

# BIOLOGY

## Standard

IX



Government of Kerala  
Department of General Education

Part - 2

2/2



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

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## The National Anthem

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

## Pledge

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

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

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

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

**State Council of Educational Research and Training (SCERT)**

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*Dear Students,*

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

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

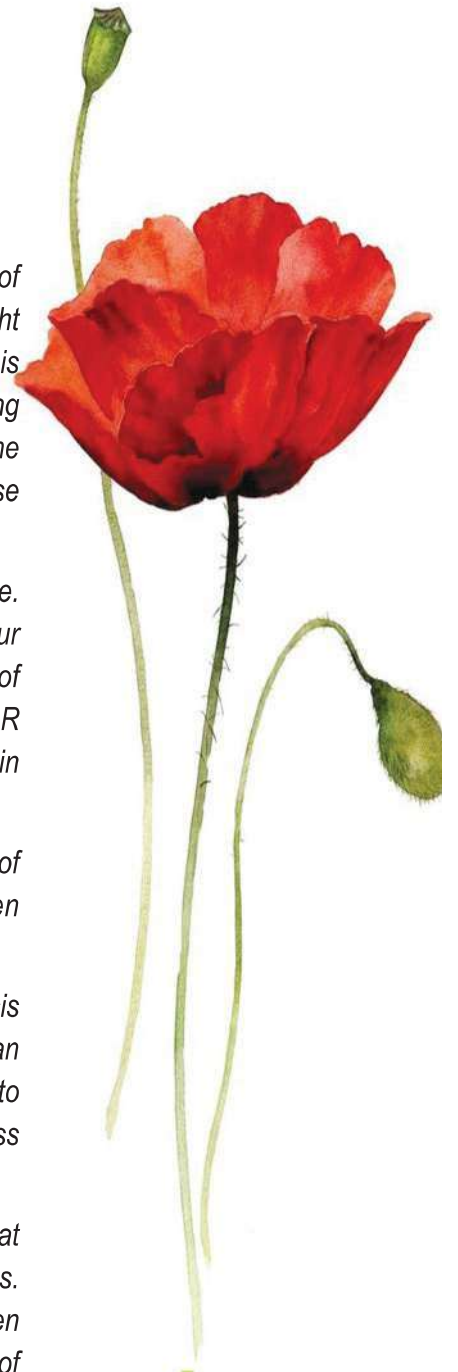
*The National Skills Qualifications Framework, the current relevance of Disaster Management and the possibilities of I.C.T. have also been considered in the textbook.*

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

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

*Love and Regards,*

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






# 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.
- 

# Content

## Part - 2

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



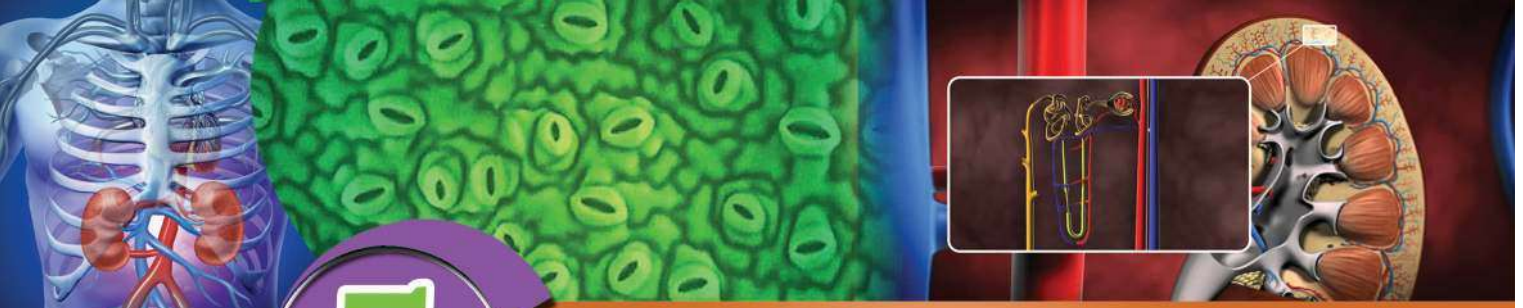
**For further reading**  
(Evaluation not required)



**Let us Assess**



**Extended Activities**



# 5

## Excretion to Maintain Homeostasis



Have you noticed garbage dumped like this?

What are the consequences of this? List out.

- 
- 

Shouldn't we avoid such situations? How is it possible?

Discuss.

We can make our external environment garbage free by processing, reusing or recycling waste material. It is understood that the external environment should be protected for the well-being of organisms.

Do we contaminate only the external environment?

Doesn't waste accumulate in our internal environment too?

Analyse the description given below and note down your findings in the Science diary.

Several byproducts are formed in cells as a result of metabolic activities. If the amount of these byproducts exceeds a certain limit, it becomes harmful to our body. Nitrogenous compounds formed by the metabolism of amino acids and nucleic acids, carbon dioxide and water which are the byproducts of respiration etc., are the main excretory products in human beings. Excretion is the process of elimination of these wastes from the body. This is one of the methods to maintain homeostasis.

How do the waste materials formed inside the cells reach excretory organs?

Analyse the flow chart given below, prepare notes and write in the Science diary.



**Excretory organs**

Name the organs that help to remove waste materials from blood and maintain homeostasis. Complete illustration 5.1 and write your inferences in the Science diary.

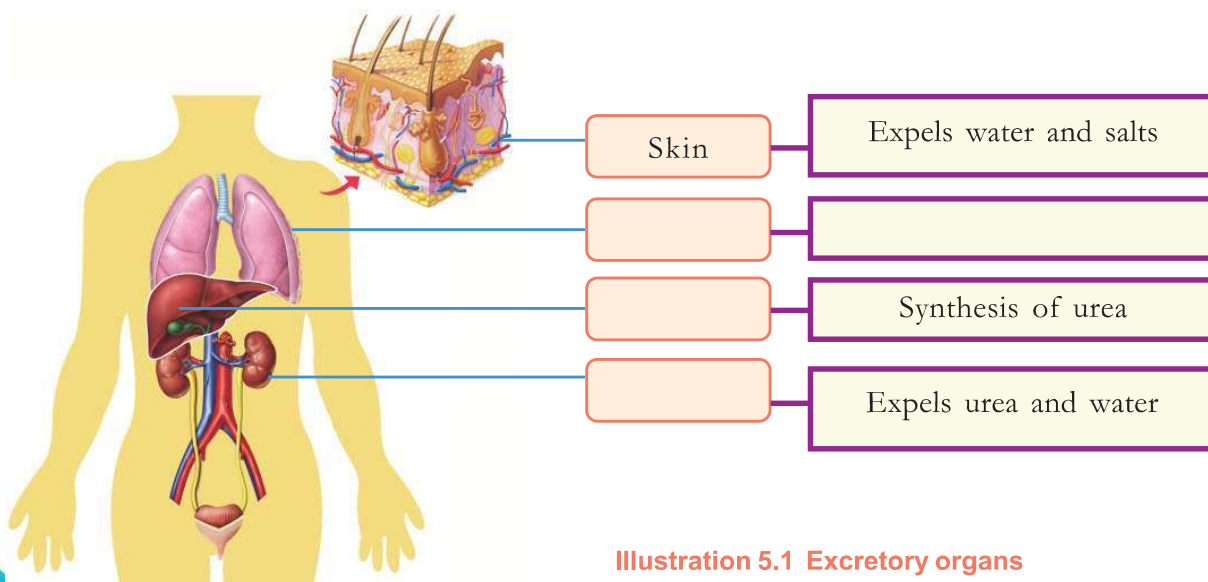


Illustration 5.1 Excretory organs



You might have understood the major excretory organs and their functions. How do these organs help to maintain homeostasis?

### Liver – the waste processing unit

Liver converts toxic substances that reach the body and those produced inside the body into harmless substances. The conversion of ammonia, a toxic substance formed as a result of metabolic activities into less toxic urea is an example for this.

How does the liver synthesize urea?

Analyse the description, based on the indicators and prepare notes on the synthesis of urea in the Science diary.

Amino acids are formed by the breakdown of proteins. As a result of the metabolic activities of amino acids, several nitrogenous byproducts are formed. The most harmful among these is ammonia. It should be removed from the body immediately. The ammonia formed in cells reaches the liver through blood. In the liver, it combines with carbon dioxide and water in the presence of enzymes and is converted to urea.

Ammonia + Carbon dioxide + Water  $\xrightarrow{\text{Enzymes}}$  Urea

#### Indicators

- Formation of ammonia
- Synthesis of urea
- Toxic substances and liver

You might have now understood that the liver uses carbon dioxide for the synthesis of urea. Similarly, carbon dioxide is utilised for many other life processes. But increase in its level in the body will adversely affect homeostasis. You have studied about the importance of timely expulsion of carbon dioxide from the body.

#### The cautious liver

Constant contact with poisonous substances destroy liver



cells. But, unlike other organs, the liver has the ability to regenerate its damaged cells. However, if the destruction of liver cells becomes higher than its regenerative power, it will lead to the complete damage of liver. This happens when alcohol enters the body and also when we consume food containing artificial ingredients.

**SAY NO TO ALCOHOL**



Apart from carbon dioxide, isn't it necessary to expel excess water, salts etc. from the body? What are the forms in which they are removed from the body? Discuss.

### Formation of sweat

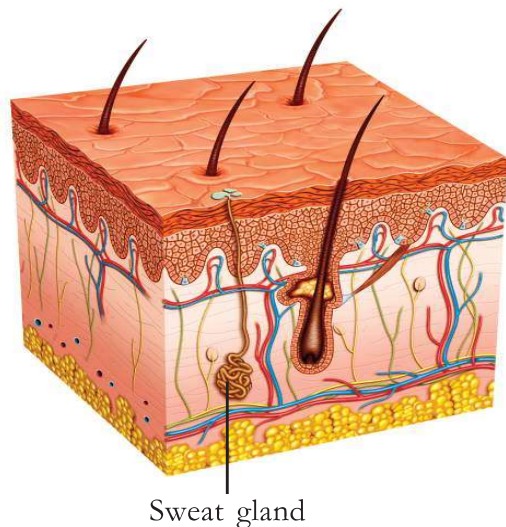


Figure 5.1 Skin

Based on the indicators, analyse figure 5.1 and the description, and enter in the Science diary how sweat is formed.

Skin is the largest organ of the human body. Sweat glands in the skin produce sweat. The sweat glands are surrounded by blood capillaries at their base. When blood flows through these capillaries, salt and water from the blood enter the sweat glands. This appears as sweat drops on the skin surface. The main objective of sweating is regulation of body temperature.

### Indicators

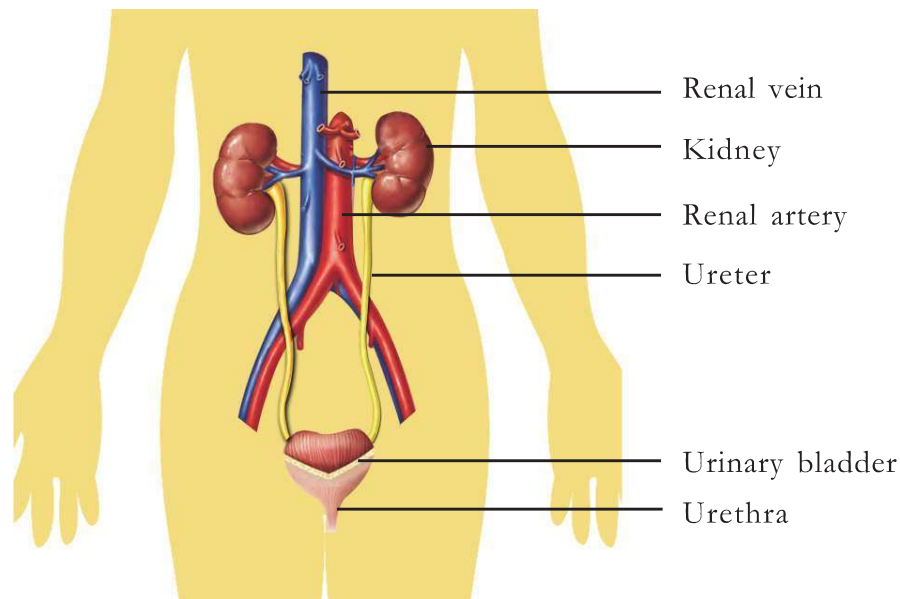
- Formation of sweat.
- Components of sweat.

