

BASIC SCIENCE

PART - 2

STANDARD VIII



**Government of Kerala
Department of General Education**

Prepared by

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

2025

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 my parents, teachers and all elders, respect 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.

BASIC SCIENCE

VIII

Prepared by

State Council of Educational Research and Training (SCERT)

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Friends,

This textbook contains fundamental information and a variety of activities for observing deeply and studying the environment in which we live. When you observe in this way, you can understand the features of creatures and things, and the connections among them. The book also provides the opportunity to understand the basic factors that influence human life as a social animal. This book includes many activities that you can do along with your friends. The Basic Science textbook offers occasions for creating knowledge through fun activities including observation, queries, discussions, debates, simple experiments, and projects. We hope that the information given in the textbook will prompt you to seek out further knowledge.

Learn and enjoy..

Wishes,

Dr. Jayaprakash R. K.

Director
SCERT, Kerala

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THE CONSTITUTION OF INDIA

PREAMBLE

WE, THE PEOPLE OF INDIA, having solemnly resolved to constitute India into a **¹[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 **²[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)

STATIC ELECTRICITY



Fig. 10.1

Look at the picture. Have you ever noticed the technicians in authorized mobile repair shops wearing gloves like this? Here, how might the teacher have resolved the children's doubt?

Rub a balloon on dry hair. Bring it near the end of hair strands.

Can you see the hairs being attracted to the balloon?

Arrange a small piece of folded paper at the tip of a pencil (Figure 10.3). Bring a plastic pen near the piece of paper. What do you observe?

Now rub the pen well on dry hair and bring it near the paper. What difference do you notice?

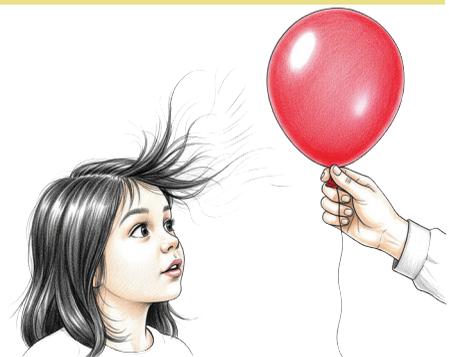


Fig. 10.2

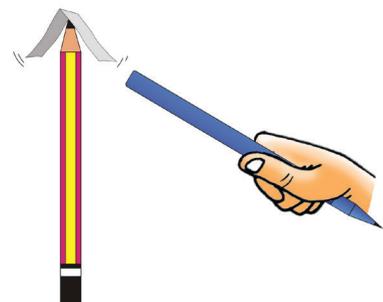


Fig. 10.3

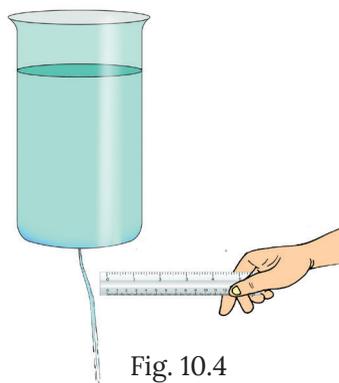


Fig. 10.4

Take a water filled container with a hole at the bottom. Hold a plastic scale near the water stream. (Figure 10.4) Is there any change for the water stream?

Hold the scale after rubbing it well on dry hair. What do you observe?

Write it down.

What can you infer from the activities done so far?

Rubbed objects can attract others, right?

Now rub the pair of objects given below against each other. Check if they can attract small pieces of paper. Can you find new rubbing pairs? Add your findings to the table.

Sl No	Object used for rubbing		Attracts small pieces of paper / Doesn't attract (X)
1	Glass rod	Silk	✓
2	Polyester Cloth	Steel spoon	×
3	PVC pipe	Polyethene	✓
4			

Table 10.1

Analyse the table. Do all objects gain the ability to attract when rubbed?

When some pairs of objects are rubbed against each other, some of them gain the ability to attract other objects.

This ability to attract when rubbed is due to the accumulation of electric charge. What are electric charges?

Electric charge is the fundamental factor that causes attraction or repulsion between objects. There are two types of charges: positive and negative.

All substances are made up of atoms, which are the basic building blocks. The attraction between objects is due to the charge gained by atoms.

Inside an Atom

The main particles of an atom are illustrated below. Let's analyse the figure.

- What are the main particles in an atom?
- The central part of an atom is the nucleus. What are the main particles in the nucleus?
- What is the charge of each of these particle?
- Electrons revolve around the nucleus. What is the charge of electrons?

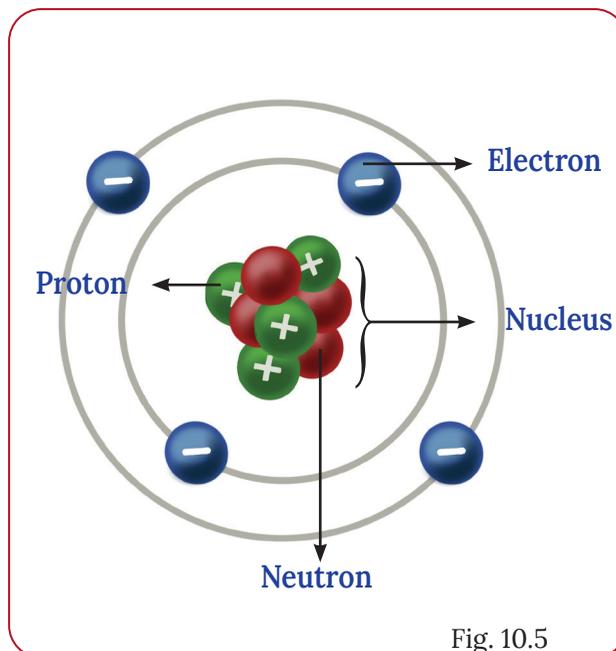


Fig. 10.5

Electrons have a charge opposite to that of protons. Therefore, in atoms with an equal number of both, the charges will cancel each other out. Neutrons have no charge.

If so, find the charge of atoms in the table given below.

No.of Protons	No. of Electrons	Charge
26	26	Positive/Negative/Neutral
26	24	Positive/Negative/Neutral
17	16	Positive/Negative/Neutral

Table 10.2

Answer the questions given below based on the table.

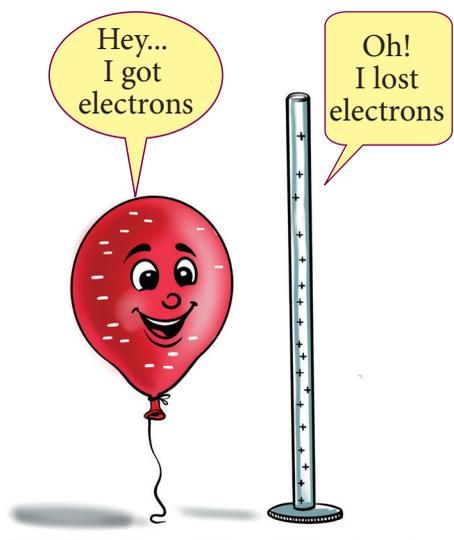


Fig. 10.6

- What is the reason for an atom to be electrically neutral?
- What is the charge obtained if the number of electrons in an atom is greater than the number of protons?
- What is the charge obtained if the number of protons in an atom is greater than the number of electrons?

When rubbed, substances get charged due to the transfer of electrons. This changes the number of electrons in the atom.

When an atom loses electrons, it becomes positively charged and when it gains electrons, it becomes negatively charged.

Complete the table given below based on the discussions so far.

Pair of objects used for rubbing and electron transfer between them		Charge gained	
Pair of objects	Electron transfer	Positive	Negative
Glass rod, Silk	Glass rod loses electrons	Glass rod	Silk
Ebonite, Woollen cloth		Woollen cloth	
Rubber, Woollen cloth		Woollen cloth	

Table 10.3

There can be attraction or repulsion between charged objects. This will depend on the characteristics of the charge.

Characteristics of Electric Charges

Hang two rubber balloons touching each other. Rub them together with a piece of wool in between [Figure 10.7(a)]. Remove the wool. Can you see the balloons repelling each other? [Figure 10.7(b)]

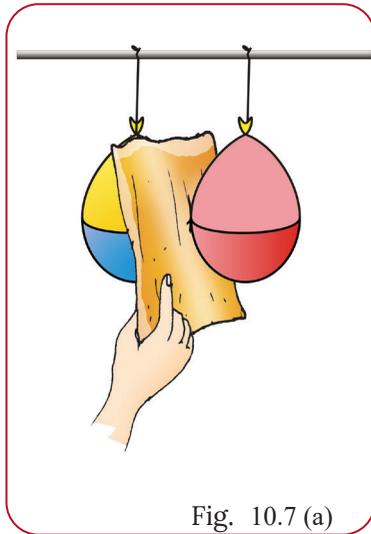


Fig. 10.7 (a)

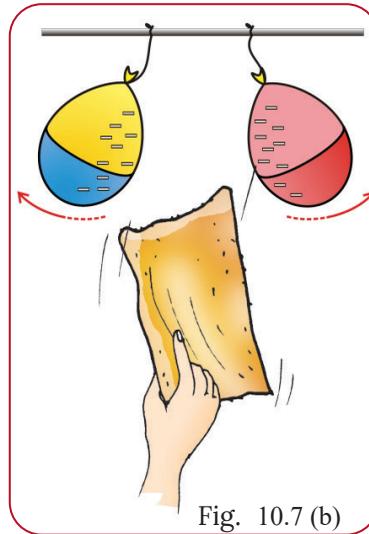


Fig. 10.7 (b)

- What charge do balloons gain when rubbed with wool?

Positive / Negative

What can be understood from the repulsion between them?

Like charges repel.

Bring the rubbed part of the wool near the balloon. What do you observe?

Is the balloon attracted to the wool?

- What charge does the wool gain after rubbing?

Positive / Negative

What can be understood from the attraction between them?

Unlike charges attract.

Do charged objects attract uncharged (neutral) objects? In the experiments shown in Figure 10.3 and Figure 10.4, did the piece of paper and the water stream have a charge? Weren't they still attracted? Let's try another experiment.

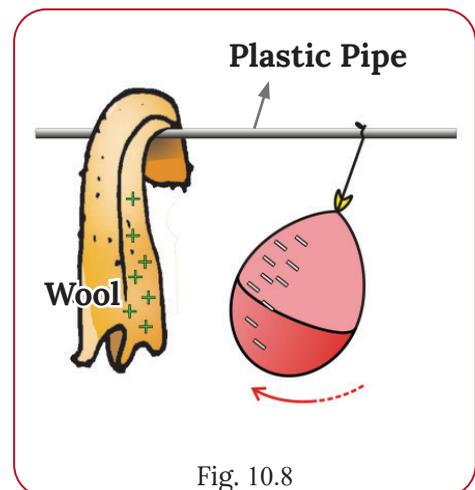


Fig. 10.8

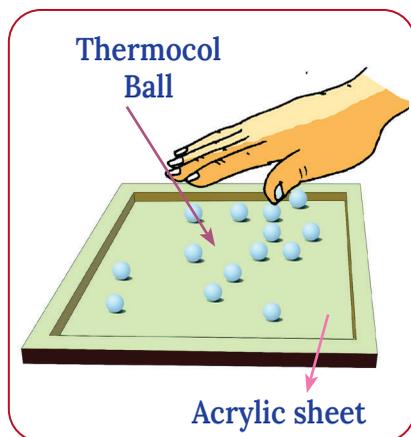


Fig. 10.9

Place a few thermocol balls in a plastic tray. Arrange a transparent acrylic sheet on the tray (Fig. 10.9). Charge the acrylic sheet by rubbing it with wool/by hand. Doesn't the acrylic sheet attract the thermocol balls? What can be inferred?

Charged objects have the ability to attract neutral objects.

Is attraction or repulsion the most suitable indication to confirm the charge of an object? If two objects attract each other, can it be confirmed that both are charged? What if they repel?

The most suitable indicator to confirm the charge of two objects is not attraction, but repulsion.

Static Electricity

Electricity is a form of energy produced due to the presence or flow of charges.

The process of making objects charged through electron transfer is called charging. Insulators are substances that do not conduct electricity. If charge accumulates in them, it remains in the same place without being able to flow. The electricity obtained in this way is called static electricity.

If electric charge remains in the same place without being able to flow, such electricity is called static electricity.

We have become familiar with the method of charging by rubbing. What are the other methods of charging?

Charging by Conduction

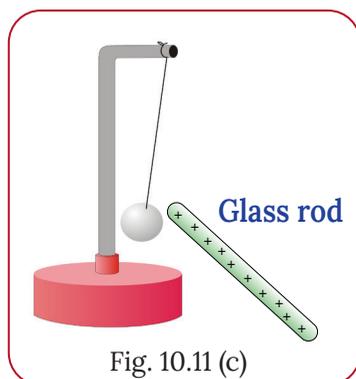
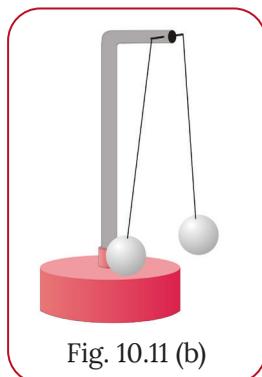
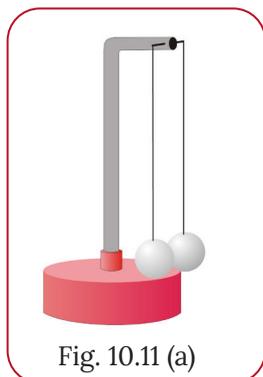
Hang two pith balls by a thread in such a way that they touch each other. Look at Figure 10.11 (a). Rub a glass rod with a silk cloth and touch it to the pith balls.

Can static electricity light up a bulb



Fig. 10.10

What do you observe? Look at Figure 10.11 (b). Again, bring the glass rod near the pith ball as in the figure 10.11 (c).



After touching the glass rod	Observations
Between the pith balls (Figure 10.11b)	Attraction / Repulsion
Between the pith balls and glass rod (Figure 10.11c)	Attraction / Repulsion

Table 10.4

What charge does a glass rod acquire when rubbed with a silk cloth? According to the table, what is the charge of the pith balls? Were the pith balls charged here by contact?

Charging by conduction is the method of charging an object by direct physical contact with a charged object. Here, the two objects that come into contact will have similar charges.



Static Electricity and Atmospheric Humidity

Humidity is the amount of water vapour in the atmosphere. It is very closely related to static electricity. At high humidity, the amount of water vapour in the atmosphere is high. This makes the surrounding air conductive, causing objects to lose static charges. Therefore, when atmospheric humidity increases, static charges cannot be retained on objects. At the same time, at low humidity, the amount of water vapor in the atmosphere is low. This helps charges accumulate on objects. The effects of static charges are very common in the places with low atmospheric humidity.

The method of charging a metal sphere using a negatively charged glass rod is shown in the picture. Observe the picture and write down the different steps.

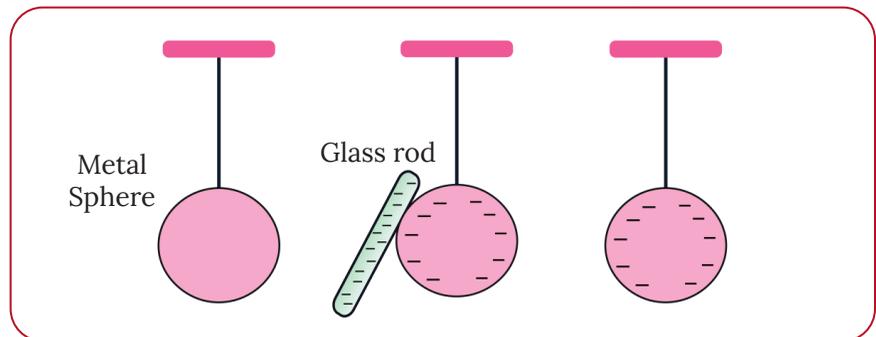


Fig. 10.12

Applications of Static Electricity

When objects are rubbed or touched, electrical charges may accumulate on them. Where do we make use of this static electricity? Look at the picture to see how materials are given appropriate charges and used in various situations. Prepare a study note.

Observe the picture of electrostatic spray painting of vehicles in workshops.

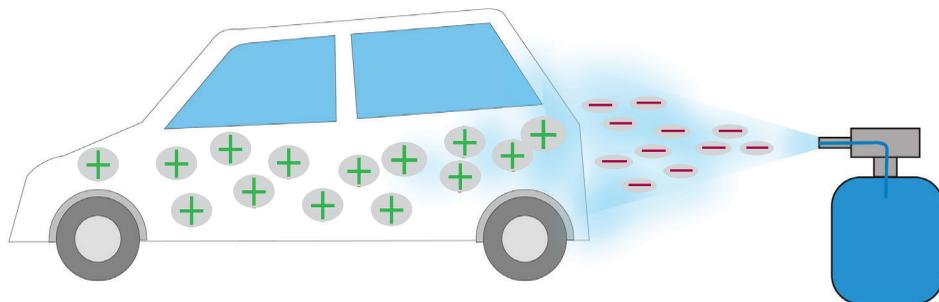


Figure 10.13

- What is the charge of the paint droplets?
- What is the charge of the part to be painted?
- Why do paint droplets stick to the charged surface?

The functioning of a photocopier machine is shown in the image. While printing, a distribution of positive charges can be seen on the surface of the drum in the shape of the characters to be photocopied (e.g., the letter A).

- What is the charge given to the toner particles here?
- What causes the toner particles to stick to the drum as it rotates?
- What is the charge given to the paper?
- Why do the toner particles stick to the paper?

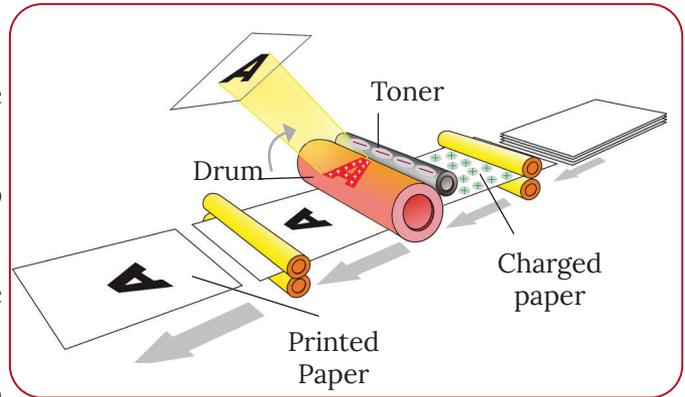


Fig. 10.14



How a Photocopier Machine Works?

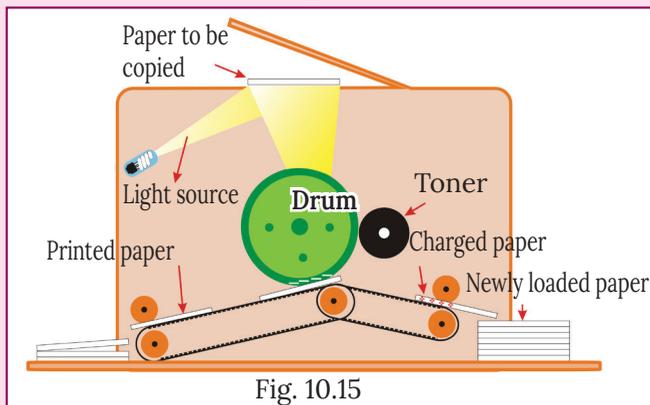


Fig. 10.15

The main part of a photocopier machine is a photo-conductive drum. A static positive charge will always be maintained on the surface of the drum.

The document to be copied is placed on the glass plate above the drum, and intense light is projected onto it. Light will reflect from the white parts of the document and fall on the drum. With this, the parts of the

drum where light falls become electrically conductive and the positive charge there is lost. However, the dark areas (text and pictures) in the document do not reflect light. Therefore, the areas on the drum's surface where light did not fall still retain their positive charge. In this way, a distribution of positive charges is formed on the surface of the drum in the shape of the text and pictures.

Negatively charged toner particles are used to trace this distribution of positive charges. When these toner particles pass over the drum's surface, they are attracted and stick to the positive charge distribution, forming an image of the document on the drum's surface.

A new sheet of paper moves towards the drum. This paper will have been given a strong positive charge. Because of this, the toner particles stuck to the drum are attracted to the paper and the image get transferred to the paper. The paper then passes through a fuser unit. This unit permanently attaches the toner particles to the paper. This is how copies of documents are made.



Fig. 10.16

While static electricity has many useful applications, it also has certain disadvantages.

Situations where static electricity is harmful

During long journeys, friction with the air can cause charges to accumulate on vehicles and on the passengers. Will these charges get transferred to other objects? Let's analyse the two situations shown in the image.



Fig. 10.17

Image 10.16 shows small sparks forming on the fingers while touching a door knob. Discuss the reasons for this and record them in your science diary.

Image 10.17 shows charges flowing when a person who has accumulated a charge touches an electronic device. Could this potentially damage the electronic components in the circuit?

Earthing

A charged plastic pen or scale will attract pieces of paper. Now, touch this pen or scale on the ground. Does it still attract? Write down your observations.

Bringing an object in contact with the earth in this manner is called earthing. The symbol \perp indicates earthing. Through earthing, an object loses its charge. What is the reason for this?

The Earth is an electron bank. Due to its size and conductivity, the Earth can donate and receive electrons. Therefore, charged objects are neutralised when earthed.

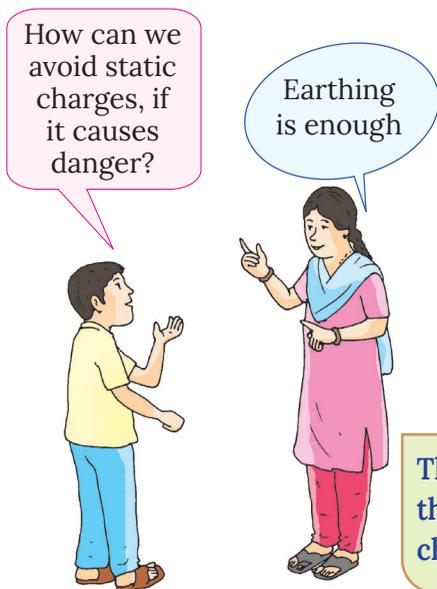


Fig. 10.18

How are positively and negatively charged objects neutralised when earthed? Explain based on the images provided below.

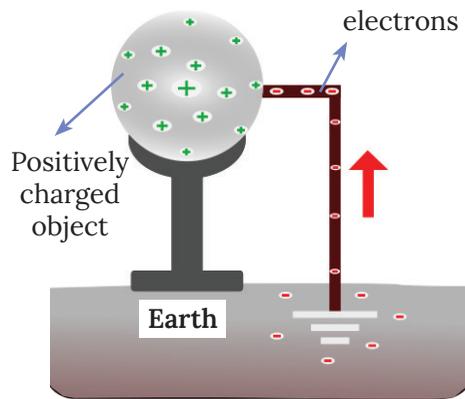


Fig. 10.19 (a)

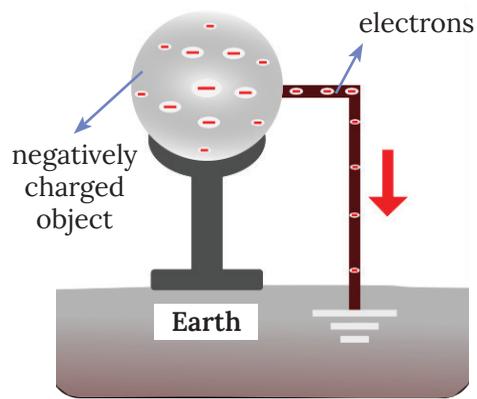


Fig. 10.19 (b)

Observe a child sliding down a ride in the park. Isn't the child's hair unusually raised?

- How did the charge accumulate in the hair?
Through friction/ Through contact
- Can you suggest a method to neutralise the charge?

While repairing electronic devices, static electrical charges can accumulate. These charges are neutralised through earthing. Repair personnel might wear anti-static gloves that are properly earthed.

Now, you might have understood why mobile technicians use anti static gloves.

We have seen some situations where static electricity can be dangerous. Can you write in your science diary about the earthing mechanism in such situations?

We have understood two ways of charging objects by contact. However, is it possible to charge objects without contact?



Fig. 10.20

Charging by Induction

Look at the image showing a negatively charged rod being brought near a metal sphere fixed on an insulating stand.

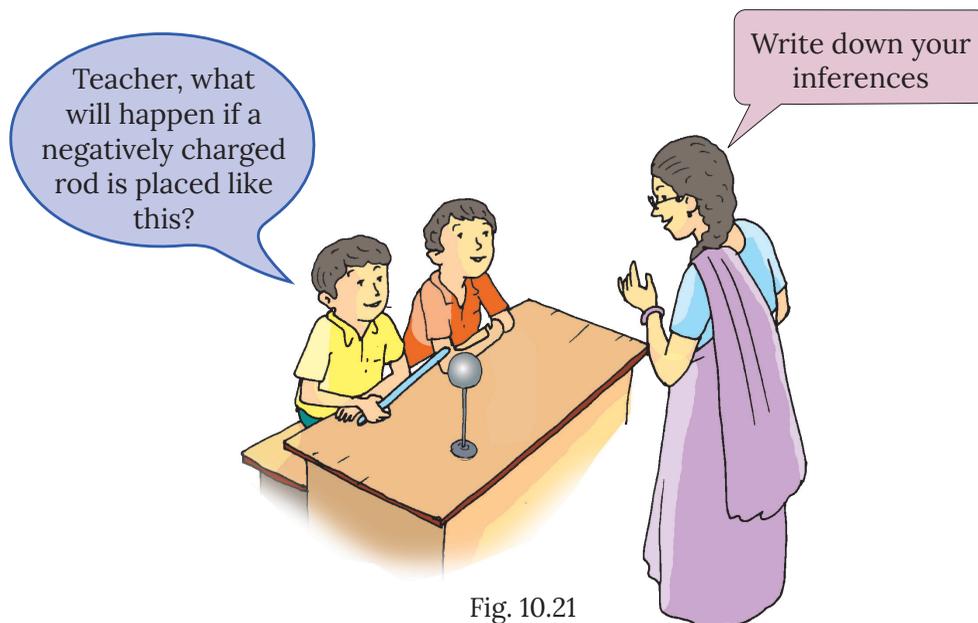


Fig. 10.21

Check the inferences by the students given in the table as suggested by the teacher.

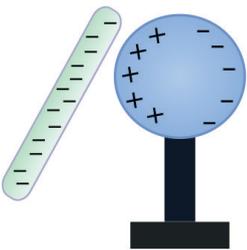
Situation	Inference	Reason
 <p>Fig. 10.22</p> <p>A negatively charged rod is brought near the metal sphere.</p>	<p>Redistribution of charges takes place in the metal sphere.</p>	<p>The electrons in the metal sphere are repelled away from the glass rod.</p>

Table 10.5

Due to the presence of a negatively charged glass rod, a redistribution of charges occurs in the nearby metal sphere. This is called electrostatic induction.

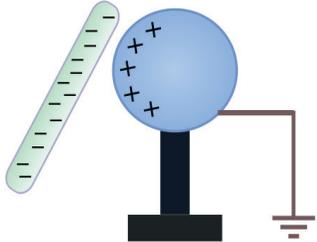
Situation	Inference	Reason
 <p>Fig. 10.23 The metal sphere is earthed.</p>	The metal sphere temporarily gains a positive charge.	The electrons in the sphere are lost due to earthing.

Table 10.6

Now, remove the earthing and then the charged rod. Won't the metal spheres acquire a permanent charge? Here, the rod used for charging did not have any physical contact with the metal spheres. This type of charging method is known as charging by induction.

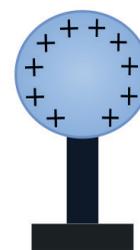


Fig. 10.24

Charging by induction is the method of charging an object without direct physical contact of a charged object.

We have understood how to charge objects in various ways. Is it possible to detect and measure the charge of objects? For this, an instrument called electroscope is used.

Electroscope

Look at the image and write down the parts of an electroscope (Figure 10.25).

- Metal sphere
-

Let's make an electroscope.

Required materials: A transparent plastic bottle, copper wire, cork, aluminium foil.

Make a small hole in the centre of the cork. Insert a part of a straw through the hole and secure it. Pass the copper wire through it. Make a 'V' shape at the end of the copper

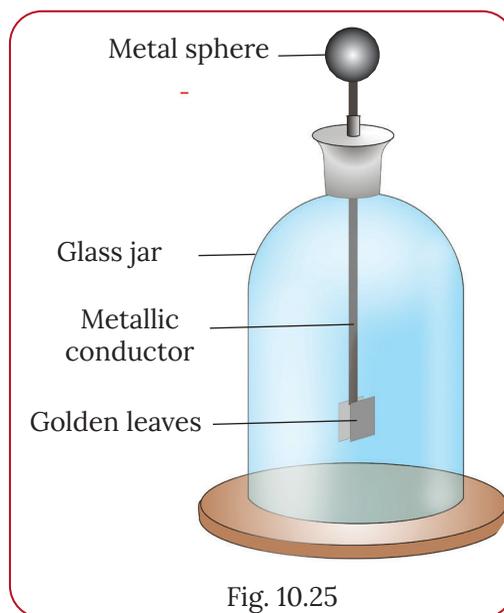


Fig. 10.25

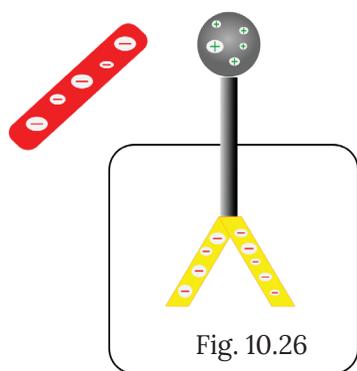


Fig. 10.26

wire and attach two small pieces of aluminium foil to it. These are the 'leaves' of the electroscope. At the other end of the copper wire, stick a ball of aluminium foil. Close the bottle with the cork. Bring a charged glass rod near the metal sphere.

- What do you observe? What is the reason?
- Bring a neutral object nearby. Do the leaves diverge now?

When an electrically charged object is brought near the metal sphere of an electroscope, the divergence between its leaves changes. However, neutral objects cause no movement in the leaves.

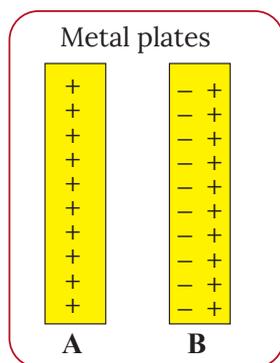


Fig. 10.27

A charged electroscope's leaves will come closer when kept for long. The loss of charge is the reason for this. Is it possible to store charge without losing it?

Capacitor

A capacitor is a device for storing electric charge. For this, place two metal plates, A and B, close together (see Figure 10.27). When plate A is positively charged, observe the induction of charges in B. What if plate B is earthed? Draw the distribution of charges.

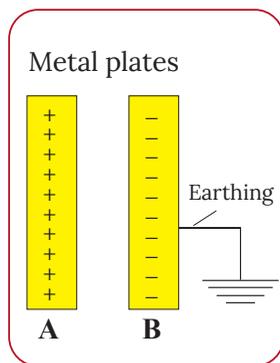


Fig. 10.28

This system can retain electric charge permanently. Its capacity to store charge can also be increased by using suitable insulators between the metal plates.

The ability of a capacitor to store charge is called capacitance. Its SI unit is Farad (F).

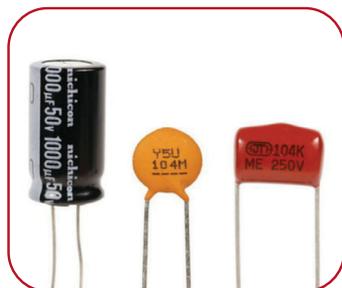


Fig. 10.29

The insulators in capacitors are also called dielectrics. Materials like paper, air, and polyester are commonly used as dielectrics. Different types of capacitors are shown in the picture.

Distribution of Electric Charges

How are charges distributed on a metal surface?

Observe the picture and examine the statements.

