

# Biology

Part 1

Standard IX



Government of Kerala  
Department of General Education

*Prepared by*

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

2024

## 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.

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

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Typesetting and Layout : SCERT

First Edition : 2024

Printed at : KBPS, Kakkanad, Kochi-30

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Dear friends,

The pursuit of scientific knowledge aims to establish scientific literacy and to imbibe the methodology of science. The world of knowledge has been continuously evolving through constant explorations. Conclusions are reached through experimentations, observations, documentation, and analysis. It is these evolving explorations that enables us to develop the ability to adapt to the challenges posed by the changing times.

The phenomena governing the survival of the living world, the essential components necessary for life's sustenance and the activities and processes combining the above contexts are encompassed in the diverse range of studies described in this text book. In each phase of the study, there are contexts for self-assessment. The book contains opportunities for engagement in inquiry-based learning activities.

The text book also presents opportunities for interaction with others and sharing findings from exploratory learning experiences. It encompasses activities aimed at expanding the scope of knowledge and engaging in endeavours such as promoting cleanliness, nature conservation, and other societal responsibilities. Wish all friends to facilitate both implementation and exploration in emerging fields of science and to participate in discoveries and investigations.

With love and regards,

**Dr Jayaprakash R.K.**  
Director  
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**Let's Find**



**Further reading**



**Evaluation  
not required**



# **THE CONSTITUTION OF INDIA**

## **PREAMBLE**

**WE, THE PEOPLE OF INDIA**, having solemnly resolved to constitute India into a <sup>1</sup>**[SOVEREIGN SOCIALIST SECULAR DEMOCRATIC REPUBLIC]** and to secure to all its citizens :

**JUSTICE**, social, economic and political;

**LIBERTY** of thought, expression, belief, faith and worship;

**EQUALITY** of status and of opportunity; and to promote among them all

**FRATERNITY** assuring the dignity of the individual and the <sup>2</sup>[unity and integrity of the Nation];

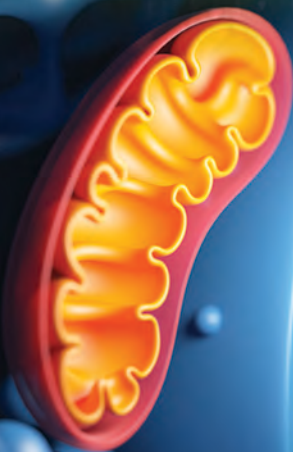
**IN OUR CONSTITUENT ASSEMBLY** this twenty-sixth day of November, 1949 do **HEREBY ADOPT, ENACT AND GIVE TO OURSELVES THIS CONSTITUTION.**

- 
1. Subs. by the Constitution (Forty-second Amendment) Act, 1976, Sec.2, for "Sovereign Democratic Republic" (w.e.f. 3.1.1977)
  2. Subs. by the Constitution (Forty-second Amendment) Act, 1976, Sec.2, for "Unity of the Nation" (w.e.f. 3.1.1977)

# 1 To Life Processes



- Metabolism
- Internal environment and Homeostasis
- Plasma membrane and Exchange of substances
- Photosynthesis and Nutrients
- Plant services
- Plant protection

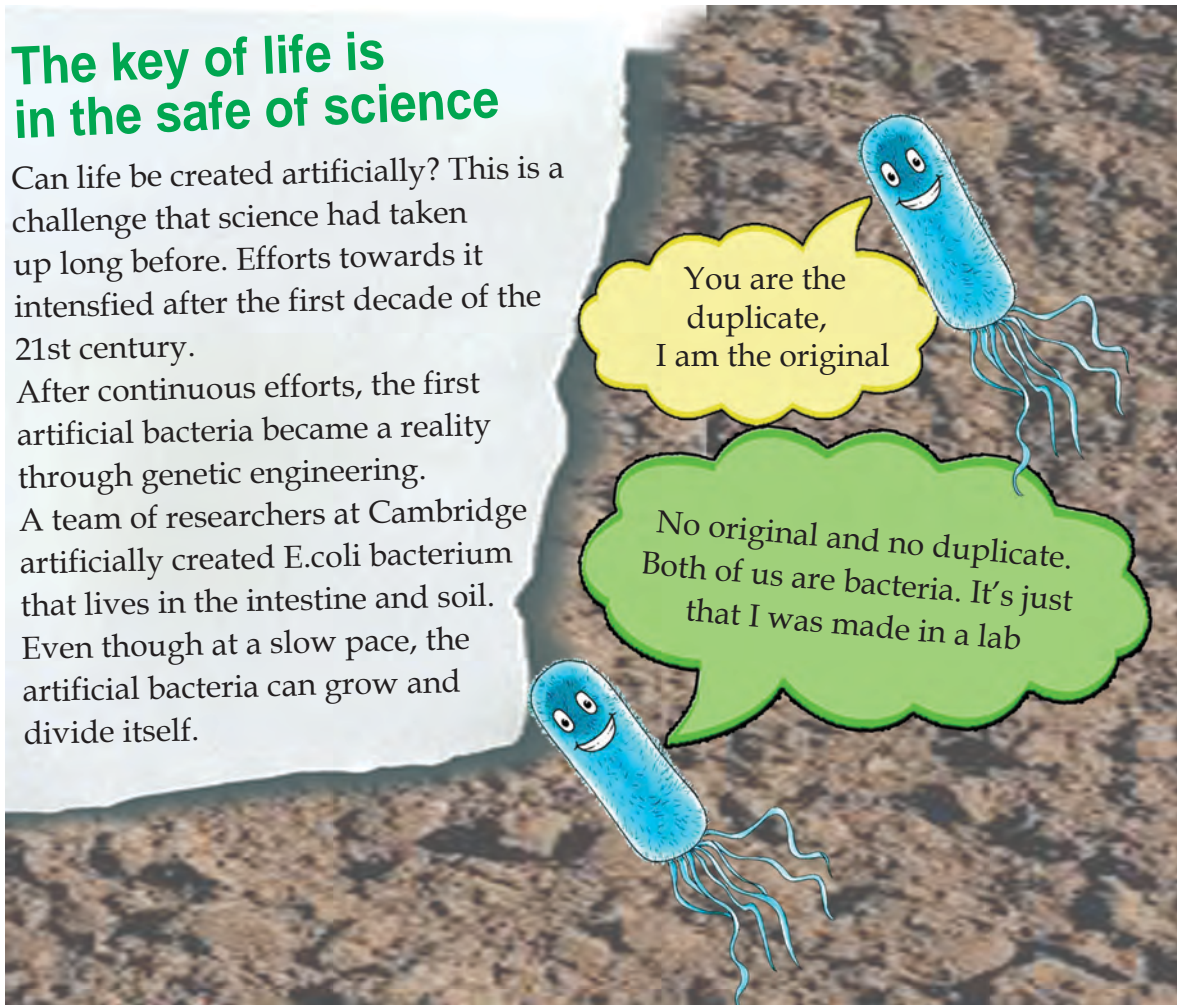


## The key of life is in the safe of science

Can life be created artificially? This is a challenge that science had taken up long before. Efforts towards it intensified after the first decade of the 21st century.

After continuous efforts, the first artificial bacteria became a reality through genetic engineering.

A team of researchers at Cambridge artificially created E.coli bacterium that lives in the intestine and soil. Even though at a slow pace, the artificial bacteria can grow and divide itself.



Above is a hypothetical conversation between naturally occurring bacteria and bacteria produced in lab. The creation of artificial bacteria was an amazing breakthrough in scientific world.

Movement, response, respiration, growth, reproduction etc. are the signs of life. You know that cell is the basic structural and functional unit of life. The chemical reactions essential for the existence of life mainly take place inside the cells.

Many molecules are required for the cell structure and cell functions. These molecules are formed by the various combinations of elements such as carbon, hydrogen, oxygen, nitrogen, phosphorous and calcium.



Carbohydrate, protein, lipid and nucleic acid are the basic building blocks of life. These are known as biomolecules.

Analyse illustration 1.1 given below about biomolecules and gain understanding.

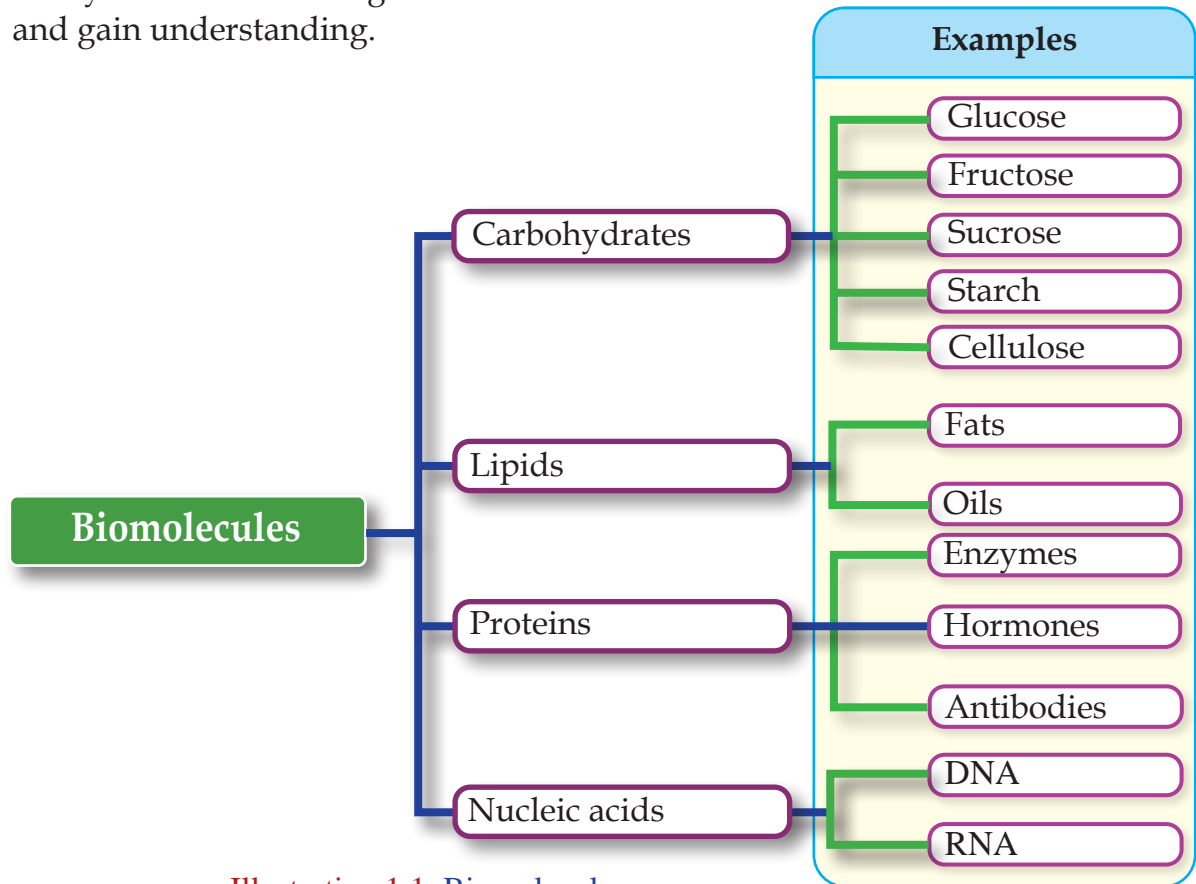


Illustration 1.1 Biomolecules

Expand the illustration by finding more examples for biomolecules.

All life signs are manifested by the actions of biomolecules and many other chemical factors inside the cell. All such chemical reactions together taking place in an organism are called metabolism.

Metabolism can be divided into two. Anabolism which combines molecules and catabolism which breaks down molecules.

Complete the illustration 1.2 given below to gain an understanding of metabolism.



### The size of a minute calculation

There are 37 trillion cells in human body. It is estimated that one billion chemical reactions take place every second in each cell. If so, how many chemical reactions take place in body cells in one second?

Read on

3700000000000000000000.

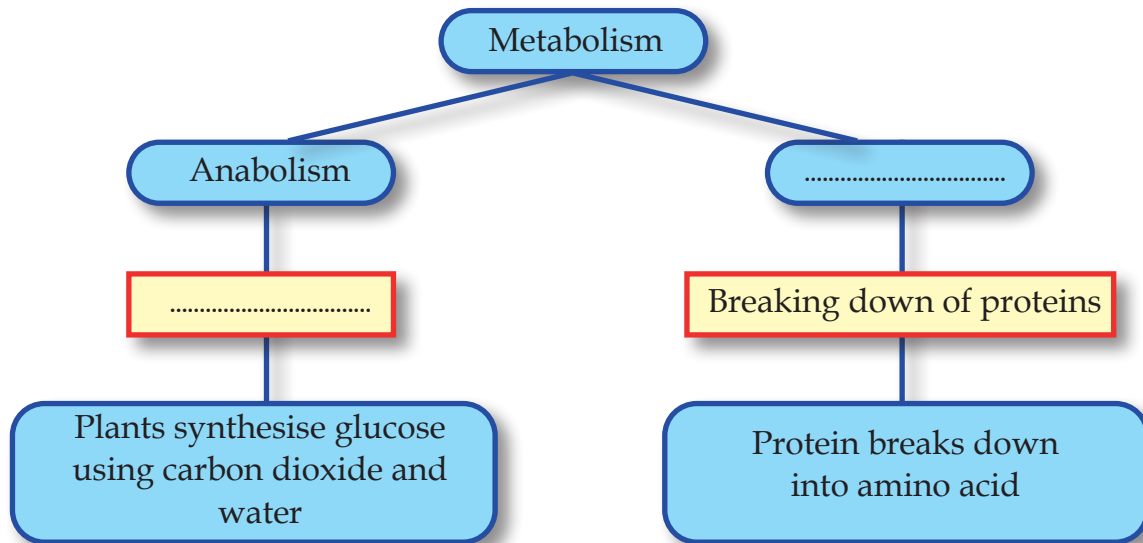


Illustration 1.2 Metabolism

Biomolecules such as enzymes and hormones are also formed inside the cell to regulate and help metabolism. Analyse the description given below and gain an understanding. Find more examples of these by gathering information.

### Enzymes and Hormones

Enzymes are molecules which help to speed up the countless chemical reactions that take place in organism every moment. Most enzymes are proteins. Salivary amylase present in saliva and pepsin present in gastric juice are examples for enzymes.

Hormones are chemical molecules that regulate and coordinate biological processes. These are produced by various endocrine glands. Testosterone, estrogen and progesterone that control the function of sex organs are examples for hormones.

You have understood that certain factors necessary for metabolism in living organisms are synthesised inside the cell. Many other factors required for metabolism are obtained from their external environment. Which are they? List out.

.....

.....

Have you ever thought how substances from the external environment get inside the cell?

Analyse the figures 1.1(a), 1.1(b), 1.1(c) and descriptions, discuss and gain understanding.

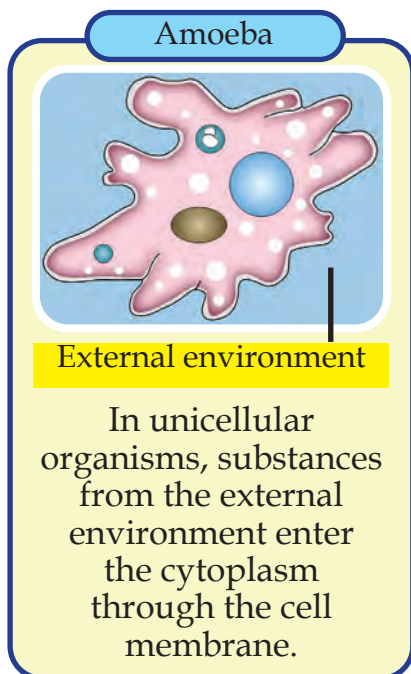


figure 1.1 (a)

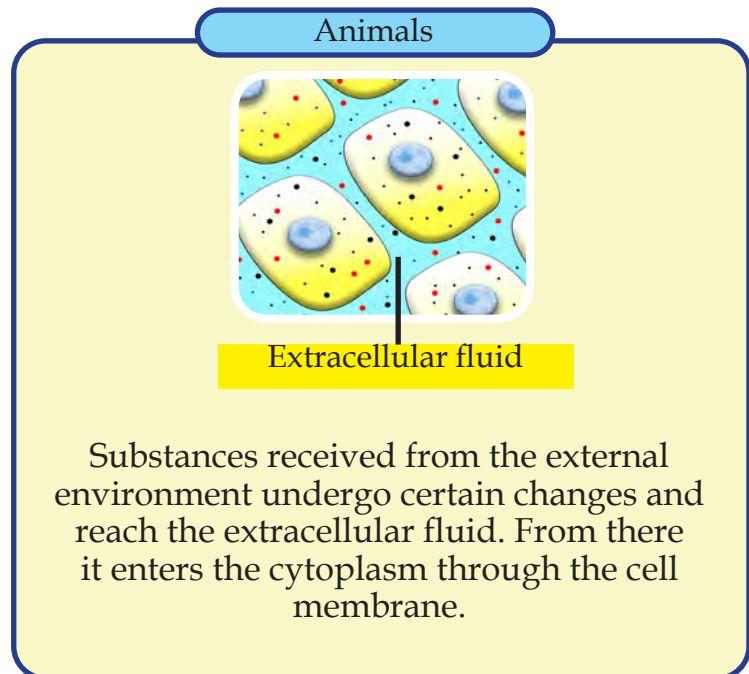


figure 1.1 (b)

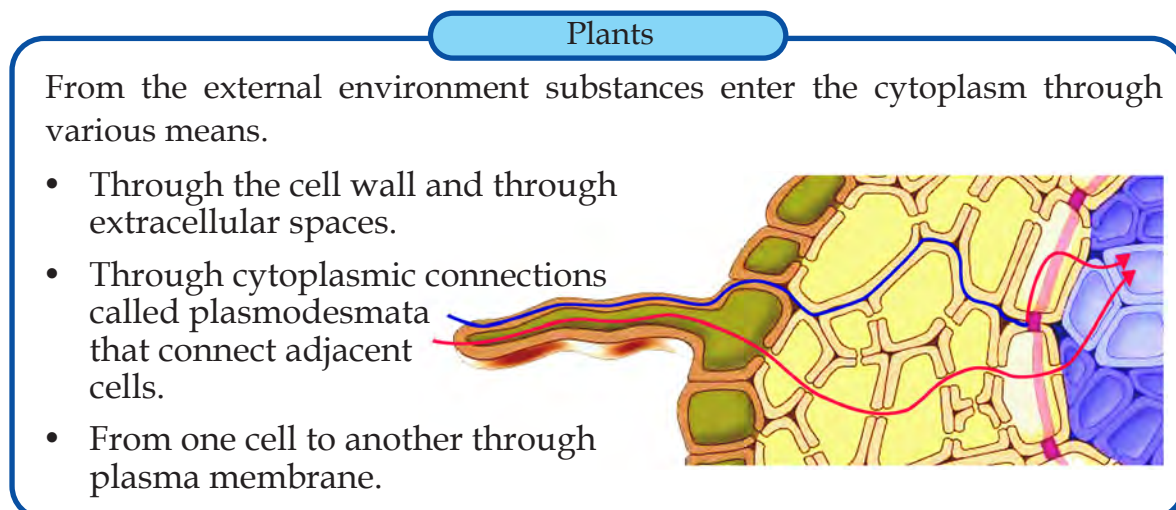


figure 1.1 (c)



Is there internal environment like external environment?

Haven't you noticed the child's doubt? Note down your guess.

Analyse the description given below and check the validity of your guess.

In animals the fluid found in the space between the cells (extracellular fluid) serves as the internal environment. The internal environment of plants consists of cell walls and their components, extracellular fluid and air sacs between cells.

Keeping the composition of the internal environment constant is called homeostasis. Homeostasis needs to be maintained for the smooth functioning of metabolism. Disruption of the chemical composition of the internal environment can be threatening to life.

You have understood that simple molecules that are required for metabolism enter cells through cell membrane from internal environment. How far suitable is the cell membrane for this?

### Exchange of materials through cell membrane

You have learned about the structure of cell membrane. Which are the main components of cell membrane? Label them in the illustration 1.3.

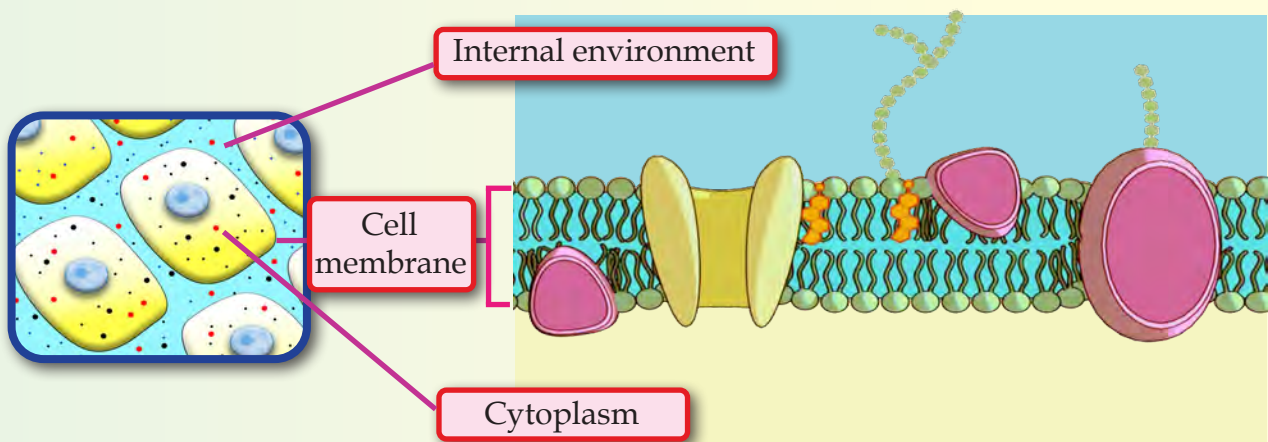


Illustration 1.3 Structure of cell membrane

Haven't you understood why cell membrane is also known as plasma membrane? Discuss.

Only certain molecules can pass through the plasma membrane. Water, oxygen, carbon dioxide etc. can easily pass through it. But certain substances and ions can only pass through special channels or pores present in the plasma membrane.

Molecules are constantly passing in and out of the cell. Don't you want to know about it?

Do the activity given below to understand how water molecules pass through the plasma membrane.

Why plasma membrane is known as selectively permeable membrane? Find out.

Take a thin outer layer of spinach/rhoeo leaf. Cut it into two pieces and put one in fresh water and the other in concentrated salt solution. After two minutes transfer both the layers to a slide and observe under a microscope.



Illustrate your observation.

Compare your drawings with figures 1.2 (a) and 1.2 (b). Identify each and record in which contexts they occur?

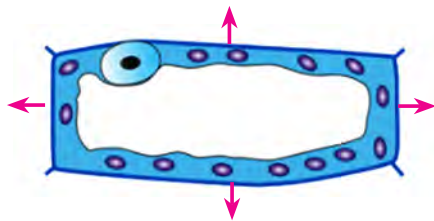


figure 1.2 (a)

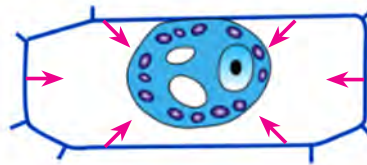


figure 1.2 (b)

Observe figure 1.2 (a) and 1.2 (b) and find out the change that happens in the cells. Based on illustration 1.4, analyse the results of observation using indicators and record inferences.