Only a very small quantity of impurities are expelled through sweat. Urea, salt and water are expelled from the body mainly through urine.

How is urine formed from blood? Which organ helps in this process?

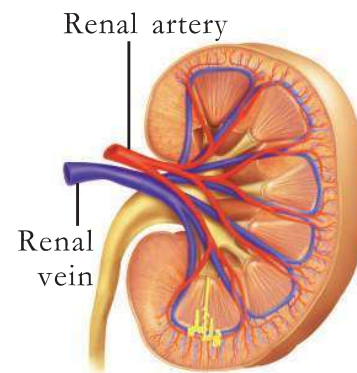
### Kidneys

Kidneys are the major excretory organs in human beings. Kidneys are the organs which filter urea, vitamins, salts and other substances harmful to the human body from blood and expel them through urine. Analyse figures 5.2, 5.3 and the description given below and complete illustration 5.2.



**Figure 5.2 Kidneys and associated 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. Compared to the right kidney, the left kidney is located slightly higher. Each kidney is covered by a strong but soft membrane. Blood with high pressure reaches the kidney through renal artery which is a branch of aorta. The filtered blood reaches the venacava through renal vein. Urine formed in the kidneys reaches the urinary bladder through the ureters and is expelled out through the urethra.



**Figure 5.3 Renal artery and Renal vein**



**Illustration 5.2 Kidneys and associated parts**

We should know the internal structure of kidney to understand how kidneys remove waste materials from the blood.

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

Analyse illustration 5.3 given below. Prepare a short note on the internal structure of kidney and the arrangement of nephrons in kidney and enter the same in your Science diary.

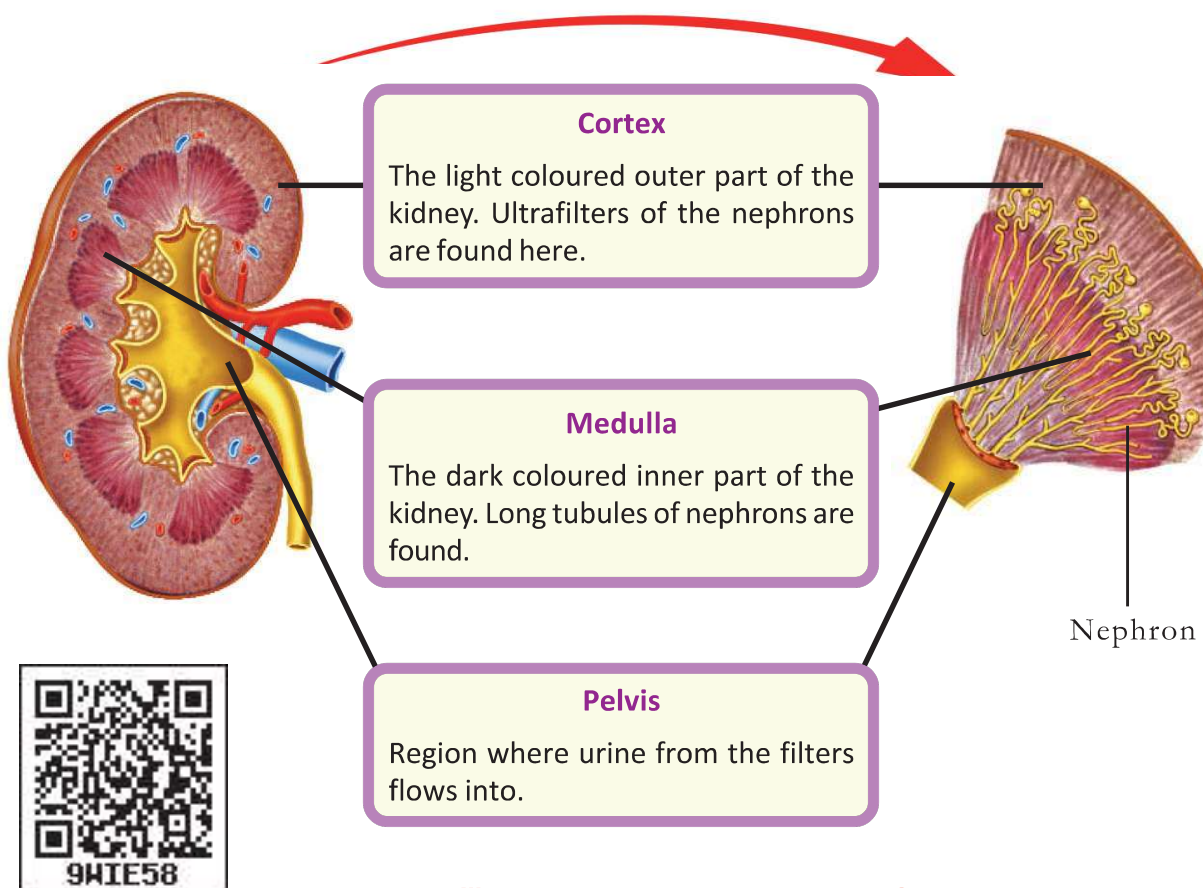


Illustration 5.3 Internal structure of kidney

You have understood how nephrons are arranged in the kidneys. Analyse illustration 5.4 given below and prepare a table including the parts and peculiarities of nephron.

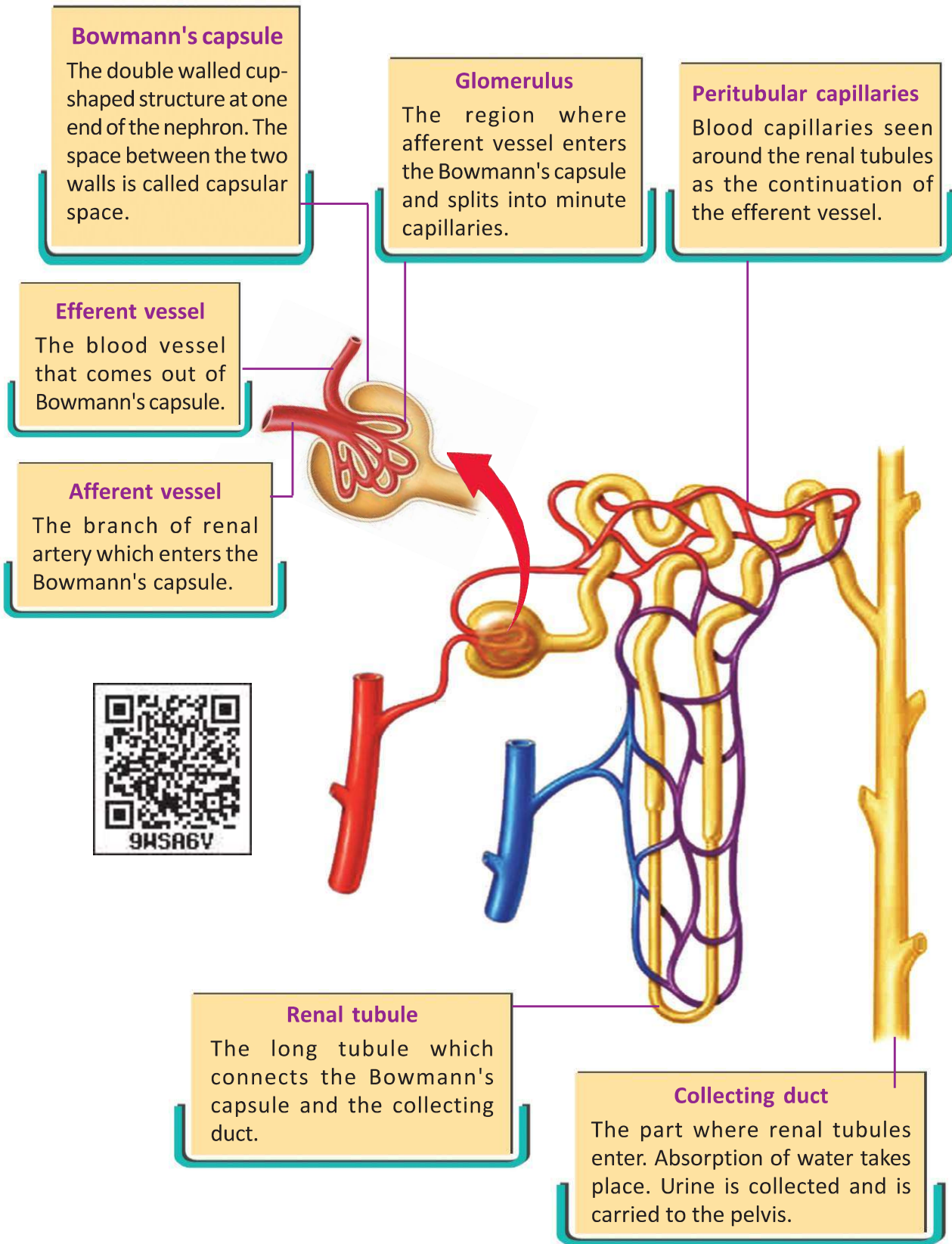


Illustration 5.4 Structure of Nephron



### Formation of urine

Urine is formed through processes like ultrafiltration, reabsorption and secretion and absorption of water. Analyse illustration 5.5, based on the indicators and prepare notes in the Science diary on the process of formation of urine.

Ultrafiltration	Reabsorption and secretion	Absorption of water
<p>When blood flows through the glomerulus, ultrafiltration takes place through its small pores. This process is supported by the high pressure developed in the glomerulus, due to the difference in the diameters of afferent vessel and efferent vessel. The glomerular filtrate formed as a result of this is collected in the capsular space.</p>	<p>When glomerular filtrate flows through renal tubules to the collecting duct, essential components are reabsorbed to the peritubular capillaries.</p> <p>The excess components that are retained in blood even after ultrafiltration are secreted to renal tubules from the capillaries.</p>	<p>The absorption of excess water from the glomerular filtrate takes place in the collecting duct. What is left behind is urine.</p>
<p>Glomerular filtrate</p> <div style="border: 1px solid #800080; padding: 5px; margin-top: 10px;"> <p style="color: #800080; font-weight: bold;">Components of the glomerular filtrate</p> <ul style="list-style-type: none"> <li>Water</li> <li>Glucose</li> <li>Amino acids</li> <li>Sodium, potassium, calcium ions, vitamins</li> <li>Urea, uric acid creatinine etc.</li> </ul> </div>		<div style="border: 1px solid #800080; padding: 5px; margin-top: 10px;"> <p style="color: #800080; font-weight: bold;">Components of urine</p> <p>Water - 96%</p> <p>Urea - 2%</p> <p>Sodium chloride</p> <p>Potassium chloride</p> <p>Calcium salts</p> <p>Phosphate, Uric acid, Creatinine etc. - 2%</p> </div>

Illustration 5.5 Formation of urine

**Indicators**

- Characteristics that help in ultrafiltration.
- Reabsorption and secretion - process and components.
- Difference between glomerular filtrate and urine.