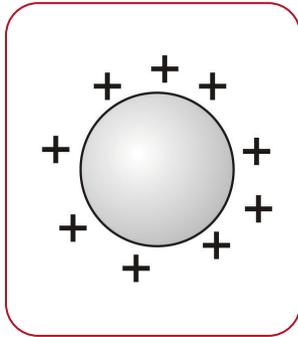


Fig. 10.30 (a)

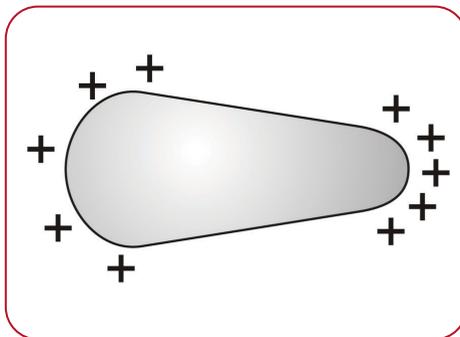


Fig. 10.30 (b)

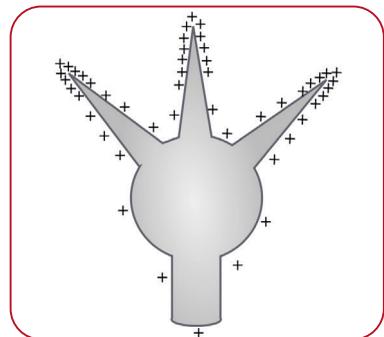


Fig. 10.30 (c)

- In electrical conductors, the charge is distributed only on the surface.
- The amount of charge will be very high at the sharp edges.

The accumulation and discharge of electric charges can cause various natural phenomena. How does lightning occur?

Lightning

Observe Figure 10.31. This is a rare photo of two children taken just before a lightning strike. Have you noticed their hairs standing up towards the sky in it? This is due to the induction of charge by the clouds.



Fig. 10.31

Did you notice the charged clouds shown in the picture. Observe the picture and answer the questions given below.

- How does the cloud get charged?
- What types of charges are accumulated in clouds ?
- Why are the objects on Earth oppositely charged?

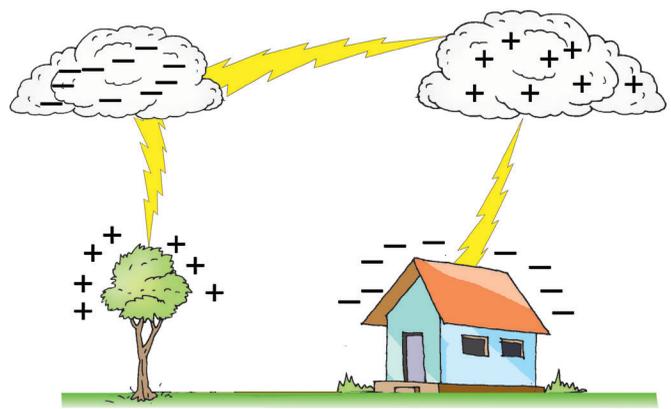


Fig. 10.32

Various air currents in the atmosphere cause positive or negative charges to accumulate in clouds. Electrostatic induction causes opposite charges to appear on objects on Earth. The electric charge thus stored is sufficient to make the air an electrical conductor. This causes electricity to flow through the air in flashes and produce light. This is lightning.

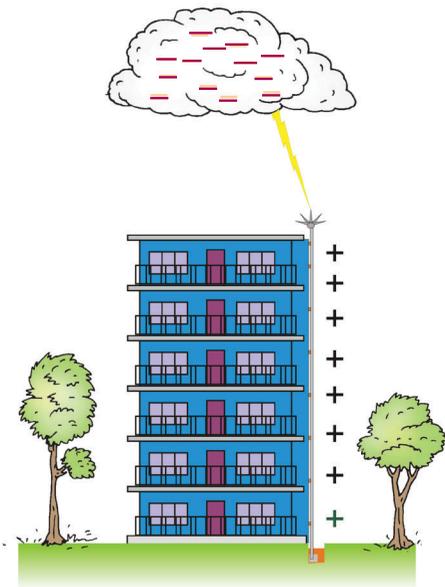


Fig. 10.33

A high amount of electricity flows when lightning occurs. Therefore, the risk is very high. What all can we do to protect ourselves from lightning? Discuss and note down in your science diary.

- Do not seek shelter under tall or isolated trees.
- Do not attempt to operate electrical appliances.
-

Have you seen any other mechanisms to protect from lightning?

Lightning Conductor

If lightning strikes a building, it can cause great damage. To protect from this, a lightning conductor (Figure 10.33) is used.

If the clouds have a negative charge, a positive charge is induced at the sharp points of the lightning conductor. What could be the reason for this? The charge accumulated in the clouds in this way causes lightning. A lightning conductor provides a safe path for the electric charge during a lightning strike to flow into the earth.

What if the clouds have a positive charge? Observe Figure 10.34 and write.

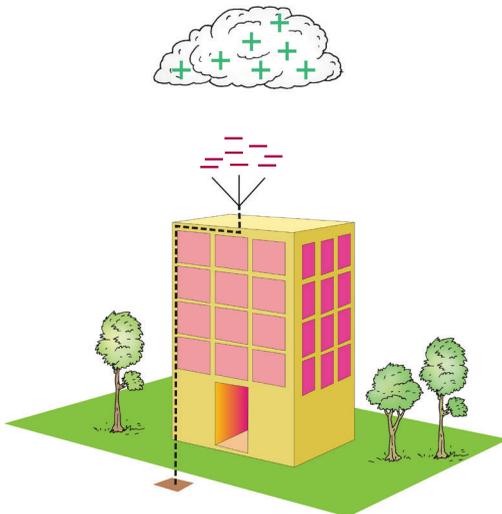


Fig. 10.34

Lightning Arrester

While a lightning conductor protects the entire building from lightning, a lightning arrester is a device used to protect electrical systems from lightning. The lightning arresters used by KSEB are shown in the picture. Visit your nearest KSEB substation and learn more about lightning arresters.



Fig. 10.35 (a)

The dangers of lightning strikes are very serious. What first aid should we provide if a person is struck by lightning?

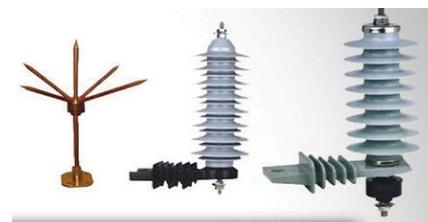


Fig. 10.35 (b)

- The person struck by lightning should be laid flat in a well-ventilated area.
- Massage the entire body to warm it up.
- Provide artificial respiration.
- Apply intermittent, pressure on the chest.
-

Collect more information about the first aid to be taken in such situations from health workers and present it in class.

Let's Assess

1. Assume you are given an object with a positive charge. Write down a suitable method to charge a metal sphere using this.

Object	Charge to be gained	Suitable charging method
Metal sphere	Positive	
Metal sphere	Negative	

2. At petrol pumps, the nozzle used for filling petrol is earthed. Why?

3. A plastic pen can be easily charged by rubbing it on hair. However, this is not possible when a steel spoon is used instead of this. What is the reason?
4. If a positively charged metal object comes into contact with another negatively charged metal object of equal magnitude, determine the charge on both objects.
5. Poorly earthed lightning conductors are more harmful than beneficial. What is the reason?



Extended activities

1. Seat a child on a plastic chair in such a way that both their feet do not touch the ground. Charge the chair using a woolen cloth. Let the child hold one terminal of a Neon bulb, and make another person touch the other terminal. What do you observe? Write down the observations.
2. Prepare and present a seminar on Van de Graff generator.

MAGNETISM AND ELECTRICITY

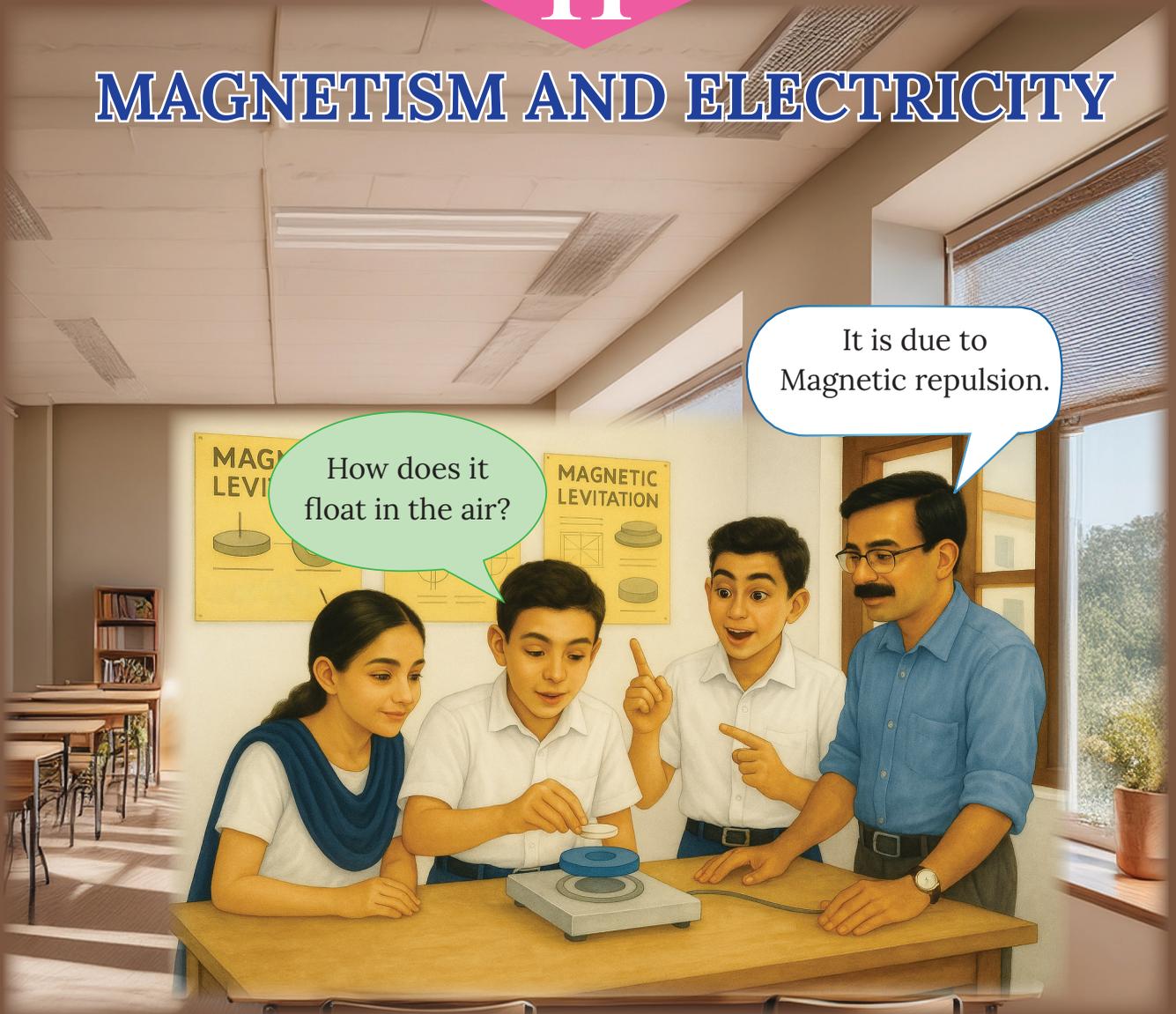


Fig. 11.1

Have you noticed the conversation above ?
As you know, a magnet can both attract and repel.
Don't we use magnets for so many purposes?

Let's look at some examples.

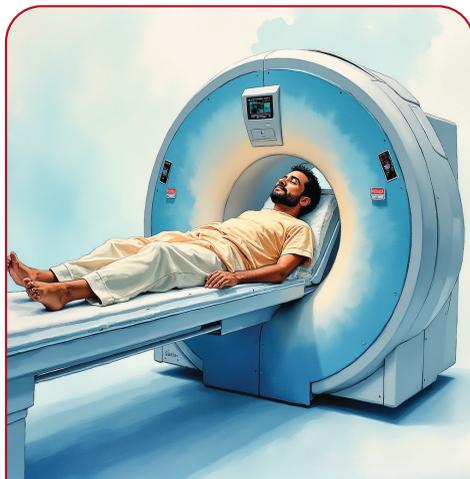


Fig. 11.2

Some situations in which magnets are used are given below. Add more situations.

- MRI scanning
- Headphones
-
-

Are all magnets obtained directly from nature?

Natural magnets and artificial magnets

Natural magnets are the magnets that are obtained directly from nature. An example of this is lodestone. Once people understood that magnets could be made artificially, they began making magnets in the shapes, sizes and strengths they needed. Artificial magnets are made using metal alloys.

Alnico Magnets- These are alloys made from aluminum (Al), nickel (Ni), cobalt (Co) and iron (Fe).

Ceramic/Ferrite Magnets - These are made by mixing iron oxide with carbonates of elements like barium or strontium.

Natural magnet



Fig. 11.3

Some familiar magnets are given below. Complete the table.

Magnet	Name of the magnet
	Magnetic needle
	
	
	
	
	Electromagnet

Table 11.1



Lodestone – The magical stone of magnetism

About 2800 years ago, ancient people in a place called Magnesia found a strange type of stone which had the power to attract iron. They called it the "leading stone" because when it was freely suspended, it always aligned in the north-south direction. This was the first tool of sailors used to find direction. Later, it came to be known as lodestone.

Lodestone was more than just an ordinary stone. Its ability to attract iron amazed people of its time. This power came from a mineral called magnetite. Because Lodestone could interact with the Earth's magnetic field, it served as a natural compass a remarkable property for a simple rock.



Fig. 11.4

Let's find the general properties of a magnet.

General Properties of a Magnet

As you know, a magnet has two poles. What happens when the north pole of a magnet is brought near to the north pole of another magnet ?

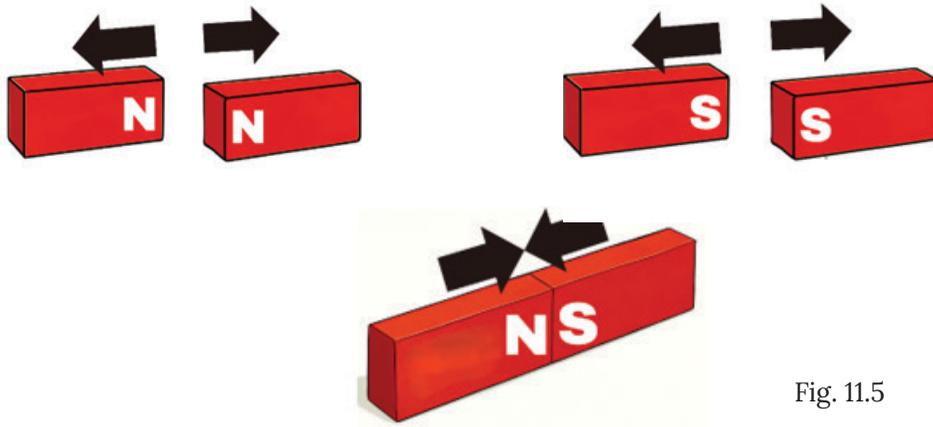


Fig. 11.5

Similarly bring the south pole, observe the changes and complete the table.

Activity	Observation
When the north poles are brought close to each other	Repels
When the north pole and the south pole are brought close to each other	
When the south poles are brought close to each other	

Table 11.2

What conclusion do you reach from the above activities?

Like poles of magnets repel and unlike poles attract.

Look at the picture.

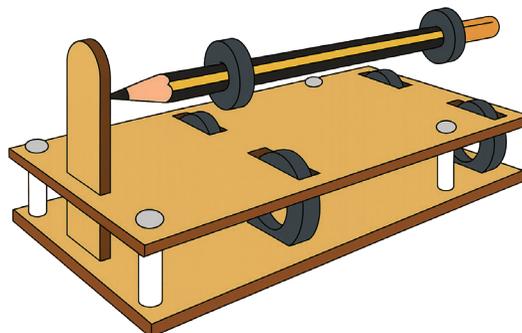


Fig. 11.6

Two magnets are placed on a pencil. Another set of magnet is fixed firmly to a cardboard below it. However, the upper magnet stays at a certain height without touching it. Why is the pencil not falling down and floating in the air like this?

Can you move the pencil backward without touching it? How can it be possible?

What will happen if you bring another magnet near one side of the top magnet?

Do you know if this special property of magnet is used in any technology?

Maglev trains, or magnetic levitation trains, are a type of train that runs without wheels. These trains use powerful electromagnets located both on the underside of the train and along the track. Due to their special design, the magnets attract and repel each other, causing the train to be suspended, or levitated, above the track. The absence of physical contact between the train and the track eliminates friction. This lack of friction allows Maglev trains to reach extremely high speeds with minimal energy loss. It also results in a significantly quieter and smoother ride compared to conventional wheeled trains.

Other uses of Magnetic Levitation:

- Maglev launch system
-

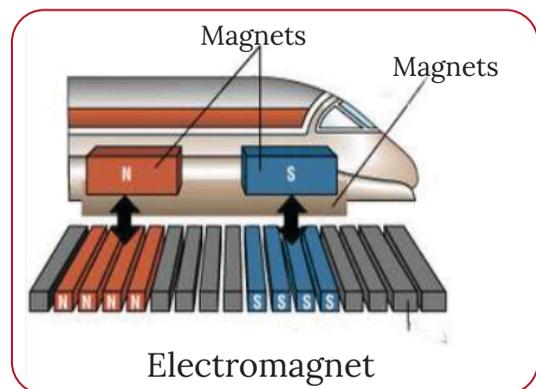


Fig. 11.8

What are
Maglev trains?



Fig. 11.7

Magnetic levitation is the phenomenon where an object is made to float in the air using magnetic force. It happens when the magnetic repulsion or attraction balances the force of gravity.

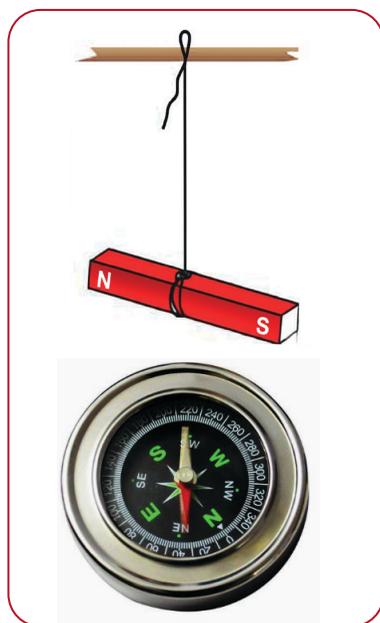


Fig. 11.9

Magnetic Compass

Suspend a bar magnet freely, using a string. In which direction does it align? Record your observation in your science diary.

If a magnet is arranged so that it can move freely, it always aligns in the north-south direction of the Earth. This directional property of magnet is used in a magnetic compass. A compass is a device with a small magnetic needle that can rotate freely. By looking at the marked directions on the compass, we can easily understand other directions like east and west too.



Digital Compass

Digital compasses have become an essential part of electronic devices like mobile phones, tablets, laptops and vehicle information systems. These compasses show directions accurately using the combined work of sensors like the magnetometer, accelerometer and gyroscope, along with systems like satellites and GPS (Global Positioning System).



Fig. 11.10

The Earth as a Giant Magnet

Why does a magnetic compass always show the north-south direction? It is because of the influence of the Earth's magnetic field. The Earth acts like a big magnet and has magnetic poles.

How are these poles formed? The Earth's magnetic nature is caused by the movement of large amounts of molten iron and nickel in its inner core. Due to this just like other magnets the Earth also has a magnetic north pole and magnetic south pole.

The magnetic north pole of the Earth is located near the geographical south pole and the magnetic south pole is near the geographical north pole.

Because of this magnetic nature of the Earth, a compass helps us find direction. The north pole of the compass needle always points towards the Earth's magnetic south pole and the south pole of the needle points towards the Earth's magnetic north pole.

We have now understood the general properties of magnets. Shall we now make a magnet?

Magnetisation

How can we make an artificial magnet?

Place a hacksaw blade on a table. Imagine one end of it as A and the other end as B. Take a bar magnet and rub its N pole from end A of the blade in the direction shown in Figure 11.12. Repeat this process several times without changing the ends. If rubbed as shown in the picture, the hacksaw blade will transform into a magnet, with end A becoming the North pole and end B becoming the South pole.

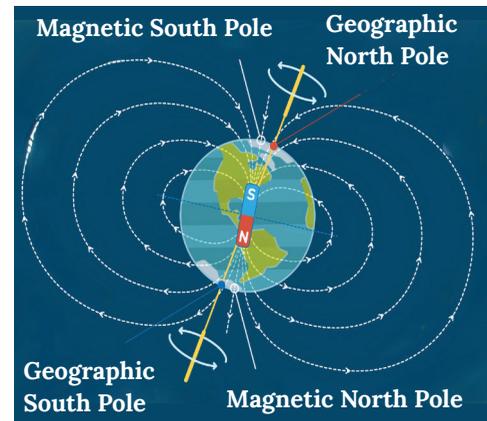


Fig. 11.11

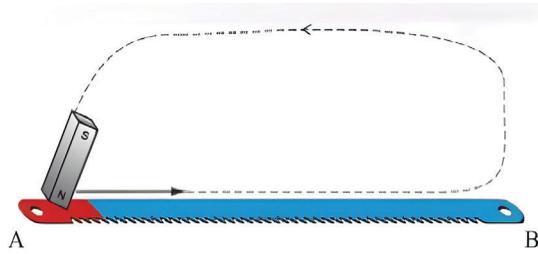


Fig. 11.12



Bring the end A (north pole) of the magnetised hacksaw blade near the north pole of a magnetic needle. What do you observe? Now carefully break off a small piece from the end A of the blade. Will the remaining part still have a north pole? Check it using a compass.

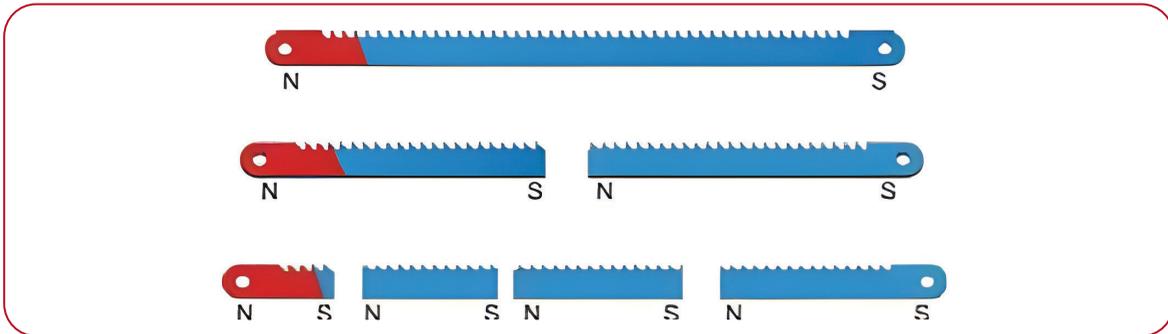


Fig. 11.13



Fig. 11.14

Carefully break off the tip of the blade once more and observe whether it becomes a magnet with only a south pole. What is your conclusion?

Bring both ends of each broken piece near a compass and observe. Record your conclusions in the science diary.

No matter how small a magnet is, it will always have two poles. A magnet with only one pole does not exist.

Let's draw magnetic field lines

We have already learned that the region around a magnet where its force can be felt is called the magnetic field. The strength and direction of the magnetic field can be shown using magnetic field lines. Let's try to draw magnetic field lines through an experiment.

Place a white paper on a surface and fix it so that it doesn't move. Using a compass, mark the North (N) and South (S) directions of the Earth on the paper. Draw a straight line between these two points. Place a bar magnet on the line, roughly at the center. Mark the ends of the bar magnet on the paper. Write "N" near the north pole and "S" near the south pole of the magnet.

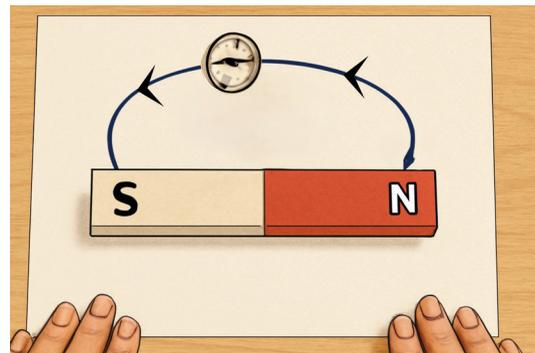


Fig. 11.15

Now, take a magnetic compass and place it near the north pole of the magnet. Observe the direction of the north tip of the compass needle. Put a small dot on the paper at that point. Then, move the compass a little forward, so that the south tip of the needle is now at the dot you marked.

Again, observe where the north tip of the needle is pointing and put another dot at this new position. In the same way, keep moving the compass step by step and each time, put a dot in the direction the north tip of the needle points. Continue this activity until you reach the south pole of the magnet. Now, carefully join the dots you have made. This line

is a magnetic field line around the magnet. Place the compass at different positions around the magnet and repeat the same steps to draw more magnetic field lines. Each time, you will get a new line. In all the magnetic field lines you draw, use arrow marks to show the direction from the north pole to the south pole of the magnet.

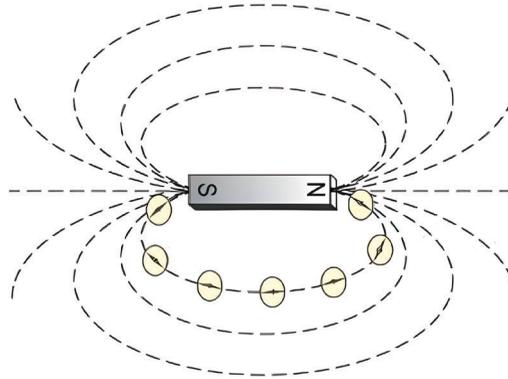


Fig. 11.16

Magnetic field lines are imaginary lines used to represent the direction and strength of a magnetic field. They are closed loops. Outside the magnet, the direction of the magnetic field lines is from the north pole to the south pole.

Characteristics of Magnetic Field Lines

We have already drawn the magnetic field lines of a bar magnet.

Now, what will happen to the magnetic field lines when two magnetic poles come close to each other? Try drawing the magnetic field lines in this situation and see how they look like.

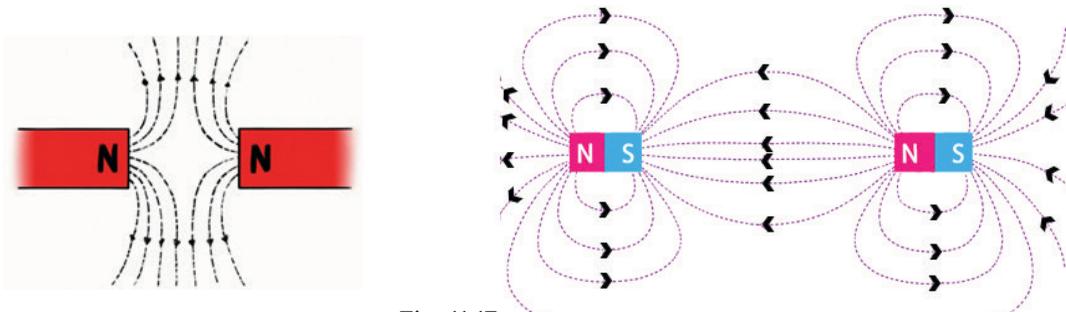


Fig. 11.17

In the picture, the magnetic poles are placed close to each other in different ways. Can you observe how the magnetic field lines change in each situation?

Record the results of your observations.

- Magnetic field lines never intersect each other.
- When like poles of two magnets come close, the magnetic field lines bend away from each other.
- When unlike poles come close, the magnetic field lines go from the north pole of one magnet to the south pole of the other.

Is the distribution of magnetic field lines the same everywhere?

How is magnetic field strength related to magnetic field lines?

Magnetic field strength and magnetic flux density

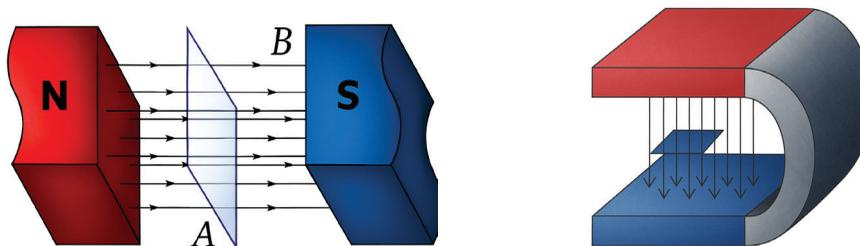


Fig. 11.18

Observe the magnetic field lines of a bar magnet and a U-magnet given above.

Imagine a small flat surface placed between the magnetic field lines, as shown. The surface can be imagined anywhere around the magnet. Count how many magnetic field lines pass through the surface. This number of field lines is called the magnetic flux through the surface.

The total number of magnetic field lines passing normally through a given surface is called magnetic flux.

What will happen to the magnetic flux if the size of the flat surface increases?

(Increase/ decrease)

If the flat surface you imagined has unit area then the amount of magnetic flux passing through it is called magnetic flux density.

The number of magnetic field lines passing normal through a unit area is the magnetic flux density of that region.

Is the flux density higher at the poles of a magnet or at other places?

Write your observation in the science diary. Let's try one more experiment.



Fig. 11.19

Take a test tube and place a bar magnet inside it. Close one end of the test tube tightly using a cork. Now take a bottle and fill about three-fourths of it with coconut oil. Add iron filings into the oil and stir it well. Carefully place the test tube with the magnet into the bottle. Try to fix the test tube at the bottom of the bottle. Close the mouth of the bottle securely. What do you observe? Don't you see the iron filings inside the bottle arrange itself under the influence of the magnet? Where do the iron filings stick the most?

Where are the iron filings seen the least? This happens because the magnetic field strength is more at the poles of the magnet and it becomes weaker as we move away from the poles. Now, try to write the relation between magnetic field strength and magnetic flux density.

Magnetic flux density is higher in places where the magnetic field strength is more. The poles of a magnet have the highest magnetic flux density.

Magnetic Induction

Can we magnetise other objects using a magnet? Let's do an experiment.

As shown in the picture, bring a pin close to one pole of a bar magnet. Now, bring a magnetic compass near the free end of the needle. Isn't the direction of the compass needle changing?

Bring another pin near the free end of the first pin. Isn't the second needle getting attracted?

Now, arrange more pins as shown in the figure and find the magnetic poles of each one.

Then, carefully remove the first needle from the magnet.

Does it still show magnetic properties? Write your observations in the science diary.

The phenomenon of a magnetic substance acquiring magnetism due to the presence of a magnet is known as Magnetic Induction. The magnetism acquired by the magnetic substance is the Induced Magnetism.

When a magnetic material comes under the influence of a magnetic field, the magnetic properties of the atoms inside it get temporarily arranged. This is the reason for induced magnetism.

Whether with contact or without contact, the polarity of the magnet produced by induction will be like polarity at the farther end and unlike polarity at the nearer end.

What are the uses of magnetic induction? Discuss.

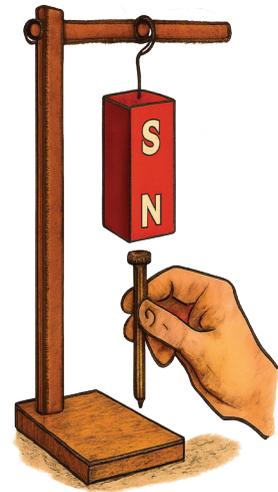


Fig. 11.20

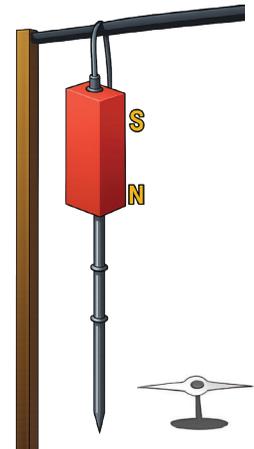


Fig. 11.21

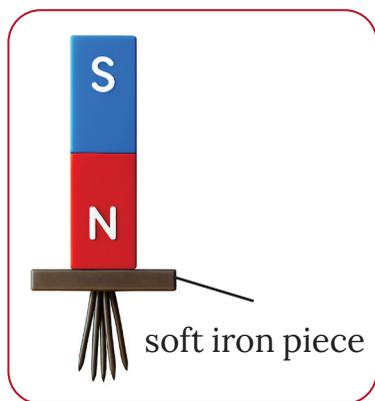


Fig. 11.22

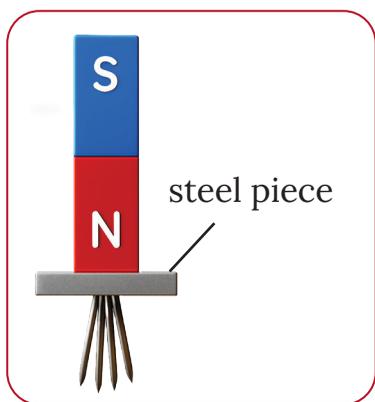


Fig. 11.23

What are susceptibility and retentivity?



Fig. 11.24

Magnetic Induction in Soft Iron and Steel

Place a piece of soft iron on one of the poles of a bar magnet. Doesn't the soft iron become magnetised? Now check whether the soft iron attracts pins.

Carefully remove the soft iron piece from the magnet and observe what happens to the pins.