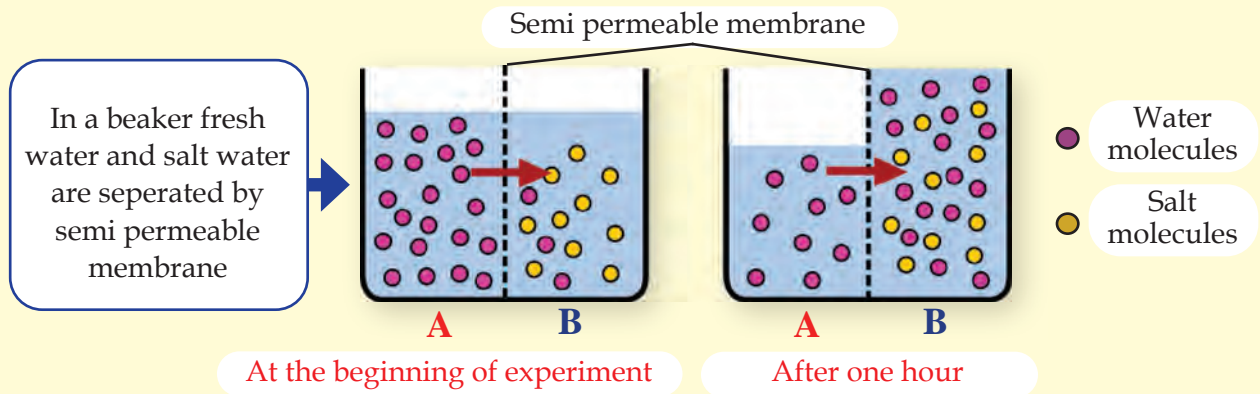


Illustration 1.4 Flow of water molecules

What happens to raisins placed in fresh water and why? Find out.

- Concentration of water molecules at the beginning of the experiment.
- Concentration of water molecules after one hour.
- Direction of the flow of water molecules.

In the place of semi permeable membrane in illustration 1.4, there is the plasma membrane of spinach/ rhoeo cell, isn't there? Why did the cell that was immersed in the salt water shrink?

.....  
Osmosis is the movement of water molecules from a region of its higher concentration to a region of its lower concentration through a semi permeable membrane.

You have understood that water moves in and out of the cell through osmosis.



There are other factors besides water. How do they get in and out of the cell?

Didn't you notice the child's doubt? Analyse the illustration 1.5 according to the indicators and record the inference by identifying how the movement of oxygen takes place through plasma membrane.

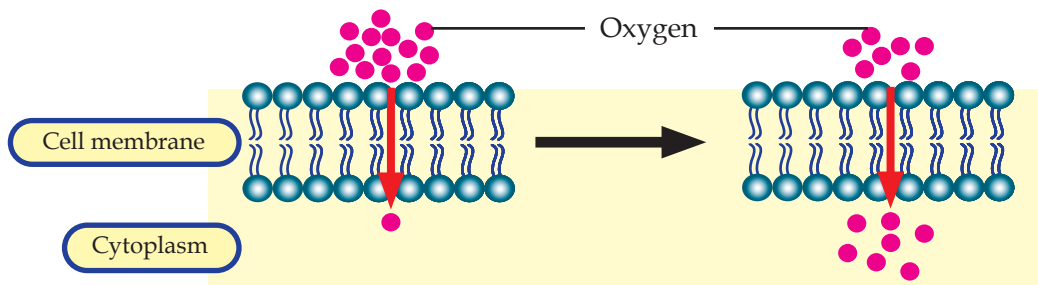


Illustration 1.5 Flow of oxygen molecules



- Difference in the concentration of oxygen molecules.
- The direction of flow of oxygen molecules.

Diffusion is this type of flow of molecules. It does not require energy.

Analyse the illustration 1.6 and 1.7 according to the indicators and make a note on two other processes that help in the exchange of materials.

Will diffusion take place through and without semi permeable membrane? Find out.

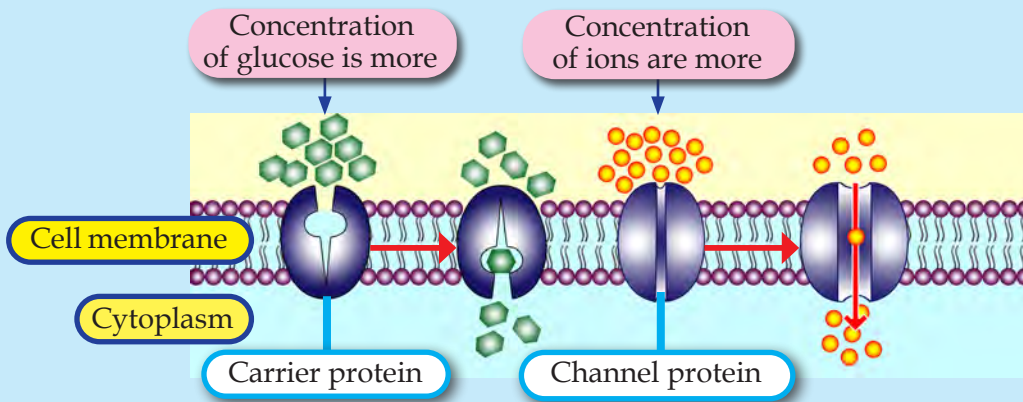


Illustration 1.6 Facilitated diffusion

### Facilitated diffusion

A process that does not require energy and takes place with the help of certain proteins in the plasma membrane.

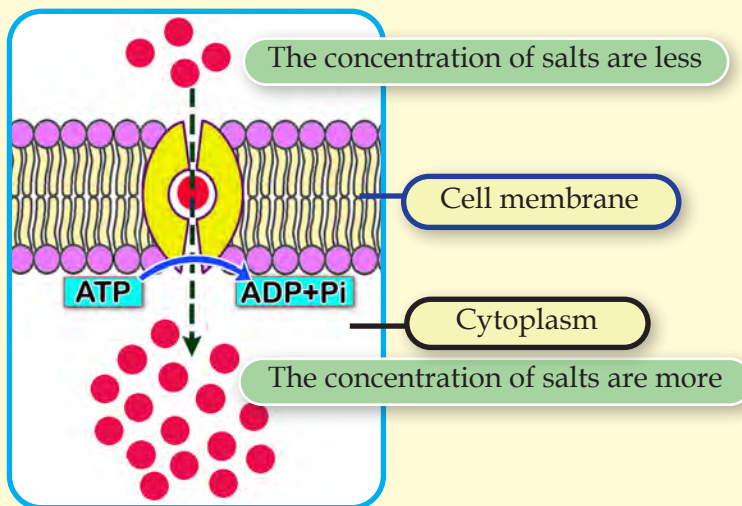


Illustration 1.7 Active transport



- Difference in the concentration of molecules.
- Proteins in the plasma membrane that help the entry of molecules into the cell.
- Requirement of energy.

### Active transport

An energy requiring process that takes place with the help of certain carrier proteins in the plasma membrane.

Complete the work sheet 1.1 by including processes involved in the exchange of materials.

The nature of flow of molecules	Name of the process
From a region of higher to lower concentration	
From a region of lower to higher concentration	
Applicable to water only	
Energy required	
Energy not required	
Carrier protein not required	
Carrier protein required	

**Work sheet 1.1** Processes related to movement of substances

You have understood the role of plasma membrane in transporting substances in and out of the cell.

**Source of nutrients**

Nutrients are essential for metabolism. How do animals get them? What about plants?

.....

.....

Photosynthesis is the process by which plants make food.

List the components required for photosynthesis.

- Chlorophyll
- .....
- .....
- .....

Observe the illustration 1.8 and discuss the parts involved in photosynthesis based on the indicators and make a note.



Algae are the group of unicellular or multicellular organisms. Algae and the blue green algae which are prokaryotes obtain nutrients through photosynthesis.



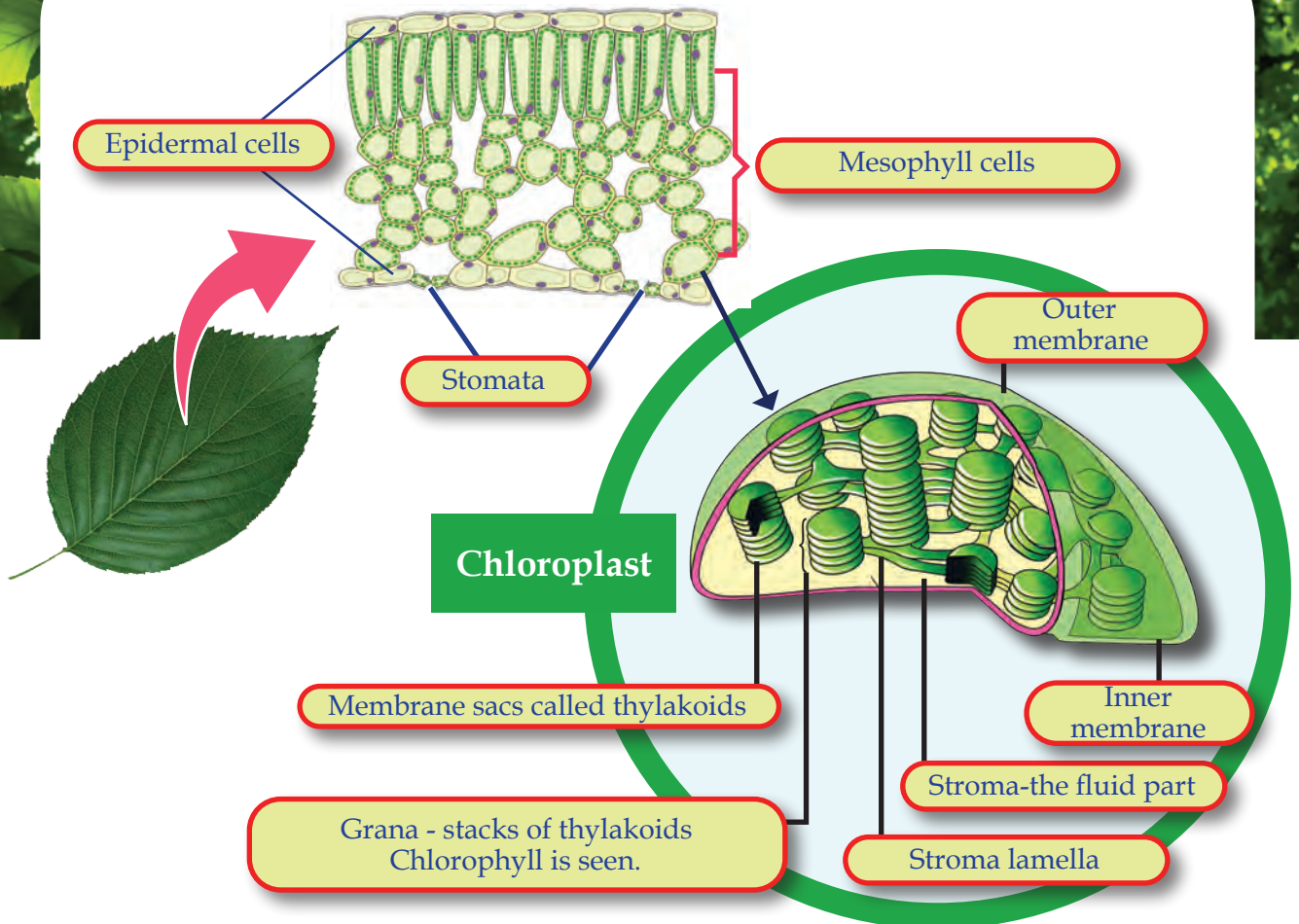


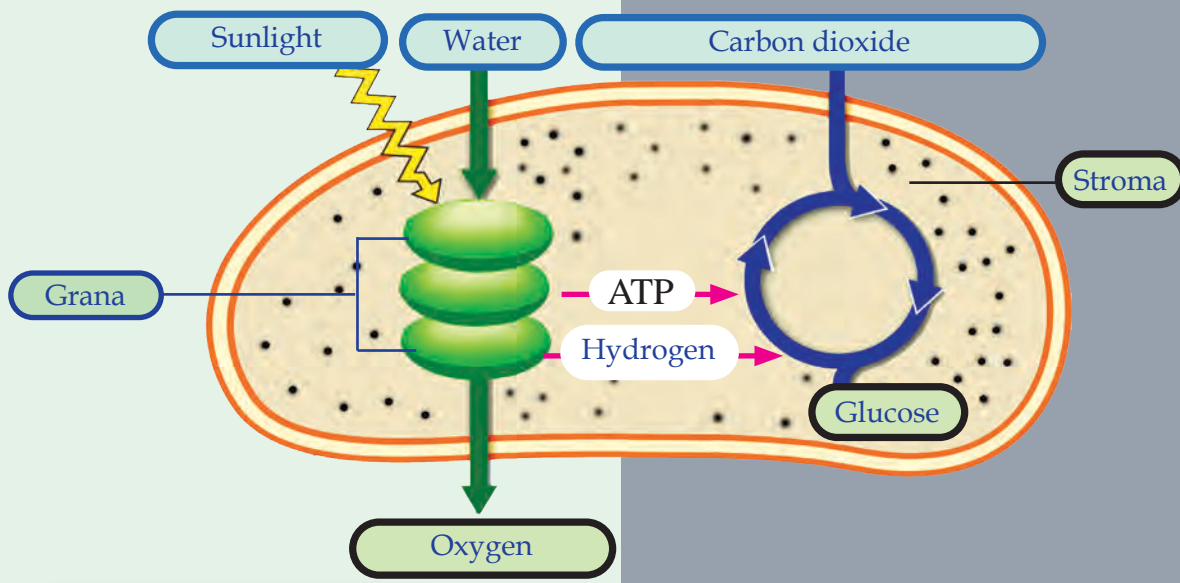
Illustration 1.8 Structure of chloroplast



- Structure of chloroplast.
- Position of chlorophyll.
- Thylakoid, grana and stroma.

## Photosynthesis

Photosynthesis has two phases. Complete the table 1.2 by analysing illustration 1.9 and the information given.




### Light phase

- Takes place in grana.
- Takes place in the presence of light.
- Water splits into hydrogen and oxygen.
- Expels oxygen.
- Hydrogen reaches stroma.
- ATP, the energy molecule is formed.

### Dark phase

- Takes place in stroma.
- Light is not used.
- Hydrogen and energy (ATP) required for this phase is obtained from light phase.
- Glucose is formed by combining hydrogen and carbon dioxide.

Illustration 1.9 Phases of Photosynthesis



**Melvin Calvin**  
 He was awarded Nobel Prize in Chemistry in 1961 for explaining the reactions in the dark phase

Photosynthesis		
Hints	Light phase	Dark phase
Place where reaction takes place		
Reactions		
Products		

Table 1.2 Phases of Photosynthesis

Complete the illustration 1.10 by including the reactants and products of photosynthesis.



Illustration 1.10 Substances involved in photosynthesis

Is sunlight itself required for photosynthesis? Can photosynthesis take place under the light of an LED bulb? Find out.

## Various nutrients from glucose

Glucose, produced as a result of photosynthesis, dissolves quickly in water so it is stored as insoluble starch. Energy required for the life processes of plants is obtained from starch. Many substances are produced when starch undergoes metabolism. Observe the pictures 1.3 and 1.4 given below and complete the illustration 1.11.

### Sources of various nutrients



Figure 1.3 Carbohydrates

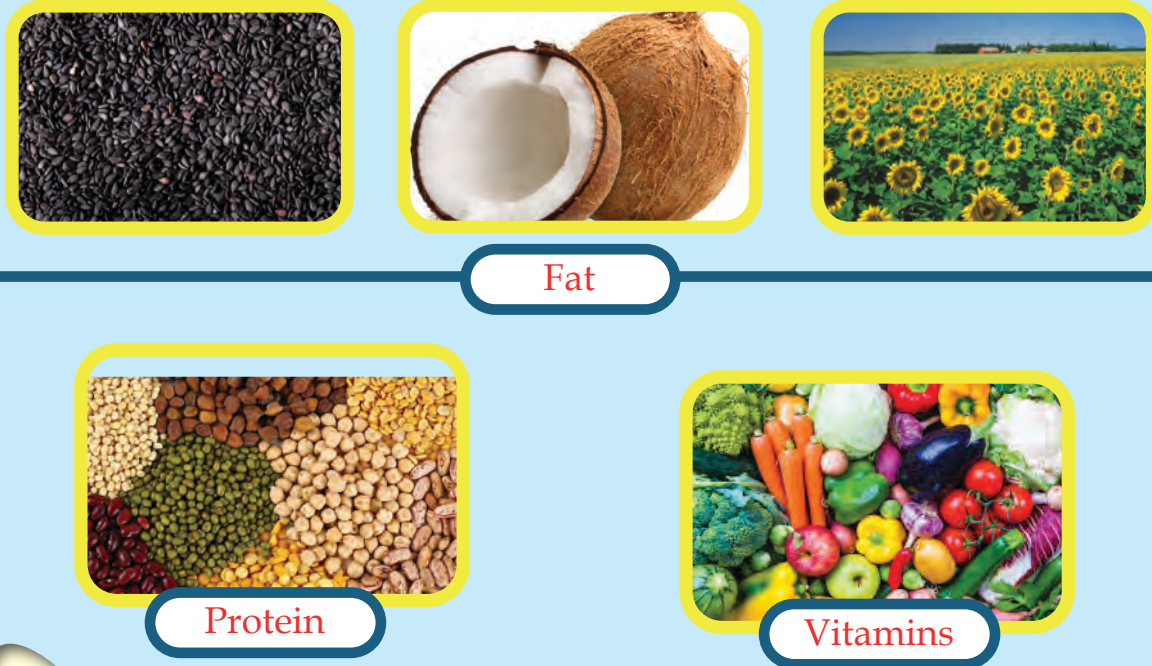


Figure 1.4 Fat, protein, vitamins

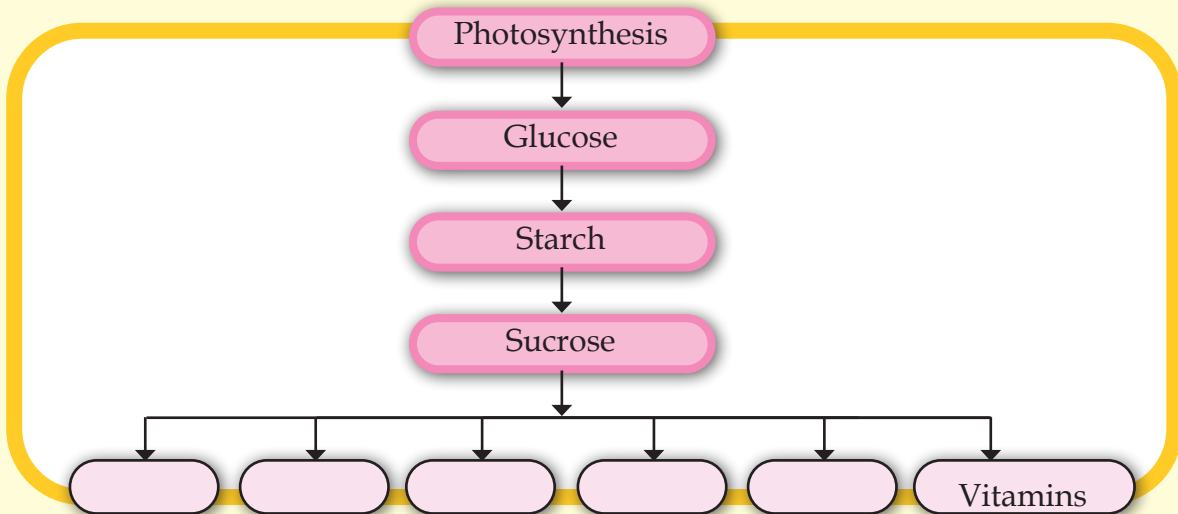


Illustration 1.11 Various nutrients from glucose

Didn't you understand how plants get nutrients? Other organisms receive these nutrients for their life activities.

You know about nutrition and nutrients. List the nutrients.

- 
- 
- 
- Minerals
- Water
-

Nutrients produced by plants through metabolism reach herbivores through food. Herbivores are eaten by carnivores. Haven't you understood why plants are called autotrophs and animals are called heterotrophs?

Plants grow in water as well as on land. Who are the producers in the ocean and other water bodies?

.....  
 .....

Substantial amount of oxygen in the atmosphere is released by producers in the ocean. Pollution is the most serious threat the marine ecosystem faces. As a result, species become extinct in large numbers.

What are the steps to be taken to prevent ocean pollution? Discuss.

Are food and oxygen the only things that plants provide? Arrive at inferences by analysing the illustration 1.12 and the description.



## Ocean a wonder

Three fourths of the earth is ocean. They include lakhs of species and many habitats. An oceans is divided into three zones based on the availability of sunlight. From the surface to 200 meters depth is the Euphotic zone. Large number of organisms live in this area, as they get sufficient sunlight.

Dysphotic zone comes below 200 meters to thousand meters. Eventhough the availability of light in this area is limited, there exists a plant centered web of life. Aphotic zone is below thousand meters. The amount of sunlight available there is very less. So photosynthesis does not take place there. But some organisms present there can produce light.

Animals in the aphotic zone feed on the dead remains of the organisms in the dysphotic zone. There are also some bacteria that survive through chemosynthesis. The UNO's prediction that by 2050 the weight of plastic swept into the ocean will surpass the weight of fish stocks is shocking. May the ocean not be an oblivion but remain as a marvel and continue to inspire human thought.





Rubber Latex



Medicines



Biopesticide



Spices



Drinks like coffee and tea

Illustration 1.12 Economic importance of plants

## Mangroves - gift of nature



Mangroves are found where back waters meet the sea. Kerala has 43 species of mangrove plants that grow in salt water. Our state had 70,000 hectares of mangroves in 1975. But ninety eight percent of it has been destroyed. Mangroves provide invaluable service to the environment.

- A source of fish wealth.
- A storehouse of biodiversity.
- Conservation of coastal soil.
- Defence against global warming by absorbing 4-5 times more carbon dioxide compared to evergreen forests.
- Prevention of tsunami

You have understood that nature and humans are receiving countless services from plants. Only some indicators are given above. After collecting more information, organize a seminar on the topic 'Plants-the protectors of biosphere'.

### Sub topics

- Economic importance of plants
- Ecological importance of plants

On the basis of the discussion, the content of sub topics may be changed in accordance with the biodiversity features in the locality.

You might have acquired a comprehensive knowledge about the role and importance of plants in the biosphere through the seminar.

Plants are the foundation stones of the biosphere. Depletion of plants will ultimately affect the survival of life itself. The concept of sustainable development is formulated by considering plants as well. If that is to be possible, activities focused on environmental awareness is necessary. We all need to be prepared for that. That will be possible only if we adopt an environmental perspective in life, based on scientific consciousness.



### Kallen Pokkudan (1937-2015)

Kallen Pokkudan is the environmentalist who conscientised on the importance of the mangroves through their conservation. He had planted more than one lakh mangrove saplings.



He upheld the view that mangroves must be grown in their natural habitat. He is called Kandal Pokkudan as a recognition for his activities in the conservation of mangroves. He proved his love for nature through the preservation of mangroves and his autobiography is titled "My Life among Mangroves". The Environmental Protection wing of the UNESCO has mentioned his name for contributions in mangrove conservation. He passed away leaving behind the dream 'A school for Mangrove study'.



## Let us Assess

- Compare the outer membrane of raw egg and boiled egg using the indicators given below
  - Permeability
  - Possibility of osmosis
  - Possibility of active transport

- Given below is an answer written by a child to the question 'How is oxygen released in photosynthesis'? Evaluate and comment on it.

Carbon dioxide and water are the raw materials for photosynthesis. Both these breakdown and oxygen is released.

- 'Though photosynthesis is ultimately anabolism, it also involves catabolism'. Analyse the statement.



## Extended activities

- There are so many people who have dedicated their lives for environmental activities. Collect information about them and prepare an album.
- Complete the table given below by observing plants in the surrounding.