Urine flows from the kidney to the urinary bladder through the ureter and is stored there temporarily. It is expelled through urethra as and when the bladder is filled. Washing out disease causing germs from the urinary tract also takes place during the process of micturition (passing out of urine).

How does avoiding timely urination affect our body? Analyse the description given below and list out the healthy habits to be followed.

Avoiding urination for a long time prevents the expulsion of bacteria that may be present in the urinary tract and urinary bladder. This causes infection in the inner membrane of the urinary bladder. Females are more susceptible to urinary tract infection, when compared to males.

You have understood that urine, the main excretory product contains water, urea and salts. Shall we conduct an experiment to understand the presence of urea in urine? Conduct the experiment with the help of your teacher and write down the procedure in your Science diary.

**Plan of experiment**

Aim : .....

Materials required : .....

Procedure : Take 2ml of urine in a test tube. Add 4-5 drops of sodium hypobromite solution into it using a dropper. Observe whether effervescence occur.

Observation : .....

Inference : .....

**To produce 1.5 litres of urine**



The entire blood in the body passes through kidneys at least 350 times in 24 hrs. About 1800 litres of blood is filtered to form 170 litres of glomerular filtrate. Approximately 127 ml of glomerular filtrate is formed in every minute. Out of this almost 126 ml is reabsorbed to blood. As a result, 1.5 litres of urine is formed from 170 litres of the glomerular filtrate.

**Hint :**

When sodium hypobromite reacts with urea, urea breaks down to form carbon dioxide and nitrogen.

## Kidneys and Maintenance of Homeostasis

Kidneys play a major role in maintaining the concentration of body fluids. They regulate the pH and the amount of water and salts present in the blood.

Analyse how the kidneys maintain homeostasis, based on illustration 5.6 and the inferences you have drawn so far about kidneys and prepare notes in your Science diary.

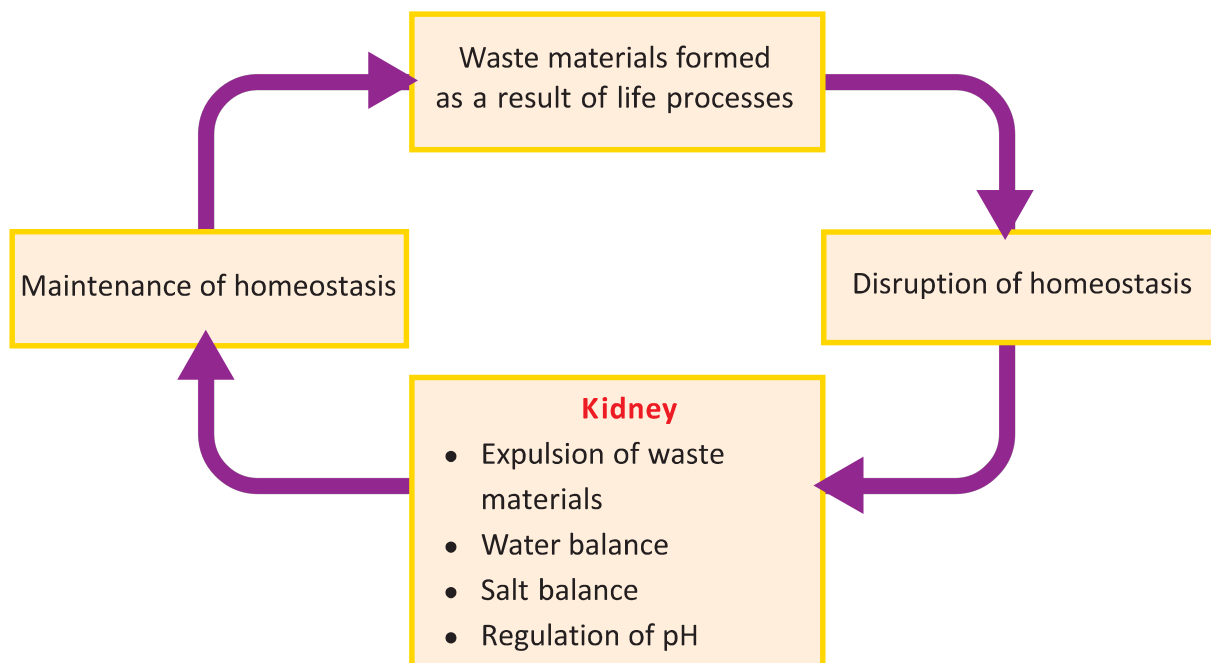


Illustration 5.6 Kidneys and maintenance of homeostasis

## Kidney Diseases



Bad health habits, life style and infection by microorganisms adversely affect the health of kidneys. Analyse table 5.1 given below, collect more information and conduct a seminar on the protection of health of kidneys.



Disease	Reason	Symptoms
Nephritis	Inflammation of kidneys due to infection or intoxication.	Turbid and dark coloured urine, back pain, fever, oedema on face and ankle
Kidney stone	Deposition of crystals of calcium salts in kidney or urinary tract.	Pain in the lower abdomen, blockage of urine, dizziness, vomiting
Uremia	Different types of kidney diseases, nephritis, diabetes, high blood pressure.	Anaemia, loss of body weight, dizziness suffocation, diarrhoea production of urine stops gradually.

Table 5.1 Kidney diseases

When kidney diseases become severe, excretory substances do not get filtered and remain in the blood. How can the lives of those suffering from kidney failure be retained?



## Haemodialysis

Haemodialysis is the process of purifying blood by passing it through artificial kidney, when the kidneys become nonfunctional. Analyse illustration 5.7 and write the steps of haemodialysis in your Science diary.

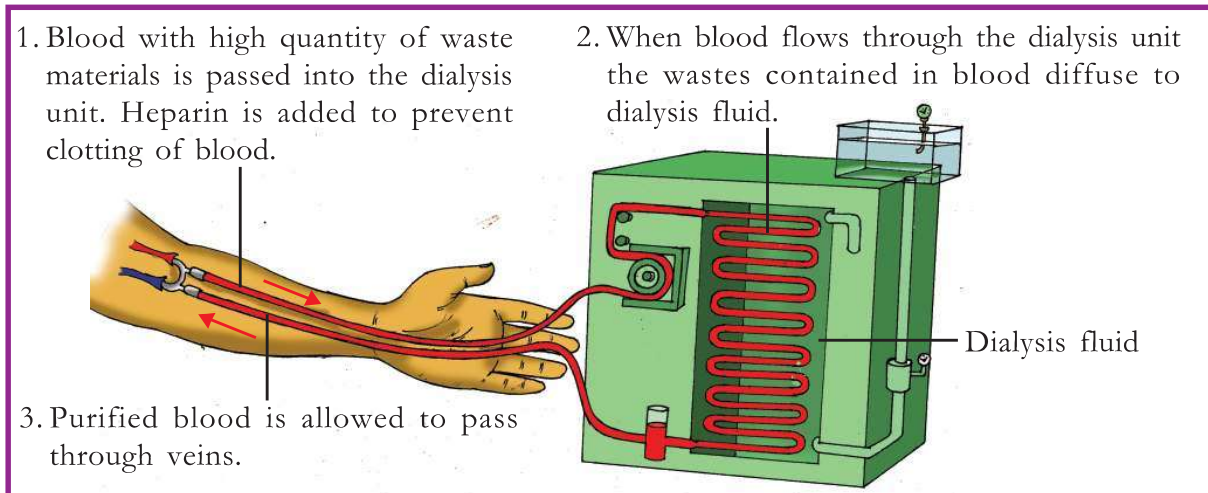
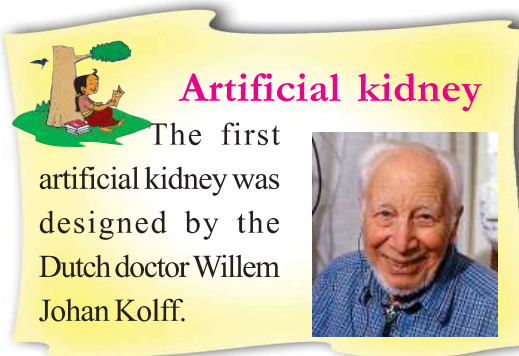


Illustration 5.7 Haemodialysis

## Kidney Transplantation

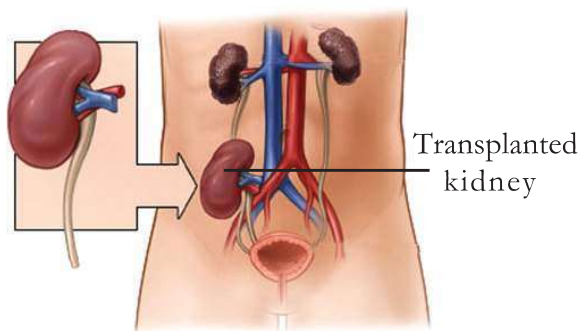


Figure 5.4 Kidney transplantation

Have you heard about kidney transplantation?

When does kidney transplantation become necessary?

A single healthy kidney is enough to purify blood. But, when both the kidneys of an individual get damaged completely, a fully functioning kidney should be received from a donor to save life.



### When a kidney is transplanted

During transplantation, damaged kidneys are not removed. Instead a new kidney is connected below the nonfunctional kidney, with the recipient's renal artery and renal vein. The ureter of the transplanted kidney is attached to the urinary bladder of the recipient. Dr. Joseph E. Murray conducted the first kidney transplantation surgery.

Kidney of a healthy person who died in an accident or of a completely healthy person can be transplanted after considering the matching of blood groups and tissues.

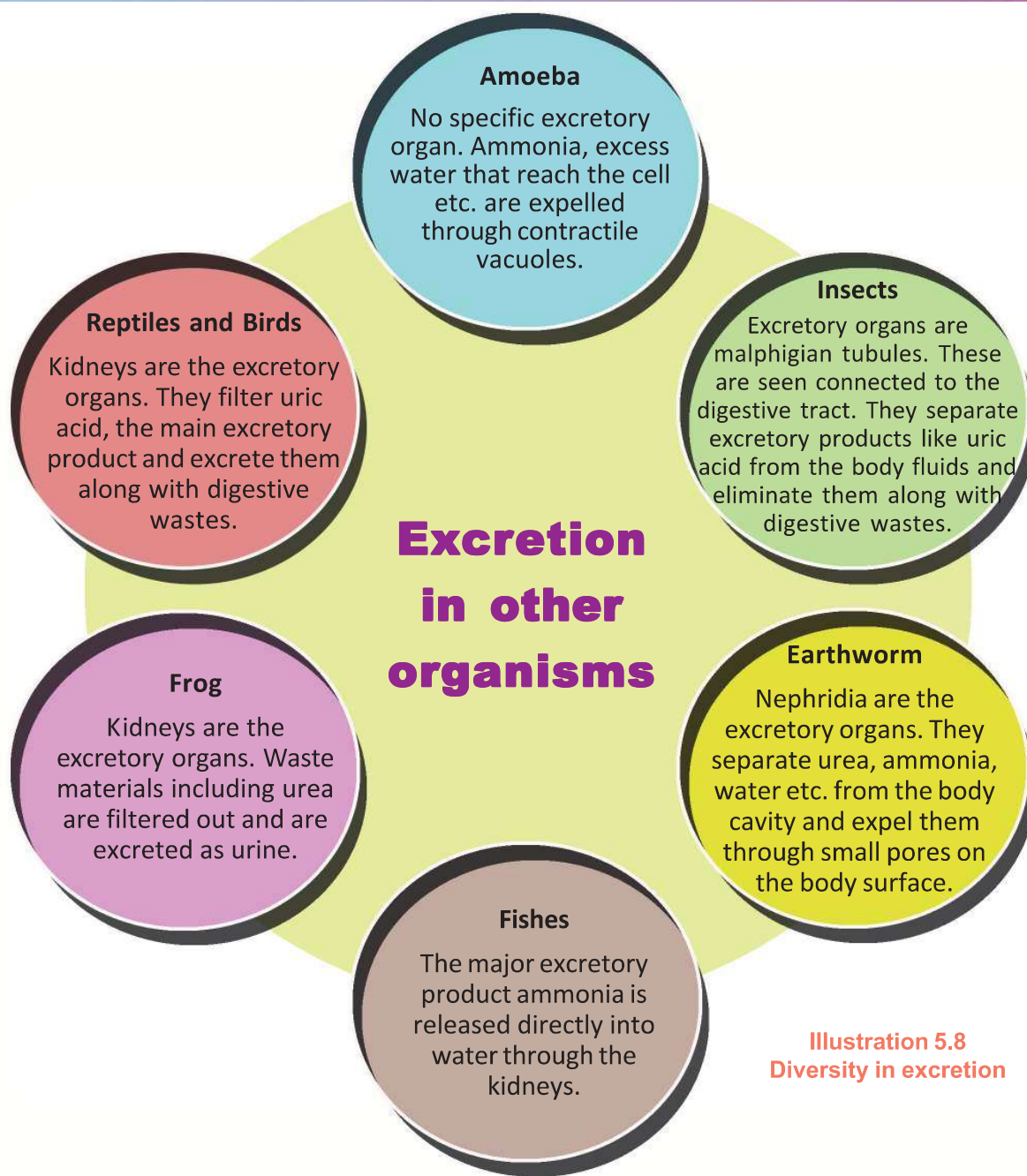
Collect more information and news excerpts about kidney donation and design a poster including the attitude to be shown towards kidney patients. Display it on the bulletin board.

