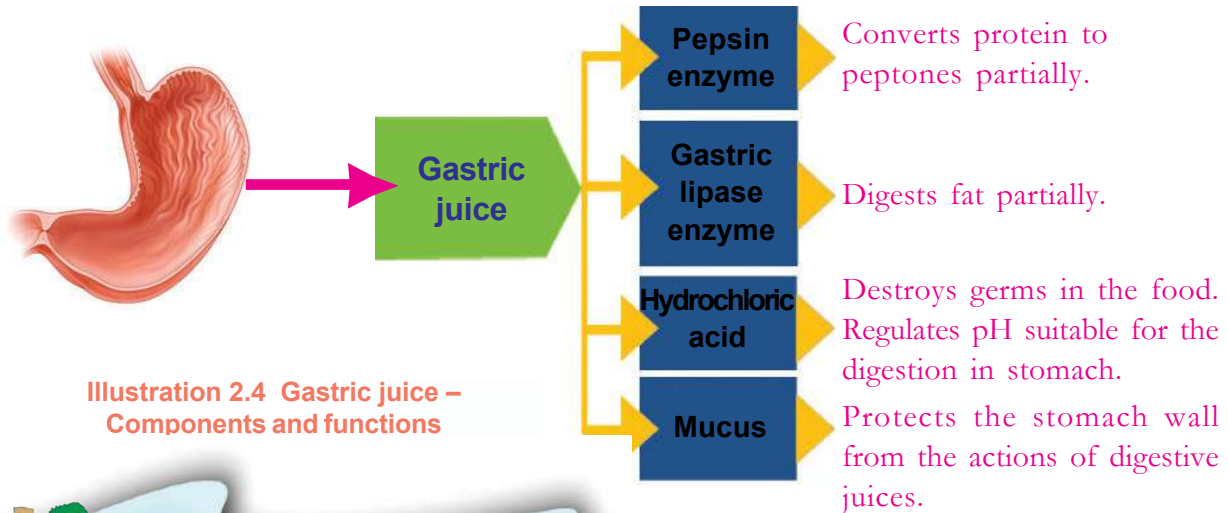


Figure 2.4 Peristalsis in the stomach

The strong peristalsis in the stomach converts food into a paste form. The special circular muscles present in the posterior part of the 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**



### Acid factory of the body

The oxyntic cells present in the stomach wall produce hydrochloric acid, a main component of the gastric juice. Its pH value ranges from 1 to 3. Why this acid which can dissolve even metals does not harm the stomach wall is a relevant question. The special cells present in the epithelial tissues secrete mucus and bicarbonate which protect the stomach wall. The mucus covers the inner wall of the stomach and protects it. The alkaline bicarbonate neutralizes the acid. But in some persons the production of acid becomes excessive and the security system fails. Acidity can become a health issue. If acidity persists it becomes gastric ulcer.

### Indicators

- Role of the muscles in the stomach wall in digestive process.
- What is the role of non-enzyme components of the gastric juice?
- Which are the nutrients that undergo digestion inside the stomach. How?

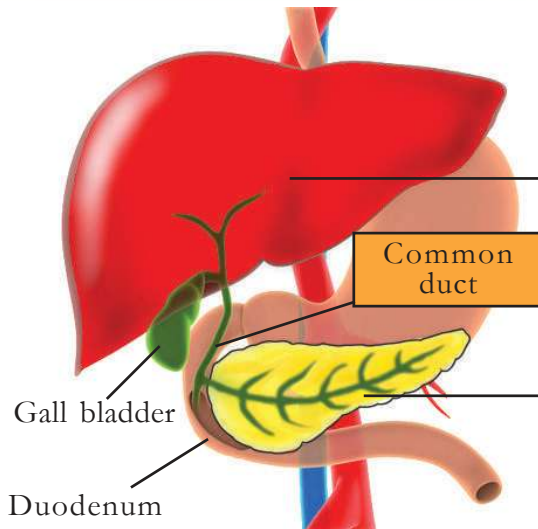
### Food in the Small Intestine

Human small intestine is about five to six metres long. It is found in the abdomen in the form of multiple folds and coils. Hence food moves very slowly through the small intestine.

The completion of digestion and the beginning of absorption of food takes place in the small intestine. From the stomach, the food in paste form enters

the duodenum which is the initial part of the small intestine. The digestive juices secreted by the liver and the pancreas reach duodenum through a common duct. The enzymes in these juices act upon the partially digested food and enhance the process of digestion. Analyse illustration 2.5 and frame inferences on the role of liver in the process of digestion.





**Liver**

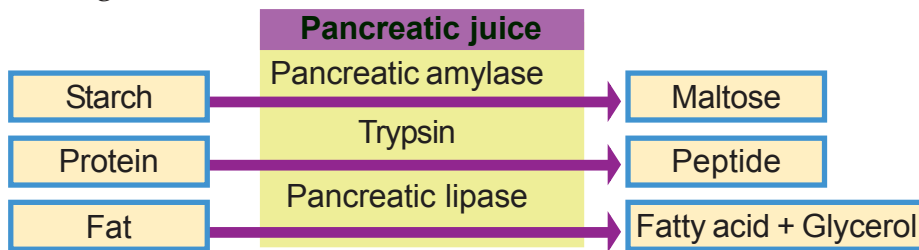
Enzymes are absent in the bile secreted by the liver. It helps in digestion by breaking down fat into smaller particles and making the food alkaline. The bile secreted by the liver is stored in the gall bladder.

**Pancreas**

Secretes pancreatic juice. Bile and the pancreatic juice reach the duodenum through a common duct.

**Illustration 2.5 Liver and Pancreas**

Have you understood the role of bile in digestion even though enzymes are absent in it? Observe the flow chart given below and prepare a note on how enzymes in pancreatic juice help in the digestion of nutrients.



When food moves forward from duodenum, it gets mixed with the intestinal juice secreted by the glands in the small intestine. Different enzymes are present in the intestinal juice, some of which convert maltose, lactose (the carbohydrate in milk) and sugar (sucrose) into simpler forms like glucose, fructose and galactose. Another set of enzymes converts peptides to amino acids. You know that the digestion of fat is almost completed in the duodenum itself. If so, which are the end products formed after digestion? Write in table 2.2.

Nutrients subjected to digestion	End products
Carbohydrate	
Protein	
Fat	

**Table 2.2**

Now you have understood that digestion is the process of conversion of carbohydrate, protein and fat which have complex structures into easily absorbable simpler forms. Which are the nutrients that do not undergo digestion?

- Water
- 
- 



What could be the reason for this? Discuss and write your inference in the Science diary.

### Absorption begins

The absorption of simple nutrients begins in the small intestine. How far is the structure of small intestine suitable for this? Analyse illustration 2.6 and the description given. Prepare notes in your Science diary.

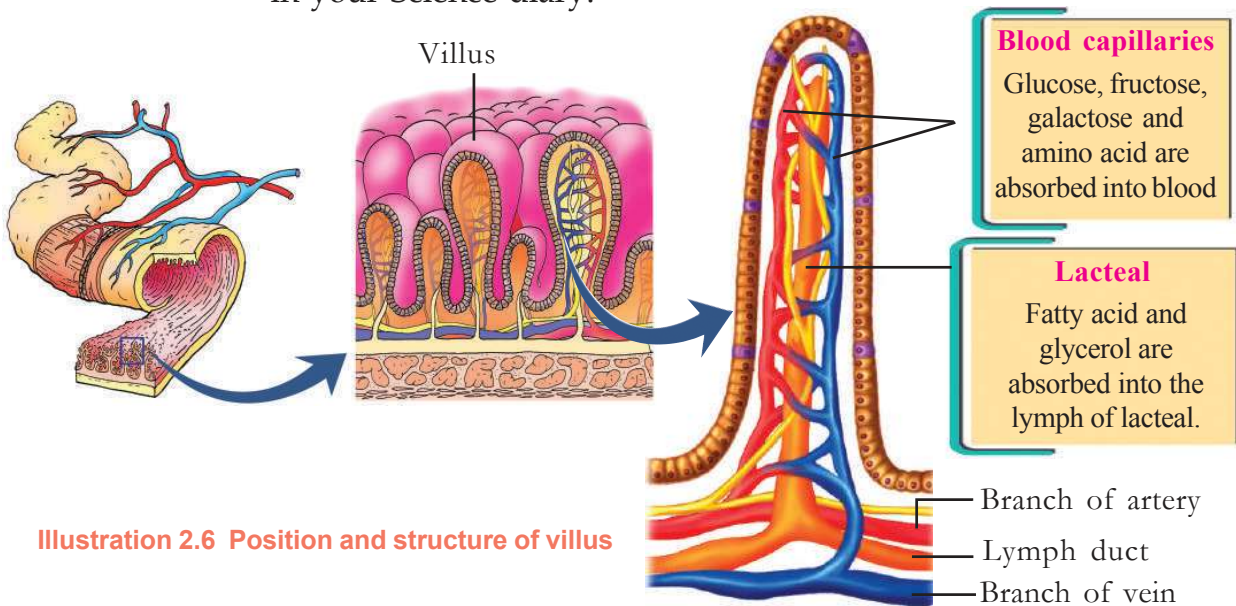


Illustration 2.6 Position and structure of villus

Villi are small finger like projections seen in the walls of the intestine. These increase the surface 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. Water soluble simple nutrients are absorbed into the blood. You can assume why fatty acids and glycerol are not absorbed into the blood. Absorption of nutrients and 90 percent of water take place through villi.

## Indicators

- Length of small intestine and structure of villus.
- Villi and surface area of absorption.
- Absorption of simple nutrients into the blood.
- Absorption of simple nutrients into the lymph.

You have understood that simple nutrients are absorbed into the blood and lymph through the walls of blood capillaries and lacteals. The cells in these walls also play a role in this process. There are certain processes working behind the movement of molecules in and out of the cell. Based on the indicators, analyse the description given below and write notes in the Science diary.

### Behind Absorption

Absorption of simple nutrients from the small intestine takes place along and against the concentration gradient. Simple diffusion, facilitated diffusion and osmosis are movements of molecules from a region of higher concentration to a region of lower concentration. As these processes take place along the concentration gradient, energy is not required.

#### Simple diffusion and facilitated diffusion

Observe figure 2.5. Haven't you noticed the movement of molecules from a higher concentrated region to a lower concentrated region? Did you notice upto which stage this flow continues? This is called simple diffusion.

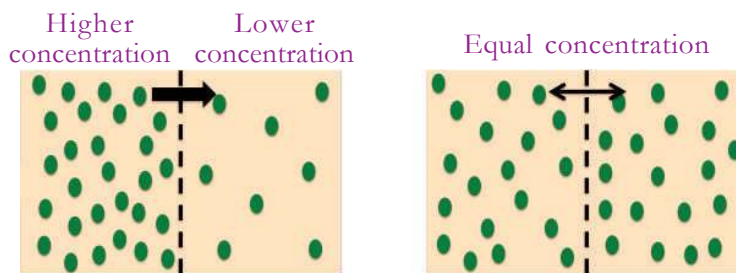


Figure 2.5 Diffusion

The absorption of fatty acid and glycerol to lacteal takes place by simple diffusion. Diffusion can also take place without a semi permeable membrane. Spread of odour in air and spread of ink in water are also diffusion.

The diffusion of some molecules takes place with the help of protein molecules present in the cell membrane. This is facilitated diffusion.



The absorption of glucose, fructose, galactose and some amino acids into the blood capillaries takes place by this process.