Plants	Value added products	Consumption
Coconut tree	Coconut oil	For cooking
	Medicine	



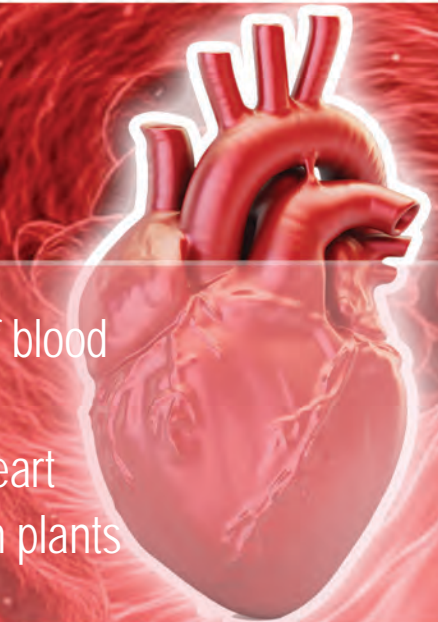


# 2

## Digestion and Transport of Nutrients



- Digestive system
- Digestion
- Absorption of nutrients
- Structure of villus
- Structure of blood
- Heart
- Health of heart
- Transport in plants





Have you noticed the given picture regarding the school Noon meal programme. A nutritious diet ensures your health.

What all food items are included in your noon meal? list out.

Analyse the prepared list and complete the given table 2.1.

Food items	Nutrients	Function
	Minerals	
	Water	

Table 2.1 : Nutrients

Although the dietary patterns of people in various parts of the world are different, for health, food must contain nutrients such as carbohydrates, proteins, fats, minerals and vitamins in addition to fiber and water. A balanced diet is a diet that provide all the nutrients in the right proportion.

## Food plate



It is essential for those in the growing age to eat a balanced diet. The food items like vegetables, fruits, cereals, milk and milk products, pulses/meat, etc. should be included in the diet. Fruits and vegetables contain plenty of vitamins, minerals, other nutrients and fibers. The concept of food plate is helpful for healthy life. A food plate consists of half a plate of fruits and vegetables, a quarter of cereals, a quarter of protein-rich foods, and a glass of milk or dairy products. There is an increase in consumption of junk food among children today. Such food items are high in calories and low in nutritional value. This leads to malnutrition and other health problems. Skipping breakfast is more common among children. This causes many problems like fatigue, drowsiness, lack of attention in studies and loss of memory. So children need to get used to proper dietary habits.



Conduct a project by including children in your school on the topic **“The food habits and health problems of children”**. Share your findings with health workers and seek means for solving the problem.

Nutrition is the process by which organisms obtain and utilize food for nutrients from the external environment. Which are the different stages of nutrition?

- 
- 
- 
- 
- Egestion of digestive waste.

Process of nutrition becomes more complex as we move from simple to complex structured organisms. Nutritional processes of amoeba, a unicellular organism and hydra, a multicellular organism are given in illustration 2.1. Compare them and complete the table 2.2.

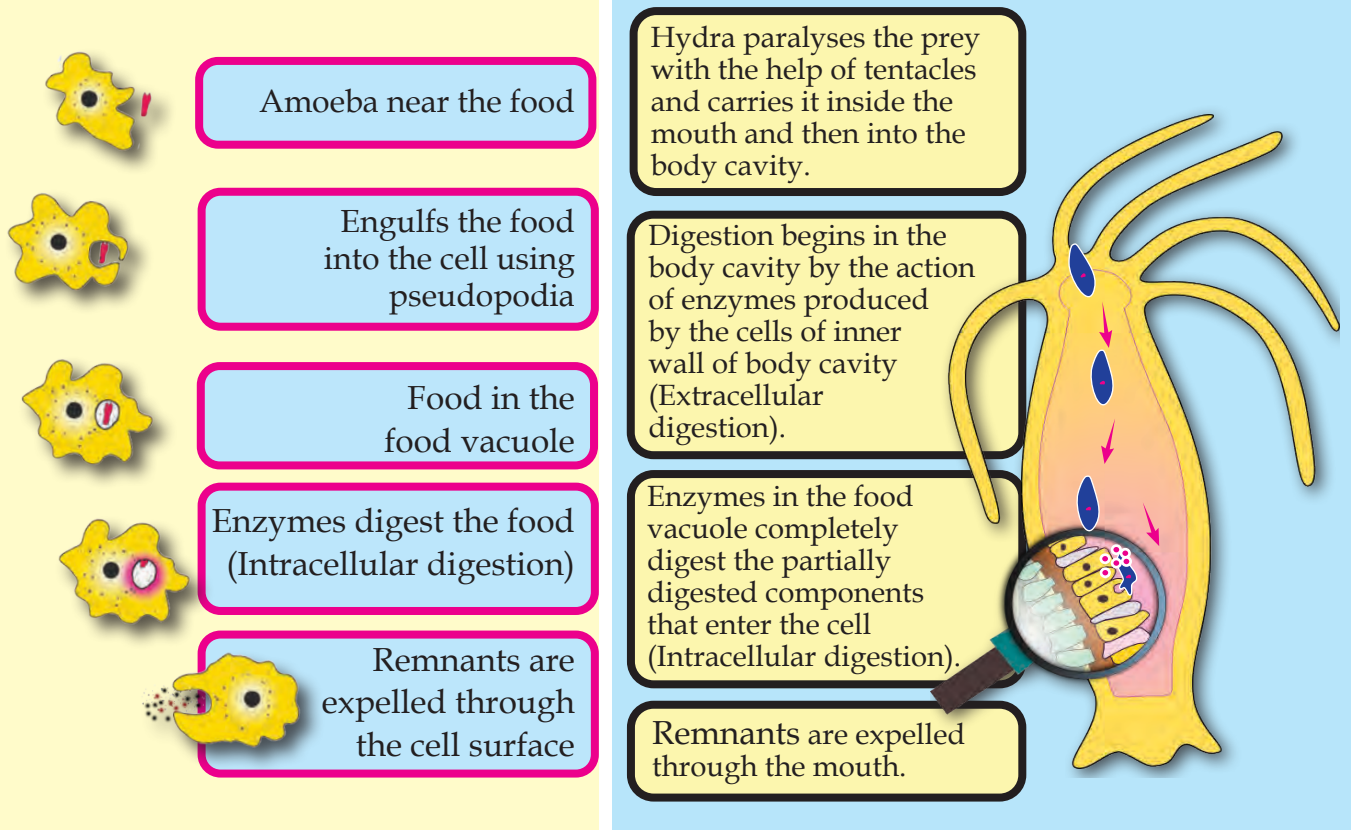


Illustration 2.1 : Nutrition in Amoeba and Hydra

Hints	Amoeba	Hydra
Body structure	Unicellular	
Means to help ingestion		
Part where digestion takes place	Inside the cell	
Egestion of digestive wastes		

Table 2.2 : Nutrition in Amoeba and Hydra

Extra cellular digestion also takes place in addition to intracellular digestion when it comes from unicellular organism amoeba to simple structured multicellular organism hydra. In multicellular organisms, the digestive system and the digestive process have much diversity and complexity in order to meet nutrient requirements.

Humans eat a wide variety of food items. How does the digestion of these nutrients take place? Analyse the illustration 2.2 and form inference.

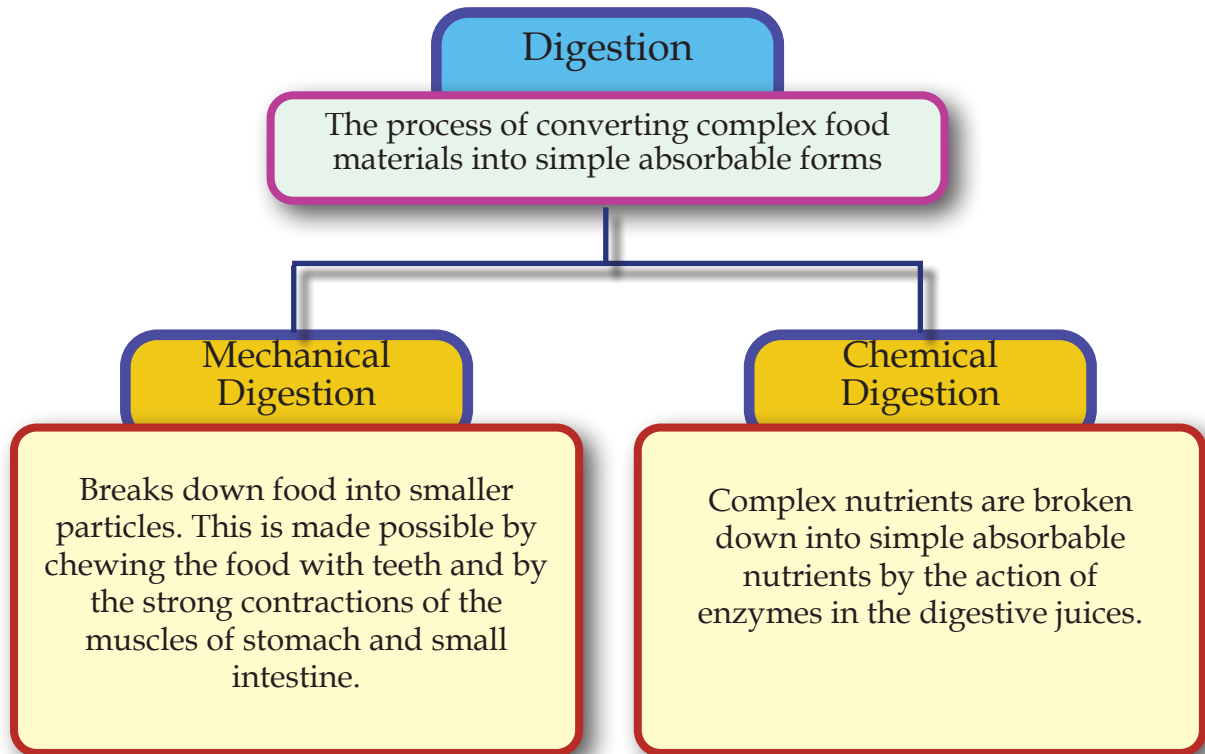


Illustration 2.2 : Digestion

Which are the parts where mechanical digestion takes place?

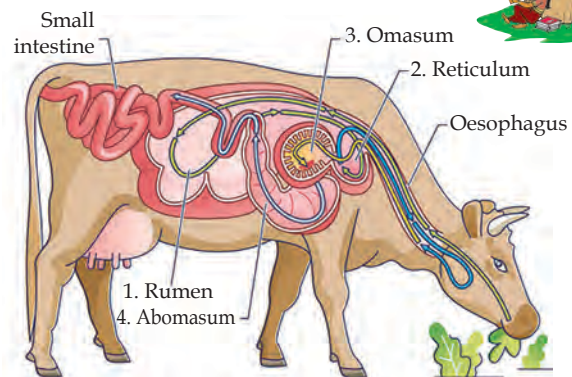
- Mouth
- 
- 

How does mechanical digestion take place in these parts?

Analyse illustration 2.3 and prepare a note based on the indicators.

### Behind Ruminantion

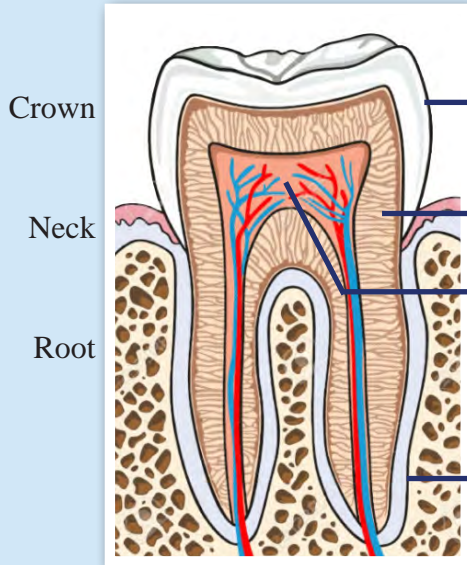
Haven't you noticed that cows chew continuously even while resting?



There are four chambers in the stomach of cows. They are rumen, reticulum, omasum and abomasum. The components in food like cellulose, hemicellulose etc. are broken down by the enzymes produced by the microorganisms present in the rumen and reticulum. The process of digestion becomes more effective in them when the food that is temporarily stored in the rumen returns to the mouth and is chewed again.

## Mouth

Teeth help to bite into pieces and chew the food. Tongue and saliva help in the chewing process. You have understood the different types of teeth and their function. Although teeth differ in external structure, they have many similarities in internal structure.



### Structure of Tooth

**Enamel** : The hardest substance in the human body. The outer covering of the tooth. Non living.

**Dentine** : Living tissue with which tooth is formed.

**Pulp cavity** : The innermost part of the tooth. Soft connective tissue called pulp is seen. Blood vessels, nerves, odontoblast cells, etc. are seen.

**Cementum** : Calcium containing connective tissue that holds the tooth in the socket of the gum.

## Stomach

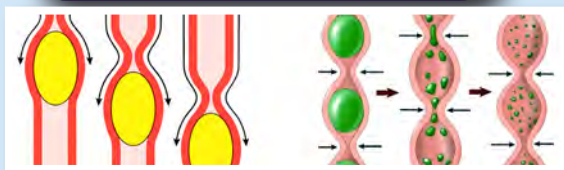


Peristalsis

Circular Muscle

The strong peristalsis in the stomach converts food into a paste form. The circular muscles of the stomach retain food in the stomach for ample time.

## Small intestine



Peristalsis

Segmentation

Mechanical processes in the small intestine such as peristalsis and segmentation help to facilitate the movement of food and mix food with digestive juices.

Illustration 2.3 : Mechanical digestion



- Structure of tooth.
- Mechanical digestion in mouth, stomach and small intestine.

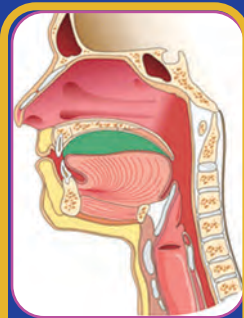
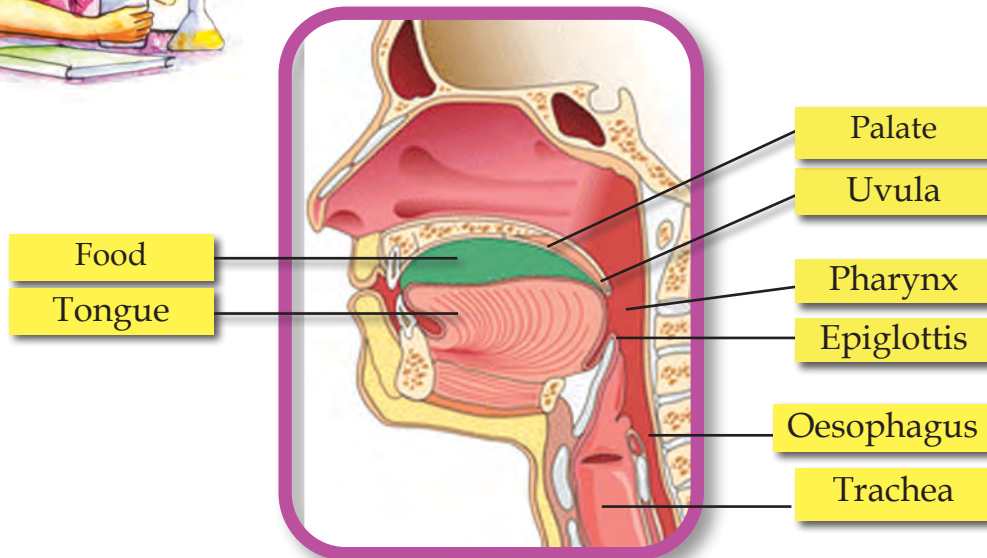
What are the things to be taken care for proper dental care? Conduct an interview with a doctor, prepare a poster and exhibit it.



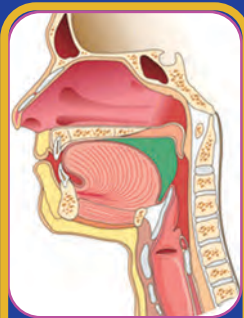
Why doesn't food enter trachea while swallowing it?

## Swallowing

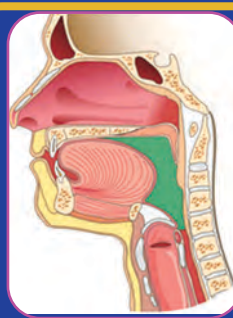
Analyze the illustration 2.4 and identify the position and function of the epiglottis and uvula and gain an understanding of the swallowing process.



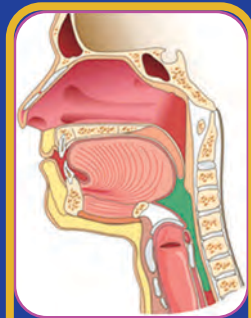
Tongue compresses the food into balls with the help of palate.



Uvula closes the nasal cavity that opens to the pharynx.



Posterior part of the tongue allows food to move over the epiglottis into the oesophagus.



Trachea rises up and is closed by the epiglottis.

Illustration 2.4 : Swallowing

Now you have understood about swallowing of food and mechanical digestion. Human alimentary canal and related parts are given in illustration 2.5. Analyze it according to the indicators and present your findings about the role of each part in digestive process and about chemical digestion.

What is the reason for saying that one should not talk while eating food? Find out.

### Mouth

The digestion of starch begins with the help of *salivary amylase* of saliva which is produced from the salivary gland.

### Oesophagus

Peristalsis moves the food into the stomach.

### Stomach

Hydrochloric acid of gastric juice produced by the gastric glands destroys germs in the food. Regulates pH. The enzymes *Pepsin* partially digest the proteins. *Lipases* help in the digestion of lipids. Mucus protects the stomach wall from the actions of digestive juices.

### Small Intestine

Digestive juices produced by the liver and pancreas reach the small intestine and help digestion. Different *Carbohydrases* of intestinal juice produced by the small intestine convert complex carbohydrates into simple components like glucose, fructose and galactose. *Proteases* convert proteins into amino acids. The absorption of simple nutrients, water, vitamins and minerals mainly takes place in the small intestine.

### Liver

Produces bile and stores it in the gall bladder. Enzymes are absent in bile. It reaches the duodenum and converts fat into small particles and regulates pH.

### Pancreas

Produces pancreatic juice. This reaches the duodenum and helps digestion. *Pancreatic amylase* in it partially digests the starch. *Trypsin* partially digests the proteins. *Lipases* completely digest the lipid into fatty acid and glycerol.

### Large Intestine

Undigested food substances reach here. The absorption of remaining water and salts occurs here. Certain bacteria of large intestine produce Vitamin K and B complex. Carries digestive waste to rectum and expels through the anus.

Illustration 2.5: Digestive system



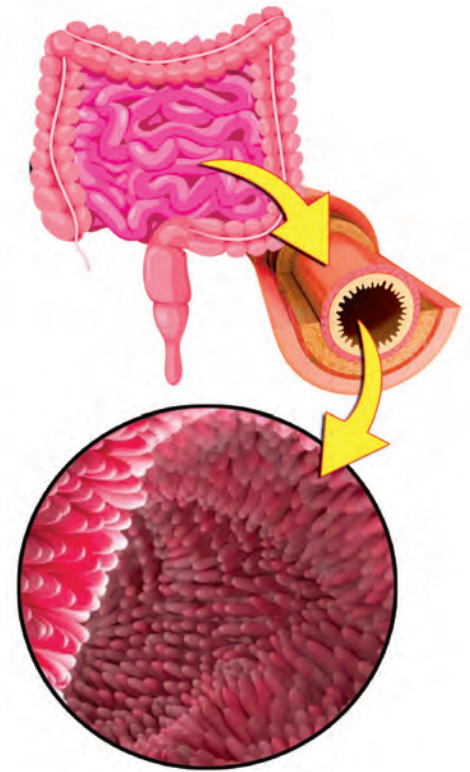
- Parts where chemical digestion takes place.
- The digestion of starch, protein and lipid in different parts.
- Role of liver and pancreas in digestion.
- Absorption in small intestine and large intestine.
- Nutrients and their simple components.



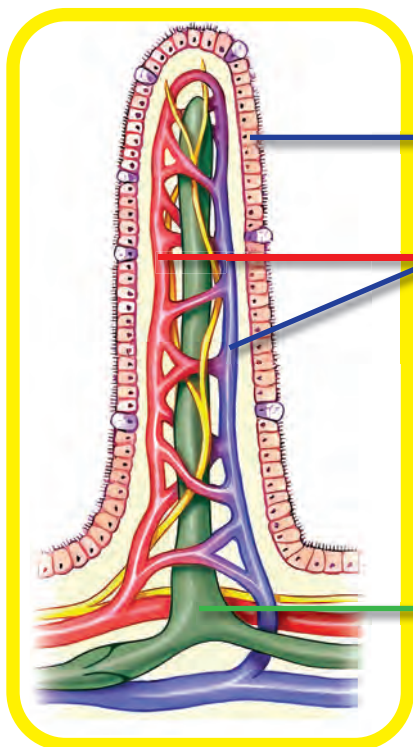
Digestion in humans is completely extracellular. Completion of digestion and absorption of simple nutrients mainly takeplace in small intestine. What are the structural peculiarities in the small intestine that are required for this? Analyse the description given below and form inferences.

### Absorption of simple nutrients

The small intestine is a long coiled muscular tube that is around six metres long and two and half centimetres in diameter. Duodenum is the initial part of this. The peculiar structure of small intestine is highly helpful for the digestion and absorption process. Finger-like projections are found throughout the inner wall. These are called villi. These increase the surface area of absorption in the small intestine by many folds. How far is the structure of villus suitable for the absorption process? Analyse illustration 2.6 and prepare note according to the indicators.



#### Villus



#### Single layered epithelial cells

The primary surface for the absorption of nutrients.

#### Blood capillaries

A branch of artery enters the villus and forms the blood capillaries. They unite to form vein and leaves the villus. Absorb glucose, fructose, galactose and amino acids.

#### Lacteal

The branch of lymph vessel. Absorbs fatty acid and glycerol into its lymph.

Illustration 2.6 : Structure of villus



- Villus and surface area of absorption.
- Lacteal and absorption.
- Blood capillaries and absorption.

Nutrients are absorbed into the blood and lymph of villus. Let's examine how the structure of blood and lymph help in the transport of nutrients.

### Blood and lymph

Don't you know the different components of blood and their function? Complete the illustration 2.7 related to the blood components.