Repeat the experiment using a piece of steel instead of soft iron. Write down your observations.

Soft iron gets magnetized easily. But when the magnet is removed, it quickly loses its magnetism.

Steel takes more time to get magnetised. However, even after the magnet is removed, it does not lose its magnetism quickly.

Susceptibility is the ability of magnetic materials to get magnetised due to the influence of an external magnetic field.

Retentivity is the ability to retain the magnetism.

How do these properties help in selecting magnetic materials?

Let us compare the properties of soft iron and steel.

- Which of these has greater susceptibility? (Soft iron / Steel)
- Which of these has greater retentivity? (Soft iron / Steel)

Based on the characteristics you observed, which is more suitable for making strong temporary magnets, soft iron or steel?

When making permanent magnets, which magnetic property of steel should be utilised?

Permeability

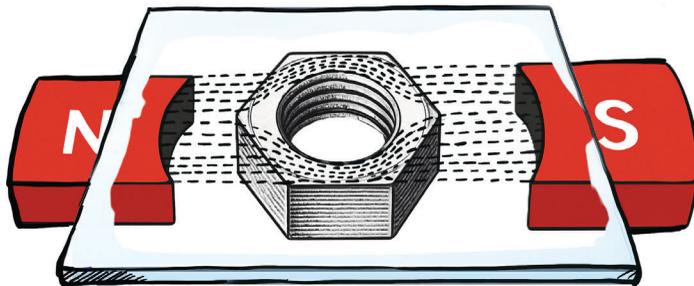


Fig. 11.25

As shown in the figure, place a large iron nut between the poles of two magnets. Place a thin glass plate gently over them. Sprinkle iron filings on the glass plate and tap it gently. What do you observe?

Are the iron filings sticking to the area where the gap in the iron nut is present? Compare the distribution of the iron filings in your experiment with the one shown in the figure. What conclusion do you reach?

Soft iron has a higher ability than air to allow magnetic field lines to pass through it.

Permeability is the ability of a substance to pass the magnetic field lines through it.

Why do compass needles not show direction when placed inside a box made of soft iron?

Making an Electromagnet

Can we change the strength of the magnets we have learned about so far ? Let's try making an electromagnet.

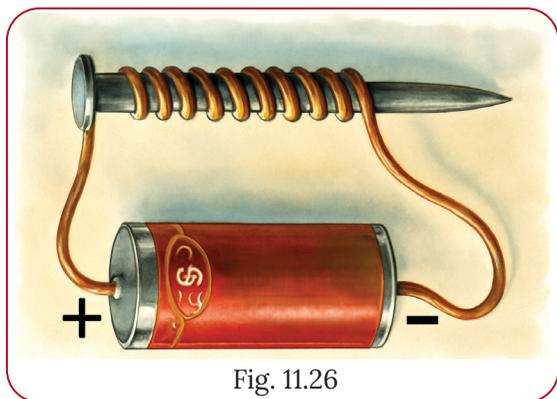


Fig. 11.26

Take a soft iron nail and wind insulated copper wire around it. Connect the ends of the wire to a cell.

Check whether the electromagnet thus made, attracts paper clips. Complete the table.

Experiment	Observation
When electricity flows, the soft iron piece and the paper clips	attracts / does not attract
After removing the cell, the soft iron piece and the paper clips	attracts / does not attract

When electricity flows, the soft iron becomes a magnet.
Such magnets are called electromagnets.

Repeat the experiment by increasing the number of turns on the nail, increasing the number of cells and using more than one nail together.

Based on this experiment, can you write down the different ways to increase the strength of an electromagnet?

- Number of turns
- Cross-sectional area of the soft iron inside the coil
-

Let's write examples of devices that use electromagnets :

- Electric bells •
- Loudspeakers •

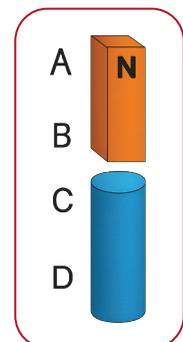
Compare electromagnets and permanent magnets. Complete the table.

Electromagnets	Permanent magnets
<ul style="list-style-type: none"> • Poles can be changed. • • • 	<ul style="list-style-type: none"> • The gained magnetism can be retained for a long time. • Magnetic strength cannot be increased. •

Now that you've understood the different types of magnets and their properties, try to find out more about the different devices that make use of these magnets.

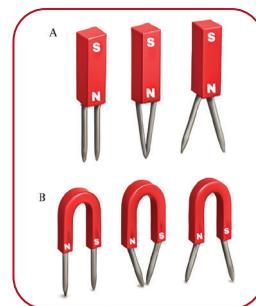


1. A student is trying to make a device to find direction using a magnetic needle. For this, he places the magnetic needle inside a box made of iron.
 - a) Will this device work properly?
 - b) Explain your answer.
 - c) What changes should be made to make this device work properly?
2. AB is a bar magnet shown in the figure below. An iron rod CD is placed near its B pole.
 - Which magnetic poles will be formed at the ends C and D?
 - Which property of magnets does this phenomenon demonstrate?



3. A bar magnet and a U magnet are shown in figures (a, b) each having two iron nails hanging from them.

- Which is the correct figure in each case?
- Explain the reason clearly.



4. You are given a soft iron piece, a steel piece of the same size, insulated copper wire and a battery:

- Suggest a method to make a powerful permanent magnet.
- Suggest a method to make a temporary magnet.

5. In an experiment, a plastic car with an iron piece inside it, is made to run on a wooden table by sliding a strong magnet below it.

- The experiment failed when a steel table was used. What is the reason for this?
- If an aluminium table is used instead of steel, what will happen? Why?



Extended Activities

- What is the important role of neodymium magnets in electric vehicles (EVs)? How does the use of these magnets affect the vehicle's efficiency, speed, and driving range? Collect information about this and prepare a report.
- Build a model of a vehicle that operates using magnetic levitation. Prepare a slide/chart explaining its working principle.

SPHERICAL MIRRORS



Fig. 12.1

Did you observe the picture? What is special about the mirror in his hand?

Do we all look in mirrors? Haven't you learned about the different types of mirrors? The mirror we usually use is a plane mirror.

How is it possible to see ourselves in it? Images are formed when light reflects off a smooth surface. Shall we try making a mirror using a cardboard.



Fig. 12.2



A silver paper (mirror sticker) has been neatly stuck on a piece of cardboard as in the picture. Doesn't it look like a mirror? Can you see your face in it?

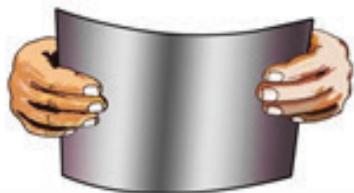


Fig. 12.3

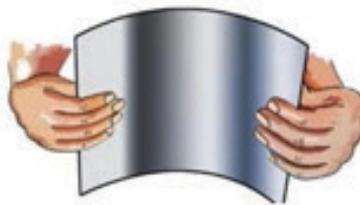


Fig. 12.4

Now, bend this inward as shown in the picture and look into it. What change do you notice in the image? What if you bend it outward? Shall we tabulate the observations?

Shape of the sheet	Characteristics of the image
Flat	
Bend outward	
Bend inward	

Table 12.1



Fig. 12.5

Let's now try another activity. Take a clean steel spoon and observe your face on its both sides.

- How does the image appear on the outer side of the spoon?
- What about the inner side?

Didn't you understand that images can form both on flat surface and curved ones? Observe and write down

A smooth curved surface can also form images like a plane surface.

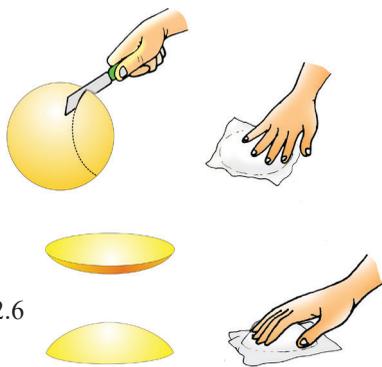


Fig. 12.6

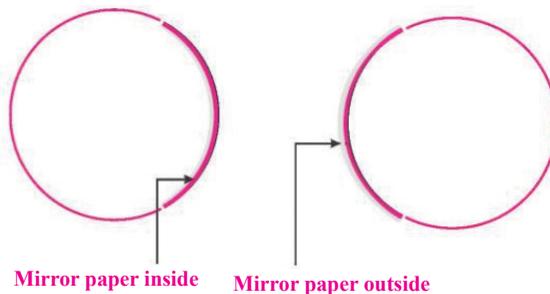


Fig. 12.7

Fig. 12.8

how the images formed on curved surfaces differ from those formed by plane mirrors.

Now let's take an empty ice cream ball and cut a portion of it as shown in the figure. Stick mirror paper on the inner surface and make it a reflecting surface. Hold it facing the sun and reflect the light rays onto a wall. Do the reflected rays converge at a point? Repeat the activity by sticking mirror paper on the outer surface. What difference do you observe now?

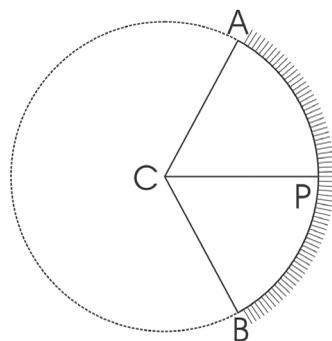
In both these experiments, mirrors were made from objects with a spherical shape.

Mirrors whose reflecting surface forms a part of a sphere are called spherical mirrors.

Spherical mirrors with a reflecting surface curved inward are called concave mirrors.

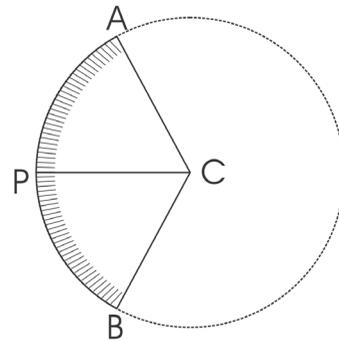
Spherical mirrors with a reflecting surface curved outward are called convex mirrors.

Let us now get familiar with some terms related to spherical mirrors.



Concave Mirror

Fig. 12.9



Convex Mirror

Fig. 12.10

Now you understand that a spherical mirror is a part of a sphere. The centre of this sphere is called the centre of curvature. In the diagram, it is represented by the letter C.

The radius of this sphere is called the radius of curvature. In the diagram, CP, CB, and CA represent the radius of curvature.

This is the distance from the centre of curvature to the image surface of the spherical mirror.

If a line is drawn from the centre of curvature to the mirror, it will be perpendicular to the mirror.

The diameter of the circular reflecting surface of a spherical mirror is called the Aperture. The midpoint of the reflecting surface is called the Pole (P).

The imaginary line connecting the centre of curvature and the pole of the mirror is called the principal axis.

Reflection in Spherical Mirrors

We already know about image formation in plane mirrors. Are the laws of reflection we learned about them applicable to spherical mirrors?

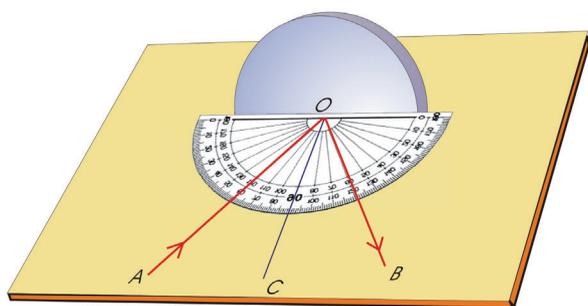


Fig. 12.11

Let's try an activity.

Mark the centre of a concave mirror using a sketch pen. Place the mirror halfway inserted into a cardboard piece, as shown in the figure. Stick a printed image of a protractor in front of the mirror.

Draw a straight line to the mirror's centre. This is the principal axis. Now, shine a laser torch at a fixed angle onto the mirror and observe the reflected ray. Try to trace the path of the reflected ray. Can you measure its angle? Shall we tabulate the angles of reflection for different angles of incidence?

Sl No	Angle of incidence (i) Degree	Angle of reflection (r) Degree
1	30	
2	40	
3	60	

Table 12.2

Record the values in your science diary.

Repeat this experiment using a convex mirror.

In spherical mirrors, the angle of incidence is equal to the angle of reflection.

Principal Focus and Focal Length in Spherical Mirrors

Hold a concave mirror facing the sun on a sunny day.

Can you reflect the rays onto a sheet of paper? Don't you see all the reflected rays converging to a single point? The rays that fall parallel to the principal axis are the ones that get focused to this point. The path of the incident and reflected rays can be illustrated as shown in Figure 12.12.

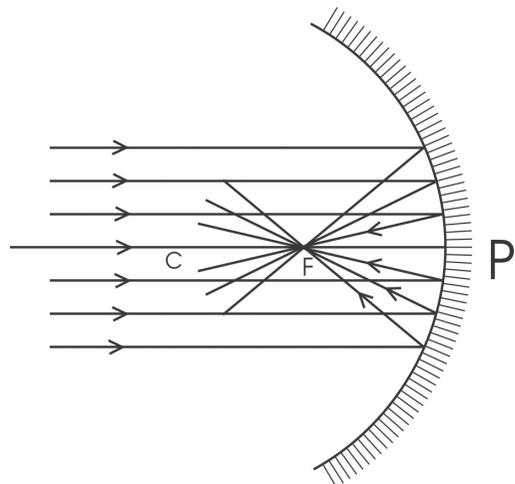


Fig. 12.12

In a concave mirror, the light rays that fall parallel to the principal axis pass through a particular point on the principal axis after reflection. This point is called the principal focus of the concave mirror.

How can we find the principal focus of a convex mirror?
Let's do an activity.

Stick a white paper on a cardboard. Cut a slit and place a convex mirror partially inserted into the slit. Mark the position of the pole and draw a perpendicular from that point on the paper to represent the principal axis. Now, draw straight lines parallel to this axis towards the mirror. Shine light rays onto the mirror using a laser torch, following those lines. Mark the path of the reflected rays on the paper. Doesn't it look like what it is shown in Figure 12.13? Now remove the mirror and

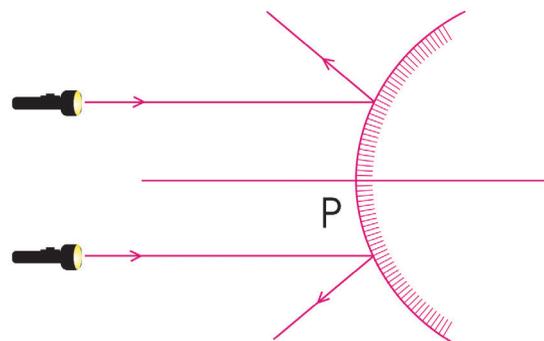


Fig. 12.13

extend the principal axis further. Extend the paths of the reflected rays backward. Don't they all appear to meet at a point on the principal axis?

In a convex mirror, the light rays that fall parallel to the principal axis after reflection appear to diverge from a particular point on the principal axis. This point is called the principal focus of the convex mirror.

In a concave mirror, the rays that fall parallel to the principal axis converge to the principal focus and it can be caught on a screen. Hence, its principal focus is real.

- The principal focus of a convex mirror is virtual. Why?

Let's discuss and write it down in your science diary.

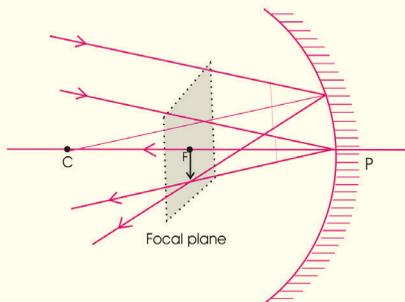
Focal Length

In a spherical mirror, the distance from the pole to the principal focus is called the focal length. Its SI unit is metre (m).



Focal Plane

Isn't the distance from the pole to the principal focus of a spherical mirror the focal length? Can we imagine a plane perpendicular to the principal axis at the same distance from the pole, which also includes the principal focus? This is the focal plane of spherical mirrors. The light rays, after reflection, converge at the points on this plane. A concave mirror forms a real image of a distant object on its focal plane.



For a spherical mirror with a small aperture, the focal length (f) will be half of its radius of curvature (R).

$$f = R / 2$$

- What would be the radius of curvature of a concave mirror with a focal length of 40 cm?

Image Formation in Spherical Mirrors

We already know about the images formed by plane mirrors. What are their characteristics?

- Erect
- Virtual
-

There are two types of images: real images and virtual images. Real images are those that can be caught on a screen. Virtual images are those that cannot be caught on a screen.

Let's try the activity given below. Try to form an image of a distant object on the wall with a concave mirror of known focal length. By adjusting the position of the mirror, make a clear image on the wall.

Write down the characteristics of the image.

- Smaller than the object
- Inverted
-

When a clear image is formed, measure the distance from the screen to the mirror. Isn't this the focal length of the mirror?

If an object is very far away, the image formed by a concave mirror will be at the principal focus of the mirror.

Are the images formed by a concave mirror always like this? Let's try an experiment. Draw a straight line on a table as shown in the picture.

At its end, place a concave mirror of known focal length on a stand. Measuring the distance from the mirror, mark the principal focus and centre of curvature on the line. Now, let's place a lit candle on the straight line. Try to arrange a screen in front of the mirror in such a way that a clear image is obtained.

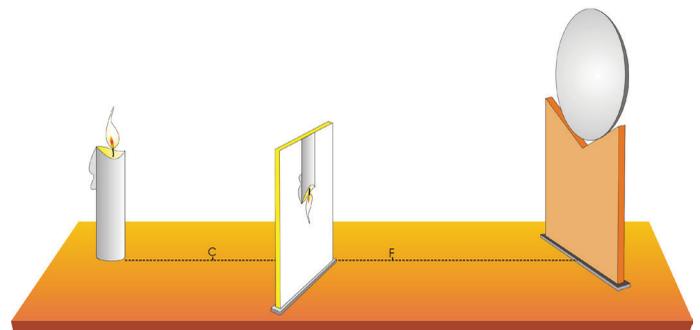


Fig. 12.14

- At what position is the screen placed to get a clear image?
- What are the characteristics of the image?

When the position of the candle is changed, shouldn't the position of the screen also be changed to form a clear image?

Complete the table given below after these activities.

Sl No	Position of the object	Position of the image	Characteristics of the image
1	Very far	At F	Small, Inverted, Real
2	Beyond C		
3	At C		
4	Between C and F		
5	At F		
6	Between F and P		

Table 12.3

Could the analysis of this table provide the answer to the question related to the introduction picture of this unit? What are the characteristics of the mirror that reflects your face at a spectacle shop? Why does the face appear larger? Write down your opinion in your science diary.

Are the same types of images formed in a convex mirror? Try this experiment using a convex mirror.

- Can you see the image?
- Can you project it on a screen?

Now, write down the characteristics of the image formed.

- Erect
- Small
-

A convex mirror always forms a small and erect image. This will be a virtual image. The image will always be between the principal focus and the pole.

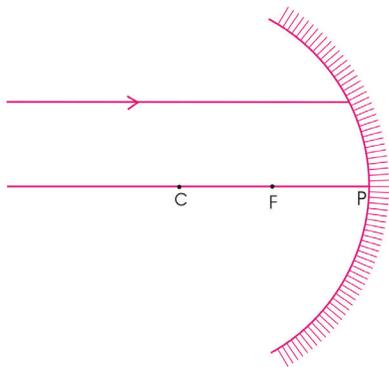
Image Formation in Spherical Mirrors Using Ray Diagrams

When drawing the path of reflected rays in spherical mirrors, the law of reflection, which states that the angle of incidence and the angle of reflection are equal, must be considered. The line drawn from the centre of curvature to the point of incidence should be taken as the normal.

The position and nature of the images formed in spherical mirrors can be understood by drawing the paths of the incident and reflected rays.

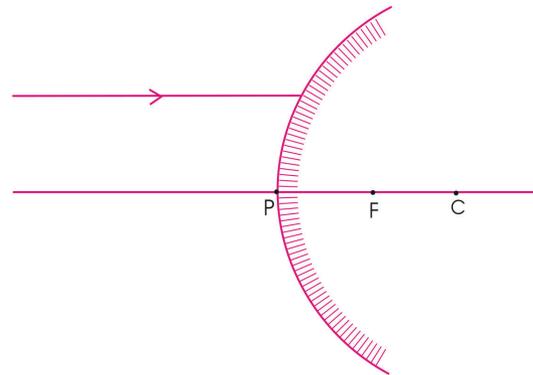
Complete the diagrams given below by drawing the normal and the path of the reflected rays.

Ray passing parallel to the principal axis.



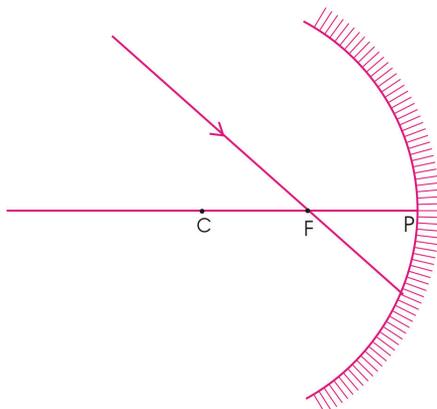
Concave Mirror
Fig. 12.15

Rays Falling parallel to the principal axis.



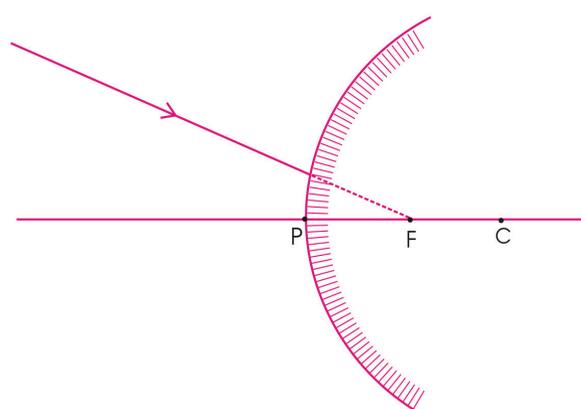
Convex Mirror
Fig. 12.16

Ray passing through the principal focus.



Concave Mirror
Fig. 12.17

Ray falling to the principal focus.



Convex Mirror
Fig. 12.18

Ray passing through the centre of curvature

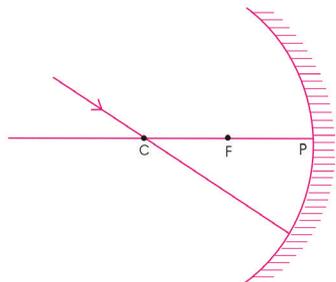


Fig. 12.19
Concave Mirror

Ray falling to the centre of curvature

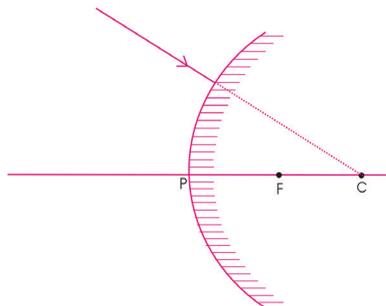


Fig. 12.20
Convex Mirror

Here, incident ray is normal.

Ray falling towards the pole.

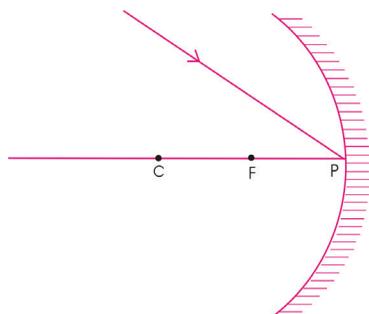


Fig. 12.21
Concave Mirror

Ray falling towards the pole.

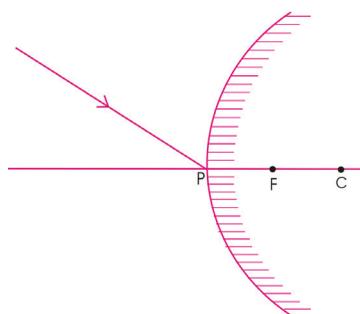


Fig. 12.22
Convex Mirror

Here, since the principal axis itself is the normal, there is no need to draw a separate one.

Image formation by concave mirror

We know that the position and size of the image vary according to the position of the object, don't we? Let's look at the image formation when the object is placed at different positions.

1. Object is at infinity

Here, the light ray comes parallel to the principal axis. After reflection, it passes through the principal focus.

So, the image is formed at the principal focus itself.

Characteristics of the image:

- Inverted
- Smaller than the object
- Real

We have already understood these characteristics when we conducted the experiment. Let's complete the diagrams given below and try to illustrate the image formation at other positions.

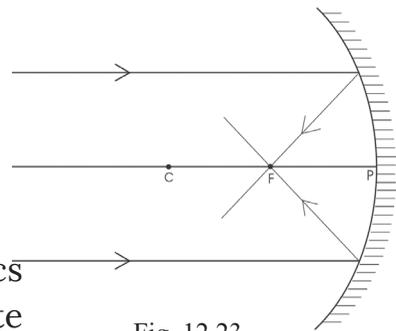


Fig. 12.23

2. Object beyond C

Position of the image

Characteristics of the image

-
-
-

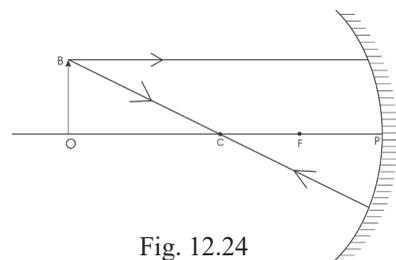


Fig. 12.24

3. Object at C

Position of the image

Characteristics of the image

-
-
-

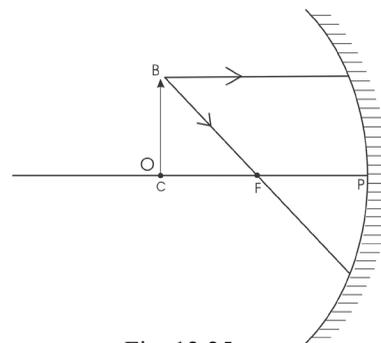


Fig. 12.25

4. Object between C and F

Position of the image

Characteristics of the image

-
-
-

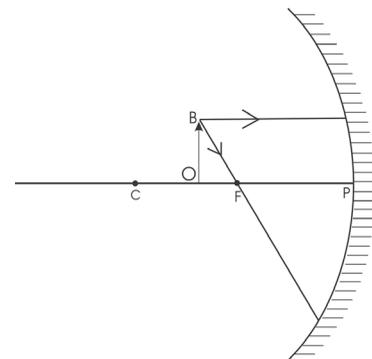


Fig. 12.26

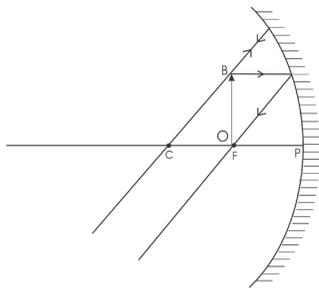


Fig. 12.27

5. Object at F

Did we get an image when we placed the object at F? What might be the reason? Observe the diagram. Here, the light rays go parallel after reflection. Here we can imagine that the image is formed at infinity.

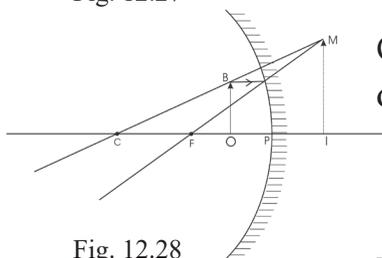


Fig. 12.28

6. Object between F and P

Observe the image formation given here. Write the characteristics of the image.

- Concave mirrors form both real and virtual images.

The virtual images formed by concave mirrors will be larger than the object.

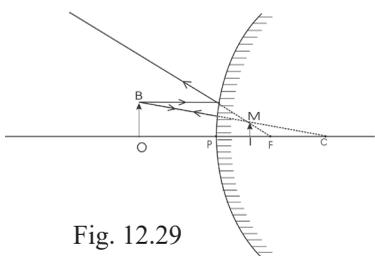


Fig. 12.29

Image Formation by Convex Mirror

We have learnt from the experiment that the images formed by a convex mirror are always erect and small. This is a virtual image. Can you find out what changes occur to the size of the image when the object is placed at different positions by observing the diagram?

We have understood that spherical mirrors form both real and virtual images.

- Convex mirrors always form virtual images that are smaller than the object.

Discuss the characteristics of real and virtual images and complete the table given below.

Real Image	Virtual Image
• Inverted	
	• Formed behind the mirror

Table 12.4

Magnification

We see that the size of the images formed by spherical mirrors changes depending on the position of the objects. The ratio of the height of the image to the height of the object is called magnification. If h_o is the height of the object and h_i is the height of the image, the magnification will be $m = h_i/h_o$.

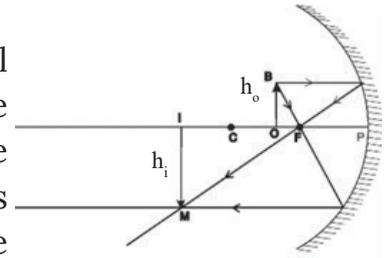


Fig. 12.30

While calculating magnification, measurements above the principal axis should be considered positive and measurements below the principal axis should be considered negative.

Spherical mirrors in daily life

Spherical mirrors have many uses in our daily life.

Uses of Concave Mirrors

1. Concave mirrors in solar thermal power plants: Rays of light incident parallel to the principal axis pass through the principal focus after reflection. Hence a lot of heat is generated at this point due to the concentration of energy. This heat can be used to convert water into steam and generate electricity from it. Such power stations are operating in Rajasthan, India.
2. We have seen that if an object is placed between the principal focus and the pole of a concave mirror, an erect and enlarged virtual image is formed. The following are made using this special feature:

- Shaving mirror
- Makeup mirror
- Mirror used by dentists



Fig. 12.32



Fig. 12.33



Fig. 12.31

- Have you ever noticed the path of light rays emitted from the principal focus of a concave mirror? They travel parallel to the principal axis. We use this property in flashlights and vehicle headlights. Observe the concave mirror in a flashlight and the position of its bulb.



Fig. 12.34

Uses of Convex Mirrors

- Rear/side view mirror: Convex mirrors are used in vehicles for rear view. It always forms erect and small virtual images. What could be the reason for using convex mirrors instead of plane mirrors? Discuss and write down the conclusions in the science diary.



Fig. 12.35

A convex mirror always forms a small and erect image. Therefore, the driver who sees the image in the rearview mirror gets the feeling that the vehicles coming from behind are at a great distance. This can cause accidents. That is why "OBJECTS IN THE MIRROR ARE CLOSER THAN THEY APPEAR" is written on the rearview mirrors of vehicles.

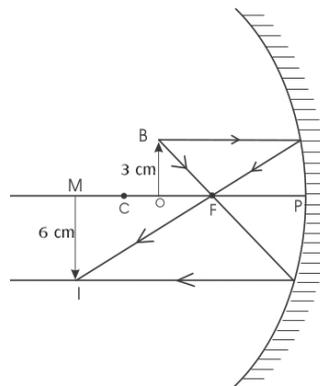
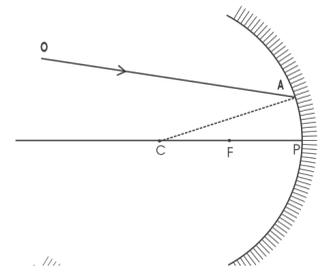
- Haven't you seen large convex mirrors placed on the sides of the roads with sharp turns? Through these, one can see vehicles coming from beyond the curves and thus reduce accidents.
- Convex mirrors are often used as reflectors in street lamps.

We use spherical mirrors for many other things. Find them and write it in your science diary.



Let's Assess

- A concave mirror has a focal length of 30 cm. Find out its radius of curvature.
- OA is a ray incident obliquely on a concave mirror. Draw and mark the path of its reflected ray. Write on what basis you marked like this.
- Write what type of spherical mirrors should be used to obtain images with the following characteristics:
 - Real, smaller than the object
 - Virtual, smaller than the object
 - Real, larger than the object
 - Virtual, larger than the object
- Observe the picture.
 - If the object shown in the picture is replaced with an object of 6 cm height at the same position, what will be the height of the image?
 - If the distance of the object from the mirror was 30 cm and an image of the same size as the object was obtained on the screen, what is the focal length of the mirror?





Extended Activities

1. Present a seminar on the uses of spherical mirrors in daily life and the devices that include spherical mirrors.
2. Make a transparent rectangular box (glass, thick plastic sheet, etc. can be used). Fix a concave mirror on one of its walls. Light an incense stick and fill the box with smoke. Use a laser torch to project light onto the mirror. Can't you see the reflected ray? Repeat the experiment using a convex mirror. Record the observations in the science diary.

