GEOGRAPHY
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6th Std Science
Unit 1 Measurements

Introduction

We have already heard about the words like weight, kilogram, litres, millilitres, kilometre, length, distance etc. In this chapter let's have a deeper look at length, weight, volume and time and the necessity to measure them. To do the tasks given above we need to know about measurement. The comparison of unknown quantities with some known quantities is known as measurement. Measurement of a quantity has two parts: a number and its unit.

What are the measuring tools that you know?

Which of these tools will you use to do the tasks listed above and the similar ones?

Length
What is length?

The distance between one end and the other desired end is called as length. It may be the distancebetween the edges of a book or a table or the corners of a football ground or even from your home to school.The standard unit of length is 'Metre'. It is represented by letter 'm'. Very small lengths can be measured in mm and cm. Still larger measures, say height of a building, a banner or a lamp post are all measured in metre. How to express still longer lengths? Say distance between two cities or villages or distance between your school and home? It is expressed in kilometre (km).

Measuring Tools

Know the unit of length
1 km (kilometre) = 1000 m (metre)
1 m (metre) = 100 cm (centimetre)
1 cm (centimetre) = 10 mm (millimetre)

Measure the length of your pencil now. For sure the lengths of all your pencils are not the same.

1. Take the meter scale
2. Check lines with marking 1,2,3,4 ... till 15 (for smaller scales) or till 30 (bigger scales). The distance between 1 and 2 is denotes a centimetre (it is written as 'cm').

3. Notice, in between 1 and 2 there will be smaller markings. If you count, there will be 9 such lines. The distance between any two consecutive smaller markings within a 'cm' denotes a millimetre (written as 'mm').

Let us now understand more about the three important quantities –Length, Mass and Time.From the activity:1 you see that your measurement is different from that of your friends. Also different measuring units are used in different countries.

Why do we need SI Units?

The sake of uniformity, scientists all over the world have adopted a common set of units to express measurements. This system is called as the International System of Units or SI Units.

SI unit for length is Metre
SI Unit for mass is Kilogram
SI Unit for time is Second
Area of Surface = m2
Volume of Solid = m3

Multiples and sub multiples of SI Units

Prefixes used in SI Units. (Always remember the base unit is metre, litre, kilogram)

Corrective Measures for Measurement

Measurement has to be accurate and the approach has to be correct always. In our day to day life approximation may not have much impact. But it has a large impact in scientific calculations. For example, if the curvature of key (lock and key) is changed by even 1 mm, the lock would not open. Let us look at some common mistakes that occur while using a scale.

To measure the length of a pin using a scale

- The head of the pin has to coincide with '0' of the scale.
- Count the number of centimetre and from there count the number of finer divisions. The count of the division is 'mm'
- In the above example the length of pin is 2 cm and 6 mm.
- Take care to write the correct submultiple

Parallax is a displacement or difference in the apparent position of an object viewed along two different lines of sight.

Correct position of the eye is also important for taking measurement. Your eye must be exactly in front of vertically above the point where the measurement has to be taken. In the above representation, to avoid parallax error, reading will be correct. From positions 'A' and 'C', the readings will be different and erroneous.

Volume

Volume of Solids

Length is a fundamental quantity. That means, it cannot be expressed in anyother quantities. Using length, we can find out other measurements like Area and Volume. Area is obtained by using two lengths. So, Area = Length × Breadth. Now, you can guess how to measure the area of your text book, your classroom or your playground.

Volume is also a derived quantity and it can be measured from measuring lengths. Let us calculate volume of a box. To know the volume of a box we need to know the length (l), breadth (b) and height (h). With a measuring scale measure the three parameters in cm. The volume of the box = l × b × h. Unit of volume would be obviously cm × cm × cm = cubic cm or cm3. What do you infer from this? Assume the volume of cubical box is 1000 cubic cm. It means 1000 cubes each with dimensions 1cm × 1cm × 1cm can be placed inside the box. Try to express this quantity in suitable unit.

Volume of Liquid

Measuring the volume of a liquid is quite easy. Liquids take the shape of the container in which they are kept. A liquid whose volume is to be found can simplybe poured into a graduated container. Graduated cylinders, beakers, pipettes and burettes are available for measuring exact volumes. The volume of liquid is usually measured in litres.

We would have often heard the word litre in our daily life. For an example 1 litre milk packet, 20 litres water can.

