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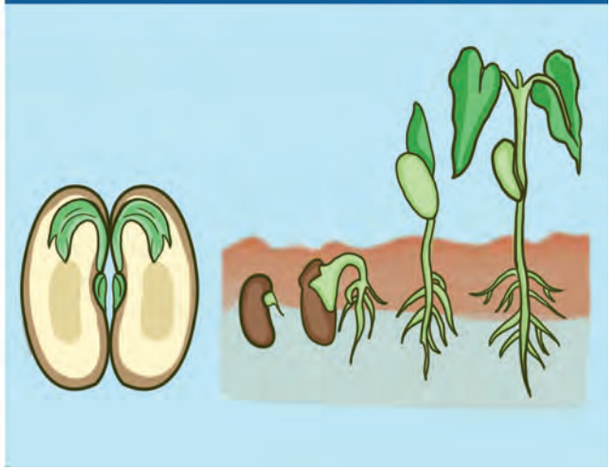
Seed Germination of Monocot Plant

Seed Germination of Dicot Plant



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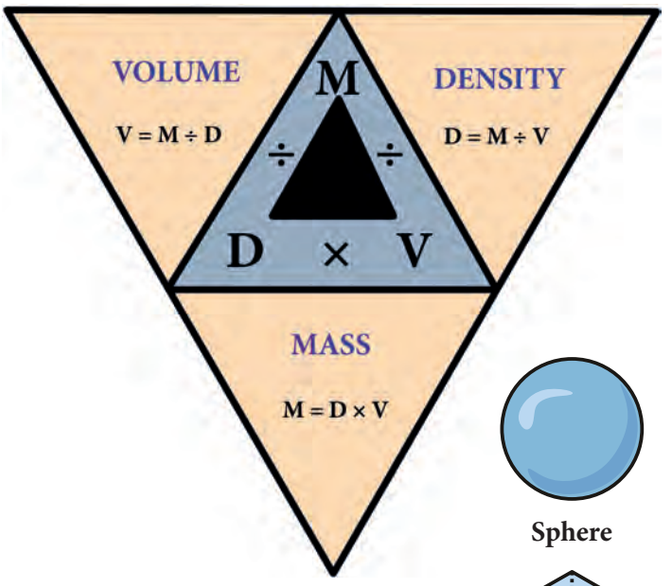
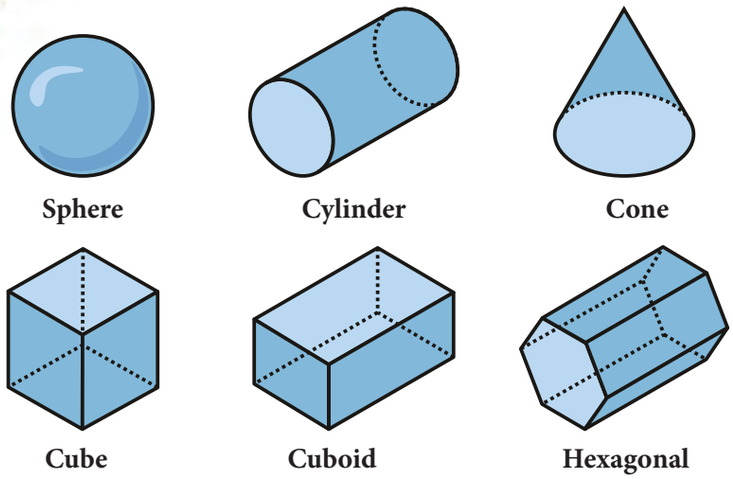
Unit 1

Measurement



3D Solid Shapes



Learning Objectives

After studying this unit, students will be able to:

- identify fundamental and derived physical quantities.
- identify fundamental and derived units.
- obtain units for certain derived quantities.
- measure the area and volume of some regular shaped and irregular shaped objects.
- convert the volume of objects from cubic metre to litre and vice versa.
- calculate the density of solids and liquids.
- define astronomical unit and light year.

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Introduction

In day to day life, we measure many things such as weight of fruits, vegetables and food grains, volume of liquids, temperature of the body, speed of the vehicles etc., Quantities such as mass, weight, distance, temperature, volume are called physical quantities. A value and a unit are used to express the magnitude of a physical quantity. For example, let us assume that you walk 2 kilometre everyday. In this example '2' is the value and 'kilometre' is the unit used to express the magnitude of distance which is a physical quantity. In this lesson, we are going to study about fundamental quantities, derived quantities such as area, volume and density, and measurement of larger quantities.

1.1 Fundamental Quantities and Derived Quantities

Generally, physical quantities are classified into two types. They are: fundamental quantities and derived quantities.

1.1.1 Fundamental Quantities

A set of physical quantities which cannot be expressed in terms of any other quantities are known as fundamental quantities. Eg. Length, Mass, Time. Their corresponding units are called fundamental units. There are seven fundamental physical quantities in SI Units (System of International Units). They are given in Table 1.1.

Table 1.1 Fundamental quantities and their units

Fundamental quantity	Fundamental unit
Length	metre (m)
Mass	kilogram (kg)
Time	second (s)
Temperature	Kelvin (K)
Electric current	Ampere (A)
Amount of substance	mole (Mol)
Luminous intensity	Candela (cd)

1.1.2 Derived quantities

All other physical quantities which can be obtained by multiplying, dividing or by mathematically combining the fundamental quantities are known as derived quantities. Eg. Area and volume. Their corresponding units are called derived units. Some of the derived quantities and their units are given in Table 1.2.

Table 1.2 Derived quantities and their units

Derived quantity	Unit
Area = Length × Breadth	m^2
Volume = Length × Breadth × Height	m^3
Speed = Distance / Time	ms^{-1}
Electric Charge = Electric Current × Time	C
Density = Mass / Volume	$kg\ m^{-3}$

*C - Coulumb

1.2 Area

Area is a measure of how much space is there on a flat surface. The area of a plot of land is derived by multiplying its length and breadth.

Area = length × breadth

The unit of the area is m^2 (Read as square metre). Area is a derived quantity as we obtain it by multiplying the fundamental physical quantity length (length x breadth).

Problem 1.1

What is the area of 10 squares each having side of 1 m?

Area of a square = side × side
= 1 m × 1 m
= 1 m^2 or 1 square metre

Area of 10 squares = 1 square metre × 10
= 10 square metre

1.2.1 Area of regularly shaped objects

The area of regularly shaped objects can be calculated using the relevant formulae. In Table 1.3, the formulae used to calculate the area of certain regularly shaped figures are given.

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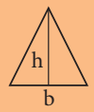
Table 1.3 Area of some regularly shaped objects

S.No.	Plane figure	Diagram	Area
1	Square		side × side $a \times a = a^2$
2	Rectangle		length × breadth $l \times b = lb$
3	Circle		$\pi \times (\text{radius})^2$ $\pi \times r^2 = \pi r^2$
4	Triangle		(1/2) × base × height $1/2 \times b \times h$

Problem 1.2

Find the area of the following regular shaped figures (Take $\pi = 22/7$).

a. A rectangle whose length is 12 m and breadth is 4 m.

b. A circle whose radius is 7 m.

c. A triangle whose base is 6 m and height is 8 m.

Solution

a. Area of rectangle = length × breadth
$= 12 \times 4 = 48\ m^2$

b. Area of circle $= \pi \times r^2 = (22/7) \times 7 \times 7$
$= 154\ m^2$

c. Area of triangle = 1/2 × base × height
$= 1/2 \times 6 \times 8 = 24\ m^2$

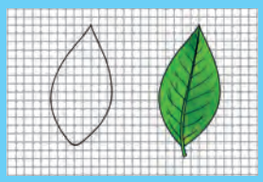
1.2.2 Area of irregularly shaped objects

In our daily life, we encounter many irregularly shaped objects like leaves, maps, stickers of stars or flowers, peacock feather etc. The area of such irregularly shaped objects cannot be calculated using any formula.

How can we find the area of these irregularly shaped objects? We can find the area of these figures with the help of a graph sheet. The following activity shows how to find the area of irregularly shaped plane figures.

ACTIVITY 1

Take a leaf from any one of the trees. Place it on a graph sheet and draw the outline of the leaf with a pencil. Remove the leaf. You can see the outline of the leaf on the graph sheet.



i. Now, count the number of whole squares enclosed within the outline of the leaf. Take it as M.

ii. Then, count the number of squares that are more than half. Take it as N.

iii. Next, count the number of squares which are half of a whole square. Note it as P.

iv. Finally, count the number of squares that are less than half. Let it be Q.

Now, the approximate area of the leaf can be calculated using the following formula.

Approximate area of the leaf
= M + (3/4) N + (1/2) P + (1/4) Q square cm.

Area of the leaf = _____ cm^2.

This method can be used to find the area of regularly shaped figures also. In the case of square and rectangle, this method gives the measure area accurately. This method can be used to calculate the area of any irregularly shaped plane figures.

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ACTIVITY 2

Draw the following regularly shaped figures on a graph sheet and find their area by the graphical method. Also, find their area using appropriate formula. Compare the results obtained in two methods by tabulating them.

a. A rectangle whose length is 12 cm and breadth is 4 cm.
b. A square whose side is 6 cm.
c. A circle whose radius is 7 cm.
d. A triangle whose base is 6 cm and height is 8 cm.

S. No.	Shape	Area using formula	Area using graphical method

DO YOU KNOW?

One square metre is the area enclosed inside a square of side 1 metre. Even though area is given in square metre, the surface need not to be square in shape

1.3 Volume

The amount of space occupied by a three dimensional object is known as its volume.

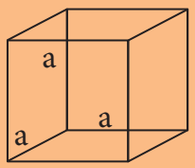
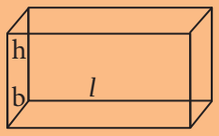
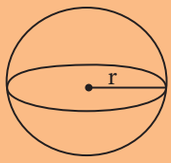
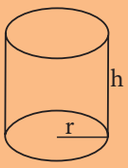
Volume = Surface area × Height

The SI unit of volume is cubic metre or m^3.

1.3.1 Volume of regularly shaped objects

As in the case of area, the volume of a regularly shaped objects can also be determined using an appropriate formula. Table 1.4 gives the formulae used to calculate the volume of the regularly shaped objects.

Table 1.4 Volume of regularly shaped objects

S.No.	Objects	Figure	Volume
1	Cube		side × side × side $a \times a \times a = a^3$
2	Cuboid		length × breadth × height $l \times b \times h = lbh$
3	Sphere		$4/3 \times \pi \times (\text{radius})^3$ $4/3 \times \pi \times r^3 = 4/3\ \pi\ r^3$
4	Cylinder		$\pi \times (\text{radius})^2 \times \text{height}$ $\pi \times r^2 \times h = \pi\ r^2 h$

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Problem 1.3

Find the volume of the following (Take $\pi = 22/7$).

a. A cube whose side is 3 cm.

b. A cylinder whose radius is 3 m and height is 7 m.

Solution

a. Volume of a cube = side × side × side
$= 3\text{ cm} \times 3\text{ cm} \times 3\text{ cm} = 27$ cubic cm or cm^3.

b. Volume of a cylinder = $\pi \times (\text{radius})^2 \times \text{height}$
$= 22/7 \times 3 \times 3 \times 7 = 198\ m^3$.

1.3.2 Volume of Liquids

Liquids also occupy some space and hence they also have volume. But, liquids do not possess any definite shape. So, the volume of a liquid cannot be determined as in the case of solids. When a liquid is poured into a container, it takes the shape and volume of the container. The volume of any liquid is equal to the space that it fills and it can be measured using a measuring cylinder or measuring beaker. The maximum volume of liquid that a container can hold is known as the capacity of the container. A measuring container is graduated as shown in figure.

Measuring containers

The volume of a liquid is equal to the volume of space it fills in the container. This can be directly observed from the readings marked in the measuring containers. If we notice the measuring cups given in figure carefully, we can observe that the readings are marked in the unit of 'ml'. This actually represents millilitre. To understand this unit of volume, let us first understand how much a litre means. Litre is the commonly used unit to measure the volume of liquids. We know that the unit of volume is cubic cm if the dimensions of the object are given in cm. This cubic cm is commonly known as 'cc'. A volume of 1000 cc is termed as one litre (*l*).

1 litre = 1000 cc or cm^3

1000 ml = 1 litre

1.3.3 Volume of irregularly shaped objects

There is no formula to determine the volume of irregularly shaped objects as in the case of area. For such objects, volume can be determined using a measuring cylinder and water.

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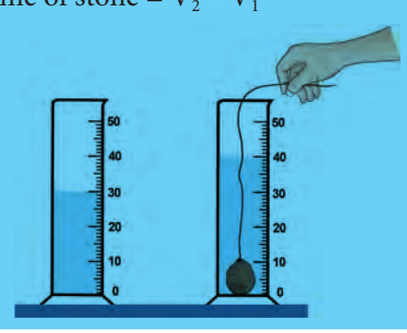
ACTIVITY 3

Take a measuring cylinder and pour some water into it (Do not fill the cylinder completely). Note down the volume of water from the readings of the measuring cylinder. Take it as V_1. Now take a small stone and tie it with a thread. Immerse the stone inside the water by holding the thread. This has to be done such that the stone does not touch the walls of the measuring cylinder. Now, the level of water will raise. Note down the volume of water and take it as V_2. The volume of the stone is equal to the raise in the volume of water.

Volume of stone = $V_2 - V_1$



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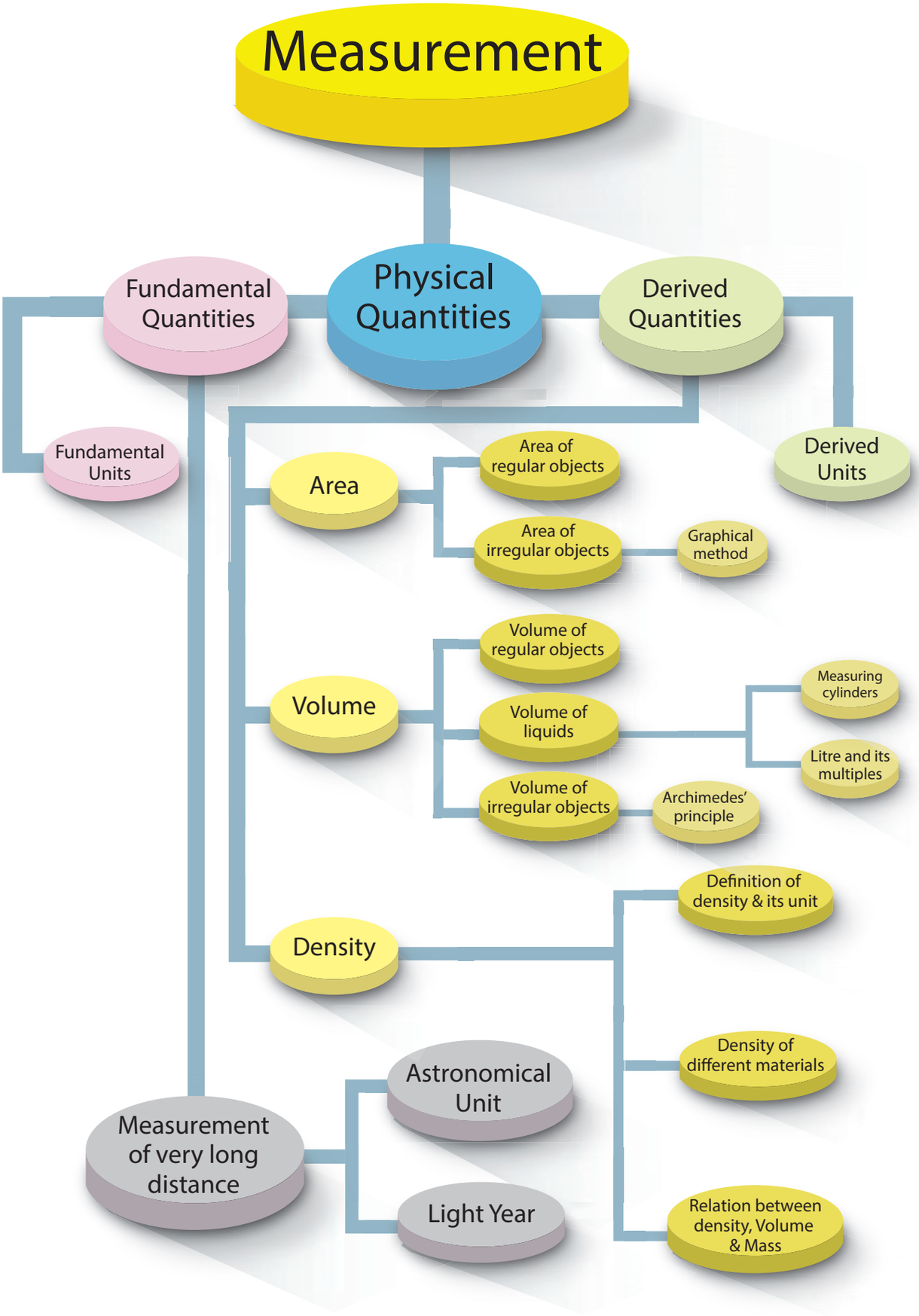

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DO YOU KNOW?

To measure the volume of liquids, some other units are also used. Some of them are gallon, ounce, and quart.

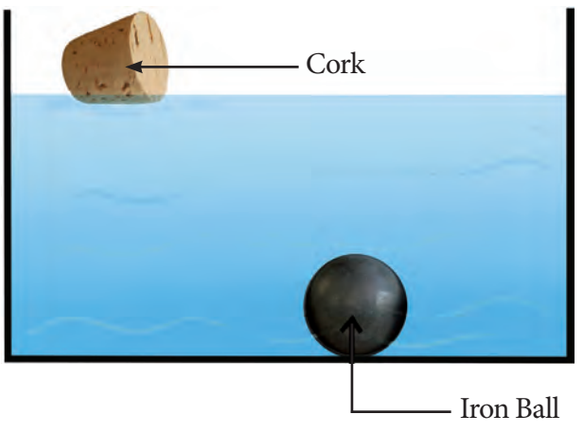
1 gallon = 3785 ml

1 ounce = 30 ml

1 quart = 1 litre

1.4 Density

Take water in a beaker and drop an iron ball and a cork into the water. What do you observe? The iron ball sinks and the cork floats as shown in figure. Can you explain why?



Iron ball sinks while cork floats in water

If your answer is heavy objects sink in water and lighter objects float in water, then, why does a metal coin sinks in water whereas a much heavier wooden log floats? These questions can be answered if we understand the concept of density.

Lighter coin sinks while heavier wooden log floats

ACTIVITY 4

a. Take an iron block and a wooden block of same mass (say 1kg each). Measure their volume. Which one has more volume and occupies more volume?
Ans: _____

b. Take an iron block and a wooden block of same size. Weigh them and measure their mass. Which one of them has more mass?
Ans: _____

From activity 4, we observe that wooden block occupies more volume than the iron ball of same mass. Also, we observe that wooden block is lighter than the iron block of same size.

The lightness or heaviness of a body is due to density. If more mass is packed into some volume, it has greater density. So, the iron block will have more mass than the wooden block of the same size. Therefore, iron has more density.

Density of a substance is defined as the mass of the substance contained in unit volume (1 m^3). If the mass of a substance is M and volume is V, then, its density is given as

$$Density\ (D) = \frac{Mass\ (M)}{Volume\ (V)}$$

$$D = \frac{M}{V}$$

SI unit of density is kg/m^3. The CGS unit of density is g/cm^3.

1.4.1 Density of different materials

Different materials have different densities. The materials with more density are called denser and the materials with less density are called rarer. The density of some widely used materials are listed in Table 1.4.

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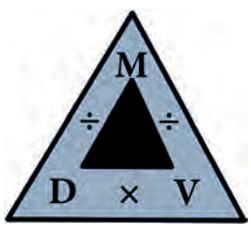
Table 1.4 Density of some common substances, at room temperature

S.No.	Nature	Materials	Density (kg/m³)
1	Gas	Air	1.2
2	Liquid	Kerosene	800
3		Water	1,000
4		Mercury	13,600
5	Solid	Wood	770
6		Aluminium	2,700
7		Iron	7,800
8		Copper	8,900
9		Silver	10,500
10		Gold	19,300

The relationship between mass, density and volume are represented in the following density triangle.



- Density = Mass/ Volume
- Mass = Density × Volume
- Volume = Mass / Density

Problem 1.4

A solid cylinder of mass 280 kg has a volume of 4 m³. Find the density of cylinder.

Solution

$$\text{Density of cylinder} = \frac{\text{Mass of cylinder}}{\text{Volume of cylinder}}$$

$$= \frac{280}{4} = 70\ kg/m^3$$

Problem 1.5

A box is made up of iron and it has a volume of 125 cm³. Find its mass if the density of iron is 7.8 g / cm³.

Solution

Density = Mass / Volume

Hence, Mass = Volume × Density

= 125 × 7.8 = 975 g.

DO YOU KNOW?

Water has more density than oils like cooking oil and castor oil, although these oils appear to be denser than water. Density of castor oil is 961 kg/m3. If we put one drop of water in oil, water drop sinks. But, if we put one drop of oil in water, oil floats and forms a layer on water surface. However, some oils are denser than water.

Problem 1.6

A sphere is made from copper whose mass is 3000 kg. If the density of copper is 8900 kg/m, find the volume of the sphere.

Solution

Density = Mass / Volume

Hence, Volume = Mass / Density

= 3000 / 8900 = 30 / 89

= 0.34 m³

1.5 Measuring larger distances

Normally, we use centimetre, metre and kilometre to express the distances that we measure in our day to day life. But, for space research, astronomers need to measure very long distances such as the distance between the earth and a star or the distance between two stars. To express these distances, we shall learn about two such units, namely,

i. Astronomical unit

ii. Light year

1.5.1 Astronomical Unit

We all know that the earth revolves around the sun in an elliptical orbit. Hence, the distance between the sun and the earth varies every day. When the earth is in its perihelion position (the position when the distance between the Earth and the Sun is short), the distance between

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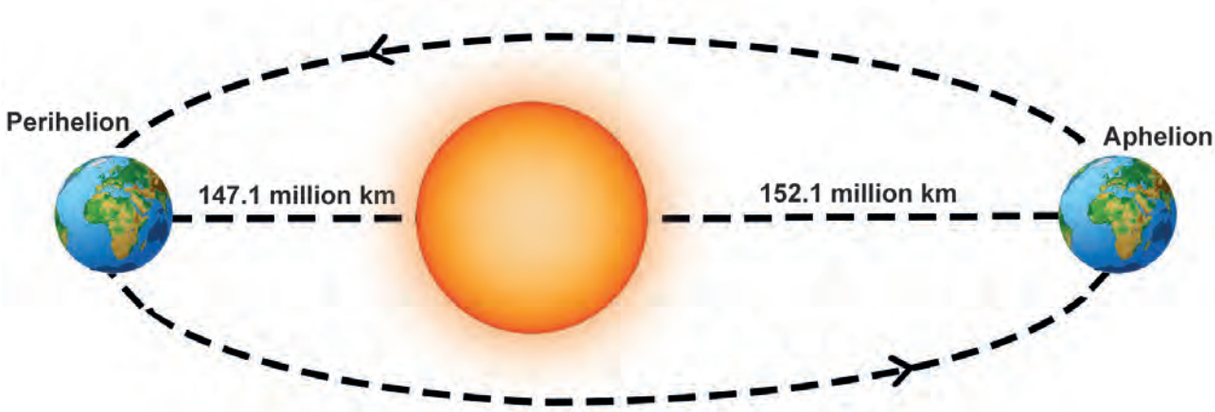

Perihelion and Aphelion position of Earth

the earth and the sun is about 147.1 million kilometre. When the earth is in its aphelion position, (the position when the distance between Earth and the Sun is the largest) the distance is 152.1 million kilometre. The average distance between the earth and the sun is about 149.6 million kilometre. This average distance is taken as one astronomical unit. Neptune is 30 AU away from the Sun. It means it is thirty times farther than the Earth.

One astronomical unit is defined as the average distance between the earth and the sun.

1 AU = 149.6 million km

$= 149.6 \times 10^6$ km $= 1.496 \times 10^{11}$ m.

1.5.2 Light year

The nearest star to our solar system is Proxima Centauri. It is at a distance of 2,68,770 AU. We can note here that using AU for measuring distances of stars would be unwieldy. Therefore, astronomers use a special unit, called 'light year', for measuring the distance in deep space. We have learnt that the speed of light in vacuum is 3×10^8 m/s. This means that light travels a distance of 3×10^8 m in one second. In a year (non-leap), there are 365 days. Each day has 24 hours, each hour has 60 minutes and each minute has 60 seconds.

Thus, the total number of seconds in one year

$= 365 \times 24 \times 60 \times 60$

$= 3.153 \times 10^7$ second

If light travels at a distance of 3×10^8 m in one second, then the distance travelled by light in one year $= 3 \times 10^8 \times 3.153 \times 10^7 = 9.46 \times 10^{15}$ m. This distance is known as one light year.

One light year is defined as the distance travelled by light in vacuum during the period of one year.

1 Light year $= 9.46 \times 10^{15}$ m.

In terms of light year, Proxima Centauri is at 4.22 light-years from Earth and the Solar System. The Earth is located about 25,000 light-years away from the galactic centre.

Points to Remember

- A set of physical quantities which cannot be expressed in terms of any other quantities are known as fundamental quantities. Their corresponding units are called fundamental units.
- The physical quantities which can be obtained by mathematically combining (i.e., multiplying and dividing) the fundamental quantities are known as

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derived quantities. Their corresponding units are called derived units.

- The area of a figure is the region covered by the boundary of the figure. Its SI unit is square metre or m^2.
- The area of irregularly shaped figures can be calculated with the help of a graph sheet.
- The amount of space occupied by a three dimensional object is known as its volume. The SI unit of volume is cubic metre or m^3.
- The volume of liquids are expressed in terms of litre. One litre = 1000 cc.
- The maximum volume of a liquid that a container can is known as the capacity of the container.
- Density of a substance is defined as the mass of the substance contained in unit volume (1 m^3).
- SI unit of density is kg/m^3. The CGS unit of density is g/cm^3. $1 g/cm^3 = 10^3 kg/m^3$.
- The materials with higher density are called denser materials and the materials with lower density are called rarer materials.
- If the density of a solid is higher than that of a liquid, it sinks in that liquid. If the density of a solid is lower than that of a liquid, it floats in that liquid.
- Density = Mass / Volume

  Mass = Density × Volume

  Volume = Mass / Density
- One astronomical unit is defined as the average distance between the Earth and the Sun. 1 AU = 149.6×10^6 km = 1.496×10^{11} m.
- One light year is defined as the distance travelled by light in vacuum during the period of one year. 1 Light year = 9.46×10^{15} m.

Evaluation

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I. Choose the best answer.

1. Which of the following is a derived quantity?
   a) mass b) time
   c) area d) length
2. Which of the following is correct?
   a) 1L = 1cc b) 1L = 10 cc
   c) 1L = 100 cc d) 1L = 1000 cc
3. SI unit of density is
   a) kg/m^2 b) kg/m^3 c) kg/m d) g/m^3
4. Two spheres have mass and volume in the ratio 2:1. The ratio of their density is
   a) 1:2 b) 2:1 c) 4:1 d) 1:4
5. Light year is the unit of
   a) distance b) time
   c) density d) Both length and time

II. Fill in the blanks.

1. Volume of irregularly shaped objects are measured using the law of _____.
2. One cubic metre is equal to _____ cubic centimetre.
3. Density of mercury is _____.
4. One astronomical unit is equal to _____.
5. The area of a leaf can be measured using a _____.

III. State true or false. If false, correct the statement.

1. The region covered by the boundary of a plane figure is called its volume.

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2. Volume of liquids can be found using measuring containers.
3. Water is denser than kerosene.
4. A ball of iron floats in mercury.
5. A substance which contains less number of molecules per unit volume is said to be denser.

IV. Match the following items.

a.

1. Area	a. light year
2. Distance	b. m^3
3. Density	c. m^2
4. Volume	d. kg
5. Mass	e. kg / m^3

b.

1. Area	a. g / cm^3
2. Length	b. measuring jar
3. Density	c. amount of a substance
4. Volume	d. rope
5. Mass	e. plane figures

V. Arrange the following in correct sequence.

1. 1L, 100 cc, 10 L, 10 cc
2. Copper, Aluminium, Gold, Iron

VI. Use the analogy to fill in the blank

1. Area : m^2 :: Volume : _____
2. Liquid : Litre :: Solid : _____
3. Water : Kerosene :: _____ : Aluminium

VII. Consider the following statements and choose the correct option.

1. **Assertion:** Volume of a stone is found using a measuring cylinder.
   Reason: Stone is an irregularly shaped object.
2. **Assertion:** Wood floats in water.
   Reason: Water is a transparent liquid.
3. **Assertion:** Iron ball sinks in water.
   Reason: Water is denser than iron.
   a. Both assertion and reason are true and reason is the correct explanation of assertion.
   b. Both assertion and reason are true, but reason is not the correct explanation of assertion.
   c. Assertion is true but reason is false.
   d. Assertion is false but reason is true.

VIII. Answer very briefly.

1. Name some of the derived quantities.
2. Give the value of one light year.
3. Write down the formula used to find the volume of a cylinder.
4. Give the formula to find the density of objects.
5. Name the liquid in which iron ball sinks.
6. Name the units used to measure the distance between celestial objects.
7. What is the density of gold?

IX. Answer briefly.

1. What are derived quantities?
2. Distinguish between the volume of liquid and capacity of a container.
3. Define the density of objects.
4. What is one light year?
5. Define - Astronomical unit.

X. Answer in detail.

1. Describe the graphical method to find the area of an irregularly shaped plane figure.
2. How will you determine the density of a stone using a measuring jar?

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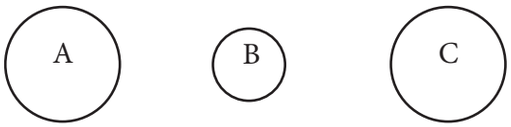
XI. Questions based on Higher Order Thinking Skills:

There are three spheres A, B, C as shown below.

Sphere A and B are made of same material. Sphere C is made of a different material. Spheres A and C have equal radii. The radius of sphere B is half that of A. Density of A is double that of C.



Now answer the following questions.

i. Find the ratio of masses of spheres A and B.

ii. Find the ratio of volumes of spheres A and B.

iii. Find the ratio of masses of spheres A and C.

XII. Numerical problems:

1. A circular disc has a radius 10 cm. Find the area of the disc in m^2 (Use $\pi = 3.14$).
2. The dimension of a school playground is 800 m × 500 m. Find the area of the ground.
3. Two spheres of same size are made from copper and iron respectively. Find the ratio between their masses (Density of copper is 8,900 kg/m^3 and iron is 7,800 kg/m^3).
4. A liquid having a mass of 250 g fills a space of 1000 cc. Find the density of the liquid.
5. A sphere of radius 1cm is made from silver. If the mass of the sphere is 33g, find the density of silver (Take $\pi = 3.14$).

XIII. Cross word puzzle.

	(1)			(a)							
	(d)					(b)					(c)
			(2)								
					(3)						
(4)											

Clues – Across

1. SI unit of temperature; 2. A derived quantity; 3. Mass per unit volume; 4. Maximum volume of liquid a container can hold

Clues – Down

a. A derived quantity b. SI unit of volume c. A liquid denser than iron d. A unit of length used to measure very long distances

Answer

1. Kelvin; 2. Volume; 3. Density; 4. Capacity a. Velocity; b. Cubic metre; c. Mercury; d. Lightyear

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ICT CORNER

Measurement

Let's know about the effects of mass and volume on density.

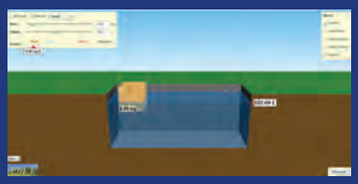
PROCEDURE :

Step 1: Use the URL or scan the QR code to open the activity page.

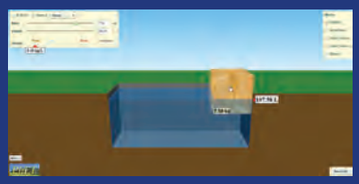
Step 2: Select the options at top right side window to customize

Step 3: Move the sliders on the top left-side window to change the Material and Mass, Volume. Now see the effects of mass and volume on density.

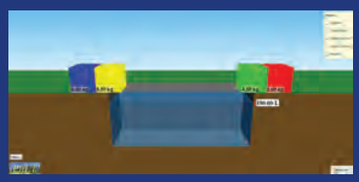
Step 4: Click 'Reset all' button to refresh



Step 1



Step 2



Step 3

Step 4

Measurement URL:

https://phet.colorado.edu/en/simulation/density (or) scan the QR Code

*Pictures are indicative only

*If browser requires, allow Flash Player or Java Script to load the page.