### Excretion in other Organisms



Is there any mechanism in other organisms, as in human beings, to remove excretory materials?

Analyse illustration 5.8 and complete table 5.2 regarding different types of excretory mechanisms present in other organisms.



**Illustration 5.8**  
Diversity in excretion

Organism	Excretory organ	Excretory products
Amoeba		
Earthworm		
Insects		
Fish		
Frog		
Reptiles and birds		

**Table 5.2** Diversity in excretion

## Do plants excrete?

Write your assumption.

Plants also have methods to excrete waste materials, but they do not have separate excretory systems as in animals. The rate of life activities are less in plants when compared to animals. Hence, the quantity of waste materials in plants are also less.

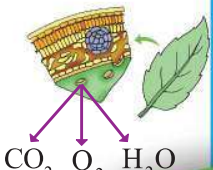
What are the main excretory products in plants?

Analyse illustration 5.9, prepare notes on excretion in plants and write in your Science diary.

### Excretion in plants


**Stomata, Lenticel**

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




**Hydathodes**

In certain grasses and shrubs, excess water is eliminated through small pores present at the tip of leaves called hydathodes.



**Formation of heartwood**

Some waste materials get accumulated in the older xylem vessels present at the centre of the tree trunk and play a major role in the formation of heart wood.



**Abscission of leaves**

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




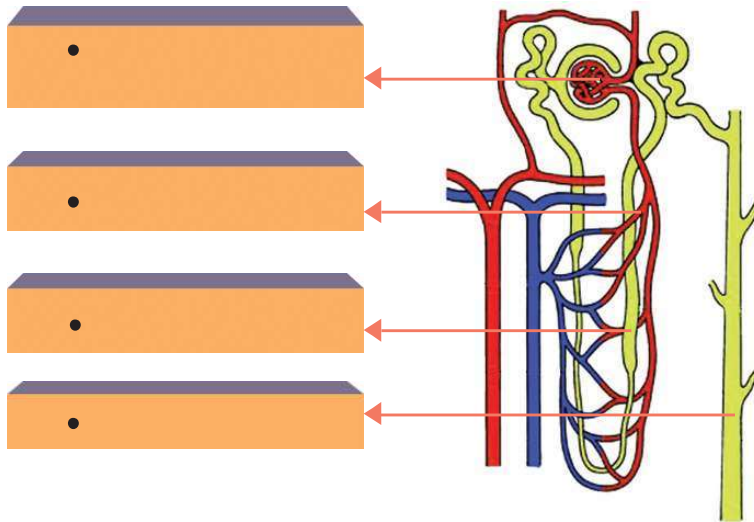
Illustration 5.9 Excretion in plants

For a healthy life external and internal environment should be free from waste. It is our responsibility to keep our external environment garbage free. Our body keeps the internal environment devoid of waste through excretory process and thus protects it. Hope you understood the role of organs like liver, kidney, skin, lungs etc. in this. Let us practise a life style which protects the health of these organs.



**Let us assess**

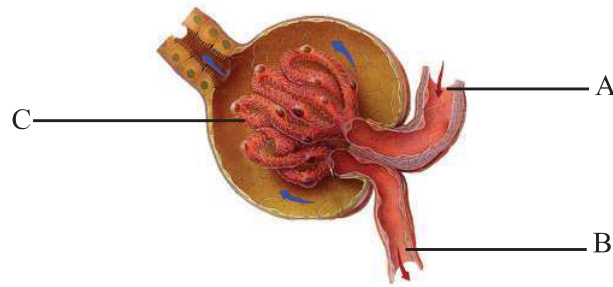
1. Glucose, amino acids etc. found in the glomerular filtrate are absent in urine. Why?
2. Statements related to the formation of urine are given below. Arrange them in the figure appropriately.
  - Ultrafiltration takes place.
  - Collects urine.
  - Glucose, amino acid, sodium, potassium etc. are reabsorbed here.
  - Urea, sodium, potassium ions etc are secreted here.



3. Alcoholism is a bad habit which should be avoided. Analyse this statement relating it to the health of liver.
4. Based on the similarities in major excretory materials, arrange the following organisms properly in the table given below .  
Frog, Amoeba, Human beings, Fish, Birds, Insects

Ammonia	Urea	Uric acid

5. Observe the figure and answer the questions.



- Identify and name the parts A, B and C.
- How does each one of these help in the process of ultra filtration?



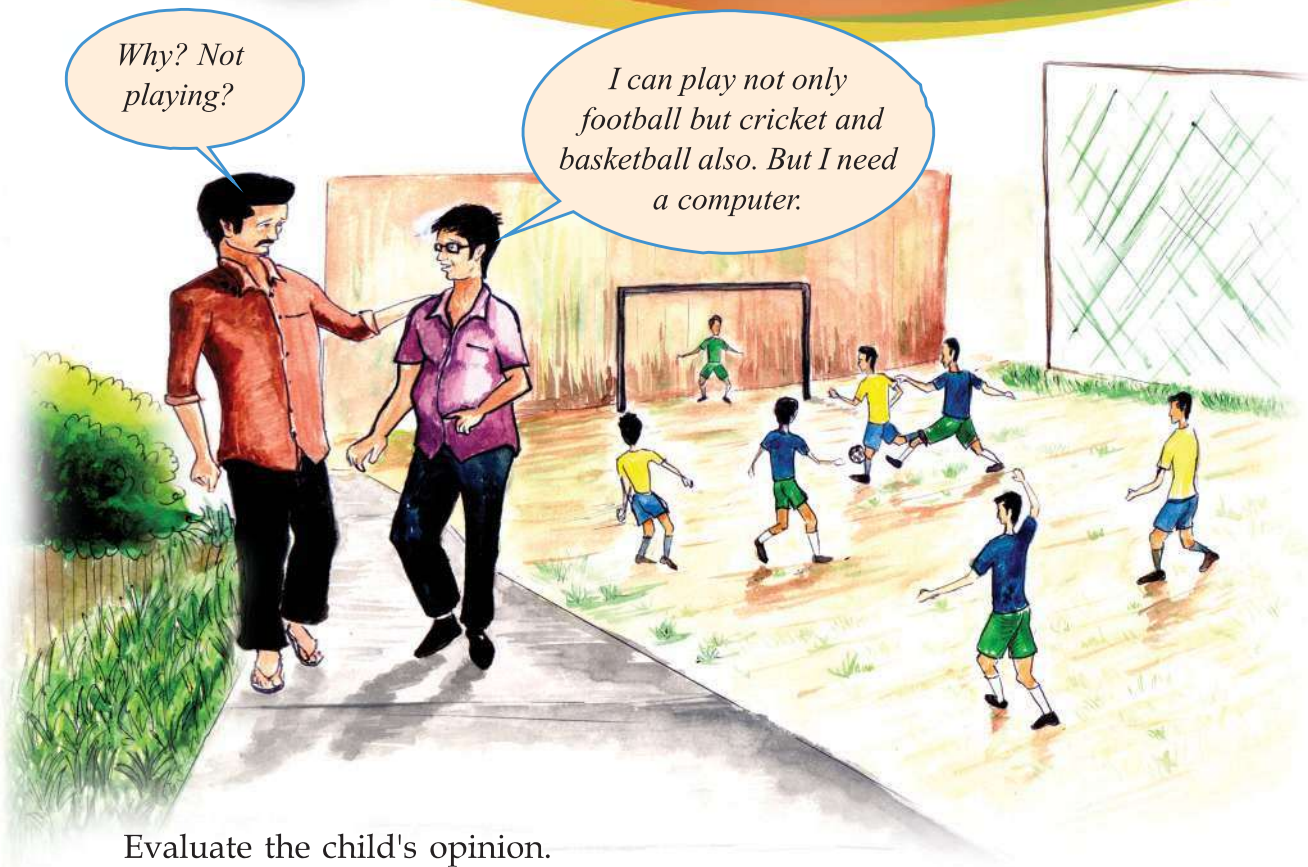
### Extended activities

- Arrange an awareness programme in your school by collecting information from a doctor, on the topic 'Our life style and health of liver, kidney etc.'
- Perform a short play on the topics 'Kidney donation' and 'Health of kidneys'.
- Make a model of nephron using scrap materials.
- Visit a medical lab, collect information regarding urine test and prepare a chart showing the normal level of components in urine and display it in the classroom.



# 6

## The Biology of Movement



Evaluate the child's opinion.

Compare the two - playing in the ground and gaming on computer. List the benefits of playing in the playground.


- 
- 
- 

Sports that resort to exercise are more beneficial to health. Aren't they?

### Importance of Exercise


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


### Importance of Exercise



- Increases blood circulation through out the body.
- Cardiac muscles become strong.


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





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

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



**Illustration 6.1 Importance of exercise**

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

Practise various kinds of exercises with the help of your physical education teacher. Prepare a pamphlet on it.

### Involuntary Movements

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

- hand movements
- heartbeat
- movement of the tongue
- 

Do all these movements occur according to our will?

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



Voluntary movements	Involuntary movements

Table 6.1 Body movements

You know the role of muscles in voluntary and involuntary movements. The diversity in movements is evident in muscles too.

## Types of Muscles

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



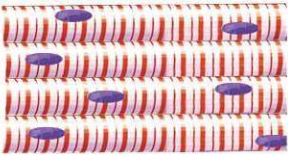

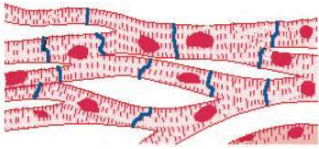
Muscles	Characteristics of muscle cells
Skeletal muscle ( Striated muscle ) 	<ul style="list-style-type: none"> <li>• seen attached to bones.</li> <li>• cylindrical cells.</li> <li>• dark and light striations are seen.</li> <li>• make voluntary movements possible.</li> </ul>
Smooth muscle ( Nonstriated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

Table 6.2 Different types of muscles and their characteristics

## Indicators

- How do skeletal muscles differ from smooth muscles?
- List out the similarities and differences of cardiac muscles with skeletal and smooth muscles.