ACIDS, BASES, SALTS

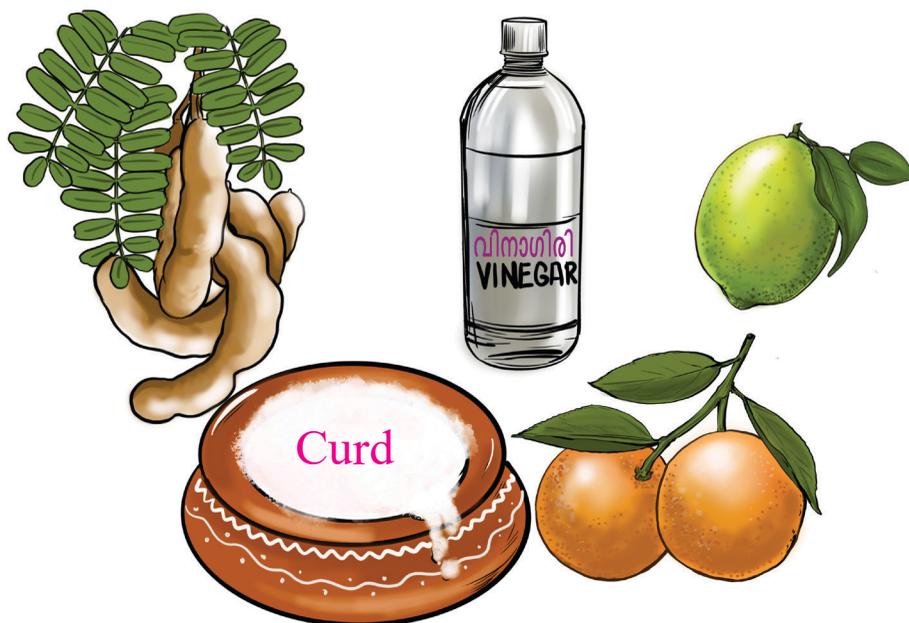


Fig 13.1

Picture of some familiar food items are shown above. Have you tasted them?

What taste do they have in common?

What could be the reason?

What colour changes occur when red litmus paper and blue litmus paper are used to test these food items?

Conduct an experiment to note the colour change to litmus paper with hydrochloric acid, sulphuric acid and nitric acid in chemistry laboratory in the school and write the observation in science diary.

It is understood from the colour change of litmus that all these shows acidic nature. Isn't it?

Take a small piece of zinc in a test tube. Add a little dilute hydrochloric acid to it. Hold a burning matchstick at the mouth of the test tube. Record your observation.

What could be the reason?

Repeat the above experiment by adding sulphuric acid instead of hydrochloric acid. Record the observation.

Repeat the experiment using magnesium and hydrochloric acid and also with magnesium and sulfuric acid. Record the observation.

Didn't the same observation occur in all four experiments?

Complete the table given below.

Metal	Acid	Chemical equation
Zinc	Hydrochloric acid	$\text{Zn} + 2\text{HCl} \rightarrow \text{ZnCl}_2 + \dots$
.....	Sulphuric acid	$\text{Zn} + \text{H}_2\text{SO}_4 \rightarrow \text{ZnSO}_4 + \text{H}_2$
Magnesium	$\text{Mg} + 2\text{HCl} \rightarrow \text{MgCl}_2 + \dots$
.....	Sulphuric acid	$\text{Mg} + \text{H}_2\text{SO}_4 \rightarrow \text{MgSO}_4 + \dots$

Table 13.1

When acids react with highly reactive metals, hydrogen gas is produced.

Let's do an experiment to understand how acids react with carbonates.

Take some calcium carbonate (marble pieces) in a boiling tube as shown in Figure 13.2. Add dilute hydrochloric acid to it through a tistle funnel. Pass the gas that comes out through clear lime water in a test tube.

What could you observe?

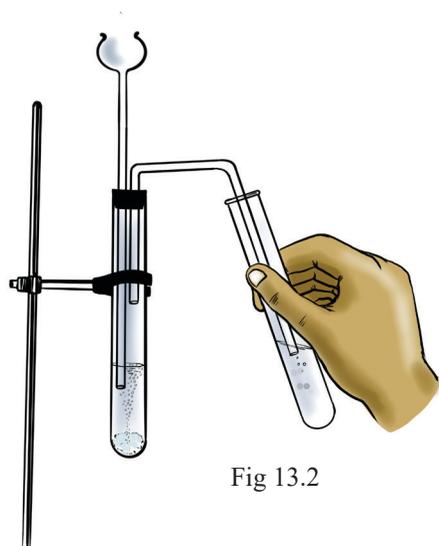


Fig 13.2

Which gas is released through the delivery tube?

Repeat the experiment using sodium carbonate and dilute sulphuric acid. Record your observations.

When acids react with carbonates, carbon dioxide gas is liberated.

Properties of acids

- Have sour taste
- Turns blue litmus red.
- Carbon dioxide gas is formed by reacting with carbonates.
- Hydrogen gas is liberated by reacting with highly reactive metals such as zinc and magnesium.

Hydrogen is the common component in acids

What is the symbol for hydrogen?

Hydrogen ion (H^+) is the ion formed from hydrogen.

What is the chemical formula of hydrochloric acid?

When hydrochloric acid dissolves in water, hydrogen and chloride ions with opposite charges are formed.



Which are the ions formed when nitric acid dissolves in water?

Complete the table given below.

Name of acid	Chemical formula	Ions liberated when dissolved in water
Hydrochloric acid	HCl ,
Sulphuric acid	$2H^+$, SO_4^{2-}
Carbonic acid	H_2CO_3 ,
Phosphoric acid	H_3PO_4 ,

Table 13.2

Hydrogen ions are the basis of the general properties of acids. Acids are substances that can increase the concentration of hydrogen ions (H^+) in aqueous solution.

H^+ ions combine with H_2O molecules to form hydronium (H_3O^+) ions

Substances with sour taste that we use in everyday life, such as lemon juice, yoghurt, and vinegar contain organic acids. Note their list in the table.

Substances	Acid responsible for the sour taste
Lemon juice	Citric acid
Yoghurt/ Buttermilk	Lactic acid
Tamarind	Tartaric acid
Venegar	Acetic acid

Table 13.3

Which is the gas liberated when a soda bottle is opened?

Find out the nature of soda water using litmus paper.

Is soda water acidic or basic?

Which is the acid in soda water?

Write the chemical formula of the acid in soda water.

Look at the chemical equation given below.



Carbon dioxide (CO_2), a nonmetal oxide, reacts with water to form carbonic acid (H_2CO_3).

Complete the chemical equation for the reaction of sulphur dioxide (SO_2) gas in water to form acid.



You know that nonmetals react with oxygen to form oxides. Some nonmetals and their important oxides are given in the table below.

Element	Main oxide of element
Carbon	Carbon dioxide (CO_2)
Nitrogen	Nitrogen dioxide (NO_2)
Phosphorus	Phosphorus pentoxide (P_2O_5)
Sulphur	Sulphur trioxide (SO_3)

Table 13.4

Write the chemical formula and chemical name of the acids formed when the oxides given in the table react with water.

Main oxide of the element	The chemical formula of the acid formed by reacting with water	The chemical name of the acid formed by reacting with water
Nitrogen dioxide (NO_2)		
Phosphorus pentoxide (P_2O_5)		
Sulphur trioxide (SO_3)		

Table 13.5

The substances formed when nonmetal oxides react with water generally show acidic properties.

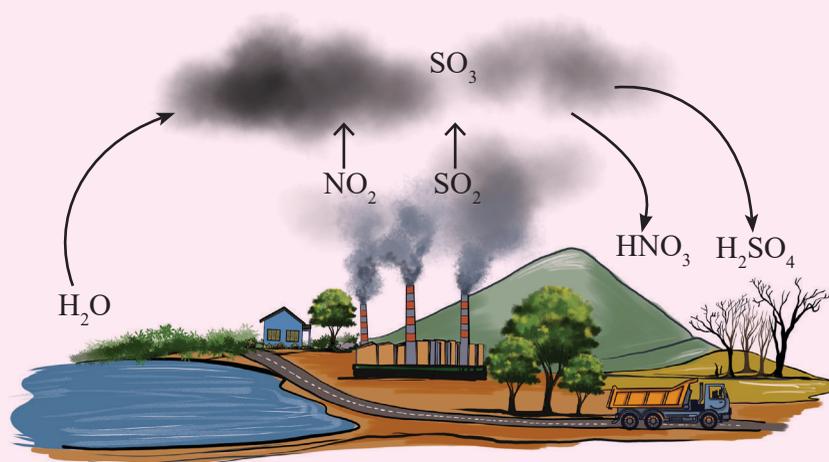
Acid Rain



CO_2 , SO_2 and NO_2 are nonmetal oxides. Generally, the substances formed by the reaction of nonmetal oxides with water show acidic properties.

The risk of air pollution is very high in places where there are many factories, motor vehicles, and thermal power plants. In such areas, gases like SO_2 and NO_2 reach the atmosphere in large quantities. Such gases dissolve in rainwater and reach the earth as acids. This is known as acid rain.

Acid Rain



Acid rain damages leaves, reducing the ability of plants to make starch through photosynthesis. Acid rain causes the acidity of water sources to increase, which in turn causes the death of fish and coral reefs. Thus, acid rain causes many environmental problems.

The situation of acid rain can be eliminated and the environmental problems caused by acid rain can be overcome by reducing the excessive use of fossil fuels and removing sulphur compounds as much as possible during the refining process of fossil fuels.

Bases

You have studied the general properties of bases in previous classes, right?

List them.

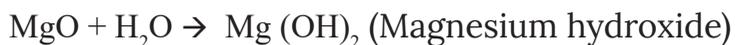
General properties of bases

- Turns red litmus blue.
-

Let's do an activity. Burn a well-scrubbed and cleaned magnesium ribbon. Record your observation. What will be the white powder obtained?

Take this product in a watch glass and add two or three drops of water. Find the nature using litmus paper.

Note the chemical equation of this reaction.



Now let's do another activity.

Add a little bit of quicklime (calcium oxide) to the water in a beaker and stir. Take a little clear solution from the beaker into a test tube and add a drop of red litmus solution to it.

What do you observe?

What does this litmus test shows about the nature of this substance?

What is the substance formed when calcium oxide reacts with water? Complete the chemical equation of the reaction.



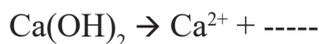
Are CaO and MgO, metal oxides or non-metal oxides?

Metal oxides generally show basic properties. Alkalies are bases that dissolve in water.

Observe the chemical equation of the reaction that occurs when sodium hydroxide dissolves in water.



Complete the ionisation equation that occurs when calcium hydroxide dissolves in water.



What is the common ion liberated when alkalies dissolve in water?



All bases are not alkalies. Alkalies are bases that dissolve in water. NaOH, KOH and $\text{Ca}(\text{OH})_2$ are alkalies. However, although $\text{Fe}(\text{OH})_3$, and $\text{Mg}(\text{OH})_2$ are bases, they are not considered as alkalies because they are insoluble in water. Metal oxides generally show basic properties. However, a few oxides have both acidic and basic properties. These are called amphoteric oxides. They can react with both acids and bases.

Eg. Al_2O_3 , ZnO

Neutral oxides are oxides that have neither acidic nor basic properties. eg. CO, NO

Alkalies are substances that can increase the concentration of hydroxide ions in aqueous solution.

Note the table 13.6 which shows common name of some alkalies along with their chemical names and chemical formulae.

Common name	Chemical name	Chemical formula
Caustic soda	Sodium hydroxide	NaOH
Milk of lime	Calcium hydroxide	Ca(OH) ₂
Caustic potash	Potassium hydroxide	KOH

Table 13.6

Neutralisation reaction

What happens when dilute hydrochloric acid and dilute sodium hydroxide solution are mixed? Let's do an activity.

Take 50 mL dilute hydrochloric acid in a burette. Take 20 mL of dilute sodium hydroxide solution in a conical flask using a pipette. Add one or two drops of phenolphthalein into it. What colour did the solution get?

Slowly add dilute HCl to the conical flask. Keep stirring the solution in the conical flask. Observe the change in colour of the NaOH solution. When the colour fades, add HCl drop by drop and stir. When the colour disappears completely on adding one drop of HCl, stop adding acid. Record the amount of HCl used by reading the level of acid in the burette.

Which was the colour of NaOH solution when phenolphthalein was added?

What property of NaOH solution does this indicate?

What can be understood from the fact that the colour of the NaOH solution decreases as HCl is added?

Will NaOH remain in the conical flask when the colour completely disappears?

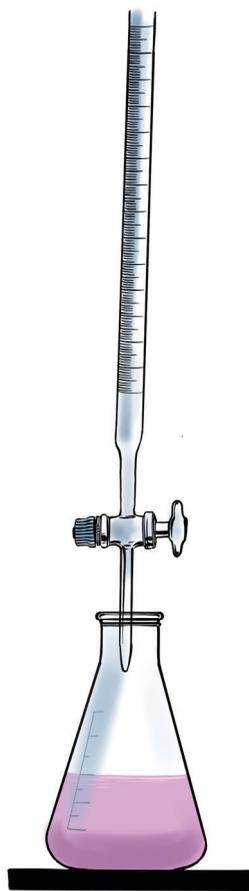


Fig 13.3

Add a little NaOH to the solution that has completely changed colour. What do you see? What is the reason for the observation?

Add dilute HCl drop by drop to it again and mix. What is your observation?

The chemical reaction in which an acid and a base react and lose their properties to form water and a salt is known as neutralisation reaction.

Hydrochloric acid produced in our stomach helps in the digestion of food. If the acid content is too high, it can cause heartburn and indigestion. Antacids are medicines used to reduce the acidity in the stomach. Magnesium hydroxide, also known as milk of magnesia, is a commonly used antacid.

pH value

The degree of acidic/basic nature of soil and other substances is determined by calculating their pH value. The pH scale was developed by the Danish scientist Sorensen. This scale is based on the concentration of H^+ ions in the solution. Note the illustration of that scale.



Fig 13.4

What is the pH value of a neutral solution?

What characteristics do solutions with a pH value greater than 7 show?

What characteristics do solutions with a pH value less than 7 show?

You can use pH paper, pH solution or pH meter to find and compare the pH values of different solutions. Dip the pH paper or add a drop of pH solution into the solution you want to check the pH. The colour formed can be compared with the pH colour chart to find the pH value of the solution.

Find the pH values of the following substances using pH paper and complete Table 13.7

Name of substance	pH value	Acidic/Basic/Neutral
Lemon juice		
Dilute Hydrochloric acid		
Water		
Common salt solution		
Sodium hydroxide solution		
Soap solution		

Table 13.7

As the pH value increases, does it become more acidic or more basic?

The pH of the soil is one of the factors that affects the proper growth of agricultural crops. Acidic soil is suitable for some crops while basic soil is suitable for others. You have understood the importance of checking the pH of the soil in an area to determine whether it is suitable for agricultural crops.

Slaked lime is added to reduce the acidity of acidic soil. Similarly, acidic substances such as ammonium sulphate and aluminium sulphate are added to the soil to reduce the basic nature of the soil.

Salts

What are the products formed when sodium hydroxide and dilute hydrochloric acid react?

Here, what is the product formed when the common component of the acid and the common component of the alkali combine?

What is the product formed when the positive ion in sodium hydroxide and the negative ion in hydrochloric acid combine?

Sodium chloride is a salt formed by the reaction of HCl and NaOH. Salts are generally ionic compounds.

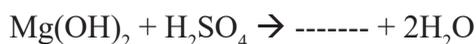
Take 5 mL of sodium chloride solution in a test tube. Add 2 mL of silver nitrate solution to it. Record your observation in your science diary.

Repeat the experiment in the same way using KCl solution, NH_4Cl solution, CaCl_2 solution, and hydrochloric acid. Are the observations the same?

In these experiments, it was observed that the chloride (Cl^-) ion, which is common in salts NaCl, KCl, NH_4Cl , CaCl_2 and hydrochloric acid, reacted with silver nitrate to form a white precipitate of silver chloride.

Chloride(Cl^-) ion react with silver nitrate to form white precipitate of silver chloride.

Complete the chemical equation for the reaction between dilute sulphuric acid and magnesium hydroxide solution.



What is the salt formed?

Find and write the acid and alkali/base that must be reacted to obtain the salts given in the table below.

Salt	Chemical formula	Acid	Alkali / Base
Calcium sulphate	CaSO_4		
Aluminium sulphate	$\text{Al}_2(\text{SO}_4)_3$		
Sodium sulphate	Na_2SO_4		

Table 13.8

Take a pinch of ammonium sulphate in a test tube and mix it well with some water. Pour barium chloride solution into it. What did you observe? Pour dilute hydrochloric acid into it. Observe the change.

Repeat the experiment using solutions of sulphate salts and sulphuric acid available in the school laboratory. Write an observation note.

The white precipitate formed in the experiments is due to the barium sulphate formed by the reaction between sulphate (SO_4^{2-}) ion and barium chloride solution. Barium sulphate does not react with dilute hydrochloric acid.

What are the products formed when sodium hydroxide and dilute nitric acid react?



What is the salt formed here?

How about an experiment to identify nitrate salts?

Take a little ammonium nitrate salt solution in a test tube. Add freshly prepared ferrous sulphate solution to it. Add concentrated sulphuric acid drop by drop very slowly through the sides of the test tube. What was observed? (Please be careful to follow the teacher's instructions on what precautions to take when using concentrated sulphuric acid before doing the experiment)

Record in your science diary what observations you make when you repeat the previous experiment using the nitrate salts and nitric acid available in the laboratory.

When nitrate (NO_3^-) ion, freshly prepared ferrous sulphate solution and concentrated sulphuric acid react, a brown ring forms between the two liquids.

Let's do an experiment to identify carbonate salts.

Take a little sodium carbonate salt solution in a test tube. Add 2 mL of dilute hydrochloric acid to it. Pass the gas released from the test tube through clear lime water. Record the observation in your science diary.

Record in your science diary what observations you obtain when you repeat the previous experiment using other carbonate salts available in the laboratory.

The formation of bubbles in the test tube is due to the liberation of carbon dioxide as a result of the reaction between carbonate salt and hydrochloric acid. Clear lime water turns milky when carbon dioxide passes through it.



Let's Assess

1. Complete the table.

Substance	The colour change that occurs when exposed to moist red litmus	The colour change that occurs when exposed to moist blue litmus
Lemon juice		
Lime water		
Sodium hydroxide		
Vinegar		
Dilute hydrochloric acid		

2. Find out which of the following statements is correct.
- Nitrogen dioxide dissolves in water to form nitric acid.
 - Phosphorus pentoxide (P_2O_5) is a non-metal oxide.
 - Sulphur trioxide turns moist red litmus blue.
3. Explain any two cases where the importance of neutralisation reaction used in daily life.
4. Solutions of some chemicals used in the laboratory are given in Box 1 below. Using these, write which salts given in Box 2 you can identify. Explain the method of experiment and observation.

Box 1
Dilute HCl
Silver nitrate solution

Box 2
Ammonium nitrate
Ammonium carbonates
Ammonium sulphate
Ammonium chloride

5. A bottle of salt in the lab had its label on it disintegrated. The details of the experiments conducted to identify the salt are given below.
- When a little barium chloride solution was added to the salt solution, a white precipitate formed.

- When dilute hydrochloric acid was added to the white precipitate, no observable change occurred.

Which salt is it? (Ammonium sulphate, Ammonium carbonate)

6. A colourless acid solution is in a bottle in the laboratory. 5 mL of it is taken in a test tube. 2 mL of dilute hydrochloric acid is added to it, no observable changes occur. After taking 5 mL of the solution in another test tube, when 2 mL of silver nitrate solution is added, a white precipitate is formed.

- (i) Which acid is the solution in the bottle?

When NaOH solution is added dropwise to 5 mL of the solution, it is observed that the pH gradually increases.

- (ii) When the pH reaches 7, what are the possible compounds present in the solution?
- (iii) Write the chemical equation for the reaction between NaOH and the acid solution.



Extended Activities

1. Collect soil from different parts around your house. Mix it with some water and stir it well. After some time, collect the clear water and find its pH value using pH solution, pH paper or pH meter. Similarly, find the pH of water from different sources and display it on a chart.
2. Collect information from farmers about the methods they use to increase or decrease the acidity of the soil while preparing the soil suitable for different crops in your area and prepare a report.

WATER



Fig 14.1

Did you observe the figure?
Why does the panchayat give importance to the conservation of water resources? Discuss.

Presence of water on the Moon, may be the evidence of life. The scientific world in excitement.

Have you noticed such news reports?

Why do people think that if there is water, there is a possibility of life?

Read the given article.

- *Water is a precious gift of nature. The presence of water is responsible for the origin and survival of life on earth.*
- *That's why scientists searching for life on other planets look for the presence of water also.*
- *Water is essential for vital functions such as respiration, digestion, excretion, etc. Water is also needed to keep the eyes moist and to regulate body temperature.*
- *Plants need water for growth and photosynthesis.*
- *Water is crucial for agriculture, industry, energy production, and transportation; it is therefore our collective responsibility to concern and protect this resource from pollution.*
- *Water bodies such as wells, streams, and rivers are the wealth of our country.*

What are the uses of water?

- For drinking
- For bathing
- For cooking
-
-

Why can water be used for so many purposes?
Let us learn about some characteristics of water.

Solubility

Take some water in different beakers. Add a little salt to one beaker, sugar to another, honey to the third, vinegar to the fourth and Caustic Soda (NaOH) to the fifth.

Test the water in these beakers using blue and red litmus paper.

Record the experiment results below.

Pure Water / Substance Added to Water	Blue / Red Litmus Paper Experiment – Observation	Inference
Pure Water	No change in the colour of the litmus paper	Water has no acidic or basic property.
Common Salt		
sugar		
honey		
vinegar		
Soap Powder		
Lime juice		
Sodium hydroxide (Alkali)		

Table 14.1

Water is used to make different types of solutions. The nature of water changes depending on the substances dissolved in it.

This special property is one of the reasons for using water for various purposes.

Since water can dissolve a wide variety of substances, it is known as universal solvent.

Hard Water and Soft Water

Take two conical flasks. Collect a direct sample of rain water in the first flask. In the other flask, take the same amount of water from a bore well. Add soap pieces of equal size to both flasks. Shake them well. What do you observe?

If the soap does not lather well, that water is called hard water. If the soap lathers well, that water is called soft water.

What could be the reason for the hardness of water? Shall we do one more experiment?

Take some water in a test tube and dissolve magnesium bicarbonate or calcium bicarbonate in it. Then, try to form a lather with soap in the solution.



Bore well water
fig 14.2 (a)



Rainwater
fig 14.2 (b)

It doesn't lather well, does it? This type of water is called hard water.

As water flows through the soil, many salts from the soil dissolve in it. These dissolved salts make the water hard. The hardness of water is caused by some salts of metals like magnesium and calcium.

Complete the table.

Substance added to water	Soap lathers well/ Doesn't lather well	Conclusion
Pure water (nothing added)		
Magnesium bicarbonate/ Calcium bicarbonate.		

Table 14.2

Boil the above solution of magnesium bicarbonate/calcium bicarbonate. After cooling, try lathering soap in it. Lathers well, does it?

The hardness caused by bicarbonates of calcium and magnesium is temporary hardness. When such water is boiled, the hardness is removed.

But if salts like sulphates or chlorides of metals such as magnesium or calcium are dissolved in water, their hardness cannot be removed by boiling. This type of hardness is called permanent hardness.

Test the water from different sources near your place to find out whether it has hardness..



Fig 14.3

Attraction towards other substances

Take a beaker and fill to half with water. Dip a thin glass tube into the water. Compare the water level inside the glass tube with that in the beaker.

How does the water level appear inside the glass tube? Although the attraction between water molecules is strong, the attraction between water and glass is even stronger. Hence water rises in the glass tube.



Fig 14.4

Now pour a little water on a leaf of colocasia. Does it wet the surface?

The reason is that the molecules in the leaf and the water molecules have very little attraction between them.

Can you list some materials around you that water cannot wet?

Now take a plastic sheet and use a syringe to drop water on it.

What is the shape of the water drops?

If the surface is not getting wet, the drops will be spherical in shape

Surface Tension

Take a beaker and fill it to the top with water. Slowly drop coins into it one by one. Try to find out how many coins can be added without the water spilling over. What change do you see in the water surface when each coin is added? Why is the water surface behaving like this?

Why can some insects walk on the surface of water? Take a tumbler filled with water. Gently place a blade on the surface of water. Can you explain why the blade stays on top without sinking? Now try placing a needle on the surface of the water. Can it stay without sinking? Try it out.



Contact angle between water and other materials

When water spreads and flows on a surface, the contact angle becomes zero. When water does not spread and stays as a drop on the surface, the contact angle increases.

In other words, when the contact angle is large, the water remains as a drop on the surface. So the contact angle is used to measure the attraction between water and a surface.



Fig 14.5 (a)



Fig 14.5 (b)

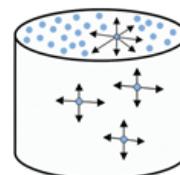


Fig 14.5 (c)

From the figure can you say in which direction the force acts on the water molecules on the surface?

As a result of this force, the water surface behaves like a stretched film. This is why a blade and needle can float and some insects can walk on water.

Due to the mutual attraction between water molecules, a force acts on the water surface, making its surface area as small as possible. This force is called surface tension.

Tie a thread across a light metal ring. Dip the ring into soap water to form a soap film. Now, gently break the soap film on one side of the thread using a pin. What is the shape of the soap film now?

Due to surface tension the film tries to reduce its surface area.



Fig 14.6

Is it easier to clean dirty clothes with plain water or with soap water? Clothes get cleaner in cold water or hot water? Water has high surface tension, so it doesn't wet clothes easily.

But when you add soap or heat the water, the surface tension decreases. This helps clothes wet better and clean more easily.

Boiling Point

As shown in the figure, fill a flask halfway with water and fix it on a stand. Close the flask with a two-holed cork. Insert a thermometer so that its bulb is touching the water. Note the initial temperature. Now heat the water.

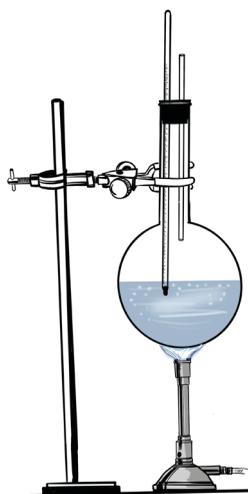


Fig 14.7

Can you see the temperature rising? After reaching a certain temperature, even though you continue heating, the temperature stops increasing. What change happens to water at this point?

This temperature is called the boiling point of water. The boiling point of water is 100°C . Is the thermometer in your experiment showing the same value? Does the temperature increase again when more heat is given?

Why doesn't the temperature rise once the water starts boiling?

When water starts to boil, the water molecules begin to change from liquid to gas. The extra heat energy is used to overcome the force of attraction between the molecules. In other words, the heat is used for the change of state, not to increase the temperature.

Which contains more energy boiling water or steam? Which can cause severe burn? Boiling water or steam? Discuss.

Pressure and Boiling Point

The boiling point of a liquid is related to the atmospheric pressure. The normal atmospheric pressure at the Earth's surface is 1 atmosphere (1 atm). You have already learned in earlier classes that as height increases, pressure decreases.

Let's do an experiment.

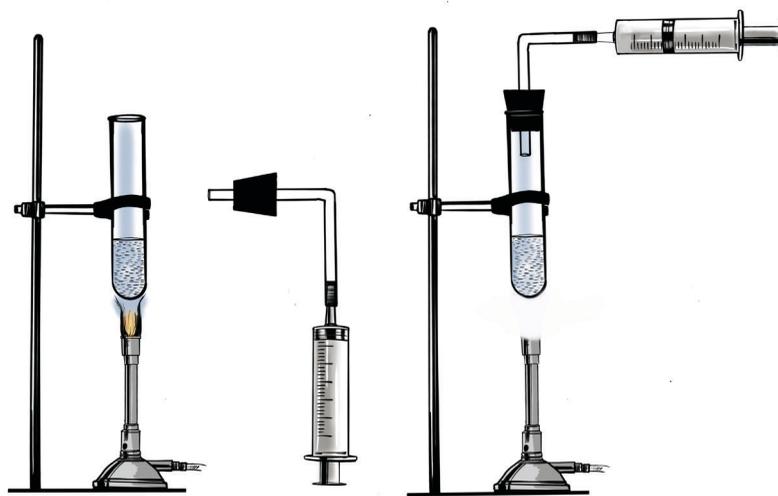


Fig 14.8

Take a boiling tube and fill half of it with water. Boil the water by placing the tube above a flame. After turning off the flame, fix a setup with a rubber cork, glass tube, and syringe to the boiling tube. Pull back the piston of the syringe. You can see that the water in the tube starts boiling again. The reason is that when pressure decreases, the boiling point decreases.



Fig 14.9

Why does cooking in open vessels take more time in high mountain regions? Discuss and write the conclusions in your science diary.

What change happens to the boiling point when pressure increases? How does cooking become easier in pressure cookers? When pressure cookers are closed and heated, steam cannot escape from them. As a result, the pressure inside increases. What change happens to the boiling point then?

Heat Capacity of Water

Take two similar beakers. In one, pour water, and in the other, take coconut oil of same mass. Place both of them in a water bath and heat them. Stir the liquids in the beakers continuously. Record the temperature at regular time intervals. When the same amount of heat is given to water and coconut oil, which one's temperature rises faster in a fixed time? Why? Water is a liquid with a very high heat capacity. So, the temperature of water does not rise quickly. How can we make use of high heat capacity of water? Water is used to cool hot objects.

Heat capacity is the amount of heat energy required to raise the temperature of a given substance by 1°C

Have you noticed that the radiators in vehicles use a mixture containing a special coolant and water? Why do you think this is used? Water also helps in maintaining the body temperature within a limit.

Structure of Water

A water molecule is made up of two hydrogen atoms and one oxygen atom.

Water is a precious natural resource that made life possible on Earth. Let us now understand more about the important physical and chemical properties of water. Water is a natural substance that can exist in all three states, solid, liquid and gas.

Even though water is formed by the combination of hydrogen and oxygen, the individual properties of hydrogen or oxygen is not maintained in water.

In which state is oxygen usually seen? What about hydrogen?

But in which state is water usually found?

What could be the reason for water to occur in the liquid state?

There is a special kind of attractive force between water molecules. This force is the reason for many special properties of water. This attractive force helps water to keep it in liquid form at room temperature. It is the reason for surface tension of water.

Now think, what would happen if this force between water molecules did not exist?

Water would stay only in the gaseous state. There would be no rivers, no seas, and probably no living things on earth. Water is formed by combining hydrogen and oxygen. Is it possible to separate water back into hydrogen and oxygen? water can be split into hydrogen and oxygen by a process called electrolysis.

The Hoffman water voltameter (fig. 14.11) is a device that electrolyses water. Hydrogen is produced at the negative electrode of the battery and oxygen is produced at the positive electrode.

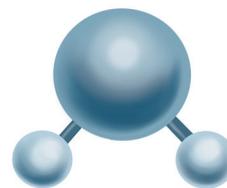


Fig 14.10

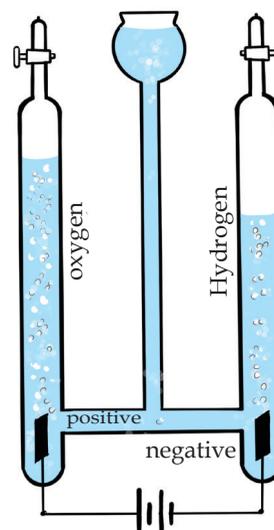


Fig 14.11



As the temperature changes, the density of water also changes.

The maximum density of water is at 4°C.

Whether water is cooled or heated from this point, its volume increases.

You may have seen ice floating on water.

If the ice had not been floating and protected the underlying water from freezing, fish and other living things could not have survived in water in cold regions.

When a substance cools, its volume normally decreases, right? Fill a glass bottle about three-quarters full of water, seal it tightly, and then place it in the freezer.

What happened to the volume of the water in the bottle when it turned into ice? You know that when water turns into ice, its volume increases. Therefore, its density decreases. Can you now explain why a piece of ice floats on the surface of water when you put it in water?

In cold countries, temperatures often drop below zero degrees Celsius. What if the water in rivers and lakes there turns completely into ice? Wouldn't aquatic life get trapped in the ice and die? Does that happen? What could be the reason?

Take the same amount of water in two beakers. Dissolve some salt in one of them. Find the boiling point of the water in each beaker using a thermometer. What difference is there in the boiling point of the water with salt added?

The boiling point of water with added substances such as salt is higher than the boiling point of pure water. When salt is added, more energy is required to boil the water. That is why the boiling point of salt water is higher than that of pure water.

Water Pollution

We have understood that water is a universal solvent. Its ability to dissolve different substances leads to the loss of its purity.

Our rivers, streams, and seas are getting polluted. What could be the reasons for this?