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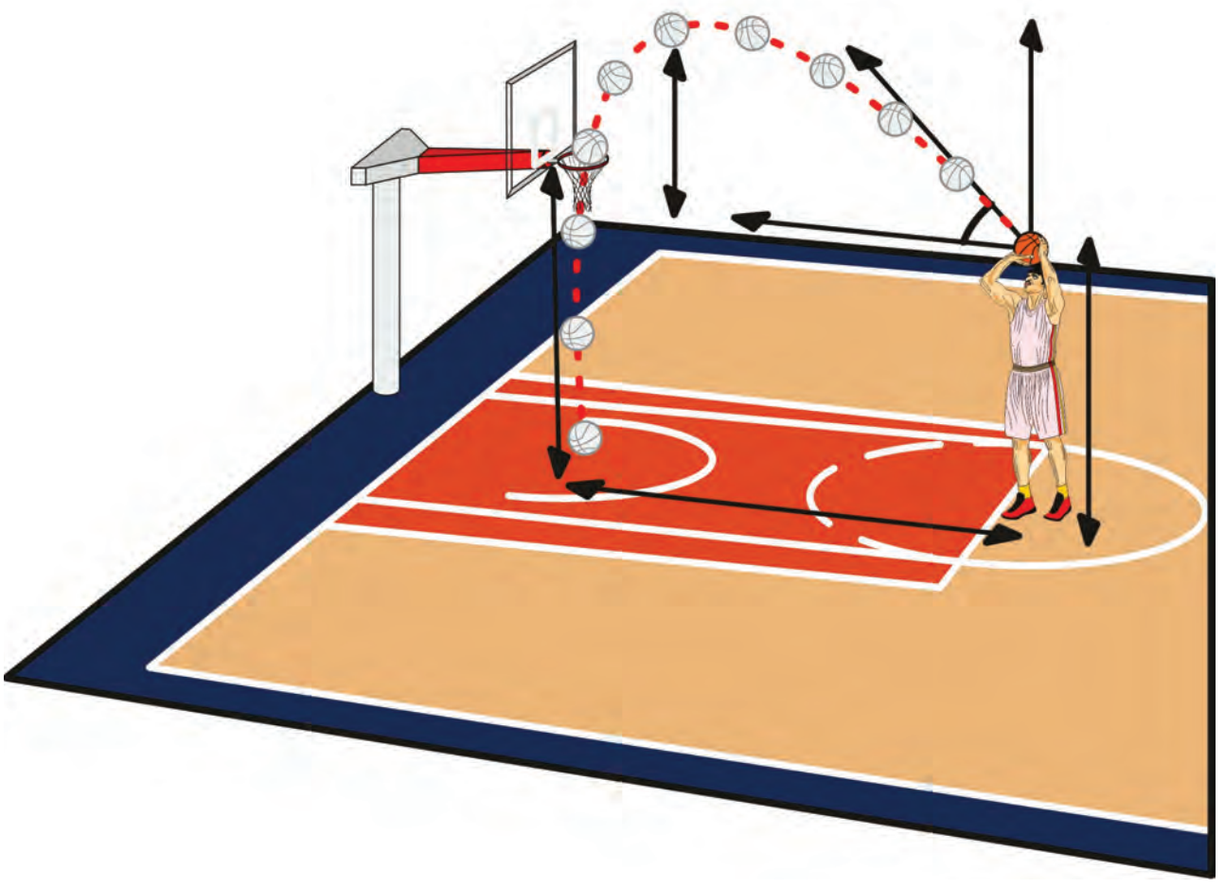
Unit 2

Force and Motion



Learning Objectives

After studying this unit, students will be able to:

- define distance and displacement.
- differentiate distance and displacement.
- define speed, velocity and acceleration.
- differentiate speed and velocity.
- draw and explain distance - time and velocity - time graphs.
- measure and calculate the speed of moving objects.
- know the day to day uses of centre of gravity and stability.

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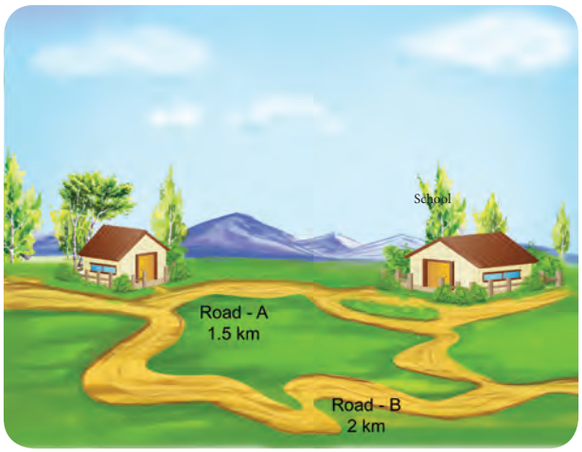
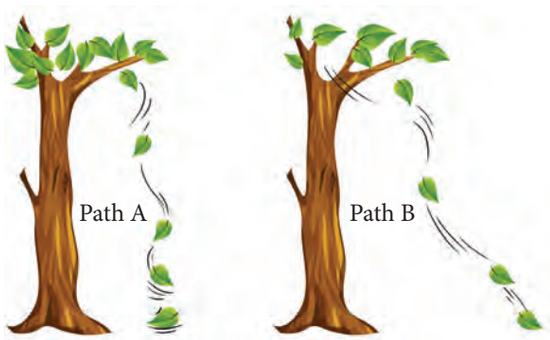
Introduction

Look at the picture given below. Kavitha can reach her school in two ways, as shown in the picture. Can you tell, by choosing which path she could reach the school early?



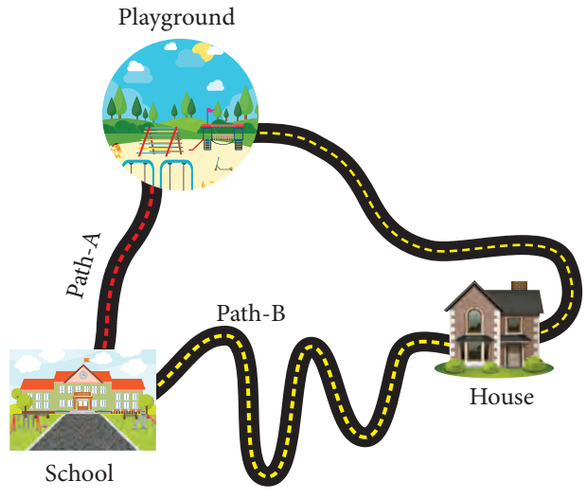
In the picture given below, you can see leaf falling from a tree. In which path the leaf will reach the ground first?



Path of the leaf, when there is no wind. *Path of the leaf when there is wind.*

Uma and Priya are friends studying in the same school. After school hours, they go to the nearby playground, play games and return back home. One day Uma told that she would reach the playground after visiting her grandmother's house. The paths which they took to reach the playground is shown here.

Take a twine and measure the length of the two paths (A and B). Which is the longest path among the two?



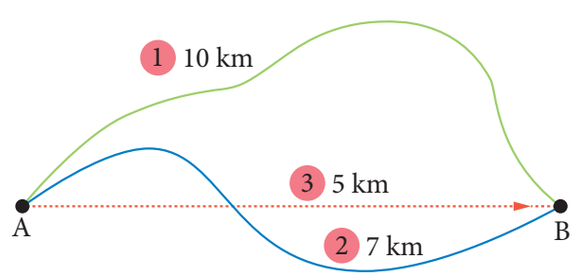
From the above examples, we could conclude that when an object travels from one place to another, it will reach faster if it travels along the straight line path. The straight line path is the shortest distance between two points.

In this lesson we are going to study about distance and displacement, speed and velocity, acceleration, distance - time graph, velocity - time graph, centre of gravity and stability.

2.1 Distance and Displacement

The total length of a path taken by an object to reach one place from another place is called distance. The shortest distance from the initial position to the final position of an object is called displacement. Both distance and displacement possess the same unit. The SI unit distance and displacement is metre (m).

The figure given below shows the motion of a person between two places A and B.



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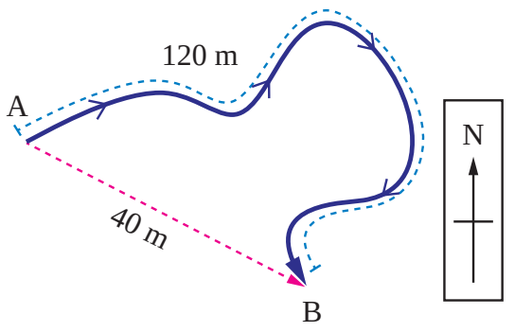
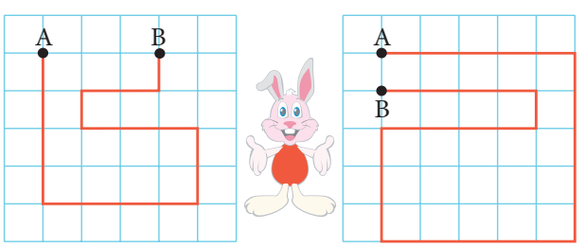
He travels 10 km along the first path. Along the second path, he travels 7 km. The distance between A and B in the case of first path is 10 km. In the case of second path, the distance is 7 km. The shortest distance between the two places is 5 km which is represented by the third path. So, the displacement is 5 km (In east direction).

The path of an object moving from point A to point B is shown in the figure. Total distance travelled by the object is 120 m. The displacement of the object is 40 m (south - east direction).



The path in which a rabbit ran is shown in the figure below. Let us consider that each square is in an unit of one square meter. The rabbit starts from point A and reaches the point B. Find the distance and displacement of it in the two figures. When will the distance and displacement be equal? (The starting point and the finishing point should be different).



Distance _____ Distance _____

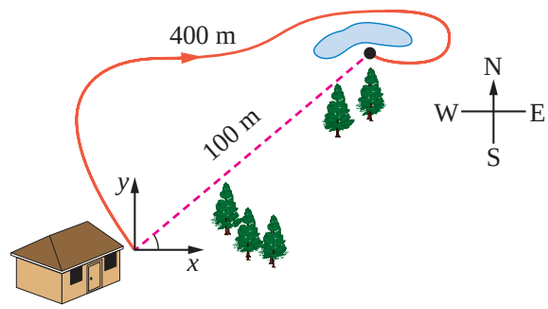
Displacement _____ Displacement _____

When we represent the displacement, we use a positive or negative sign depending on the direction in which it travels.

Let us consider the point A as the starting point. While the object moves from A to B the displacement is considered to be positive and it is negative, when it travels from B to A.

Subha goes to the nearby playground from her home. Look at the picture and answer the following questions.

1. What is the distance she travelled?
2. What is her displacement?



Can you answer the following questions?

- The distance travelled by an object is 15 km and its displacement is 15 km. What do you infer from this?
- The distance travelled by a person is 30 km and his displacement is 0 km. What do you infer from this?

DO YOU KNOW?

Nautical mile

Nautical mile is the unit for measuring the distance in the field of aviation and sea transportation. One nautical mile is 1.852 km.

The unit for measuring the speed of aeroplanes and ships is knot. It means that they travel one nautical mile in one hour.

2.2 Speed - Velocity

2.2.1 Speed

In sixth standard you have already studied about speed in detail. Speed is the rate of change of distance.

Speed = Distance / Time

The unit of speed is metre/second (m/s). We can classify speed into two types.

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Uniform speed

If a body in motion covers equal distances in equal intervals of time, then the body is said to be in uniform speed.

Non- uniform speed

If a body covers unequal distances in equal intervals of time, the body is said to be in non-uniform speed.

$$\text{Average Speed} = \frac{\text{Total distance travelled}}{\text{Time taken to travel the distance}}$$

DO YOU KNOW?

1 km/h = 5/18 m/s

How we got this ?

1 km = 1000 m; 1 h = 3600 s

1 km / h = 1000 m / 3600 s = 5/ 18 m /s

DO YOU KNOW?

Know the speed

Tortoise	0.1 m/s
Person walking	1.4 m / s
Falling raindrop	9-10 m / s
Cat running	14 m/s
Cycling	20-25 km/h
Cheetah running	31 m/s
Bowling speed of fast bowlers	90-100 miles /h
Badminton smash	80-90 m/s
Passenger jet	180 m/s

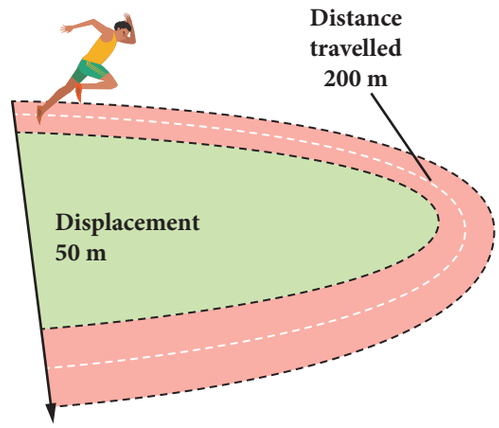
2.2.2 Velocity

Velocity is the rate of change in displacement.

Velocity (v) = Displacement / Time

SI unit of velocity is metre / second (m/s).

Look at the figure. An athlete takes 25 s to complete a 200 m sprint event. Find her speed and velocity.



$$\text{Speed} = \frac{\text{Distance}}{\text{Time}} = \frac{200}{25} = 8 \text{ m/s}$$

$$\text{Velocity} = \frac{\text{Displacement}}{\text{Time}} = \frac{50}{25} = 2 \text{ m/s}$$

Uniform velocity

A body is said to have uniform velocity, if it covers equal displacement at equal intervals of time in the same direction. **E.g.** Light travels through vacuum.

Non-uniform velocity

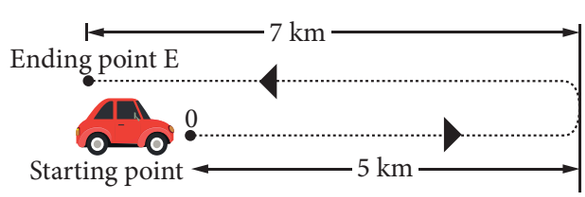
If either speed or direction changes, the velocity is non-uniform. **E.g.** A train starting and moving out of the station.

Average velocity

If the total displacement of an object is divided by the total time taken by the object we get the average velocity.

$$\text{Average velocity} = \frac{\text{Total displacement}}{\text{Total time taken}}$$

In the figure given below, a car travels 5 km due east and makes a U – turn to travel another 7 km. If the time taken for the whole journey is 0.2 h, calculate the average velocity of the car.



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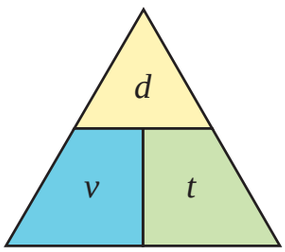
Average velocity = Total displacement/Time taken.
(Taking the direction due east of point O as positive)

Average velocity = (5 – 7) / 0.2
= –2 / 0.2
= –10 km/h or – 10 × 5/18
= – 25/9 = –0.28 m / s

The triangle method can help you to recall the relationship between velocity (v), displacement (d), and time(t).



v = d / t , t = d / v, d = v × t

Answer the following questions.

- Calculate the velocity of a car travelling with a uniform velocity covering 100 m in 4 seconds.
- Usain Bolt covers 100 m in 9.58 seconds. Calculate his speed. If Usain Bolt competes with a Cheetah which is running at a speed of 30 m/s, who will be the winner?
- You are walking along east direction covering a distance of 4 m, then 2 m towards south, then 4 m towards west and at last 2 m towards north. You cover the total distance in 21 seconds. What is your average speed and average velocity?

2.3 Acceleration

Acceleration is the rate of change of velocity. In other words, if a body changes its speed or direction then it is said to be accelerated.

$$\text{Acceleration} = \frac{\text{Change in velocity}}{\text{Time}}$$

$$= \frac{\text{Final velocity (v)} - \text{Initial velocity (u)}}{\text{Time}}$$

$$a = \frac{(v - u)}{t}$$

SI unit of acceleration is m/s^2

A car at rest starts to travel in a straight line path. It reaches a velocity of 12 m/s in 4 s . What is its acceleration, assuming that it accelerates uniformly?

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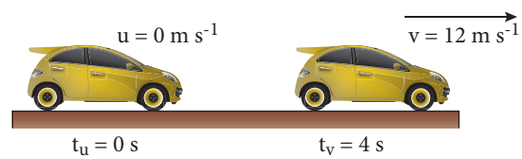


Initial velocity, u = 0 m/s (Since the car starts from rest)
Final velocity (v) = 12 m /s
Time taken (t) = 4 s

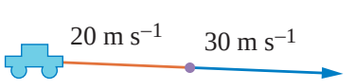
$$\text{Acceleration (a)} = \frac{(v - u)}{t} = \frac{(12 - 0)}{4} = 3\,m/s^2$$

See how brisk I am !

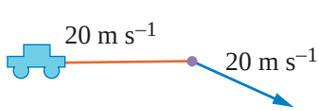
My name is cheetah. I can run at great speed. Do you know what my speed is? It is 25 m/s to 30 m/s. My speed changes from 0 to 20 m/s in 2 second. See how good my acceleration is ! Can you calculate it?

2.3.1 Positive acceleration

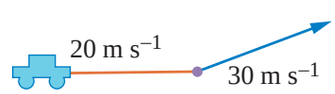
If the velocity of an object increases with respect to time, then the object is said to be in positive acceleration.



(a) Change in speed



(b) Change in directoin



(c) Change in both speed and directoin

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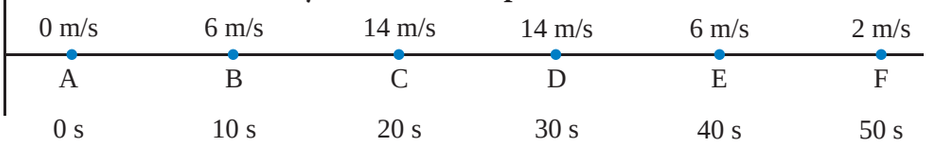
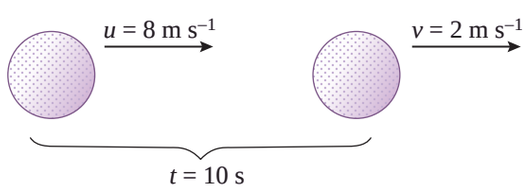
The velocity of a train at different times is given in the figure. Analyse this and complete the table .



The distance travelled by train	Initial velocity (u) m/s	Final velocity (v) m/s	Change in velocity (v – u) m/s	Time taken (t) s	Acceleration = Change in velocity / Time a = (v – u) / t m / s²
A-B	0	6	6	10	0.6
B-C					
C-D					
D-E					
E-F					

2.3.2 Negative acceleration or Deceleration or Retardation

If the velocity of an object decreases with respect to time, then the object is said to be in negative acceleration or deceleration or retardation.



The velocity of a golf ball rolling in a straight line changes from 8 m/s to 2 m/s in 10 s. What is its deceleration, assuming that it is decelerating uniformly ?

Initial velocity (u) = 8 m/s

Final velocity (v) = 2 m/s

Time taken(t) = 10 s

Acceleration (a) $= \frac{(v - u)}{t} = \frac{(2 - 8)}{10} = -0.6\,m/s^2$

The deceleration is $-0.6\ m/s^2$

2.2.3 Uniform acceleration

An object undergoes uniform acceleration when the change (increase or decrease) in its velocity for every unit of time is the same.

The table given below shows the uniform acceleration of a bus.

Time (s)	1	2	3	4	5
Velocity (m/s)	20+20	40+20	60+20	80+20	100 + 20
	(acceleration)				
Velocity (m/s)	100 – 20	80-20	60-20	40-20	20-20
	(deceleration)				

When the velocity of the object is increasing by 20 m/s the acceleration is $20\ m/s^2$. When the velocity of the object is decreasing by 20 m/s the deceleration is $20\ m/s^2$.

2.3.4 Non – uniform acceleration

An object undergoes non–uniform acceleration if the change in its velocity for every unit of time is not the same.

Time (s)	0	1	2	3	4	5
Velocity (m/s)	0	10	40	60	70	50
Change in Velocity (m/s)	0	10	30	20	10	20

Note here that the change in velocity is not the same for every second. Thus, the moving object is undergoing non-uniform acceleration.

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2.4 Distance – Time Graphs

A car travelling along a straight line away from the starting point O is shown in the figure. The distance of the car is measured for every second. The distance and time are recorded and a graph is plotted using the data. The results for four possible journeys are shown below.

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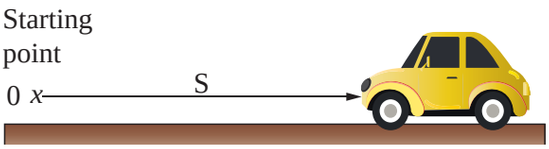
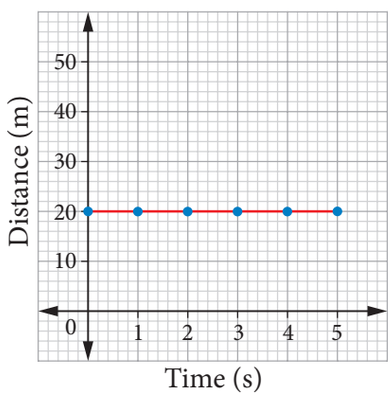


a. Car at rest

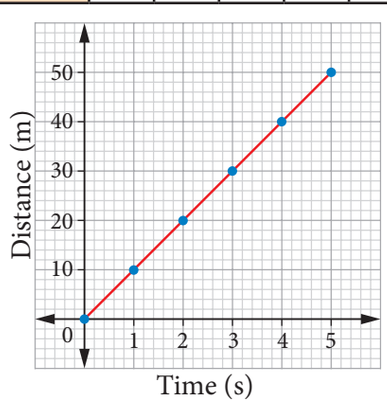
Time (s)	0	1	2	3	4	5
Distance (m)	20	20	20	20	20	20



The graph has zero gradient. i.e. the distance is constant for every second. Thus, the car is at rest.

b. Car travelling at uniform speed of 10ms^{-1}

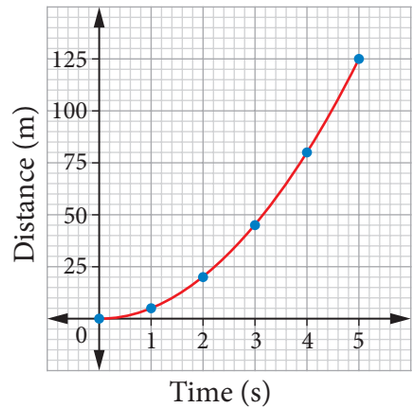
Time (s)	0	1	2	3	4	5
Distance (m)	0	10	20	30	40	50



The graph has constant gradient. The distance increases 10 m in every second. Thus, the car moves with uniform speed.

c. Car travelling at increasing speed

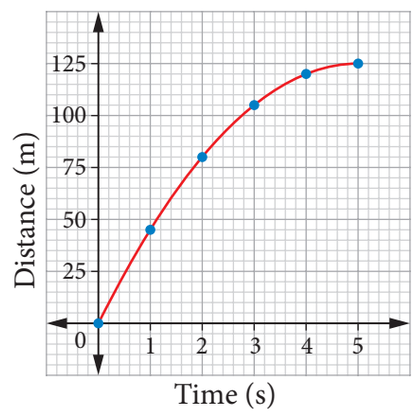
Time (s)	0	1	2	3	4	5
Distance (m)	0	5	20	45	80	125



The graph has an increasing gradient, i.e. That is, the speed increases.

d. Car travelling at decreasing speed

Time (s)	0	1	2	3	4	5
Distance (m)	0	45	80	105	120	125



The graph has a decreasing gradient. That is, the speed decreases.

2.5 Speed – Time Graphs

Let us consider a bus travelling from Thanjavur to Trichy. The speed of the bus is measured for every second. The speed and time are recorded and a graph is plotted using the data. It is known as speed-time graph. The results for four possible journeys are shown.

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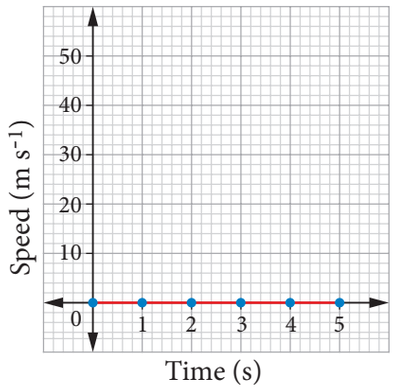
a. Bus at rest

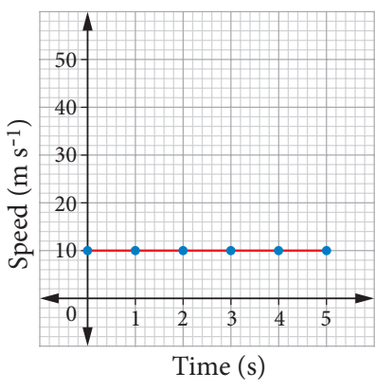
Time (s)	0	1	2	3	4	5
Speed (ms^{-1})	0	0	0	0	0	0



The speed of the bus remains at 0 ms^{-1}. So, the bus has zero acceleration.

b. Bus travelling at uniform speed of ms^{-1}

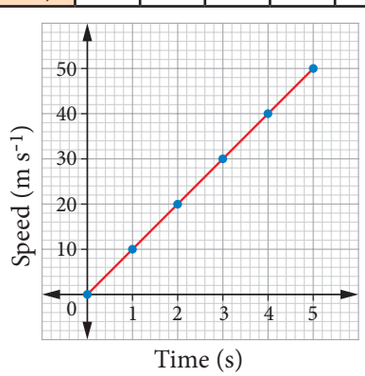
Time (s)	0	1	2	3	4	5
Speed (ms^{-1})	10	10	10	10	10	10



The speed of the bus remains at 10 ms^{-1}. Here, slope of the line is zero. So, the bus has zero acceleration.

c. Bus travelling uniform acceleration

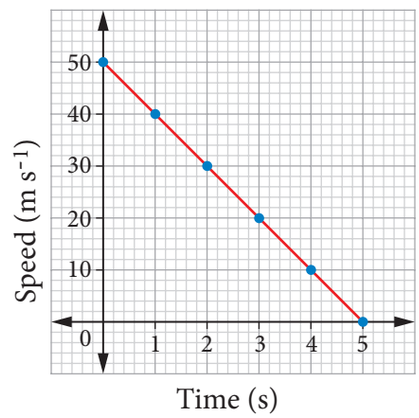
Time (s)	0	1	2	3	4	5
Speed (ms^{-1})	10	10	20	30	40	50



The speed of the bus increases by 10 ms^{-1} every second. Hence, the graph has a positive and constant gradient, and the acceleration is constant.

d. Bus travelling uniform deceleration

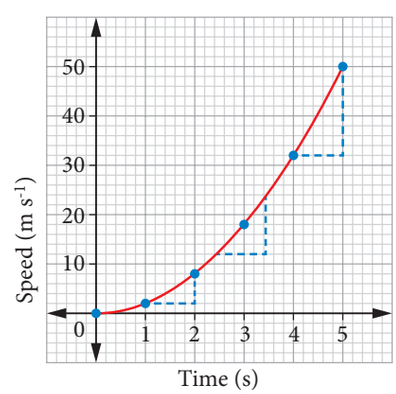
Time (s)	0	1	2	3	4	5
Speed (ms^{-1})	50	40	30	20	10	0



The speed of the bus decreases by 10 ms^{-1} very second. Hence, the graph has a negative and constant gradient and the acceleration is negative and constant.

e. Bus travelling with increasing acceleration (Non-uniform acceleration)

Time (s)	0	1	2	3	4	5
Speed (ms^{-1})	10	2	8	18	32	50



The speed of the bus is increasing with time. Hence, the graph has a positive and increasing gradient and the acceleration increases.

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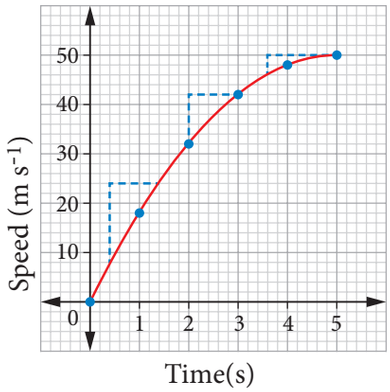
f. Bus travelling with decreasing acceleration (non-uniform acceleration)

Time (s)	0	1	2	3	4	5
Speed (ms^{-1})	10	18	32	42	48	50

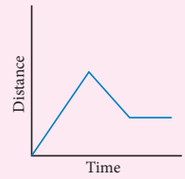


The speed is decreasing with time. Hence, the graph has a positive and decreasing gradient, and the acceleration decreases.

2.5.1 Comparison between Distance – Time and Speed – Time Graphs

The Speed – Time graphs and Distance – Time graphs may look very similar. But, they give different information. We can differentiate them by looking at the labels.

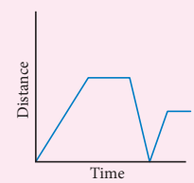
Graph and Story



Raju began walking to his school. Suddenly he remembered that he forgot his pen and walked back home. But he stopped suddenly when he heard a noise.

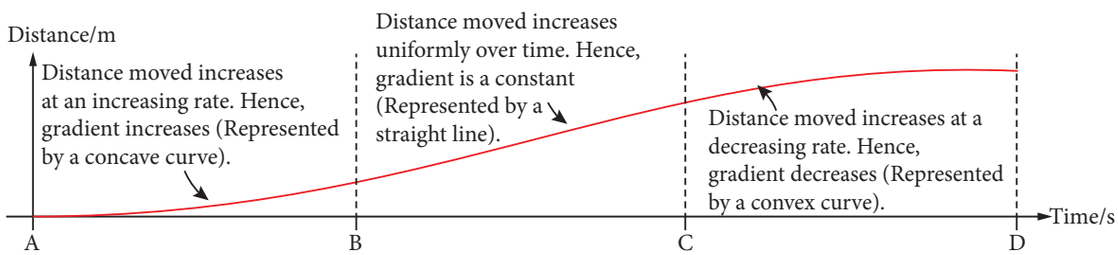
Rani was waiting for her mother for some time. When she saw her mother, she ran out of her home hugged her and stood there for a while.

Imagine and write a story on your own for the given graph?

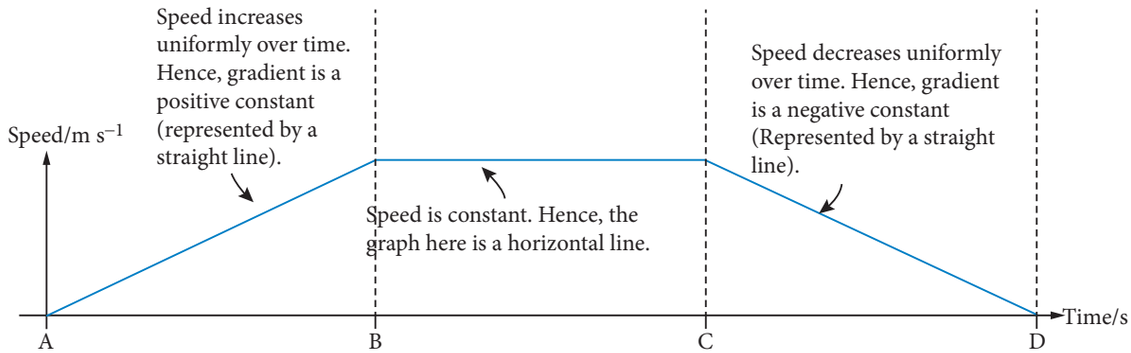


From A to B	From B to C	From C to D
Car accelerates uniformly from rest.	Car moves at constant speed.	Car decelerates uniformly to a stop.

Distance–Time Graph



Speed–Time Graph



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2.6 Centre of Gravity

Try to balance a cardboard on your finger tip. What do you observe? You can notice that there is only one point at which the cardboard is balanced. The point at which the cardboard is balanced is called the centre of gravity of the cardboard.

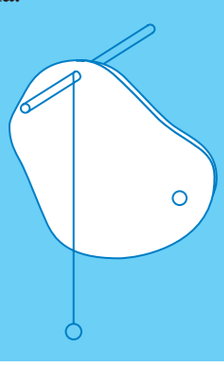
The centre of gravity of an object is the point through which the entire weight of the object appears to act. How do we find the centre of gravity of an object ?

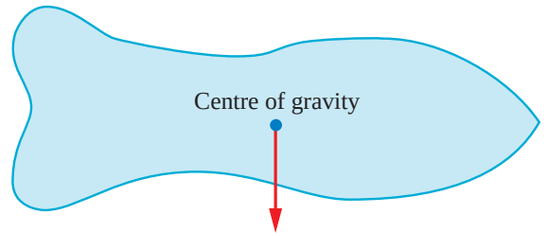
ACTIVITY 1

What about irregular shaped objects ?

Apparatus: Irregularly shaped card, string, pendulum bob, stand

1. Make three holes in the lamina.
2. Suspend the lamina from the optical pin through one of the holes as shown in figure.
3. Suspend the plumbline from the pin and mark the position of the plumbline on the lamina.
4. Draw lines on the lamina representing the positions of the plumbline.
5. Repeat the above steps for the other holes.
6. Label the intersection of the three lines as X, the position of the centre of gravity of the lamina.