Measuring the volume of objects with irregular shape

Suppose you want to measure the volume of an object which has irregular shape. How will you do this? There is no mathematical formula to measure this but there are many ways to do. Remember, volume is the space occupiedby an object. We can use this property to measure the volume of an object with irregular shape, for example a stone.

Let us try to find volume of a small piece of stone.

Fill a graduated measuring cylinder with water to certain level, say 50 ml. Tie the stone with a piece of fine thread. Immerse the stone completely into water.

As the stone is immersed, we can observe that water level increases. Why? The stone displaces the water to occupy the space inside the measuring cylinder. How much water would be displaced? It would be equal to the space taken up by stone. So the amount of water displaced will be the volume of the stone. This method is called as water displacement method.

Suppose initially the water level was 50 ml. After you immerse a stone the water level rises to 75 ml. What is the volume water displaced? Volume of the water displaced is 75 ml – 50 ml = 25ml

1ml = 1 cubic cm

25ml = 25 cm^3.The volume of Stone = 25cm^3

Volume of gas

We can also measure the volume of gases. Gases expand to fill the container into which they are placed. When you compress, a gas you can make the same gas to occupy lesser space. (as in LPG gas cylinder). Therefore it is not easy to talk about the volume of gas in the same way as a volume of a stone or a liquid. It is essential to take into account the pressure at which the gases are kept. We will learn about these later.

SI unit for Volume of solid is cubic metre. Liquids and gases are usually measured in litres. But also can be measured in m3 or cubic metre. Similar to the length,

1 m^3 = 1 kilolitre (kl or kL)

1cm^3 = 1 millilitre (ml or mL)

1mm^3 = 1 microlitre (µl or µL)

Mass

Mass and Weight

Mass is the measure of the amount of matter in an object. Weight is the gravitational pull experienced by the mass.

Hold a sheet of paper in one hand and a book in another. Which hand feels the heaviness? The mass of the book is more than that of a single sheet of paper. Therefore the pull on the book is more than that of the paper. Hence our hand has to give more force to hold a book than a paper. This force is what we experience as 'heaviness'.

The SI unit of mass is kilogram. It is represented by the 'kg'.

Now a question, what is your mass? If you measure it grams that would be a huge number is it not? So it is expressed in kilogram. Bigger weights are measured in tonne or Metric Tonne.

1000 milligram = 1 gram
1000 gram = 1 kilogram
1000 kilogram = 1 tonne

Beam Balance

We use beam balances to measure mass. A beam balance works by comparing themass of an object to that of known mass (called a standard mass)

Electronic Balance

An electronic balance is a device used to f nd accurate measurements of weight. It is used very commonly in laboratories for weighing chemicals to ensure a precise measurement of those chemicals for use in various experiments. Electronicbalances may also be used to weigh food, other grocery items, as well as jewellery.

Time

Day changes into night and night in to day. Seasons also change. We know time passes. How do we measure the passage of time? Clocks are used to measure time. You know how to read a clock face and note the time. You can also use your pulse to measure 'rough' time. Count the number of pulses. That can tell you the time elapsed. In your normal speed of speaking, say "one little second"; "two little second" to count the passage of time.

- In earlier days people used sand clock and sundial to measure the passage of timeduring the day. The shadow cast by a stick can be used to estimate time. One can also use a vessel with a small hole for computing time. Take a vessel or bottle with a small hole in it and fill it with water. The time taken for water to drain can also be used as a measuring device.
- These are rough methods for counting passage of time. We can use electronic clock, stopwatch and other instruments to count even

smaller durations of time

An odometer is a device used for indicating distance travelled by an automobile.
The metric system or standard set of units was created by the French in 1790.
A ruler or scale, used now a days to measure length was invented by a William Bedwell in 16th century.
A standard metre rod made of an alloy of platinum and iridium is placed at the Bureau of weights and measures in Paris. National Physical Laboratory in Delhi has a copy of this metre rod.
One kilogram is equal to the mass of a certain bar of platinum-iridium alloy that has been kept since 1889 at the International Bureau of Weights and Measures in Sevres, France.

Numerical Problems

- Look at a meter scale carefully and answer the following:
- How many mm are there in a cm?
- How many cm are there in a m?
- Complete the following:
  ¾ 7875 cm =_______ m ______cm
  ¾ 1195 m =______ km ________ m
  ¾ 15 cm 10 mm = ________ mm
  ¾ 45 km 33 m =________ m.