### **Osmosis**

Absorption of water takes place by osmosis. Osmosis is the movement of water molecules from a region of higher concentration to a region of lower concentration through a semi permeable membrane. Though this happens along the concentration gradient, this is applicable only to water molecules.

### **Active transport**

In some instances absorption takes place against the concentration gradient. Molecules are absorbed from a region of lower concentration to a region of higher concentration by utilising energy and with the help of carrier proteins. This process is called active transport.

When the concentration of glucose, salts etc. decreases in the small intestine, absorption takes place by active transport. Thus, based on the requirement of the cell, maximum glucose and salts enter blood without any loss.

### **Indicators**

- Processes which help in the absorption of simple nutrients.
- Differences and similarities between simple diffusion, facilitated diffusion and osmosis.
- Absorption of glucose.

### **In and out of the Large Intestine**

The digestive wastes left after the absorption of nutrients move towards the large intestine. A major portion of the 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. Subsequently, the digestive wastes stored in the rectum are eliminated out through the anus. The process of digestion is completed through various complex processes taking place in the digestive tract. It requires about 4-5 hours. Hence it is necessary to regulate the intake of food accordingly.

Has the doubt raised by Adithyan in the beginning of this chapter been clarified? In light of the new knowledge, modify the answer you wrote in the Science diary, if required. Digestion is the process of conversion of complex nutrients into simple and easily absorbable forms. But plants prepare glucose, which itself is a simple nutrient. So it need not undergo further digestion.

A graffiti prepared to show the relationship between food and health is given below. Analyse the graffiti and the child's response on the basis of indicators, collect additional information and conduct a seminar.



### Indicators for gathering information

- Importance of roughage for a healthy digestive system.
- Health issues created by junk food and fast food.
- Harmful chemical substances added to food to enhance its taste and colour.

Selecting food items by giving importance to taste can be harmful to health. Though fibre content in cereals and vegetables do not undergo digestion, they help in the absorption process, ease defecation and thus protect the health of the digestive system. Health through food should be our motto because health of the individual is the foundation stone for the progress of society.



### Let us Assess

- Identify the correct statements related to bile.
  - Produced in liver
  - Enzymes are found
  - Secreted into the stomach
  - Breaks down fat into tiny particles
- Complete the table related to the process of digestion in humans.

Part of digestive tract	Enzyme	Action
Mouth	.....	Starch → Maltose
.....	Pepsin	.....
Small intestine	Trypsin	.....
.....	Pancreatic lipase	.....

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



### Extended Activities

- Construct the model of a tooth showing its internal structure using available materials and exhibit it in the classroom.
- With the help of your teacher and dietician, identify the nutrients present in food. Acquaint yourself with the symptoms of lifestyle diseases and deficiency diseases, suggest preventive measures.
- Through a health survey find out the unhealthy food habits in children and adults and prepare a survey report.

# 3

## Simple Nutrients into Cells

*Simple nutrients reach cells through blood. If so, does blood enter cells?*

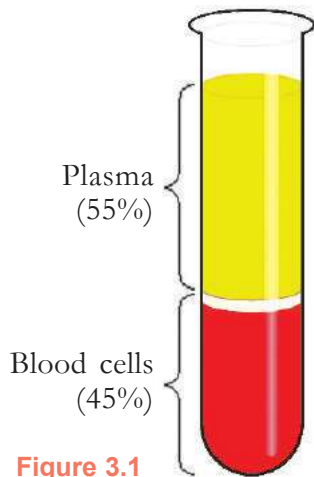
*Does it...?*



Don't you have doubts like these? Do simple nutrients get absorbed into the blood and lymph in the small intestine? Let's modify the doubt raised by Sabu and Sini.

**How do simple nutrients reach the cells through blood and lymph?**

Is the structure of blood suitable to carry substances?



**Figure 3.1**  
Components of blood

To know this, we must understand the components of blood. You know that blood contains plasma and blood cells. But, they cannot be distinguished in a single glance. Let's familiarise ourselves with an experiment to understand this.

If you add chemicals like EDTA (Ethylene Diamine Tetra Acetic acid) which is an anticoagulant of blood, to a test tube containing blood, and wait for sometime, we can observe blood cells and the liquid part of the blood distinctly as shown in figure 3.1.

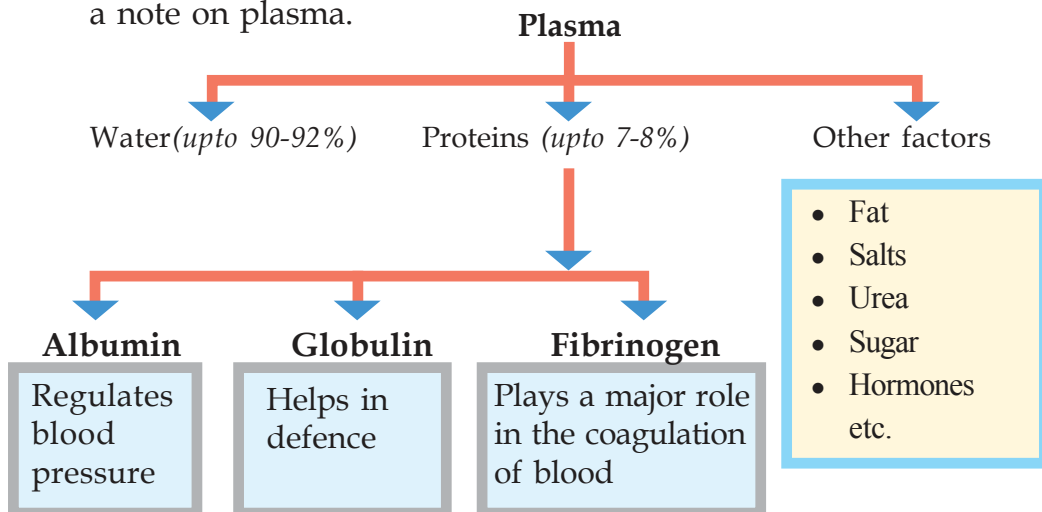
Blood cells constitute 45% of blood. List the various types of blood cells.

- 
- 
- Platelets

Eventhough blood cells perform various functions, plasma plays a major role in the transport of simple nutrients.

### Plasma

Plasma is the pale 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 3.1 given below, and prepare a note on plasma.



**Illustration 3.1** Components of plasma



## Indicators

- Factors absorbed through plasma.
- Plasma proteins and their functions.

You know that the blood circulates all over the body through blood vessels. But, are blood vessels alone sufficient for this?

## Heart

As the human heart works relentlessly like a pump, blood flows through blood vessels continuously in all directions. The heart is situated slightly tilted towards the left in between the two lungs, behind the sternum in the thoracic cavity (Figure 3.2). The size of the human heart is equal to the size of one's 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 when the heart beats.



Figure 3.2 Position of heart

Based on the indicators, analyse figure 3.3 given below and prepare a note.

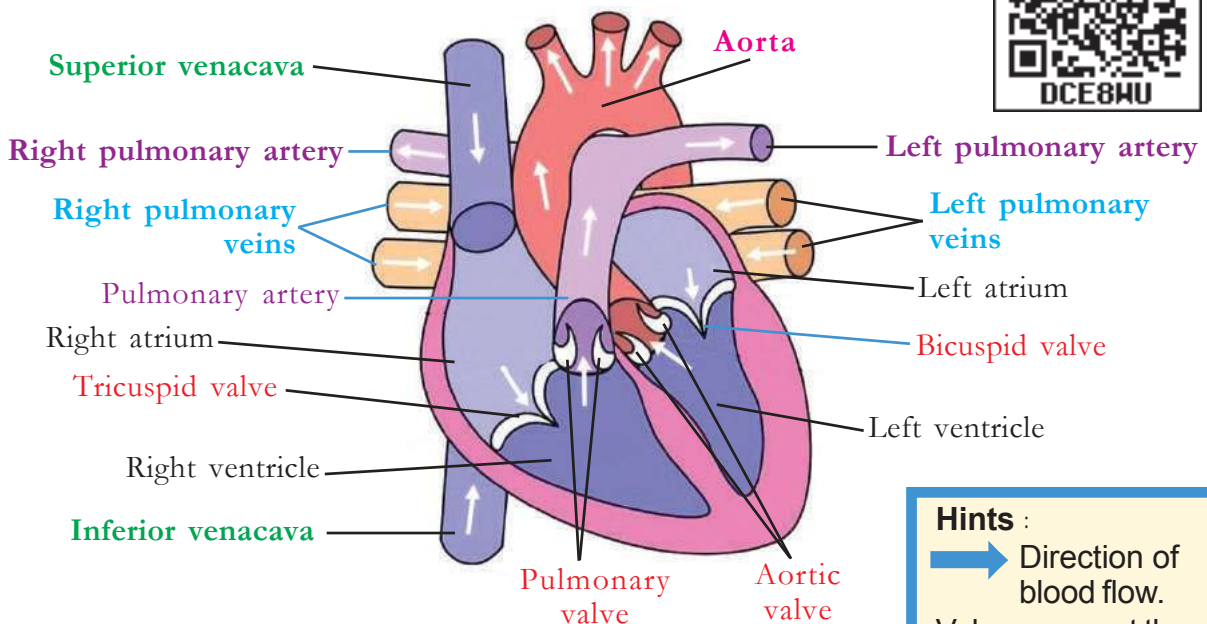


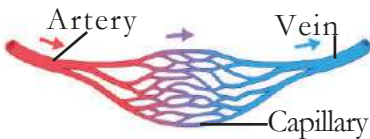
Figure 3.3 Longitudinal section of the heart

### Hints :

- ➔ Direction of blood flow.
- Valves prevent the backward flow of blood.

**Indicators**

- Chambers of the heart.
- The blood vessels which carry blood to the heart and the heart chambers where they end.
- The blood vessels which carry blood from the heart and the heart chambers from where they begin.
- Valves - position, function.

**Figure 3.4 Blood vessels**

Have you understood that along with the heart, the blood vessels also have a role in circulating blood to different parts of the body? Large arteries arising from the heart, split into small arteries and these in turn split into capillaries. Further, these capillaries unite to form small veins and these small veins unite to form larger veins and finally reach the heart. Blood vessels are of 3 types.

Observe illustration 3.2 to know more about blood vessels. Based on the indicators, compare the blood vessels and complete table 3.1.

**Vein**

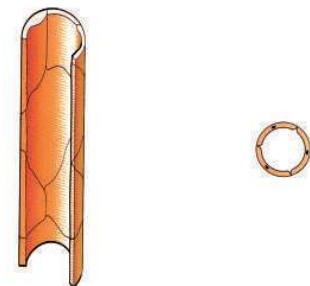
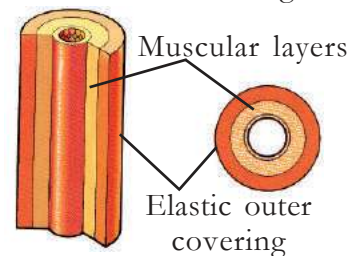
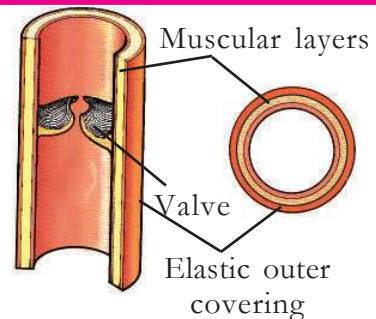
- carries blood to the heart.
- thin wall.
- valves are seen inside.
- blood flows with low speed and low pressure.