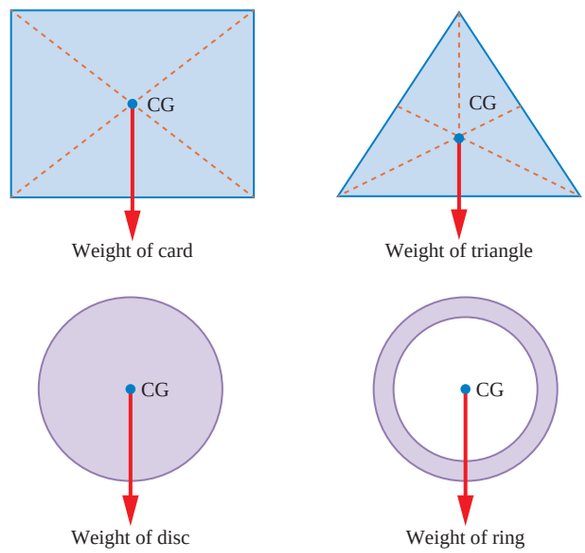




Total pull of the earth (weight) appears to act through the centre of gravity

2.6.1 Centre of gravity of regular – shaped objects

Generally the centre of gravity of the geometrical shaped objects lie on the geometric centre of the object.



The ruler is in equilibrium when supported at its centre of gravity. For a regular object such as a uniform meter ruler, the centre of gravity is at the centre of the object. When the object is supported at that point, it will be balanced. If it is supported at any other point, it will topple.

2.7 Stability

Stability is a measure of the body's ability to maintain its original position. Three types of stability are:

a. Stable equilibrium
b. Unstable equilibrium
c. Neutral equilibrium

Let us demonstrate them by taking a frustum.

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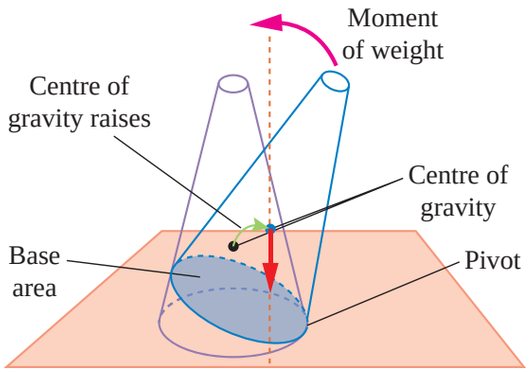
Stable Equilibrium

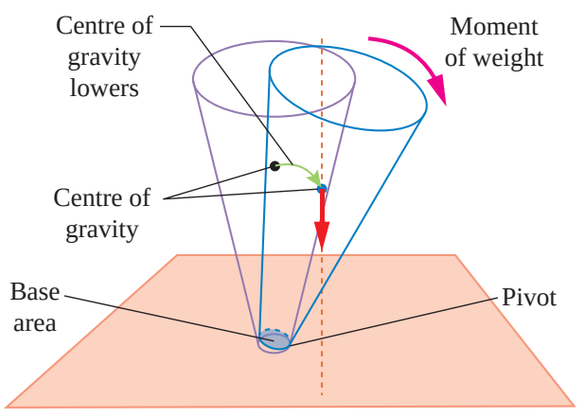
In stable equilibrium, the frustum can be tilted through quite a big angle without toppling.



Its centre of gravity is raised when it is displaced. The vertical line through its centre of gravity still falls within its base. So, it can return to its original position.

Unstable Equilibrium

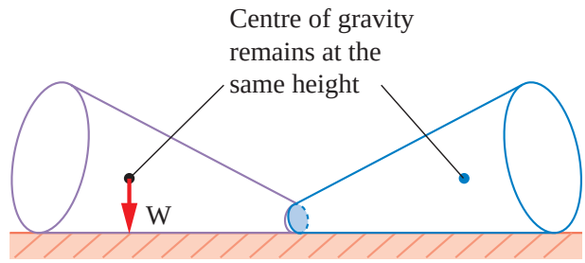
In this equilibrium, the frustum will topple with the slightest tilting. Its centre of gravity is lowered when it is displaced.



Here, the vertical line through its centre of gravity falls outside its base. So, it will not come back to its position.

Neutral Equilibrium

It causes frustum to topple. The frustum will roll about but does not topple. Its centre of gravity remains at the same height when it is displaced. The body will stay at any position to which it has been displaced.



2.7.1 Condition for Stability

Stability can be increased by the following ways.

- Lowering its centre of gravity
- Increasing the area of its base
- A heavy base lowers the centre of gravity So, the object will be stable.
- A broad base makes the object more stable.

DO YOU KNOW?

The Thanjavur Doll

It is s type of traditional toy made in Thanjavur from terracotta material. The centre of gravity and the total weight of the doll is concentrated at its bottom most point, generating a dance-like continuous movement with slow oscillations.

2.7.2 Real Life Applications of Centre of Gravity

In order to have stability, the luggage compartment of a tour bus is located at the bottom and not on the roof.

- Extra passengers are not allowed on the upper deck of a crowded double decker bus.

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- Racing cars are built low and broad for stability.
- Table lamps and fans are designed with large heavy bases to make them stable.

Points to Remember

- The total length of a path taken by an object to reach one place from the another place is called distance.
- The shortest distance from the initial to the final position of an object.
- Acceleration is the rate of change in velocity. SI unit of acceleration is m/s^2.
- Velocity is the rate of change in displacement. SI unit of velocity is metre / second (m/s).
- The centre of gravity of an object is the point through which the entire weight of the object appears to act.
- Generally the centre of gravity of the geometrical shaped object lie on the geometric centre of the object.
- Stability is a measure of the body's ability to maintain its original position.
- The three types of stability are: stable equilibrium, unstable equilibrium, neutral equilibrium.

AJZEAV

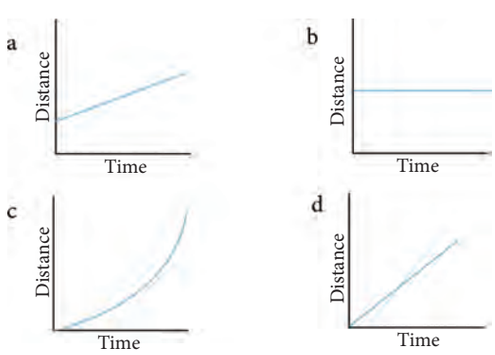
Evaluation

I. Choose the best answer.

1. A particle is moving in a circular path of radius *r*. The displacement after half a circle would be

   a. Zero b. R c. 2 *r* d. *r* / 2

2. Which of the following figures represent uniform motion of a moving object correctly?

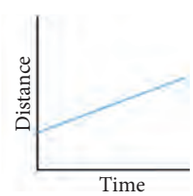


3. Suppose a boy is enjoying a ride on a merry go round which is moving with a constant speed of 10 m/s. It implies that the boy is

   a. at rest
   b. moving with no acceleration
   c. in accelerated motion
   d. moving with uniform velocity

4. From the given v-t graph it can be inferred that an object is

   a. in uniform motion b. at rest
   c. in non - uniform motion
   d. moving with uniform accelerations



5. How can we increase the stability of an object?

   a. Lowering the centre of gravity
   b. Raising the centre of gravity
   c. Increasing the height of the object
   d. Shortening the base of the object

II. Fill in the blanks.

1. The shortest distance between two places is _____.
2. The rate of change of velocity is_____.

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3. If the velocity of an object increases with respect to time, then the object is said to be in_____ acceleration.
4. The slope of the speed–time graph gives _____.
5. In _____ equilibrium, the centre of gravity remains at the same height when it is displaced.

III. Match the following.

Displacement	Knot
Light travelling through vacuum	Geometric centre
Speed of ship	Metre
Centre of gravity of geometrical shaped objects	Larger base area
Stability	Uniform velocity

IV. Analogy

1. Velocity : metre / second :: Acceleration : _____ .
2. Length of scale : metre :: Speed of aeroplane : _____ .
3. Displacement / Time : Velocity :: Speed / Time : _____ .

V. Answer very briefly.

1. Asher says all objects having uniform speed need not have uniform velocity. Give reason.
2. Saphira moves at a constant speed in the same direction. Rephrase the same sentence in fewer words using concepts related to motion.
3. Correct your friend who says that acceleration gives the idea of how fast the position changes.

VI. Answer briefly.

1. Show the shape of the distance – time graph for the motion in the following cases.
   a. A bus moving with a constant speed.
   b. A car parked on a road side.
2. Distinguish between speed and velocity.
3. What do you mean by constant acceleration?
4. What is centre of gravity ?

VII. Answer in detail.

1. Explain the types of stability with suitable examples.
2. Write about the experiment to find the centre of gravity of the irregularly shaped plate.

VIII. Numerical problems.

1. Geetha takes 15 minutes from her house to reach her school on a bicycle. If the bicycle has a speed of 2 m/s, calculate the distance between her house and the school.
2. A car starts from rest and it is travelling with a velocity of 20 m /s in 10 s. What is its acceleration?
3. A bus can accelerate with an acceleration of 1 m / s^2. Find the minimum time for the bus to attain the speed of 100 km / s from 50 km / s.

IX. Fill in the boxes.

S.No.	First Move	Seconde Move	Distance (m)	Displacement
1.	Move 4 metres east	Move 2 metres west	6	2 m east
2.	Move 4 metres north	Move 2 metres south		
3.	Move 2 metres east	Move 4 metres west		
4.	Move 5 metres east	Move 5 metres west		
5.	Move 5 metres south	Move 2 metres north		
6.	Move 10 metres west	Move 3 metres east		

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Unit 1

Heat and Temperature

Learning Objectives

- To understand the working principle of thermometer
- To measure temperature using thermometer
- To know about Thermometric Liquids
- To differentiate between Clinical and Laboratory Thermometer
- To know the various units of temperature
- To convert a temperature from a thermometer scale to others.

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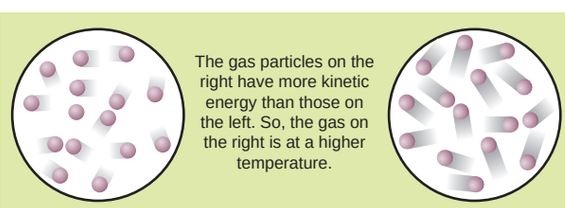
Introduction

You shiver when it is cold outside and sweat when it is hot outside, but how can you measure those weather temperatures? Temperature is involved in many aspects of our daily lives, including our own bodies and health; the weather; and how hot the stove must be in order to cook food.

The measurement of warmness or coldness of a substance is known as its temperature.

It is a measure of the average kinetic energy of the particles in an object. Temperature is related to how fast the atoms within a substance are moving.



1.2 Temperature Units:

There are three units which are used to measure the temperature: Degree Celsius, Fahrenheit and Kelvin.

Degree Celsius: Celsius is written as°C and read as degree. For example 20°C; it is read as twenty degree Celsius. Celsius is called as Centigrade as well.

Fahrenheit: Fahrenheit is written as °F for example 25°F; it is read as twenty five degree Fahrenheit.

Kelvin: Kelvin is written as K. For example 100K; it is read as hundred Kelvin.

❖ The SI unit of temperature is kelvin (K).

1.3 Measuring Temperature

The temperature of the object is well approximated with the kinetic energy of the substances. The high temperature means that the molecules within the object are moving at a faster rate.

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But the question arises, how to measure it? Molecules in any substance are very small to analyze and calculate its movement (Kinetic energy) in order to measure its temperature. You must use an indirect method to measure the kinetic energy of the molecules of a substance.

We studied that solids expands when heat is supplied to it. Like solid substances, liquids are also affected by heat. To know this let us do the activity 1.

In a thermometer, when liquid gets heat, it expands and when it is cooled down, it contracts. It is used to measure temperature.

Like solid and liquid objects, the effect of heat is also observed on gaseous objects.

1.4 Thermometer:

Thermometer is the most common instrument to measure temperature.

There are various kinds of thermometers. Some of them are like glass tubes which look thin and are filled with some kind of liquid.

Why Mercury or Alcohol is used in Thermometer?

Mostly Alcohol and Mercury are used in thermometers as they remain in liquid form even with a change of temperature in them. A small change in the temperature causes change in volume of a liquid. We measure this temperature by measuring expansion of a liquid in thermometer.

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ACTIVITY 1

What is required?

A small glass bottle, a rubber cork, an empty refill, water, colour, a candle, a fork, a paper.

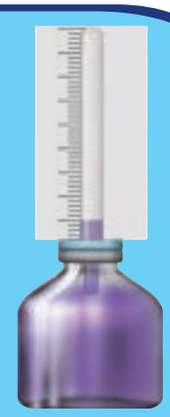
What to do?

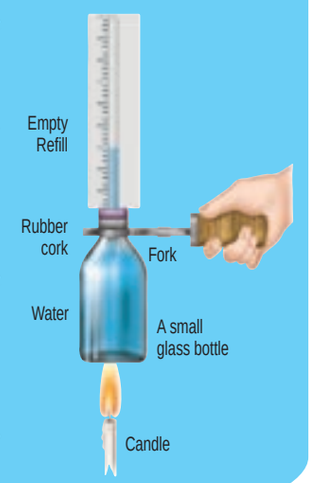
- Take a small glass bottle. Fill it with coloured water.
- Make hole at the centre of the rubber cork.
- Pass empty refill from the hole of the rubber cork.
- Make the bottle air tight and observe the water raised in the refill.
- Make a scale on paper, place it behind the refill and note down the position of the surface of water.
- Hold bottle with fork and supply heat to it with candle. Then observe.

What is the change in the surface of water?

- Stop the supply of heat. When water is cooled, observe the surface of water in the refill, **what change takes place? Why?**

When, a liquid is heated, it expands and when it is cooled down, it contracts.





Properties of Mercury:-

- Its expansion is uniform. (For equal amounts of heat it expands by equal lengths.)
- It is opaque and shining.
- It does not stick to the sides of the glass tube.
- It is a good conductor of heat.
- It has a high boiling point (357°C) and a low freezing point (−39°C). Hence a wide range of temperatures can be measured using a mercury thermometer

Properties of Alcohol

- The freezing point of alcohol is less than −100°C. So it can be used to measure very low temperatures.
- Its expansion per degree Celsius rise in temperature is very large.
- It can be coloured brightly and hence is easily visible.

1.4 Types of Thermometers

There are different types of thermometers for measuring the temperatures of different things like air, our bodies, food and many other things. Among these, the commonly used thermometers are clinical thermometers and laboratory thermometers.

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1.4.1 Clinical Thermometer

These thermometers are used to measure the temperature of a human body, at home, clinics and hospitals. All clinical thermometers have a kink that prevents the mercury from

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ACTIVITY 2

What is required?

A big bottle, a balloon, threads, candle, water, fork

What to do?

- Take one big bottle, and fill some water in it.
- Attach one balloon on the mouth of bottle and fix it with thread.
- Hold bottle with a fork. Heat the bottle with a candle and take observation.
- What change occurs in the state of balloon after heating the bottle? ----------
- What change occurs in the state of balloon after heating the bottle?

Why? ----------

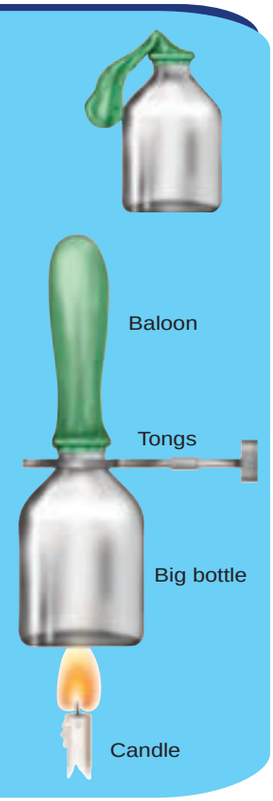
Now, let the bottle get cooled down.

What change occurs in the state of balloon after bottle gets cool down?

Why? ----------

When gases substance gets heat, it expands; when it cools it contracts.

Why does a tyre get burst in summer? ----------



flowing back into the bulb when the thermometer is taken out of the patient's mouth, so that the temperature can be noted conveniently. There are temperature scales on either side of the mercury thread, one in Celsius scale and the other in Fahrenheit scale. Since the Fahrenheit scale is more sensitive than the Celsius scale, body temperature is measured in F only. A clinical thermometer indicates temperatures from a minimum of 35°C or 94°F to a maximum of 42°C or 108°F.

Precautions to be Followed While Using a Clinical Thermometer

- The thermometer should be washed before and after use, preferably with an antiseptic solution.
- Jerk the thermometer a few times to bring the level of the mercury down.
- Before use, the mercury level should be below 35°C or 94°F.
- Do not hold the thermometer by its bulb.
- Keep the mercury level along your line of sight and then take the reading.
- Handle the thermometer with care. If it hits against some hard object, it may break.
- Do not place the thermometer in a hot flame or in the hot sun.

1.4.2 Laboratory Thermometers

Laboratory thermometers are used to measure the temperature in school and other laboratories for scientific research. They are also used in the industry as they can measure temperatures higher than what clinical thermometers can record. The stem and the bulb of a lab thermometer are longer when compared to that of a clinical thermometer and

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there is no kink in the lab thermometer. A laboratory thermometer has only the Celsius scale ranging from –10°C to 110°C.

Precautions to be Followed While Using a Laboratory Thermometer

- Do not tilt the thermometer while measuring the temperature. Place it upright.
- Note the reading only when the bulb has been surrounded by the substance from all sides.

DO YOU KNOW?

In humans, the average internal temperature is 37°C (98.6°F), though it varies among individuals. However, no person always has exactly the same temperature at every moment of the day. Temperatures cycle regularly up and down through the day according to activities and external factors.

ACTIVITY 3

Measure your body temperature

Wash the thermometer preferably with an antiseptic solution. Hold it firmly by the end and give it a few jerks. These jerks will bring the level of Mercury down. Ensure that it falls below 35°C (95°F). Now place the thermometer under your tongue or arm pit.

After one minute, take the thermometer out and note the reading. It tells you your body temperature. **What did you record as your body temperature?_____**

ACTIVITY 4

Use of Laboratory thermometer

- Take some water in a beaker.
- Take a laboratory thermometer and immerse its bulb end in water; holding it vertically. Ensure to dip whole portion of bulb end. The bulb end should not touch the bottom or side of the beaker.
- Observe the movement of rise of mercury. When it becomes stable, take the reading of the thermometer.
- Repeat this with hot water and take the reading.

Difference between clinical and laboratory thermometer

Clinical Thermometer	Laboratory Thermometer
Clinical thermometer is scaled from 35°C to 42°C or from 94°F to 108°F.	Laboratory thermometer is generally scaled from –10°C to 110°C.
Mercury level does not fall on its own, as there is a kink near the bulb to prevent the fall of mercury level.	Mercury level falls on its own as no kink is present.
Temperature can be read after removing the thermometer from armpit or mouth.	Temperature is read while keeping the thermometer in the source of temperature, e.g. a liquid or any other thing.
To lower the mercury level jerks are given.	No need to give jerk to lower the mercury level.
It is used for taking the body temperature.	It is used to take temperature in laboratory.

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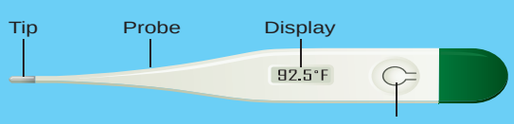
1.4.3 Digital Thermometer

Here is a lot of concern over the use of mercury in thermometers. Mercury is a toxic substance and is very difficult to dispose of if a thermometer breaks. These days, digital thermometers are available which do not use mercury. Instead, it has a sensor which can measure the heat coming out from the body directly and from that can measure the temperature of the body.

Digital thermometers are mainly used to take the body temperature.

ACTIVITY 5

Use of Digital thermometer



1. Wash the tip with warm (not hot), soapy water.
2. Press the "ON" button.
3. Insert the tip of the thermometer into the mouth, bottom, or under the armpit.
4. Hold the thermometer in place until it beeps (about 30 seconds).
5. Read the display.
6. Turn off the thermometer, rinse under water, and put it away in a safe place.

Caution

Alex wanted to measure the temperature of hot milk using a clinical thermometer. His teacher stopped him from doing so.

We are advised not to use a clinical thermometer for measuring the temperature of any object other than human body. Also we are advised to avoid keeping it in the sun or near a flame. Why?

A Clinical thermometer has small temperature range. The glass will crack/ burst due to excessive pressure created by expansion of mercury.

DO YOU KNOW?

Maximum _ minimum thermometer

The maximum and minimum temperatures of the previous day reported in weather reports are measured by a thermometer called the maximum - minimum thermometer.

1.5 Scales of thermometers

Celsius scale

Celsius is the common unit of measuring temperature, termed after Swedish astronomer, **Anders Celsius** in 1742, before that it was known as Centigrade as thermometers using this scale are calibrated from (Freezing point of water) 0°C to 100°C (boiling point of water). In Greek, '**Centium**' means 100 and '**Gradus**' means steps, both words make it **centigrade** and later **Celsius**.

Fahrenheit Scale

Fahrenheit is a Common unit to measure human body temperature. It is termed after the name of a German Physicist **Daniel Gabriel Fahrenheit**. Freezing point of water is taken as 32°F and boiling point 212°F. Thermometers with Fahrenheit scale are calibrated from 32°F to 212°F.

Kelvin scale

Kelvin scale is termed after **Lord Kelvin**. It is the SI unit of measuring temperature and written as K also known as absolute scale as it starts from absolute zero temperature.

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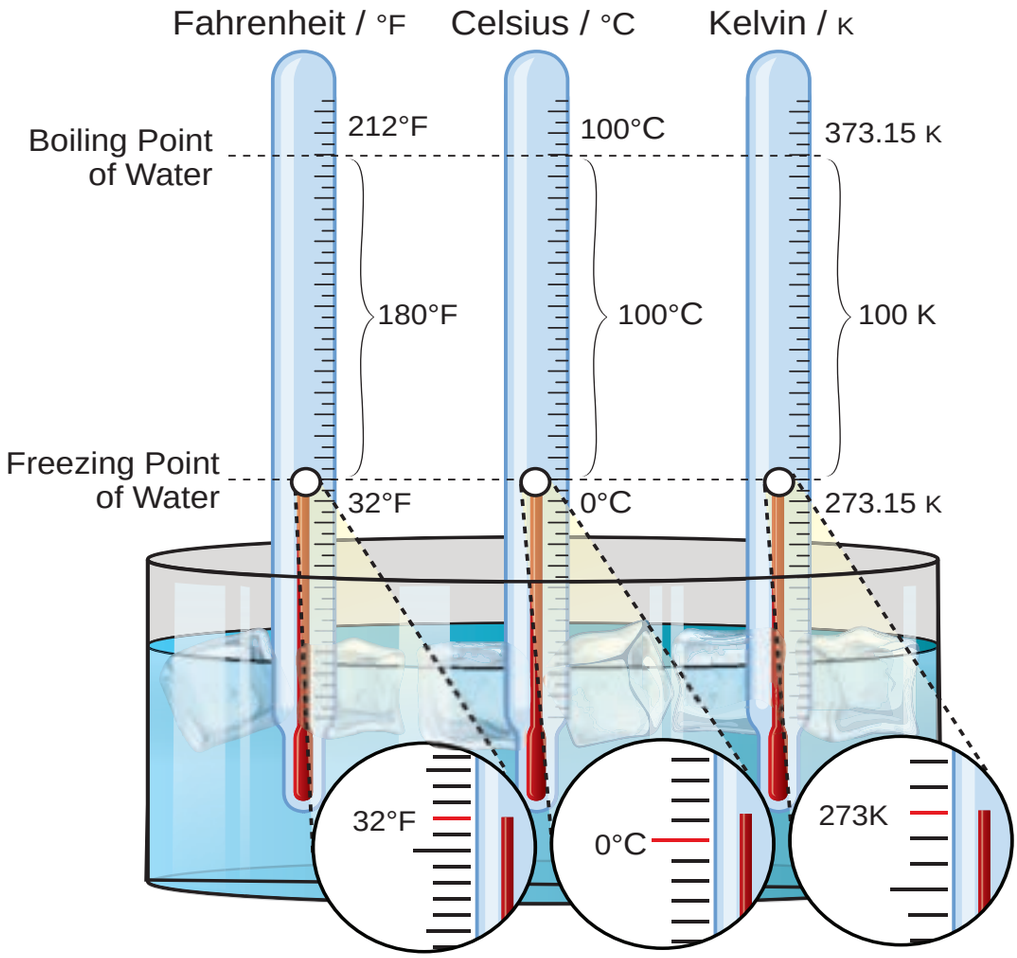
Temperature in Celsius scale can be easily converted to Fahrenheit and Kelvin scale as discussed ahead



Relation between Fahrenheit scale and Celsius scales is as under.

$$\frac{(F-32)}{9} = \frac{C}{5}, \quad K = 273.15 + C$$

The equivalence between principal temperature scales are given in Table for some temperatures.

Temperature	Celsius scale (°C)	Farenheit scale (°F)	Kelvin scale (K)
Boiling point of water	100	212	373.15
Freezing point of water	0	32	273.15
Mean temperature of human body	37	98.6	310.15
Room temperature (Average)	72	23	296.15

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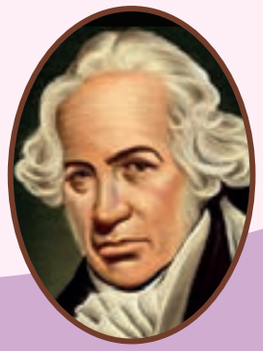
HEAT AND TEMPERATURE

KEY CONTRIBUTORS

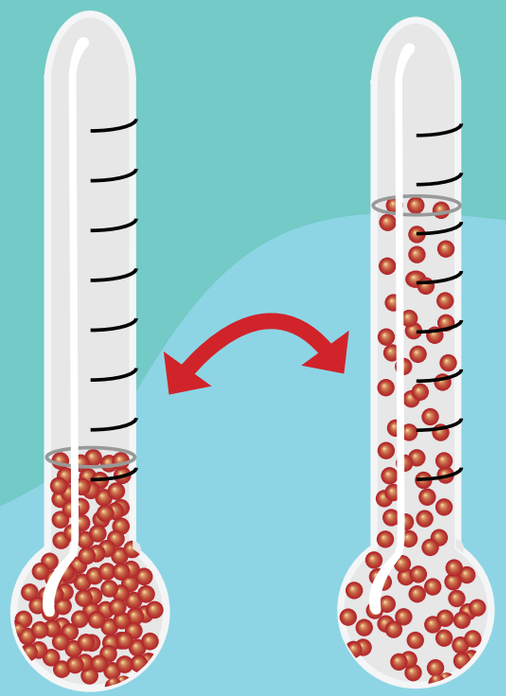
Lord Kelvin

Anders Celsius



Gabriel Fahrenheit

Rankine



Thermometer Liquid Expands when Heated

10^{32} KELVIN

Temperature of the Universe in the earliest moments after the Big Bang

373.15 KELVIN

Boiling point of water

100 °C, 212 °F

329.85 KELVIN

Hottest natural temperature ever recorded on Earth.

56.7 °C, 134.06 °F

310.15 KELVIN

Average human body temperature

37 °C, 98.6 °F

273.15 KELVIN

Freezing point of water

0 °C, 32 °F

178.45 KELVIN

Coldest natural temperature ever recorded on Earth

-94.7 °C, -138.46°F

1 KELVIN

The Boomerang Nebula maintains the coldest known natural temperature in the universe

-272.15 °C, -457.87 °F

0 KELVIN

Absolute zero Temperature

-273.15 °C, -459.67 °F

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DO YOU KNOW?

Most of the people in the world use the Celsius scale to measure temperature for day to day purpose. The Kelvin scale has been designed in such a way, it is not only an absolute temperature scale, but also 1°C change is equal to a 1K change. This makes the conversion from Celsius to absolute temperature scale (Kelvin scale) easy, just the addition or subtraction of a constant 273.15

But in United States they prefer to use the Fahrenheit scale. The problem is, converting Fahrenheit to absolute scale (Kelvin) is not easy.

To sort out this problem they use The Rankine scale. It named after the Glasgow University engineer and physicist **Rankine**, who proposed it in 1859. It is an absolute temperature scale, and has the property of having a 1°R change is equal to a 1°F change. Fahrenheit users who need to work with absolute temperature can be converted to Rankine by

R= F+ 459.67

1.6 Numerical Problems

Solved examples

1. How much will the temperature of 68°F be in Celsius and Kelvin?

Given :

Temperature in Fahrenheit = F = 68°F

Temperature in Celsius = C = ?

Temperature in Kelvin = K = ?

$$\frac{(F-32)}{9} = \frac{C}{5}$$

$$\frac{(68-32)}{9} = \frac{C}{5}$$

$$C = 5x\frac{36}{9} = 20°C$$

$$K = C + 273.15 = 20 + 273.15 = 293.15$$

Thus, the temperature in Celsius = 20ºC and in Kelvin = 293.15 K

2. At what temperature will its value be same in Celsius and in Fahrenheit?

Given : If the temperature in Celsius is C, then the temperature in Fahrenheit (F) will be same,

i.e. F = C. $\frac{(F-32)}{9} = \frac{C}{5}$

(or)

$$\frac{(C-32)}{9} = \frac{C}{5}$$

$$(C–32) \times 5 = C \times 9$$

$$5C – 160 = 9 C$$

$$4 C = – 160$$

$$C = F = – 40$$

The temperatures in Celsius and in Fahrenheit will be same at – 40

3. Convert the given temperature :

1) 45°C	= ..... °F	2) 20°C	= ..... °F
3) 68°F	= ..... °C	4) 185°F	= ..... °C
5) 0°C	= ..... K	6) -20°C	= ..... K
7) 100 K	= ..... °C	8) 272.15 K	= ..... °C

POINTS TO REMEMBER

1. The measurement of warmness or coldness of a substance is known as its temperature.
2. There are three units which are used to measure the temperature: Degree Celsius, Fahrenheit and Kelvin.
3. The SI unit of temperature is Kelvin (K).
4. In a thermometer, when liquid gets heat, it expands and when it is cooled down, it contracts. It is used to measure temperature.

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5. Relation between Fahrenheit scale and Celsius scales is

$$\frac{(F-32)}{9} = \frac{C}{5}$$

$$K = 273.15 + C$$

EVALUATION

S6P7M6

I. Choose the correct answer

1. International unit of measuring temperature is .....
   a. Kelvin b. Fahrenheit
   c. Celsius d. Joule
2. In thermometer when bulb comes in contact with hot object, liquid inside it
   a. expands b. contracts
   c. remains same d. none of above
3. The body temperature of a healthy man is;
   a. 0°C b. 37°C c. 98°C d. 100°C
4. Mercury is often used in laboratory thermometers because it _____
   a. is a harmless liquid
   b. is silvery in colour and is attractive in appearance
   c. Expands uniformly
   d. is a low cost liquid
5. Which of the following temperature conversions is incorrect

   K (Kelvin) = °C (Celsius) + 273.15

	°C	K
a.	-273.15	0
b.	-123.	+150.15
c.	+ 127.	+ 400.15
d.	+ 450	+ 733.15

II. Fill in the blanks

1. Doctor uses _____ thermometer to measure the human body temperature.
2. At room temperature Mercury is in _____ state.
3. Heat energy transfer from _____ to _____
4. – 7°C temperature is _____ than 0°C temperature.
5. The common laboratory thermometer is a _____ thermometer

III. Match the following

i) Clinical thermometer	A form of energy
ii) Normal temperature of human body	100°C
iii) Heat	37°C
iv) Boiling point of water	0°C
v) Melting point of water	Kink

IV. Give very short answer

1. Temperature of Srinagar (J&K) is – 4°C and in Kodaikanal is 3°C which of them has greater temperature ? What is the difference between the temperatures of these two places?
2. Jyothi was prepared to measure the temperature of hot water with a clinical thermometer. Is it right or wrong? Why?
3. A clinical thermometer is not used to measure the temperature of air, why?
4. What is the use of kink in clinical thermometer?
5. Why do we jerk a clinical thermometer before we measure the body temperature?

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V. Give short Answer

1. Why do we use Mercury in thermometers? Can water be used instead of mercury? What are the problems in using it?

2. Swathi kept a laboratory thermometer in hot water for some time and took it out to read the temperature. Ramani said it was a wrong way of measuring temperature. Do you agree with Ramani? Explain your answer.

3. The body temperature of Srinath is 99°F. Is he suffering from fever? If so, why?

VI. Give long answer

1. Draw the diagram of a clinical thermometer and label its parts.

2. State the similarities and differences between the laboratory thermometer and the clinical thermometer.

VII. Higher Order Thinking questions

1. What must be the temperature in Fahrenheit, so that it will be twice its value in Celsius?

2. Go to a veterinary doctor (a doctor who treats animals). Discuss and find out the normal temperature of domestic animals and birds.