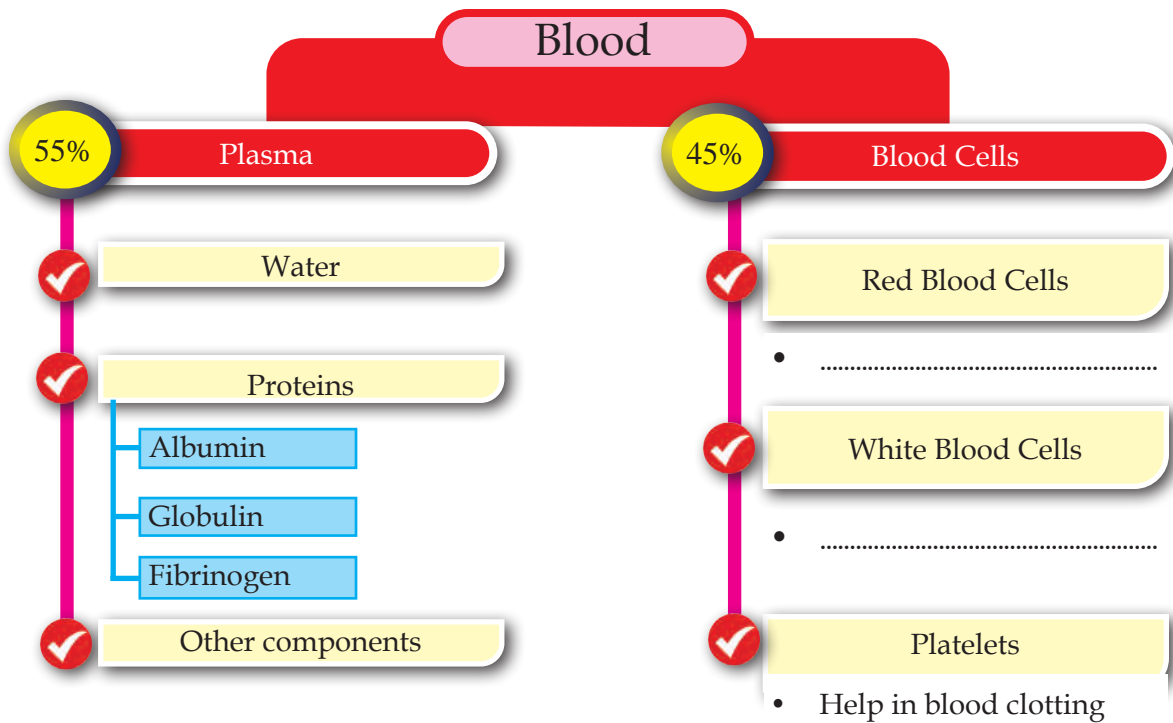


Illustration 2.7 : Components of Blood

Find out the functions of different proteins in plasma.

How does the exchange of substances between blood and cells take place in humans? Don't you know the importance of tissue fluid found in the space between cells, in the exchange of substances? How is it formed?

Analyse the illustration 2.8 according to the indicators and record inferences.

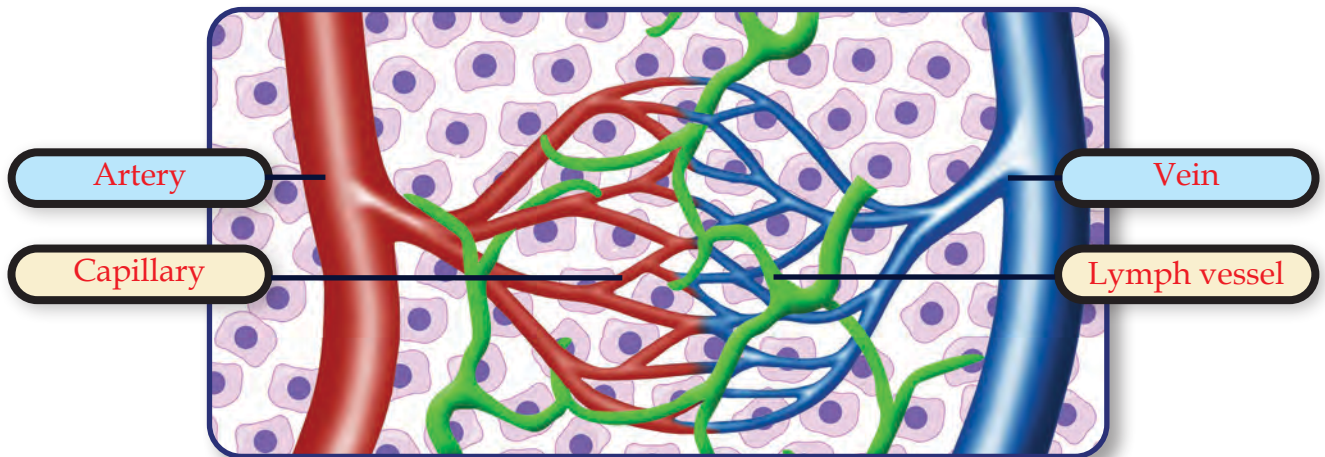


Illustration 2.8 : Formation of tissue fluid

### 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 is the *tissue fluid*. Transport of substances takes place between cells and tissue fluid.

### Lymph

One part of the tissue fluid enters the lymph capillaries. This is called the *lymph*. Simple components formed as a result of fat digestion and fat-soluble vitamins are transported through the lymph.

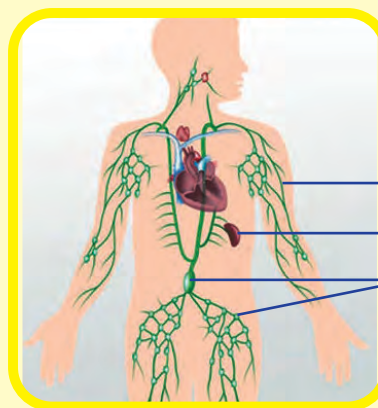


- Formation of tissue fluid.
- The role of tissue fluid in the exchange of substances.
- Formation of lymph.
- The role of lymph in the transport of substances.

How is the quantity of tissue fluid regulated in the space between cells?  
Find out.

## Lymphatic system

The lymphatic system consists of lymph, lymph vessels, lymph nodes, spleen, bone marrow and thymus gland. Red blood cells and large protein molecules are not seen in the lymph. Lymphatic system plays a major role in immunity.



Lymph vessel  
Spleen  
Lymph node

Now haven't you understood the importance of blood and lymph in the transport of substances. After entering the villus, the branch of artery again divides into capillaries and they join together to form small veins and then into vein. Find whether blood vessels are arranged in this way throughout the body to exchange substances.

Analyse the illustration 2.9 according to the indicators and record the inferences.

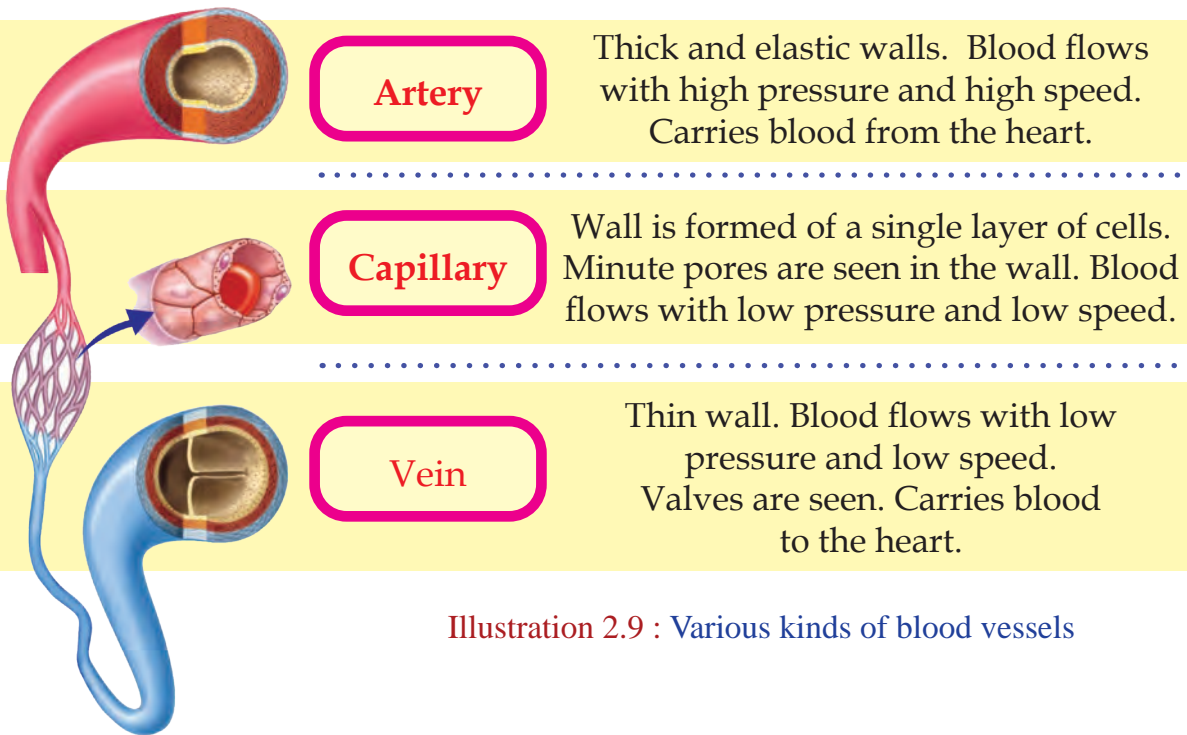


Illustration 2.9 : Various kinds of blood vessels



- Peculiarity of the wall of artery, vein and capillary.
- Blood vessels and direction of the blood flow.
- Speed and pressure of blood flow.
- Presence of valves.



### Portal Veins

Certain veins do not reach the heart. Instead, they carry blood from organ to organ. Such veins are called portal veins. The nutrients that are absorbed from the small intestine into the blood are carried to the liver by the Hepatic portal vein. It is an example for portal vein.

How will nutrients absorbed from the small intestine into the blood and lymph reach different parts of the body? Does it include all the three types of blood vessels that you have understood? Analyse the illustration 2.10, complete the flowchart using the hints and write your inference.

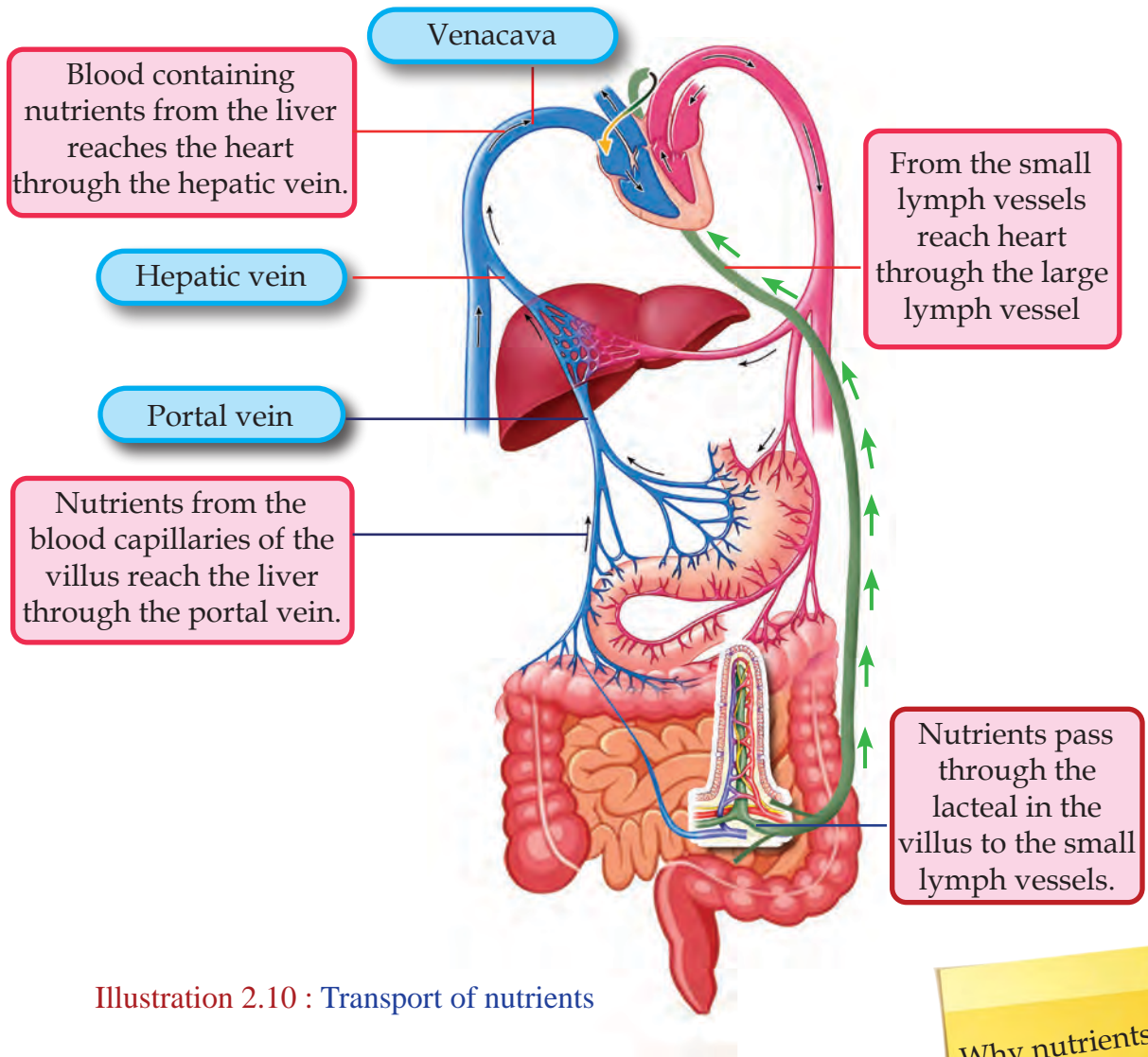
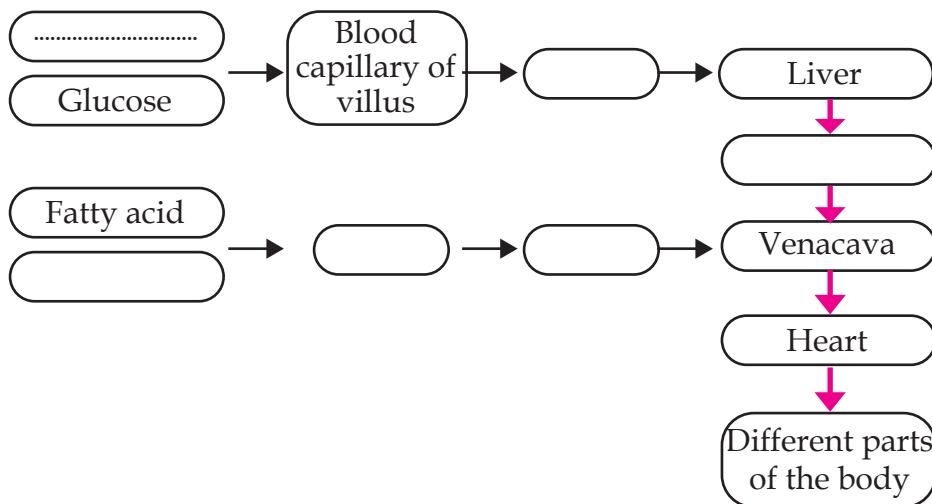


Illustration 2.10 : Transport of nutrients



Why nutrients reach the liver before the heart? Find out.

**Hints**

- Portal vein
- Lacteal of villus
- Amino acids
- Glycerol
- Hepatic vein
- Lymph vessel

For the continuous flow of blood to different parts of the body, are blood vessels alone sufficient?

A pump is needed to keep blood flowing continuously through the blood vessels to different parts of the body. Heart performs that function. Let us examine how far does the structure of the heart help in this.

## Heart

The heart is an organ made up of muscles that is situated slightly tilted towards the left in the thoracic cavity. Analyze the illustration 2.11 based on the indicators and understand the position and protection of the heart.

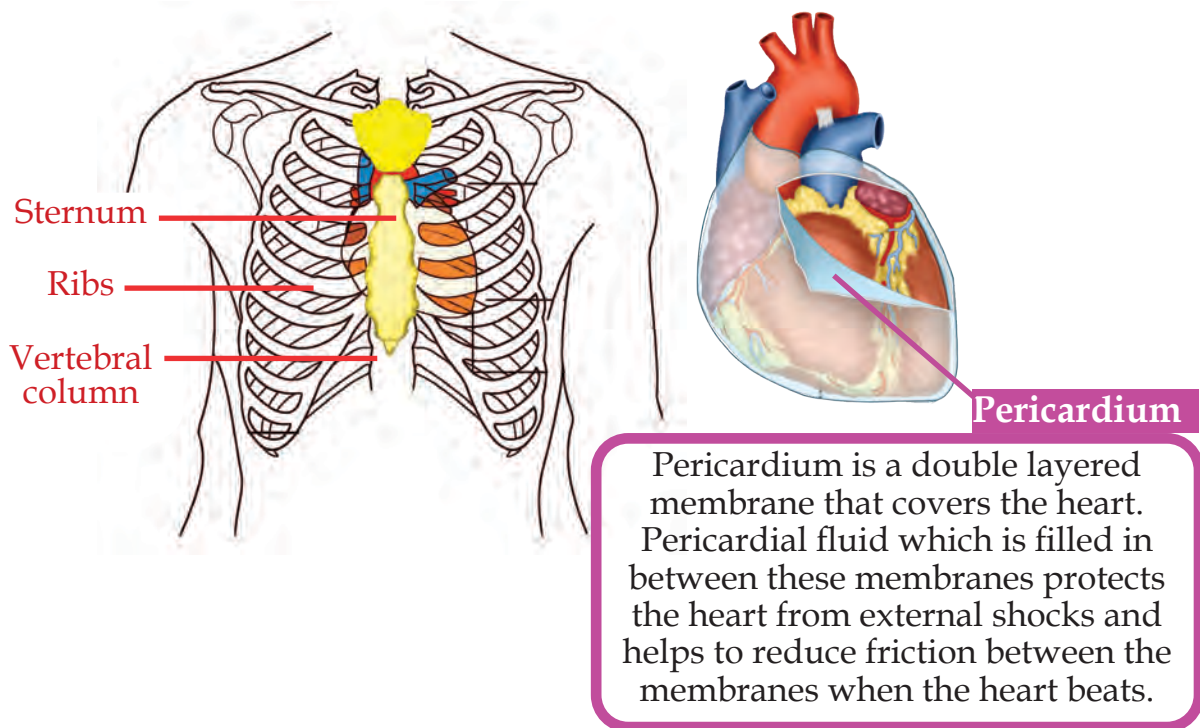


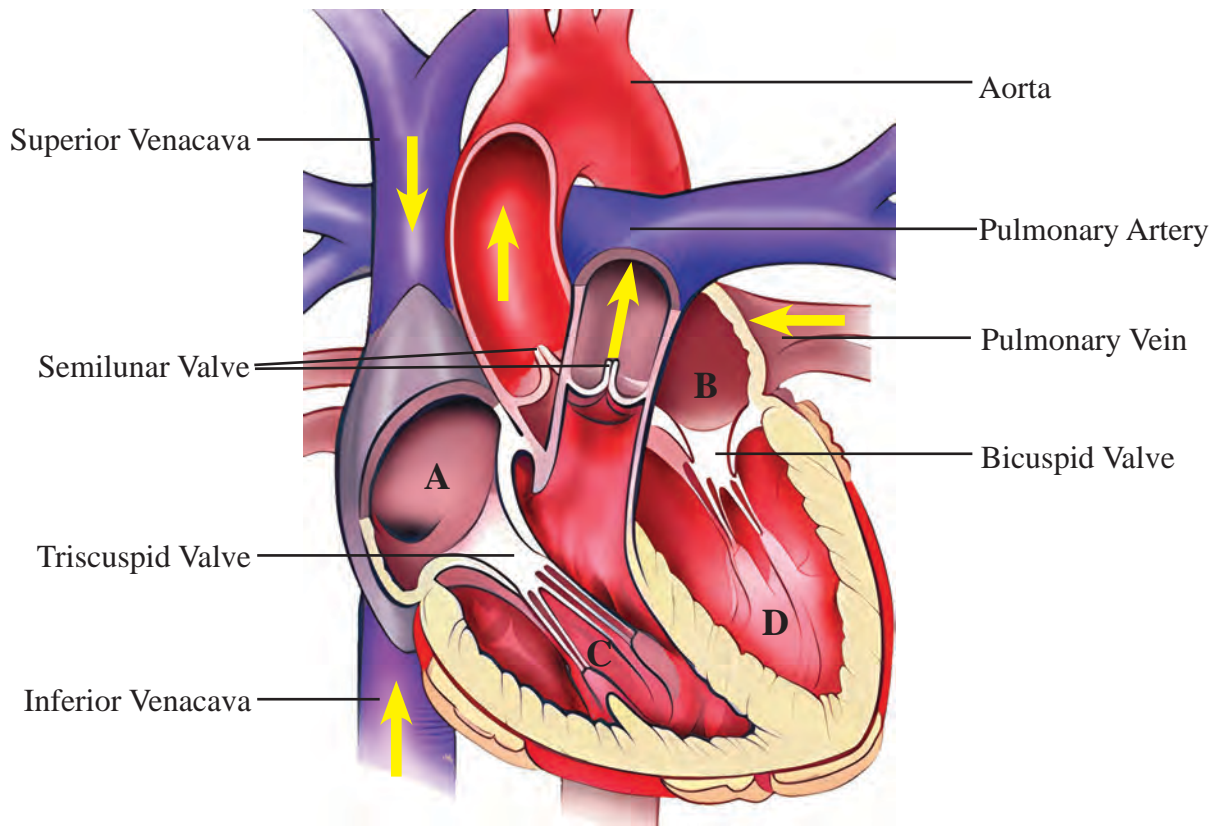
Illustration 2.11 : Position and protection of the heart



- Position of the heart.
- Protection of the heart.
- Function of the Pericardial fluid.

To know the function of the heart, we need to understand more about its structure.

Analyse the illustration 2.12 and discuss based on the indicators and form inferences.



### Hint

#### Chambers of the heart

- |                    |                   |
|--------------------|-------------------|
| A. Right atrium    | B. Left atrium    |
| C. Right ventricle | D. Left ventricle |

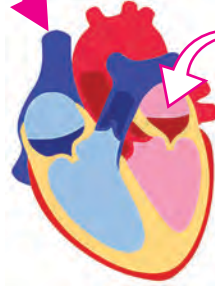
Illustration 2.12 : Structure of the heart



- The blood vessels which carry blood to the heart and the heart chambers where they reach.
- The blood vessels which carry blood from the heart and the heart chambers from where they begin.
- Heart valves, position, function.

How does the heart work? Complete the illustration 2.13 according to the indicators and present your findings.

Blood from different parts of the body (Blood after the kidneys have filtered out the wastes and rich in carbon dioxide and nutrients)



Blood from the lungs (Blood rich in nutrients and oxygen)



**Contraction of atria (Atrial systole)**

The chamber where blood enters from the right atrium

The chamber where blood enters from the left atrium



**Contraction of ventricles (Ventricular systole)**

The blood vessel into which blood enters from the right ventricle

The blood vessel into which blood enters from the left ventricle

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

When the ventricles contract, blood from the right ventricle is transported to the lungs through the pulmonary artery and blood from the left ventricle is transported to all parts of the body through aorta.

For what does blood enter the lungs?



**Return to the previous state of atria and ventricles (Joint Diastole)**

After the flow of blood from the heart into the blood vessels due to the contraction of the ventricles, four chambers return to normal state at the same time.

The heart chambers to which blood flows from Venacavae and Pulmonary veins when the heart chambers return to normal state.



Illustration 2.13 : Working of the heart

By repeating these processes cyclically, blood is continuously pumped throughout the body.



## Heart beat

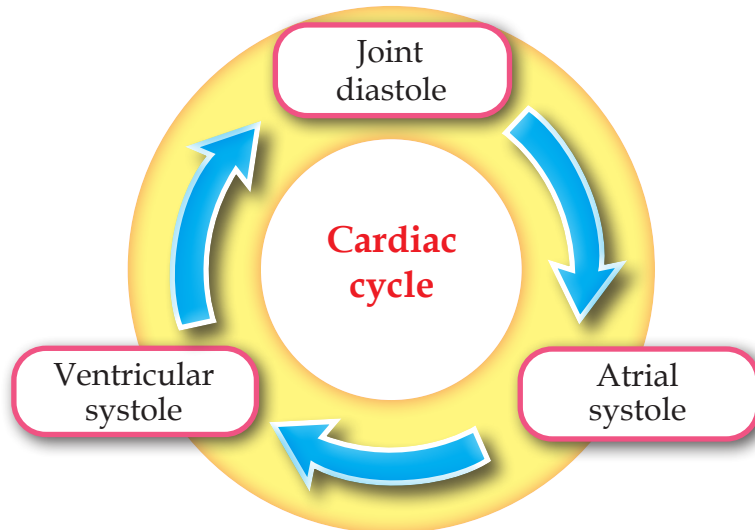


Illustration 2.14 : Cardiac cycle

Have you noticed the illustration 2.14. Which are the phases included in a cardiac cycle?