**Artery**

- carries blood from the heart.
- thick and elastic walls.
- blood flows with 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.
- valves are absent.
- blood flows with low speed and low pressure.

**Illustration 3.2 Various kinds of blood vessels**

Indicators	Arteries	Veins	Capillaries
Peculiarity of the wall			
Valves			
Peculiarity of blood flow			
Direction of blood flow			From arteries to veins

**Working of the heart**

The heart beats continuously with a rhythm. Initiation of the contraction and relaxation of the heart and regulation of the rate of heartbeat are controlled by the Sino Atrial Node. It is located on the right atrial wall. As it functions like an electric cell, it is known as pacemaker.

Complete illustration 3.3. Based on the hints, analyse it and prepare notes on the function of heart in the Science diary.

Table 3.1

**Artificial pacemaker**

The pacemaker has to function properly for the heart to beat rhythmically, otherwise the heart beat will become non rhythmic. This can be life threatening if not resolved. However, nowadays it is not a problem. Medical science has made possible to implant the artificial pacemaker beneath the skin through surgery. The artificial pacemaker has two parts. The first part is the pulse generator. The second part is the mechanism which transmits electric signals from the first part to the heart. Wilson Greatbatch, an American electrical engineer was the one behind the invention of this equipment. Artificial pacemaker surgeries have been conducted since 1960.

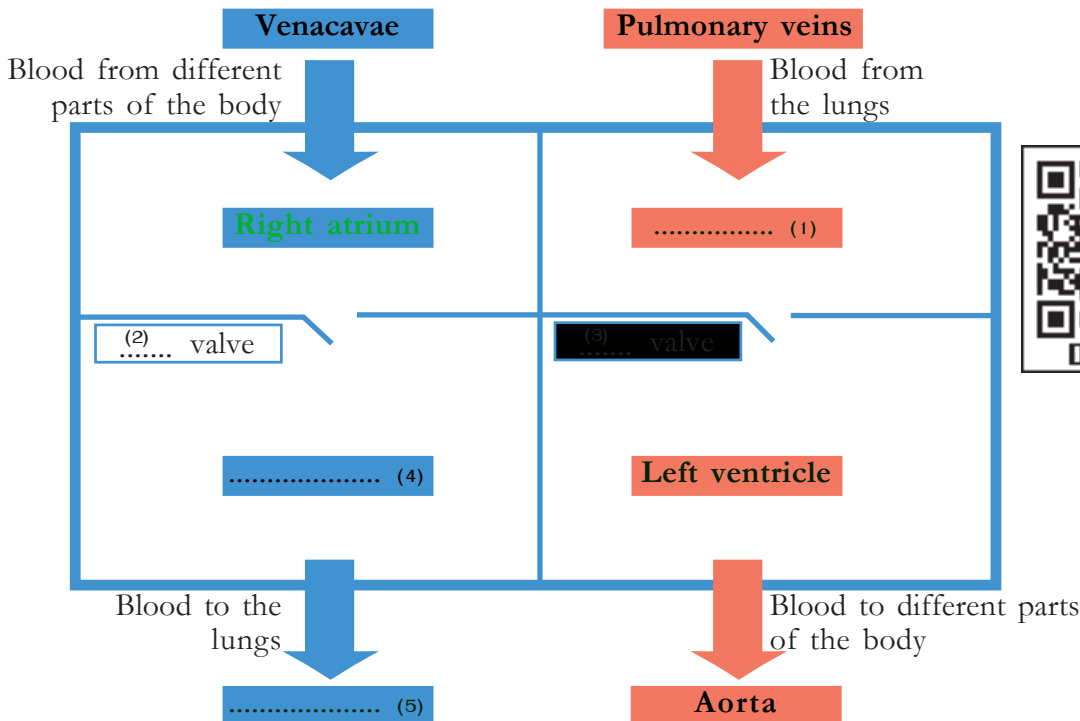


Illustration 3.3

**Hints**

- The carbon dioxide rich blood from different parts of the body reaches the right atrium. The oxygen rich blood from the lungs reaches the left atrium through the pulmonary veins. Subsequently atria contract.

**Where does the blood go when the atria contract?**

- Further the ventricles contract.

**Does the blood flow back to the atria when the ventricles contract? Why?**

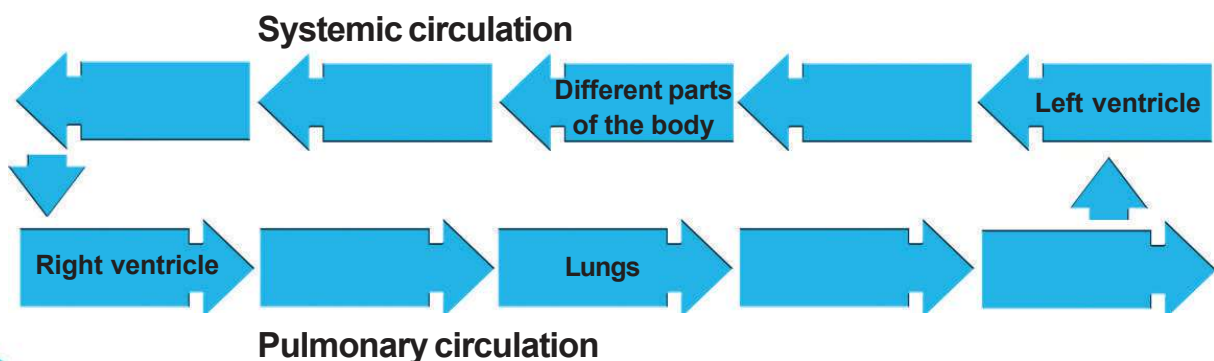
**When the ventricles contract, which blood vessels does the blood flow to?**

- You know that blood supplies oxygen to all cells and receives carbon dioxide from them. Reception of oxygen and expulsion of carbon dioxide take place in the lungs.

**If so, what causes an increase in the level of carbon dioxide in the blood present in venacavae and the level of oxygen in the blood present in pulmonary veins?**

**Double Circulation**

When blood flows from the heart to different parts of the body and vice versa, it passes twice through the chambers of the heart. Hence the circulation of blood in man is said to be double circulation. Double circulation includes systemic circulation and pulmonary circulation. Systemic circulation starts from the left ventricle and ends in the right atrium. The circulation which starts from the right ventricle and ends in the left atrium is called pulmonary circulation. Complete the flowchart given below by including the heart chambers and the blood vessels involved in double circulation.

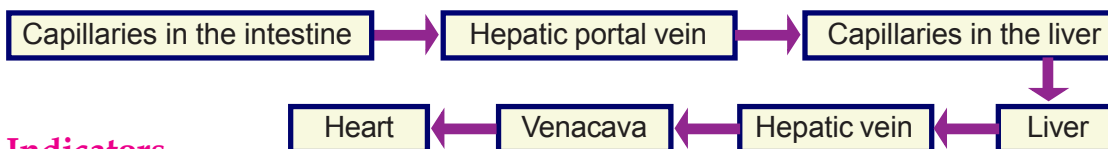


## Simple nutrients to the heart

How do the simple nutrients, which are absorbed into the blood from the small intestine reach heart? Based on the indicators, analyse the description and flow chart given below and form inferences.

### Portal Circulation

Certain veins do not reach the heart and they carry blood from organ to organ. Such veins are called portal veins. They begin from one organ as capillaries and end in another organ as capillaries. Portal system is the system of blood circulation in which portal veins are included. Eg: Hepatic portal system.



### Indicators

- Peculiarities of portal veins.
- The path of simple nutrients from the small intestine to the heart.
- Hepatic portal system.

Have you ever thought why simple nutrients reach the liver? Liver is the centre of metabolism. Simple nutrients undergo several changes in the liver. Storage of glucose in the form of glycogen, releasing energy from fatty acids, producing cholesterol etc. are such changes. Have you understood the role of heart in the distribution of simple nutrients to all parts of the body? It is through rhythmic heart beats that the functioning of heart is made possible.

### Heart beat, Pulse, Blood pressure

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



Identify the point on the wrist where you can feel the pulse.

Illustration 3.4 Know your pulse



**Figure 3.5**  
Sphygmomanometer



**Figure 3.6**  
Digital B.P. apparatus

The heart beats at an average rate 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. Using the method shown in illustration 3.4, check the number of pulses in a minute and record it. After doing exercise for a few minutes check the pulse rate again. What difference do you notice? What is its reason? Apart from the wrist, what are the other parts of the body where we can feel the pulse?

- both sides of the forehead.
- 

With the help of your teacher, check your own and your class mates' pulse rate and record it. Compare the pulse rate and the heart beat rate with the help of a stethoscope and identify the relation between them.

About 70 ml of blood is pumped into the arteries everytime the heart contracts. The pressure exerted by this excess blood on the walls of the arteries is systolic pressure. This is 120 mm Hg. When the heart dilates fully the same quantity of blood enters the heart. A low pressure felt in the arteries during this time is known as diastolic pressure. This is 80 mm Hg. The blood pressure of an individual is stated in terms of these two pressures. Sphygmomanometer is the instrument (figure 3.5) used to measure blood pressure. Digital B.P. apparatus (figure 3.6) is also available nowadays. Visit a nearby laboratory or Health Centre. Seek the help of experts and get trained to measure blood pressure using these two instruments.

### Variation in Blood Pressure

You might have understood that the desired rate of blood pressure is 120/80 mmHg. The condition in which the blood pressure increases above the normal rate is a disease condition called hypertension. This happens due to many reasons. Unhealthy habits, such as excess use of salt and fat, smoking, lack of exercise etc. often lead to high blood pressure. The condition in which the

blood pressure rate goes below the prescribed rate is called hypotension. If not regulated, hypotension and hypertension may lead to stroke or heart attack.

### From the blood to the cell

You have understood how blood reaches different parts of the body. If so, how do cells get nutrients from blood?

Based on the indicators, analyse illustration 3.5 and the description given below and write your inference in the Science diary.