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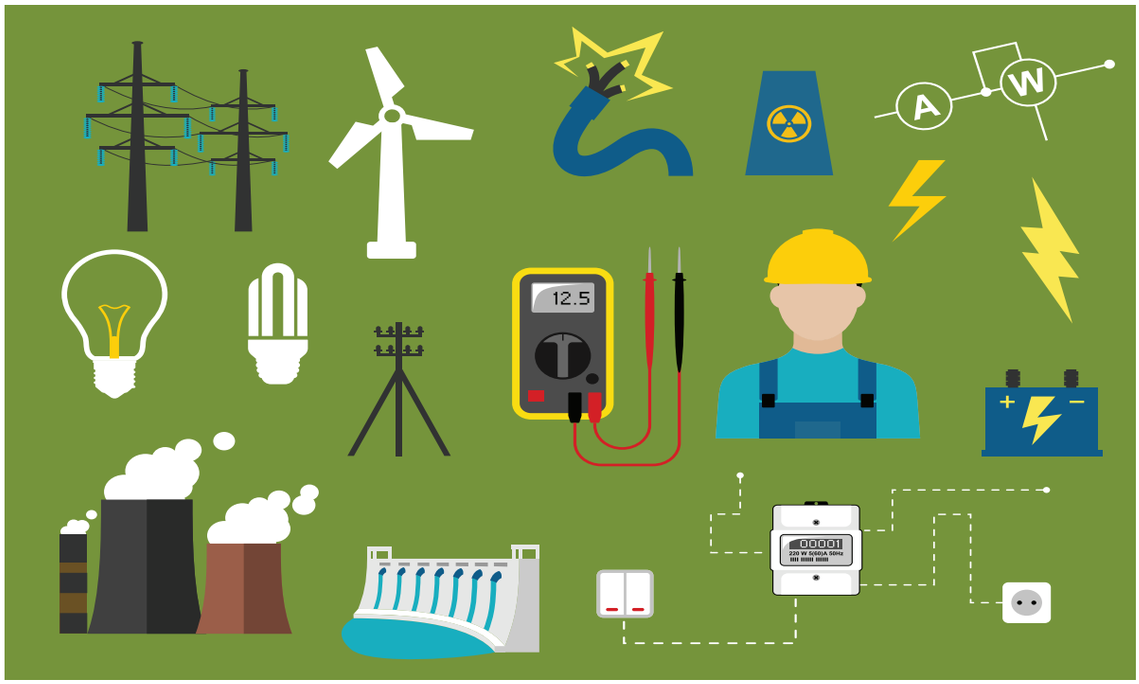
Unit 2

ELECTRICITY



Learning Objectives

- Understanding the flow of electric current and learning to draw the circuit diagram
- Understanding the difference between conventional current and electron flow.
- Understanding the different types of circuit based on flow of electricity and the connection of bulbs in a circuit
- Distinguishing a cell and a battery
- Understanding the effects of electric current and factors affecting the effect of electric current
- Applying their knowledge in identifying the components of electrical circuits.
- Understanding the discrimination between different type of circuits.
- Doing numerical problems and drawing the circuit diagram of their own.

A8T3D9

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Introduction

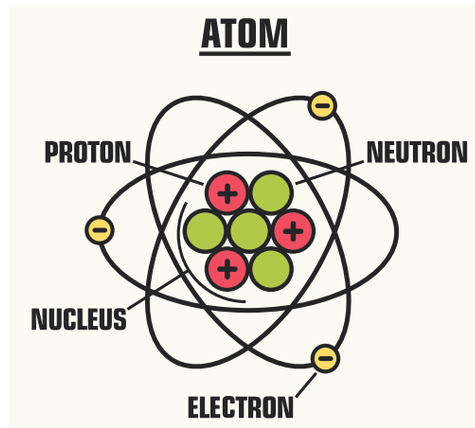
In 1882, when it was sun set in the west that miracle happened in New york city. When Thomas Alva Edison gently pushed the switch on 14,000 bulbs in 9,000 houses suddenly got lighted up. It was the greatest invention to mankind. From then the world was under the light even in the night.

Many countries began using electricity for domestic purposes. Seventeen years after the New York, in 1899 electricity first came to India. The Calcutta Electric Supply Corporation Limited commissioned the first thermal power plant in India on 17 April 1899

Around 1900s, a thermal power station was set up at Basin Bridge in Madras city and power was distributed to the government press, general hospital, electric tramways and certain residential areas in Madras. Today electricity is a common household commodity.

In your class 6, we learned about electricity and their sources. From operating factories, running medical equipments like ventilator, communications like mobile, radio and TV, drawing water to the agricultural field and light up homes electricity is important. What is electricity? We can see that. it is a form of energy, like heat and magnetism.

We have learnt that all materials are made up of small particles called atoms. The centre of the atom is called the nucleus. The nucleus consists of protons and neurtrons. Protons are positively charged. Neutrons have no charge. Negatively charged electrons revolve around the nucleus in circular orbits. Electricity is a form of energy that is associated with electric charges that exists inside the atom



ACTIVITY 1

Comb your dry hair. Immediately after combing the dry hair, bring the comb closer to the bits of paper . what will you observe?

When you are getting up from the plastic chair , the nylon shirt seems to be stuck to the chair and make crackling sound. What is the reason for the creation of the sound?

A balloon sticks to wall without any adhesive after rubbing on your hand.

Do you know the reason for all?

In all the above activities, when a body is rubbed against some other body become charged.

Electric charge is measured in a unit called coulomb. One unit of coulomb is charge of approximately 6.242×10^{18} protons or electrons.

Electrical charges are generally denoted by the letter `q`

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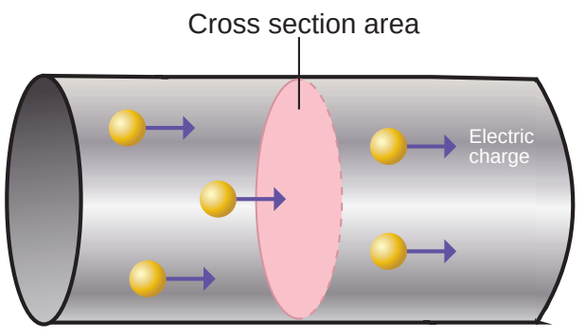
2.1. Electric Current

The flow of electric charges constitute an electric current. For an electrical appliance to work, electric current must flow through it. An electric current is measured by the amount of electric charge moving per unit time at any point in the circuit. The conventional symbol for current is 'I'.



Unit of Electric Current

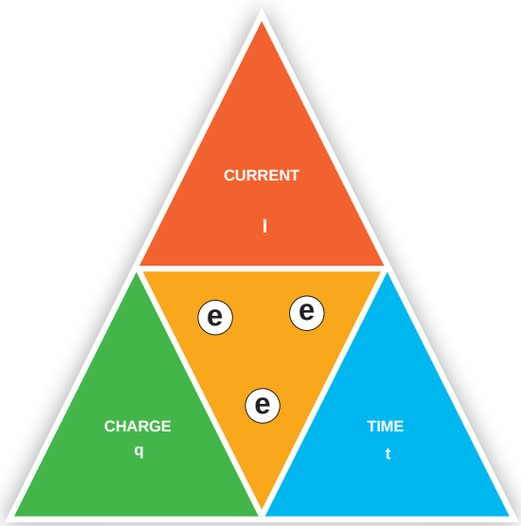
The SI unit for measuring an electric current is the ampere, which is the flow of electric charge across a surface at the rate of one coulomb per second.

$$I = q / t$$

Where I ⇒ current (in Ampere - A)

q ⇒ charge (in coulomb - c)

t ⇒ time taken (in seconds - s)



Worked example 2.1

If 30 coulomb of electric charge flows through a wire in two minutes, calculate the current in the wire?

Solution

Given :

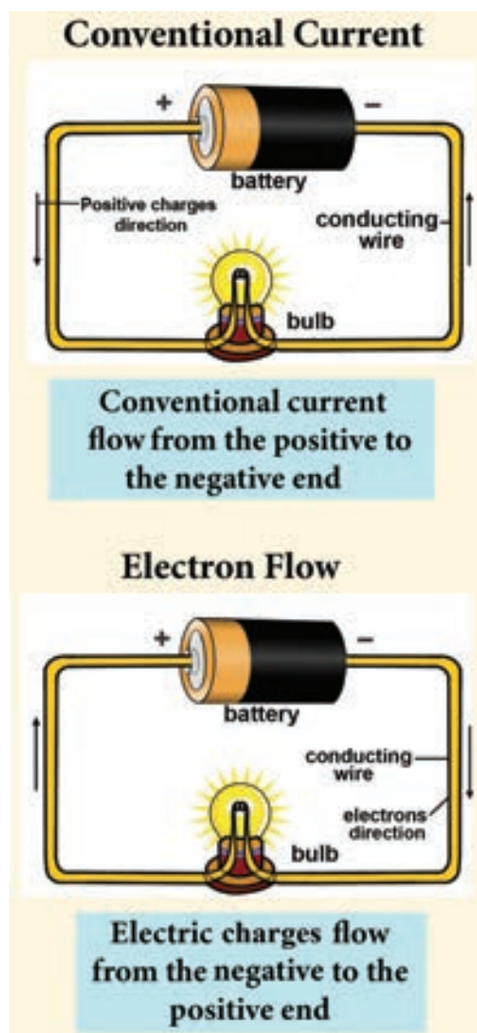
Charge (q) = 30 coulomb

Time (t) = 2 min x 60s

= 120 s

Current I = q/t = 30C/120s = 0.25 A

2.1.1. Conventional Current and Electron Flow



Before the discovery of electrons , scientists believed that an electric current consisted of moving positive charges.

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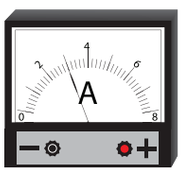
This movement of positive charges is called conventional current.

After the electrons were discovered, it was known that electron flow actually takes place from the negative terminal to the positive terminal of the battery. This movement is known as electron flow.

Conventional current is in the direction opposite to electron flow.

2.1.2. Measurement of electric current



Electric current is measured using a device called ammeter. The terminals of an ammeter are marked with + and - sign. An ammeter must be connected in series in a circuit.

Instruments used to measure smaller currents, in the milli ampere or micro ampere range, are designated as milli ammeters or micro ammeters.

1 milliampere (mA) = 10^{-3} ampere.
= 1/1000 ampere
1 microampere (μA) = 10^{-6} ampere
= 1/1000000 ampere

Worked Examples 2.2

If 0.002A current flows through a circuit, then convert the current in terms of micro ampere?

Solution:

Given that the current flows through the circuit is 0.002A

We know that

$$1\ A = 10^6\ \mu A$$

$$0.002A = 0.002 \times 10^6\ \mu A$$

$$= 2 \times 10^{-3} \times 10^6\ \mu A$$

$$= 2 \times 10^3\ \mu A$$

$$0.002A = 2000\ \mu A$$

2.2. Potential difference (v)

Electrical charges need energy to push them along a circuit.

Water always flows from higher to lower ground. Similarly an electric charge always flows from a point at higher potential to a point at lower potential.

W1B9B6

An electric current can flow only when there is a potential difference (V) or P.D.

The potential difference between any two points in the circuit is the amount of energy needed to move one unit of electric charge from one point to the other.

2.2.1. Unit of potential difference

Did you ever notice the precautionary board while crossing the railway track and the electrical transformer? What does the word high voltage denotes?

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The term metioned in the board volt is the measurement for the electric potential difference.

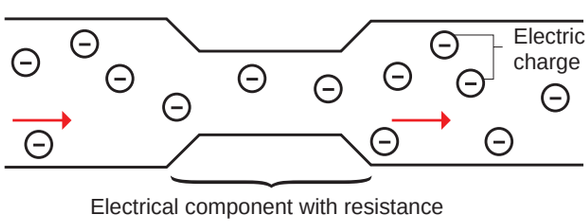
The SI unit of potential difference is volt (V). potential difference between two points is measured by using a device called voltmeter.

Water at the top of the waterfall has more potential energy

Water near the base of the waterfall has less potential energy

The electric current flow from the higher potential level to the lower potential level is just like the water flow.

2.2.2. Electrical conductivity and Resistivity



Resistance (R)

An electrical component resists or hinders the flow of electric charges, when it is connected in a circuit. In a circuit component, the resistance to the flow of charge is similar to how a narrow channel resists the flow of water.

The higher the resistance in a component, the higher the potential difference needed to move electric charge through the component. We can express resistance as a ratio.

Resistance of a component is the ratio of the potential difference across it to the current flowing through it. $R = \frac{V}{I}$

The S.I unit of resistance is ohm

Greater the ratio of V to I, the greater is the resistance

Electrical conductivity (σ)

Electrical conductivity or specific conductance is the measure of a material's ability to conduct an electric current. It is commonly represented by the Greek letter σ (sigma) The S.I Unit of electrical conductivity is Siemens/meter(S/m)

Electrical resistivity (ρ)

Electrical resistivity (also known as specific electrical resistance, or volume resistivity) is a fundamental property of a material that quantifies how strongly that material opposes the flow of electric current. The SI unit of electrical resistivity is the ohm-metre (Ω.m).

Material	Resistivity (ρ) (Ω m) at 20°C	Conductivity (σ) (S/m)at 20°C
Silver	1.59×10^{-8}	6.30×10^{7}
Copper	1.68×10^{-8}	5.98×10^{7}
Annealed Copper	1.72×10^{-8}	5.80×10^{7}
Aluminum	2.82×10^{-8}	3.5×10^{7}

2.2.3. Analogy of Electric Current with Water Flow

An electric current is a flow of electrons through a conductor (like a copper wire). We can't see electrons, however, we can imagine the flow of electric current in a wire like the flow of water in a pipe.

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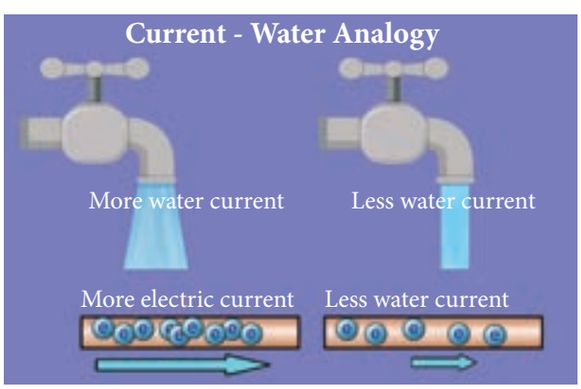
Let us see the analogy of flow of electric current with the water flow.

Water flowing through pipes is pretty good mechanical system that is a lot like an electrical circuit. This mechanical system consists of a pump pushing water through a closed pipe. Imagine that the electrical current is similar to the water flowing through the pipe. The following parts of the two systems are related

- The pipe is like the wire in the electric circuit and the pump is like the battery.
- The pressure generated by the pump drives water through the pipe.
- The pressure is like the voltage generated by the battery which drives electrons through the electric circuit.
- Suppose, there are some dust and rust that plug up the pipe and slow the flow of water, creating a pressure difference from one end to the other end of the pipe. In similar way, the resistance in the electric circuit resists the flow of electrons and creates a voltage drop from one end to the other. Energy loss is shown in the form of heat across the resistor.



2.3. Sources of Electric current - Electro chemical cells or electric cells

An electric cell is something that provides electricity to different devices that are not fed directly or easily by the supply of electricity.

ACTIVITY 2

Shall we produce electricity at our home?

Materials required:

Zinc and copper electrodes, a light blub, connecting wires, and fruits such as lemons, orange, apples, grapes, and bananas.

Procedure:

1. Set up a circuit as shown in figure
2. Note the brightness of the blub when the circuit is connected to a lemon.
3. Repeat the experiment using the other fruits listed above. Do you notice the differences in the brightness of the bulb when it is connected to different fruits? Which fruit gives the greatest brightness? Why? (If you do not know please get the appropriate reason from your teacher)

Inference:

In the above activity what makes enabled the bulb to glow. Why there is a difference in the brightness of the bulb? The reason is that the fruits which you have connected to the bulb produces the electric energy at different levels

The sources which produce the small amount of electricity for shorter periods of time is called as electric cell or electro chemical cells. Electric cell converts chemical energy into electrical energy

In addition to electro chemical, we use electro thermal source for generating electricity for large scale use.

It has two terminals. When electric cells are used, a chemical reaction takes place inside the cells which produces charge in the cell.

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Primary Cell	Secondary Cell			
Dry cell	Lithium cylindrical cells	Button cells	Alkaline cells	Automobile battery
				

2.3.1. Types of cell – primary cell and secondary cell

In our daily life we are using cells and batteries for the functioning of a remote, toys cars, clock, cellphone etc. Event hough all the devices produces electrical energy, some of the cells are reusable and some of them are of single use. Do you know the reason why? Based on their type they are classified into two types namely – primary cell and secondary cell.

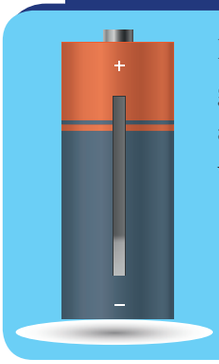
Primary cell

The dry cell commonly used in torches is an example of a primary cell. It cannot be recharged after use.

Secondary cells

Secondary cells are used in automobiles and generators. The chemical reaction in them can be reversed, hence they can be recharged. Lithium cylindrical cells, button cells and alkaline cells are the other types that are in use.

ACTIVITY 3



I am so exhausted. I am going to faint. What first aid will you give me to wake up?

2.3.2. Difference between primary cell and secondary cell

PRIMARY CELL	SECONDARY CELL
1. The chemical reaction inside the primary cell is irreversible	The chemical reaction inside the secondary cell is reversible
2. It cannot be recharged.	It can be recharged
3. Examples of secondary cells are lead accumulator, Edison accumulator and Nickel – Iron accumulator.	It is used to operate devices such as mobile phones, cameras, computers, and emergency lights.
4. Examples- simple voltalic cell, Daniel cell, and lechlanche cell and dry cell	Examples of secondary cells are lead accumulator, Edison accumulator and Nickel – Iron accumulator.

2.3.3. Primary cell – simply Dry cell

A dry cell is a type of chemical cell commonly used in the common form batteries for many electrical appliances. It is a convenient source of electricity available in portable and compact form. It was developed in 1887 by Yei Sakizo of Japan.

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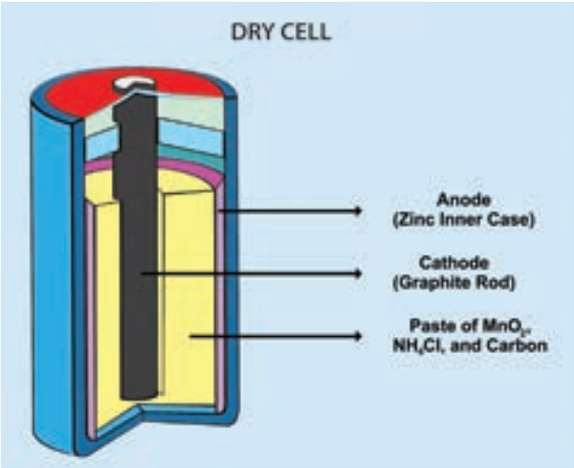


Dry cells are normaly used in small devices such as remote control for T.V., torch, camera and toys.

A dry cell is a portable form of a leclanche cell. It consists of zinc vessel which acts as a negative electrode or anode. The vessel contains a moist paste of saw dust saturated with a solution of ammonium chloride and zinc chloride.

The ammonium chloride acts as an electrolyte.

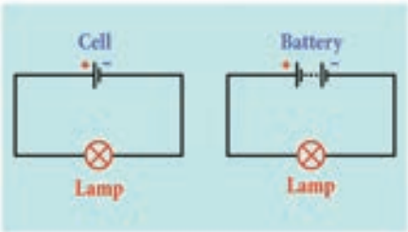
Electrolytes are substances that become ions in solution and acquire the capacity to conduct electricity.

The purpose of zinc chloride is to maintain the moistness of the paste being highly hygroscopic. The carbon rod covered with a brass cap is placed in the middle of the vessel. It acts as positive electrode or cathode.

It is surrounded by a closely packed mixture of charcoal and manganese dioxide (MnO_2) in a muslin bag. Here MnO_2 acts as depolarizer. The zinc vessel is sealed at the top with pitch or shellac. A small hole is provided in it to allow the gases formed by the chemical action to escape. The chemical action inside the cell is the same as in leclanche cell.

The dry cell is not really dry in nature but the quantity of water in it is very small, as the electrolyte is in the from of a paste. In other cells, the electrolyte is usually a solution

2.3.4. Batteries



Batteries are a collection of one or more cells whose chemical reactions create a flow of electrons in a circuit. All batteries are made up of three basic components: an anode (the '+' side), a cathode (the '–' side), and some kind of electrolyte. Electrolyte is a substance that chemically reacts with the anode and cathode.

2.3.5. Invention of the Battery

One fateful day in 1780, Italian physicist, physician, biologist, and philosopher, Luigi Galvani, was dissecting a frog attached to a brass hook. As he touched the frog's leg with an iron scapel, the leg twitched.

Galvani theorized that the energy came from the leg itself, but his fellow scientist, Alessandro Volta, believed otherwise.

Volta hypothesized that the frog's leg impulses were actually caused by different metals soaked in a liquid.

He repeated the experiment using cloth soaked

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in brine instead of a frog corpse, which resulted in a similar voltage. Volta published his findings in 1791 and later created the first battery, the voltaic pile, in 1800.

The invention of the modern battery is often attributed to Alessandro Volta. It actually started with a surprising accident involving the dissection of a frog.

2.4. ELECTRIC SWITCH

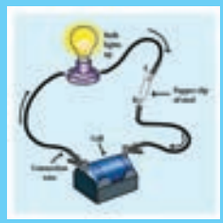
Our country faces a shortage of electricity. So wastage of electricity means you are depriving someone else of electricity. Your electricity bill goes up. So, we must use electricity very carefully and only when it is needed. We must use the electricity as long as we need it in our house hold activities.

Can you remember what you did last year to turn the current on or off?

This time, we shall use a switch to turn the current on or off. You may have used different kinds of switches to turn your household electric appliances on or off. Switches help us to start or stop the appliances safely and easily.

ACTIVITY 4

Make your own switch



Let us make a switch of our circuits. Take 10 cm – long iron strip. Bend it twice as shown in figure. Now drive a nail into the bend of the wooden block. Nail one end of the strip to the other end of the wooden block so that its free end rests just above the first nail without touching it. Your switch is ready.

Would you like to test your switch? To do so, first set up the circuit as shown in the figure.

How would you use the switch to open or close the circuit.

If the bulb in your circuit glows when the metal strip of your switch is pressed on the nail and turns off when it is not, then your switch is working. The switch you made is a simple one. You may have seen many different types of switches on switchboards and appliances at your home and school. The switches are designed according to their usage, convenience and safety. But all of them work on the same principle. Switch is a mechanical component that consists of two or more terminals that are internally connected to a metal strip. Commonly used switches are listed below:

Tapping key		**Toggle switch**		**Illuminated switch**	
Plug key		**Rocker switch**		**Slide switch**	

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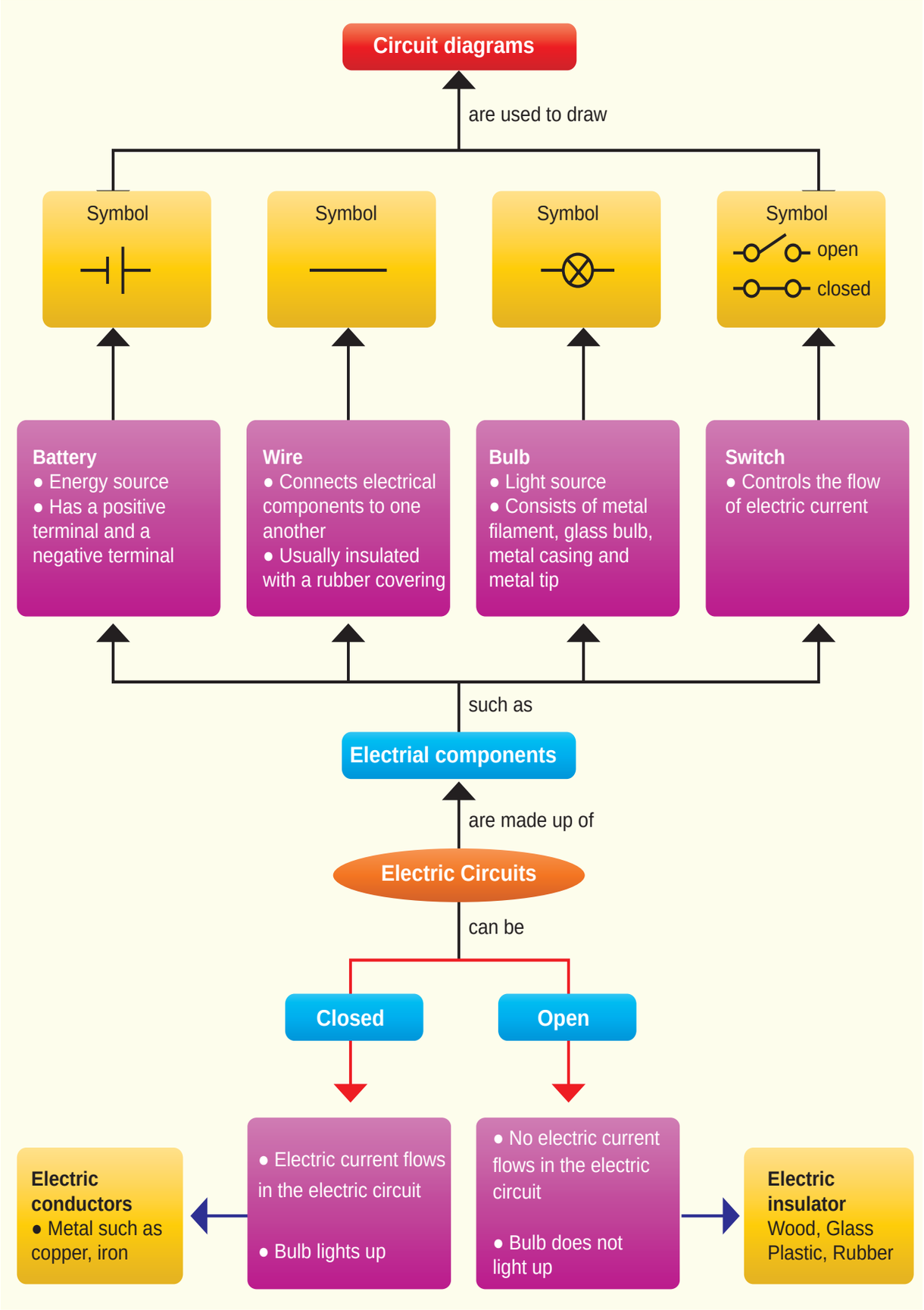

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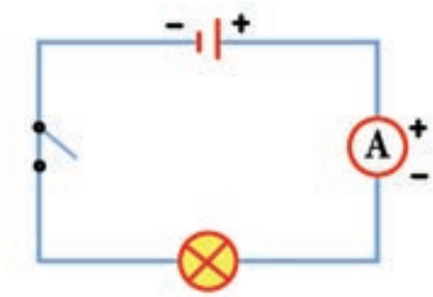
2.5. Electric circuit

It is difficult to draw a realistic diagram of this circuit. The electrical appliances you use at home have even more difficult circuits. Can you draw realistic diagrams of such circuits which contain many bulbs, cells, switches and other components? Do you think it is easy? It is not easy.

Scientists have tried to make the job easier. They have adopted simple symbols for different components in a circuit. We can draw circuit diagrams using these symbols.

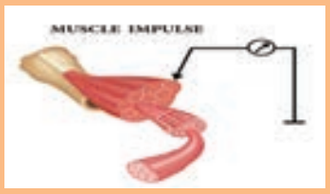
Symbols for bulbs, cells and switches are shown in figure.

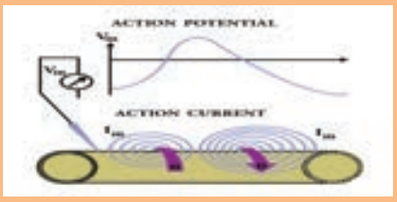


In a cell, the longer line denotes the positive (+) terminal and the short line denotes the negative (-) terminal. We shall use these symbols to show components in the circuits we draw. Such diagrams are called circuit diagrams.

DO YOU KNOW?

All muscles of our bodies move in response to electrical impulses generated naturally in our bodies





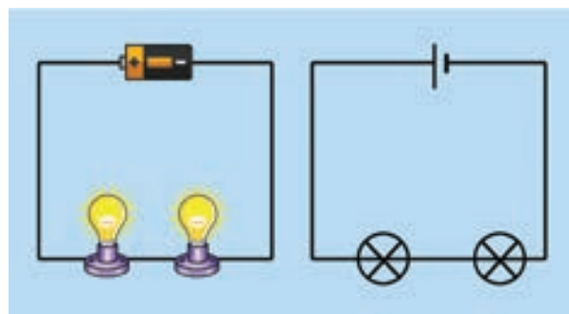
2.5.1. Types of electrical circuits

In the above experiment, we make a circuit with a bulb and a cell. We make only one kind of the circuit with a cell and a bulb. But we can make many types of circuits if we have more than one bulb or cells by connecting these components in different ways .

2.5.2. Series circuit

Two kinds of circuits can be made with two bulbs and a cell. In this experiment we shall make one of them and study it.

Look at the circuit with two bulbs, and a cell and a switch given here (Figure)



It is clear from the circuit diagram, that the two bulbs are connected one after the other. The circuit diagram shows the sequence of the bulbs and cell, not their real position. The way in which the bulbs have been connected in this circuit is called series connection.

Now make the circuit by joining the two bulbs and cell. Do both the bulbs light up? Do both glow equally bright? If one glows less bright, will it shine more brightly if we change its place in the sequence? Change the sequence of bulbs and notice.

Sometimes bulbs appear to be similar can differ from each other. So, similar looking bulb do not always glow equally bright when connected in series. The circuit can be broken at several places. For example, between the cell and the bulb, between the two bulbs etc.

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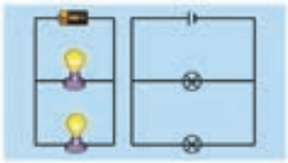
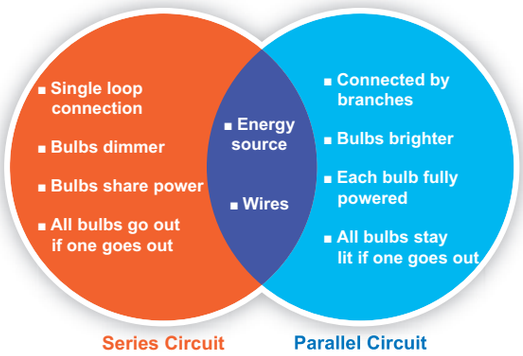
2.5.3 Parallel Circuit

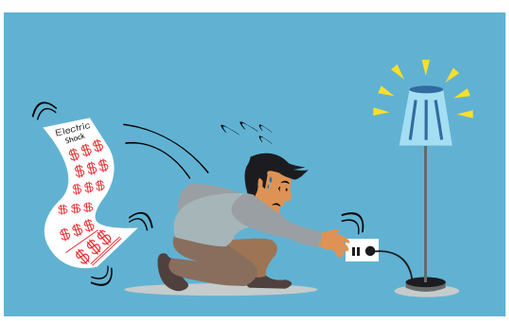
Figure - shows a circuit in which two bulbs are connected in different places. This is a second type of circuit. Two bulbs in this circuit are said to be connected in parallel and such circuits are called parallel circuits.



2.5.4. Similarity and Difference between Series and Parallel Circuit



Science to mind pricking



If an electrician attending an electrical fault at your home gets current shock, will you touch him in order to get rid off him from current risk? Will you use the wet stick to beat him to avoid further effects of electric shock?

Why do the electric line man are wear rubber gloves in their hands while doing electrical works on a electrical pole?

We know that all materials are made up of the basic building block, the 'atom'. An atom, in turn, contains electrically charged particles. Many of these particles are fixed to the atoms but in conductors (such as all metals) there are lots of particles that are not held to any particular atom but are free to wander around randomly in the metal. These are called 'free charge'.

DO YOU KNOW?

Short circuit

You might have observed the spark in the electric pole located nearby your house. Do you know the cause of this electric spark? This is due to the short circuiting of electricity along its path.A short circuit is simply a low resistance connection between the two conductors supplying electrical power to any circuit.

Arc welding is a common example of the practical application of the heating due to a short circuit.

2.6. Conductors And Insulators

Based on the property of conductance of electricity, substances are classified into two types, namely, Conductors and Insulators (or) bad conductors of electricity

T8Y1E1

The electrons of different types of atoms have different degrees of freedom to move around. With some types of materials, such as metals, the outermost electrons in the atoms are loosely bound and they chaotically move in the space between the atoms of that material. Because these virtually unbound electrons are free to leave their respective atoms and float around in the space between adjacent atoms, they are often called as free electrons.