Picture of water pollution
Fig 14.12

- Chemicals from agricultural fields
- Chemicals from factories
- Oils from vehicles
-
-

Find out the main chemical substances that cause water pollution in the surroundings of your home and school.

What are the main problems caused by water pollution?

- Destruction of aquatic plants
- Damage to the food chain
- Soil pollution
- Diseases
-

Pure water is a basic need of human beings. But in our world, many people still do not have access to clean water. Every year, millions of people suffer from water-borne diseases, and many die of it.

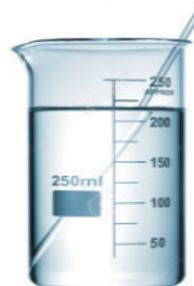
In this situation, the slogan "Right to water is a birthright" becomes very meaningful.



Let's Assess

1. What changes will occur on heating water that has already reached boiling point?
2. Explain how the boiling point of water varies under the following conditions:
 - a. In high-altitude areas
 - b. At sea level
 - c. In vacuum containers
 - d. In pressure cookers
3. Due to the intermolecular attraction between water molecules, a force arises that tends to minimize the surface area of water. How can this be demonstrated?
4. Write any three special properties of water and explain situations in daily life where we make use of these properties.
5. Observe the picture.

Compare the attraction between water molecules and the attraction between water and other substances, and explain why the water level rises inside a glass tube.



Extended Activities

1. Investigate and prepare a study report on the efforts taken in your locality to conserve water sources.
2. Based on rainfall availability across Kerala, prepare a rainfall distribution map.

CHEMISTRY OF MATTER



Fig 15.1

Look at the pictures. These materials are familiar to you. List them as described.

Items made from natural materials	Items made from synthetic materials
Door - Made of wood	Jar - Made of glass

Table 15.1

The diverse objects we use include not only natural substances but also synthetic materials.

Material Chemistry is a branch of science that helps in transforming various substances into useful products for humans.

Glass

Objects made of glass are essential part of our daily life. You know that glass is a synthetic material.

Try writing down the items made of glass:



Fig 15.2

- Mirror
- Glass jar
-
-

An accidentally discovered transparent substance

Once, Phoenician mariners were transporting washing soda on their ship. They landed on sandy banks of a river to cook food using fire, but with no stones to build a hearth, they used blocks of washing soda (Sodium carbonate) instead. As the fire burned, a thick transparent liquid flowed out. This was glass. It was said that they added different colours to it and sold it. Whether the story is true or not, the silicon dioxide in

the sand undergoes a chemical reaction with metal salts at high temperature, forming glass.



Fig 15.3

Are the glasses used to make the objects shown in the picture of the same type?

Haven't you seen the shattered glasses of vehicles met with accidents?

What is special about them?

Do you know the name of glass used in the display of mobile phones?

A table showing some types of glass used today, their uses and their major components is given.

Types of Glasses	Uses	Major Components
Soda lime glass/ Soft glass	To make mirrors, window glass, bottles, etc.	Silica, Sodium oxide, Calcium oxide
Borosilicate Glass	To make laboratory equipments, cookwares, etc.	Silica,,
Flint Glass / Optical Glass	Used in the manufacture of lenses, prisms, etc.	Silica,,

Table 15.2

Which is the component present in all types of glass?

Find out the other components present in each type of glass.



Fig 15.4

Try writing down the common properties of glass:

- Transparency
-
-

Haven't you seen glasses of different colours?

How do they get their colour?

Glasses get a variety of colours when different chemicals are added during the manufacturing process.

Look at the table.

Chemicals Added	Colour of the Glass Obtained
Cadmium sulphide	Yellow
Gold chloride	Ruby red
Chromium oxide	Green
Cobalt oxide	Blue

Table 15.3

Polymers

Polymerisation is the process in which small molecules combine under high pressure and temperature to form large molecules. The small molecules used are called monomers. The large molecules formed in this way are called polymers. The study of polymers is known as polymer chemistry.

Bakelite is the first synthetic polymer. Hermann Staudinger, who laid the foundation for modern polymer chemistry, is known as the Father of Polymer Chemistry.

Today, many polymers are produced. Commonly known plastics like polyethylene and PVC are all polymers. Not only plastics, but rubber and fibers are also polymers.

Polymers are large molecules formed by the combination of large number of small molecules. Look at the fig 15.6. The molecular mass of polymers are much higher than those of ordinary molecules. Therefore, they exhibit different properties.



Hermann Staudinger

Fig 15.5

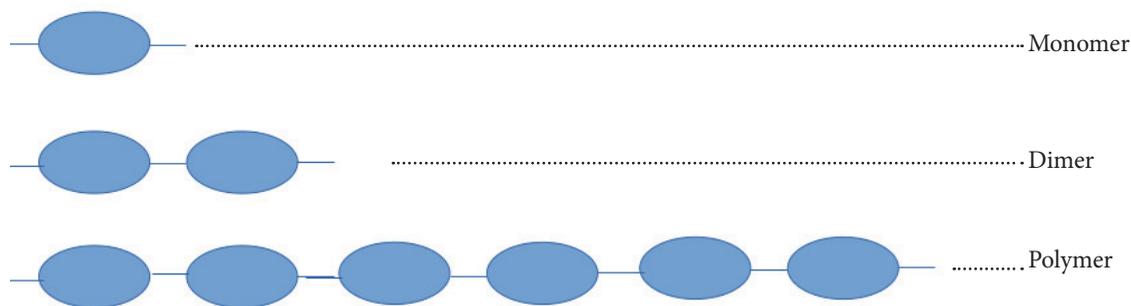


Fig 15.6

Why does the molecular mass increase when monomers participate in polymerisation? Can you observe and explain that from the above picture?

Plastic tables, chairs, etc. can be manufactured easier than wooden ones. Why?

Observe the table showing some polymers, their characteristics and uses.

Polymers	Characteristics	Uses
Polyethylene (Polythene)	Inert nature	Food containers, packaging
Polytetrafluoroethylene (PTFE)	Heat resistance	Cookwares used at high temperatures (Non stick)
Polyvinyl chloride (PVC)	Electrical resistance	Cables, Pipes
Polyethylene terephthalate (PET)	Prevents gas permeation	Used in bottle manufacturing

Table 15.4

Polymers are of natural and synthetic types. Most polymers are synthetic.

Natural polymers	Synthetic polymers
<ul style="list-style-type: none"> • Cellulose • Starch • Natural rubber 	<ul style="list-style-type: none"> • Polythene • Nylon • Bakelite • PVC • Synthetic rubbers

Table 15.5

Polymers can be classified based on their physical properties into plastics, rubber, and fibres. Plastics themselves can be further classified based on their nature into thermoplastics and thermosetting plastics.



Fig 15.7

Observe the plastic items in the picture.

Don't you know even more of such objects? Why is there such a high demand for plastic materials?

What are the unique properties of plastic materials that natural materials do not have?

- Can be reshaped
-
-

Difference between Thermoplastics and Thermosetting Plastics

Thermoplastics and thermoplastic products can be reheated, melted and reshaped into new products. However, thermosetting plastics or thermosets cannot be reheated and melted to make new reshaped products.

For example, the plastic carry bags we use are made of thermoplastics (Polythene), whereas items like the handle of a pressure cooker are made from thermosets.

Are most of the objects we use daily, natural or synthetic? Discuss.

How can we identify different types of plastics? Look at the picture. Have you seen such symbols on plastic items? What do they indicate?

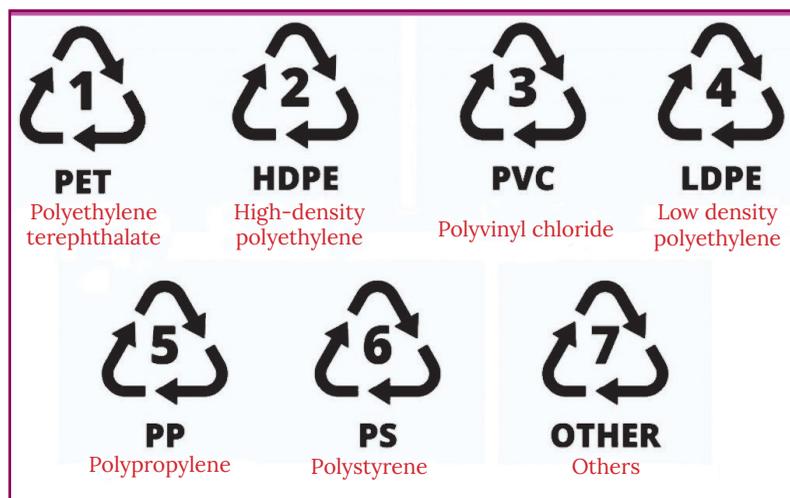


Fig 15.8

Code	Abbreviation
1	PET
2	
3	
4	
5	
6	
7	

Table 15.6

Are there only benefits from the materials produced through material chemistry?

Plastic Pollution

Plastic is something unavoidable due to its diverse benefits. However, due to uncontrolled use, plastics and plastic products accumulate in various places, causing water and soil pollution. As a result, the natural chemical composition of soil, air, and water is altered. It affects the growth of plants and organisms living in the soil. The picture shows an example of plastic pollution.



Fig 15.9

Is there a similar situation in your surroundings as well? How can this be resolved? Discuss.

To reduce plastic pollution, the 4R approach is often recommended.

4R

- Refuse – Avoid giving or accepting plastic products.
- Reduce – Minimise the use of plastic products.
- Reuse – Reuse plastic products.
- Recycle – Convert plastic products into new items through suitable physical and chemical processes.

Thiruvananthapuram: The government has taken strict action against plastic. A heavy fine will be imposed on the use of banned plastic items. Legal action will also be strengthened against those who litter such waste. Additionally, rewards will be given to those who report such littering.

A ban will be imposed on serving water in plastic bottles during functions, including wedding ceremonies. The initiative to make Kerala completely free from waste is being implemented with the support of Clean Kerala Company, Suchitwa Mission, and Haritha Kerala Mission.

Can plastic pollution be completely avoided using the 4R method alone? Shouldn't the production and distribution of single-use disposable products also be regulated?

Are the existing laws sufficient for that? Analyse the given newspaper report, collect more information, and conduct a debate on the topic: "Plastic – Friend or Foe?"

Rubbers

Polymers are classified based on their physical properties into fibres, plastics, and rubbers.

Natural rubber is an elastic natural polymer. Natural rubber is obtained from the latex collected from the rubber tree. When the demand increased, natural rubber alone was not sufficient to meet it. This led to the production of synthetic rubbers. Moreover, synthetic rubber shows less wear and tear compared to natural rubber. That is why synthetic rubbers are used in the manufacture of tyres.

Fibres

Fibres are polymers that are strong and long. Apart from clothing, they are used to make ropes, mats, nets, etc. Artificial fibres were developed to overcome the limited availability and quality issues of natural fibres.

Today, the universal availability of clothing and the diversity in the textile field is due to synthetic fibres. Nylon is the first synthetic fibre made by humans.

For a polymer to be considered a fibre, its length must be at least a hundred times of its diameter.

Try doing this activity.

- After marking two points 5 centimeters apart on a rubber band, stretch it and keep it like that for some time. Then untie it and allow it to return to its original state. Is the distance between the markings still 5 centimeters? Does the rubber band return completely to its original state? Why?
- Try pulling and stretching a jute rope and a rubber band with force. What happens? Why?

Complete the table based on the characteristics of natural and synthetic fibres.

Characteristics	Natural Fibres	Synthetic Fibres
Air circulation	More	Less
Water absorption ability		
Durability		
Weight		

Table 15.7

From this, it is clear that both natural and synthetic fibres have many limitations. To overcome these limitations, natural fibres are blended with synthetic fibres. Write down the uses of fibres.

- Can be used to prevent soil erosion and to make geotextiles for agricultural use.
- Nylon fibres are used to make fishing nets.
-

Complete the table based on their characteristics.

Characteristics	Polymer
Suitable for making strong threads
Polymer that can be moulded into various shapes	Plastic
Polymer with elastic nature

Table 15.8

Are glasses and plastics the only materials made by us? How are the medicines made? List the other materials around us that are made with the help of chemistry.

- Dyes
- Perfumes
- Soaps
-

As a branch of science that helps to create new materials with suitable properties, material chemistry plays a crucial role in human progress.



Let's Assess

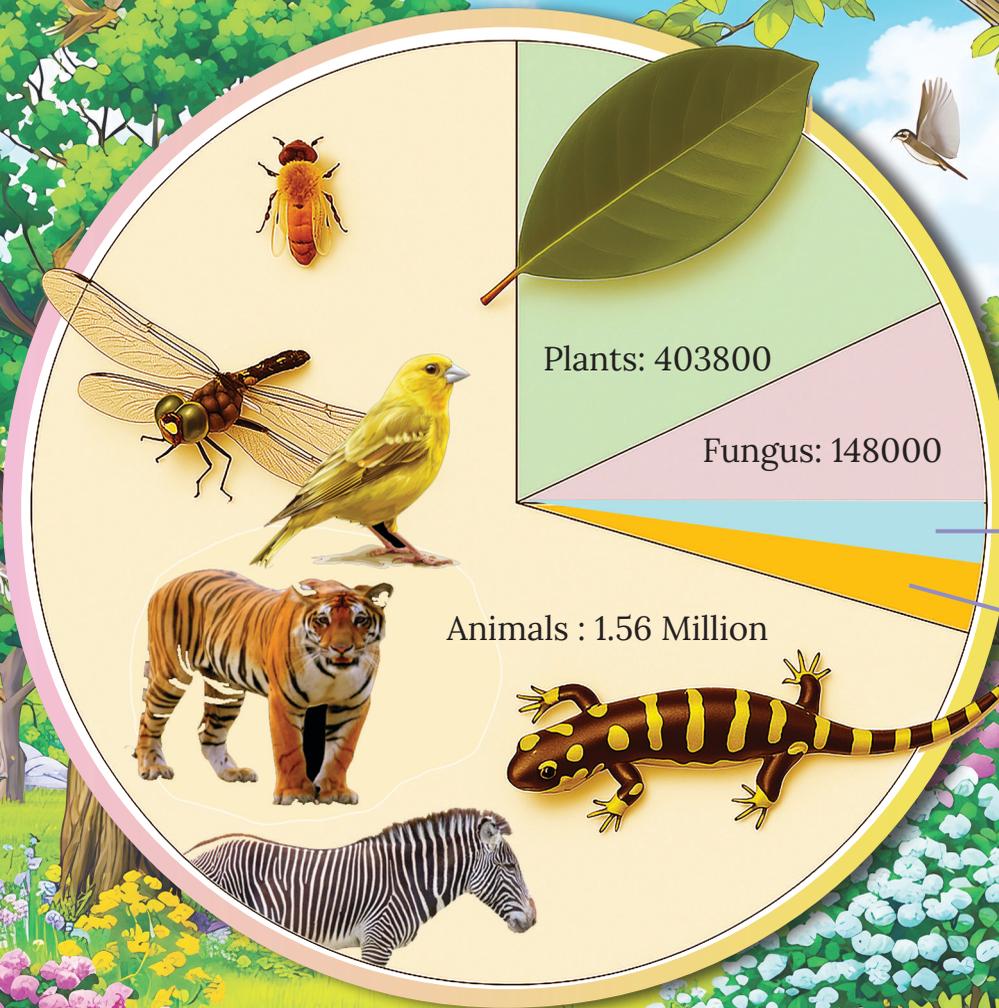
1. Which of the following is made of a synthetic material?
 - a. Iron nail
 - b. Aluminium vessel
 - c. Glass test tube
 - d. Gold ornament
2. Which of the following is not a polymer?
 - a. Bakelite
 - b. PVC
 - c. Rubber
 - d. Copper
3. What is the difference between thermoplastics and thermosets?
4. Write one reason why synthetic rubber is used in the manufacture of tyres.
5. What is the advantage of blending natural fibres along with synthetic fibres?
6. "Material chemistry provides us with both advantages and disadvantages" Do you agree with this statement? Why?



Extended Activities

1. Organize an exhibition on the theme "The Discovery of Glass and the Growth of Science," including descriptions and pictures of the history of glass making and different types of glasses.
2. Prepare a seminar paper on the topic "Microplastic Pollution"

TREE OF LIFE



Bacteria and
Archaea:
30000

Protista :
33100

Observe the poster displayed at the science fair.
What is the main idea conveyed by the poster?

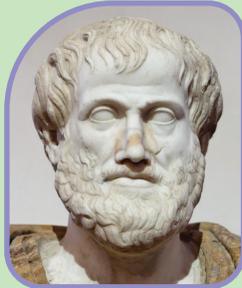
Can you suggest a suitable title for the poster?

•
How is it possible to identify and study so many living organisms?

Attempts to classify and study living organisms began a long time ago.

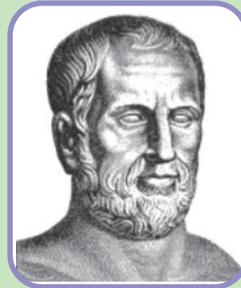
Let us get to know some personalities who made significant contributions in this field.

In the early days, organisms were classified as useful and non useful. Later, scientists tried to classify living organisms in various ways.



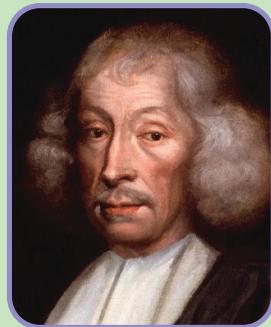
Aristotle classified living beings as those with red blood and those without.

Figure 16.1



Theophrastus classified plants into trees, shrubs, and herbs.

Figure 16.2



John Ray, who lived in the 17th century, initiated the scientific method of classification and was the first to use the term 'species'.

Figure 16.3

Ernst Haeckel, who lived in the 19th century, classified living organisms into three kingdoms : Animalia, Plantae and Protista.

Figure 16.4

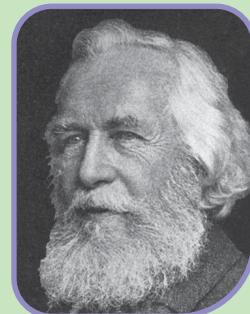




Figure 16.5

Carl Linnaeus, who lived in the 18th century, was the one who introduced the different levels of classification. Since he refined these classification levels and provided a scientific foundation for classification, he is considered the Father of Taxonomy.

Many scientists have contributed to this field. Collect more information and prepare a wall poster titled History of Taxonomy.

The classification of living beings was based on the similarities and differences in their characteristics.

Taxonomy is the branch of science that deals with classifying organisms by comparing their characteristics, identifying similarities and differences and giving them scientific names. Through taxonomy, we can understand biodiversity and the relationships between different organisms.

In the classification of Linnaeus, the level that includes all multicellular heterotrophic organisms is Kingdom Animalia. The level just below the kingdom is called Phylum. All vertebrates in the kingdom Animalia are included in the Phylum Chordata. The most basic level of classification is **Species**.

A species is a group of organisms that can naturally reproduce fertile offspring. Human beings, cats, dogs, and cashew trees are examples of different species. What are the classification levels between species and phylum? Refer the illustration 16.1.

Levels of classification

Identification, classification and naming of organisms are the main steps in classification.

Observe the picture given and complete Table 16.1 by verifying the classification levels of the tiger.

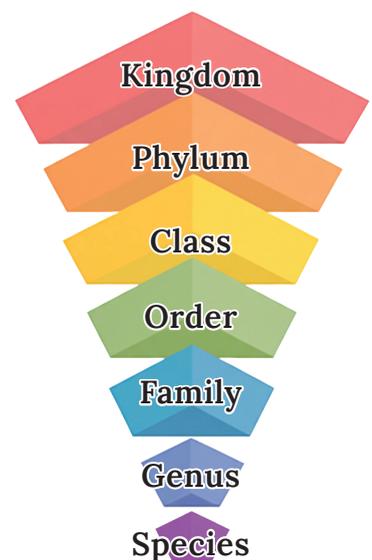


Illustration 16.1



Figure 16.6

The classification levels of the tiger.

Levels of classification	Group and characteristics	Organisms
Kingdom:	Animalia (Animals) – Multicellular, eukaryotic, heterotrophic organisms.	
Phylum:	Chordata (Vertebrates) – Presence of vertebrae and vertebral column.	
Class:	Mammalia (Mammals) – Warm-blooded, body covered with hair, nourish young ones with milk.	
Order:	Carnivora (Carnivores) – Sharp teeth and claws adapted for hunting and eating meat.	
Family:	Felidae – Retractable claws, excellent night vision.	
Genus:	Panthera (Big cats) – Ability to roar, large and powerful body structure.	
Species:	<i>Panthera tigris</i> (Tiger) – Orange fur with black stripes and strong large body.	

Table 16.1

The classification levels developed by Carl Linnaeus are still in use today. In classification, we group organisms into large groups based on similarities and into smaller groups based on differences. These classification levels such as kingdom, Phylum, Class etc. are called Taxa. Just like animals, plants can also be classified.

It was Carl Linnaeus who classified plants by including the levels from species to kingdom.

Observe Table 16.2 which shows the classification levels of the coconut tree.

Kingdom:	Plantae (Plants) – Multicellular, eukaryotic, autotrophic organisms.
Division:	Magnoliophyta (Flowering plants) – Plants with seeds enclosed inside fruits.
Class:	Liliopsida (Monocotyledons) – Plants with parallel leaf venation and fibrous roots.
Order:	Arecales – Plants with long and hard stems.
Family:	Arecaceae – Plants with large compound leaves and unbranched stems.
Genus:	Cocos – Produces large, single-seeded fruits.
Species:	<i>Cocos nucifera</i> (Coconut) – Produces fruits with a hard shell, fibrous husk, with a liquid and solid endosperm, inside.

Table 16.2

Observe and identify one or two plants or animals found in your surroundings and find out their classification levels. Present your findings in class and compile the collected information into a well-organised classification register.



Classification levels of coconut tree

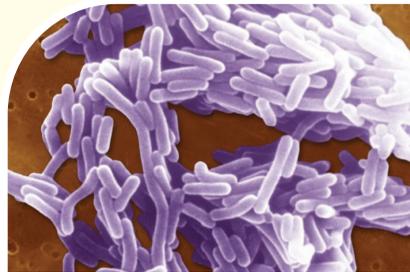
Figure 16.7

According to Carl Linnaeus' classification system, living organisms were divided into two kingdoms: Animalia and Plantae. This was known as the **two-kingdom classification system**.

Neither a plant nor an animal!

Can we include the organisms shown in Figure 16.8 (a, b, c, d) in the kingdoms we have studied earlier? Why?

Analyse the pictures and clues and write a suitable explanation for this.



Bacteria

Figure 16.8 (a)

- Unicellular organism
- Prokaryote



Paramecium

Figure 16.8 (b)

- Unicellular organism
- Eukaryote
- Heterotroph
- Have mobility



Mushroom

Figure 16.8 (c)

- Eukaryote
- Have no mobility
- Heterotrophs



Yeast

Figure 16.8 (d)

Five Kingdom classification

Bacteria, Paramecium, Mushroom and Yeast cannot be included in the Plant or Animal kingdoms. To overcome this limitation of the two-kingdom classification, the scientist Robert H. Whittaker classified organisms into five kingdoms.



Robert H. Whittaker

Monera, **Protista**, **Fungi**, **Plantae** and **Animalia** are the five kingdoms. Analyse the description of the five-kingdom classification and complete Table 16.3 appropriately.

Figure 16.9

Kingdom
Monera

Prokaryotes, do not have a distinct nucleus. They include some of the most ancient living organisms. Eg: Bacteria.

Kingdom
Protista

Most of them are unicellular eukaryotes. They can be autotrophs or heterotrophs. Flagella, cilia, and pseudopodia are their locomotory structures. Amoeba, Paramecium and Euglena are examples.

Kingdom
Fungi

Eukaryotes that are saprophytes. They do not have chlorophyll. Examples are mould and yeast.

Kingdom
Plantae

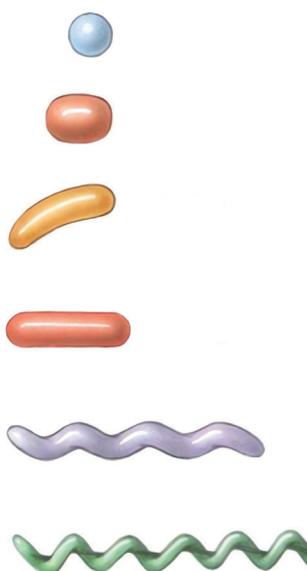
Multicellular eukaryotes that produce their own food through photosynthesis. They are primary producers. They have roots, stems and leaves. They grow in soil or water.

Kingdom
Animalia

Multicellular eukaryotes and heterotrophs. They have locomotory organs and definite receptors. They range from simple organisms like sponges to complex organisms like humans.

Kingdom	Characteristics	Examples
Animalia		
Plantae		
Monera		
Protista		
Fungi		

Table 16.3



Bacteria of various shapes

Figure 16.10

Find out the advantage of the five-kingdom classification. Monera, Protista, and Fungi are groups that include simple microorganisms. However, Plantae and Animalia include organisms with more complex structures.

Monera

Monera is the group of the simplest and most ancient organisms. They are all unicellular and prokaryotic. The main organisms included in this group are bacteria (Figure 16.10). Bacteria can be found in soil, water, air, food, and even inside our bodies. They play an important role in nutrient cycles like nitrogen fixation in the soil. Although most bacteria are useful, some can cause diseases.



Human Microbiome Project (HMP)

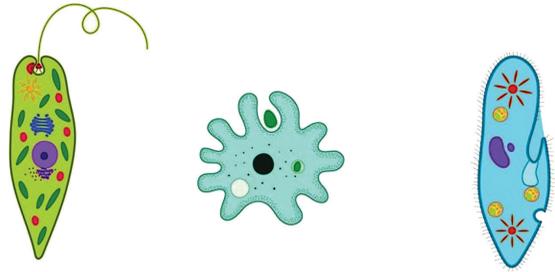


The Human Microbiome Project is a research initiative launched in 2007 by the U.S. National Institutes of Health (NIH) to study microbial communities related to human health and disease. The human microbiome includes microorganisms such as bacteria, viruses, and fungi which live in and outside the human body. These play a vital role in maintaining health and influence digestion, immunity, and even mental well-being.

Protista

These are unicellular eukaryotes. Most protists live in aquatic habitats. Paramecium, Amoeba, and Euglena are examples.

Plasmodium and *Entamoeba histolytica* are disease-causing protists.



Figures 16.11, 16.12, 16.13

Fungi

These are eukaryotes. Except for a few, like yeast, the others are multicellular.

Fungal cells have a cell wall made of a substance called chitin. Since fungi do not have chlorophyll, they cannot perform photosynthesis. They absorb nutrients from dead and decaying matter, so they are called saprophytes.

Mould on bread, mushrooms, and yeast are examples of fungi. Edible mushrooms, yeast used in baking and preparation of wine and alcohol are useful fungi. Some fungi cause diseases such as candidiasis and ringworm.



Figure 16.14

Behind the name

What is this plant known as in your area?

Papaya, Karumoosa, Kappalanga,

You've understood now that in different places, the same plant has different names. Even in Malayalam, there are various names, so it's certain that in different languages, it will have different names too. Wouldn't this make it difficult to identify and study the same living organism when it is known by different names?

What could be the solution to this?

Write down your guess.

.....



Figure 16.15

This issue is solved by giving names that are universally accepted beyond language barriers.

It was Carl Linnaeus who developed the method of naming organisms scientifically. This scientific method of naming where the genus name comes first and the species name second is called **Binomial nomenclature**.

When a name is given in this manner, the organism will have the same name everywhere in the world. Accordingly, the scientific name of human is *Homo sapiens*.



The names of living organisms are mentioned in Latin. The names in other languages are transformed to Latin style to give scientific names to organisms.

Rules of Binomial Nomenclature

In the scientific naming system, the name of an organism should have two parts. The first part of the name is the genus name and the second part is the species name. When writing the scientific name in English, the genus name should begin with a capital letter. The scientific name should be printed in italics.

Find the scientific names of the organisms mentioned below and complete Table 16.4.

Organism	Scientific name
Tiger	
Coconut tree	
Dog	

Table 16.4

New paths in classification

As new organisms are discovered, the existing classification systems become insufficient to accurately categorize them. Classification methods are continuously updated based on physical characteristics, genetic relationships, and other factors. Classification is constantly being revised in accordance with new observations, discoveries and understandings.

The methodology of modern classification

In the early days, organisms were classified based on their external structure and utility. What is the limitation of such a method of classification?



Figure 16.16

Can the simply structured Salvinia and Wolffia be classified under the same genus?

Based on the indicators given, examine the description below.

According to modern classification methods, they do not even belong to the same family. The non-flowering Salvinia belongs to the family **Salviniaceae** which includes plants like Azolla. On the other hand, Wolffia is classified under the family **Araceae** which includes flowering plants like Anthurium. Both Wolffia and Anthurium are flowering plants and are believed to have evolved from a common ancestor. This evolutionary relationship is the reason they are placed in the same family, despite their large external differences.

Similarly, classifications based only on external features may lead to genetically related organisms being placed in different groups. Today, organisms are classified by considering both evolutionary (phylogenetic) and genetic characteristics.

Indicators

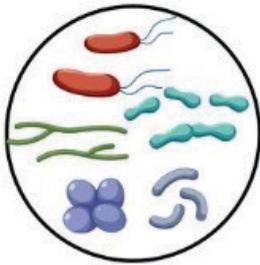
- Limitations of classification based only on external features
- Changes in the criteria of classification

Six-Kingdom classification

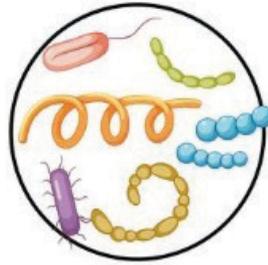


Figure 16.17

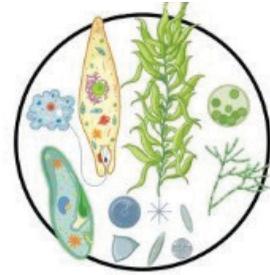
The scientist **Carl Woese** introduced the six-kingdom classification system. The kingdom Monera was divided into two distinct kingdoms to form this system. Based on modern scientific observations, the kingdom Monera was split into two groups: Archaeobacteria and Eubacteria.



Archaeobacteria



Eubacteria



Protista



Fungi



Plantae



Animalia

Illustration 16.2

Do all humans belong to the same species?



Illustration 16.3

Although humans living in different parts of the earth show some differences in their external appearance due to the influence of local geography and environmental factors, there is no significant genetic or other fundamental difference among them. All humans around the world share a common ancestor. That is why all humans are classified under the same species, *sapiens*.

As science progresses, advancements in molecular-level studies have led to changes and improvements in classification systems. With the discovery of each new organism, taxonomy continues to evolve. This process deepens our connection with nature.



Let's Assess

1. Examine the following passage and correct the errors if any, found in the underlined parts.

Classifying living beings into larger groups based on similarities and further into smaller groups based on differences is the basis of the cell theory. The various levels of classification were developed by Theophrastus. He is known as the Father of Taxonomy. The smallest

unit in classification is phylum. The method of scientifically naming organisms was developed by Carl Linnaeus. The practice of identifying an organism by using both its genus and species name is known as taxon. According to this, when writing the scientific name of an organism, the species name should be written first.

2. Match the following.

A	B
1. John Ray	a) Living things were classified into 5 kingdoms
2. Carl Linnaeus	b) Plants were classified as trees, shrubs, and herbs
3. Ernst Haeckel	c) Living things were classified into 3 kingdoms
4. Robert H. Whittaker	d) Father of taxonomy
5. Aristotle	e) Initiated the scientific method of classification
	f) Animals were classified into those with red blood and those without red blood.

Example: Aristotle classified animals into two groups – those with red blood and those without red blood.

3. Which of the following does not belong to the group? What is the common feature of the others?
- A. Housefly, Lizard, Butterfly, Grasshopper
- B. Cat, Dog, Tiger, Snake
- C. Arecanut tree, Coconut tree, Jack tree, Palm tree



Extended Activities

1. Prepare a magazine including pictures and contributions of scientists related to the history of classification.
2. List the plants found in the school surroundings and biodiversity parks, find their scientific names, and display them.