- 
- 
- 

Time required for completing these is 0.8 sec. One cardiac cycle is known as one heart beat. If so, what is the rate of normal heart beat?

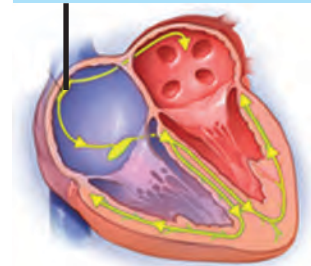
Heart rate is controlled by the rhythmic contraction and relaxation of the heart muscles. The electrical impulses necessary for the contraction of the heart chambers are produced by the SA node in the wall of the right atrium. It is also known as Pacemaker.

## Electrocardiogram (ECG)

ECG (Electrocardiogram) is a graphical representation of the electrical waves felt in the walls of the heart when the heart beats. The functional defects of heart can be identified by checking the ECG.



SA node  
(Pacemaker)



How the function of heart is maintained in people with a functionless pacemaker. Find out.

## Pulse

Have you noticed the doctors checking the wrist of the patients as shown in the figure? Why is it done so?



Press the index finger and middle finger of your right hand on your left wrist as shown in the figure.

Don't you feel a throbbing sensation in your fingers? This is called Pulse.

Formulate a practical definition on pulse after conducting discussion based on the given hints.

- Contraction of left ventricle.
- Elasticity of arterial wall.
- The expansion of the arterial wall and regaining the previous state.

Is there any relationship between the rate of heart beat and pulse rate?

Do this activity.

Apart from the wrist, which are the other parts of the body where we can feel pulse? Find out.



Let students form pairs. Let one of them check one's own rate of heart beat and also find the pulse rate with the help of the other child at the same time. Use a stop watch to ensure the time limit. Record the values obtained in table 2.3.

After that, let the same child engage in exercise for one minute. Then record the heart beat and pulse rate in the table as mentioned above.

Let children take turns and repeat the same activities and record it in table 2.3.

Sl No	Name of Children	Rate of heart beat		Pulse rate	
		At rest	After doing exercise	At rest	After doing exercise
1					
2					

Table 2.3 : Rate of heart beat and Pulse rate

Analyse the data in the table and find out what difference is there in the heart beat rate and pulse rate at rest and after exercise.

## Blood pressure

Blood pressure is the pressure felt in the arteries when the heart contracts and relaxes.

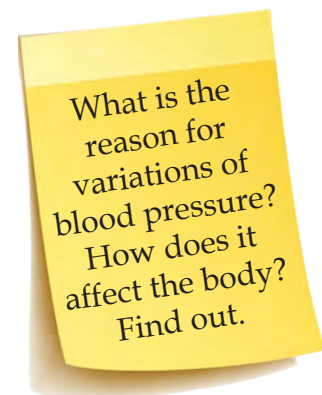
Is the pressure felt in the arteries the same when the heart contracts and relaxes?

Analyse the table 2.4 and form inference about blood pressure and prepare a note.

Working of heart	Direction of the blood flow	Pressure experienced in arteries (mmHg)	Name of the blood pressure
Systole	About 70 ml of blood is pumped into the arteries when the heart contracts.	120	Systolic pressure
Diastole	About 70 ml of blood enters into the heart when it relaxes.	80	Diastolic pressure

Table 2.4 : Blood pressure

These two pressures together form one's Blood pressure. The normal blood pressure of a healthy person is recorded as 120/80 mmHg. Blood pressure rising above this level is called hypertension and lowering from this level is called hypotension.



Sphygmomanometer



Digital BP Apparatus

Haven't you seen the equipments shown in the figure? What are these used for?

Practice the method of checking blood pressure using any of these devices with the help of an expert. Then under the auspices of the school health club, check the blood pressure of the children in your school.

### Double circulation

How many times does the blood from one part of the body pass through the heart before returning to the same part?

Analyse the illustration 2.15 and description and then form inference.

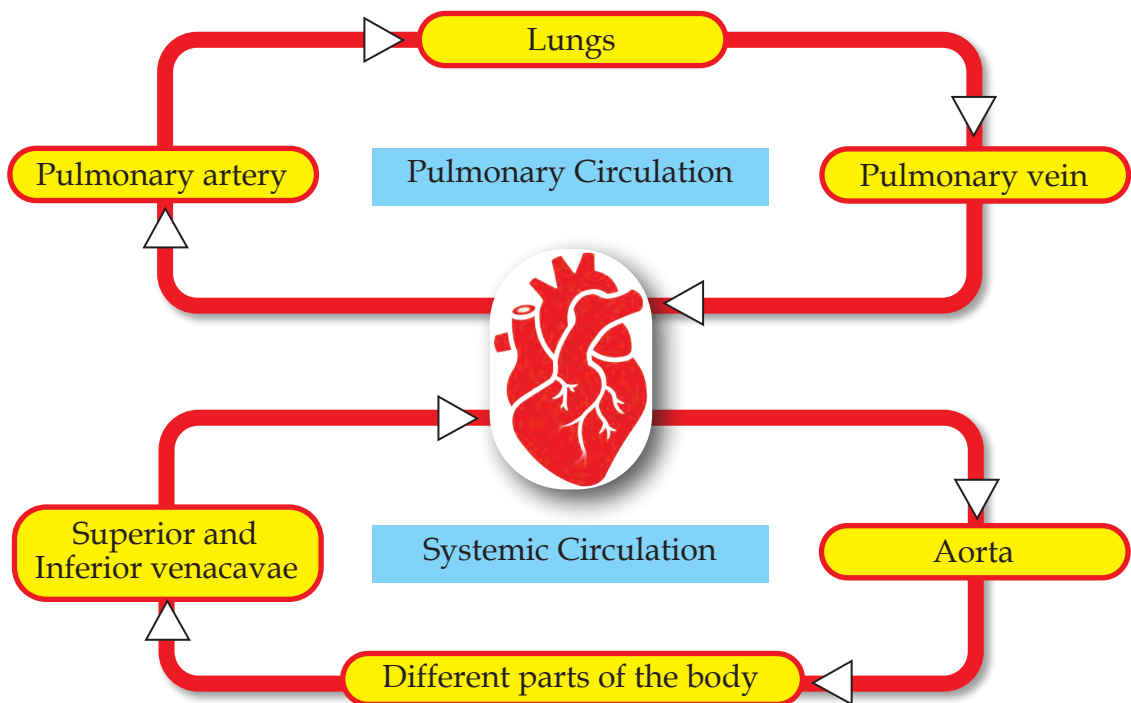


Illustration 2.15 : Blood circulation in man

What all circulations are involved in the blood circulation in human beings?

.....

.....

Systemic circulation begins from the left ventricle and ends in right atrium. Pulmonary circulation begins from the right ventricle and ends in left atrium. As the same blood passes through the heart twice, the blood circulation in human is known as Double circulation.

Prepare flow charts on systemic circulation and pulmonary circulation by including heart chambers in the illustration 2.15.

Blood is pumped throughout the body as a result of the activities of the heart. This blood contains oxygen, nutrients and other factors. These enter the cells through tissue fluid. Assimilation is the utilization of these nutrients by the cells.

### Health of the Heart

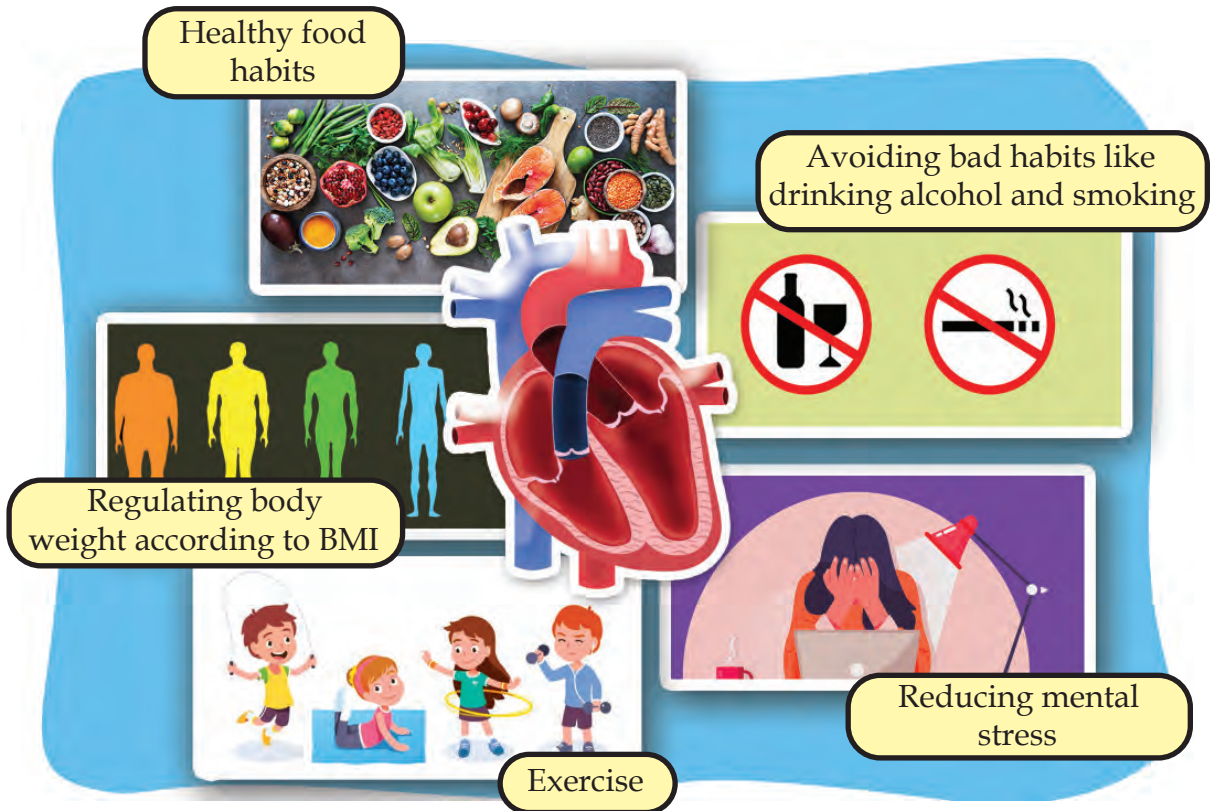
Doesn't the malfunctioning of the heart adversely affect the functions of other organs as well? What are the factors that adversely affect the health of the heart? Expand the list.

- Lack of exercise.
- Unhealthy food habits.
- 
- 

How do these factors affect the health of the heart?

A part of an article related to the health of the heart is given. After analysing it and collecting information, prepare an edition on the topic '**Health of the heart**'.

How does the body utilise each nutrient?  
Find out.



## Protect the heart with care



**World Heart Day**

Studies indicate that the number of heart patients is increasing. Unhealthy food habits and lack of exercise are the main reasons for this.

Consuming too much of fatty food causes deposition of fat in the arterial walls. This leads to a condition called **Atherosclerosis**. As a result of this, blood is clotted in the coronary artery leading to the condition called **Coronary thrombosis** and this in turn may cause heart attack. **Stroke** is caused by the blockage or rupture of blood vessels in the brain.

You have understood the digestion of food and the transport of nutrients. How does the transport of substances take place in plants which prepare food for all organisms?

How do water and salts that are absorbed through the roots reach the leaves and the food synthesised in the leaves reach different parts of the plant, including huge trees?

Discuss and complete the table 2.5 given below.

Substances that are transported	Vascular tissue
Water and salts	.....
.....	Phloem

Table 2.5 : Transport in plants

Analyse illustration 2.16, prepare a note on how far the structure of xylem and phloem are suitable for transport of substances.

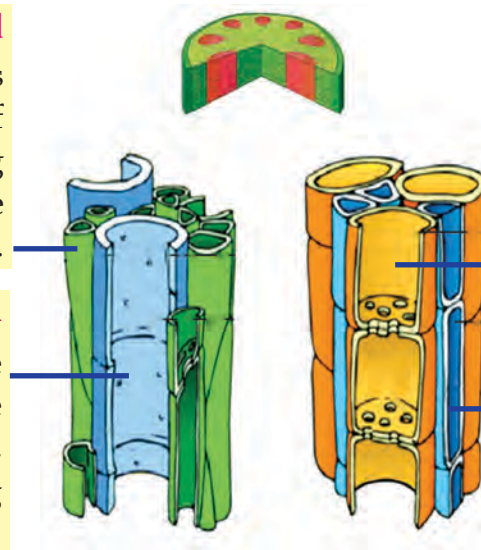
### Xylem

#### Tracheid

Dead cells. Forms the small veins of the leaves. Long and spindle shaped.

#### Vessel

Dead cells. As the cross walls have been disintegrated, look like long pipes.



### Phloem

#### Sieve tube

Arranged one above the other. Since the cytoplasm is inter connected through the pores of the cross wall, food molecules can travel through it.

#### Companion cell

Along with the sieve tube, it helps in the transport of food.

Illustration 2.16 : Vascular tissues in plants

You have understood the structure of xylem and phloem. How does the conduction of substance take place through them?

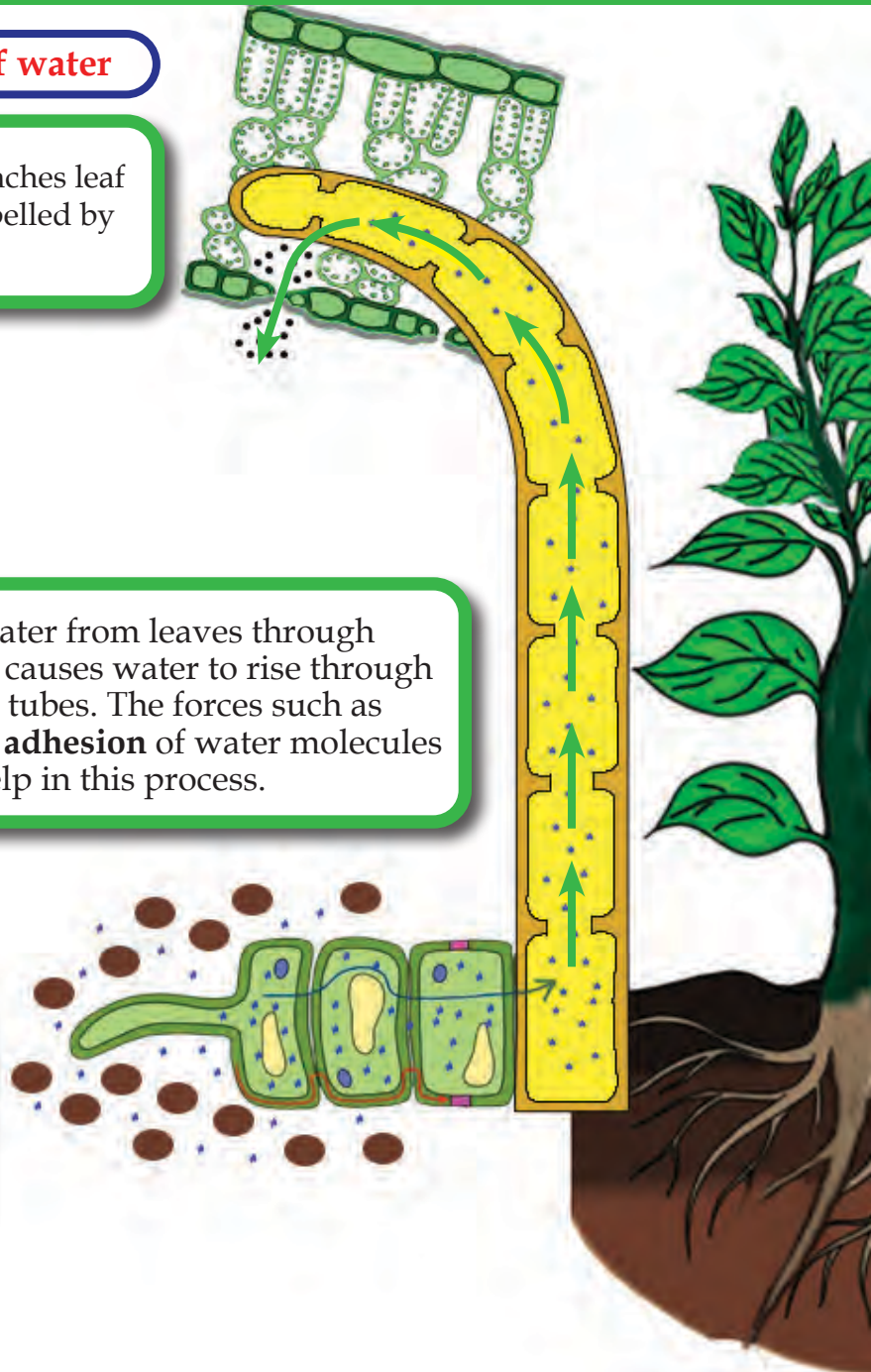
Analyse the illustration 2.17 based on the indicators and record the inferences.

### Conduction of water

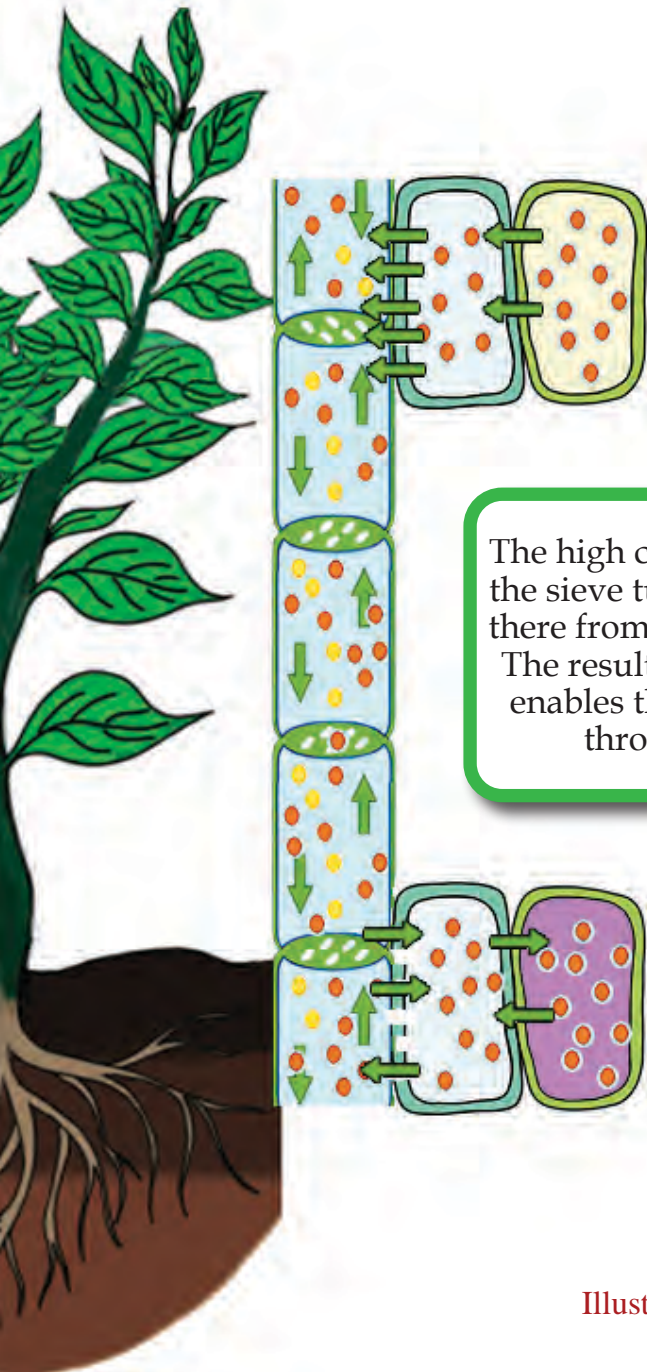
Water from xylem tubes reaches leaf cells by **osmosis** and is expelled by transpiration.

Loss of water from leaves through transpiration causes water to rise through the xylem tubes. The forces such as **cohesion** and **adhesion** of water molecules help in this process.

Water enters the root cells by osmosis. To some extent, **root pressure** helps in the rise of the water that reaches the xylem tube.







### Conduction of Food

Glucose produced in the leaves as a result of photosynthesis is transferred to the sieve tubes in the form of sucrose using energy.

The high concentration of sucrose in the sieve tubes causes water to enter there from the adjacent xylem tubes. The resulting high **turgor pressure** enables the conduction of sucrose through the sieve tubes.

Entry of sucrose to the cells

Illustration 2.17 : Conduction in plants



- Processes which help in the conduction of water.
- Absorption of water from soil to root.
- Conduction of water through the stem.
- Transpiration and conduction of water.
- Conduction of materials from leaf cells to other parts of the plant.



Haven't you noticed the water droplets that are on the margins of the leaves of some plants in the early morning? What is the reason? Find out.

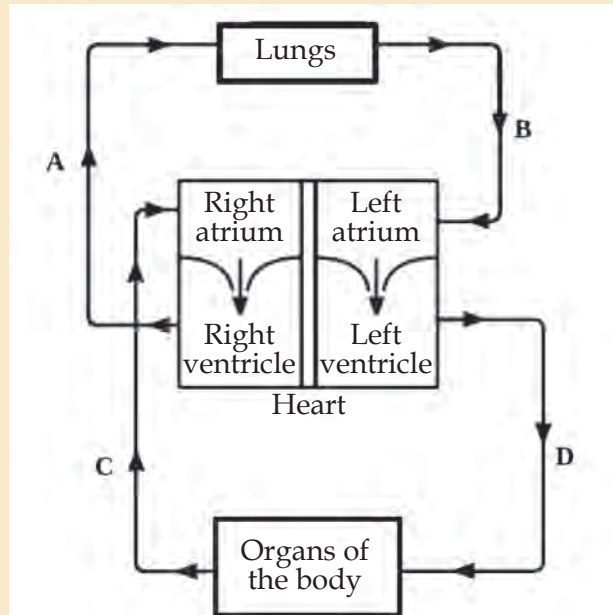
The food stored by plants in various forms such as protein, starch and fat is consumed by heterotrophic organisms and this makes possible the existence of the living world. You have understood the process of breaking down of the nutrients thus obtained into simple particles and the absorption and conduction of the simple molecules formed from various nutrients. It is our duty to follow a lifestyle that is conducive to the healthcare of the digestive system and circulatory system which help in this.

Life processes are carried out as a result of constant chemical reactions of various components produced in the cell and the components that reach the cell from the external environment. Energy production is such a process. As a result of these life processes, many excretory products are also formed. Timely removal of these products are essential for the balance of the life processes. How this can be made possible will be examined in the next chapter.

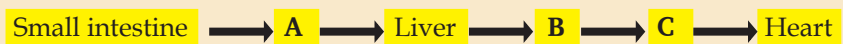


## Let us Assess

- Which one of the following is related to the digestion of Fat?
  - Protease
  - Lipase
  - Amylase
  - Carbohydrase
- An illustration related to the circulatory system of human beings is given below. Analyse it and answer the questions.