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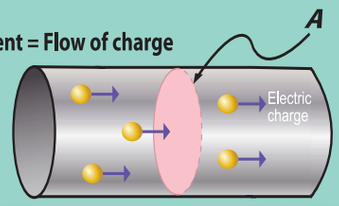
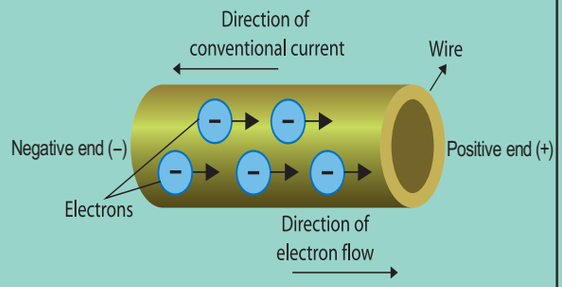
Electricity

Electric current is the flow of electric charges, typically through wires, conductors and electric devices

Current = Flow of charge



Conventional current and Electric current



Conventional current

Conventional current flow is from positive (`+`) to negative (`-`)

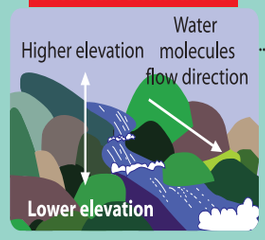
Electric current

Electric current flow is from (`-`)negative to (`+`) positive

Electric current I = Q/t

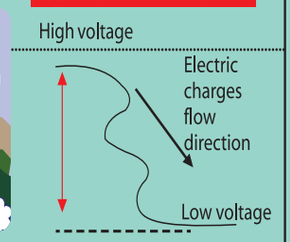
Water current vs electric current - Analogy

Water current in a river



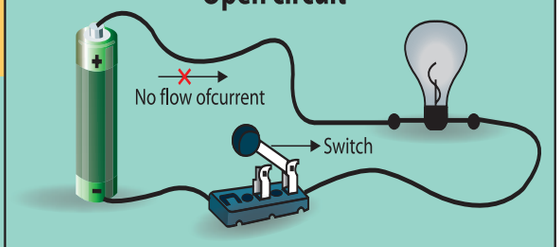
water molecules flow towards a point of lower elevation

Electric current in a wire



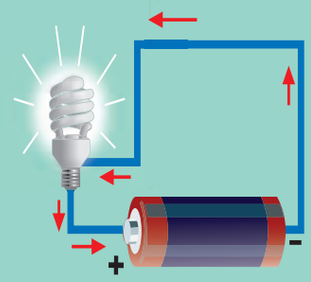
Electric charges flow towards a point of lower voltage

Open circuit



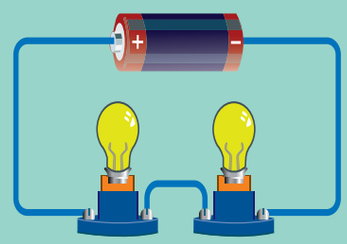
An incomplete electrical circuit in which no current flows

Closed circuit



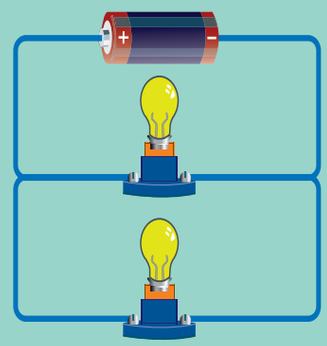
An electric circuit providing an uninterrupted endless path for the flow of current

Series circuit



Circuit that has only one closed path through which the electric current flows

Parallel circuit



Circuit that Offers more than one path for the flow of electric current

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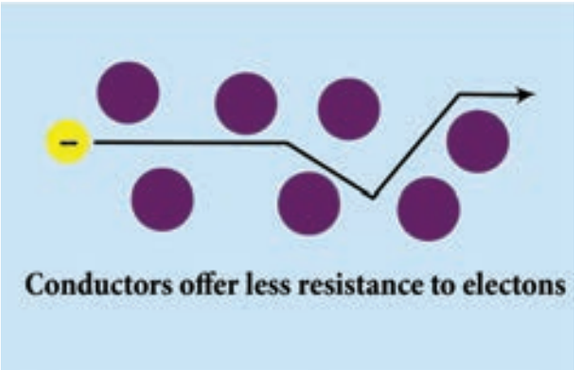
Let's imagine that we have a metal in the form of a wire. When a voltage is connected across the ends of the metal wire, the free electrons drift in one direction.

So, a really good conductor is one that has lots of free charges while those who don't have enough 'free charges' would not be good at conducting electricity or we can say that they would be 'poor conductors' of electricity.

2.6.1. Conductors

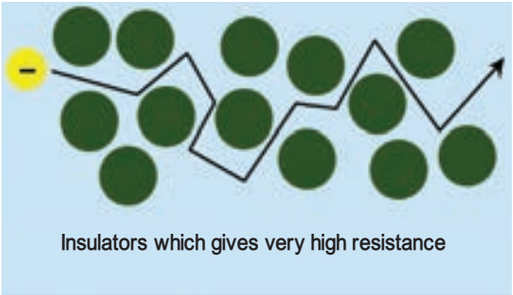
Conductors are the materials whose atoms have electrons that are loosely bound and are free to move through the material. A material that is a good conductor gives very little resistance to the flow of charge (electron) on the application of external voltage. This flow of charge (electron) is what constitutes an electric current. A good conductor has high electrical conductivity in the above activity.



In general, more the free electrons, the better the material will conduct (for a certain applied voltage).

2.6.2. Insulators

Those materials which don't have enough 'free electrons' are not good at conducting electricity or we can say that they would be 'poor conductors' of electricity and they are called insulators.



DO YOU KNOW?

This is the material used in SIM Cards, Computers, and ATM cards. Do you know by which material I am made up off?

The chip which are used in SIM Cards, Computers, and ATM cards are made up of semiconductors namely, silicon and germanium because of their electrical conductivity lies between a conductor and an insulator.

An insulator gives a lot of resistance to the flow of charge (electron). During the drift of the electrons in an object when an external voltage is applied, collisions occur between the free electrons and the atoms of the material also affect the movement of charges. These collisions mean that they get scattered. It is a combination of the number of free electrons and how much they are scattered that affects how well the metal conducts electricity. The rubber eraser does not allow electric current to pass through it. So rubber is a non-conductor of electricity. Rubber is an insulator

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Most of the metals are good conductors of electricity while most of the non-metals are poor conductors of electricity.

DO YOU KNOW?

Wires made of copper, an electrical conductor, have very low resistance. Copper wires are used to carry current in households. These wires are in turn enclosed in electrical insulators, or materials of high electrical resistance. These materials are usually made of flexible plastic.

2.7.Effects of Electric Current

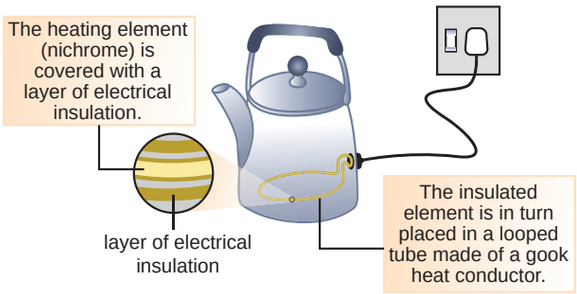
X4Z4Z6

You performed many experiments with electricity in Class 6 and learned quite a few interesting facts. For example, you saw that a bulb can be made to light up by making electricity flow through it. The light of the bulb is thus one of the effects of electricity. There are several other important effects of electricity. We shall study some of these effects in this chapter. There are 3 main effects of electricity as,

- Heating effect
- Magnetic effect (Magnetism)
- Chemical effect

2.7.1.Heating effect

When an electric current passes through a wire, the electrical energy is converted to hear. In heating appliances, the heating element is made up of materials with high melting point. An example of such a material is nichrome (an alloy of nickel, iron and chromium).



The heating effect of electric current has many practical applications. The electric bulb, geyser, iron box, immersible water heater are based on this effect. These appliances have heating coils of high resistance.

Generation of heat due to electric current is known as the heating effect of electricity.

Factors affecting Heating Effect of current

1. Electric Current
2. Resistance
3. Time for which current flows

Electric Fuse

Electric fuse is a safety device which is used in household wiring and in many appliances. Electric fuse has a body made of ceramic and two points for connecting the fuse wire. The fuse wire melts whenever there is overload of the current in the wire. This breaks the circuit and helps in preventing damage to costly appliances and to the wiring. In electrical devices, a glass fuse is often used. This is a small glass tube, in which lies the fuse wire.

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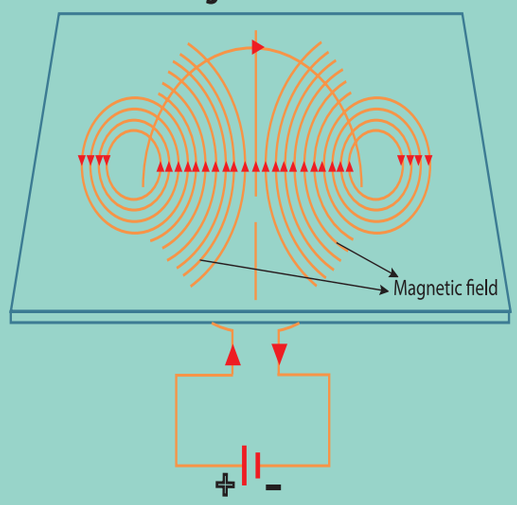
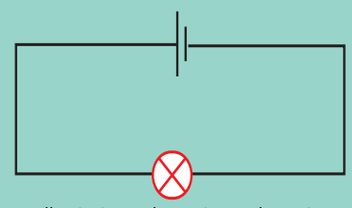
Effects of Electric current

Magnetic effect



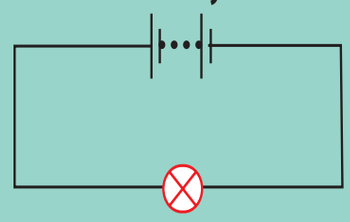
Production of magnetic field when the current flows through the coil of wire

Cell



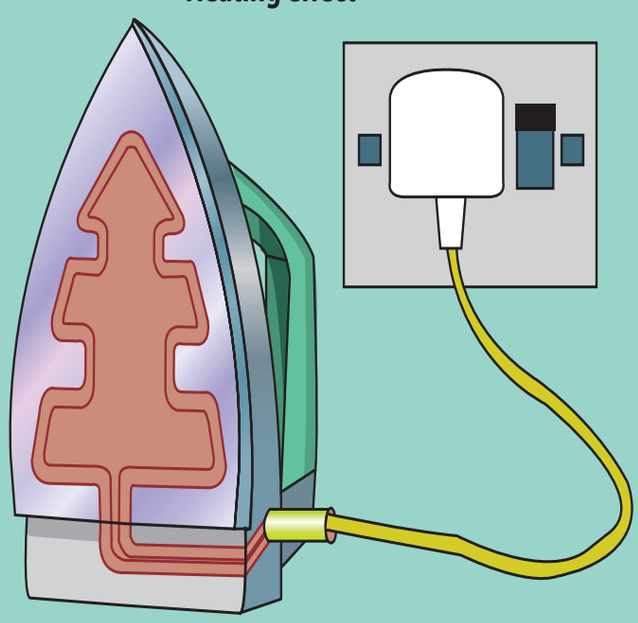
Cell is the basic electrochemical unit that converts chemical energy into electrical energy

Battery



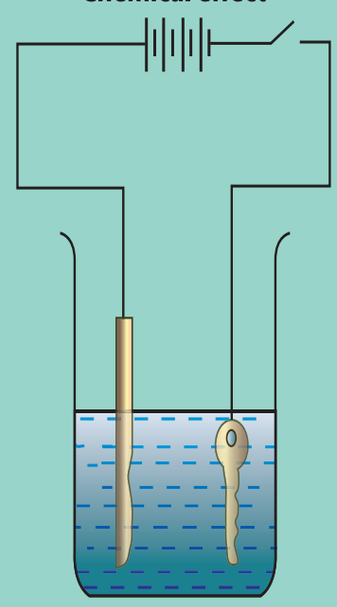
Baterry is a group of cells

Heating effect



Prodction of heat by flow of electric current in a circuit

Chemical effect



Chemical reaction happens when electricity passes through various conducting liquids

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MCBs (Miniature Circuit Breaker)

MCBs have been replacing electric fuse from wirings at most of the places. The electric fuse has a big practical problem. Whenever the wire fuses, one needs to replace the wire to resume electric supply. More often than not, this proves to be a cumbersome task. Miniature circuit breakers break the circuit automatically. One just needs to switch it on to resume the electric supply. Many models of MCBs have a built in mechanism by which the electric supply is automatically resumed.

2.8. Magnetic Effect of electricity

The next effect of electric current is Magnetism. In 1819, Hans Christian Oersted discovered the electricity that has a magnetic effect. The experiment in activity-5 will help you understand the magnetic effect of electric current.

2.8.1. Application of magnetic effect of electric current - Electromagnet

Magnetic effect of electric current has been used in making powerful electromagnets. Electromagnets are also used to remove splinters of steel or iron in hospitals dealing with eye injuries.

Electro magnets are used in many appliances that we use in our day to day life, namely, electric bell, cranes and telephone. Let us know how the magnetic effect of electric current is applied in telephones.

ACTIVITY 5

Materials required

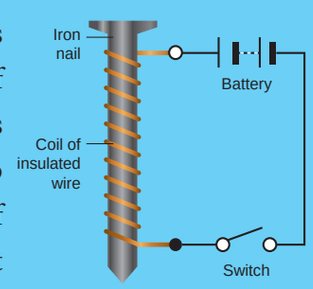
- Iron nail
- Battery & Switch
- Wire

Take around 75 cm long piece of insulated flexible wire and an iron nail say about 8 - 10 cm long. Wind the wire tightly around the nail in the form of a coil. Connect the free ends of the wire to the terminals of a cell as shown. Place some pins on or near the end of the nail. Now switch on and switch off the current, What happens?

When the switch is kept in on position the pins starts to cling to the end of the nail.

When the electric current is switched off the coil generally loses its magnetism. Such coils are called as electromagnets.

The polarities of both ends of the coil changes according to the direction of electric current passes.



2.8.2. Telephone

In telephones, a changing magnetic effect causes a thin sheet of metal (diaphragm) to vibrate. The diaphragm is made up a metal that can be attracted to magnets.

1. The diaphragm is attached to spring that is fixed to the earpiece.
2. When a current flows through the wires, the soft – iron bar becomes an electromagnet.

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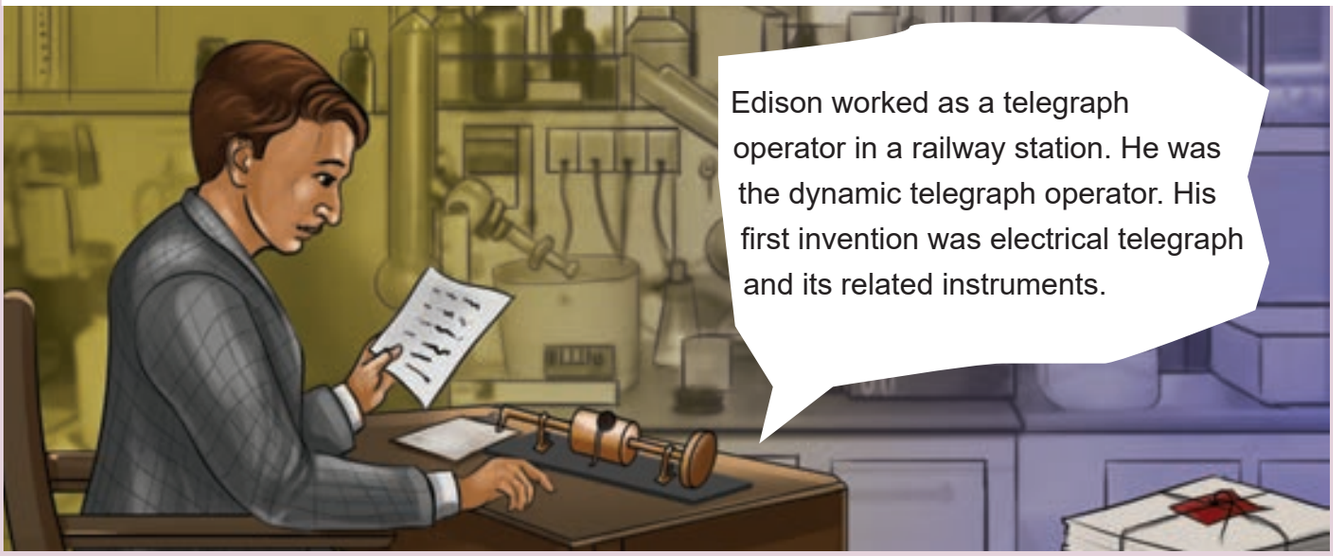
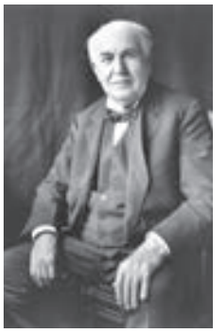
The world comes to brightness

Thomas Alva Edison (1847-1931)

Thomas Alva Edison was affected by scarlet fever and hence he joined the school at Fort Huron in America only at the age of eight.

After leaving the school, his mother who was a teacher taught lessons at home for three years.





He invented an advanced instrument Gramophone in 1877.

He used a platinum wire coil in a vacuum glass and discovered the first electric bulb in 1879.

Thomas Alva Edison invented a commercially viable electric bulb. This was exhibited in 1897

By using mechanical power in a battery, electric power was generated by providing the voltage. Edison proved that voltage is given in the ends of battery. The same was transferred into an electric motor which provided mechanical energy.

By extending Kinetoscope into 50 feet film strip, he made first talkie film by using electric motor and magnifying glass in 1891.

As a mark of respect to Edison on his death, the light of “Statue of Liberty” in New York was turned off. Except the road lights of Chicago and Broadway, all the lights in the city were turned off.

Edison was an American Scientist and Industrialist. He invented many instruments like Electric bulb, electric motor, gramophone and kinetoscope. He was known as for taking the world of darkness to brightness crossing all the obstacles in life.

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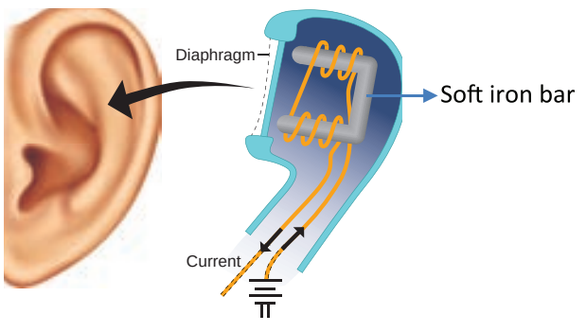
3. The diaphragm becomes attracted to the electromagnet.
4. As the person on the other end of the line speaks, his voice cause the current in the circuit to change. This causes the diaphragm in the earpiece to vibrate, producing sound.



2.9. Chemical Effects of Electricity

Chemical reactions happens, when electricity passes through various conducting liquids. This is known as chemical effects of electricity. You will learn chemical effect of electricity in your higher classes.

POINTS TO REMEMBER

- An electric current is a flow of electric charge or the amount of charge flowing through a given cross section of a material in unit time.
- Conventional current is in the direction opposite to electron flow.
- One ampere is defined as the flow of electric charge across a surface at the rate of one coulomb per second.
- An electric cell is something that provides electricity to different devices that are not fed directly or easily by the supply of electricity
- A dry cell is a portable form of a leclanche cell
- Batteries are a collection of one or more cells whose chemical reactions create a flow of electrons in a circuit
- The cell is the basic single electrochemical unit which converts chemical energy to electrical energy.
- Ammeter — An instrument for measuring the flow of electrical current in amperes. Ammeters are always connected in series with the circuit to be tested.
- Ampere (A) — A unit of measure for the intensity of an electric current flowing in a circuit. One ampere is equal to a current flow of one coulomb per second.
- Circuit — A closed path in which electrons from a voltage or current source flow. Circuits can be in series, parallel, or in any combination of the two.
- Current (I) — The flow of an electric charge through a conductor. An electric current can be compared to the flow of water in a pipe. Measured in ampere.
- Fuse — A circuit interrupting device consisting of a strip of wire that melts and breaks an electric circuit if the current exceeds a safe level.
- Conductor — Any material where electric current can flow freely. Conductive materials, such as metals, have a relatively low resistance. Copper and aluminum wire are the most common conductors
- Insulator — Any material where electric current does not flow freely. Insulation materials, such as glass, rubber, air, and many plastics have a relatively high resistance. Insulators protect equipment and life from electric shock.

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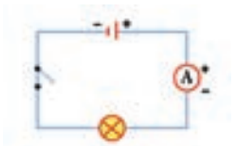
- Parallel Circuit — A circuit in which there are multiple paths for electricity to flow. Each load connected in a separate path receives the full circuit voltage, and the total circuit current is equal to the sum of the individual branch currents.
- Series Circuit — A circuit in which there is only one path for electricity to flow. All of the current in the circuit must flow through all of the loads.
- Short Circuit — When one part of an electric circuit comes in contact with another part of the same circuit, diverting the flow of current from its desired path.
- One unit of coulomb is charge of approximately 6.242×10^{18} protons or electrons.
- The potential difference between any two points is the amount of energy needed to move one unit of electric charge from one point to the other.
- Electrical conductivity or specific conductance is the measures a material's ability to conduct an electric current
- Electrical resistivity is the property of a material that quantifies how strongly that material opposes the flow of electric current.
- The sources which produce the small amount of electricity for shorter periods of time is called as electric cell or electro chemical cells.
- Electrolytes : A substance that dissociates into ions in solution and acquires the capacity to conduct electricity. Sodium, potassium, chloride, calcium, and phosphate are examples of electrolytes.

EVALUATION

I. Choose the correct answers

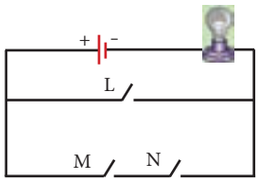
M6Z8D1

1. In the circuit diagram below, 10 units of electric charge move past point x every second What is the current in the circuit ----------



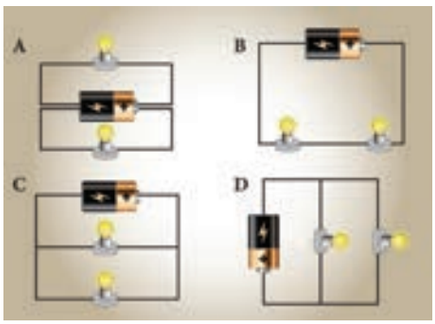
   a) 10 A b) 1 A
   c) 10 V d) 1 V

2. In the circuit shown, which switches (L,M or N) must be closed to light up the bulb?



   a) switch L only
   b) switch M only
   c) Switch M and N only
   d) either switch L or switches M and N

3. Small amounts of electrical current are measured in milliampere (mA). How many milliampere are there in 0.25 A ?
   a) 2.5 mA b) 25 mA
   c) 250 mA d) 2500 mA
4. In which of the following circuits are the bulb connected in series?



II. Fill in the blanks.

1. The direction of conventional current is ---------- to electron flow.

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2. One unit of coulomb is charge of approximately ---------- protons or electrons.
3. ---------- is used to measure the electric current.
4. In conducting materials electrons are ---------- bounded with atoms.
5. S.I. unit of Electrical conductivity of a conductor is ----------

III. True or False – If False give the correct answer

1. Electron flow is in the same direction to conventional current flow.
2. The fuse wire does not melts whenever there is overload in the wiring.
3. In a parallel circuit, the electric components are divided into branches.
4. The representation of the electric current is A.
5. The electrical conductivity of the semiconductor is in between a conductor and an insulator.

IV. Match the following

1.	Cell	-	used to open or close a circuit
2.	Switch	-	safety device used in electric circuit
3.	Circuit	-	A complete path for the flow of an electric current
4.	Miniature circuit Breaker	-	Reset by hand, circuit becomes complete once again
5.	Fuse	-	A device which converts chemical energy into electrical energy

V. Analogy

1. Water : pipe :: Electric current :----------
2. Copper : conductor :: Wood : ----------
3. Length : metre scale :: Current : ----------
4. milli ampere: micro ampere :: 10^{-3}A : ------

VI. Assertion and Reason

1. Assertion (A) : Copper is used to make electric wires.

   Reason (R) : Copper has very low electrical resistance.

   Option:

   A. Both A and R are true and R is the correct explanation of A.

   B. Both A and R are true but R is NOT the correct explanation of A.

   C. A is true but R is false.

   D. A is false but R is true.

   E. Both A and R are false

2. Assertion (A): Insulators do not allow the flow of current through themselves.

   Reason (R) : They have no free charge carriers.

   A. If both A and R are true and the R is correct explanation of A.

   B. If both A and R are true but R is not a correct explanation of A.

   C. If A is true and R is false.

   D. If both A and R are false.

VII. Very short answer

1. What is the speed of electric current?
2. What is the S.I unit of electrical conductivity?
3. Name the device used to generate electricity.
4. Define fuse.
5. Name some devices that run using heat effect of electric current
6. Name few insulators.
7. What is a battery?

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VIII. Short Answer

1. Define an electric current.
2. Differentiate parallel and serial circuits.
3. Define electrical conductivity.

IX. Long Answer

1. Explain the construction and working of an Telephone.
2. Explain the heating effect of electric current.
3. Explain the construction and working of a dry cell.

X. Higher Order Question

A student made a circuit by using an electric cell, a switch, a torch bulb (fitted in the bulb holder) and copper connecting wires. When he turned on the switch, the torch bulb did not glow at all. The student checked the circuit and found that all the wire connections were tight.

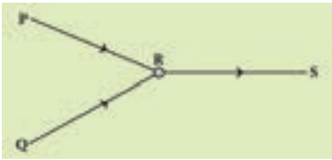
- ❖ What could be the possible reason for the torch bulb not glowing even when the circuit appears to be complete?

XI Picture based Questions

1. Three conductors are joined as shown in the diagram

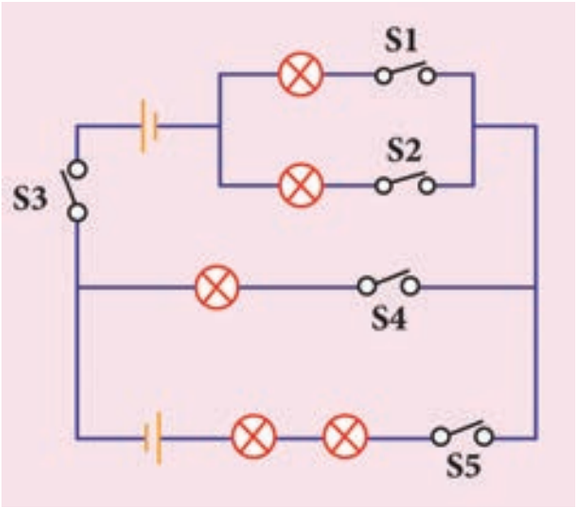
The current in conductor RS is 10 A. The current in conductor QR is 6 A. What will be the current in conductor PR

a) 4 A
b) 6 A
c) 10 A
d) 16 A

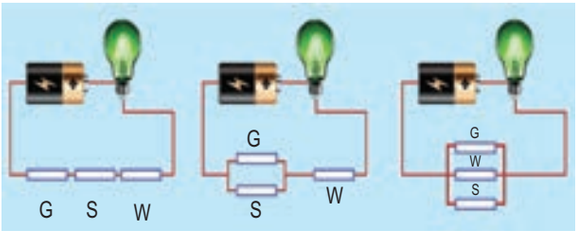


2. Draw the circuit diagram for the following series connection

3. Study the electric circuit below. Which of the following switches should be closed so that only two bulbs will light up
   a) S1,S2 and S4 only
   b) S1, S3 and S5 only
   c) S2, S3 and S4 ony
   d) S2, S3 and S5 only



4. Study the three electric circuits below. Each of them has a glass rod (G), a steel rod (S), and a wooden rod (W).
   In which of the electric circuits would the bulb not light up .
   a) A only b) C only
   c) A and B only d) A , B and C



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ICT CORNER

ELECTRICITY

This activity helps the students to understand about the Parrellel and series circuit

PROCEDURE :

Step 1: Type the URL link given below in the browser or scan the QR code. A page opens with a battery , some cables, two sets for circuit and two bulbs.

Step 2: Ask the students to fix the wires to the battery and the circuit

Step 3: Let the students do it and understand the concept with different combinations

Step 1

Step 2

Step 3

Electricity URL:

http://www.physics-chemistry-interactive-flash-animation.com/electricity_electromagnetism_interactive/components_circuits_association-series_parallel.htm

*Pictures are indicative only

*If browser requires, allow Flash Player or Java Script to load the page.

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Unit	Titles	Page No.	Month
1.	Light	1	January
2.	Universe and Space	24	February
3.	Polymer Chemistry	42	February
4.	Chemistry in Daily Life	65	March
5.	Animals in Daily Life	81	March
6.	Visual Communication	93	April

Q9R2V2
E - book

Z1Z1F1
Assessment

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DIGI links

Lets use the QR code in the text books ! How ?
- Download the QR code scanner from the Google PlayStore/ Apple App Store into your smartphone
- Open the QR code scanner application
- Once the scanner button in the application is clicked, camera opens and then bring it closer to the QR code in the text book.
- Once the camera detects the QR code, a url appears in the screen.Click the url and goto the content page.

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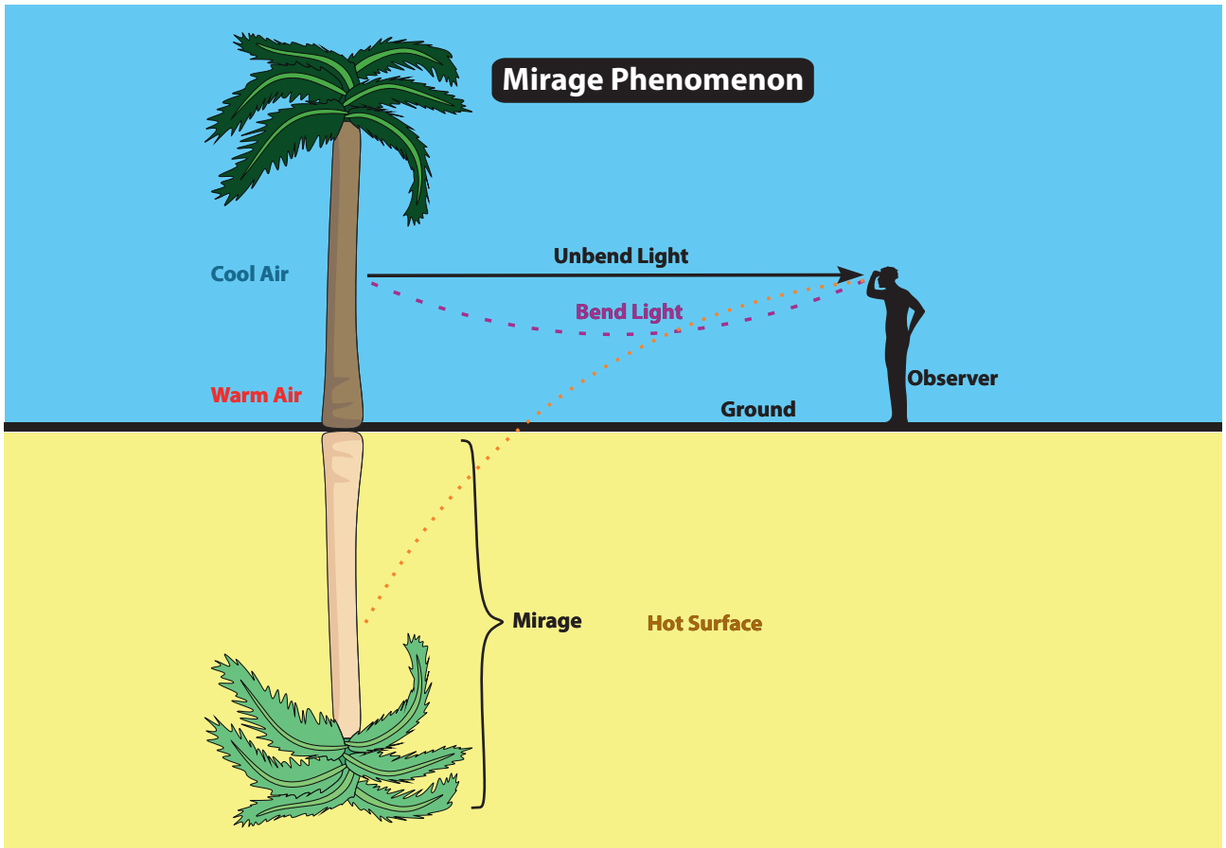
Unit 1

Light



Learning Objectives

The students will be able to

- understand that light is an energy
- differentiate natural and artificial light sources
- understand rectilinear propagation of light
- understand formation of shadows
- know reflection of light and its types
- know the laws of reflection
- understand the properties of the images formed in a plane mirror
- understand dispersion and spectrum
- understand synthesis of colors

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Introduction

When you enter into a dark room, nothing is visible. The moment you switch on the light, everything in the room becomes visible. How do we see things with our eyes? When you look at this book, the light falling on the book is reflected and enters your eyes. Light is a type of energy that helps us to see all the things around us. Light can be detected by the human eye. We all know that light is essential for vision. Let us see more about light in this chapter

DO YOU KNOW?