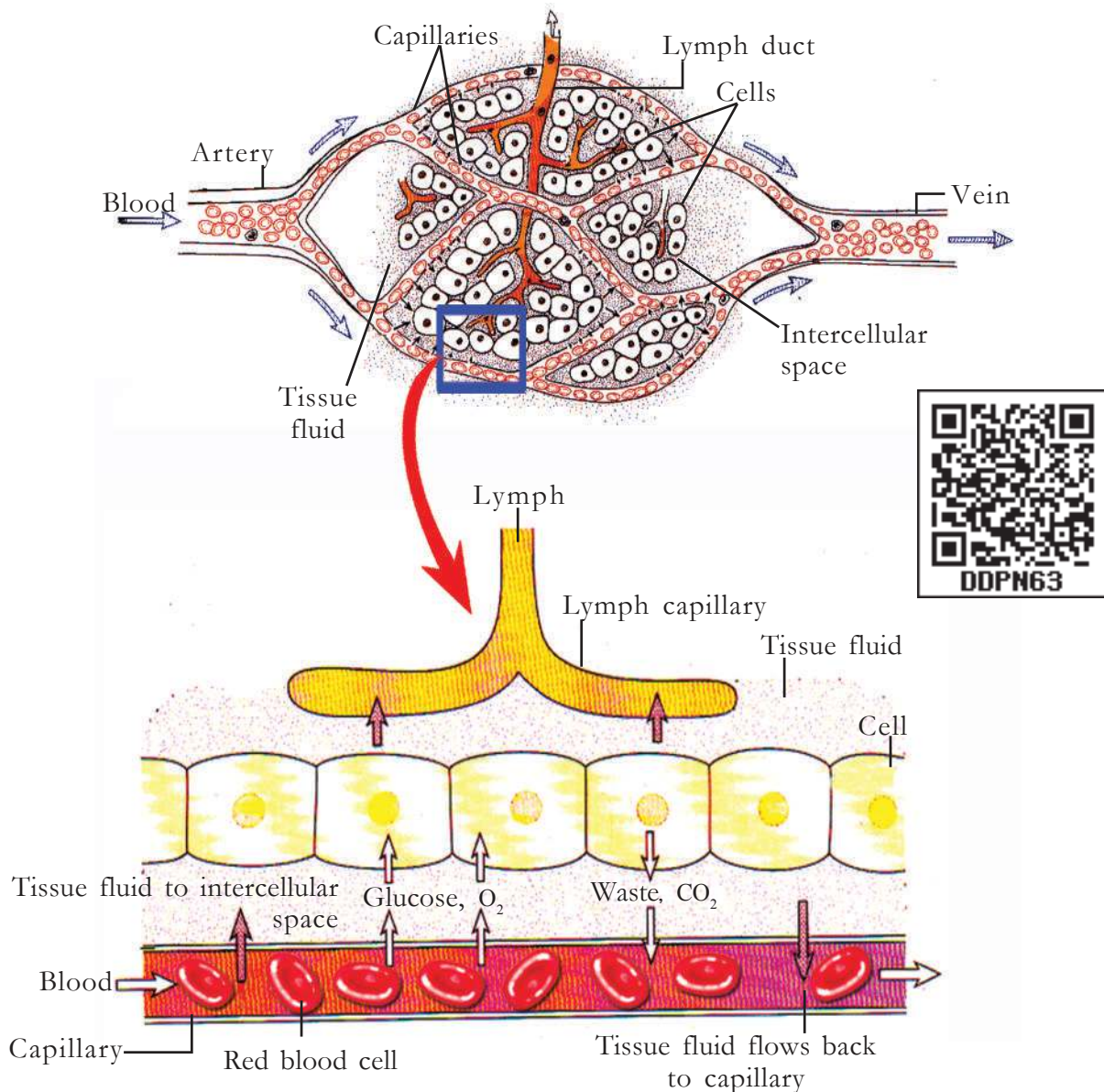


Illustration 3.5 Formation and backward flow of tissue fluid

When blood flows through capillaries, the fluid part of blood oozes into 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, large protein molecules and platelets. Exchange of materials takes place between the tissue

fluid and cells. Tissue fluid is absorbed into the blood and lymph capillaries. Lymph is the tissue fluid inside the lymph capillaries.

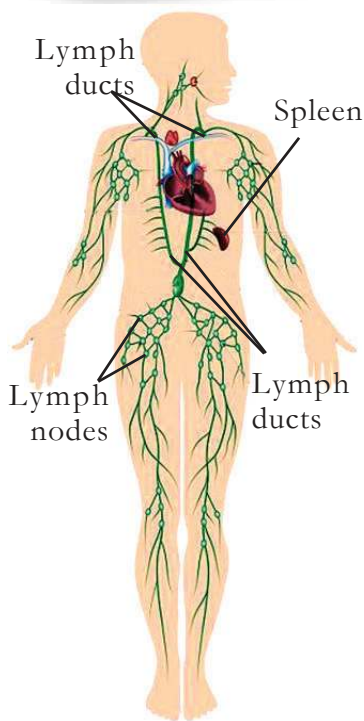
**Indicators**

- Method of formation of tissue fluid.
- Exchange of materials between cells and tissue fluid.
- Method of maintaining the level of tissue fluid in intercellular space.
- Tissue fluid inside the lymph capillaries.



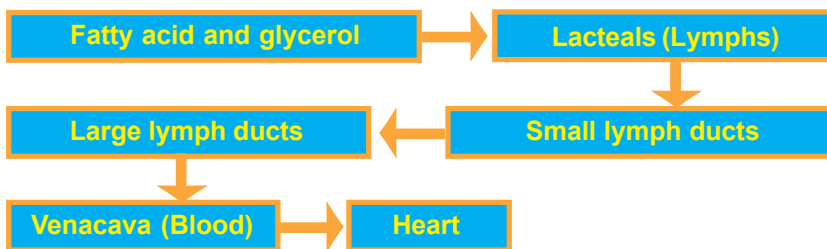
**Armoury of the human body**

About 4 inches of size, purple in colour, about 200 gms weight. Located above the abdomen on the left side of the stomach. The largest organ of the immune system, named spleen. Though it performs various functions, providing immunity is the main function. Spleen consists of 2 types of tissues. Red pulp tissues filter and remove old and damaged RBCs present in blood. The reusable components in it, like iron are protected. White pulp cells store T cells and B cells which are the main components of the immune system. The lymphocytes which identify and destroy pathogenic bacteria and viruses that enter the body, are produced in the spleen and lymph nodes. In short, this small organ is considered as the armoury or military camp of the body.



**Figure 3.7**  
Lymphatic system

The question raised by Sini in the beginning of the chapter is answered now. Along with blood, lymph also participates in the transport of materials. Observe the flow chart given below, prepare a description on how fatty acid and glycerol that are absorbed into the lymph from the small intestine reach cells and note it in the Science diary.



You have understood that along with the blood circulatory system the circulation of lymph also takes place. The lymph formed from blood passes through



lymph ducts and returns to blood near the heart. In addition to lymph, the lymphatic system consists of lymph capillaries, lymph ducts, lymph nodes and spleen (figure 3.7). Spleen and lymph nodes play a major role in defending disease causing germs.

### A Healthy Heart - Vital for Life

A healthy heart is indispensable for life. Excerpts from the wall magazine prepared by students on World Heart Day are shown below. Analyse them and provide suggestions to maintain a healthy heart.



### Heart transplantation and artificial heart

Organ donation and transplantation is not a breaking news today. There are records of transplantation of skin parts done in India during BC 200. In 1946 the first heart transplantation surgery was initiated by transplanting a dog's heart by Demikov, a Russian doctor. In humans, this surgery was first performed successfully in 1967 under the leadership of Christian Bernard in South Africa. Eventhough the patient survived only for 18 days, it was a great beginning. In 1994 Dr. P.Venugopal and team repeated the success at All India Institute of Medical Sciences, New Delhi. Heart transplantation is done world wide nowadays. Moving forward, in 1982 under the leadership of Robert Jarvik and Johan Kolff another milestone was created in the field of medical science by transplanting artificial heart in place of a diseased heart.



### September 29 World Heart Day

Atherosclerosis is the condition in which accumulation of fat in the arterial walls take place due to consumption of excess fatty food. As a result of this, the inner diameter of the artery reduces. Moreover arterial

#### Number of heart patients are booming

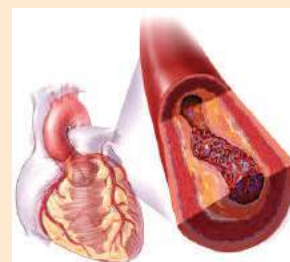


### Deep from the Heart...

#### Exercise, alien to youth

walls lose elasticity and may rupture. Inner wall becomes rough. Hence RBCs may clump together to form blood clot in the coronary vessels which may cause heart attack.

#### Fat too a villain, if in excess



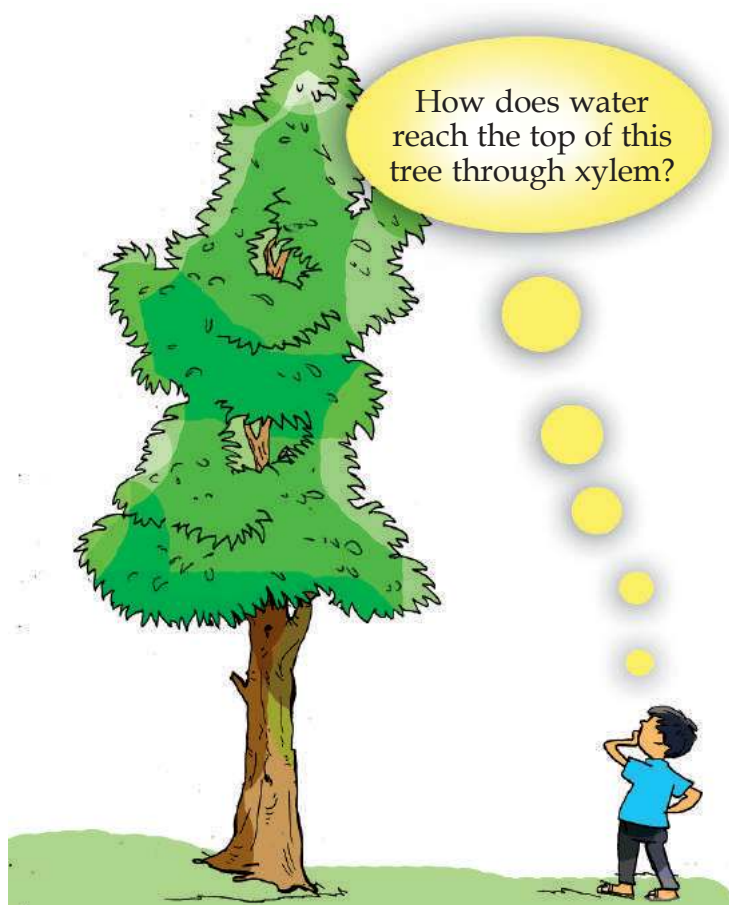
## Transportation in Plants

As in animals, substances are transported in plants too. You have studied about the vascular tissues in plants. Complete table 3.2 related to vascular tissues in plants and their functions.

Vascular Tissue	Function
Xylem	

Table 3.2 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 (figure 3.8).

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 3.9.

Examine both the bags after sometime.

What changes do you observe?

.....  
 .....

It can be inferred that water came out from the 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 3.6 and the description given. Write a note in your Science diary on how water reaches leaves from roots.