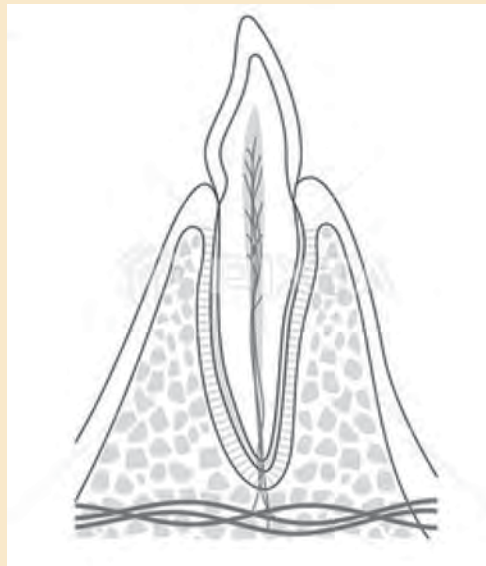


- Which letter indicates Pulmonary artery?
  - Which blood vessel is indicated by the letter D?
  - Does the blood that has entered the ventricles return to the atria? Why?
  - What is the importance of double circulation in human?
- A flowchart on the path of nutrients is given below. Observe it and answer the questions.



- Name the blood vessels indicated by the letters A, B and C.
- Do all the nutrients absorbed from the small intestine have the same path? Explain.

4. Which among the following processes takes place by utilising energy?
  - a) Entry of water into the root cells.
  - b) Entry of sucrose into the sieve tube.
  - c) Loss of water from leaves through transpiration.
  - d) Conduction of water molecules through xylem tubes.
  
5. Redraw the figure given below, name and label the parts based on the indicators.



- a) Part where odontoblast cells are seen.
- b) Tissue that holds the tooth in the gum.
- c) The living tissue by which tooth is made.



### Extended activities

1. Conduct an awareness class on the topic 'Bad habits and health of the heart'.
2. Organize a nutritious food fest under the auspices of the school health club using locally available food items.

# 3

## Respiration and Excretion



- Human respiratory system
- Gaseous exchange
- Cellular respiration
- Respiration in other organisms
- Synthesis of urea
- Formation of urine
- Excretion in plants
- Hemodialysis
- Kidney transplantation
- Homeostasis



## What is respiration?

Antoine Lavoisier (1743-1794) was an eighteenth century scientist who successfully explained the process of respiration in organisms. He inferred that the process which takes place during burning of objects and during respiration in organisms are the same. In order to prove this he placed a guinea pig in a small bucket. Then he immersed it in another bucket filled with ice and covered the guinea pig with a net. In order to prevent the melting of ice due to external heat insulation precautions were taken. But the ice melted. Lavoisier proved that the ice melted due to the heat from the guinea pig's body. He calculated that 80 kilo calories of energy was used for this from the guinea pig's body. This energy was received through respiration. When a piece of wood is burned oxygen is used and carbon dioxide and heat energy are formed. The same happens during respiration, when oxygen breaks down glucose.



You have read the description of an interesting experiment conducted by Lavoisier during the eighteenth century. Analyse and improve your idea on respiration based on the indicators.



- Role of oxygen in respiration and burning
- Products of respiration and burning

Now you have understood that oxygen is used and carbon dioxide is formed during respiration. A suitable respiratory surface and related systems are required for the exchange of these gases.

A large respiratory surface is required in human beings to get sufficient oxygen to cells for the production of energy. Which is the respiratory surface in human beings? How is it arranged in our body?

Complete the illustration 3.1, analyse the description and prepare a short note on respiratory surface in human beings .

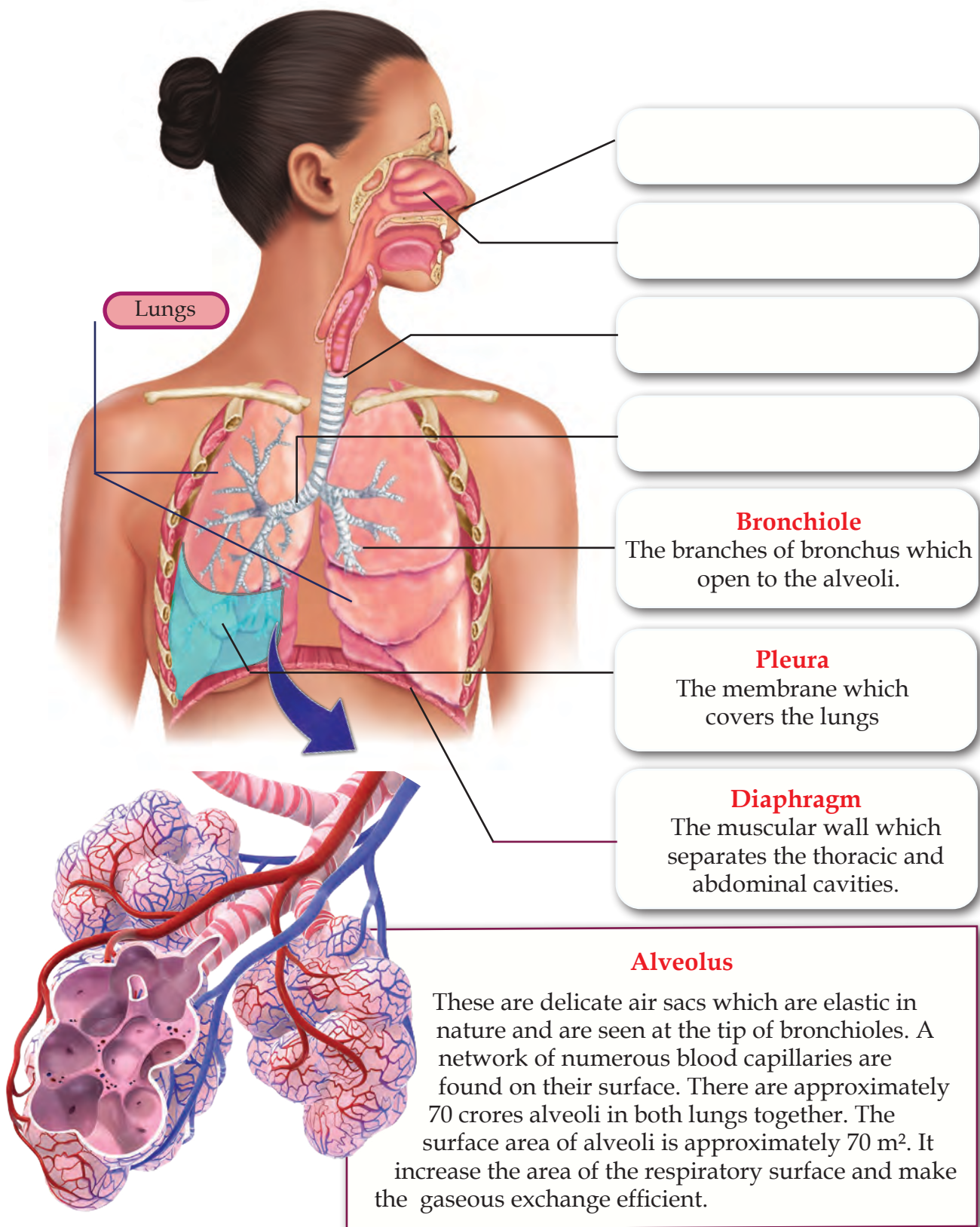


Illustration 3.1: Human Respiratory system

Now you have understood the parts of the human respiratory system. Prepare a flowchart to illustrate the path of atmospheric air, entering the nostrils till it reaches alveoli.

Don't you involve in sports and physical exercises? Is there any change in the rate of **ventilation (breathing)** during such activities? Do the activity given below.



- Form a group of two children each.
- Take rest for 5 minutes. Both of them record the number of inspirations that happen within a minute during this time.
- Record the time using a stop watch.
- In an interval of one minute, record the number of inspirations two more times.
- Then record the number of inspirations of the two children after running for three minutes as mentioned above.
- Continue to record the number of inspirations in every minute till they reach the normal condition.
- Complete the table given below using the recorded results, draw a line graph and compare the rate of ventilation of both the children.

Hint	Number of inspirations in resting state			Number of inspirations after exercise		
	1	3	5	9	11	13
Time in minutes						
Child 1						
Child 2						

Table 3.1: Rate of ventilation

### Inference

.....

.....

Since muscular activities increase during exercise more energy is required. As more energy is required, the requirement of oxygen also increases. Besides more carbon dioxide has to be eliminated from the body. This is the reason for the rate of increase of breathing, which is the first step of respiration.



## Ventilation

Movement of air from the atmosphere to lungs and back is called as ventilation.

Which are the stages of ventilation?

- Inspiration (Inhalation) : The process by which atmospheric air enters the lungs.
- Expiration (Exhalation) : .....

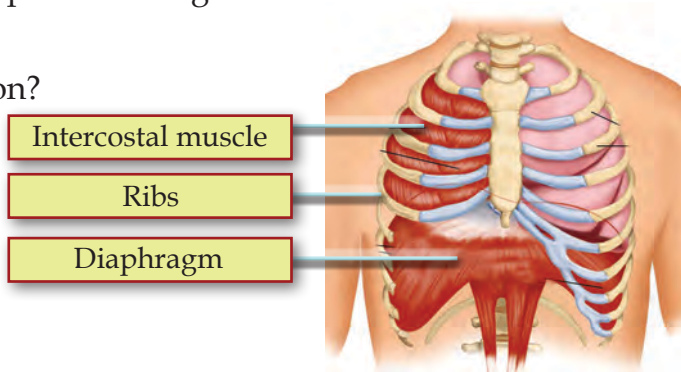


Figure 3.1

How do these happen?

Analyse the figure 3.1 and illustration 3.2 and complete the table 3.2.

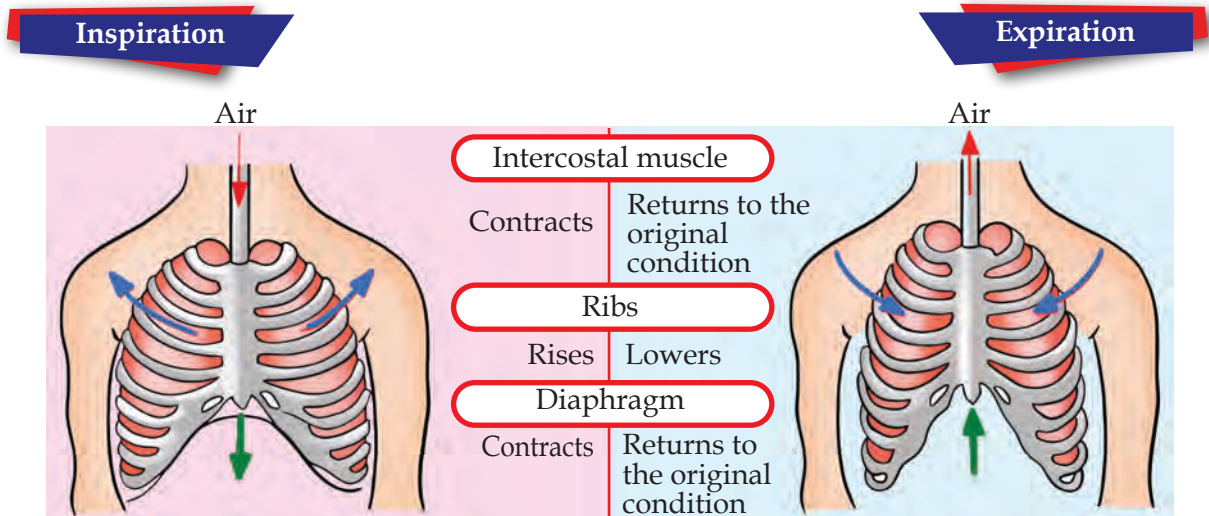


Illustration 3.2: Ventilation

Indicators	Inspiration	Expiration
Action of intercostal muscles		
Movement of ribs		
Change that occurs to the diaphragm		
Volume of thoracic cavity	Increases	Decreases
Pressure of air in the lungs		
Movement of air		

Table 3.2 : Ventilation

Now you have understood the first stage of respiratory process. The next stage of respiration is the exchange of oxygen from the air which has entered the alveolus, into the blood and exchange of carbon dioxide into the alveolus from the blood. This is called alveolar exchange of gases.

### Alveolar exchange of gases

Exchange of gases occur between alveoli and the blood in the capillaries which covers them. How does this process take place? Analyse the illustration 3.3 as per the indicators. Form inferences based on the discussions and prepare short notes.

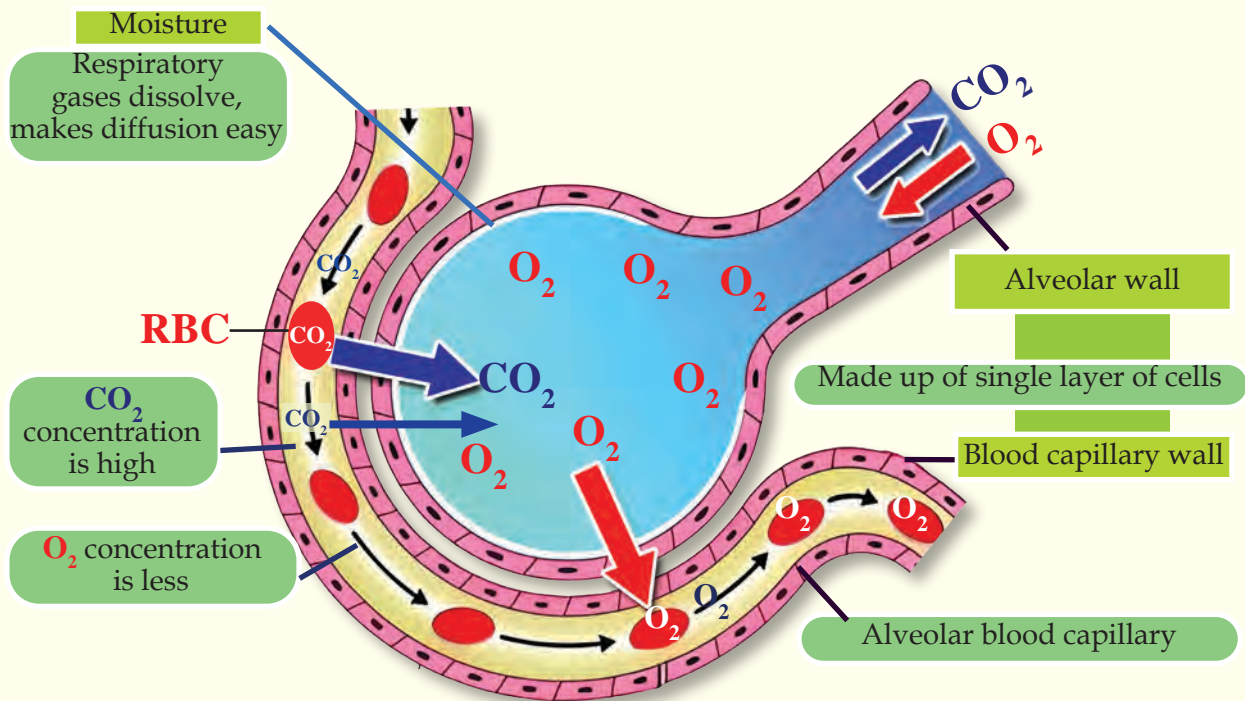


Illustration 3.3 : Alveolar exchange of gases



- Characteristic features of the walls of the alveolus and blood capillaries.
- Importance of moisture in the wall of the alveolus.
- Concentration of  $O_2$  and  $CO_2$  in the alveolus and in blood capillaries.
- The exchange of  $O_2$  and  $CO_2$  between alveolus and blood capillaries.



The distance between the air in the alveolus and the blood in the alveolar capillary is less than one by thousand of a millimetre.



## Surfactant

The substances inside the alveoli which help them to expand freely when air enters and contract slowly when air is released is called as surfactant. If the level of surfactant is too low, breathing becomes difficult. This condition is generally seen in premature babies. Such new born babies are prone to death.

### Let's understand the presence of carbon dioxide in the inhaled and exhaled air

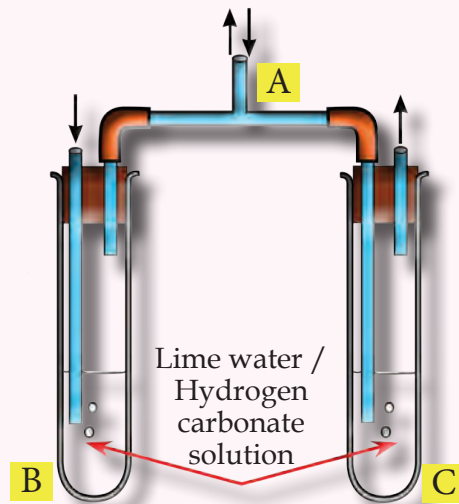


Figure 3.2

- Arrange equipments as shown in the figure.
- Breathe slowly using mouth through tube A.
- Observe the colour change in the indicator solution in test tubes B and C.

*(Hint: If lime water is used as indicator, it turns milky when carbon dioxide passes through it. If hydrogen carbonate indicator solution is used, its colour changes from red to yellow.)*

### Observation and inference

Now you have understood the alveolar exchange of gases. Analyse the illustration 3.4 which includes other stages of respiration. Based on the indicators complete the table 3.3.

## Alveolar exchange of gases

As the concentration of carbon dioxide is high in plasma, carbon dioxide diffuses into the alveolus.

O<sub>2</sub> diffuses into the blood in the alveolar blood capillaries as the concentration of O<sub>2</sub> is high in the alveolus.

## Transport of gases

In the alveolar blood capillaries carbamino haemoglobin and bicarbonate dissociate and CO<sub>2</sub> reaches plasma.

7% CO<sub>2</sub> dissolves in plasma. 23% combines with haemoglobin to form carbaminohaemoglobin. 70% combines with the water in the RBC to form bicarbonate.

In the lungs a small portion of the O<sub>2</sub> dissolves in plasma. The remaining O<sub>2</sub> combines with haemoglobin to form oxyhaemoglobin.

Adjacent to the cell oxyhaemoglobin dissociates and oxygen becomes free.

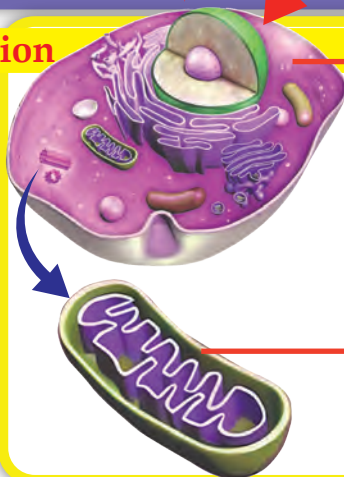
## Systemic exchange of gases

CO<sub>2</sub> passes from cells to tissue fluid and from there to blood.

Oxygen from the blood reaches the tissue fluid and from there enters the cells.

## Cellular respiration

The process of breaking down of glucose using oxygen and releasing energy, which occurs in cells.



### Glycolysis

First phase of cellular respiration. Takes place in the cytoplasm. Oxygen is not required. Glucose is converted into pyruvic acid. 2ATP molecules are formed.

### Krebs cycle

Second phase of cellular respiration. Takes place in mitochondria. Oxygen is required. Pyruvic acid is converted to carbon dioxide and water. 28 ATP molecules are formed.

Illustration 3.4 Respiratory process



- Transport of oxygen
- Entry of oxygen from the blood to tissues
- Cellular respiration
- Entry of carbon dioxide from the tissues to blood
- Transport of carbon dioxide
- Elimination of carbon dioxide
- Phases of respiration

Indicators	Glycolysis	Krebs cycle
Site of activity		
Substances that take part in the chemical process		
Products		
Requirement of oxygen		

**Table 3.3 : Cellular respiration**

ATP molecules formed as a result of respiration is the source of energy for body activities. The byproducts, carbon dioxide and to some extent, water, are eliminated immediately through exhaled air. The process of transport of respiratory gases and the breaking down of glucose in cells using oxygen to release energy, together constitute respiration.

Complete the chemical process illustrated below by including the missing reactants required for cellular respiration and the products formed.

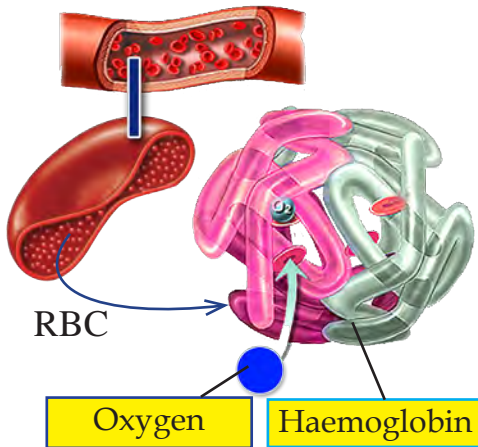


Photosynthesis and respiration are metabolic processes that take place in the living world. Compare these two processes and revise the table 3.3 replacing glycolysis and Krebs cycle with photosynthesis and respiration respectively.

Hans Adolf Krebs (1900-1981) is the German biochemist who discovered the chemical processes in the second phase of cellular respiration. So this phase is called Krebs cycle. He shared the Nobel prize for medicine with Fritz Lipmann for this discovery in 1953.



## Haemoglobin



- Pigment in RBC
- Protein having iron as the main component.
- 270 million haemoglobin molecules are present in each RBC.
- One haemoglobin molecule transports either four oxygen molecules or four carbon dioxide molecules.
- The level of haemoglobin in females is 12-16 gm/dL of blood and in males it is 14-18 gm/dL of blood.
- Decrease in levels leads to anaemia.

What are the conditions that lead to the decrease in the level of haemoglobin? What are the different types of anaemia? Find out.

Illustration 3.5 : Haemoglobin

What are the healthy habits that can be followed to prevent anaemia? Discuss.

Now you have understood the process of respiration in human beings.

Discuss how respiration takes place in other animals and plants.

## Respiration in other organisms

The respiratory process in organisms which use oxygen for respiration is similar to that of human beings. However, there are differences in gaseous exchange and transportation. Respiratory surfaces are different in various organisms. Discuss and present your findings regarding different respiratory surfaces and gaseous exchanges after observing the illustration 3.6 and gathering information.