Light is the only source of energy for plants. So, they entirely depend on light. People and animals derive energy from carbohydrates, protein and fat through their food. Plants produce food using the energy from Sun light, carbon-di-oxide and water by the process called as Photosynthesis. Sun light acts a vital role in the process of photosynthesis.

Sources of Light.

Objects which are able to emit light are known as light sources. Light rays can come from different sources. There are two types of sources of light.

1. Natural sources of light
2. Artificial sources of light

G5L3R8

Natural Sources of light

Sources which emit light naturally are known as natural sources of light. The Sun is the primary and the major source of natural light. Stars also produce light, in the same way as the Sun do. However, as they are much farther away than the Sun, the light from them are too weak. The moon provides light, particularly in the night. Some living organisms have the ability to produce light named by bioluminescence. It is the effect of certain chemical reactions occurring in the organism. Fireflies, jellyfish, glow worm, certain deep sea plants and some microorganisms can emit light naturally.

Artificial Sources of light

Apart from the natural sources, light can also be produced artificially. The different light sources that are able to produce light artificially can be put under three broad categories.

DO YOU KNOW?

Is the moon a luminous object?

The moon provides light as well, but it cannot produce light by its own. The light emitted by the Moon is the light of the Sun reflected towards the Earth. When we see the Moon, we see only the Moon's lighted part. Thus, half of the moon is always facing the Sun and receiving light from it. Hence, we receive light from the moon.

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Artificial sources are man – made light sources such as flame of candle, incandescent lamp, neon lamp, Sodium lamp etc.

1. Incandescent Sources: When certain objects are heated to a high temperature, they begin to emit light. The glowing of hot iron rod is a kind of Incandescent light.

Example: Candle, incandescent lamp.

2. Gas Discharge Sources: Passing electricity through certain gases at a very low pressure (discharging) can produce light .

Example: Neon lamp, Sodium lamp

DO YOU KNOW?

We often use a kind of gas-discharge lamp that uses fluorescence to produce visible light. The electric current in the gas excites mercury vapour, which produces short-wave ultraviolet light that then causes a phosphor coating on the inside of the lamp to glow in visible light.

Properties of light

In this section, we shall examine some properties of light. Light has some fundamental properties as mentioned below

- ❖ Rectilinear propagation of light
- ❖ Reflection
- ❖ Speed
- ❖ Interaction of light with matter
  - Types of material according to permeability
  - Formation of shadows
  - Plane mirror and images
- ❖ Spectrum

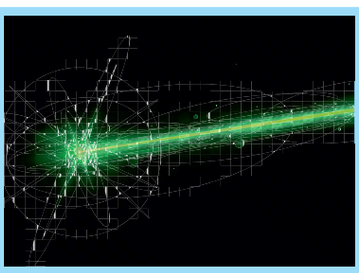
The path of light

How does light travel?

- Have you ever seen the scene of light penetrating through the branches of trees in denser forest?
- Have you ever seen the path of sun light entering through the hole of a cement grill building?
- Have you ever seen the path of a laser light?

Light penetration through trees

Light travels through the holes in cement grill



Laser beam

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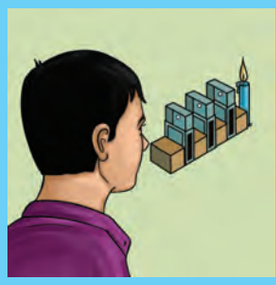
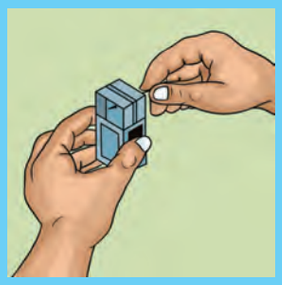
ACTIVITY 1

Requirement: Three empty match boxes, pin, candle and wooden blocks.





Procedure: Arrange empty match boxes and wooden blocks as shown in the figure. First, you make a hole in the inner tray of each match box such that all three holes are in the same spot. Arrange the match boxes as shown in figure. Now, adjust the three inner trays in such a way that the three holes are in a straight line. Place a lighted candle at one end of this arrangement and try to see the flame of candle from a hole at the other end. Is the flame visible?

Now, arrange the trays such a way that they are not at the same height. Try to see the flame. Is it visible? What does this activity tell you about the path of light?

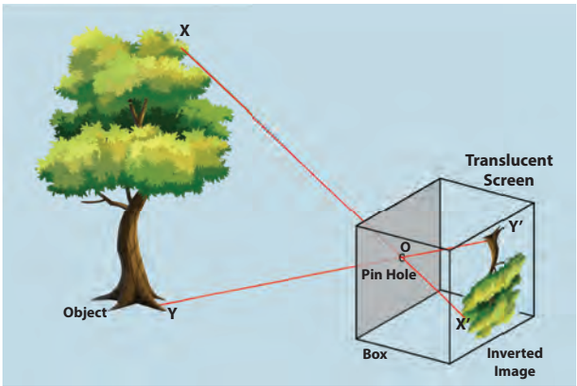
Light travels in straight line, it cannot bend the path itself. This is called as the *rectilinear propagation of light*. This is one of the most important property of light.

DO YOU KNOW?

Al-hasan -Haytham was a scientific thinker who made important contribution to the understanding of vision, optics and light. He observed that light coming through a tiny hole travelled in straight lines and projected an image onto the opposite wall. Based on such experimentation, he concluded that vision is accomplished by rays coming from external luminous sources and entering the eye, rather than through rays emitted from the eye as was then commonly believed. He is the first one to experiment with light and found important properties like the rectilinear propagation of light.

Pinhole Camera

Pin hole camera is a simple device which helps us to understand about the rectilinear propagation of light



The above picture shows a model of a pin – hole camera. O is small hole by a pin. XY is the object and Y'X' is the image of XY. As light travels in straight line, one light ray from X travels along the XO strikes the screen X'.

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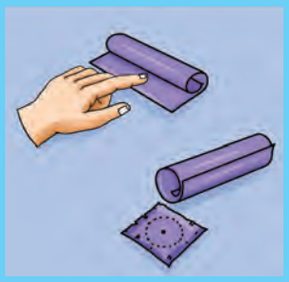
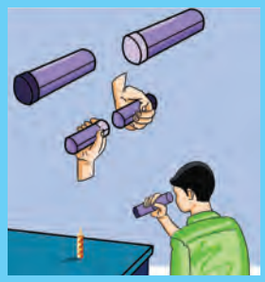
ACTIVITY 2

Make your pin-hole camera

Requirement : Two rectangular pieces of thick paper, carbon paper, a semi-transparent paper, adhesive





Procedure : Make two tubes using thick paper as shown in figure. One tube should be slightly smaller in diameter so that it can slide into the other tube without leaving much gap between the tubes. Fix a carbon paper to one side of the tube of greater diameter. Make a hole with a pin at the center of the carbon. Close one end of the second tube with the butter paper. Slide the smaller tube into the bigger one such a way that the butter paper is inside. Keep a lighted candle on a table and look through the hole with black side towards the candle. If you go closer to the candle, you will see a smaller, but brighter image. You can also change the image size by adjusting the tubes.

Use the pin-hole camera to see things in sun light outside the window and see how good an image you get. What are your observations about the image? Is it straight, inverted, bright and sharp?

In similar way, another light ray staring from Y and travels along YO strikes the screen Y'. Similarly, all the rays in between X and Y fall on the screen between Y' and X'. Thus Y'X' becomes the image of XY. The image produced is temporary, if a simple paper is used. The image can be made permanent if the paper is replaced by a photographic plate.

Reflection

L8C1X8

A mirror reflects our face. A still water body like a pond reflects the scenery around it. When we see our face in the mirror, we see the light rays from our face bouncing off the surface of the mirror. How the rays of the light are reflected?

Take a plane mirror. Cover it with black paper. Cut a small slit as shown in the figure. If

DO YOU KNOW?

Before the advancement of camera, Pinhole camera was used to photograph movement of the sun over a long period of time. This type of photography is known as ***solography*** and also be used for observing and recording solar eclipses. And it was also used to take photograph of stationary objects.

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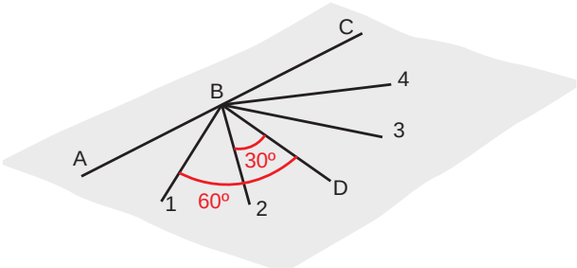
you shine light on the mirror from a torch light or sunlight, you will get a small ray of light. We can use this to study the properties of light.



Place a blank white sheet on a level ground out in the open. Choose a place where partly the sheet gets sunlight and partly it is in shadow. Hold the mirror with the slit facing the sun. You can see a straight ray of light reflected from the slit on the paper. Hold another mirror to reflect this ray. Observe well.

The light falling on the mirror is called as incident ray and the light reflected is called reflected ray..

Is there any relationship between the incident ray and reflected ray?

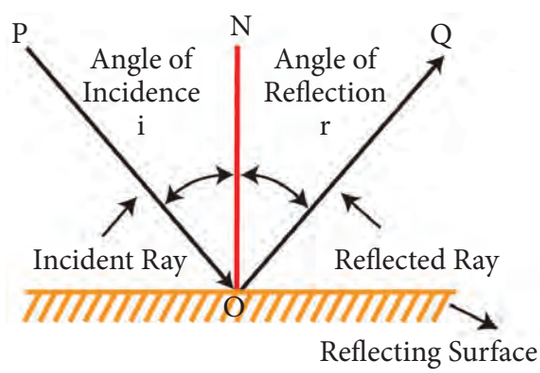
Draw a straight line ABC and angles as shown in the figure above. The line 1 is at 60° from BD, 2 at 30° from BD. Now , the line 4 at 60° from BD and line 3 at 30° from BD. The line BD is perpendicular, to ABC. Hold the mirror along the line ABC. Use the mirror with slit and make a ray go along the line 1 and reach the mirror at point B. Observe where the reflected ray is? Is the reflected ray go along 4?

Now, try keeping the mirror with slit and make the incident ray go along line 2. Now do we see that the reflected ray is along line 3?

Line BD, which is perpendicular the mirror surface is called as normal. The angle between the incident ray and the line BD is called angle of incident. Similarly, the angle between reflected ray and the normal is called as angle of reflection.

Can you make out relationship between the angle of incident ray and the angle of reflected ray? Yes. Is it not obvious that the angle of incident is same as the angle of reflection?

Terms used in reflection of light.



Incident ray: The ray of light that falls on the surface of the reflection materials. In figure, PO is the incident ray.

Reflected ray: The ray of light that comes from the point when the incident ray falls on the reflection material. In the figure, OQ is the reflected ray.

Point of incidence : The point of which are incident ray strikes the reflecting surface is the point of incidence. In the figure 'O' point of incidence.

Normal : The perpendicular line drawn from the point of incidence to the plane of reflecting surface is called normal. In figure, ON is the normal.

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Angle of incidence: The angle formed between the incident ray PO and the normal 'ON' is angle of incidence. It is denoted by ∠i

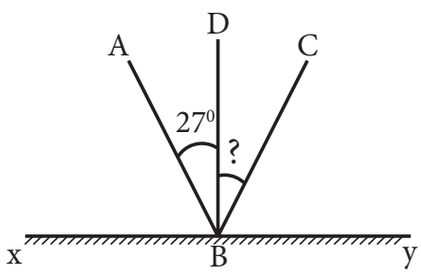
Angle of reflection: The angle formed between the reflected ray OQ and the normal ON is angle of reflection. It is denoted by ∠i

Laws of reflection:

1. The angle of incidence is always equal to the angle of reflection. ∠i = ∠r
2. The incident ray, the reflected ray and the normal at the point of incidence lie on the same plane.

Example 1

In the figure, the incident ray makes 27° with the normal, then find the angle of reflection.



Solution:

Angle of incidence = 27°

∴ According to the laws of refelection, the angle of refelection = Angle of incidence = 27°

Example 2:

A light ray strikes a reflective plane surface at an angle of 43° with the plane surface.

i. Find the angle of incidence.

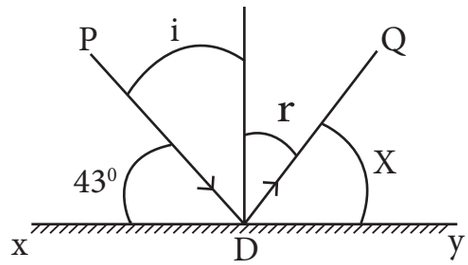
ii. Find the angle of reflection.

iii. Find the angle between the incident and the reflected ray

iv. Find the angle between the reflected ray and the plane surface.

Solution:

We use the diagram shown below to answer the questions.



a) Angle of incidence: i = 90 -43 = 47 °

b) angle of reflection r = i = 47°

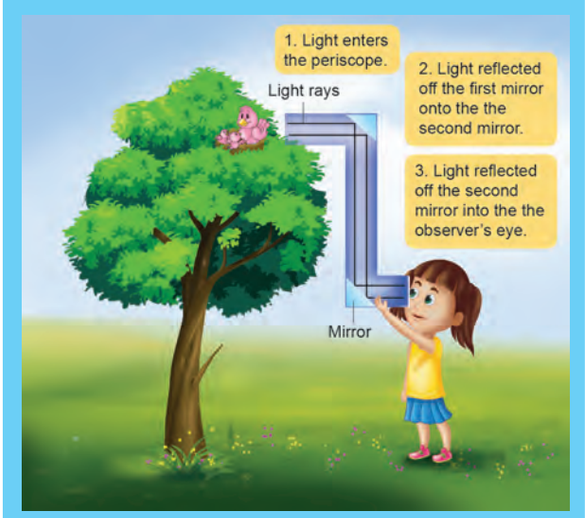
c) i + r = 47 + 47 = 94 °

d) x = 90 - r = 90 - 47 = 43 °

ACTIVITY 3

Make your own periscope : You can use an empty agarbathi box and two plane mirrors to make a periscope.

As shown in the figure below, two plane mirrors are kept 45 degrees to horizontal.



As shown the figure above, the light rays from the distant object enter through the tube at 1, and hit the mirror at 2. As the angle of incident must be equal to angle of reflection, the reflected rays flow through the tube downwards. As the light rays hit the mirror at 3 once again they are reflected. This reflected rays then travel out of the box to our eye. As you can see, periscope uses the laws of reflection.

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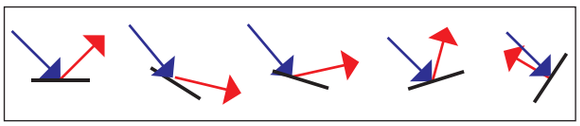
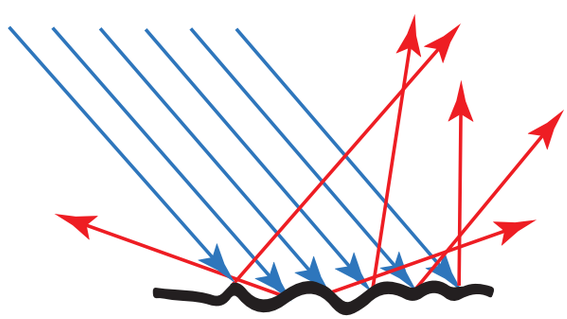
Types of reflection

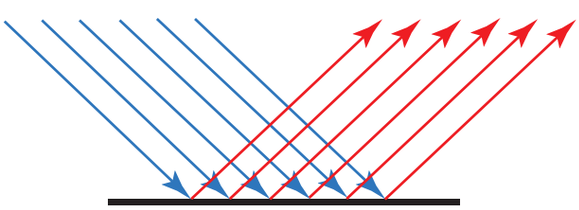
On a mirror we can see our image, but not on the wall. Why? Both the surface reflects light. Only because the reflected light comes to our eyes, we are able to see it. If the wall was not reflecting light, then we cannot see it.



We saw earlier that the light reflects off surfaces in a very predictable manner, in accordance with the law of reflection. The laws of reflection holds good for all surfaces irrespective of the shape. Vertical surfaces, angled surfaces, and even over the curved surfaces, the laws of reflection holds good. As long as we can draw the normal, perpendicular to the surface at the point can be drawn, the angle of incidence at that point will be equal to angle of reflection.



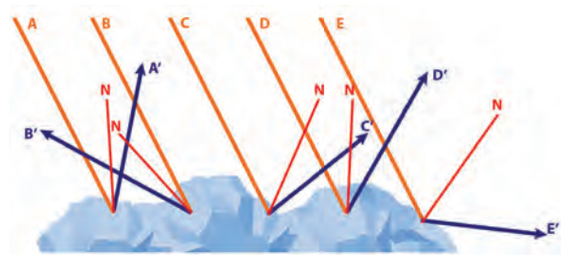
Diffuse Reflection
(Rough surface)



Specular Reflection
(Smooth surface)

The law of reflection is always observed regardless of the orientation of the surface. If the surface is smooth, and flat, all points on it have the normal in the same direction. Therefore a set of parallel rays striking the surface will be reflected at an angle, but the rays themselves will still remain parallel to each other.

However ,consider a surface which is not smooth. Such as the surface of a wall. What happen when the light ray hits the rough surface? Roughness of the wall means that each individual ray meets a surface which has a different orientation. The diagram below depicts the case. Five incident rays labelled as A, B, C, D and E approach a surface. The normal line at each point of incidence is shown in black and labelled with an N. In each case, the law of reflection is followed, resulting in five reflected rays labelled A', B', C', D', and E'. While the incident rays were parallel to each other, the reflected rays are going in different directions. The result is that the rays of light are incident upon the surface in a concentrated bundle and are diffused upon reflection.



Broadly, we can say that there are two types of reflection. If the surface is smooth then we have specular reflection. The parallel light rays striking the surface gets reflected, yet individual reflected rays remain parallel.

If the surface is rough, then we have diffused reflection. Light rays, after reflection go in many directions.

In fact during the day, our class room is illuminated by sunlight . Walls and floors are exposed to diffused reflection. Suppose walls

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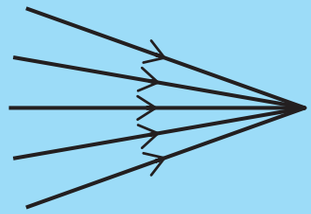
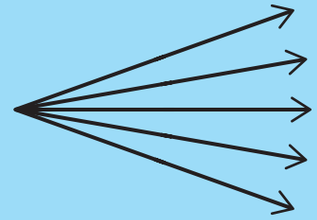
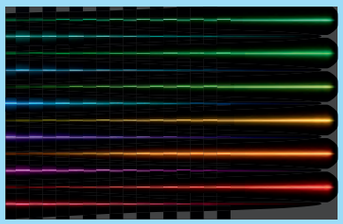
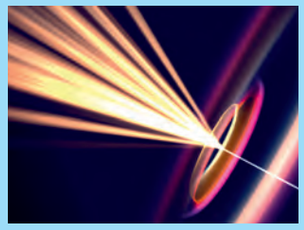
Parallel rays	Convergent rays	Divergent rays
		
		

were smooth mirror like. Then sunlight entering through the window will get bounced by the floor at an angle above towards the roof. And it will never get reflected to left or right. That is left and right walls will remain dark. However walls and floors are not smooth surfaces. Therefore, incident light from the window get bounced in all directions that the whole room is illuminated with diffused light.

Types of beam of light

Generally light is not a single ray, but a bundle of rays which are called as a beam of light.

A light beam can be a bundle of parallel rays, convergent rays or divergent rays. Let us look at the light coming from the Sun. The rays of sunlight are parallel. Often the headlight of car gives parallel rays. However look at the rays of light coming out of a candle. Light rays go in all directions, from the candle fire. These rays are divergent. Light rays from a flash light is also divergent. Using lenses we can converge light rays. Using a lens, you can focus sunlight at a point. That is what we are making the light rays to converge.

Speed of light:

When lighting a bulb in a dark room, light spreads the whole room quickly. This is because the light travels very fast. Light travels three lakh kilometers per second in air or vacuum. In theory , nothing can travel faster than light

Interaction of light with matter

Take a piece of clear glass, a paper and a metal sheet. Shine a light from one side of each object and see if the light penetrate on the other side. Readily, we can see light enters and comes out of the other end of clear glass, whereas the light is bit dim through a paper. Light does not pass through metal sheet. Depending upon permeability, materials can be classified into three categories.

Transparent Material:

Materials that allow light to pass through completely are known as transparent material.

Example: Eye glasses, clear drinking glass, clear water, face glasses used in buses.

Translucent Material:

Objects that allow light to pass through partially are called translucent material. For

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example, we cannot see the image of someone who stands behind a rough window glass, because it allows only a part of light from the person.

Opaque Material:

Materials that are not able to allow light to pass through, are called opaque material. **Example**: Wall, thick card board, stone, etc.

ACTIVITY 4

Let's categorize transparent material, translucent material and opaque material among the given materials

(Clear plastic ruler, cellophane paper , some water in a glass jar, tissue paper, drinking glass, beaker, tap water, kerosene, coconut oil, note paper, card board, milk, diluted milk, aluminum foil, thick colored plastic lid, rough glass piece, measuring glass with water, wooden piece)

Place all the materials given above in the dark room. Focus a torch light on one side of each material. Inspect the light coming out at the other side of each material and then classify the materials in the table.

S. No	Transparent Material	Translucent Material	Opaque Material

Shadows

I1V3E5

How are shadows formed?

As we saw earlier, light is obstructed by certain materials. Light travels in a straight line. Hence it cannot go around such objects. That is why we see shadow. Shadow is always against, opposite side of light source. It is caused by opaque objects that stop light from propagating.

Parts of shadow

When an opaque object is placed in the path of light from a point source, a uniform dark shadow will appear on the screen. This is shadow is called as umbra. When an opaque object is placed in the path of light coming from a broad source of light, a small umbra will appear on the screen and an illuminated shadow area appears around umbra. This illuminated shadow area is called as penumbra. The penumbra always surrounds the umbra. The umbra is the darkest part of a shadow. In this part, light rays are completely prevented by the opaque object. The lighter shade of shadow is the penumbra.

Properties of shadow

1. All objects do not form shadows. Only opaque objects form shadows
2. Shadows will be formed in the opposite side of light source

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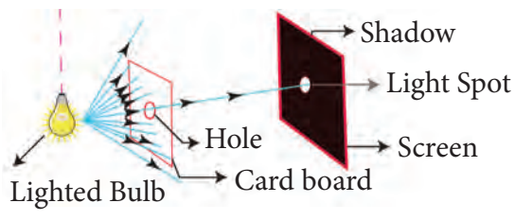
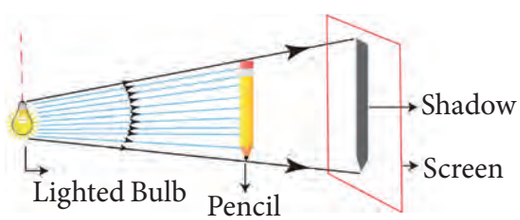
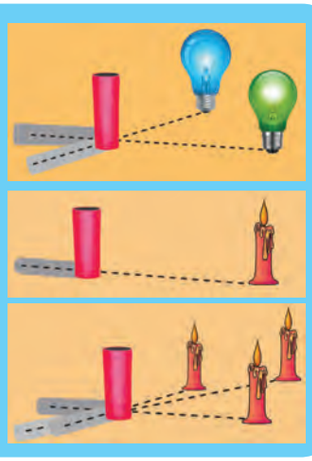
3. It cannot be determined the characteristics of an object by its shadow.
4. The shadow will be always darker, whatever may be the color of light rays
5. Light source, opaque object are shadow all are in a straight line.
6. The size of shadow depends upon the distance between light source and object and the distance between object and the screen.

Arrangement	Activity	Observation	You Learn
	Place a lighted bulb in front of a rectangular card board with a hole at the center	A shadow with a spot light appears in the screen.	Light rays are passing only through the hole and are not allowed by the remaining part of card board
	Place a pencil in the path of light ray coming from a bulb	A shadow of pencil appears in the screen	The size of the shadow is proportional to the size of the opaque objects.

ACTIVITY 5

Requirement : A white screen, a cylindrical opaque object and three bulbs in different sizes.

Use the three different size lamps and examine the umbra and penumbra formed. Keep the distance between the lamp and the cylinder, cylinder and the screen same. As the size of the lamps grow smaller, the umbra region begins to enlarge. If the size of the lamp is a point, then there will be no penumbra. There would be only umbra shadow. Can you tell what the reason is for that?



Eclipses

An eclipse is an incident, when any astronomical object is partially or fully obscured due to the placement of another astronomical object in the presence of light. Thus, solar and lunar eclipses are occurring that are due to the property of light known as the rectilinear propagation of light.

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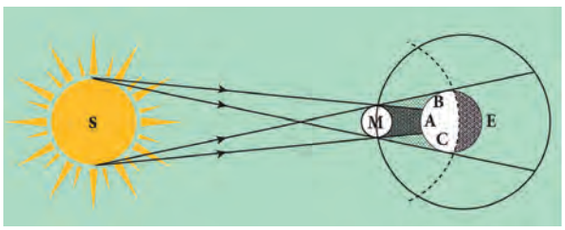
Solar eclipse

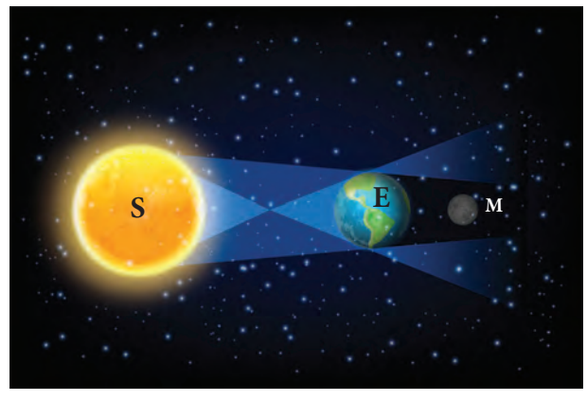
Solar eclipse occurs, when the moon arrives between the sun (S) and the earth(E). The shadow of the moon appears on the earth at A as shown in picture. Hence, those who are at the region A are unable to see the Sun instantly. This is solar eclipse. But, those who are at the region B and C are able to see the sun partially.

Solar eclipse



Lunar eclipse

Lunar eclipse: Lunar eclipse occurs, when the earth (E) comes between the sun (S) and the moon (M). The earth prevents light coming from the sun and makes shadow on the moon. This is lunar eclipse



TRY THIS

ACTIVITY 6

Surfaces	Property of Image (Clearer / blurred)
Glass	
Metal Sheet	
Aluminum foil	
White paper	

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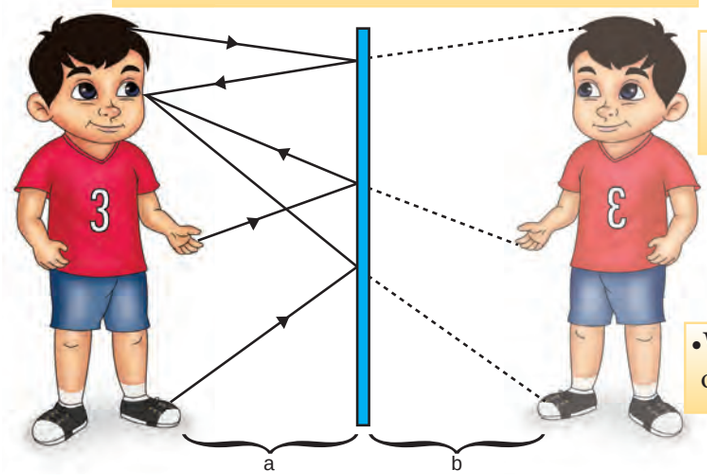
Plane Mirror and Reflection

A polished (or) smooth surface (like glass) which forms image by reflection is known as mirror. A plane mirror is a mirror with a flat reflective surface. A plane mirror makes an Image of objects in front of it.

- The image is upright.
- The image and the object are the same size.
- The image is virtual.



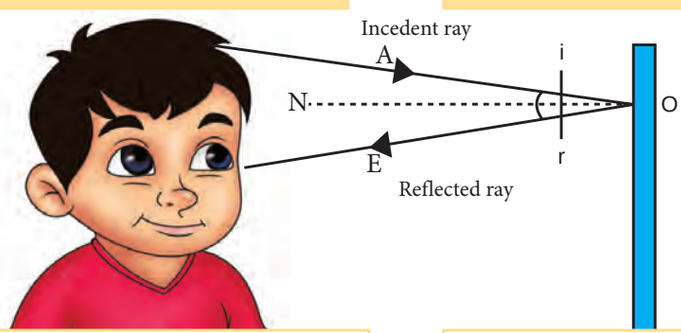
- The image is laterally inverted. The boy's left hand is his image's right hand.

- We can determine the position of an object's image by drawing light rays.

- The distance of the object from the mirror is equal to the distance of the image from the mirror (a=b).

The ray of light AO from the boy head strikes the mirror at point O. AO is called the incident ray.

The incident ray makes an angle of incidence. i. with the perpendicular line ON.



The light ray OA strikes the surface and is reflected as OE. OE is called the refelected ray. This ray makes an angle of reflection r with normal.

The lline, ON, perpendicular to the surface is known as the normal.

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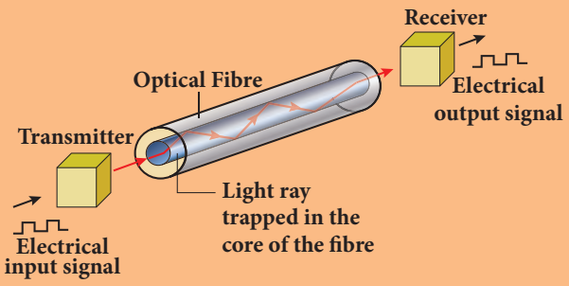
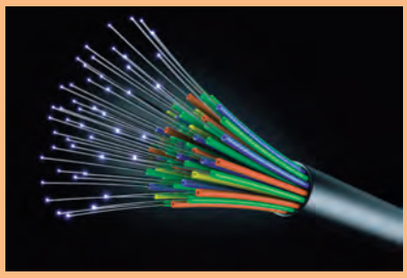
DO YOU KNOW?

Optical fibre is a device that works on the principle of ***total internal reflection*** by which light signals (huge data) can be transmitted from one place to another place with a negligible loss of energy in a very short time. It consists of a cable having one or more thin flexible fibers with a glass core through which light signals can be sent. Optical fiber can be twisted and bent easily. When a light a ray of light is incident at one end of the core of optical fiber, it suffers total internal reflection at the many places inside the fiber and emerges at the other end with negligible loss of energy. The data or information in the form of pulses of light, can be sent through bundles of optical fibers. Optical fibers have become very important in high-speed communications, such as cable TV and high-speed broadband services. Fiber optic cables are able to carry more signals than traditional **copper** cable telephone lines.





Real and virtual images

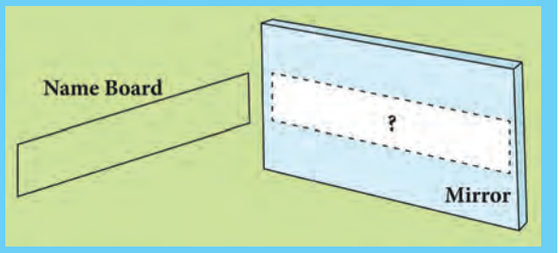
We have seen images being formed in a pinhole camera and a mirror. Can we see what is different in both of these images? Firstly, the image of the pinhole camera was formed on a screen. While the image made by the mirror is not obtained on a screen. The images that are obtained on a screen are called 'real image' and that which cannot be obtained on a screen 'virtual image'. Also notice that the image on pinhole camera was upside down. While the mirror image was upright.

Properties of Image formed in a plane mirror
Image formed in a plane mirror is upright
Image formed in a plane mirror is virtual
The image is of the same size as the object
The distance of the image from the plane mirror is equal to the distance of the object from the mirror
Image is laterally inverted.

ACTIVITY 7

There are eight letters in the word **EINSTEIN**

1. Write the word in front of a plane mirror shown in diagram
2. Write down how these letters appear in the mirror
3. How many of these letters appear to be different, when the word is reflected?
4. Write down the letters that appear to be the same.