THE BEAUTY OF DIVERSITY

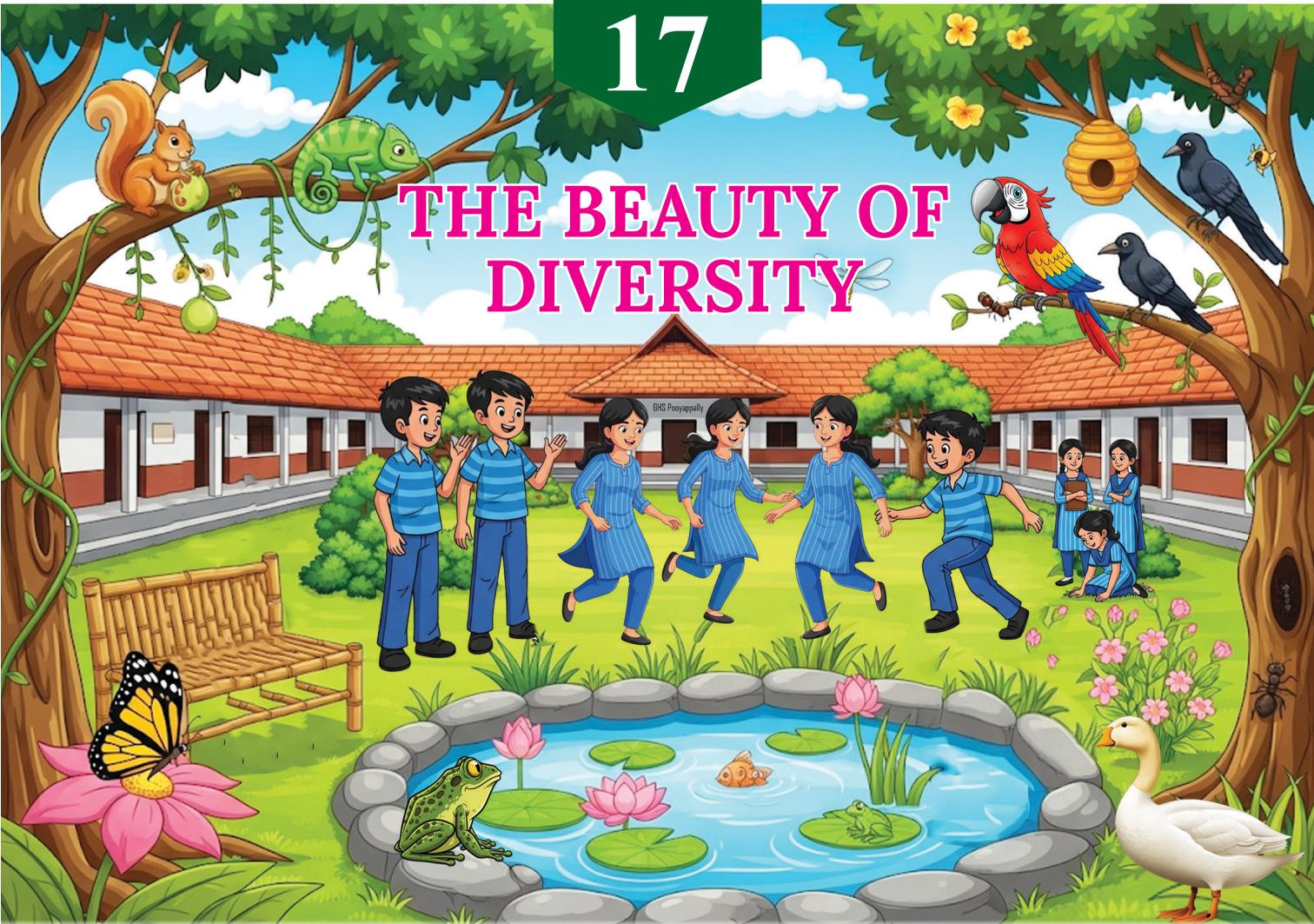


Figure 17.1

Look at the picture of the biodiversity park in a school. Which are the living organisms that you see in the picture?

In what different ways can you classify the organisms you identified? Discuss.

Apart from the organisms you identified in the picture, what other organisms can be seen in a biodiversity park?

List the place observed, the plants and the animals. Why is this place called a biodiversity park?

173 species of lichens were discovered on the surface of a single tree in Papua New Guinea. This finding indicates the extent of hidden biodiversity in tropical rainforests.

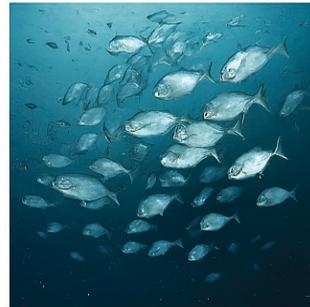
In 2024, 683 new species were discovered in India. Kerala ranked first in discovering new animal species, with 101 of them.

Lichens

Some algae or cyanobacteria live inside certain fungi. The fungus provides structure and protection, while the algae or cyanobacteria produce food for both organisms through photosynthesis. The symbiotic organisation of these organisms* is known as lichens.

Didn't you notice the news? What conclusions can we arrive about the biodiversity, after analysing this information? Discuss.

.....
Observe Figure 17.2 and write down the habitats of the organisms.



.....
Land, water

Figure 17.2

The natural surroundings where each living being lives is called its habitat.

Observe Figure 17.3



Coral reef

Mangrove Forest

Desert

Wetlands

Figure 17.3

What are the organisms found only in these habitats?

What are the non-living (abiotic) factors that help the survival of organisms in these habitats?

The plants, animals and microorganisms in a particular area interact with each other and with abiotic factors. This community along with the physical environment is known as an ecosystem. The ecosystem is the basic unit that supports the existence of the biosphere. The biosphere on Earth is made up of various ecosystems.

Don't we see a variety of organisms in each ecosystem? Observe the different ecosystems in the biodiversity park near your surroundings.

Have you noticed that a single organism can exist in different forms as shown in the pictures?

Some organisms are able to live only in certain habitats. Why? Find out.

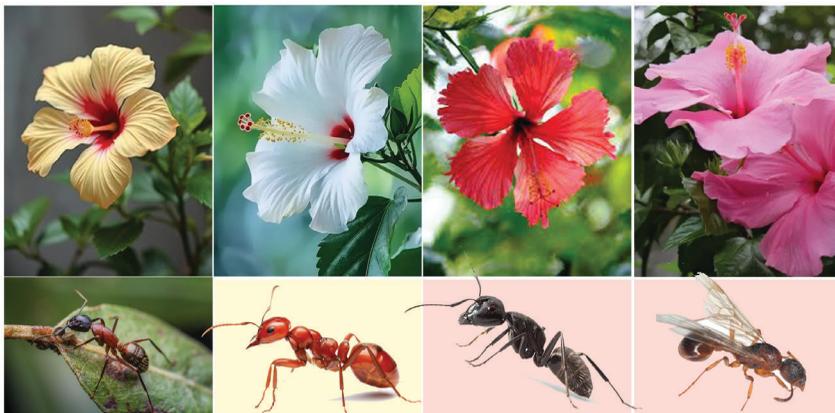
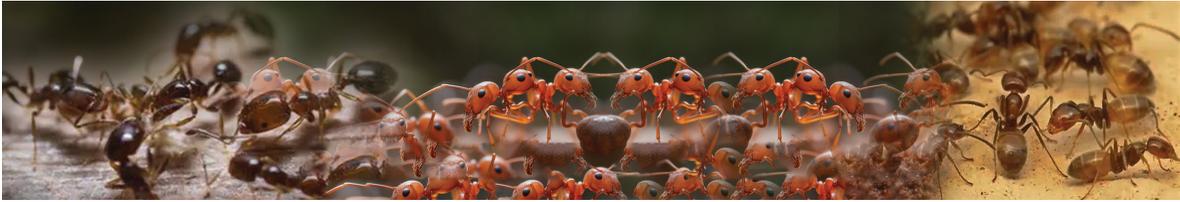


Figure 17.4



More than 15,000 types of ants have been discovered and named by scientists across the world! It is believed that many more species will be there in forests, deserts and underground soil. Why are there so many different types of ants? Ants exist on Earth for over 100 million years. They can survive in various habitats such as deserts, rain forests and mountains. They have evolved adaptations to suit these different habitats over time. This is the reason for the emergence of so many species.



There are also organisms in ecosystems that cannot be seen with the naked eye. How can we observe them?

- Collect soil samples from different areas around the school and observe them using a hand lens.
- Collect water samples from various water bodies and examine them using a microscope with the help of your teacher.

Figure 17.5

Record your observations.

Biodiversity

What is biodiversity?

Observe illustration 17.1, showing the different levels of biodiversity.

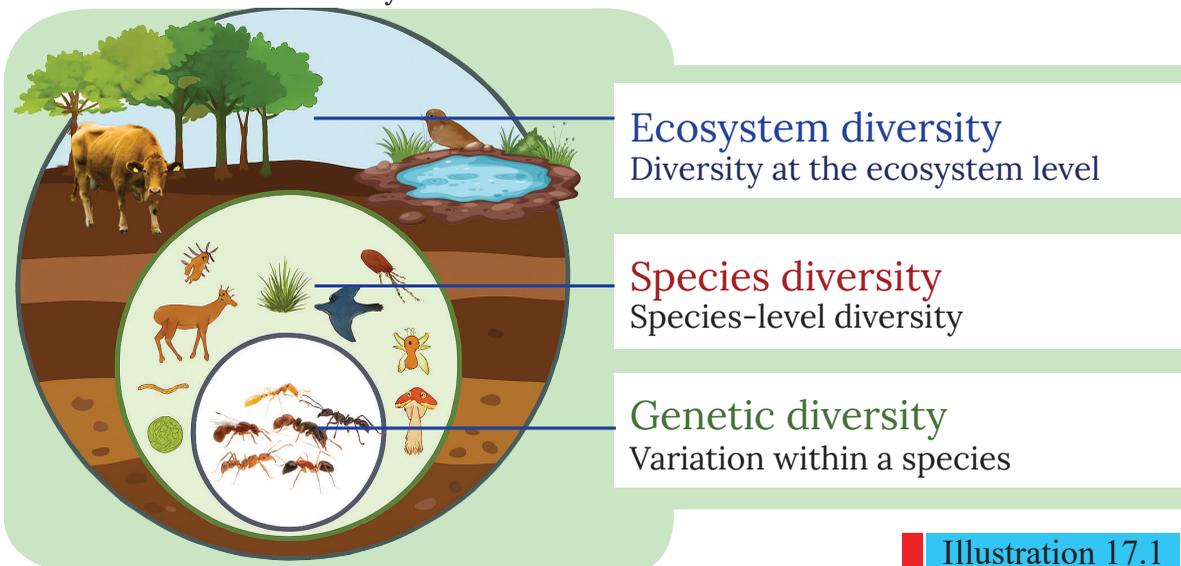


Illustration 17.1

Identify and write down which level of biodiversity that each of the following represents.

There are more than 50,000 rice varieties and over 1,000 mango varieties in India.

In a forest, there are elephants, monkeys, birds, snakes, grasses and even bacteria.

In a village, there are paddy fields, coconut groves, hills, rivers and marshes.

Shall we now formulate an operational definition for biodiversity?

All the diverse living organisms on Earth, including plants, animals, and microorganisms, along with their habitats, together form biodiversity.

Importance of Biodiversity

Observe the poster prepared by the students of a science club.



Our biodiversity, our food, our health

Illustration 17.2

**Frogman
of India-
Sathyabhama
Das Biju**



Dr. Sathyabhama Das Biju, who is known as the Frog Man of India, discovered many new species of frogs in the Western Ghats. He conducted research on frogs living in different habitats and proved how important they are to the environment. He warned about the threats frogs face due to pollution and loss of habitat. His work is an inspiration for protecting nature and biodiversity.



India- a Country of mega biodiversity

India, with only 2.4 percent of the world's land area, is home to over 45,000 plant species and more than 91,000 animal species. This accounts for about 7 to 8 percent of the recorded species in the world. Out of the 34 globally recognized biodiversity hotspots, four are in India – the Himalayas, the Western Ghats, the Northeastern region including Assam and the Nicobar Islands.

What does the poster indicate?
 What role does biodiversity play in the survival of living beings, including humans?
 How does biodiversity benefit each living organism?
 Shall we collect information on these topics and organize a seminar in the class on the topic "**Biodiversity and the Survival of Living Beings**".

Seminar subtopics

- Food, clothing, shelter, fuel, medicines and biodiversity.
- Biodiversity and the stability of soil, water and air.
- Biodiversity in nutrient cycling, pollination, biological control and seed dispersal.
- Biodiversity and aesthetic values.

Biodiversity and the balance of the ecosystem

A representation of a food chain is given in illustration 17.3 below. Analyse it based on the indicators.

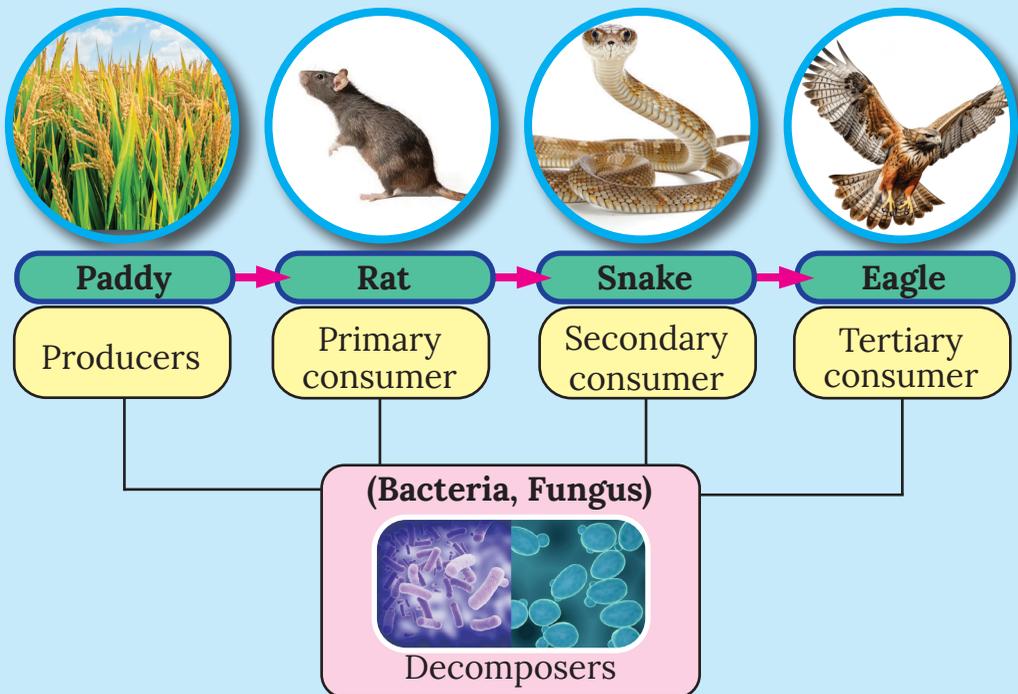


Illustration 17.3

Indicators

- From whom does the food chain begin?
- Why are green plants called producers?
- Who are the consumers?
- What is the characteristic of primary consumers?
- What is the characteristic of secondary consumers?
- Who are the tertiary consumers?
- What is the role of decomposers in the food chain?

A food web is a network of interconnected food chains found in an ecosystem.

Create a food web using the given organisms.

Plant	Deer	Rabbit	Rat	Snake	Grasshopper
Squirrel	Tiger	Fox	Vulture	Frog	Calotes

Decomposers

Bacteria, fungi, and other organisms that break down complex molecules in dead bodies and other remains in the ecosystem into simpler molecules and return them to nature are called decomposers.

Trophic level

How about depicting the organisms in the food web in another way?

Prepare a note analysing the illustration 17.4 and the description based on the indicators.

Trophic level 4
Tertiary consumers

Trophic level 3
Secondary consumers

Trophic level 2
Primary consumers

Trophic level 1
Producers

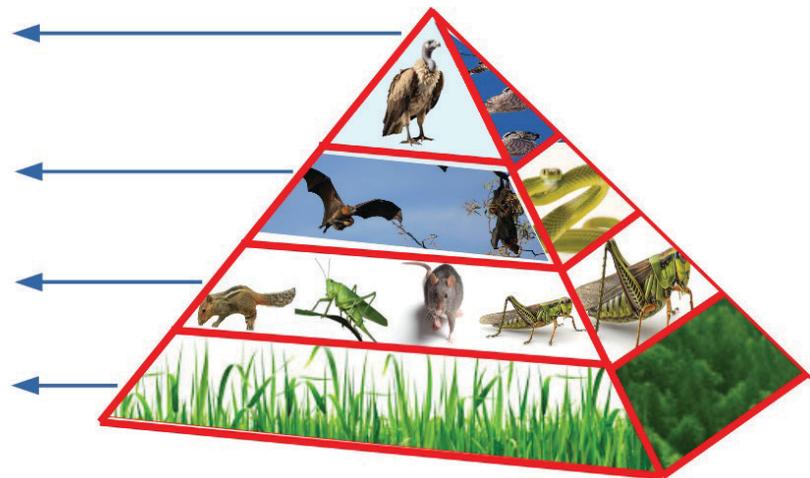
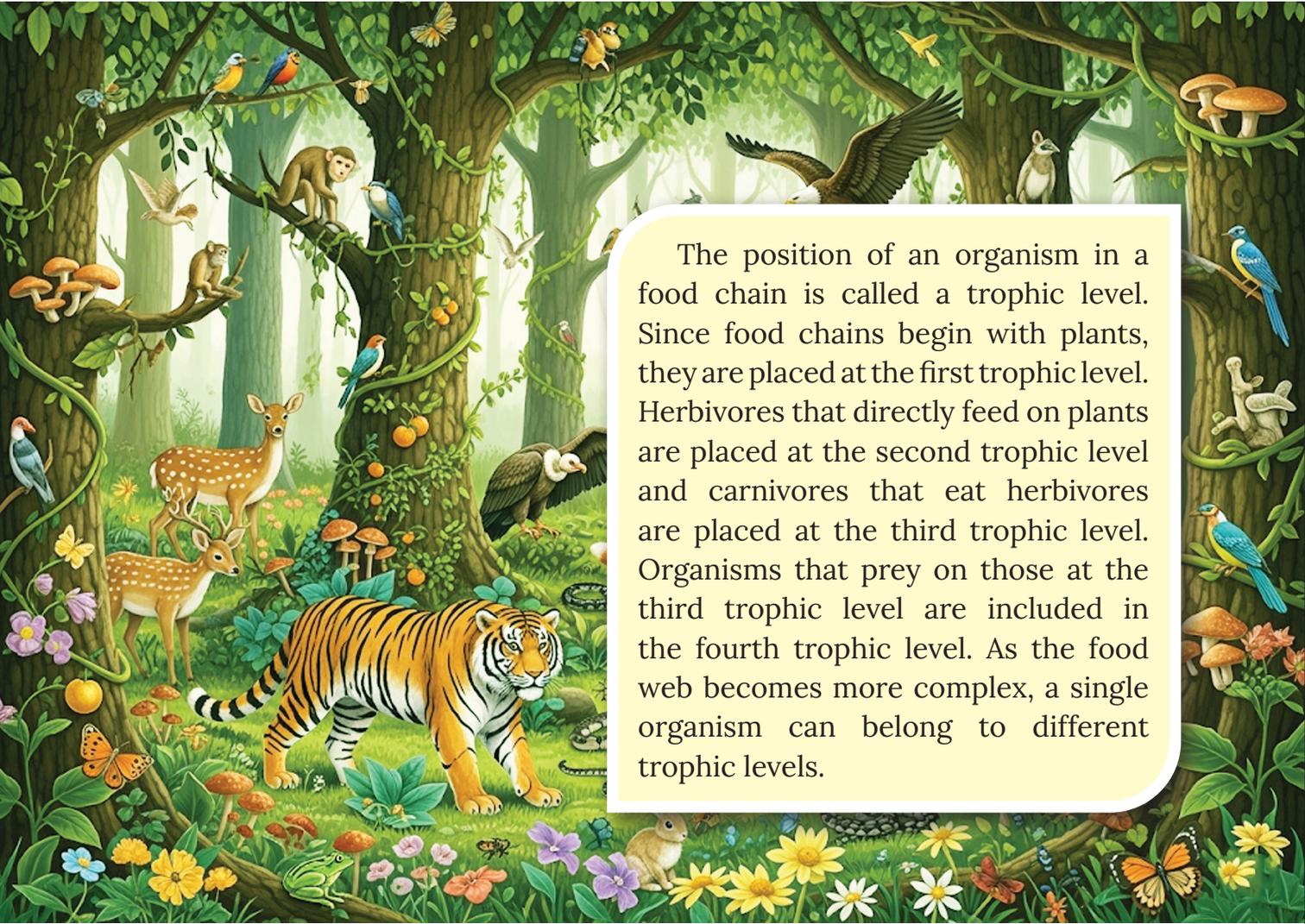


Illustration 17.4



The position of an organism in a food chain is called a trophic level. Since food chains begin with plants, they are placed at the first trophic level. Herbivores that directly feed on plants are placed at the second trophic level and carnivores that eat herbivores are placed at the third trophic level. Organisms that prey on those at the third trophic level are included in the fourth trophic level. As the food web becomes more complex, a single organism can belong to different trophic levels.

Indicators

- The trophic level with the maximum number of organism.
- The trophic level with the least number of organism.
- How does the disappearance of top-level organisms in a trophic level affect the balance of biodiversity?

Ecological interactions

In illustration 17.5, the relationships between different pairs of organisms are indicated. Find out more examples of such relationships.

Dog- Flea



Parasitism

One is benefited, the other is harmed. A parasite depends on the host organism for food.

Example:

Eagle- Chicken



Predation

Beneficial to one, harmful to another. The prey becomes food for the predator.

Example:

Vanda- Tree



Commensalism

Beneficial to one, neither beneficial nor harmful to another.

Example:

Tree- Butterfly



Mutualism

Beneficial to both organisms.

Example:

Crop- Weed



Competition

At first, harm to both; later, benefit for the winner.

Example:

Illustration 17.5

Are such relationships necessary to maintain the balance and stability of an ecosystem? Discuss.

Energy flow in an ecosystem

You have understood the trophic levels in a food chain, haven't you? What all are transferred from one trophic level to the next in a food chain? Energy is needed for various functions of the body, right? What is the source of energy for living organisms? Analyse the illustration 17.6 given below using the indicators and prepare a note.

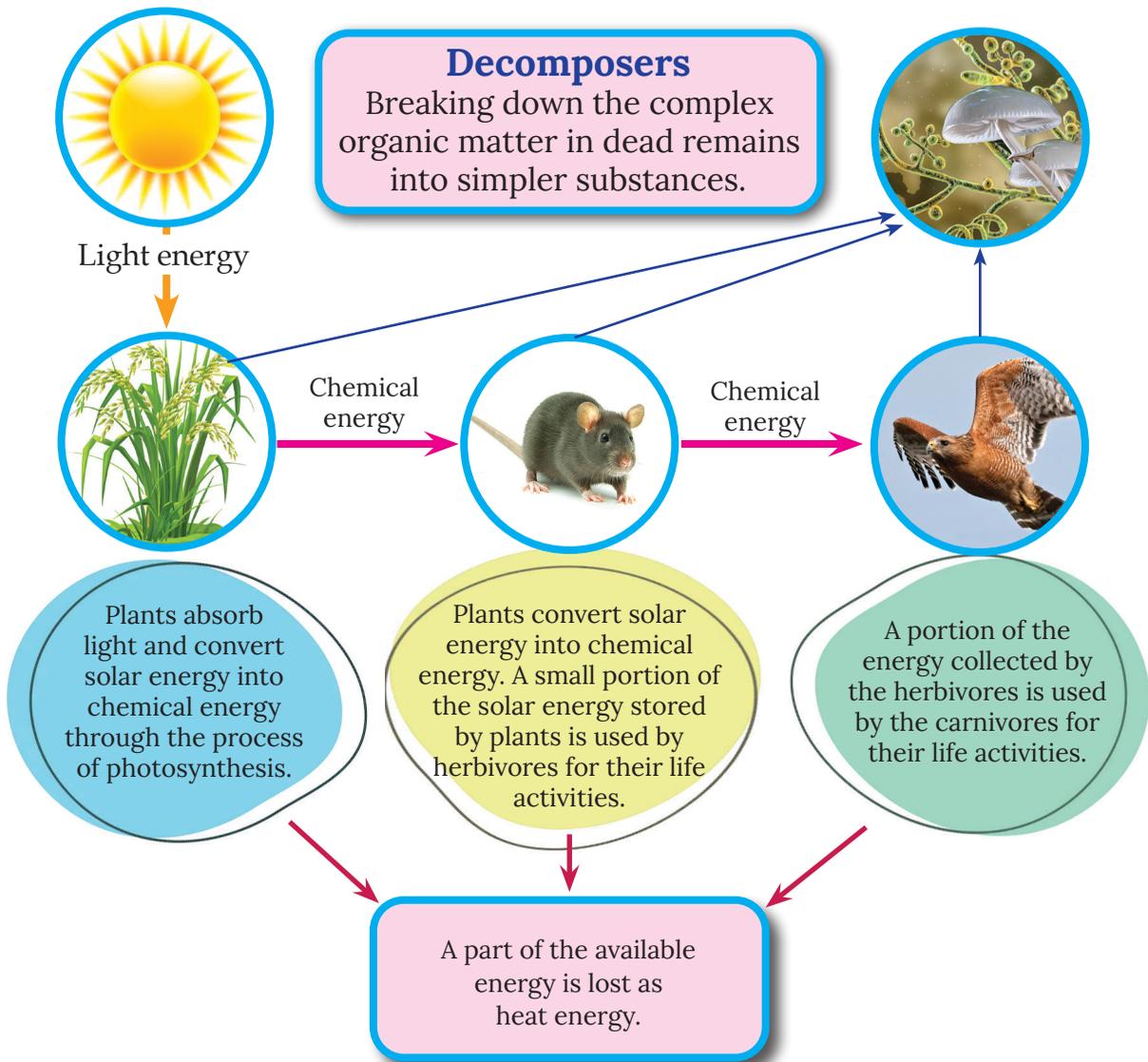


Illustration 17.6

Indicators

- The ultimate source of energy in the food chain.
- Storage of solar energy in producers.
- Energy transfer and energy loss.
- Energy availability at different trophic levels.

Flow of matter in an ecosystem

Various substances and elements are needed for the growth of living beings, repair of body damages and reproduction.

Which are the important elements and substances among them?

Observe an example of material flow occurring in an ecosystem.

Carbon cycle

Most of the substances in living organisms are organic compounds.

How is carbon cycled in different forms in an ecosystem?

Analyse the given illustration 17.7 using the indicators provided and prepare a note.

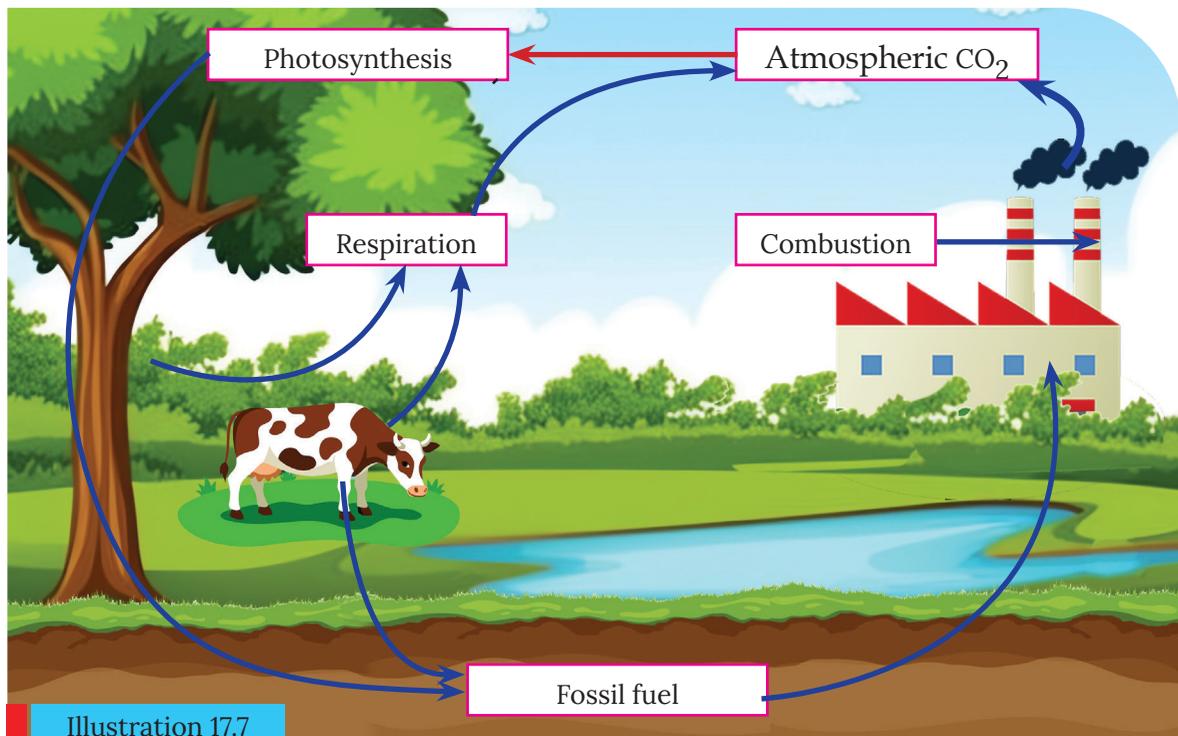


Illustration 17.7

Indicators

- In what form is carbon present in the atmosphere?
- Why do plants use carbon dioxide?
- How does carbon dioxide return to the atmosphere from living organisms?
- What are the situations that lead to an increase in atmospheric carbon dioxide?
- How does biodiversity conservation help in maintaining carbon balance in ecosystems?

Collect information and illustrate other material cycles.

- Water cycle
- Nitrogen cycle
-

For the survival of ecosystems and biodiversity, the flow of matter and energy must take place effectively. The various substances absorbed from the non-living environment must circulate through living organisms and return to where they came from. To enable this, food chains and biodiversity must be conserved. Decomposers play a vital role in this.

You have read a part of the science article. What would happen if decomposers disappeared? Transform your imagination into creative writings and display them on the wall magazine.

Biodiversity depletion

Discuss the pictures 17.6 and 17.7 given below based on the indicators.



Figure 17.6

Figure 17.7

Indicators

- What are the differences between the two pictures?
- How does deforestation affect other living beings?

Are all the organisms that once lived in your area still seen today?

Is biodiversity in our area increasing or decreasing?

Is this kind of biodiversity loss happening only in our region?

Observe the pictures given below and discuss their importance. Shall we collect similar pictures of organisms and prepare a pictorial album?



Hornbill

Figure 17.8



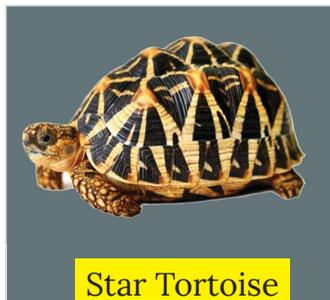
Purple frog

Figure 17.9



Lion tailed macaque

Figure 17.10



Star Tortoise

Figure 17.11



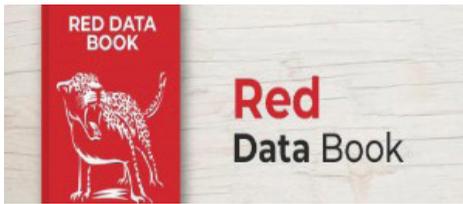
Nilgiri tahr

Figure 17.12

Purple frog/Mahabali frog

The underground dwelling purple frog comes to the surface only once a year. After mating and laying eggs, it returns underground. These frogs existed even during the time of the dinosaurs. Since they have undergone very little evolutionary change, they are often referred to as living fossils.

Red Data Book



The Red Data Book is a document published by the International Union for Conservation of Nature (IUCN) that contains information about the rare and endangered animals and plants that exist within a state or country.

It is highly useful for planning activities to conserve biodiversity. Observe the pictures of some Indian species listed in the Red Data Book, collect more information about such animals and plants and prepare a presentation based on your findings.



Ganges Shark

Figure 17.13



Malabar civet cat

Figure 17.14



Kashmir stag

Figure 17.15



Rameswaram
Parachute spider

Figure 17.16

Can we protect all species at all times?

Is it possible to fulfill human needs and conserve biodiversity at the same time?

Conduct a debate in the class related to this.

Go through the news item.

Wild elephant menace – Farmers in crisis.

Chirappadam: As the summer heat is intensifying, wild elephants are increasingly venturing into human settlements. A herd of elephants entered and completely destroyed about two acres of banana plantation. The agricultural officer reported a loss of nearly Rs. 2 lakhs. Farmers are not receiving adequate...

A shelter will be prepared for tigers outside the forest.

A special sanctuary will be set up outside the tiger reserve to house tigers. The new project aims to prevent tigers from entering human settlements.

AI technology to drive wild animals back into the forest

When wild animals enter farmland or the boundary of human settlements, they are identified through cameras and with the help of AI, various sounds are generated to drive them back into the forest.

What are the reasons for wild animals to enter human settlements?

Can you suggest any solutions to this problem? Discuss.