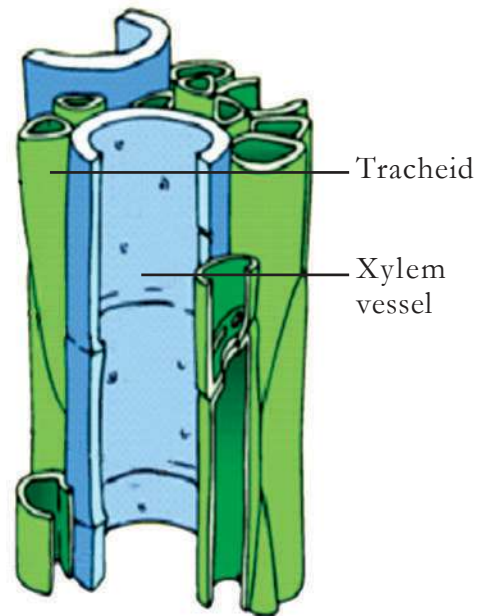
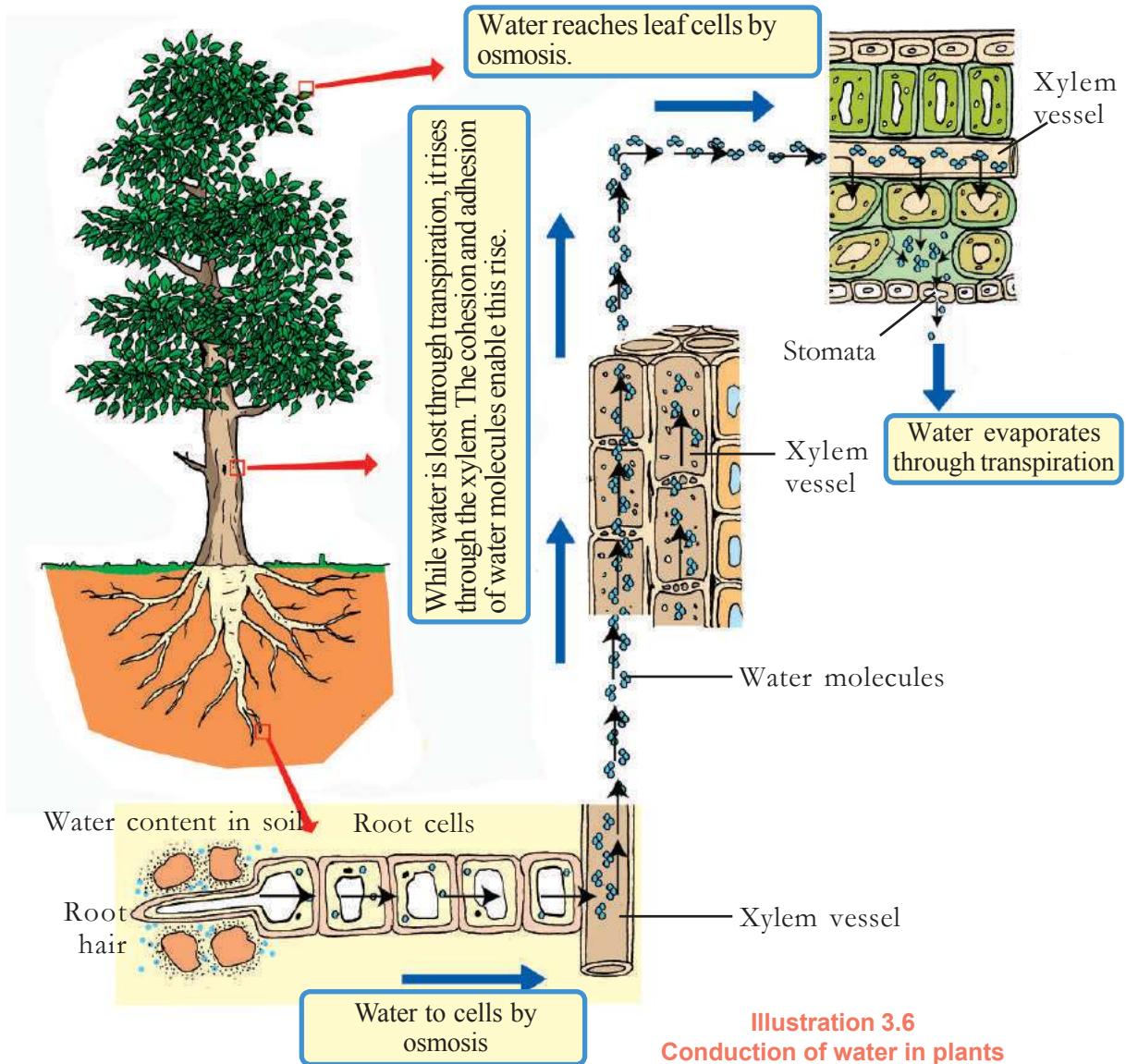


Figure 3.8 Xylem



Figure 3.9



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 the top. 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.

## Transport through 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 (figure 3.10). 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.

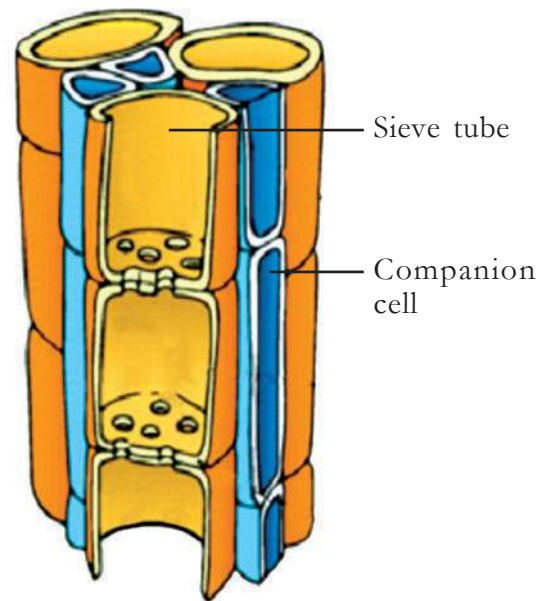


Figure 3.10 Phloem

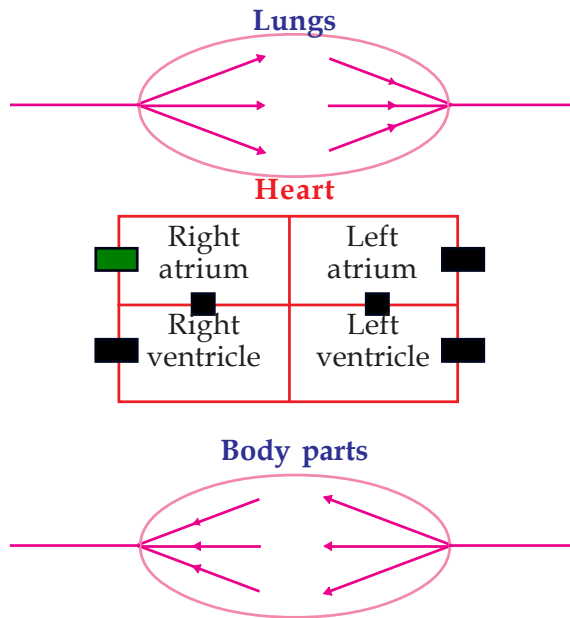
Now, the difference between the transport of substances in plants and human beings is clear to you. Most of the vital activities taking place in plants and animals are similar. One such activity is the production of energy. For the production of energy, is it enough that simple nutrients alone reach the cells? This question will be analysed in detail in the next chapter.



### Let us Assess

1. Choose the simple nutrients which are absorbed into blood from those given below.
  - A) Fatty acid
  - B) Amino acid
  - C) Fructose
  - D) Glycerol
  - E) Glucose

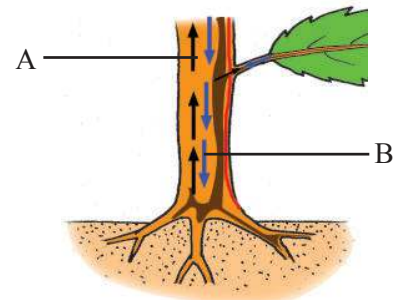
2. Observe the illustration of the lungs, the heart and body parts.



Redraw 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 materials in 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?



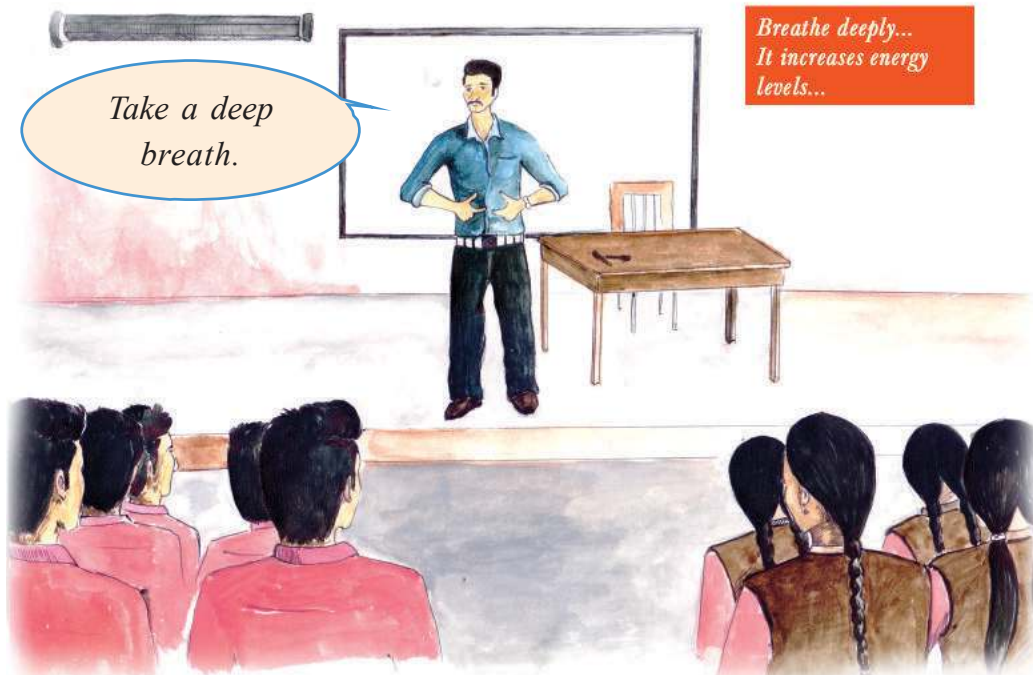
### Extended Activities

1. Construct a model of double circulation using coloured threads, thermocol etc. Show the direction of flow of blood also.  
(Part where oxygenated blood is present - red colour  
Part where deoxygenated blood is present - blue colour)
2. Prepare a Science edition by including information regarding Cardiac Health Care.



# 4

## Breathing for Energy



Students practice breathing exercise as per the instructions of the teacher. Did you notice the message on the sticker? How does the availability of energy increase when we breathe deeply? Can you make an assumption? Note down the assumption in the Science diary. Let us examine whether your assumption is right.

Energy for doing work is released in the cells. Along with nutrients, oxygen is essential for this.

The respiratory system helps to take oxygen from the atmospheric air into the body.

List the parts of the respiratory system you know.

- 
- 
-



Based on illustration 4.1 elaborate the list and prepare a table as given below.

Parts of the Respiratory System	Peculiarity/Function

**Nostril**  
An opening through which air passes in and out of the body.

**Nasal cavity**  
The cavity which connects the nostrils with the pharynx.

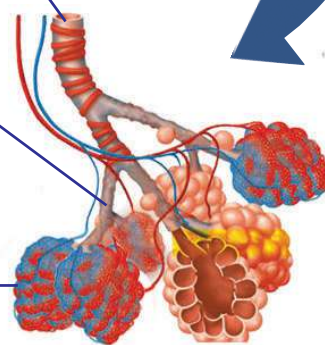
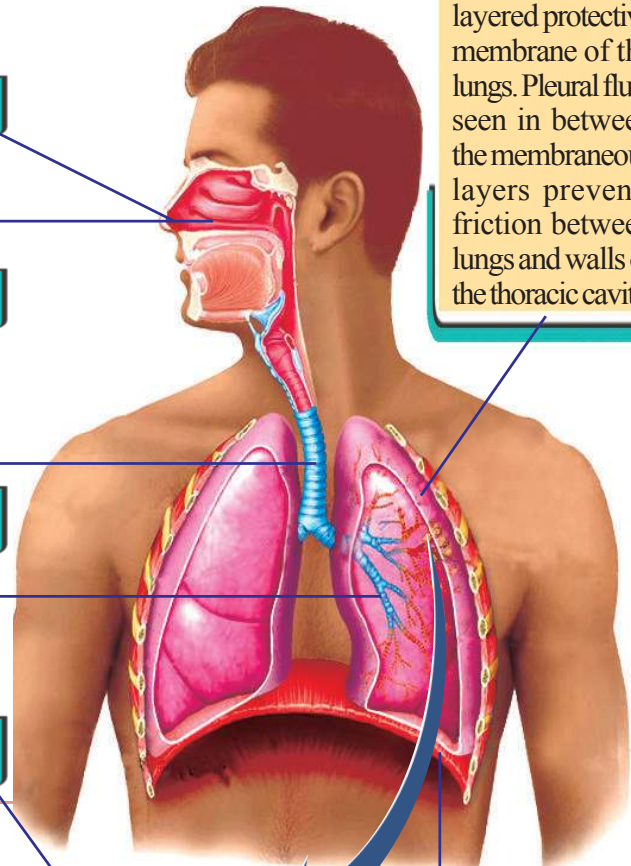
**Trachea (Wind Pipe)**  
A long tube strengthened by 'C' shaped cartilaginous rings. Cartilaginous rings help trachea to remain open always.