While engaging in physical activities, the muscles have to undergo continuous contraction and relaxation. This needs energy. What are the factors required for the production of energy in muscle cells?

- 
- 

### Muscle Fatigue

When we engage in continuous and strenuous exercises, if sufficient oxygen is not available, lactic acid accumulates in the muscles through anaerobic respiration. This increases acidity in muscles which in turn slows down the action of many enzymes associated with muscle contraction. As a result, muscles get exhausted and temporarily lose their power of contraction. This condition is called muscle fatigue. On taking rest, the lactic acid is dispelled from the muscles and they regain their capacity for contraction.

Is movement possible by means of muscles alone? Don't the bones have any role in movement, along with muscles?

#### Axial skeleton

#### Appendicular skeleton

### Bones and Movement

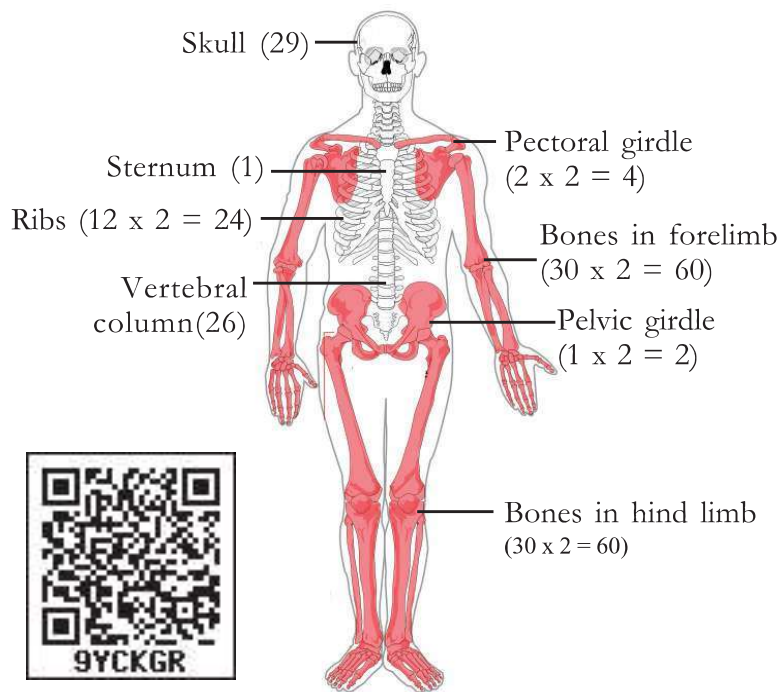


Figure 6.1 Human skeletal system

In what all ways can you move your hands? Different types of movements are effected by the combined action of bones and muscles. The human skeletal system consists of 206 bones. Based on their position, the human skeleton can be divided into axial skeleton and appendicular skeleton. Observe figure 6.1 of the human skeletal system. Complete illustration 6.2 showing the number of bones in the axial and appendicular skeleton.

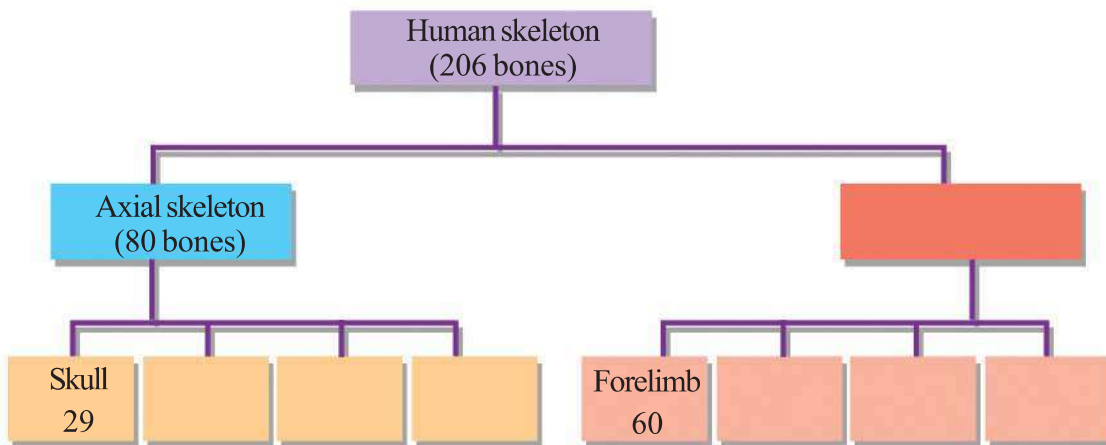


Illustration 6.2

Let us examine how the combined action of bones and muscles facilitate a variety of movements. We can understand this easily by observing the movement of muscles and bones of our hand. Observe figure 6.2. Based on the indicators, discuss and frame inferences and write down in your Science diary.

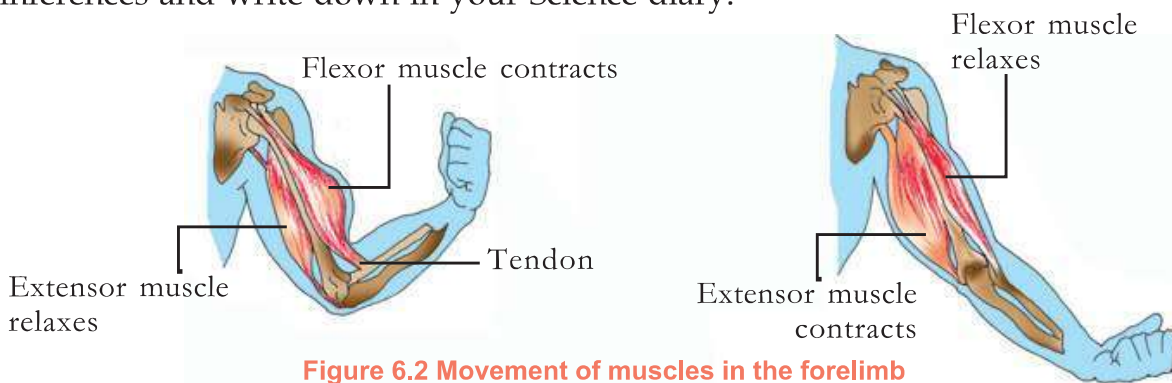


Figure 6.2 Movement of muscles in the forelimb

### Indicators

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

### Steroids - protector and villain

Chemicals known as steroids are prescribed as medicines for certain diseases. Consumption of medicines as per the prescription of doctor is a part of health care. But there has been news from the sports sector about the abuse of steroids by some sports stars. The reason is that steroids enhance production of energy in the muscle cells. We forget that the unwise use of steroids for momentary achievements may lead to hypertension, cardiac problems, imbalance of sex hormones etc. It is both an offence towards oneself and the society.



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

### Joints and Movements

Joints are the meeting place of two bones. They help in the movement of bones. Joints give more flexibility to bones to move. The nature of movement varies with the nature of joints. Observe figure 6.3 of the human skeleton. Formulate inferences and complete table 6.3.

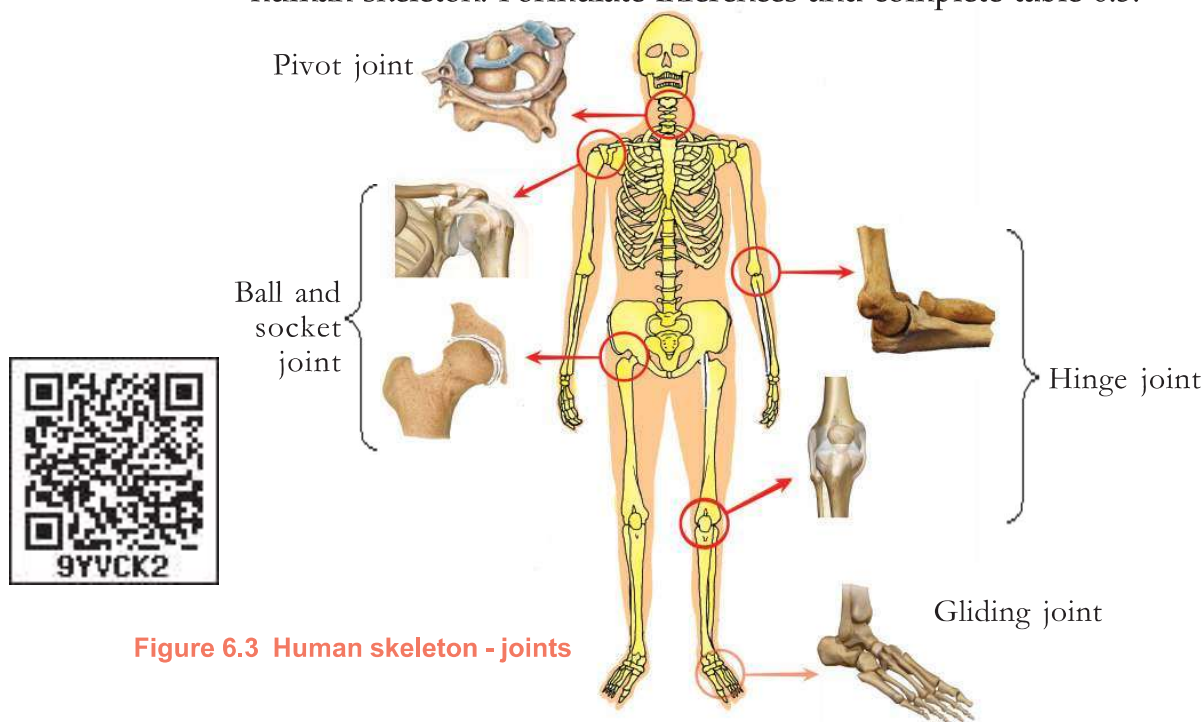


Figure 6.3 Human skeleton - joints

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

Table 6.3 Skeletal joints

Let's examine how the structure of a joint is adapted for its function. Analyse figure 6.4 of a typical joint and write notes in your Science diary on the basis of the indicators.

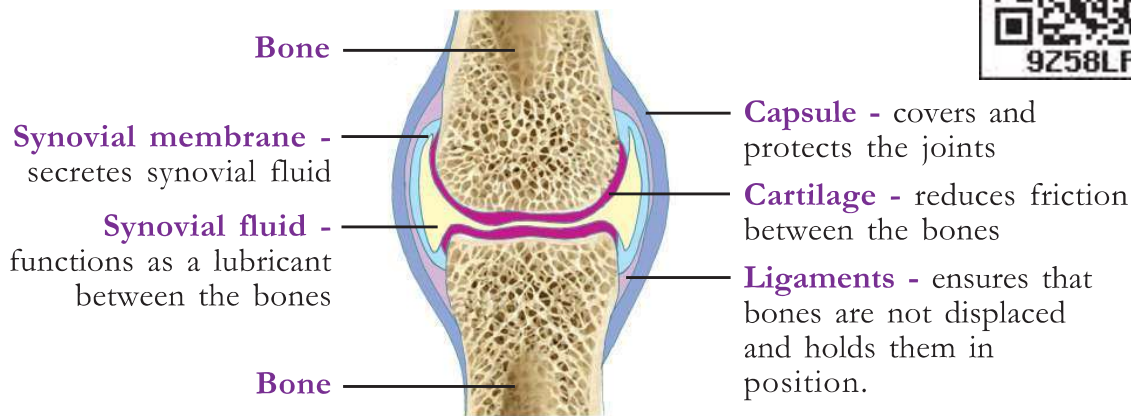


Figure 6.4 A typical joint

### Indicators

- Role of synovial fluid and cartilage in the smooth functioning of joints
- Function of ligaments
- Function of capsule

The functions of the skeletal system are not limited to facilitating our movements. List the other functions of the skeletal system.