Biodiversity Conservation

Why is it necessary to conserve biodiversity? Analyse the given description and write down your conclusions.

Fruits, vegetables, rice, fish, etc. are part of our daily food. In addition to this many medicines are made from plants, animals, and microorganisms. Bees, butterflies, and other creatures help in pollination. Without biodiversity, we would not have healthy food, useful medicines, or even clean air.

Understanding the importance of biodiversity, many efforts are being made to conserve it in various ways. Examples of international organizations working for this cause include **WWF** (World Wide Fund for Nature) and **IUCN** (International Union for Conservation of Nature).

What are the organizations in our country that work for nature conservation?

There are also government institutions and schemes aimed at protecting local ecosystems. The Kerala State Biodiversity Board is as for this. Explore and learn more about their activities.



Plants - Nature's reservoir of medicine.

Since ancient times, humans used plants to treat diseases and maintain a healthy life. Even today, many modern medicines are made from plants or based on compounds derived from them. Medicinal chemicals can be extracted from leaves, roots, flowers, bark, and other parts of the plant. It is impossible to say which plant has no medicinal value. A plant considered a weed today might be the source of a valuable medicine tomorrow. All plants deserve protection.

People's Biodiversity Register - PBR

Under each local self-government body, a Biodiversity Management Committee (BMC) has been established. Its main responsibility is to conserve the biodiversity of the respective area. The People's Biodiversity Register (PBR) is prepared under the leadership of the BMC with active people's participation. The register mainly includes information about microorganisms, plants, and animals, their availability and their unique characteristics.

Mainly, there are two types of Biodiversity conservation.

- (1) In-situ conservation
- (2) Ex-situ conservation

In-situ conservation

This refers to the protection of natural habitats and the species living in them.

Examples:

- National Parks – Eravikulam, Silent Valley
- Wildlife Sanctuaries – Periyar
- Biosphere Reserves – Nilgiri
- Community Reserves – Kadalundi
- Ecological Hotspots – Himalayas, Western Ghats

Ex-situ conservation

Ex-situ conservation is the protection of plant and animal species that are at risk of extinction or may become rare, by creating a similar habitat outside their natural environment and conserving them under controlled conditions.

Examples:

- Botanical gardens, Zoological gardens
- Gene banks
- Aquariums

Visit a biodiversity conservation center in your locality. Prepare a report on the conservation activities taking place there and present it in the class.



Let's Assess

(1) Based on Box A, identify and write the appropriate items from Boxes B and C.

A	B	C
1. Parasitism	a. At first, harm to both; later, benefit for the winner.	a. Butterfly and the flower
2. Predation	b. Beneficial to one, neither beneficial nor harmful to another.	b. Vanda and mango tree
3. Commensalism	c. Beneficial to both organisms.	c. Tiger and deer
4. Mutualism	d. Beneficial to one, harmful to another The prey becomes food for the predator	d. Weed and crop
5. Competition	e. One benefits, the other is harmed.	e. Cat and flea

2. Examine the illustration and answer the following questions.



- Rearrange the given food chain in the correct order.
- Identify and write the producer, primary consumer, secondary consumer and tertiary consumer in the food chain.
- Which organism belongs to the third trophic level in this food chain?
- If the fish in this food chain completely disappear, how would it affect the ecosystem?

(3) A food chain created by a student is given below. Examine it and answer the following questions.



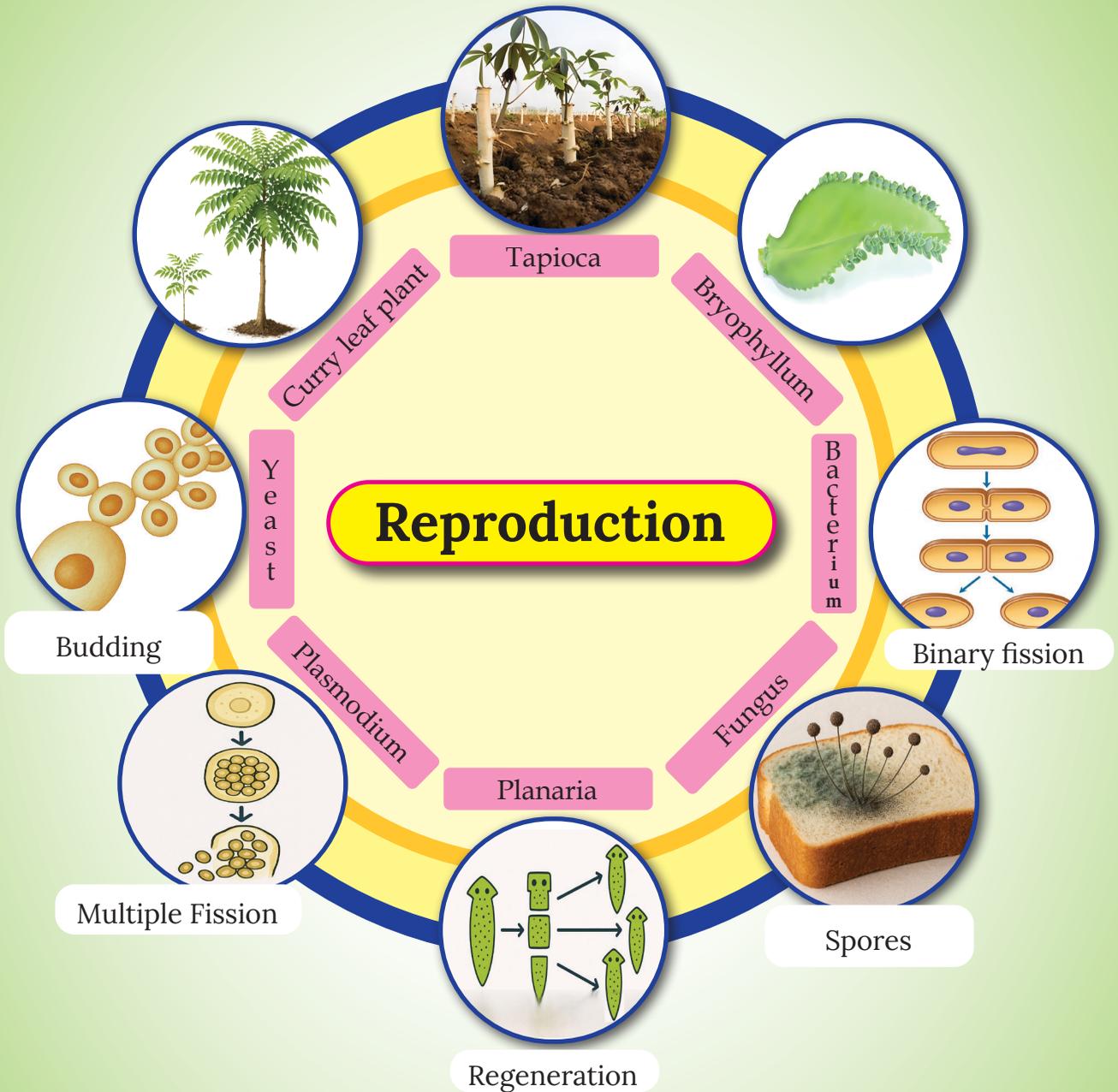
- Is the food chain created by the student correct? What is your opinion? What is the justification for it?
- What would happen if decomposers like bacteria did not exist?
- Write an example of a decomposer other than bacteria.



Extended Activities

- Examine the People's Biodiversity Register (PBR) of the local self-government body (Panchayat/ Municipality / Corporation) where your school is located. List the species found under each category and their current status (increasing/ decreasing). Present your findings in the class.
- Plant at least 10 different types of plants at your home and make a small garden. Before making your garden, record the organisms that were already present and the composition of the soil. After one month of planting, observe and record the changes that occurred. Present your findings and conclusions in the class.

CELLS THAT BECOME DAUGHTER CELLS



You have already learned about the different modes of reproduction in various organisms in earlier classes, right? Analyse the illustration and complete the given Table 18.1.

Number	Modes of reproduction	Examples
1		Bryophyllum Sansevieria
2	New plants grow from the root.	
3		Tapioca, Rose, Hibiscus, Sugarcane
4	Under favourable conditions, the cell divides and becomes two organisms.	Amoeba, Paramecium, Euglena
5	In unfavourable conditions, cells in organisms like plasmodium develop a thick outer covering. The cytoplasm and nuclear materials inside the cell divide into several parts. When the conditions become favourable, the outer covering of the cell breaks open, releasing many tiny cells, each of which grows into a new organism.	Plasmodium
6		Planaria, Hydra
7		Yeast

Table 18.1

Reproduction is the process that ensures the continuation of a species.

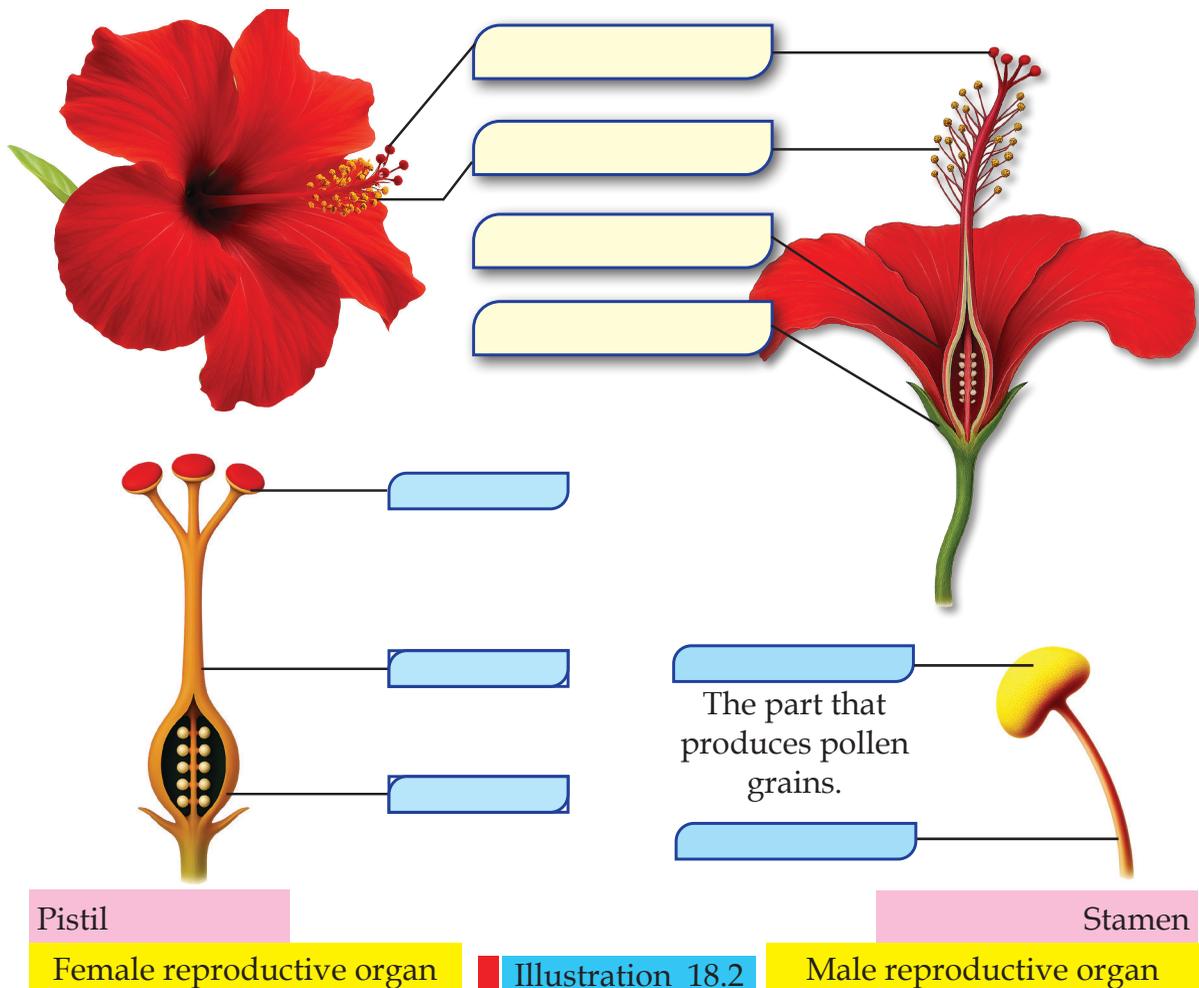
What is the fundamental difference between the reproductive methods we have discussed so far and the method of reproduction shown in the illustration below?



Illustration 18.1

How are seeds formed?

Observe the structure of flowers, which are the reproductive organs of plants and complete the illustration.



Pistil
Female reproductive organ

Illustration 18.2

Stamen
Male reproductive organ

How do pollen grains from the anther reach the stigma?

Pollination

The male reproductive organ in flowers is the stamen. Pollen grains are formed in the pollen of the stamen. The process of these pollen grains settling on the stigma of the pistil, the female reproductive organ, is called pollination. Animals like insects and birds as well as wind and water, help in pollination.

What happens to the pollen grain after pollination?

Shall we try a simple experiment with the help of the teacher?

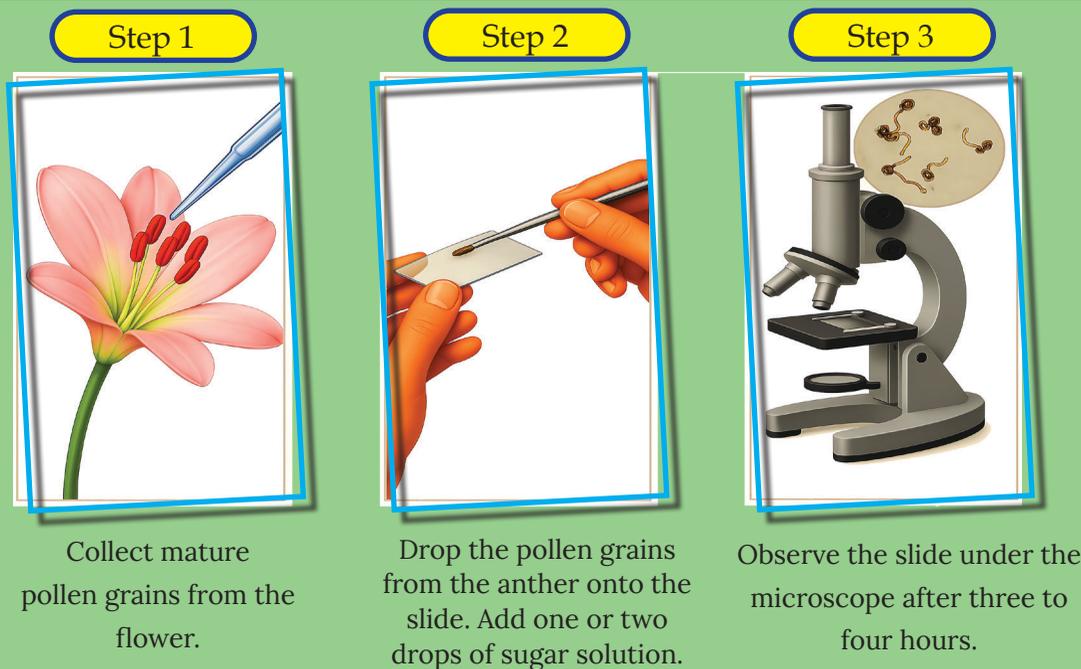
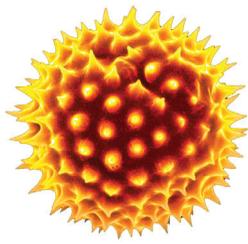


Illustration 18.3

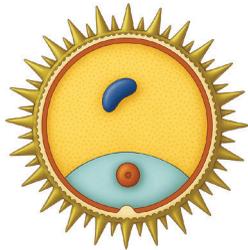
Prepare a note with diagram based on the experiment you conducted.

The pollen tube grows from the deposited pollen grains at the stigma towards the ovary.

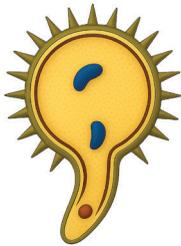
Prepare a report analyzing how fertilization occurs in plants, using illustrations and descriptions based on indicators. Then, complete Worksheet 18.1 provided below.



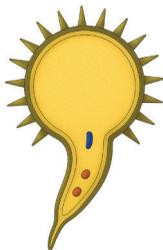
Pollen Structures suitable for attaching to the bodies of organisms that help in pollination.



Generative nucleus The male gamete is formed from this.



Tube nucleus It controls the formation and growth of the pollen tube. After the growth of the pollen tube, it disintegrates.



Pollen tube Helps to transport nuclei into the ovary.

Male gametes The generative nucleus divides to form two male gametes.

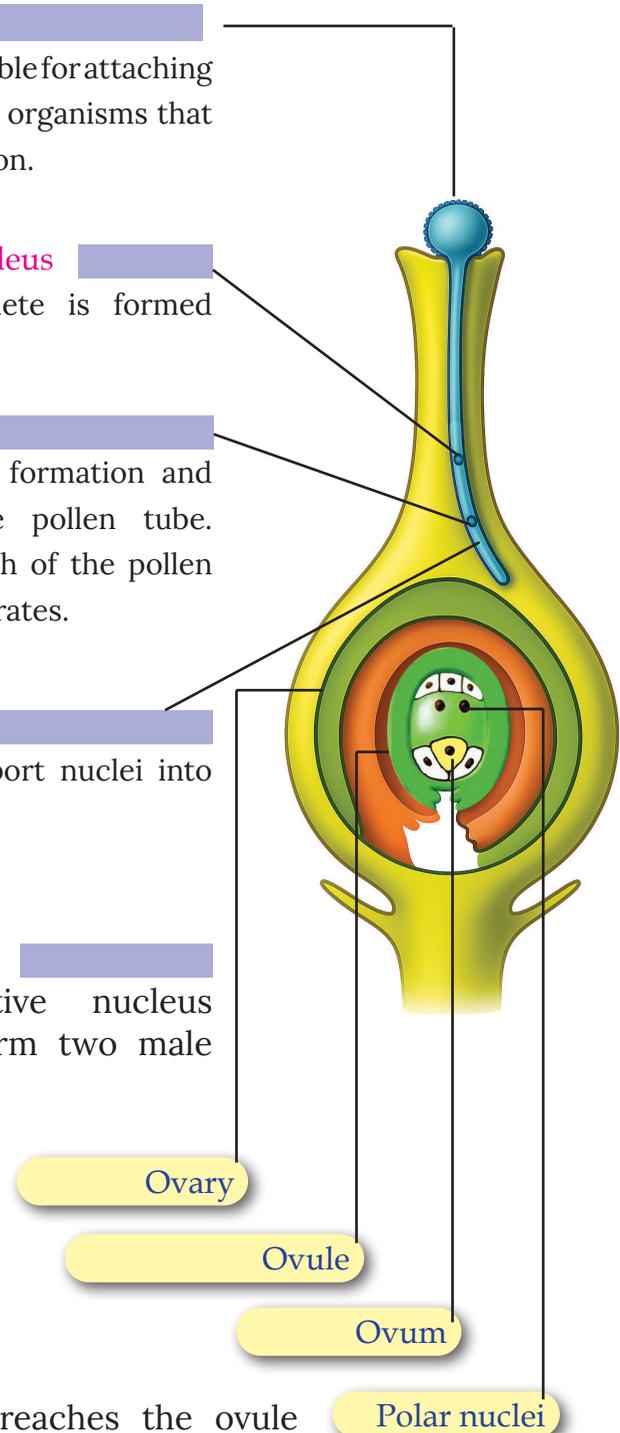


Illustration 18.4

Fertilization

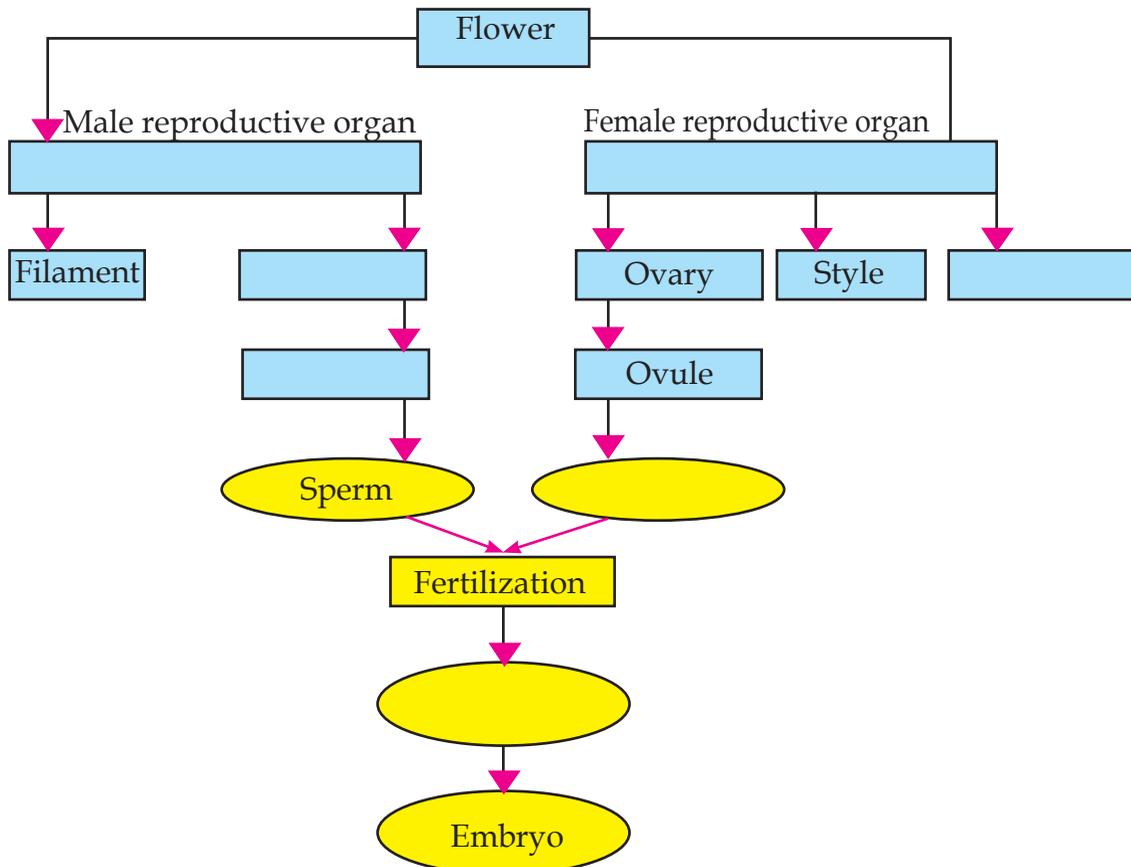
One of the male gametes that reaches the ovule through the pollen tube fuses with the egg cell to form a zygote. This process is known as fertilization. The zygote grows and becomes an embryo. The embryo then grows into a seedling. The second male gamete fuses with the polar nuclei to form the endosperm. The endosperm stores the food needed for the growth of the embryo.

Indicators

- Function of the tube nucleus
- Function of the pollen tube
- Formation of male gametes
- Fertilization
- Formation of endosperm

In monocot plants like paddy, maize and coconut, endosperm cells are formed through the division of the endosperm nucleus. During the stage when the seed germinates and becomes a seedling, the stored food required for the growth of the embryo is found in the endosperm cells. You may already know that in monocot seeds, the edible part is the endosperm. But in dicot plants, the food required for the growth of the embryo is stored in the cotyledons.

Sexual reproduction in plants



When reproduction happens through fertilization, it is called sexual reproduction.

Then, form an operational definition for asexual reproduction.

Reproduction in humans

Just like in plants, we know that animals also have specialized organ systems for reproduction. What are the parts of the reproductive system in humans? Where are the gametes produced?

Analyse the illustrations 18.5, 18.6 and prepare a note, based on the indicators.

Male reproductive system

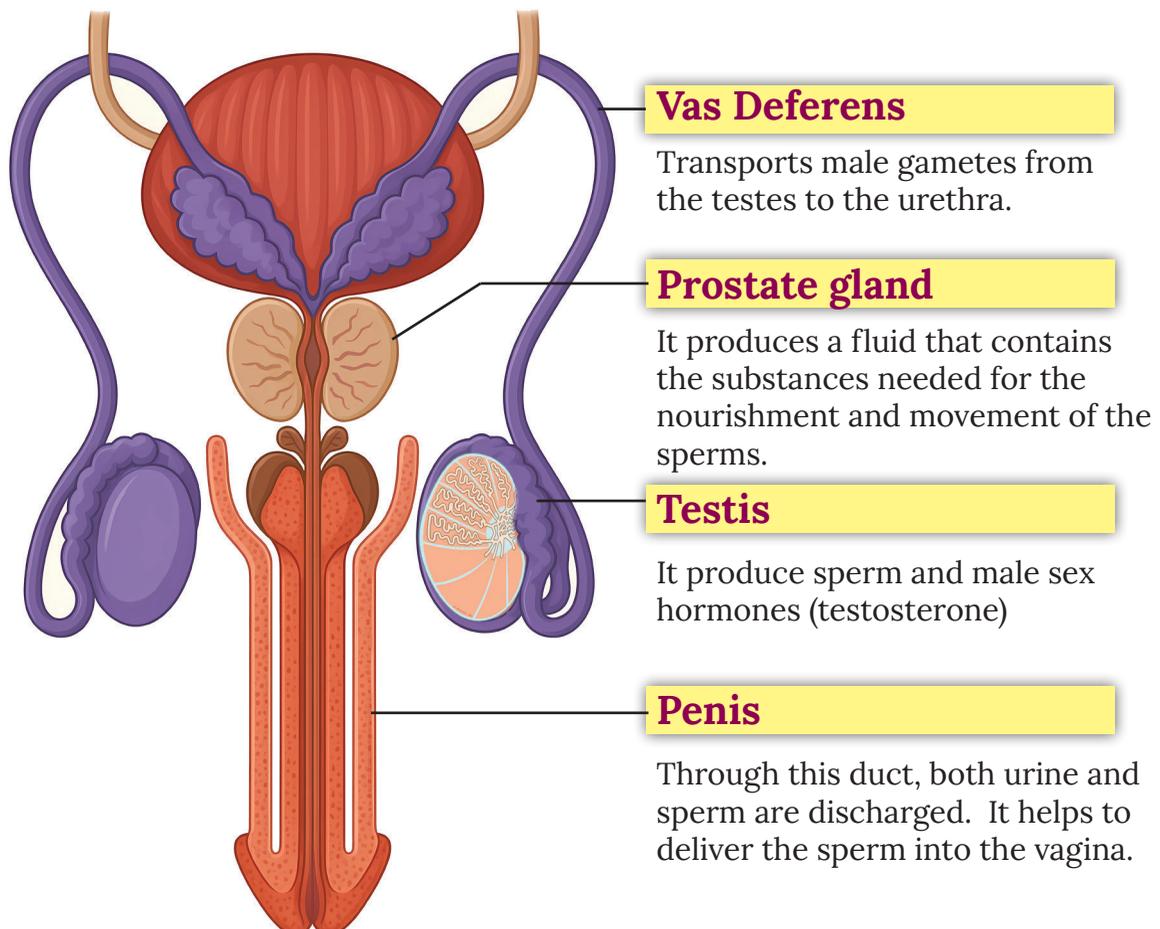


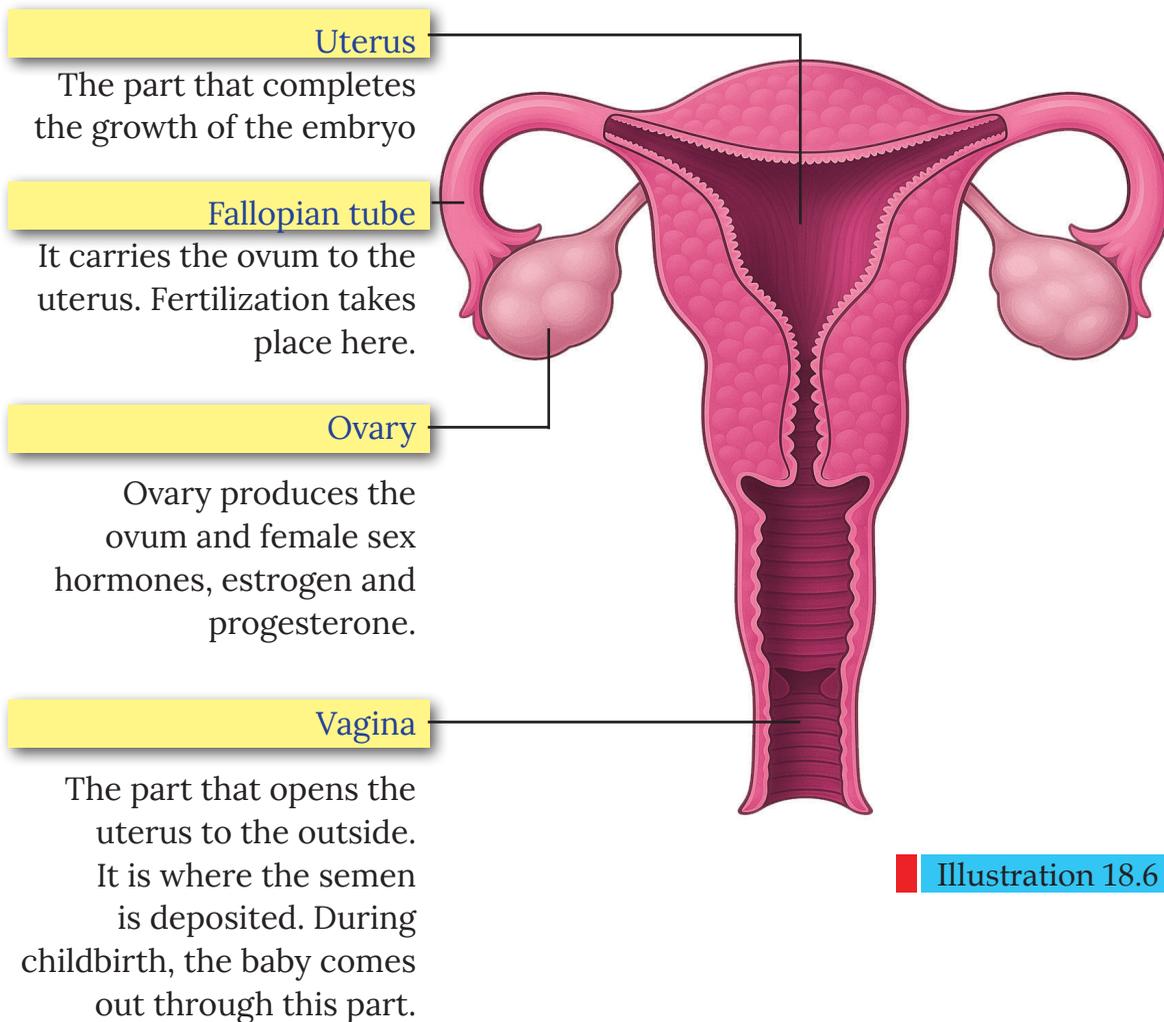
Illustration 18.5

Hormones

Hormones are chemical substances produced by endocrine glands. They control and co-ordinate various life activities.

In males, the testes are located in the scrotal sac just below the penis. For sperm production, a temperature 2 to 2.5 degrees Celsius lower than the normal body temperature is to be maintained. The contraction and relaxation of the scrotal sac helps in maintaining this temperature.

Reproductive system in females



Indicators

- Parts and functions of the reproductive system in human being.
- Production of gametes
- Sexual hormones

Gametes in human beings

Analyse the given pictures and descriptions and appropriately complete Table 18.2.

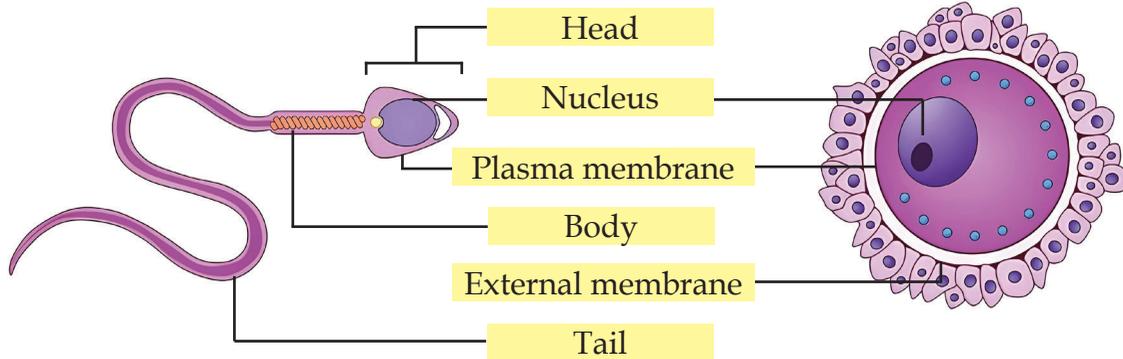


Figure 18.1

Figure 18.2

Sperm

The male gamete has three parts: head, body, and tail. The nucleus is located in the head. The tail helps it to move in a fluid medium.