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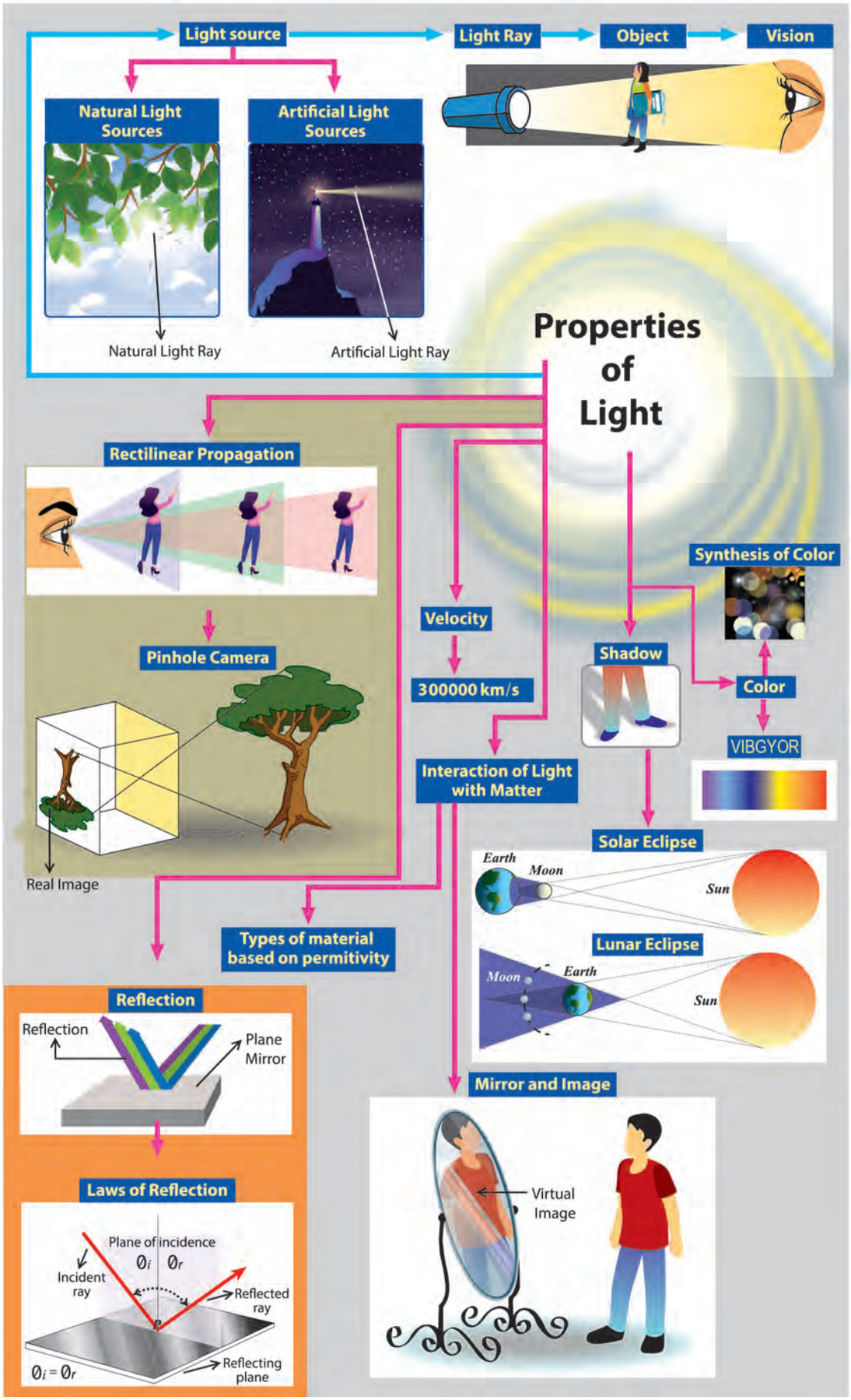

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Colour

Colour of sunlight : Light is a form of energy in the form of a wave that simulates that retina of our eyes. Visible light is a spectrum of a number of waves with different wavelength range from 400nm to 700nm (1nm = 10^{-9} metre) each wave has a definite wavelength represents a particular color. The band of visible light is VIBGYOR.

V – Violet

I – Indigo

B – Blue

G – Green

Y – Yellow

O – Orange

R – Red

Violet colour has shorter wavelength and red color has longer wavelength.

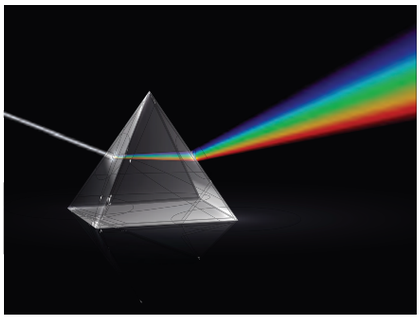
When light ray of particular wavelength (Colour) strikes the retina of our eye, our brain perceives that specific colour. When all colors of visible light strikes the retina of our eye at the same time, our brain perceives white. This shows, white is not a colour at all. But, it is the combination of all the colors of the visible light spectrum. If all the wavelength (colours) of visible light spectrum give appearance of white similarly, the observe of all there wavelength of visible light, will lead appearance of black

DO YOU KNOW?

Why is the word "**AMBULANCE**" written backwards in ambulance vehicle? This is due to lateral inversion .The phenomenon due to which the left side of an object appears to be right side of the object in its image in a reflecting medium (mirror). so that drivers see the word the right way around in their rear-view mirror

What is prism?

A prism is an object made up of a transparent material, like glass or plastic that has at least two flat surfaces that from an acute angle (less than 90° degrees).



ACTIVITY 8

We have seen that white light is made of different colors and we can split white light. Is it possible to do the reverse? That is, can you get white color by mixing colors? Try this activity.

You need oil pastel and white paper. Take different oil pastel colors. Choose colors which are exactly seen on the rainbow. Apply colors over each other on a white paper. Did you get white color?

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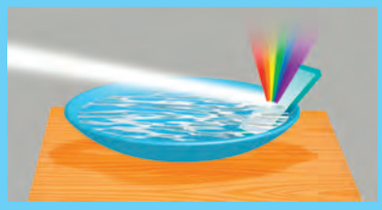
Difference between the images formed in Pinhole camera and Plane mirror	
Images formed by Pin hole camera	**Images formed in Plane mirror**
The image is real	The image is virtual
The image may not be equal to the size of the object	The image is equal to the size of the object
The image is inverted	The image is erect

ACTIVITY 9

Let's make a rainbow

You must surely have seen a rainbow in the sky. Why don't you try making one at your class room?



Place a flat but deep pan. Place this pan where there is direct sunlight. Place a plain mirror in the pan as shown in the diagram, so that you see sunlight reflected on you ceiling or on a white wall. Next slowly pour water in to the pan. At particular level of water, you will get a beautiful rainbow colors on the wall. If the colors are not clear adjust the position of the mirror to bring it into focus. This arrangement of colors in sunlight is called spectrum.

DO YOU KNOW?

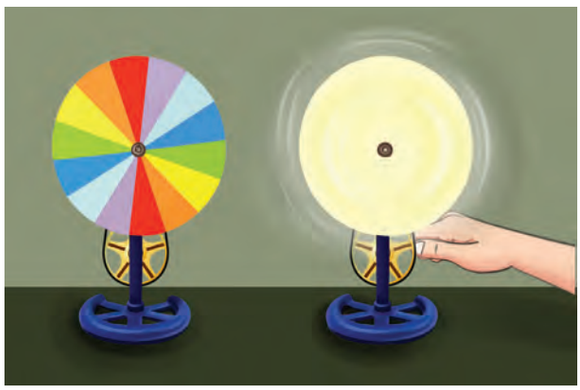
Why danger lights in vehicles are red in colour?

1. Red color is scattered the least by air molecules.
2. Red color has the highest wavelength of all the other colors. So red color is able to travel the longest distance through air, fog.

When white light is passed through a prism as shown in the figure, the colors of the rainbow emerge from the prism.

Newton Disc:

Newton suggested a process of mixing different colors to make white color by setting an arrangement as shown figure below. Newton Disc is a card board disc with seven equal sectorscolored red, yellow,orange, green, blue, indigo and violet. When the disc turned quickly, the retina receives the sensation of the spectrum simultaneously and disc appears white. Using this disc, one can explain that white is a combination of VIBGYOR



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ACTIVITY 10

You need Gelatin papers of Red, Blue and Yellow. Fold each gelatin paper three times and look different color objects listed below through each folded paper. Observe what color each object has. Write your observations in the table.

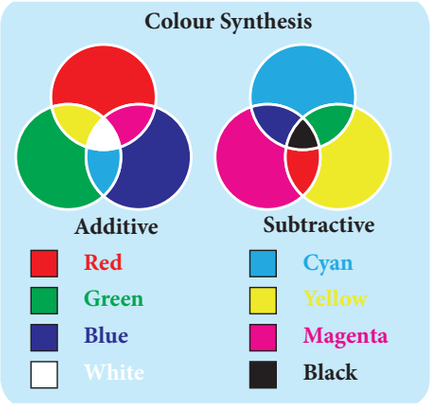
Object	Original color of object	Color through Red gelatin paper	Color through Blue gelatin paper	Color through Yellow gelatin paper
Blue sky				
Orange flower				
Yellow banana				
leaves				
Brown trouser				
White shirt				
Black board				

We know that white shirt will reflect white light and we have seen that white light consists of different colours. When we look at the white shirt through the yellow gelatin paper, we see it as yellow in color. From this, we can say that the yellow gelatin paper did not allow any other color except yellow to pass through. Similarly, we conclude that red gelatin paper allows only red light and blue gelatin paper allows only the blue light.

Synthesis of colour

Synthesis of colour is the method of creating colour by mixing various proportion of two (or) three distinct colours of light. These distinct colours are Red, Green and Blue called as primary colours.

- Equal proportions of two primary colour create a secondary color.
- Magenta, Cyan and yellow are called secondary colour.



1 Red	+	1 Blue	=	Magenta
1 Blue	+	1 Green	=	Cyan
1 Green	+	1 Red	=	Yellow

- Equal proportions of all three primary colour create white.

1 Red	+	1 Blue	+	1 Green	=	White

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EVALUATION

K2K3V2

I. Choose the correct option

1. Light travels only in a _____. It is because of this property that _____ are formed
   a. curved line, shadows
   b. straight line, shadows
   c. straight line, reflection
   d. curved line and then straight line, shadows

2. Light that hits a mirror gets _____
   a. Transmitted
   b. Reflected
   c. Absorbed
   d. Refracted

3. _____ Surface reflects the light well.
   a. water
   b. compact disc
   c. mirror
   d. stone

4. Light is a form of _____
   a. matter
   b. energy
   c. medium
   d. particle

5. You can see your image in polished floors, but not in wooden table because _____
   a. regular reflection takes place in wooden table and irregular reflection in polished floor
   b. regular reflection takes place in polished floor and irregular reflection in wooden table
   c. regular reflection takes place in both polished floor and wooden table
   d. irregular reflection takes place in both polished floor and wooden table

6. Choose the translucent substance from the following
   a. glass b. wood
   c. water d. Clouds

7. Reflection occurs , when the light
   a. about to reach a surface
   b. approaches a surface
   c. passes through a surface
   d. None of these

8. Which of the following is the best reflector of light?
   a. plastic plate
   b. plane mirror
   c. wall
   d. paper

9. Sivarajan placed a meter stick in the playground at 7.00 am in the morning. How will the shadow of the stick at noon look in comparison to the one in the morning
   a. There will be no shadow
   b. The shadow will be longer and on the opposite side as the sun
   c. The shadow will be shorter and on the same side as the sun
   d. The shadow will be shorter

10. The image formed by a pinhole camera is inverted because,
   a. light travels in straight lines
   b. light rays become laterally inverted as they pass through a pinhole camera
   c. light rays pass through the pinhole

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d. light rays get reflected

11. Which of the following facts explain how shadows are formed?

a. Light travels in straight lines

b. Opaque bodies do not allow light to pass through them

c. Reflection occurs at a smooth surfaces like mirrors

d. Lateral inversion happens

a. both A and B

b. both A and D

c. both B and C

d. only A

II. Fill in the blanks

1. A plane mirror produces a _____ image
2. A _____ reflection helps us to see the objects
3. The light ray gets _____ when it falls on any polished surface.
4. Sunlight is a blend of _____ colors
5. The splitting of white light in to seven colors is called _____
6. The moon _____ sun light
7. The sunlight can be split into its constituent colors using _____
8. Reflection of light from rough surface is called _____ reflection

III. Say TRUE or FALSE

1. The image of right hand in a plane mirror looks like a left hand
2. Rainbow is formed by dispersion of which light by water drops
3. The image formed by the plane mirror is laterally inverted, hence the image seen through the periscope is also laterally inverted
4. We see planets because they reflect light from the sun
5. We see a book because it reflects the light that falls on its surface
6. The image formed in a pinhole camera is always inverted
7. The image formed in a pinhole camera is always the same size as the object
8. The image formed in a plane mirror is upside down
9. A plane mirror is opaque
10. A shadow is formed on the same side of the object as the source of light.
11. we are able to see things around us with the help of regular reflection
12. After passing through a prism, white light splits into a band of seven colours

IV. Match the following

1. Rectilinear propagation	-	Primary source of light
2. Plane Mirror	-	Non-luminous object
3. Fire fly	-	Periscope
4. The Moon	-	Pinhole camera
5. Wide light source	-	Spectrum of light
6. Regular reflection	-	luminous object
7. The sun	-	Penumbra
8. Band of seven colors	-	Glossy surface

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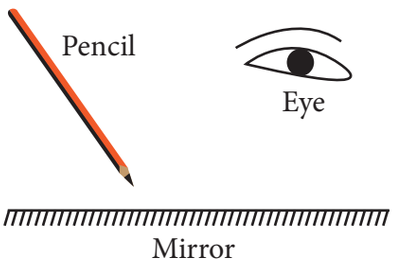
V. Answer the following questions in short

1. With the help of a diagram, state the laws of reflection

2. Figure shows a pencil placed above a mirror



   a. Draw its image formed by the mirror

   b. Show how light rays from the object are reflected at the mirror to form the image for the eye.

3. A person is looking at the image of a tree in a mirror placed 3.5 m in front of him. Given that the tree is at 0.5 m behind his eyes. Find the distance between the image of the tree and his eyes. What are needed to see an object?

4. What are luminous objects?

5. Is the moon a luminous object?

6. What are the three types of materials based on the absorption of light?

7. What are the parts of shadow?

8. What are the properties of shadow?

9. What is plane mirror?

10. What is prism?

11. What do you mean by visible light?

12. Write the items given here in the correct column **(Stars, brick walls, plants, mirror, planets, electric light bulb,candle)**

Sources of Light	Objects that reflect light

13. A boy of height 1m 45 cm is standing in front of a long mirror at a distance of 2 m. From this information, fill up the following sentences:

   a. The distance between the boy and his image is _____

   b. The height of the image is _____

   c. When the boy moves 1m forward, the distance between her and her image is _____

14. Draw a diagram of a pin hole camera showing the rays of light passing between the Object and its image

15. Why is the writing on the front of an ambulance back to front as shown in the picture?

16. Explain with examples, why some capital letters look the same in a mirror but others are reversed.

17. Two plane mirrors M1 and M2 are placed perpendicular with each other, as shown in figure. The ray AB makes an angle 39 ° with the plane mirror M1, then

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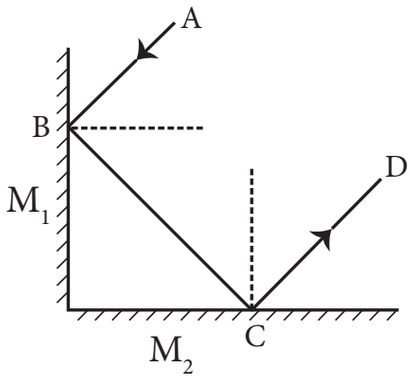


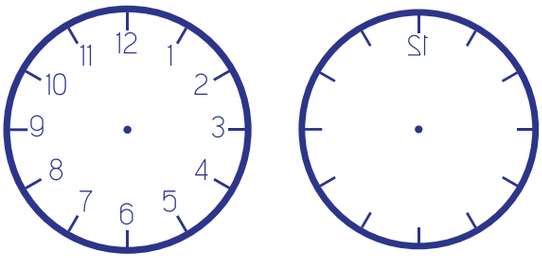
1. The reflected rays are _____, _____

2. The incident rays are _____, _____

3. What is the angle of incident corresponding to the ray BC?

4. What is the angle of reflection corresponding to the ray CD

18. Rajan was playing with the mirror images of a clock. He looked at the clock in his room. It was showing 1:40. Draw the position of the hands on the real clock and on its mirror reflection. Write below the picture what time each picture is showing.



19. What is reflection of light?

20. If a ray of light is falling on a plane mirror at an angle of 500 is formed, what will be the angle of reflection?

21. What do you mean by lateral inversion?

22. How do you obtain a spectrum of light?

23. Why do we see white color in Newton's disc, when we rotate it very fast?

24. What is a shadow? What things are necessary for the formation of a shadow?

VI. Answer the following questions in detail

1. What are regular and irregular reflection? Explain with the help of diagrams

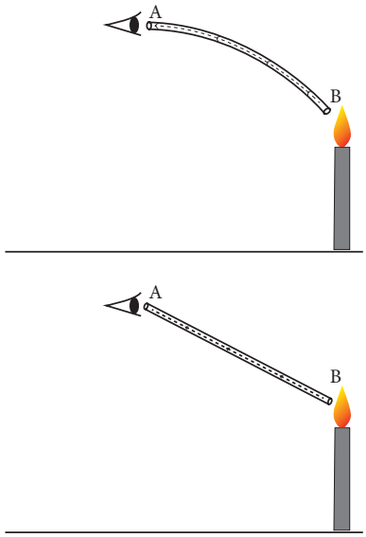
2. What are the difference between luminous and non-luminous objects? Give two examples of each.

3. Write about two everyday situations that tell you that light travels in a straight line.

4. Differentiate between a reflection and a shadow

5. What are the characteristics of an image formed in a plane mirror?

6. Describe the pictures.



7. Define the following terms
   a. Incident ray
   b. Reflected ray
   c. Normal
   d. Angle of incidence

8. Compare the images formed by plane mirror with that by pinhole camera

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ICT CORNER

LIGHT

Explore the activity to know about law of reflection.

PROCEDURE :

Step 1: Type the following URL in the browser or scan the QR code from your mobile to open the activity page.

Step 2: Click the torch to see how the light ray reflects off the mirror and drag the torch to different angles. You can learn the angle of incidence at that point will be equal to angle of reflection.

Step 3: Next Scroll down and select the prism. Click the torch how the prism changes the path of the light ray.

Step 1

Step 2

Step 3

Step 4

Light URL:

https://simpop.org/reflection/reflection.htm

*Pictures are indicative only

*If browser requires, allow Flash Player or Java Script to load the page.

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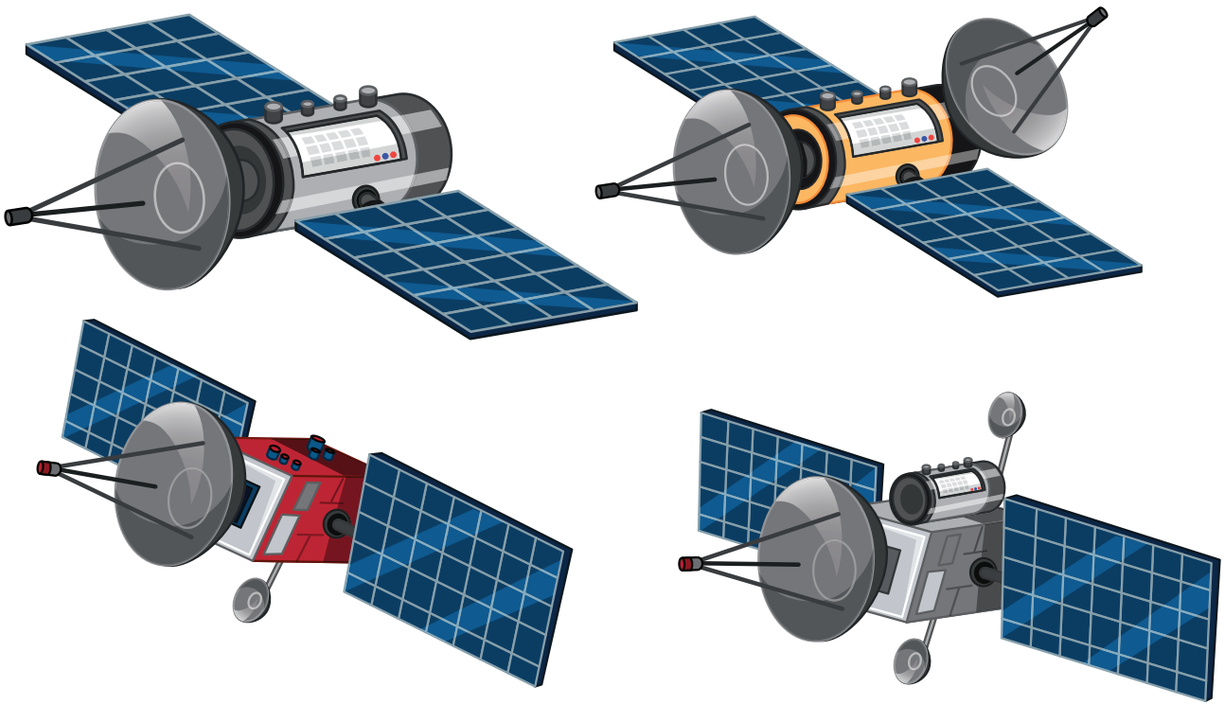
Unit 2

Universe and Space



Learning Objectives

The students are able to

- Explain the beginning of universe
- Know about galaxies and its types
- Recognise different constellations in the night sky
- Get information about the stars
- Distinguish between natural and artificial satellites.
- Understand the functions of ISRO

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Introduction

"My goal is simple. It is a complete understanding of the universe, why it is as it is and why it exists at all."

—Stephen Hawking

Starry night sky is a wonder which has fascinated humans from time immemorial. Our ancestors have observed and documented the objects seen in the night sky. The field of study of the universe is called astronomy. We know that there are billions and billions of stars in the universe, although only about 2000 or so are visible to naked eye. Have you ever think of the size of our universe? The universe is unimaginably and infinitely big. Universe is commonly defined as the totality of everything that exists or is known to exist. Even though the spatial size of the entire universe is still unknown, it is possible to measure the observable universe.

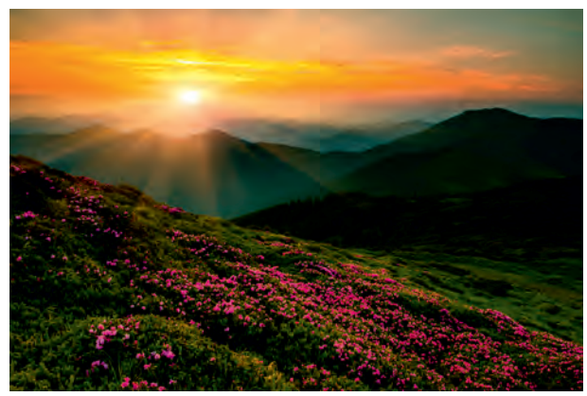
The universe consists of galaxies, planets, stars, meteorites, satellites and all other forms of matter and energy. And it is a world of wonder. Let us move into this world of wonder to know more interesting facts about the place of residence of our solar system.

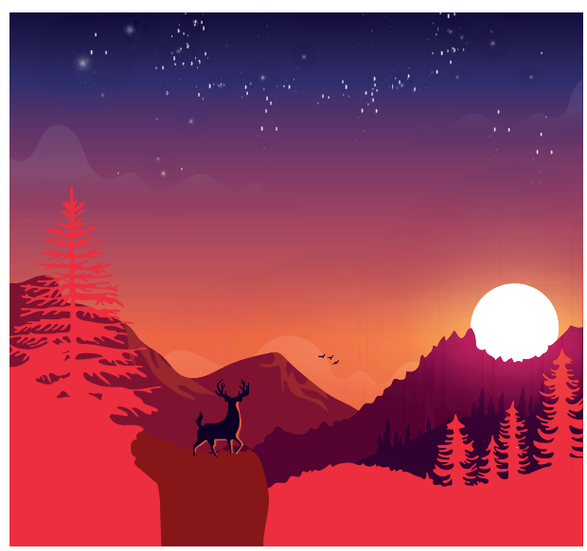
GEO Centric Theory

Sky is a wonder. Sun, Moon, stars all appear to rise in the East and move towards the west, giving us an impression that all these objects are going around the Earth. Just as in a moving bus the distant mountains and trees appear to move backwards, perhaps really Earth is spinning and that is why Sun, Moon and stars appear to go around the Earth. Does the Earth revolve around the Sun, or the Sun revolves around the Earth? How do you know about it?

When you look at the night sky you can see lot of twinkling objects. But a few of them differ from the others. They don't twinkle and while the other stars hold a fixed pattern from night to night, these drift. They wander across the sky, moving against the backdrop of stars. These are called planets. Our ancestors observed this and they imagined a universe with the Earth at the center, the stars in the distant background, and Sun, Moon and the planets orbiting around us.

Two observations supported the idea that Earth was the center of the Universe. First, from anywhere on the Earth, the Sun appears to revolve around the Earth once in a day. While the Moon and the planets have their own motions, they also appear to revolve around the Earth about once per day. Even the celestial sphere studded with stars appears to rise and set in the evening, and make one complete rotation in a year. Second, the Earth seems to be unmoving from the perspective of an earthbound observer; it feels stationary.





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As civilization progressed the early astronomers found two types of motion of celestial objects. Let us take the case of Moon. On a daily basis Moon appears to rise in the east and set in the west. Thus, one can say that Moon is going around the Earth with a period of one day. But for a careful observer, it was clear that the Moon was also exhibiting another motion. Suppose, the Moon is appearing in the sky today near the star Asvini, tomorrow we will observe that the Moon is near the star Bharani, a star east of Asvini. And the next day it will be near the star Kartikai, east of Bharani. After 27 days, moving little by little eastwards, the Moon again stations itself near asvini. Thus, everyday Moon appears to move from east to west in one day where as it appears to go in a circle from west to east in the background of stars in about 27 days.

These two motions were puzzling. Very soon astronomers like Aryabhata said that Earth is spinning in its axis, that is the cause of apparent daily motion from East to West. Whereas the eastward motion of Moon in the celestial sphere with a period of about 27 days, was seen as the 'actual' motion of the celestial objects.

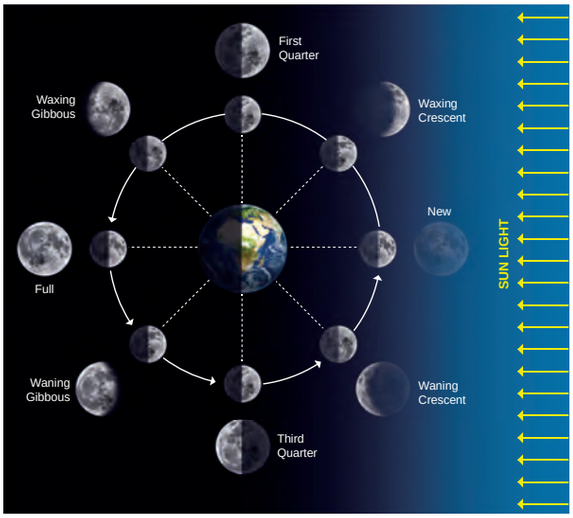
Thus, the geocentric model (also known as geocentrism), that is a description of the Universe with spherical and spinning Earth at the center and the Sun, Moon, stars, and planets all orbits the Earth emerged in various cultures. In Greece, this model was put forth by the Greek philosopher Plato and his disciple Aristotle in 6th century B.C. It was standardized by a Greeco Roman mathematician Ptolemy in the 2nd Century A.D. A similar model is seen in the Siddhanthic astronomy in India like Aryabhateeyam of Aryabhata.

How moon exhibit phases

Astronomers in ancient times also observed certain facts. The Purananuru (65) of Sangam literature, the poet Poet Kalathalaiyar singing in appreciation of Cheraman Peruncheralathan says"

On the day when the full moon appears, the sunand moon look at each other with their bright light. In the evening time, one sphere hides behind the mountains."

On the full moon day, when the Sun is setting in the west, precisely at the same time, Moon rises at the East. That is both Sun and Moon are in the opposite side. Likewise when it is waning half moon, the Moon is rises when it is midnight and the waxing half moon rises during noon. From such observations and modelling ancient astronomers could explain why we have waxing and waning of moon.



It is probably easier to understand the waxing and waning of Moon in the order of new moon & full moon and then how the first and third quarter moon (half moon) appear and then the phases in between.

Sun is the source of light. Sun light falls on the spherical earth, but only on the side facing

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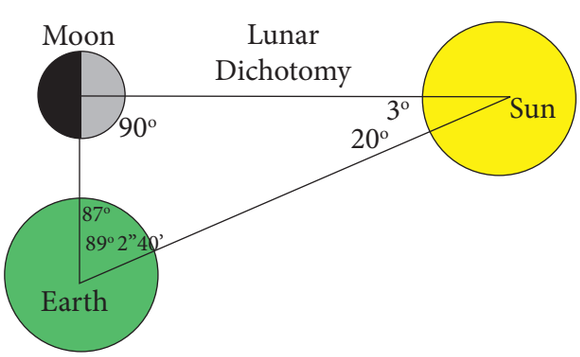
Sun. The opposite side of Earth is without sunlight. As the Earth spins day and night follows as different parts of Earth appear before the Sun. That is at all times one half of Earth is illuminated by Sun and one half is in darkness.

Like wise at all times one half of Moon is illuminated by Sun and the opposite side is shroud in darkness.

As shown in the above diagram, when the moon is positioned between the earth and sun, notice all the illuminated part of Moon is away from Earth. Hence we cannot see any part of the illuminated side of the Moon. Only the dark side of Moon is towards Earth. When the moon is in this position, we have new moon.

Now look at the moon when it is behind the Earth. Now the portion of the moon illuminated by sun is totally towards Earth. The dark side is away from the Earth. This means the moon will appear to be round in the sky. This is full moon.

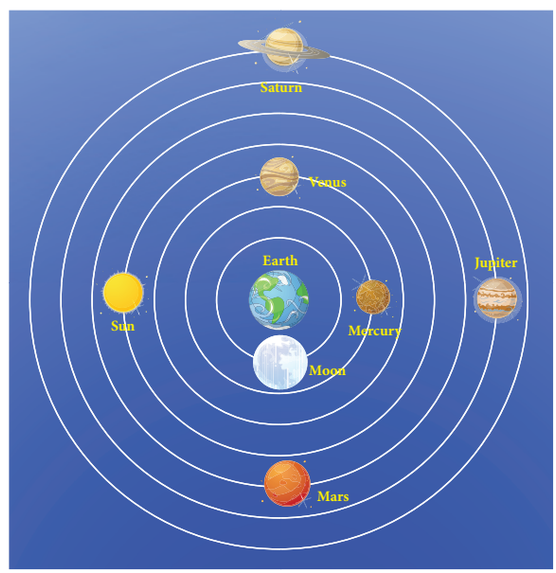
When the Sun, Earth and Moon are in 90 degree angle how will the moon appear to a person on the surface of the Earth? Now if you look at the portion of moon facing Earth, we will see half if it illuminated and half is dark side. Thus, the moon will appear as half moon. The half moon during the waxing period is called as first quarter and the half moon during the waning period is called as third quarter. (figure



sun moon and earth are at right angles)

Once we understand those four key moon phases, the phases between them should be fairly easy to visualize.

The word crescent refers to the phases where the moon is less than half illuminated. The word gibbous refers to phases where the moon is more than half illuminated. Waxing essentially means "growing" or expanding in illumination, and waning means "shrinking" or decreasing in illumination. Note all so that these discoveries could be made with naked eye. You do not need telescope or any modern equipment.



Epicycles

Moon going around Earth with 27 day period nicely explained its motion. However astronomers in ancient times faced problem in explaining the motion of the then known five planets- Mercury, Venus, Mars, Jupiter and Saturn.

Moon in the background of stars moved everyday eastwards nicely. However for example, if we were observing the motion of Mars from January , it would appear to move eastward in

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the background stars. That is the position of mars today will be near a star which is east of the star near which it was yesterday. However on June 28 , we will see a change. From that date the Mars would appear to move west rather than its normal eastward motion. This reversal of direction of planets is called as 'retrograde motion'. If we continue to observe, on August 28 once again the Mars would appear to reverse the direction and again on its usual eastward motion in the celestial sphere. Usually Jupiter is brighter than Mars, however, around the period of retrograde motion the Mars was much bright than other times; even brighter than Jupiter.

Other planets also exhibited number of puzzling behaviours. Venus and Mercury always appeared very close to Sun, and hence never appeared in the midnight sky. The brightness of Jupiter also varied again when it exhibited retrograde motion. For example in 2018, Jupiter reversed its direction of motion on March 9, 2018 and again resumed its normal eastward motion on July 11, 2018.

The simple geocentric model, where planets go around the Earth could not explain why the brightness of the planets changed, and why they reversed their directions. Change in brightness and retrograde motion would be impossible if we assumed that the planets were at the same distance at all times from Earth.

To explain the puzzling phenomena astronomers in early times proposed a change in the simple geocentric model. This is called as epicycle model.

Ptolemy (2nd cent) in Greece, Aryabhatta in India and others used the epicycle model to explain the motion of the celestial objects. Their models were improved by generation of astronomers like Tycho Brahe and Neelakanta Somayaji.

Although, the model explained many phenomena there were number of mismatches. The model was becoming messy.

Arrival of telescope.

Telescope was invented by Hans Lippershey but Galilio used it for studying the sky for the first time. The telescope showed more universe was than visible to naked eye. With his simple telescope matching toy telescopes of today, Galilio was able to see mountains on the Moon, small dim stars invisible to naked eye, sunspots on the face of Sun. He was able to demonstrate that the milky way, an hazy bright patch in the sky is nothing but thousands of stars huddled together, Jupiter had moons going around it and Saturn had mysterious appendage which we now know as rings.