- Gives shape to the body
- Helps in hearing
- .....

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

#### Rheumatic Arthritis

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

#### Dislocation

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

**Sprain**

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

**Osteoporosis**

- A condition in which bones become brittle and cause fracture.
- This may be due to the deficiency of calcium, defects in metabolic activities and deficiency of Vitamin D.
- Severely affects hip bone, wrist and vertebral column.

**Muscular dystrophy**

- A condition that leads to degeneration of muscles due to various reasons.
- Muscles become weak.
- Generally affect boys.



Figure 6.5 Organisms with exoskeleton

**Skeleton outside the muscles**

In all vertebrates, skeleton is seen inside muscles. So it is called endoskeleton. Don't you remember studying about invertebrates? Invertebrates possess exoskeleton even though they do not have bones inside the body. Organisms that have endoskeleton also possess remnants of exoskeleton. Observe the organisms seen around and complete the table 6.4.

Organisms	Parts of exoskeleton
Humans	Nail, Hair
Reptiles	Scales, Nail

Table 6.4

**Locomotion without skeleton**

Movement is a common feature of life. There are organisms which move without skeleton. They have special means for movement. Read the description given below and draw inferences on different types of movement.

### Paramecium

Cilia enable movement of Paramecium in water. Cilia are small protein filaments seen on the cell surface.

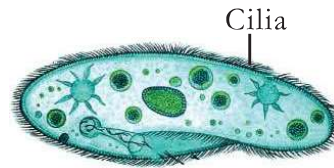


Figure 6.6 Paramecium

### Euglena

Locomotory structures of the Euglena are flagellum. These are long whip-like protein filaments.



Figure 6.7 Euglena

### Earthworm

There are two types of muscles in earthworm. They are circular muscles and longitudinal muscles. Locomotion in earthworm is effected by the rhythmic contraction and relaxation of these muscles. Apart from these muscles, tiny structures projecting out from the body called setae also help in locomotion.

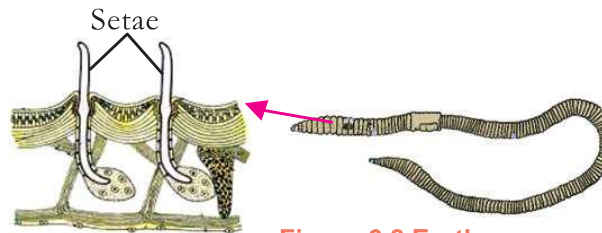


Figure 6.8 Earthworm

### Locomotion and Movement

Have you thought about the difference between movement and locomotion?

Movement is the displacement occurring in any part of the body. Displacement of the entire body is called locomotion. Look at nature. We can see a great diversity in the mode of locomotion in the animal world. Prepare an album collecting information on the diversity of locomotion in animal world.



Arctic tern

This gallivant travels every year to and fro between the north pole and the south pole.



Monarch butterfly

A beautiful short lived butterfly with its life dedicated for migration.



Humpback whale

A giant mammal that travels upto 5000 kilometers for food and reproduction.

Figure 6.9

## Do plants move?

What is your opinion?

Plants exhibit movements in response to various stimuli. Light, gravity, water, touch, chemicals etc., are various stimuli which cause movements in plants. Analyse illustration 6.3 and complete table 6.5 given below.

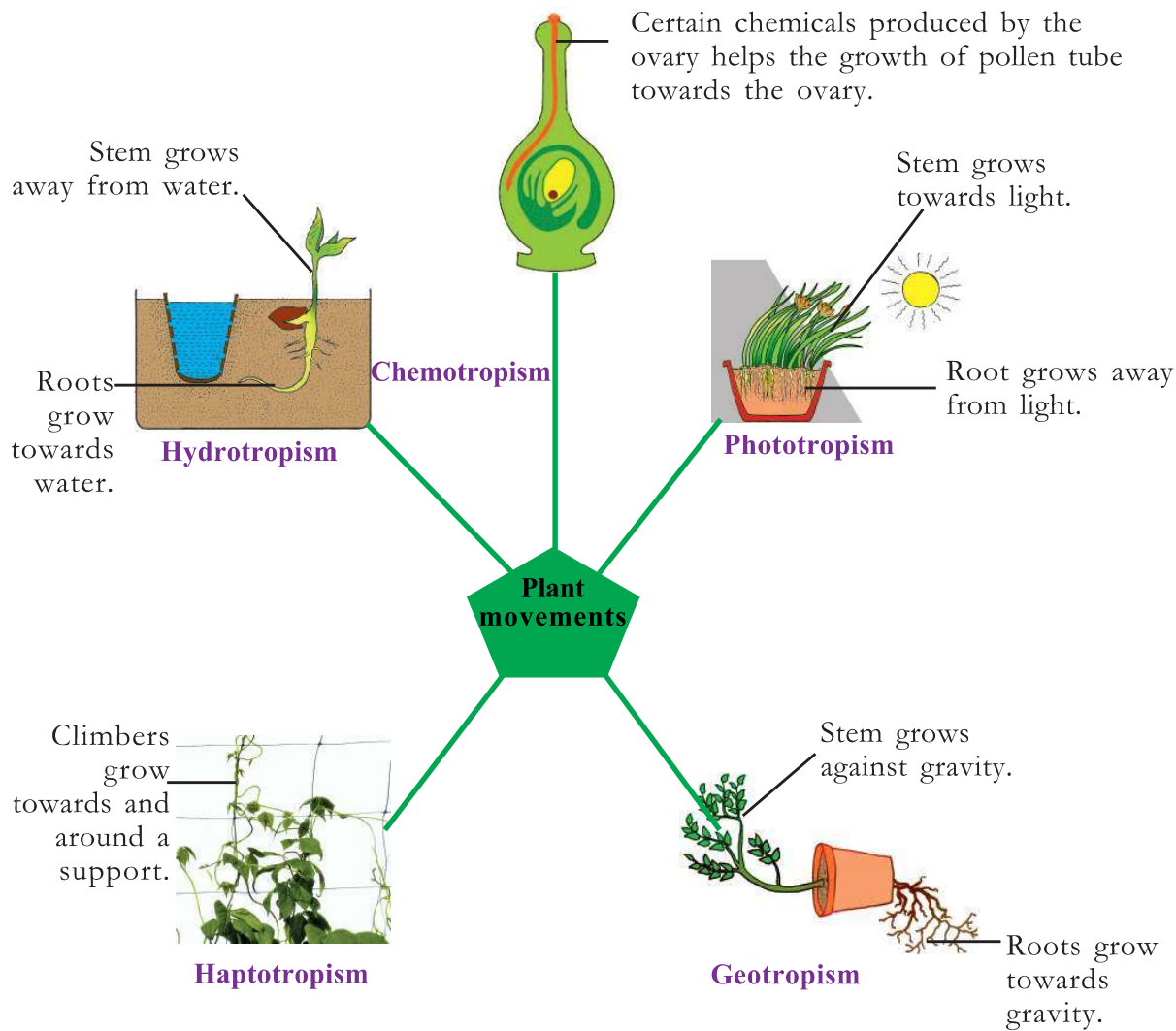


Illustration 6.3 Various types of plant movements

Do you see any relation between the direction of stimulus and direction of movement in the illustration?



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

Table 6.5

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

You are very much familiar with Mimosa (touch-me-not). What is its peculiarity? Observe figure 6.10.



Figure 6.10 Movement in touch-me-not plant

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

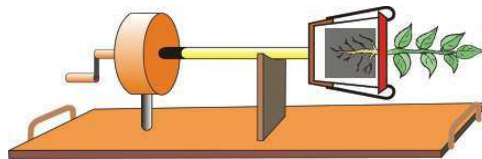
If the direction of plant movement is not in accordance with the stimulus, it is called nastic movement. Collect more examples for nastic movements from your surroundings.

We have studied different types of movements in the human body. How many complex activities take place in a split second! The combined action of the skeletal system and the muscular system help to maintain the beautiful shape of our body and the movement of body. Shouldn't we need to protect these organ systems with utmost care?



### Let us Assess

1. What is the reason for muscle fatigue?
  - A. Lack of glucose in muscle cells.
  - B. Lack of oxygen in muscle cells.
  - C. Increase in the level of carbon dioxide in muscle cells.
  - D. Cellular respiration ceases.
2. Observe the figure and answer the following questions.

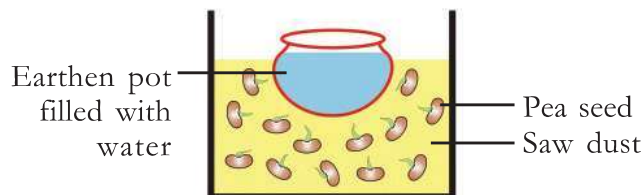


- a. What changes do you observe in the growth of root and stem in a plant, if it is kept stationary as shown in the figure for a few days. Why?
  - b. If the apparatus is rotated gently and continuously, what change would you observe in its root and stem?
3. Identify the odd one and give reason.
  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



### Extended Activities

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



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

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

# 7

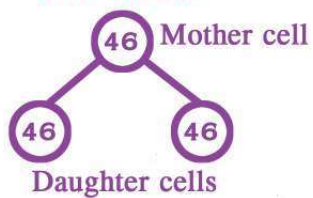
## Division for Growth and Reproduction

*When a cell divides into two, shouldn't the chromosome number - 46, be halved?*

### Division for growth

Human chromosome number : 46

Cell division



Did you notice the student's doubt?

Life begins from a single cell, the zygote. You might have understood the importance of cell division from this. However, can growth be attained by cell division alone?

Based on the indicators, analyse illustration 7.1 and the description, and prepare notes in the Science diary.

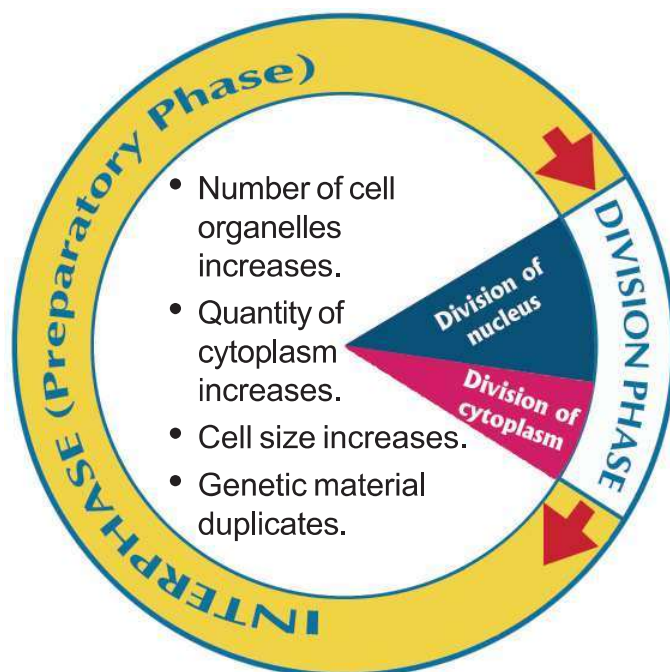


Illustration 7.1 Cell cycle

A cell attains its complete growth during interphase. The fully grown cell undergoes division and becomes daughter cells. As the interphase and the division phase get repeated in a cyclic manner, they together constitute the cell cycle. Growth of the body is brought about by cell division and cell growth.