**Bronchus**  
Branches of trachea which enter the lungs, supported by cartilaginous bronchial rings.

**Bronchiole**  
The terminal branches of bronchi that open to the alveoli. There are no cartilaginous rings in the bronchioles.

**Alveoli**  
Delicate air sacs, elastic in nature, seen at the tip of bronchioles. These air sacs are surrounded by a large number of capillaries. The exchange of gases takes place here.

**Pleura**  
The double layered protective membrane of the lungs. Pleural fluid seen in between the membranous layers prevents friction between lungs and walls of the thoracic cavity.



**Diaphragm**  
The muscular wall that separates the thoracic and abdominal cavities.

Illustration 4.1 Parts of the Respiratory System



Respiratory tract is the pathway of atmospheric air from the nostrils to the alveoli. Analyse illustration 4.1 and complete the pathway of air.



### Atmospheric Air into the Lungs

Breathing is a process that takes place without our knowledge, during which air is taken in and expelled.

The basis of respiratory movements is the expansion and contraction of the thoracic cavity. This repeats rhythmically. With the increase in size of the thoracic cavity, air enters the lungs. This is called inspiration. As a result of the contraction of the thoracic cavity, air is expelled from the lungs. This is called expiration. Let us now see how the thoracic cavity expands and contracts rhythmically. The combined working of intercostal muscles (specialised muscles between the ribs) and the diaphragm (dome-shaped muscular layer 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.

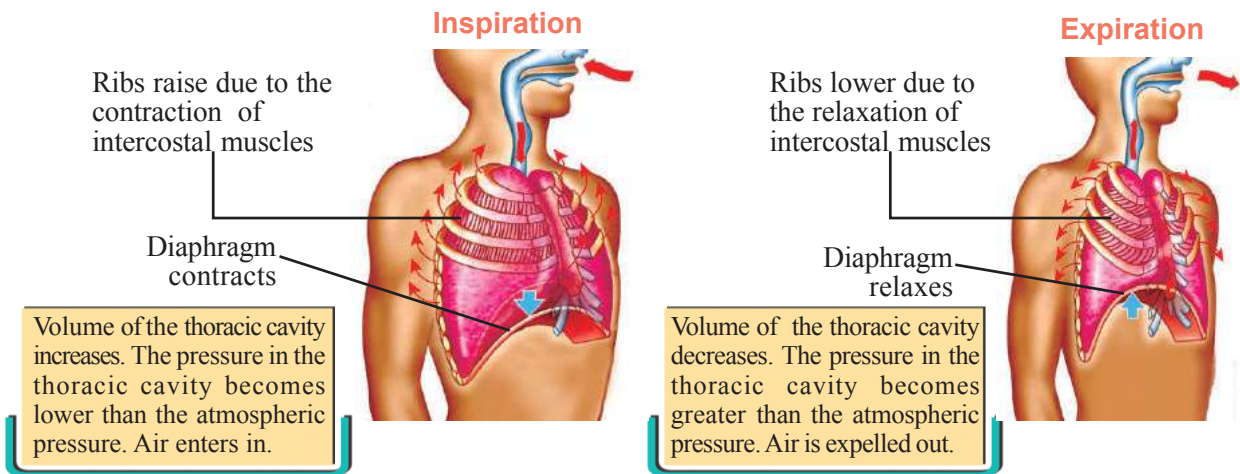


Illustration 4.2 Respiratory movements

Inspiration		Expiration
..... ⇐	Diaphragm	⇒ .....
..... ⇐	Ribs	⇒ .....
..... ⇐	Volume of thoracic cavity	⇒ .....
..... ⇐	Pressure in the thoracic cavity	⇒ .....
..... ⇐	Air	⇒ .....



Table 4.1 Thoracic movements and breathing

## Exchange of Gases in 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 helps in the easy exchange of respiratory gases.

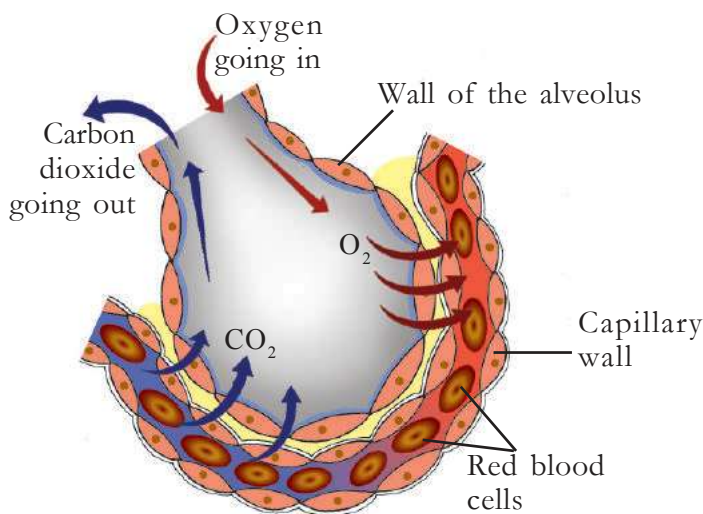


Figure 4.1 An alveolus



higher and the concentration of carbon dioxide is lower in the alveoli. But, in the blood capillaries the concentration of oxygen is lower and the concentration of carbon dioxide is higher. As a result of this, oxygen from the alveoli diffuses into the capillaries and carbon dioxide from the capillaries diffuses into the alveoli.

Atmospheric air reaches the alveoli as a result of inspiration. The exchange of respiratory gases like oxygen and carbon dioxide takes place in the alveoli. How far is the structure of alveoli suitable for this?

Based on the indicators, analyse figure 4.1 and the description given and prepare notes in your Science diary.

Bronchioles, the 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 blood capillaries. The inner wall of the alveoli is always kept moist. The walls 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 is

## Indicators

- Alveoli and the respiratory surface area.
- Peculiarities of the walls of the alveoli and blood capillaries.
- Concentration gradient of the respiratory gases and the exchange of gases.

In the previous lesson you learnt that simple nutrients are transported through the plasma. Do you know which component of blood carries oxygen? Haemoglobin in the red blood cells carry oxygen. Don't you want to know the peculiarities of the red blood cells?

Identify the difference in the number of red blood cells and white blood cells by observing a slide of blood through a microscope, with the help of your teacher. How far is the structure of red blood cell suitable for carrying oxygen? Discuss and formulate your inference.

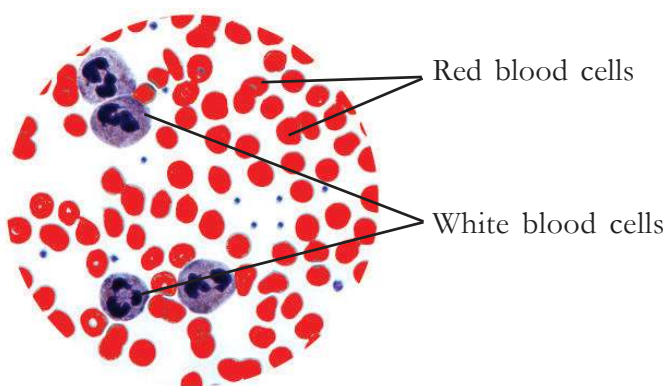


Figure 4.2 Blood cells



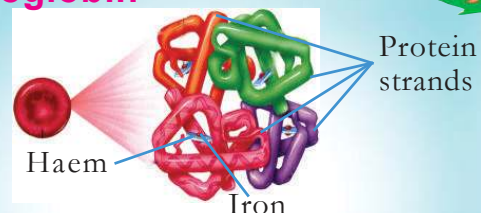
## Oxygen into Cells

How does oxygen reach the cells from the alveoli? Analyse illustration 4.3 and complete the flow chart given below using the indicators.



- Disc shaped
- Between 45 lakh to 60 lakh per milli litre.
- Do not have nucleus or other cell organelles.
- Full of haemoglobin which has affinity to oxygen

## Haemoglobin



The structure of haemoglobin consists of four protein strands with iron containing haem. Oxygen combines with iron in the haem. Each haemoglobin molecule can carry four oxygen molecules since a haemoglobin molecule contains four protein strands and a haem.

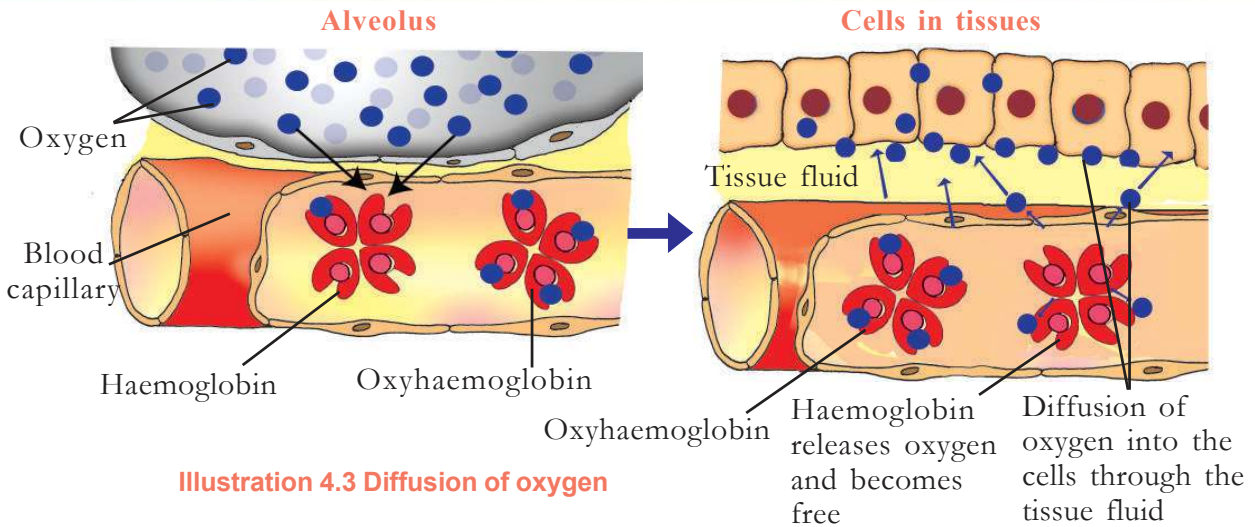


Illustration 4.3 Diffusion of oxygen



### When trapped in a smoke - filled room

Haemoglobin has more affinity to carbon monoxide than oxygen. Haemoglobin combines fast with carbon monoxide and forms a more stable compound called carboxy haemoglobin. Unlike oxyhaemoglobin, carboxy haemoglobin does not breakdown and causes the destruction of the haemoglobin molecule. This may become dangerous in some situations. If trapped in rooms where there is fire, it leads to inhaling of carbon monoxide along with smoke. So the rescue of persons from a smoke filled room is equally important to extinguishing of fire. Cover your nose and mouth with a damp cloth and move to an aerated place by sprawling on the ground. By this way, rescue operators can also rescue persons who cannot escape themselves.