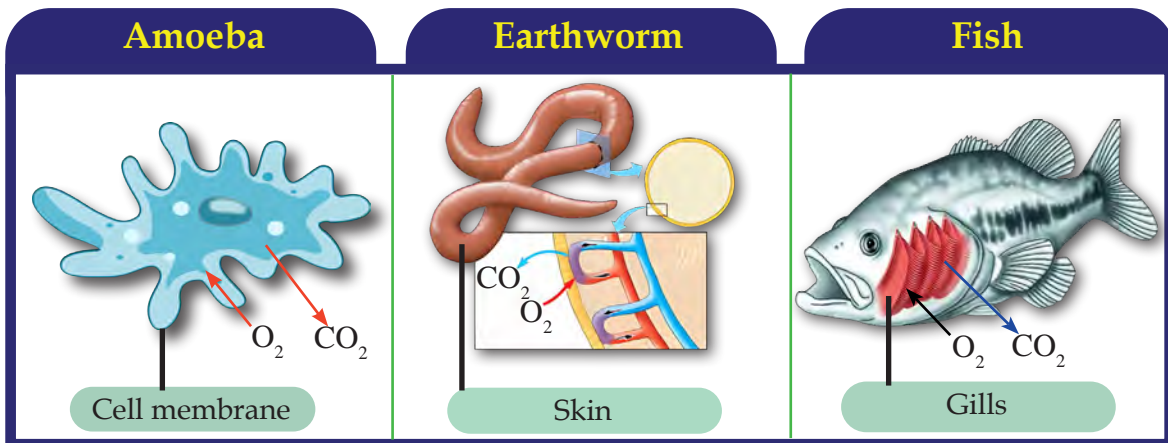
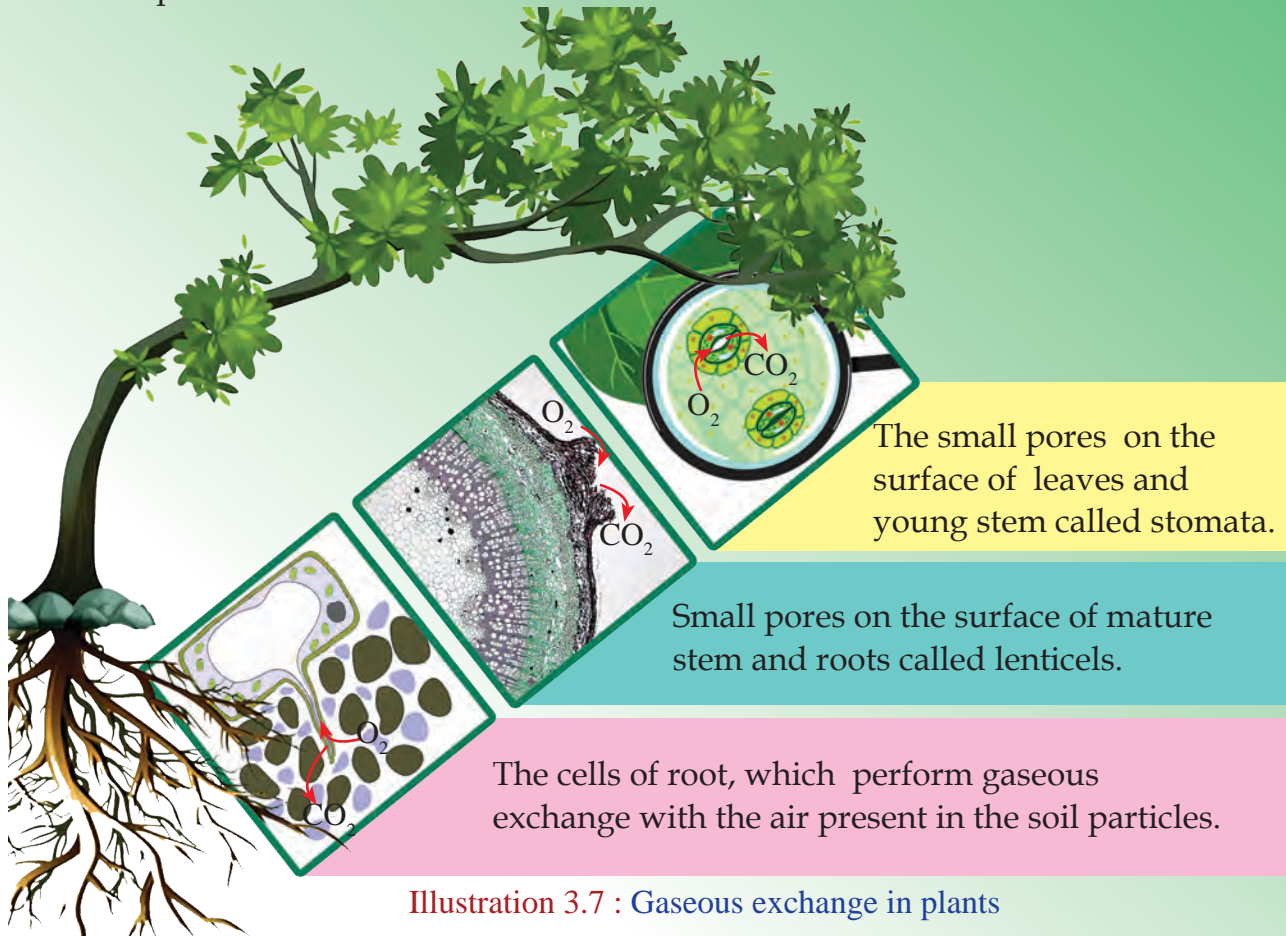


Illustration 3.6 : Respiration in other organisms

Now you have understood that the cellular respiration in plants is similar to that of human beings. They do not have respiratory system or separate organs for transport of gases. But they have special features in leaf, stem and root for the exchange of gases. Analyse the illustration 3.7 and description. Now prepare a short note on respiration in plants.



**Illustration 3.7 :** Gaseous exchange in plants

Stomata remain open in the day time and close at night. During the day photosynthesis and respiration take place simultaneously in the mesophyll cells of leaves. Since the rate of photosynthesis is high during the day, oxygen formed is used for respiration and the excess oxygen is expelled.  $\text{CO}_2$  formed as a result of respiration is utilised for photosynthesis and the insufficient  $\text{CO}_2$  is received from the atmosphere. During night when stomata close, exchange of respiratory gases takes place through diffusion.

Observe the illustration 3.8, compare the cellular respiration of lactobacillus bacteria and yeast with the aforementioned organisms. Make discussions based on the indicators and form inference.

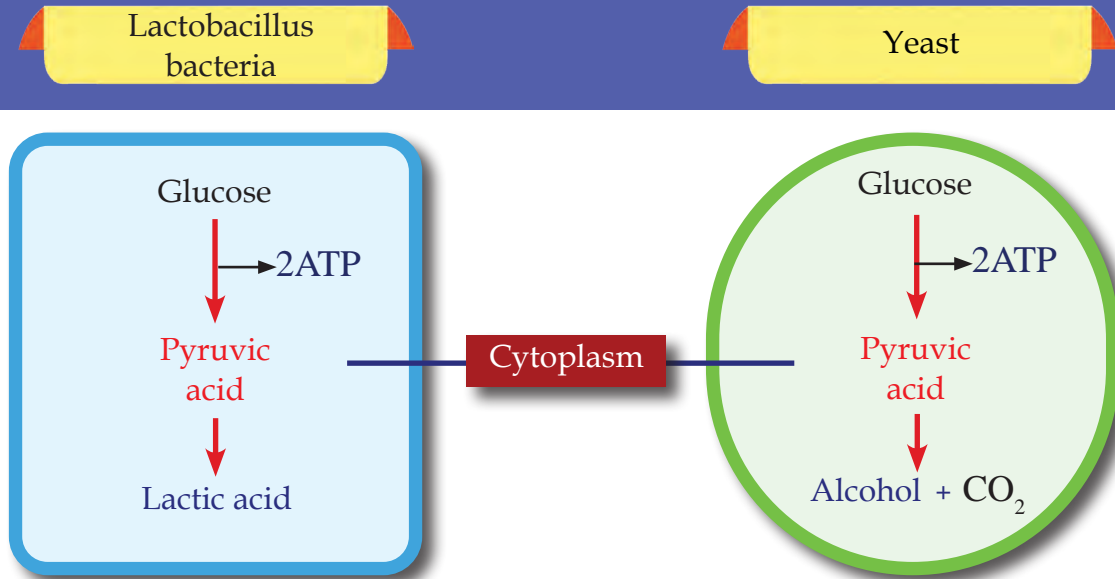


Illustration 3.8 : Anaerobic respiration



- Requirement of oxygen.
- Similarities and differences in the phases of respiration.
- Number of ATP.
- Difference in the cellular respiratory processes in bacteria and yeast.

Does anaerobic respiration take place in human beings? Find out.

All animals including human beings and plants use oxygen for cellular respiration. Such type of respiration is called aerobic respiration. But in some bacteria and yeast respiration takes place without using oxygen. Such type of respiration is called anaerobic respiration.

Some situations in daily life are given below. Discuss how anaerobic respiration is beneficial in such situations and prepare short notes on the same.

- Yeast is added to leaven the dough.
- Curd is added to milk to prepare curd.



Now you have understood how energy is produced from glucose. As a result of such metabolic activities several byproducts are formed in the cells. If they become harmful to homeostasis, they are turned into waste. The process of removal of such waste materials from the body is called excretion.

Which are the major excretory substances in our body? List out those which are familiar to you.

.....  
 .....

You have understood how carbon dioxide formed as a result of cellular respiration is eliminated in time from the body. However carbon dioxide is utilised in various life processes. The process which converts the toxic substance ammonia formed as a result of the metabolism of protein into less toxic urea, is an important one among these. How does this process occur?

Analyse illustration 3.9 based on the indicators and prepare short note on synthesis of urea.

### Urea synthesis

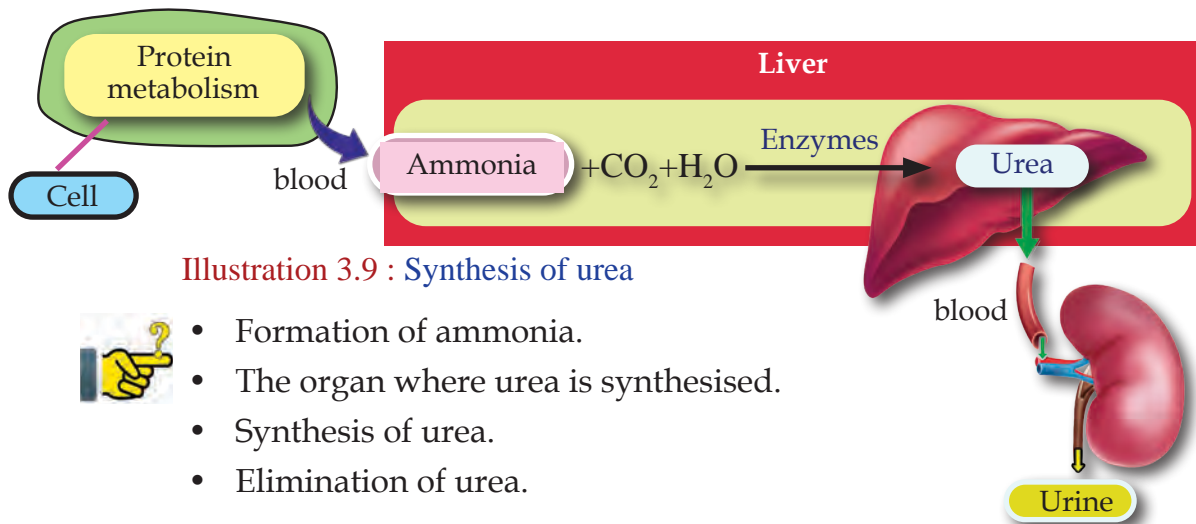


Illustration 3.9 : Synthesis of urea



- Formation of ammonia.
- The organ where urea is synthesised.
- Synthesis of urea.
- Elimination of urea.

Kidneys play a major role in the excretion of urine which contains waste materials including urea. Which are the excretory organs in our body?

- Kidney - Excretes water and salts through urine.
- Liver - Synthesises urea.
- Skin.....
- Lungs.....

If  $\text{CO}_2$  is not eliminated in time, how does it adversely affect the body? Find out.

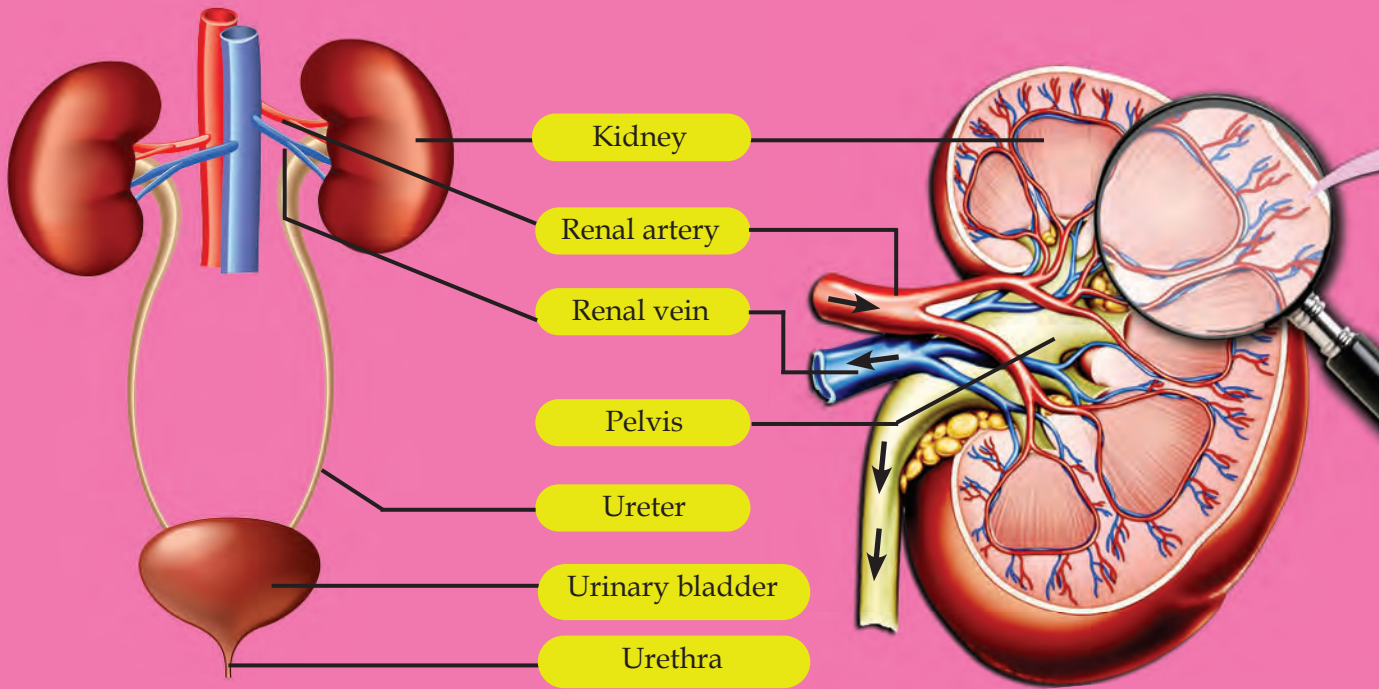


Illustration 3.10 : Kidney and related parts

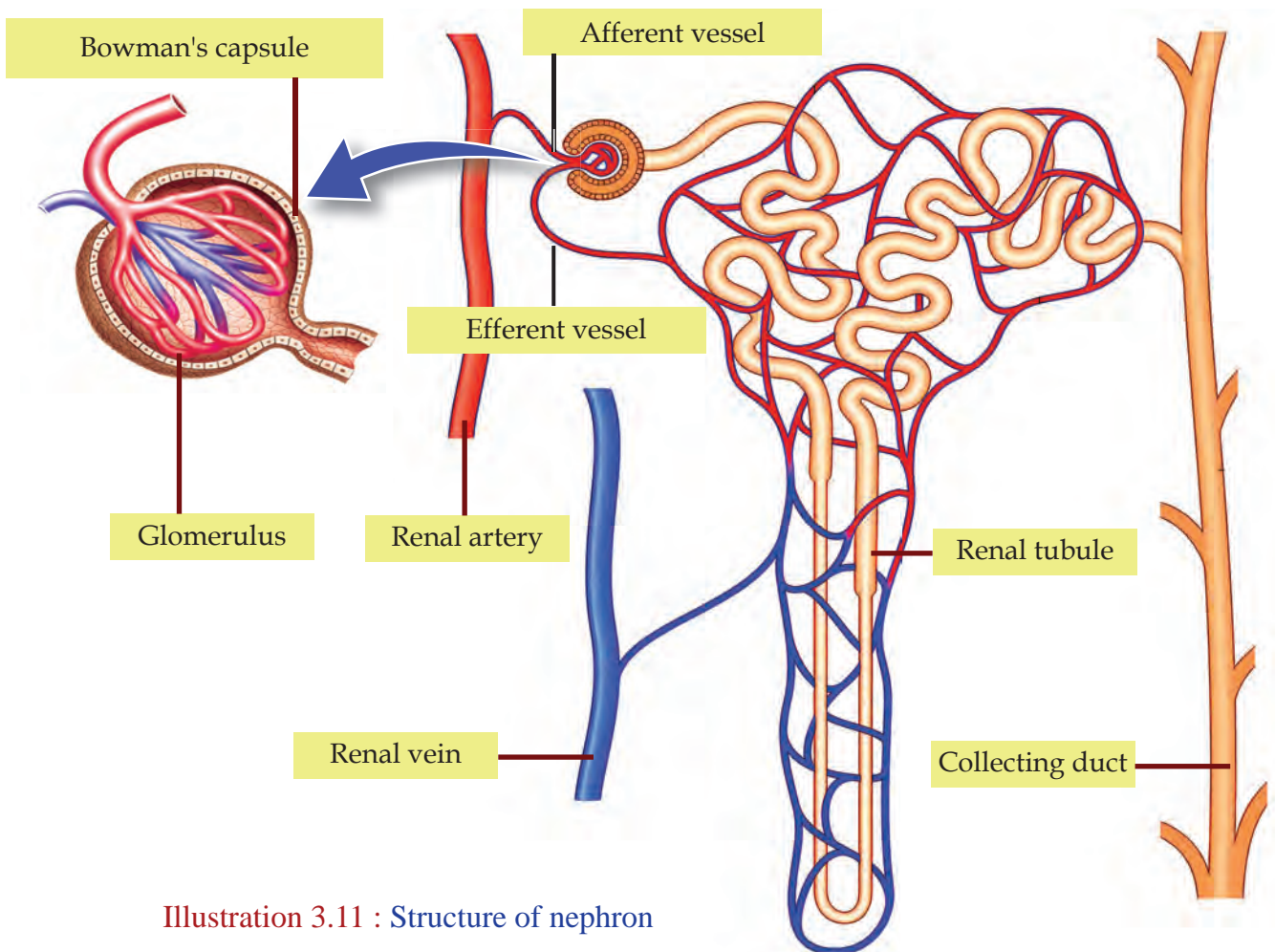
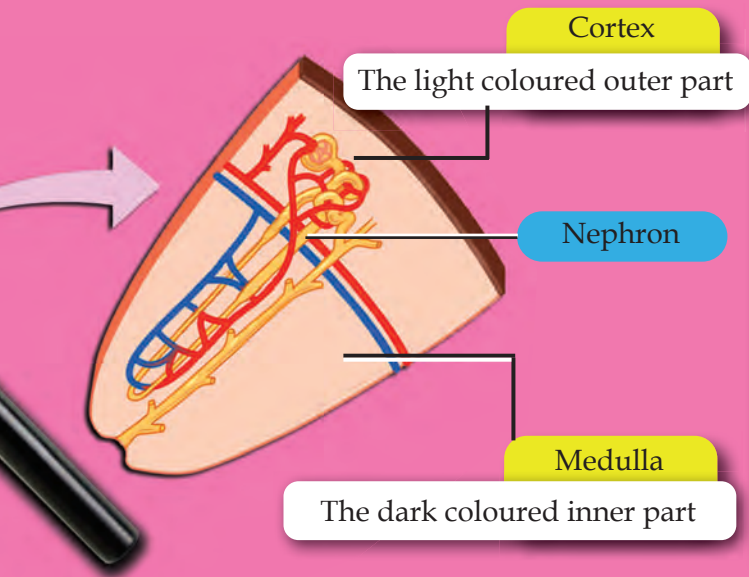


Illustration 3.11 : Structure of nephron



## Kidney and related parts

Human beings have a pair of kidneys. They are bean-shaped and are located in the abdominal cavity on either sides of the vertebral column. Kidneys contain ultra filters which filter waste from the blood. They are called nephrons. Nephrons are the basic structural and functional units of kidneys. Around 12 lakh nephrons are present in each kidney.

Analyse illustration 3.10, 3.11 based on the hints and find out how the structure of kidney and nephrons are suitable to remove waste materials and complete the table 3.4.

Hints	Parts
Blood vessel which carries blood to the kidneys	
Blood vessel which carries blood away from the kidneys	
Ultra filters present in the kidneys	
The double walled cup-shaped structure present at one end of the nephron	
Network of minute capillaries present in the Bowman's capsule	
Blood vessel which carries blood to the capillary network	
Blood vessel which carries blood away from the capillary network	
The long tubule which connects the Bowman's capsule and the collecting duct	
The part where renal tubules enter, collects urine and carries it to the pelvis.	
The initial part of ureter	
Part that carry urine to urinary bladder.	

Table 3.4 : Kidney and related parts

## Urine formation

Now you have understood the parts and functions of ultra filters in kidneys. How do these filters filter blood and eliminate the waste materials? Analyse illustration 3.11 and complete the worksheet 3.1 using the hints.

1

### Ultrafiltration

When blood flows through the glomerulus, ultrafiltration takes place through its small pores. As a result of this a fluid called glomerular filtrate is formed. The high pressure developed in the glomerulus, due to the difference in the diameters of afferent vessel and efferent vessel helps in this process.

#### Components of Glomerular filtrate

Water, glucose, amino acids, sodium, potassium, calcium ions, vitamins, urea, uric acid, creatinine etc.

2

### Reabsorption

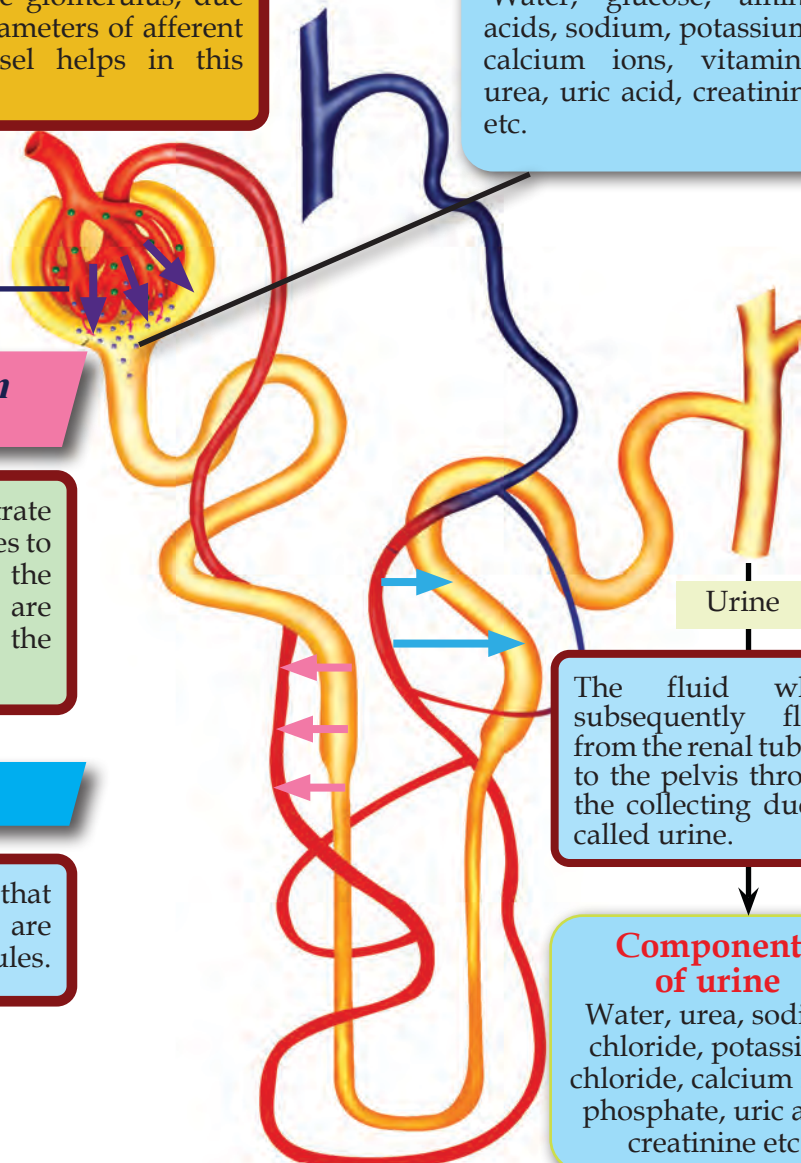
When glomerular filtrate flows through renal tubules to the collecting duct, the essential components are reabsorbed from it into the blood.

3

### Secretion

The excess components that are retained in blood are secreted into the renal tubules.