### Indicators

- Main stages of cell division
- Important changes that take place during interphase
- Cell cycle and cell growth

Hope you have understood the relationship between cell division and cell growth. There are two types of cell division - mitosis and meiosis.

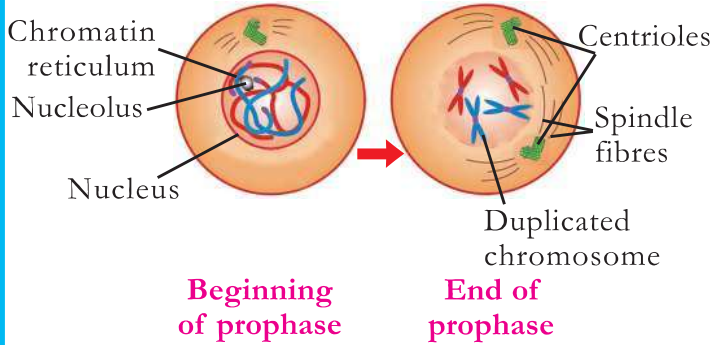
### Mitosis

Mitosis is the type of cell division that helps in the growth of the body. This is a process by which a mother cell divides into two daughter cells. During mitosis, division of nucleus takes place first. This phase is known as karyokinesis.

## Karyokinesis

The division of nucleus is completed through four phases. Analyse illustration 7.2 based on the indicators and complete table 7.1 on the changes that occur during the division of nucleus.

### Prophase

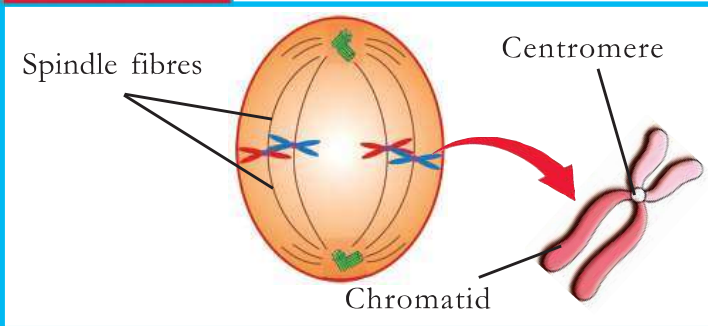


### Indicators

- Changes that occur in the chromatin reticulum.
- Number of chromosomes.
- Changes that occur in the nucleus and nuclear membrane.
- Formation of spindle fibres.

As centrosomes are absent in plant cells, spindle fibres are formed without centrioles.

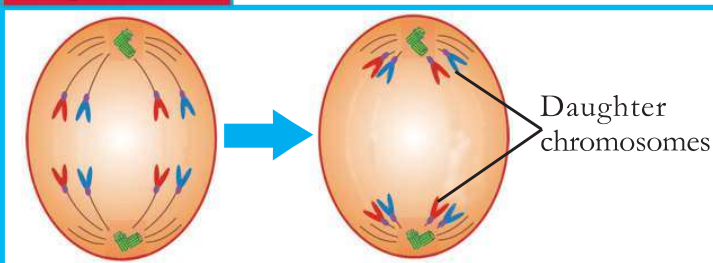
### Metaphase



- Position and arrangement of chromosomes.
- Spindle fibres and chromosomes.

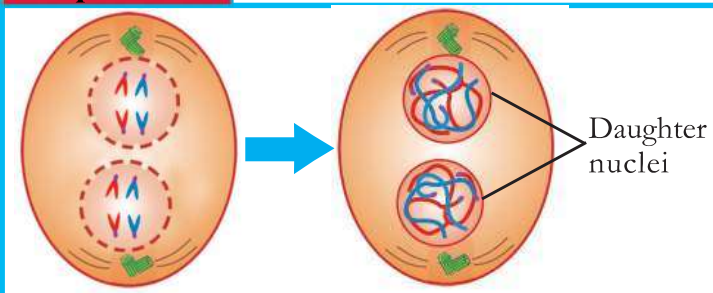


### Anaphase



- Changes that take place in chromatids.
- Formation of daughter chromosomes.

### Telophase



- Formation of daughter nuclei.
- Number of daughter nuclei.
- Number of chromosomes in each daughter nucleus.

Illustration 7.2 Stages of nuclear division

Nuclear division	
Stages	Changes

Table 7.1

When the division of nucleus gets completed, two daughter nuclei are formed in the mother cell. You understood that there will be no change in their chromosome number. Did the existing cell has changed into two daughter cells? How does this cell become two daughter cells?

Cell division becomes completed only after the division of cytoplasm. Division of cytoplasm is known as cytokinesis. The stages in the division of nucleus is almost similar in animal cells and plant cells. However, is the division of cytoplasm similar in animal cells and plant cells? Observe illustrations 7.3, 7.4 and list out the differences between them.



**Cytokinesis**

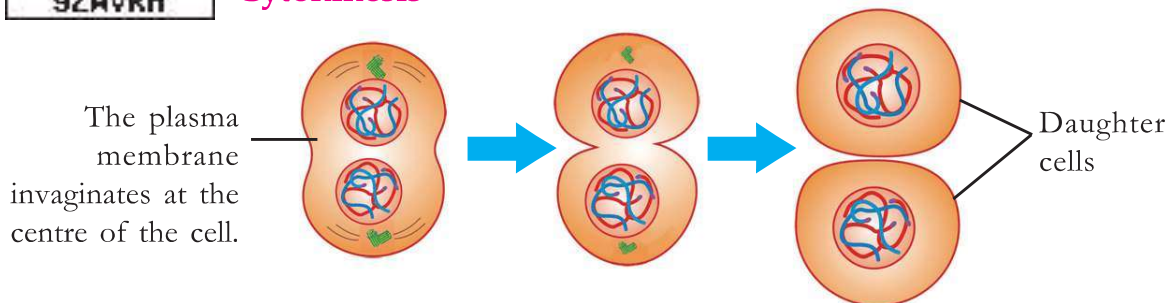


Illustration 7.3 Division of cytoplasm - Animal cell

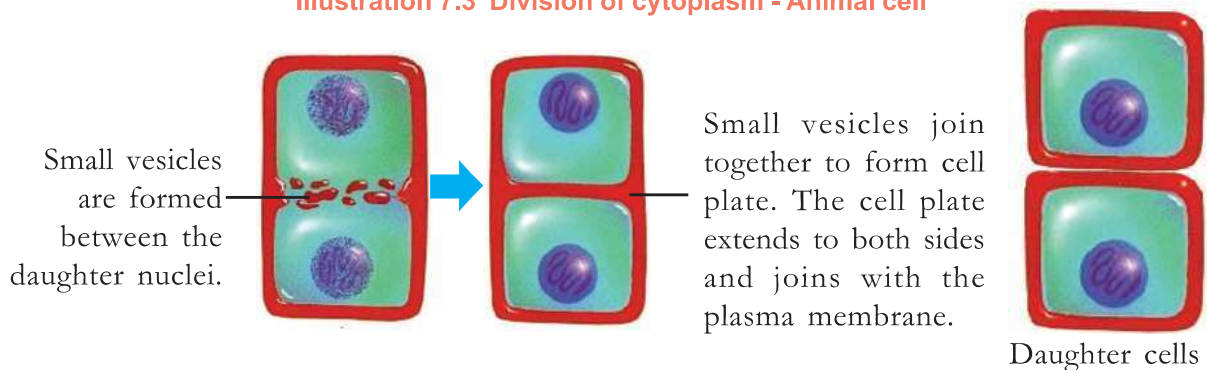


Illustration 7.4 Division of cytoplasm – Plant cell

## Indicators

- Changes which occur to plasma membrane.
- Formation of cell plate.

The daughter cells formed as a result of cell division grow and divide further. At each division, the cell divides after the duplication of genetic material. Hence, there will not be any change in the chromosome number even if the cell divides several times. This is the characteristic of mitosis.

Observe the process of mitosis which takes place at the tip of an onion root with the help of your teacher and prepare a practical record.



Mitosis is a controlled process. A disruption in this controlled process leads to the excessive division of a cell and its proliferation. This condition leads to cancer.

Mitosis makes repair of tissues and growth of the body possible.

## Different stages of growth

You have studied different stages in the growth of human beings in previous classes.

List out the stages.

- Zygote
- Embryo
- Foetus
- 

Adolescence is the period of peculiarities in the growth of human beings. The adolescent period is between 10 to 19 years of age. The growth of an individual is complete by the beginning of the twenties. The body does not grow thereafter. Then the person proceeds to old age. However, it takes a few more years for a person to show the signs of old age.

Old age is an inevitability of life.

## Characteristics of Old age

Changes, quite different from other stages occur in old age. What are the physical peculiarities of old age?

Analyse the facts given below.

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



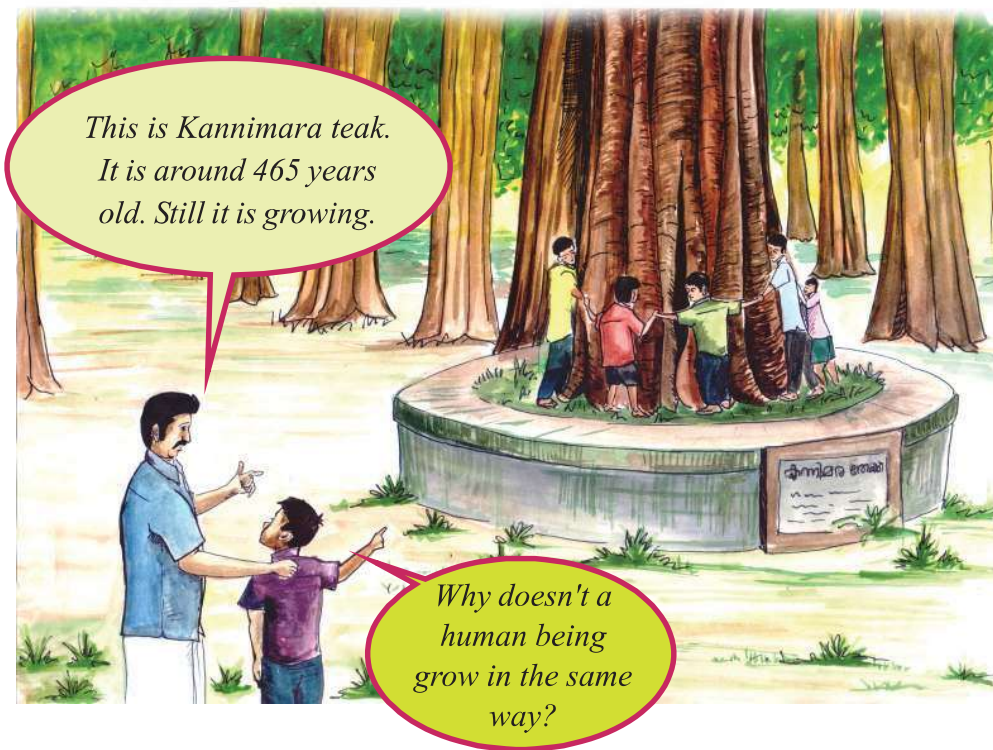
Do you help elders in this way?

Remember, one day we also will become old. How should we behave to elders? What should be our attitude towards them? Discuss in class.

You have understood that there are different stages in human life. The growth of mankind is a combination of social and cultural peculiarities. But, in the case of other organisms growth includes biological specialities only. Even among them plant growth and animal growth are not similar.

Observe the cartoon.





Isn't the student's doubt genuine?