### Hints

- Tissue fluid
- Blood
- Oxyhaemoglobin
- Cell
- Oxygen

Haven't you understood the role of haemoglobin in the transport of oxygen? The main constituent for the synthesis of haemoglobin is iron molecules. So it is said that food items like leafy vegetables with iron content should be included in our diet. The average amount of haemoglobin in a healthy man is 15gm/100ml and that of woman is 13gm/100ml of blood. Anaemia is a condition in which the amount of haemoglobin in the blood decreases. You have now understood the importance of distribution of iron tablets in schools as a part of the WIFS project.

**To release energy**

How does oxygen that reaches 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.

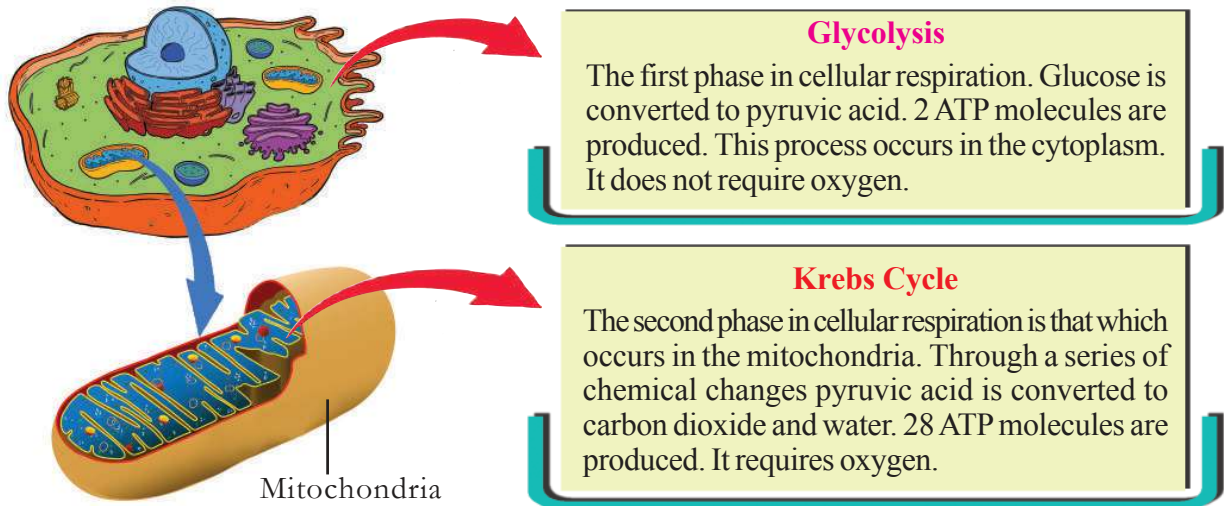


Illustration 4.4 Cellular respiration- stages

Indicators	Glycolysis	Krebs Cycle
Part where 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 worksheet of cellular respiration based on the indicators given below.



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 formed in the cells as a result of respiration. During respiration, trace amount of water is eliminated from the body in the form of water vapour. But how is carbon dioxide, the major byproduct of respiration, eliminated from the cells? Based on the indicators, analyse illustration 4.5 given below and note down your inferences in the Science diary.

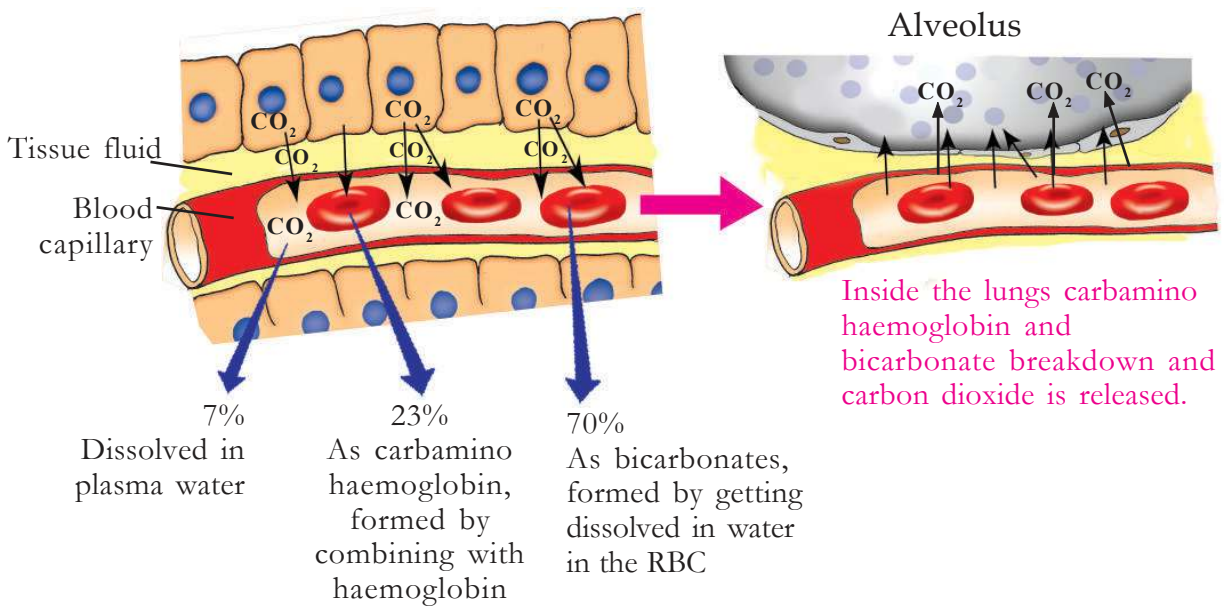


Illustration 4.5 Expulsion of carbon dioxide

### Indicators

- Role of tissue fluids.
- Transportation of carbon dioxide and the components of blood.
- Expulsion of carbon dioxide from the lungs.

### When carbon dioxide becomes excessive

You have understood that carbon dioxide is expelled through the lungs. What will happen if this does not take place? Analyse the description given below on the basis of indicators and write it down in the Science diary.

Various metabolic activities take place in our body. The cellular respiration is one of its kind. As a result of cellular respiration products like carbon dioxide, water, etc., are formed. When the level of these products increases beyond the limit, the very existence of life is in danger. Carbon dioxide combines with water present in and out of the cell to form carbonic acid. The increase in the level of carbonic acid increases the acidity in the body. This changes the internal environment. Substances that cause change in the internal environment must be duly removed. This is also a part of maintaining the homeostasis.

#### Indicators

- Change in homeostasis due to the increase in carbon dioxide.
- Respiratory system and the maintenance of 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 illustrations 4.6 and 4.7 and write your inferences in the Science diary.

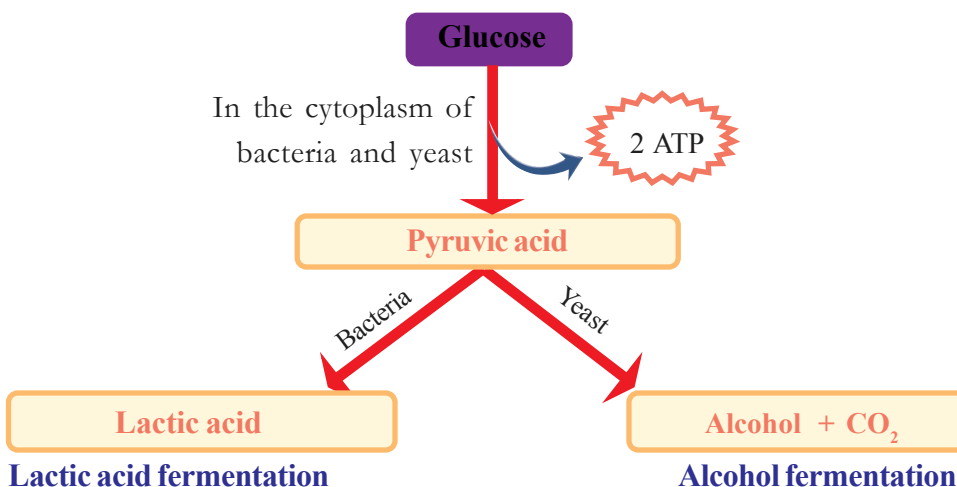
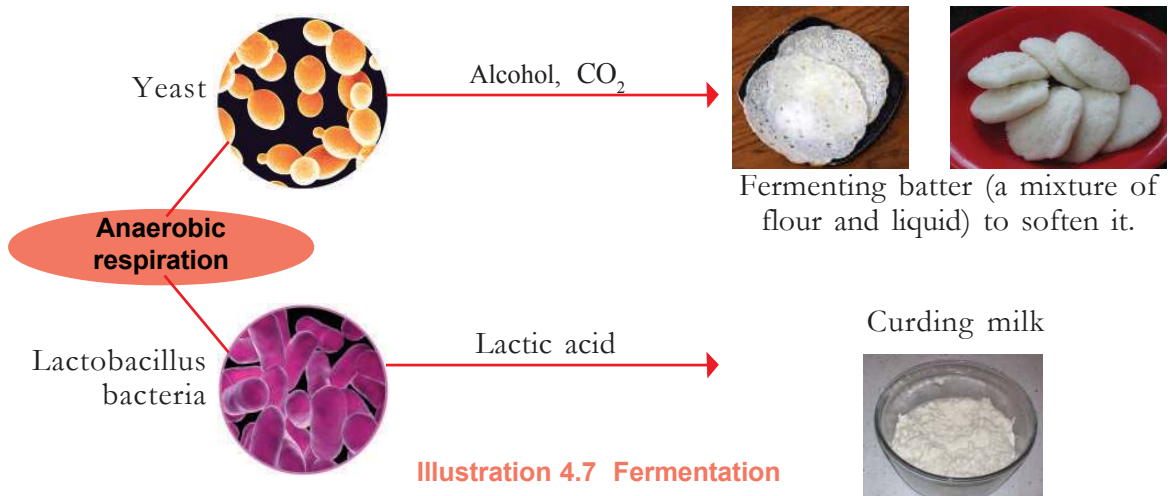


Illustration 4.6  
Anaerobic  
respiration

## Fermentation in Daily Life



### Indicators

- Fermentation during the curding of milk and the microorganisms.
- Process behind batter becoming soft and puffy.
- A practical definition for fermentation.

In certain circumstances, anaerobic respiration takes place in human beings also. 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.

Fermentation is used not only in daily life, but as a technology in the industrial sector also. Production of many bakery items can be associated with this. The possibilities of this technology can be made use of in small scale industries and in other vocations. Conduct a workshop on the topic with the help of experts.

### Do not damage the respiratory system

What are the instances that are harmful to the health of the respiratory system?

- 
-



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.

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 4.8 and collecting additional information.