-  Ultra filtration
-  Reabsorption
-  Secretion

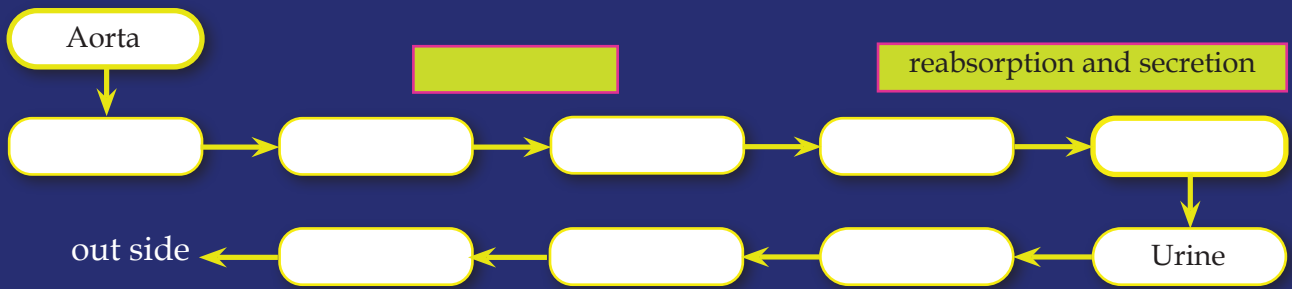


The fluid which subsequently flows from the renal tubules to the pelvis through the collecting duct is called urine.

#### Components of urine

Water, urea, sodium chloride, potassium chloride, calcium salts, phosphate, uric acid, creatinine etc.

Illustration 3.12 : Formation of Urine



Hint

ultrafiltration, glomerular filtrate, ureter, renal tubule, collecting duct, urinary bladder, pelvis, glomerulus, renal artery.

### Work sheet 3.1 : Formation of urine

Why all components in the glomerular filtrate are not present in urine? Find out the components which are reabsorbed and the components which are secreted.

Urine from the nephrons reaches the pelvis through the collecting duct. From there it reaches the urinary bladder through the ureter and then it gets excreted through urethra.

### Health of kidneys

Several factors are to be considered for the health of kidneys. The washing out of disease causing germs from the urinary tract takes place during the process of micturition. Avoiding urination for a long time prevents the expulsion of bacteria that may be present in the urinary tract. This may cause infection in the inner membrane of the urinary bladder and may lead to serious kidney diseases. Drinking sufficient quantity of water and timely urination are necessary to avoid urinary tract infection.



Is diagnosis of diseases possible through urine test?

Haven't you noticed the doubt raised by the child?

Analyse the table 3.5 and generate more ideas regarding this.

Components	Possible diseases
Glucose	Diabetes
Albumin	Kidney diseases
Blood	Kidney diseases
Bilirubin	Jaundice
Calcium oxalate crystals	Kidney stone
Pus cells	Urinary tract infections

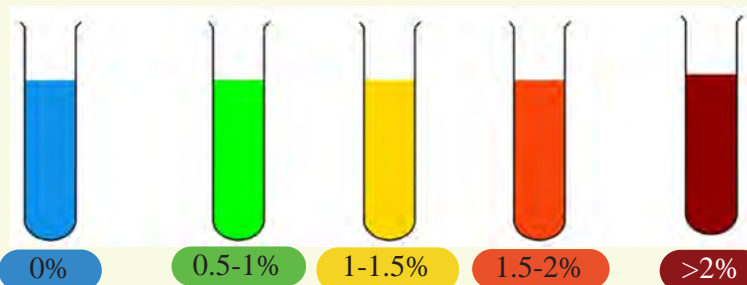
Table 3.5 : Abnormal components in urine



### Detection of the presence of glucose in urine

Take two clean and dry test tubes. Take 2 ml urine sample in one of them. In the second test tube take 2 ml of glucose solution. Add 2 ml Benedict reagent in both the test tubes using a dropper. Heat for 2 minutes. Observe the colour change in both the samples.

**Hint :** *The colour of the sample changes from blue to green, then to yellow, orange and red depending up on the amount of glucose.*



Observation: .....

Inference : .....

Now did you understand that certain diseases can be diagnosed by testing the abnormal constituents found in urine?

Visit the medical lab in your area and collect information regarding urine test. Then prepare a table which includes the normal level of urine constituents and exhibit in the class.

Kidney stone, nephritis, uraemia etc. are some of the diseases which affect kidney. Prepare a presentation including the causes, symptoms etc of these diseases and present it in the class.

## Hemodialysis

The process of removal of waste materials from the blood will get interrupted if both the kidneys stop functioning. Therefore excretory materials may remain in blood without being filtered. This inturn disrupts homeostasis. Haemodialysis is done in such situations to save life. Analyse the illustration 3.13 and prepare a short note on how hemodialysis is done.

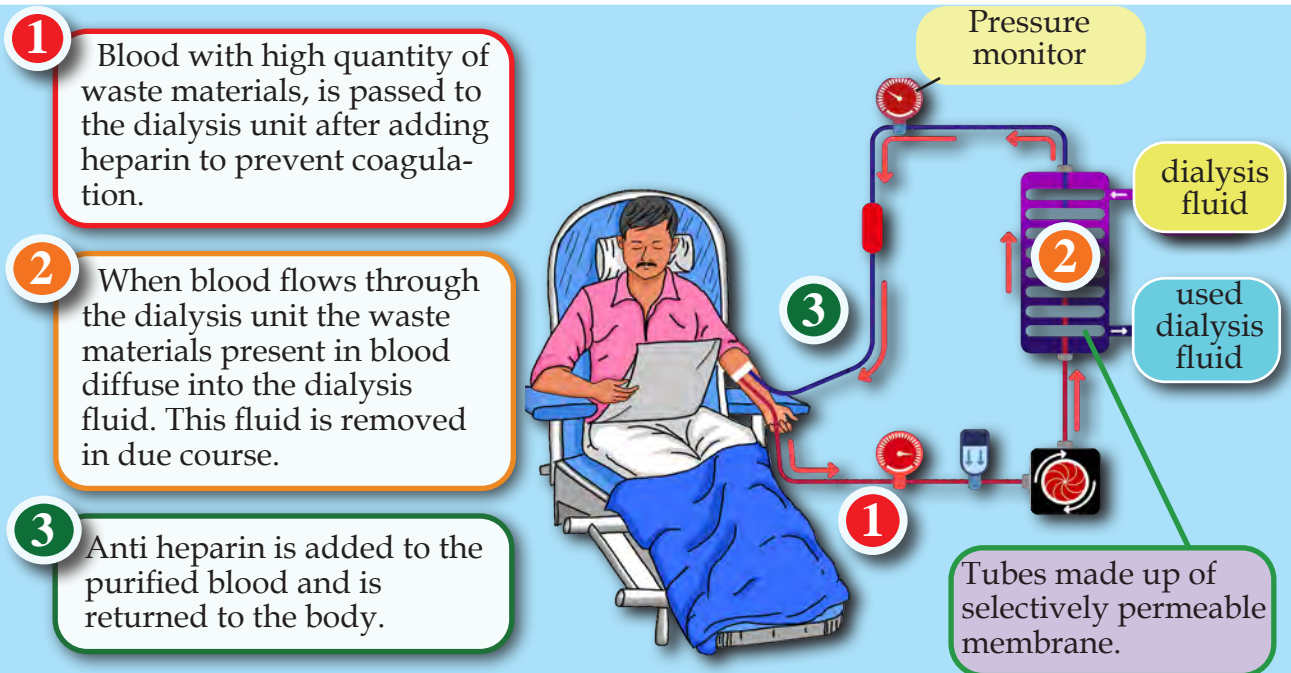


Illustration 3.13 : Hemodialysis.

Collect information regarding different types of dialysis and present it in the class. Prepare a short animation video on hemodialysis process and present it in the class.

## Kidney transplantation

When is kidney transplantation required?

Why is the dialysis fluid removed from the dialysis unit in due course of time?

Analyse illustration 3.14 and prepare a note on kidney donation.

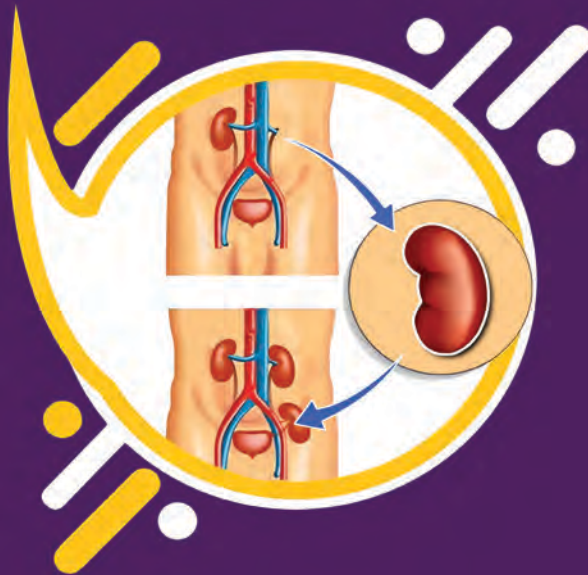


Illustration 3.14 : Kidney Transplant

### Donor

A healthy person or a healthy person who died in accident or by other means.

### Preparation

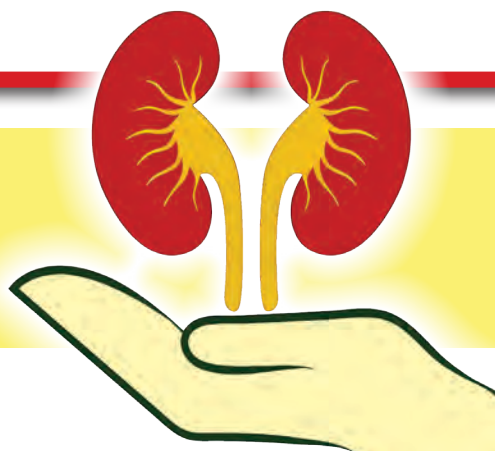
Blood group matching, tissue matching, cross matching.

### Surgery

The blood vessels and ureter of the kidney taken from the donor is connected with the recipient's.

### Post surgery

Medicines which suppress immunity are to be used. Follow up examinations need to be done.



Collect more information on the importance of kidney donation, prepare a digital poster using a suitable software and display it to the class.





## Excretion in other organisms

Doesn't the excretory material differ in each organism depending on its life processes? Is kidney the main excretory organ in all organisms like human beings? Complete the given table 3.6 collecting information about the main excretory products and excretory organs of the organisms.

Organism	Main excretory product	Main excretory organ/mechanism
Amoeba	ammonia	Contractile vacuole
Earthworm		
Insects		
Fish		
Frog		
Reptiles		
Birds		

Table 3.6 : Excretion in other organisms

Animals have extensive systems for excretion. But plants do not have special excretory system like animals. Analyse the illustration 3.15 and prepare a short note on excretion in plants.

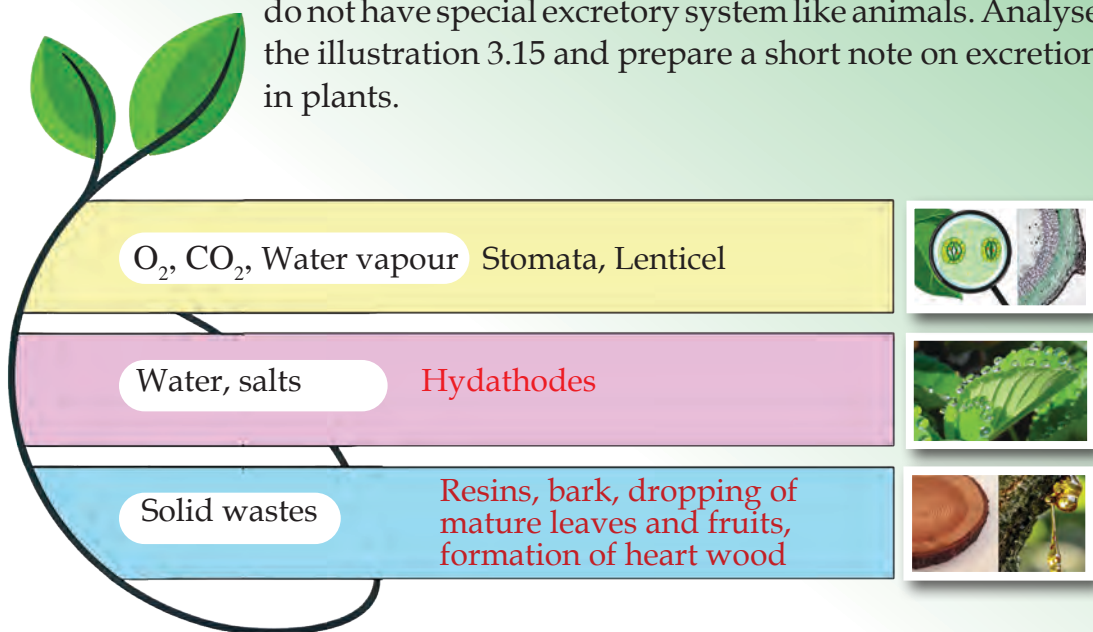


Illustration 3.15 : Excretion in plants

## Maintenance of homeostasis

Maintenance of homeostasis is the sign of life. Now you have understood how liver, kidney, lungs and skin take part in the process of excretion. This is also a means to maintain homeostasis. How do these organs help in maintaining homeostasis?

Analyse the illustration 3.16 and prepare a short note.

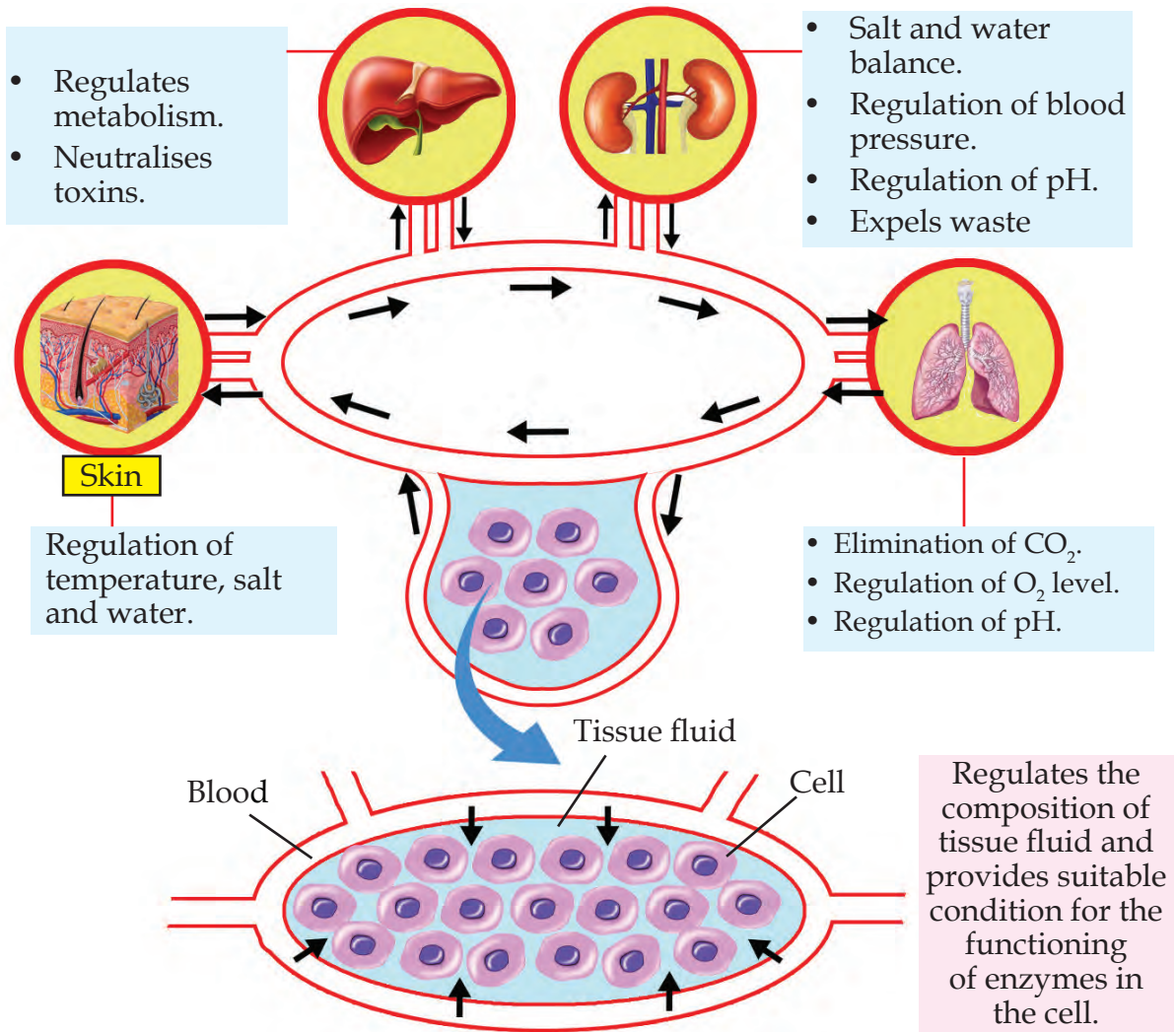


Illustration 3.16 : Maintenance of homeostasis

Any change in the internal environment disrupts homeostasis. Our improper life styles play a major role in this. Hints related to factors which affect homeostasis are given below. Collect information and conduct a seminar in the class.

## Sub themes

- Wrong food habits, over nutrition, under nutrition.
- Lack of exercise, mental stress.
- Alcoholism, smoking, use of additive drugs.
- Pollution, lack of hygiene, abundance of pathogens.
- Improper use of medicines, contact with toxic substances.

External environment is also important as internal environment. Observe the figure 3.3. If such situation prevails in your area, find out how these would affect the external environment and prepare a report on the same.



Figure 3.3 : Environment and pollution

Conduct a panel discussion on the steps to be taken to avoid such harmful changes in the external environment.

### Sub themes

- |                                |                             |
|--------------------------------|-----------------------------|
| • Individuals                  | • <i>Haritha karma sena</i> |
| • Society                      | • Attitude                  |
| • Local self government bodies | • Laws                      |



Perform a role play on the topic  
'Waste Free New Kerala' based on the ideas  
generated from the discussion.

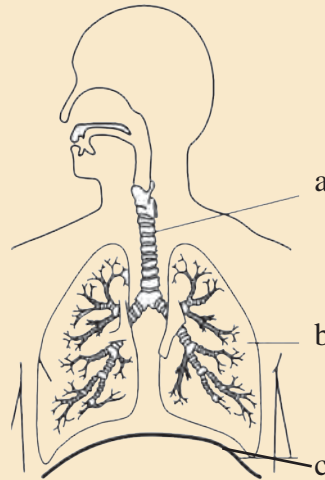
External environment should be kept waste free for the wellbeing of living organisms. Every individual should develop the right attitude towards this. Prepare a master plan for making the school and its surroundings waste free on behalf of the health club and implement it as part of the school master plan.

Wellbeing of both external and internal environments is required for a healthy life. It is our responsibility to keep the external environment waste free and follow the life style that does not disrupt the balance of the internal environment. So let us follow a life style which is required to preserve good health.

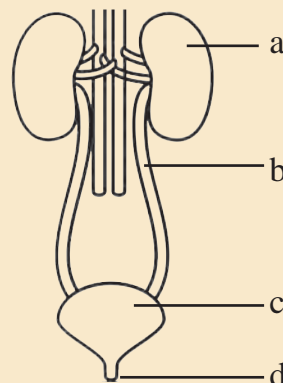


## Let us Assess

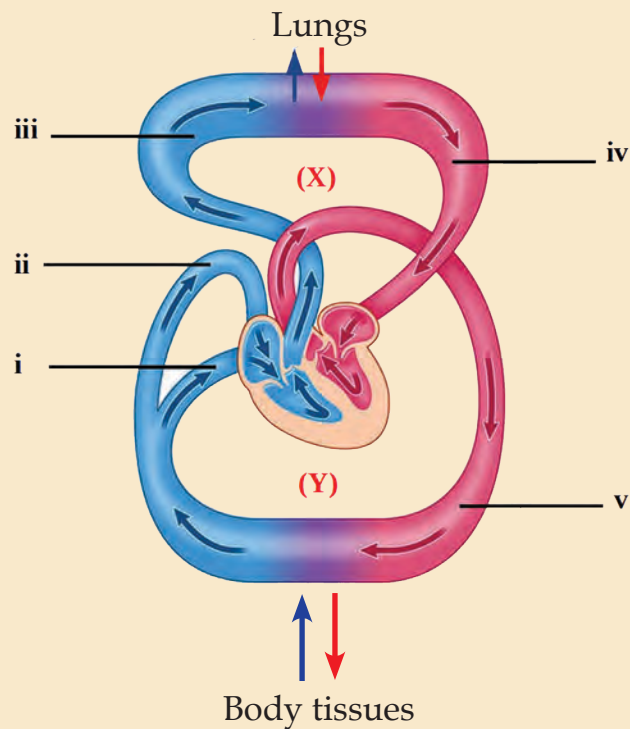
- Which among the following given below is not the characteristic feature of an efficient gaseous exchange surface?
  - Thick cell wall
  - Proximity to blood capillaries
  - Moist membrane
  - Large surface area
- Redraw the diagram and label the parts.



- Write the role of each of the following in the exchange of gases.
  - Plasma
  - RBC
  - haemoglobin
  - Tissue fluid
- Redraw the diagram, label the parts and write their functions.



5. Analyse the figure and answer the questions.



- Write the names of the circulations X and Y.
- Write the names of the blood vessels i, ii, iii, iv, v.
- What is the role of these circulations in the exchange and transport of gases
- Explain the role of these circulations in the process of excretion.



### Extended activities

- Visit a primary health centre and conduct an interview with a doctor on diseases affecting lungs and kidney.
- Construct models of respiratory system, kidney and related parts and display them in the class.
- Organise an awareness class on organ donation.
- Organise and implement programs to make your home and school waste free.

# 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.

## CHILDREN'S RIGHTS

*Dear Children,*

*Wouldn't you like to know about your rights? Awareness about your rights will inspire and motivate you to ensure your protection and participation, thereby making social justice a reality. You may know that a commission for child rights is functioning in our state called the **Kerala State Commission for Protection of Child Rights**.*

*Let's see what your rights are:*

- Right to freedom of speech and expression.
- Right to life and liberty.
- Right to maximum survival and development.
- Right to be respected and accepted regardless of caste, creed and colour.
- Right to protection and care against physical, mental and sexual abuse.
- Right to participation.
- Protection from child labour and hazardous work.
- Protection against child marriage.
- Right to know one's culture and live accordingly.
- Protection against neglect.
- Right to free and compulsory education.
- Right to learn, rest and leisure.
- Right to parental and societal care, and protection.

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### Major Responsibilities

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- Protect school and public facilities.
- Observe punctuality in learning and activities of the school.
- Accept and respect school authorities, teachers, parents and fellow students.
- Readiness to accept and respect others regardless of caste, creed or colour.

*Contact Address:*



**Kerala State Commission for Protection of Child Rights**

'Sree Ganesh', T. C. 14/2036, Vanross Junction

Kerala University P. O., Thiruvananthapuram - 34, Phone : 0471 - 2326603

Email: [childrights.cpcr@kerala.gov.in](mailto:childrights.cpcr@kerala.gov.in), [rte.cpcr@kerala.gov.in](mailto:rte.cpcr@kerala.gov.in)

Website : [www.kescpcr.kerala.gov.in](http://www.kescpcr.kerala.gov.in)

**Child Helpline - 1098, Crime Stopper - 1090, Nirbhaya - 1800 425 1400**

**Kerala Police Helpline - 0471 - 3243000/44000/45000**

*Online R. T. E Monitoring : [www.nireekshana.org.in](http://www.nireekshana.org.in)*