Ovum

It is spherical in shape and has a special protective coat outside the cell wall. It is larger in size than the male gamete. It has no ability to move.

Characteristic	Sperm	Ovum
Shape		
Size		
Motility		

Table 18.2

Fertilization

Semen is a combination of sperm cells formed in the testes and secretions produced by glands like the prostate.

The process by which semen is expelled through the penis is called ejaculation.

The sperm cells reach the vagina through penis, pass through the uterus and enter the fallopian tube.

In the fallopian tube, the sperm unites with the egg that has arrived there from the ovary. The process of the sperm uniting with the egg is called fertilization.

What happens if fertilization does not take place? Analyse the illustration 18.7 and prepare a note based as the indicators given.

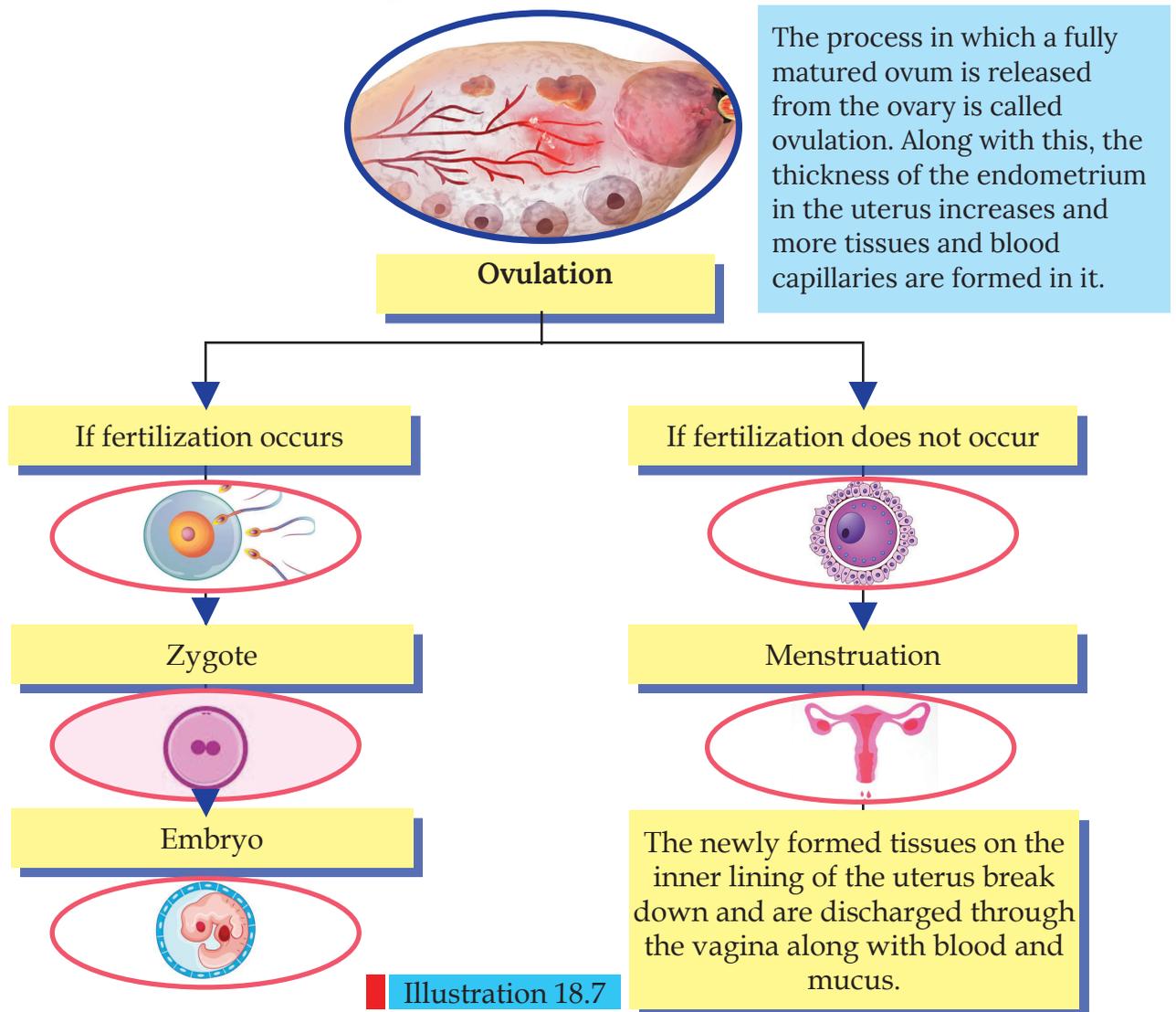


Illustration 18.7

Indicators

- Site of fertilization
- Embryo formation
- Menstruation

Behind the growth



Did my body, with so many different types of cells, really come from a single zygote?

You noticed the child's doubt, didn't you?

After fertilization, how does a single-celled zygote develop into a multi-celled organism?

Growth is one of the common characteristics of living beings.

Analyse the illustration given below related to this.

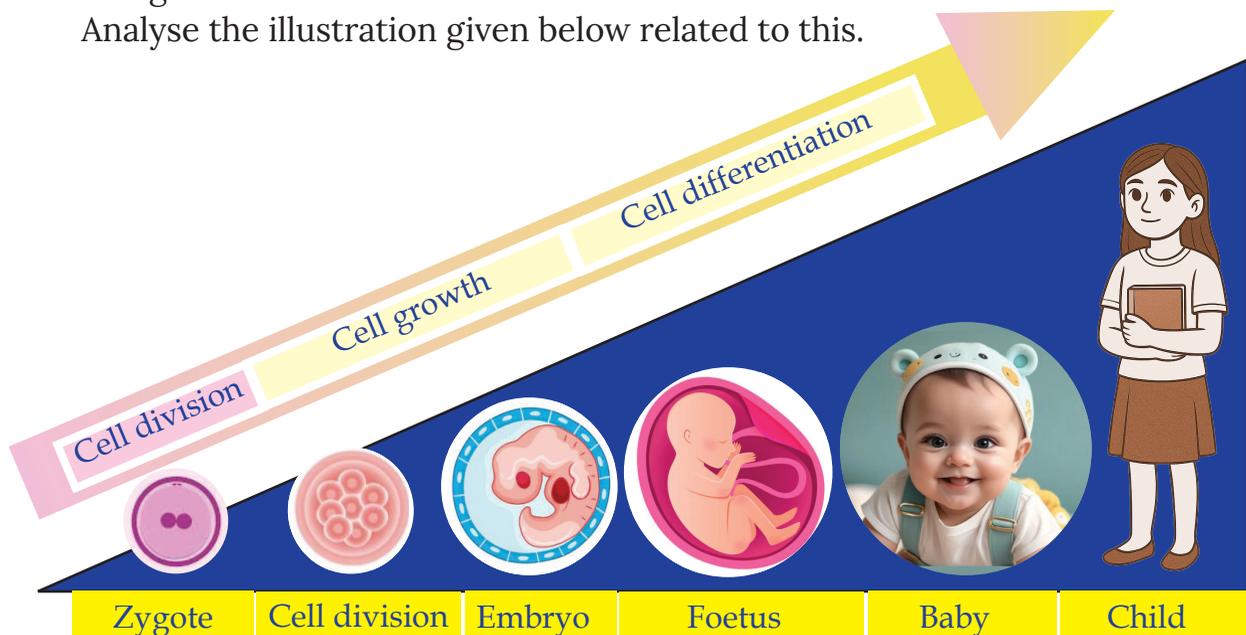


Illustration 18.8

The reason for the growth of living beings is cell division and the growth of the cells formed through it.

The following changes in the newly formed cells as a result of division indicate cell growth:

- The number of cell organelles increases
- The amount of cytoplasm increases
- The size of the cell increases

What happens when cell division occurs in unicellular organisms?

Cell division

There are two types of cell division in living beings. The type of cell division that helps in growth is called mitosis. The type of cell division that helps in the formation of gametes is called meiosis.

Mitosis

Mitosis takes place in two stages:

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

Karyokinesis

Each organism has a specific number of chromosomes. In human cells, the chromosome number is 46. Does the number of chromosomes change during nuclear division (karyokinesis)?

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

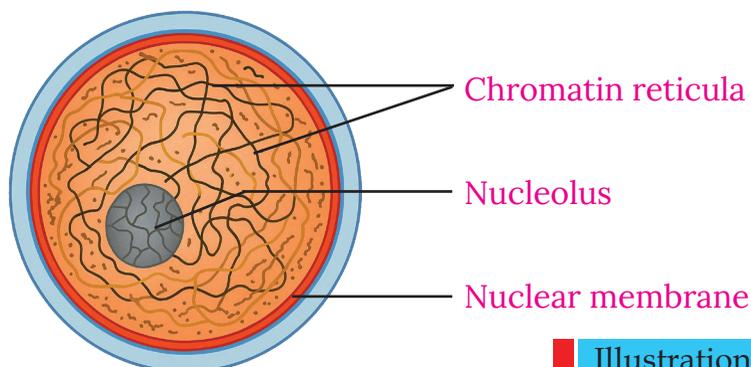
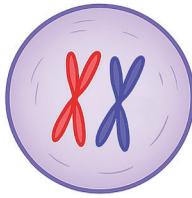


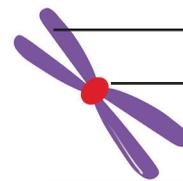
Illustration 18.9

Before cell division, the genetic material in the chromatin network of the nucleus duplicates.

Prophase



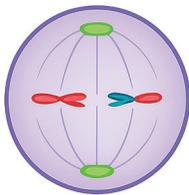
The chromatin network condenses and changes into chromosomes.



Chromatid

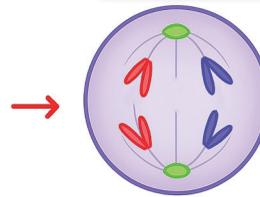
Centromere

Metaphase



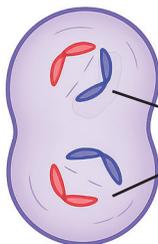
Chromosomes are arranged at the center of the cell.

Anaphase

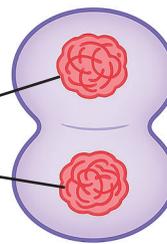


The chromatids separate and move towards the two poles of the cell as daughter chromosomes.

Telophase



Daughter nuclei



Chromosome changes into chromatin networks. Daughter nuclei are formed.

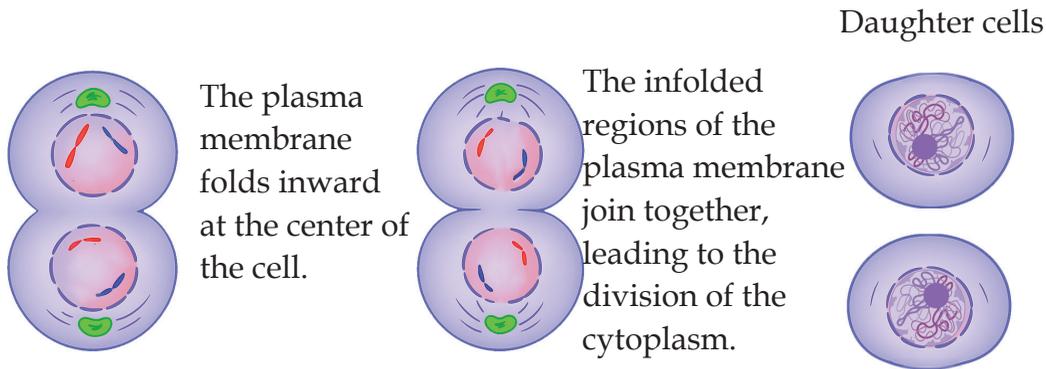
Illustration 18.10

Indicators

- Formation of chromosomes.
- Stages of cell division
- Number of chromosomes in the parent cell and daughter nuclei.
- Number of daughter nuclei formed in one division

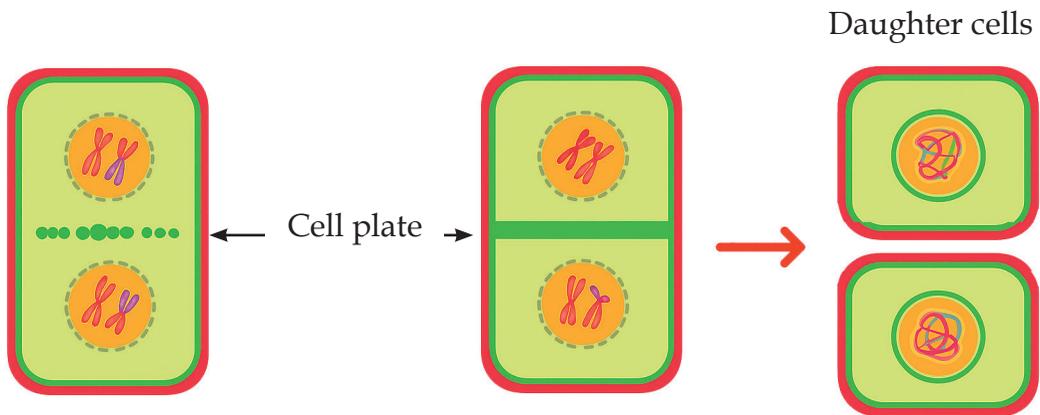
Cytokinesis

The process of cell division is completed only when the cytoplasm also divides following nuclear division. In both animal and plant cells, nuclear division occurs in a similar manner. Analyse illustrations 18.11 and 18.12 given below and identify the difference in cytoplasmic division between plant and animal cells.



Cytoplasmic division in an animal cell

Illustration 18.11

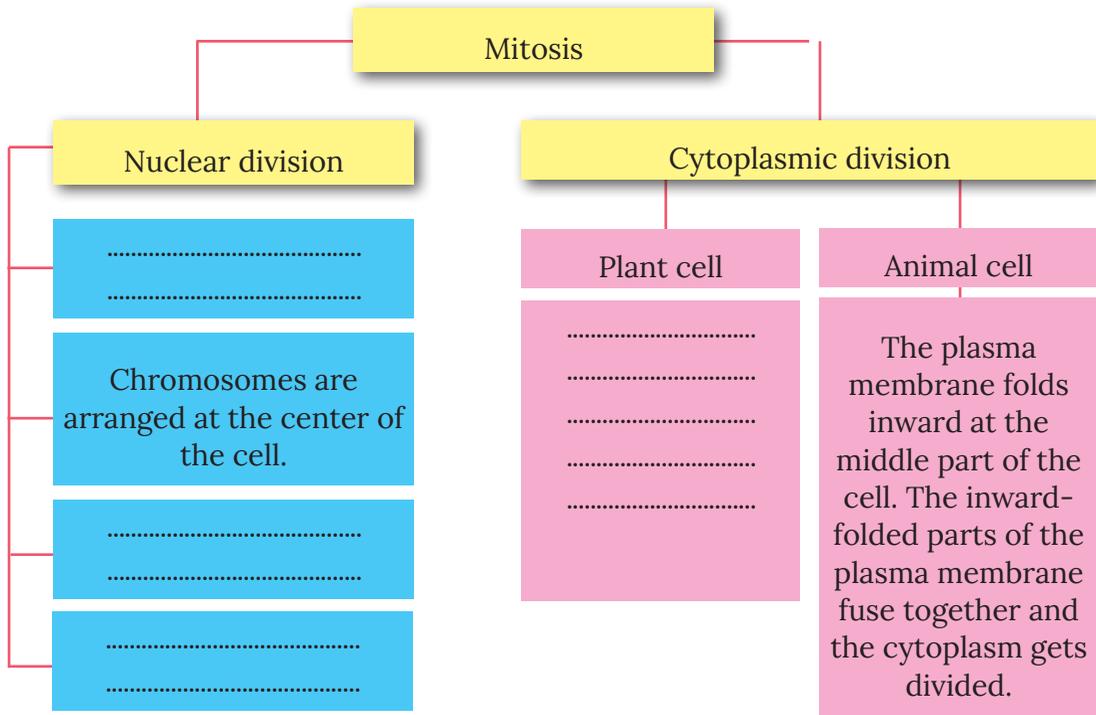


The cell plate formed between the daughter cells divides the cytoplasm into two.

Cytoplasmic division in a plant cell.

Illustration 18.12

You have understood the different stages of cell division, haven't you? Based on that, complete illustration 18.13.



Mitosis is the type of cell division that helps in body growth and the repair of damaged tissues. In the daughter cells formed through mitosis, there is no change in the number of chromosomes.

Illustration 18.13

Meiosis

What happens if germ cells are formed due to mitosis?



You noticed the child's doubt, didn't you? What is your opinion about it? Analyse the illustration 18.14 based on the indicators. Then complete the given Table 18.3.

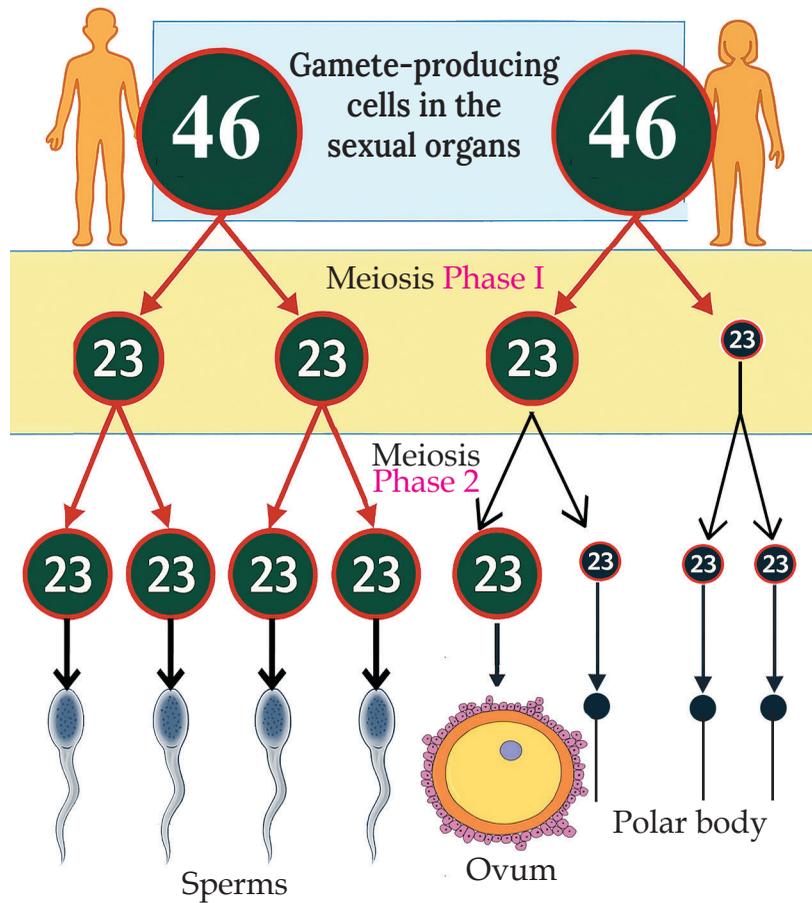


Illustration 18.14

Gametes are formed as a result of meiosis that occurs in the germ cells of the reproductive organs. In the first phase of meiosis, the germ cell divides to form two daughter cells, each with 23 chromosomes. In the second phase, these two daughter cells divide again. This is similar to mitosis. In this second division, there is no change in chromosome number. As a result of meiosis, one germ cell in the testis produces four daughter cells, each with 23 chromosomes. These later become gametes. In the ovary, when meiosis occurs in the germ cells, one large ovum and three small cells are formed. These small cells, which do not have the ability to reproduce, are known as polar bodies.

Indicators

- Number of chromosomes in human germ cells
- Characteristic of Meiosis Stage I
- Similarity between Meiosis Stage II and Mitosis
- Difference observed in the process of gamete formation in males and females

Details	Mitosis	Meiosis
In which cells does it occur?	In the normal cells of the body	
Changes in chromosome number		
Number of daughter cells		
Significance		Germ cells are formed. In organisms that undergo sexual reproduction helps to maintain a constant number of chromosomes across generations.

Table 18.3

Twins

Don't humans sometimes have two babies in a single delivery?

Why does this happen?

Analyse the given illustration 18.15 and complete Table 18.4.

- The external appearance and hereditary traits of the offspring will be the same
- They will belong to the same sex.

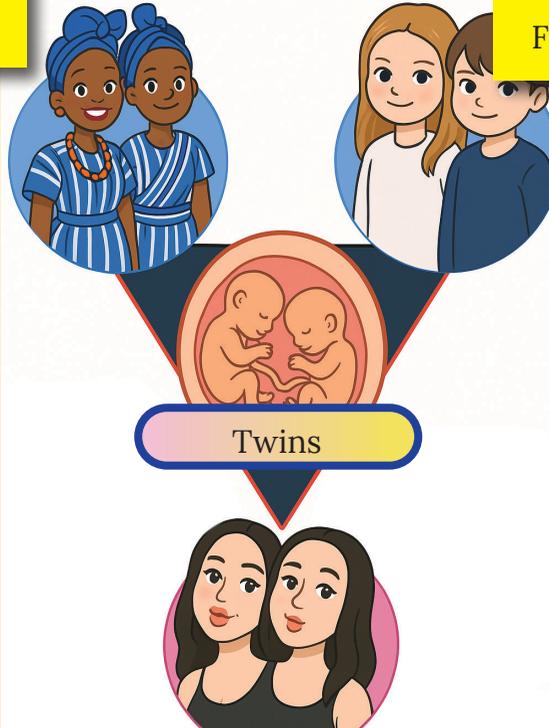
Before reaching the uterus, the zygote divides into two and separates.

Identical twins

- The external appearance and hereditary traits of offspring will not be the same.
- They do not necessarily have to be of the same gender.

Two eggs are produced.
Each of them unites with a different male sperm.

Fraternal twins



Isn't it true that more than two babies are born in a single delivery? Find out the reason for this.

Illustration 18.15

Conjoined twins (Siamese twins)

- Incomplete division of the ovum after fertilization
- The separated zygote fuse again
- Body parts will be joined together.
- They will be of the same sex.
- The external appearance and hereditary traits of the offspring will be the same.

Details	Fraternal twins	Identical twins	Siamese twins
Formation method			
Structural similarity			
Hereditary factors			
Sexual characteristics			

Table 18.4

Stages of human growth

You are growing, aren't you? Which stage of growth are you currently in? What are the characteristics of this stage?

Analyse illustrations 18.16, 18.17, and their descriptions, and write down your conclusions.

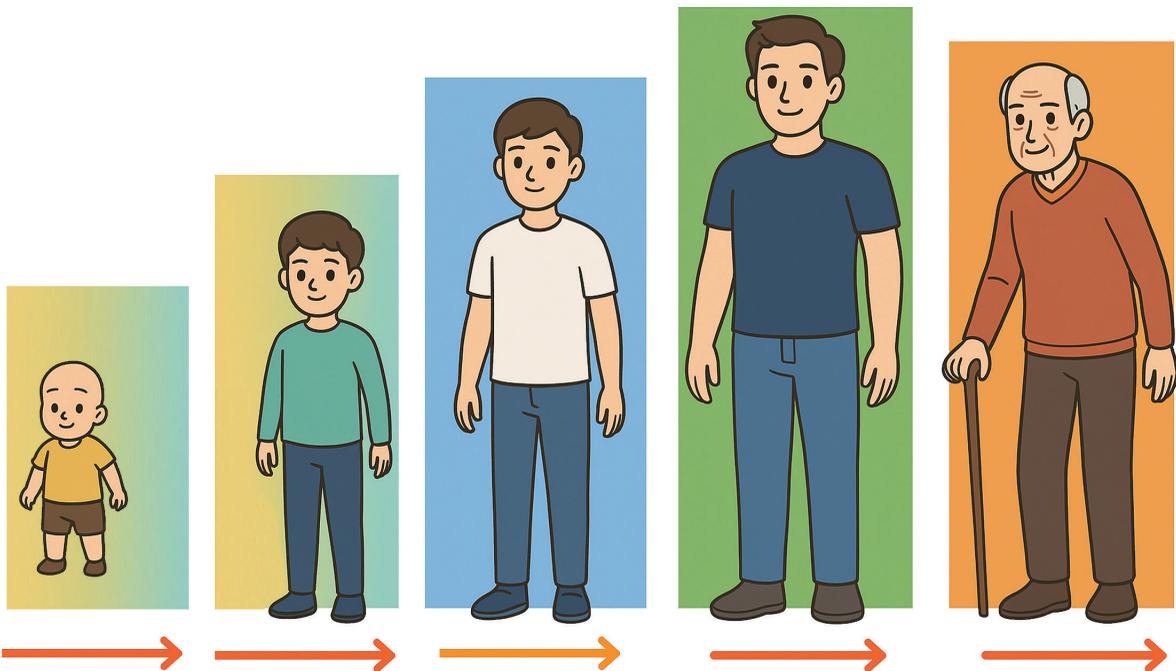


Illustration 18.16

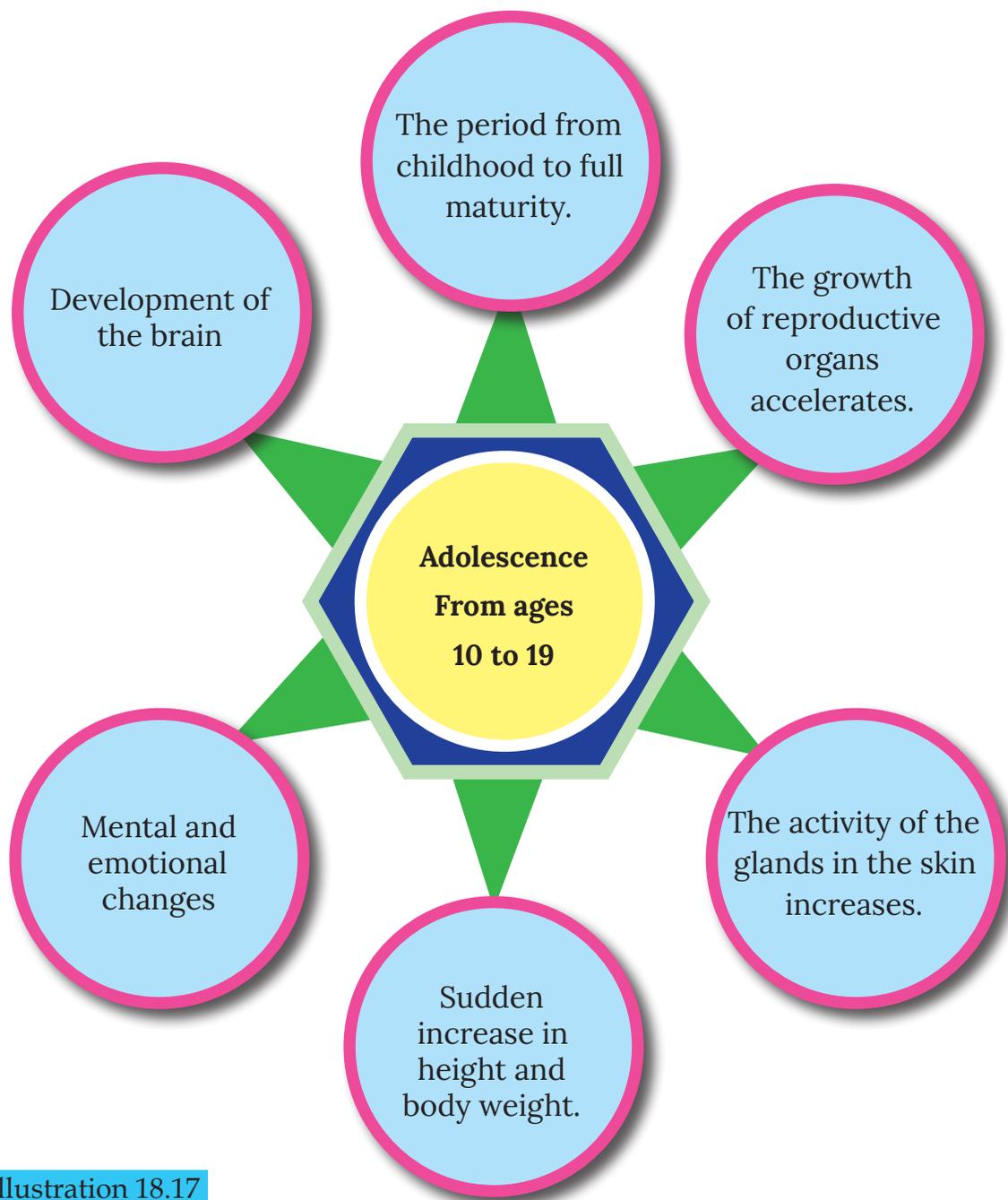


Illustration 18.17

The parts of the brain that control the physical and mental changes during adolescence develop faster in girls.

Therefore, the growth during puberty occurs faster in girls compared to boys.

Puberty

These are the physical changes that occur during adolescence as part of becoming capable of reproduction.

Health problems during adolescence

During adolescence, the production of sex hormones like androgen increases. As a result, the sebaceous glands in the skin produce more of an oily substance called sebum. Acne occurs when dead cells and sebum accumulate in the skin. This is a natural process.

Mistaking appearance as the measure of personality and overusing beauty products or following unscientific exercise routines can lead to several health issues. Reducing food intake excessively to lose weight can result in eating disorders such as anorexia, where a person develops an aversion to food.

It is important to adopt a diet that provides the right nutrients needed for the rapid growth during adolescence. Both over nutrition and lack of essential nutrients can negatively affect the body. We must stay alert and avoid bad influences like harmful friendships, smoking, alcohol, drug use, sexual abuse, and temptations.

New media can help in learning and gaining knowledge in various fields. But it is essential to use them wisely, recognising both their benefits and risks. Spending too much time in front of screens can cause many physical and mental health problems.

Adolescence is also a time full of opportunities. Participation in various school clubs helps in personality development and nurturing a spirit of service. Good friendships are vital for our mental well-being and growth. We are not alone – we have the support of our parents, teachers, friends, and relatives, who stand by us and share our hopes. Let's not forget that.



Let's Assess

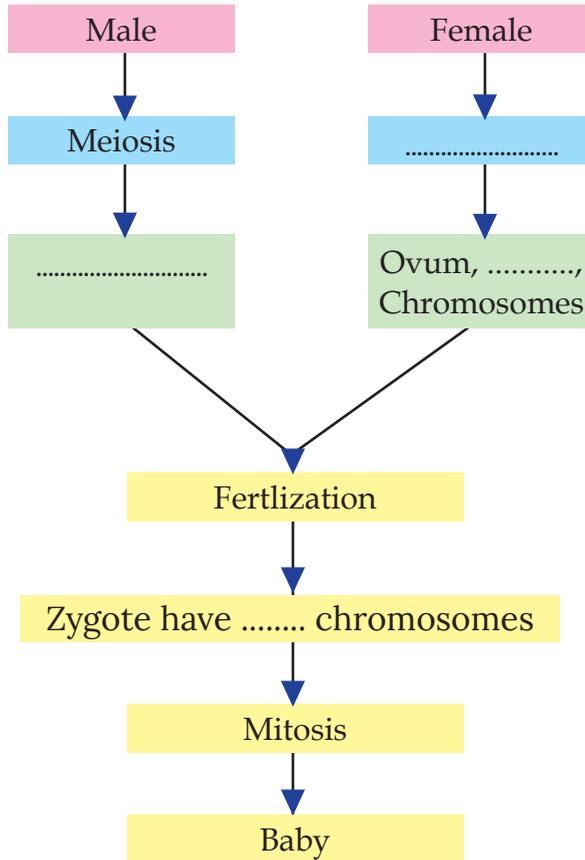
- Complete the table by selecting the appropriate human reproductive organs and associated parts from the box.

Details	Male reproductive system	Female reproductive system
1. Function		
2. Important parts		
3. Where gamete production occurs		

- Produces sperm and sex hormones
- Testes, scrotum, penis
- In the testes
- In the ovary
- Produces eggs and female sex hormones
- Ovary, fallopian tube, uterus, vagina

- Find the incorrect statements given below and rewrite them correctly.
 - The number of chromosomes in germ cells is 46.
 - The number of chromosomes in a human zygote is 92.
 - Budding is an example of asexual reproduction.
 - Four eggs are produced from a single germ cell of an ovary.

3. Complete the flowchart and give an appropriate title.



Extended activities

1. Prepare suitable questions about the human reproductive system and sexual hygiene, conduct an interview with a doctor and prepare a report.
2. Prepare a chart/slide presentation about diseases related to the reproductive organs.

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.

Major Responsibilities

- 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

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Email: childrights.cpcr@kerala.gov.in, rte.cpcr@kerala.gov.in

Website : 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