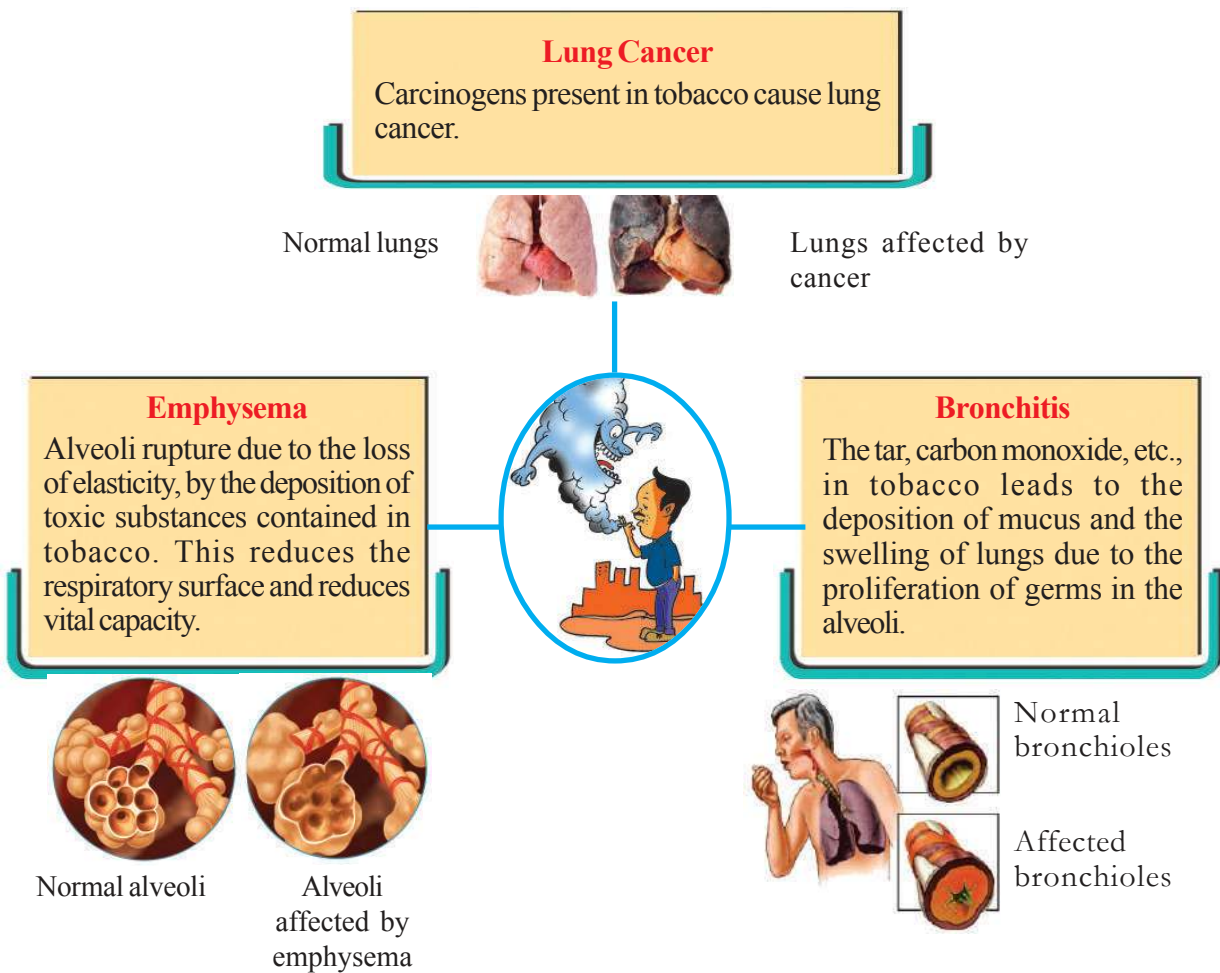


Illustration 4.8 III- effects of smoking

Besides protecting the lungs from diseases, we must also be equipped to face unexpected accidents. There may be situations that lead to drowning. As we can't breathe air in water, it is impossible to remain in water for a longer time. There is a very





low chance of self rescue too. Hence the person who meets with the accident must be rescued from water and first aid must be provided. Hence it is necessary that all of us must know how to expel water which has entered the body and how to perform the artificial respiration. Observe the video in Samagra and practice with the help of your teacher.

### Vital Capacity

Apart from protecting the lungs, care should be taken to increase its capacity too.

Tidal volume is the volume of air we breathe in and out during 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 activity and the strength of muscles in the thoracic cavity. This is about 4.5 litres in male and about 3 litres in female.

### Let's measure vital capacity

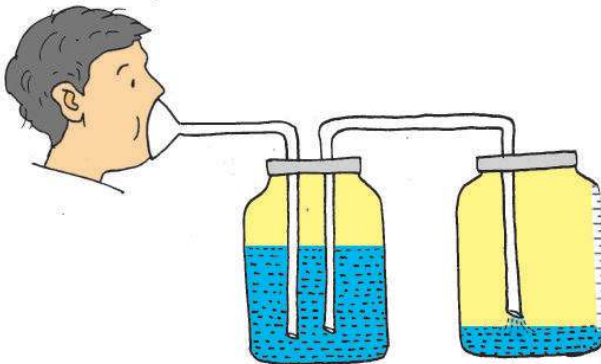


Figure 4.3 Measurement of vital capacity

Arrange the plastic jars and tubes as shown in figure 4.3. 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. Vital capacity can be increased through breathing exercise.

Doesn't the level of oxygen dissolving in blood increase when vital capacity increases? And yes, due to this, energy production also increases!

Have you understood the meaning of the message given at the beginning of the chapter. Modify the guess you have recorded, if necessary.

### Respiration in other Organisms

You know that other organisms too respire like humans. Cellular respiration is a process more or less similar in all organisms. The structure of the respiratory organs and the process of exchange of gases become complex from organisms with simple organisation to complex organisation.

Don't you remember the process of respiration in organisms like amoeba, fish, insects, etc. that you have studied in your lower classes? Collect data on respiratory diversity in organisms and complete table 4.4.

Organism	Respiratory Organ/ Mode of Respiration	Exchange of Gases
Amoeba		
Cockroach		Directly between tissues
Fish		

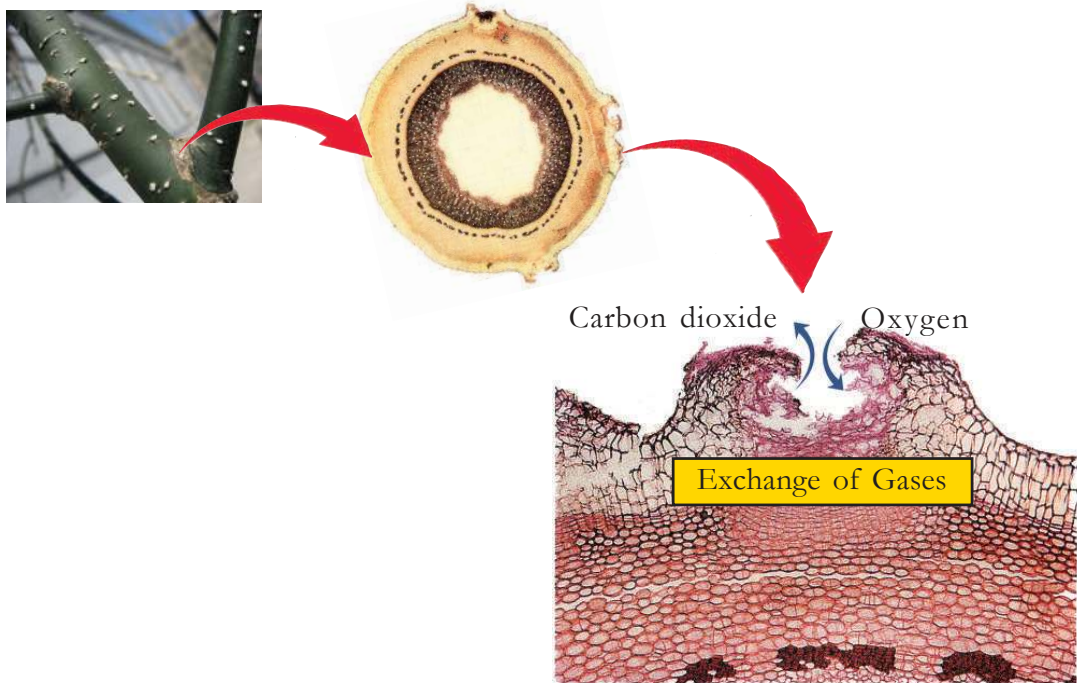
Table 4.4

### Do plants breathe?

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.

How do the roots and stems get oxygen? Observe the stem of Mexican lilac (Sheemakonna) and moringa and the root of jackfruit tree using a hand lens.



**Figure 4.4 Lenticel**

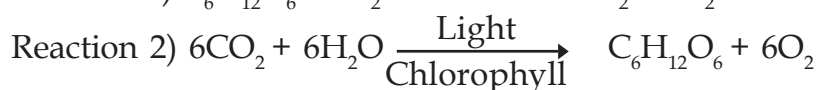
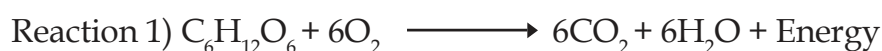
Can't you see small pores on the surface of stems and roots? These are called lenticels. Exchange of carbon dioxide and oxygen takes place in stems and roots through the cells of lenticels by diffusion.

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.



### 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 the above.
- Observe the two reactions given below.



- 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 by preparing a questionnaire on the topic 'Increasing Lung Diseases'.

### Notes

A large rectangular area with a black background and horizontal dashed lines, intended for writing notes.

# CONSTITUTION OF INDIA

## Part IV A

### FUNDAMENTAL DUTIES OF CITIZENS

#### ARTICLE 51 A

*Fundamental Duties- It shall be the duty of every citizen of India:*

- (a) to abide by the Constitution and respect its ideals and institutions, the National Flag and the National Anthem;
- (b) to cherish and follow the noble ideals which inspired our national struggle for freedom;
- (c) to uphold and protect the sovereignty, unity and integrity of India;
- (d) to defend the country and render national service when called upon to do so;
- (e) to promote harmony and the spirit of common brotherhood amongst all the people of India transcending religious, linguistic and regional or sectional diversities; to renounce practices derogatory to the dignity of women;
- (f) to value and preserve the rich heritage of our composite culture;
- (g) to protect and improve the natural environment including forests, lakes, rivers, wild life and to have compassion for living creatures;
- (h) to develop the scientific temper, humanism and the spirit of inquiry and reform;
- (i) to safeguard public property and to abjure violence;
- (j) to strive towards excellence in all spheres of individual and collective activity so that the nation constantly rises to higher levels of endeavour and achievements;
- (k) who is a parent or guardian to provide opportunities for education to his child or, as the case may be, ward between age of six and fourteen years.

**Its high time we protected nature and natural resources....!**

Forests have a great role in conserving the health of the environment in which we live. Forests are decisive in many respects. Source of the water we drink and the air we breathe, balancing atmospheric temperature, determining weather, managing agriculture, source of our food etc., are some of those areas.

Wild animals inhabit forests. Each animal has a function to perform in the environment in which it lives. Thus wild animals have a vital role in aspects like pollination of plants, dispersal of seeds, sustenance of forests etc.

It is our duty to protect and preserve forests, lakes, rivers, wild animals etc, which are all part of our nature. Also, Article 51(g) of our constitution reminds every citizen of India to have a compassion for living creatures.

Activities taken up for the conservation of forests and wild life by the Forest Department:

- Establishing Forestry clubs in schools, for spreading knowledge about forests.
- Establishing Eco-tourism centres as a part of encouraging eco-friendly tourism.
- Conducting Nature study camps as a part of forest and wild life education.
- Making public places green.
- Providing financial aid to conserve '*kaavu*'.
- Turtle conservation project.
- Instituting 'Vanamitra award' for promoting creative contributions in the field of green projects.
- Instituting 'Prakritimitra award' for conserving habitats outside forests and biodiversity.
- Conducting the 'Citizen Conservator Programme' for ensuring the role of public in forest conservation.

**Toll free number of Forest department: 18004254733**