One of the most startling observations he made was related to telescopic observation of Venus. This convinced him to accept the theory of the Polish Astronomer Nicolus Copernicus, that it is not Sun, planets and Stars that go around Earth, but it is Earth and other planets that go around the Sun- heliocentric theory.

Heliocentric model.

Dissatisfied with the messy epicycle model Nicolus Copernicus, radically proposed that the model will become simple if we assume Sun is at the center and all planets, including Earth, go around it.

Suppose, Earth and Mars are on the two sides of the Sun, then Mars would be far and appear dim, compared to when they are on the same side. Earth orbit around Sun in 365 days, whereas Mars takes 687 days. This implies at

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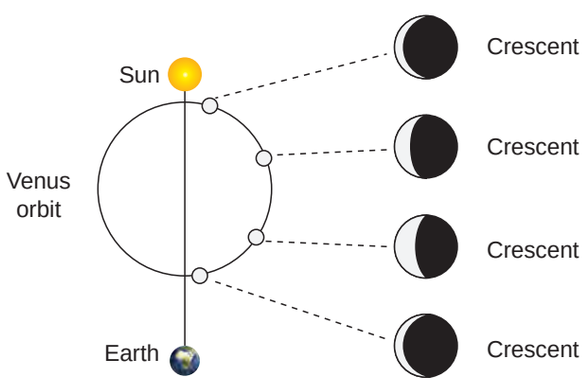
times Earth will overtake Mars. When the Earth is approaching and overtaking Mars, the Mars would appear to exhibit retrograde motion. In short all the observed phenomena could be explained in a simple way.

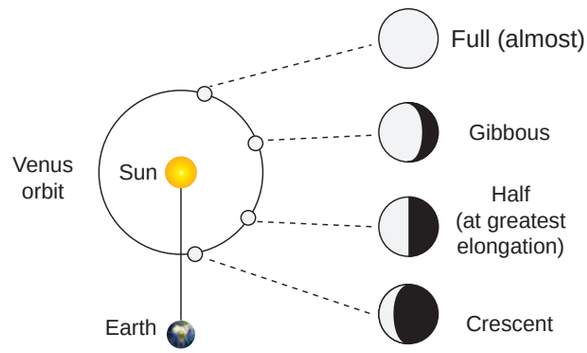
However how do we know that actually Sun is at the center or not?

Galileo found that his observation of Venus gave the observational evidence to support the heliocentric theory. Galileo observed Venus in 1610-1611 with a telescope. To naked eye, Venus is just a gleaming bright spot. However, through a telescope, the shape of the planet can be seen. Galilio was startled to find like Moon Venus too exhibited phases. The shape varied from crescent to gibbous. Also, the size of the planet varied. When the planet was in gibbous phase the size was small, and when it was thin crescent the size was many folds higher.



As the Venus went around the epicycle, as shown in the diagram Venus would exhibit phases. Also at times the planet would be nearer, making the apparent size grow bigger and at times far making the apparent size smaller. Thus, the variation in the brightness can also be explained.

It became clear to Galilio that the geo-centric epicycle model will not help in accounting for the observed phases of the Venus.



Look at the above diagram. If the Venus was going around the Sun, and its orbit is inside that of Earth, Venus would appear always near the Sun in the sky. It can never be seen in the midnight sky. Two when it is near the Earth, it would be brighter and bigger compared to when it is on the other side of the Sun. Thirdly only if the Venus is revolving around the Sun, it can exhibit gibbous phase, and the size of the gibbous phase smaller than the crescent phase. If the Venus was revolving around the Earth, we can never see the gibbous phase of the Venus and it would be seen only if it is orbiting tthe he Sun. This clinching observational evidence proved that at the least Venus orbited around the Sun. Further evidences collected by astronomers using telescope and other advanced modern instruments gave enough evidence that all planets revolve around the Sun.

If Galileo were around today, he would surely be amazed at exploration of our solar system and beyond by ISRO, NASA, Russian space agency and others.

Now we can observe planets orbiting around other stars (called exoplanets), proving that not only planets orbit around the Sun in

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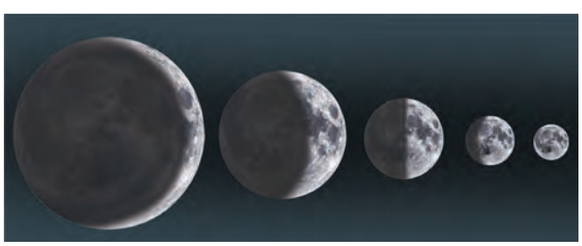
solar system, but all around the universe such planetary systems exist. Who knows, in some of there could be life and in rare cases intelligent life, like humans wondering and exploring universe. Imagine a future time when such life meet us; how exciting and momentous it would be!

Origin of the Universe

P5E6Q1

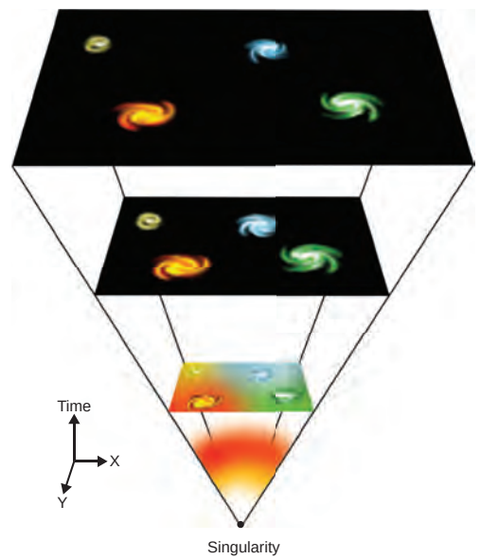
You are a student who belong to a particular class studying in VII std. In your school, there might me many section for VII std. Likewise, there are VI std class, VIII std class and so on. All of them together make the school. Likewise, our Sun is a star with a planetary system. Billions of such stars consitute a system called as galaxy. The name of our galaxy is, Milky Way. Like Milky Way, there are at least hundreds of billions of galaxies in the Universe.



How did all these come about? Where they in existence always or was there a beginning?

When we observed other galaxies we found a strange behavior. All the galaxies were appearing to move away from us. Further, farther they are faster they appear to move. Cosmologists , scientists who study the structure and evolution of universe that is cosmos, reason that this imply at one point of time in the past all matter was confined in a single point and since then it has started to expand.

The event when the matter confined in a single point and began to expand is called 'big bang'. This is considered as the origin of our universe as we know it.



The Big Bang Theory is the prevailing model of the evolution of the Universe. Under this theory, space and time emerged together about 14 billions of years ago. At that time, the entire Universe was inside a bubble that was thousands of times smaller than a pinhead. It was hotter and denser than anything we can imagine. Then it suddenly expanded. The present Universe emerged .Time, space and matter all began with the Big Bang.

In a fraction of a second, the Universe grew from smaller than a single atom to bigger than a galaxy. And it kept on growing at a fantastic rate. It is still expanding today. Over the next three minutes, the temperature dropped below 1 billion degrees Celsius. After 300 000 years, the Universe had cooled to about 3000 degrees. Atomic nuclei could finally capture electrons to form atoms. At that stage of the evolution of the Universe, it was filled with clouds of hydrogen and helium gas. Giant clouds of hydrogen and

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helium were gradually drawn to the places where dark matter was most dense, forming the first galaxies, stars, and everything else seen today.

We cannot see anything that happened during the first 300000 years of the Universe. Scientists try to work it out from their knowledge of atomic particles and from computer models. The only direct evidence of the Big Bang itself is a faint glow in space, called cosmic microwave background.

As millions of years passed, the dense areas pulled in material because they had more gravity. Finally, about 100 million years after the Big Bang, the gas became hot and dense enough for the first stars to form. New stars were being born at a rate 10 times higher than in the present-day Universe. Large clusters of stars soon became the first galaxies.

The Hubble Space Telescope and powerful ground-based telescopes are now beginning to find galaxies that were created about one billion years after the Big Bang. These small galaxies were much closer together than galaxies are today. Collisions were common. Like two flames moving towards each other, they merged into bigger galaxies. Our Milky Way galaxy came together in this way.

Building Blocks Of Universe.

As stated above universe is constituted of galaxies, just as lot of houses in our locality constitute a village or a city. We have lot of things such as rooms, furniture etc. in our homes. Likewise lot of stellar objects such as stars, planets, asteroids and meteors are the building blocks of our universe.

More to know

Astronomical unit : The average distance between the Earth and the Sun is called an astronomical unit. It is denoted by 'au'.

1 au = 1.496×10^8 km

Light year : The distance travelled by light in one year is called a light year. It is denoted by 'ly'.

1 ly = 9.4607×10^{12} km

Parsec: A parsec is defined as the distance at which one astronomical unit subtends an angle of one arc second. It is denoted by 'pc'

1 pc = 3.2615 ly = 3.09×10^{13} km

Galaxies.

Q7E4F8

A galaxy is a large collection of stars or cluster of stars and celestial bodies held together by gravitational attraction. There are about billions of galaxies in the universe. Most galaxies range from thousand to ten thousand parsec in diameter. As we have different types of houses in a locality, the galaxies are also of different types.

Types of galaxies

There are various types of galaxies such as spiral, elliptical, barred spiral and irregular

Spiral Galaxy

Spiral galaxies consist of a flat, rotating

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disk containing stars, gas and dust, and a central concentration of stars known as the bulge. These are often surrounded by a much fainter halo of stars. Spiral galaxies are named by their spiral structures that extend from the center into the galactic disc. The spiral arms are sites of ongoing star formation and are brighter than the surrounding disc because of the young, hot stars that inhabit them.

Elliptical Galaxy

An elliptical galaxy is a type of galaxy having an approximately ellipsoidal shape and a smooth image. Unlike flat spiral galaxies with organization and structure, elliptical galaxies are three-dimensional, without much structure, and their stars are in somewhat random orbits around the center. Interestingly Stars found inside of elliptical galaxies are on an average much older than stars found in spiral galaxies. Elliptical galaxies tend to be surrounded by large numbers of globular clusters.

Irregular Galaxy

An irregular galaxy is a galaxy that does not have a distinct regular shape, unlike a spiral or an elliptical galaxy, they are often chaotic in appearance, with neither a nuclear bulge nor any trace of spiral arm structure. About one forth of the galaxies found so far are of this type.

Cosmologists say that some irregular galaxies were once spiral or elliptical galaxies but were deformed by an uneven external gravitational force. Irregular galaxies may contain abundant amounts of gas and dust.

Barred Spiral

A barred spiral galaxy is a spiral galaxy with a central bar-shaped structure composed of Stars. Bars are found in approximately in two-thirds to one third of all spiral galaxies.The Milky Way Galaxy, where our own Solar System is located, is classified as a barred spiral galaxy.

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Milky Way

K1W3E1

The Milky Way is the galaxy in which our solar system is located. The diameter of Milky Way is over 100,000 light years. The Milky Way includes stars smaller than our Sun as well as many other stars that are thousands of times bigger than the Sun. It includes many other celestial bodies of gases, clouds of dust, dead stars, newly born stars, etc. It is also thought to contain at least 100 billion stars. The galaxy that is closest to our Milky Way is Andromeda. The descriptive "milky" is derived from the appearance from Earth of the galaxy – a band of light seen in the night sky formed from stars that cannot be individually distinguished by the naked eye. In Indian mythology, this patch called as Akasha Ganga. From the Earth, the Milky Way appears as a band because its disk-shaped structure is viewed from within. Galileo Galili first resolved the band of light into individual stars with his telescope in 1610. Until the early 1920s, most astronomers thought that the Milky Way contained all the stars in the Universe. Observations by Edwin Hubble showed that the Milky Way is just one of many galaxies.

The Milky Way does not sit still, but is constantly rotating. Our solar system is located within the disk of the galaxy, about 27,000 light years away from the centre of the galaxy. The solar system travels at an average speed of 828,000 km/h. Even at this rapid speed, the solar system would take about 230 million years to travel all the way around the Milky Way. When the solar system was in the same spot as it is now, there were no humans, no Himalayan mountain on Earth and the dinosaurs were roaming around the Earth.

Tucked inside the very center of the galaxy is a monstrous black hole, billions of times as massive as the sun. Although, black holes cannot be directly viewed, scientists can see their gravitational effects as they change and distort the paths of the material around it, most galaxies, like our milkyway, are thought to have a black hole in their heart.

Constellation

A constellation is a recognizable pattern of stars in the night sky when viewed from the Earth. International Astronomical Union has classified 88 constellations to cover the entire celestial sphere. Many of the old constellations have Greek or Latin names and are often named after mythological characters.

Ursa Major (Saptha Rishi Mandalam) is a large constellation and it covers a large part of the sky. The most striking feature of this constellation is a group of seven bright stars known as big dipper (seven Sages in Indian astronomy).

Ursa Minor in Lattin means 'the little bear' it lies in the northern sky. The Pole star – Polaris (Dhrua) lies within this constellation. The main group, 'little dipper', consists of seven stars and is quite similar to that found in Ursa Major.

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Orion was a hunter in Greek mythology. The constellation comprises around 81 stars out of which all but 10 are too faint to be seen with naked eye.

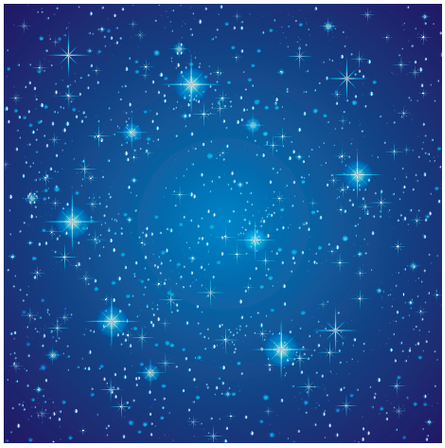
Different constellations become visible in the sky at different times in the year. This happens due to the revolution of the Earth around the Sun.

Unlike galaxy, constellations are mere optical appearance and not real objects. In galaxy stars are bound by gravity and constitute a system. In a constellation, one star may be near and another very very far, but because they are in the same direction appear to be near to each other in the sky.

Name of Constellations	
Indian Name	**English Name**
Mesham	Aeries
Rishabham	Taurus
Midhunam	Gemini
Kadakam	Cancer
Simmam	Leo
Kanni	Virgo
Thulam	Libra
Vrischikam	Scorpio
Dhanusu	Sagittarius
Makaram	Capricorn
Kumbam	Aquarius
Meenam	Pisces

Stars

A Star is a luminous heavenly body that radiate energy. With naked eyes, we can see nearly 3000 stars in the night sky and many more with the help of a telescope. The stars are remotely located and appear as tiny dots of light. Their light travels long distances to reach us. The atmosphere disturbances do not allow light to reach us in a straight line path. Because of this the stars appear to twinkle. The Sun is the nearest star to the Earth. The next nearest star is Alpha Centauri

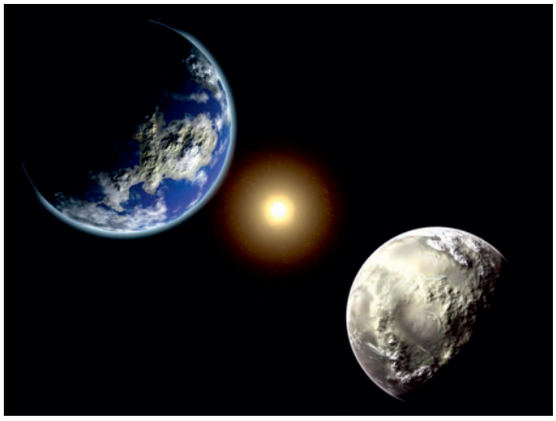


Satellites

An object that revolves around a planet in a stable and consistent orbit is called a satellite. Satellites can be classified into two categories – natural and artificial.

Natural satellites

All natural objects revolving around a planet are natural satellites. They are also called moons. Most moons are spherical, the ones that are not usually asteroids or meteors that were captured by the strong gravity of a planet. All planets except mercury and Venus in our solar system have moons. Earth has only one moon- whereas planets like Jupiter and Saturn have more than 60 moons.



Artificial satellites

Artificial satellites are man-made objects placed in an obit to rotate around a planet – usually the Earth. The world's first artificial

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Spiral galaxies

Flat rotating disc containing Stars.

Elliptical galaxies

Three dimensional without structure

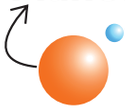
Irregular galaxies

Irregular in shape

Satellites

Objects revolving around the planets

Planets



Objects revolving around the stars

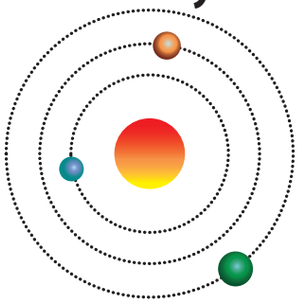
Stars

Luminous heavenly bodies radiating light

Milky way

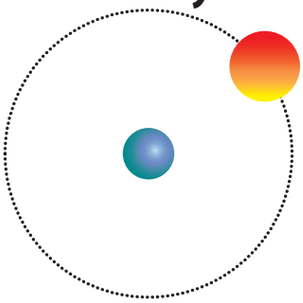
The galaxy in which our solar system is located.

Heliocentric theory



Sun is supposed to be at the centre

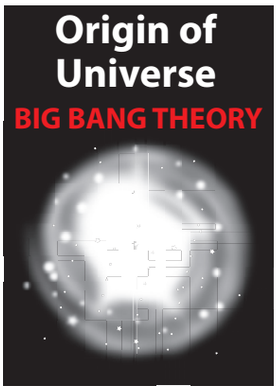
Geocentric theory



Earth is supposed to be at the centre

Origin of Universe

BIG BANG THEORY



Space and time emerge together about billions of years ago

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satellite launched was Sputnik-1 by Russia, Aryabhatta was the first satellite launched by India. These satellites are used in television and radio transmission, studying agriculture yield, locating mineral resources, weather forecasting, locate different places on earth.

ISRO

The Indian Space Research Organisation (ISRO) is the space agency of the Government of India headquartered in the city of Bangalore. Its vision is to "harness space technology for national development while pursuing space science research and planetary exploration."

Know your Scientist

Subrahmanyan Chandrasekhar (19 October 1910 – 21 August 1995) was an Indian Americanastrophysicist who spent his professional life in the United States. He was awarded the 1983 Nobel Prize for Physics with William A Fowler. His mathematical treatment of stellar evolution yielded many of the best current theoretical models of the later evolutionary stages of massive stars and black holes. The Chandrasekhar limit is named after him. Chandrasekhar worked on a wide variety of physical problems in his lifetime.

Formed in 1969, ISRO superseded the erstwhile Indian National Committee for Space Research (INCOSPAR) established in 1962 by the Scientist Vikram Sarabhai. The establishment of ISRO thus institutionalized space activities in India. It is managed by the Department of Space, which reports to the Prime Minister of India.

ISRO built India's first satellite, Aryabhatta, which was launched by the Soviet Union on 19 April 1975. It was named after the Indian astronomer Aryabhata. In 1980, Rohini became the first satellite to be placed in orbit by an Indian-made launch vehicle, SLV-3. ISRO subsequently developed two other rockets: the Polar Satellite Launch Vehicle (PSLV) for launching satellites into polar orbits and the Geosynchronous Satellite Launch Vehicle (GSLV) for placing satellites into geostationary orbits. These rockets have launched numerous communication satellites and earth observation satellites. Satellite navigation systems like GAGAN and IRNSS have been deployed. In January 2014, ISRO used an indigenous cryogenic engine in a GSLV-D5 launch of the GSAT-14.

ISRO sent a lunar orbiter, Chandrayan -1, on 22 October 2008 and a Mars orbiter, Mars Orbiter Mission, on 5 November 2013, which

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entered Mars orbit on 24 September 2014, making India the first nation to succeed on its first attempt to Mars, and ISRO the fourth space agency in the world as well as the first space agency in Asia to reach Mars orbit. On 18 June 2016 ISRO set a record with a launch of 20 satellites in a single payload. On 15 February 2017, ISRO launched 104 satellites in a single rocket (PSLV-C37) and created a world record. ISRO launched its heaviest rocket, Geosynchronous Satellite Launch Vehicle-Mark III (GSLV-Mk III), on 5 June 2017 and placed a communications satellite GSAT-19 in orbit. With this launch, ISRO became capable of launching 4 ton heavy satellites.

ISRO launched Chandran 2 on July 22, 2019, Geosynchronous Satellite Launch Vehicle (GSLV-Mk III). It entered the Moon's orbit on August 20, 2019 and its lander landed on the Moon on September 7.

DO YOU KNOW?

In 1989, Galileo Galilei was memorialized with the launch of a Jupiter-bound space probe bearing his name. During its 14-year voyage, the Galileo space probe and its detachable mini-probe, visited Venus, the asteroid Gaspra, observed the impact of Comet Shoemaker-Levy 9 on Jupiter, Europa, Callisto, IO, and Amalthea.

In order to avoid the possible contamination of one of Jupiter's moons, the Galileo space probe was purposely crashed into Jupiter at the end of its mission in September 2003.

Points to Remember

- The field of study of the universe is called astronomy.
- The universe consists of galaxies, planets, stars, meteorites, satellites and all other forms of matter and energy.
- The half moon during the waxing period is called as first quarter and the half moon during the waning period is called as third quarter.
- The word crescent refers to the phases where the moon is less than half illuminated. The word gibbous refers to phases where the moon is more than half illuminated..
- The reversal of direction of planets is called as 'retrograde motion'.
- The geocentric theory followed by the ancient people proposed that the Earth is at the centre and the sun and other planets revolve around it.
- The helio-centric theory states that the sun I at the centre and the planets revolve around it
- Galilio gave the observational evidence to support the heliocentric theory
- There are at least hundreds of billions of galaxies in the Universe.
- A galaxy is a large collection of stars or cluster of stars and celestial bodies held together by gravitational attraction.
- A constellation is a recognizable pattern of stars in the night sky when viewed from the Earth.
- An object that revolves around a planet in a stable and consistent orbit is called a satellite.
- The Indian Space Research Organization (ISRO) is the space agency of the Government of India headquartered in the city of Bangalore.

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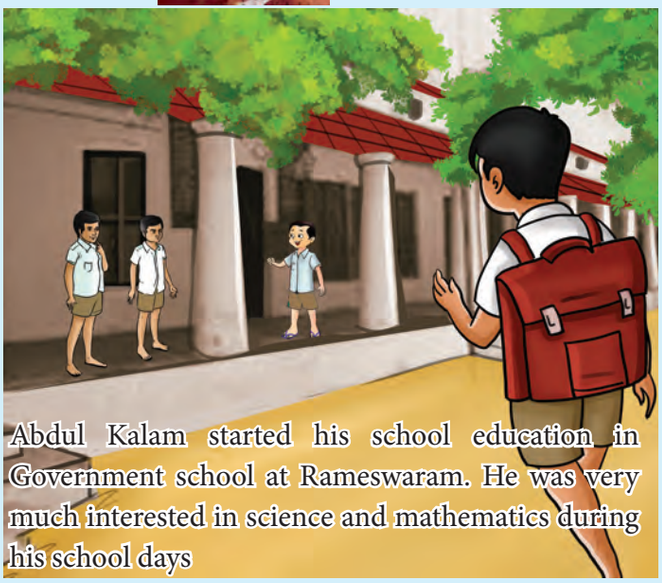
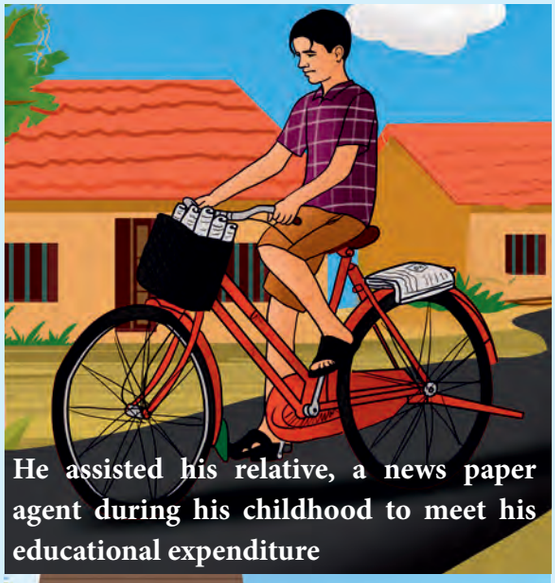
The Missile Man Of India

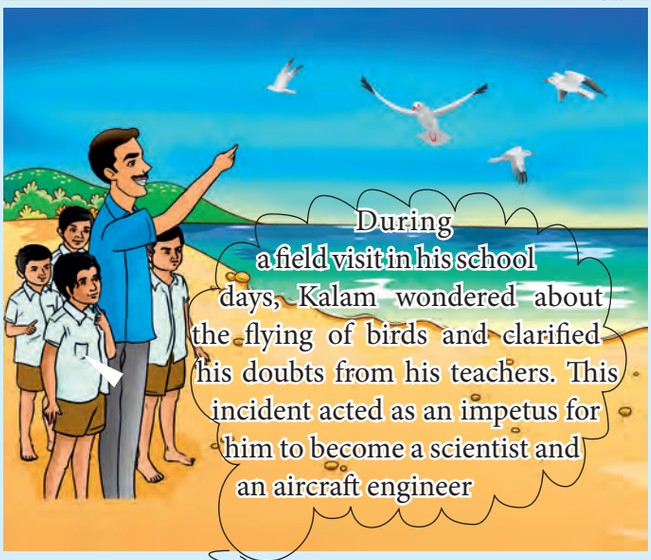
A.P.J. Abdul Kalam (1931-2015)



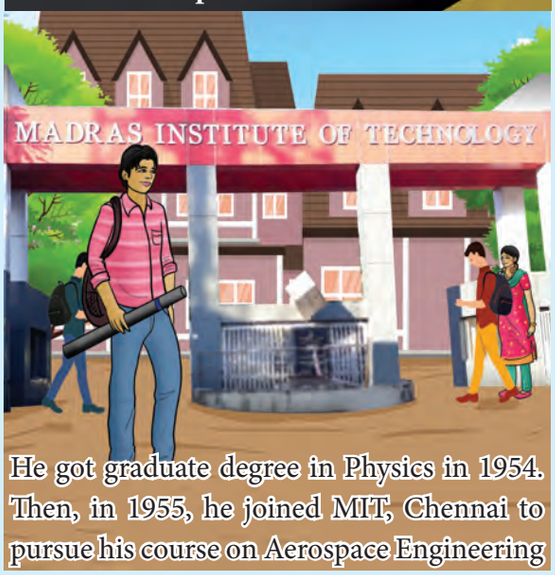
Abdul Kalam started his school education in Government school at Rameswaram. He was very much interested in science and mathematics during his school days



He assisted his relative, a news paper agent during his childhood to meet his educational expenditure



During a field visit in his school days, Kalam wondered about the flying of birds and clarified his doubts from his teachers. This incident acted as an impetus for him to become a scientist and an aircraft engineer



He got graduate degree in Physics in 1954. Then, in 1955, he joined MIT, Chennai to pursue his course on Aerospace Engineering

After completing his studies at MIT, he designed an aircraft named 'Nandhi' using indigenous materials with the help of indigenous technologists, He operated that flight himself

He took charge as the Director of Indian Defence Research Development Organisation and the scientific advisor to the Defence Ministry of India in 1983

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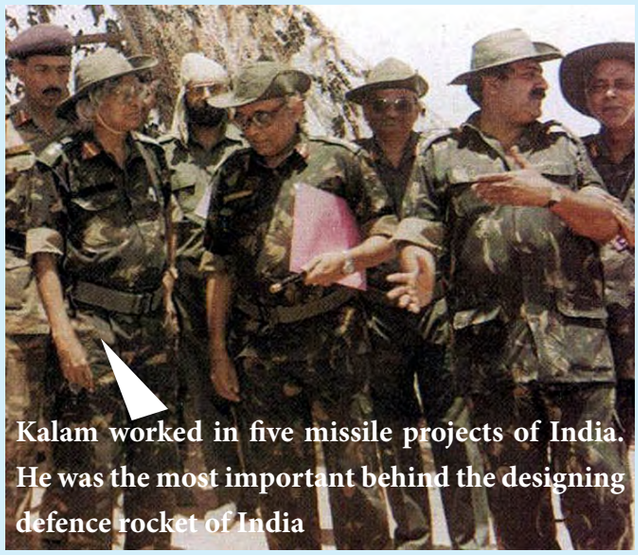
Kalam successfully launched the 'Rohini-1' satellite using the India's first satellite launch vehicle SLV-3 in 1980. He acted as the Project Director when the missiles Thrishul, Agni,Prithvi, Nag and Akash were designed in the Indian Defence

India for the first time experimented nuclear explosion test named 'Smiling Buddha' in 1974. Kalam was one among the sixty Aeronautical Engineers in this project

Abdul Kalam played a vital role in the nuclear explosion test project in Pokran named "Operation Sakthi" in 1998. The credit that the India has become a nuclear power goes to him



Kalam worked in five missile projects of India. He was the most important behind the designing defence rocket of India

The Government of India awarded him the Bharatha Ratna. He was the President of India during the period from 2002-2007

The missile man who quoted "Man needs difficulties because to enjoy the success they are needed to and you have to dream before your dreams can come true" lives among us even after his death. Let's also sacrifice for the country like him

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EVALUATION

B5W4H3

I Choose the correct answers

1. The moon takes _____ days to complete one revolution around the Earth

   a. 25 b. 26 c. 27 d. 28

2. If the Moon is appeaing in the sky today near the star Karthikai , the position of the Mon after 27 days is near the star

   a. Bharani b. Karthikai
   c. Rohini d. Asvini

3. Telescope was invented by

   a. Han Lippershey b. Galilio
   c. Nicolus Coppernicus d. Ptolomy

4. The galaxy containing young and hot stars is

   a. elliptical galaxy b. irregular galaxy
   c. cluster d. spiral galaxy

5. With the launch of this satellite, ISRO became capable of launching 4 ton heavy satellites.

   a. GSAT- 13 b. GSAT- 14
   c. GSAT- 17 c. Way par GSAT- 19

II. Fill in the blanks.

1. Waxing of moon means _____
2. Heliocentric model is proposed by _____
3. _____ is the prevailing model of Evolution of the Universe
4. _____ is a large constellation which covers a large part of the sky.
5. _____ is the first satellite launched by India

III True or False – If False give the correct answer

1. On a full moon day, when the Sun is setting in the west, moon rises in the West.
2. The word crescent refers to the phases where the moon is less than half illuminated.
3. Galilio accepted the Geo-centric model.
4. Our Milky Way galaxy is identified as an elliptical galaxy.
5. The planet Venus in our solar system doesn't have a moon.

IV Match the following

1.	Rohini	-	GSLV-Mark III
2.	GSAT-14	-	GSLV Mark III M1
3.	GSAT-19	-	SLV-3
4.	Chandrayaan-2	-	PSLV-XL C25
5.	Mangalyaan	-	GSLV-D5

V Analogy

1. Older stars : elliptical galaxies :: younger stars :----------
2. Nearest galaxy : Andromeda :: Nearest star :-------- -------.

VI Very short answer

1. The word ---------- refers to the phases where the moon is less than half illuminated (cresent / gibbous)
2. ---------- and ---------- planets never appear in the mid-night sky.
3. Number of days taken by the Mars to orbit around the Sun.
4. In which phase does the size of the planet Venus is small?
5. The only evidence of the big bang theory is
6. The galaxy which contains abundant amount of gas and dust is _____

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7. Which country launched the world's first artificial launch vehicle?

VII Short Answer Questions

1. What is epicyclic model?
2. Name the four different types of galaxies.
3. What is constellation?
4. Give the expansions of PSLV and GSLV

VIII Answer in Detail

1. Explain the waxing and waning phases in Venus
2. Write short notes on constellations.

IX. HOT Question

Neelan and Mala are having a conversation about our Universe. Neelan is telling our earth will be the only planet in the entire Universe to have a life with. But, Mala is opposing his view by citing certain points. What would be the argument of Mala. Do you support Mala? Justify your stand.

ICT CORNER

UNIVERSE AND SPACE

Let us know about Universe and space

PROCEDURE :

Step 1: Use the URL or scan the QR code to open the activity page.

Step 2: Click the start button and then Click anywhere to open side bar.

Step 3: Click the top most icon in the side bar then Click the RUN INTRO button to see the various views of the solar system and universe

Step 4: Click the bottom most search icon in the side bar to search a particular planet, constellation, stars and Spacecraft.

Step 5: By dragging the mouse left ,right, up and down you can see the various views and scroll the Mouse to zoom in and zoom out .

Step 6: Click the play button to see the solar system in year wise.


Step 1


Step 2


Step 3


Step 4

Universe and Space URL:

https://www.solarsystemscope.com/

https://play.google.com/store/apps/details?id=air.com.eu.inove.sss2

*Pictures are indicative only

*If browser requires, allow Flash Player or Java Script to load the page.

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