Is the growth of a tree and that of a human being same?

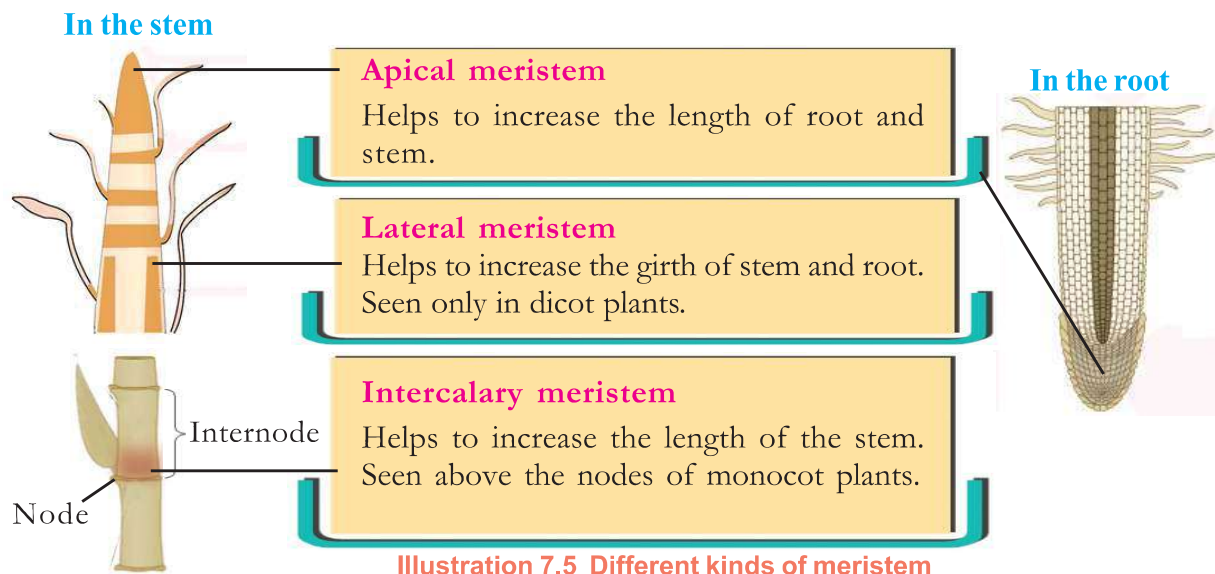
What are the differences between the growth in plants and animals? Draw a comparison and complete table 7.2.

Animals	Plants
<ul style="list-style-type: none"> <li>Animals grow only up to a certain stage.</li> </ul>	<ul style="list-style-type: none"> <li></li> </ul>
<ul style="list-style-type: none"> <li></li> </ul>	<ul style="list-style-type: none"> <li></li> </ul>

Table 7.2

You know that plants grow due to the rapid division and differentiation of meristematic cells. Plants can grow throughout their lives due to the presence of meristematic cells.

Where are the meristemic cells located in plants? Analyse illustration 7.5 based on the indicators and prepare notes.



### Indicators

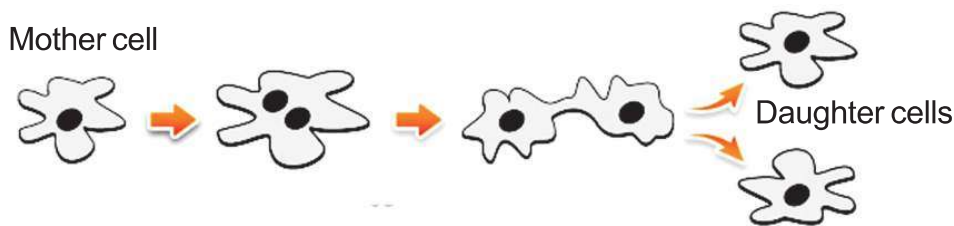
- Why is it that growth in plants is localised only at certain parts?
- The stem of monocots increases in length faster than dicots. Why?
- The stem of monocots does not increase its girth beyond an extent. Why?

Unlike plants, animals do not have localised centres of growth. In animals during growth phase, growth takes place in almost all body parts.

Aren't there organisms which grow in a manner different from both plants and animals?

### Growth in Unicellular Organisms

Is the growth of unicellular and multicellular organisms similar? Does cell division in unicellular organisms lead to growth or reproduction? Observe the illustration of cell division in Amoeba and form inferences.

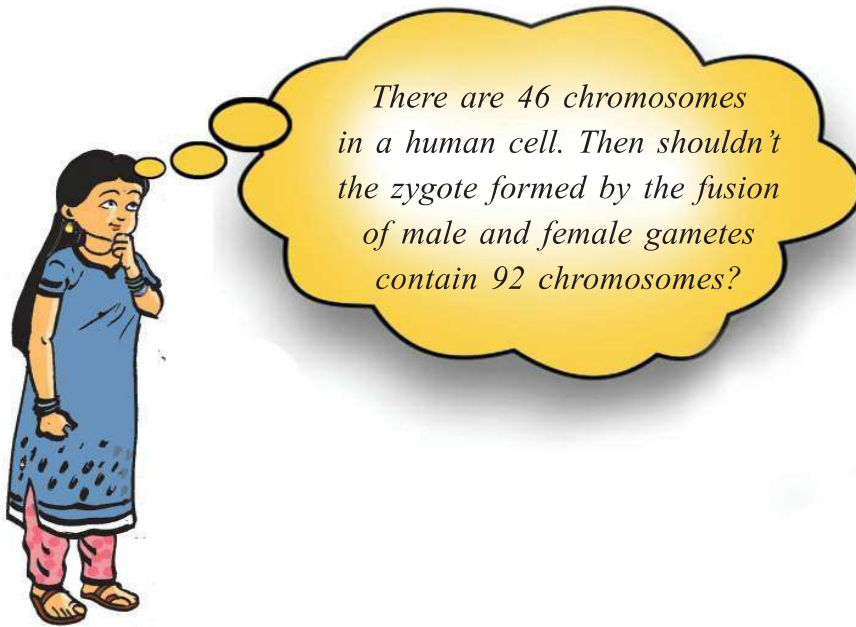


**Illustration 7.6 Division in Amoeba**

You have understood that mitosis leads to reproduction in unicellular organisms. But, how far is this applicable to sexually reproducing organisms?

Does mitosis alone take place in the body?

Observe the cartoon given below.



Have you had such doubts? Observe illustration 7.7 given below and form inferences.

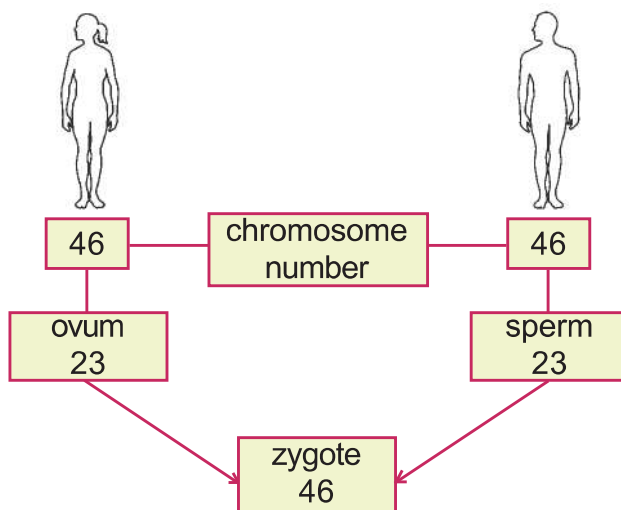


Illustration 7.7

Analyse the description and illustration 7.8, based on the indicators and check the validity of inferences.

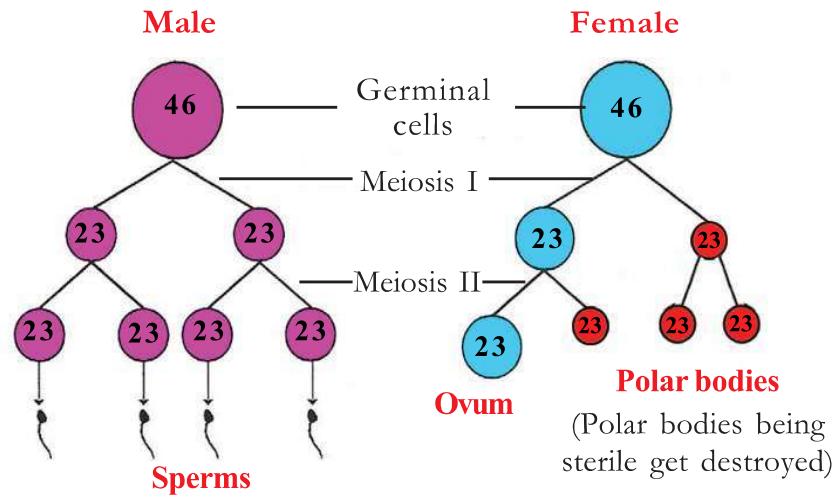


Illustration 7.8 Meiosis



### Meiosis

Meiosis is the mode of cell division in which gametes are formed. Meiosis occurs in the germinal cells of the reproductive organs. Germinal cells in humans have 46 chromosomes and they divide twice continuously. These divisions in meiosis are known as Meiosis I and Meiosis II respectively. In meiosis I, the chromosome number becomes half. As a result, two daughter cells, each having 23 chromosomes are formed. In meiosis II, each daughter cell again divides. Meiosis II is similar to mitosis. In meiosis II the chromosome number does not change.

In males, after meiosis, four sperms having 23 chromosomes are formed from a single germinal cell. But in females, only a single ovum is formed from one germinal cell.

#### Indicators

- Number of chromosomes in germinal cells.
- Difference of meiosis I from mitosis.
- Similarity between meiosis II and mitosis.

- Difference in the number of sperm and ovum formed from one germinal cell.

You have understood how the chromosome number becomes 46 in the zygote, formed by the fusion of male and female gametes. In sexually reproducing organisms, it is through meiosis that the chromosome number is maintained constant even after generations.

Compare mitosis and meiosis and complete table 7.3.

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

**Table 7.3 Mitosis and meiosis**

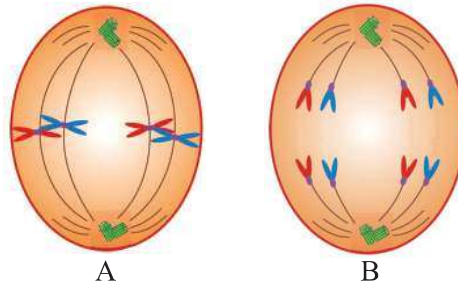
Body growth and development depend on cell division. Peculiarities in cell division ensure the uniqueness and continuity of organisms. Body growth should be in equilibrium. The disruption in the equilibrium of cell division leads to diseases like cancer. Similarly, the unbalanced growth and development of society may lead to the destruction of environment and cause natural calamities.



### Let us Assess

- The stage of karyokinesis in which daughter nuclei are formed.
  - Prophase
  - Metaphase
  - Anaphase
  - Telophase
- List the meristems in various parts of the plant and list their functions.
- In females, only a single ovum is formed from a germinal cell, whereas in males, more than one sperm is formed. Give reason.

4. Observe the figures.



- a. Which stages of mitosis are indicated in the figures ?
- b. What are the changes that occur in the chromosomes during these stages?



### Extended activities

1. Conduct a seminar at the class level to create awareness on 'What should be our attitude towards the old people'.
2. Watch time-lapse videos that help to observe growth in plants, by visiting relevant Science websites.

## NOTES

A large blue rectangular area with a red border, containing horizontal dashed lines for writing notes.

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

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

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

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

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

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

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