A Quick Look

- The comparison of an unknown quantity with some known quantity is known as measurement.
- All physical quantities have standard units for the sake of uniformity.
- Lengths, mass and time are some of the fundamental physical quantities.
- The SI units for Length - metre Mass - kilogram Time - second Volume - litre (or) cm3
- While using ruler, the accurate measurement can be arrived by avoiding three types of possible errors.
- Volume of solids, liquids and regular objects is measured by direct measurement.
- Volume of irregular objects can be measured by water displacement method.
- Electronic balance is an instrument to provide accurate measurement of mass correct up to milligram.

Some open ended questions

- The school authority planned to conduct a mini marathon race within the school campus. They decided that the running distance to be 2 kilometres. Is it possible to have a school campus with circumference of 2km? Discuss with your friends of how big the campus should be?

- Give other options if it is not a big campus.
- Is the distance in the sea also calculated in kilometres? How is it possible to calculate the distance in sea water? Explore!
- We know that the distance between celestial bodies is calculated in terms of light year. (Ah! Unit of distance in terms of year???) Yes, it's the distance travelled by light in one year. Now without calculator find how many kilometres light would have travelled in a year. (No Calculator). Get the speed of light from your class teacher.
- We see that the distances between Chennai and Madurai is '462' kms. But from which point to which point is this distance calculated?. As we are science students we need to know it with the precision. Is it between the twobus Stand? Or between the two railway stations? Discuss and figure it out. Check your answers with your class teacher.
- A person needs to drink two litres of water a day. Note down how much water you drink each day? Make a rough calculation and check if you are drinking the required amount of water.

6^{th} term 1
Unit 2 Forces and Motion

Introduction

We had studied in our earlier classes that push or pull results in some motion of the object. When we open the door, kick a football, lift our school bag, all involve motion and there is some push or pull.

Motion and Rest
What is rest? What is motion?

Suppose there is a book on your table right in the middle. Is the book moving? You will say "it is not moving; it is at rest". If you push the book to one side of the table to clear space for keeping your notebook, then you will say the book is moving.

When the book was at the same place with respect to the table, you say the book was at rest; but when it was pushed from one place on the table to another place, you say it was moving.

When there is a change of position of an object with respect to time, then it is called motion, if it remains stationary it is called rest.

Is Mohan in motion?

We can readily observe that both Reka and Babu are correct. From the point of view of Babu, Mohan along with the bus is in motion; but for Reka who is sitting beside him, he is at one place; therefore stationary. So, according to Babu, Mohan is in motion; Mohan is at rest from Reka's observation. Can you think any other examples?

Hi! Please answer honey by observing the situation in the picture

Event 1: The man in the boat is moving with respect to the bank of river. He is at rest with respect to the boat.

Event 2:
The girl on the swing is _______with respect to the seat of the swing. She is with respect to the garden.

Event 3: Nisha is going to her grandmother's house by bicycle. The girl on the bicycle is __________ with respect to the road. She is _______with respect to the bicycle.

Take the case of a book on a table at rest. Is it really without any motion? We know that Earth is rotating on its axis; therefore the table along with the book must be rotating. Is it not? We are also moving along with the earth. Therefore, from the point of view of ground on which we stand, the book is at 'rest'. Similarly, while travelling in a speeding bus, we feel that the poles and trees seem to move backwards, and the things inside the bus are stationary.

An object may appear to be stationary for one observer and appear to be moving for another. An object is at rest in relation to a certain set of objects and moving in relation to another set of objects. This implies that rest and motion are relative.

Aryabatta, an ancient Indian astronomer, said that like the banks of the river appear to move back to a person in a boat floating gently in a river, the night sky studded with stars appear to move from east to west while Earth rotates from west to east. Learn more by asking others and reading up on your own.

How things move?

When we kick a ball it moves. When we push the book on the table, it moves. When a bullock pulls the cart moves. Motion occurs when the object is pulled or pushed by an agency.

In daily life, we pulled out water from the well, with bucket or "the animal pulls a bullock cart". It is a person or animal, that is an animate agency that does the pushing or pulling. Sometimes we see a tall grass in the meadow dancing in the wind, a piece of wood is moving down a stream. What pushes or pulls them? We know that blowing wind and flowing water is the cause. Sometimes the push or pull can be due to the inanimate agency.

Forces are push or pull by an animate or inanimate agency.

Contact, Non-Contact Forces

In all the above cases, the force is executed by touching the body. so, these type of force is called Contact Force. Mysteriously ripen coconut falls to the ground. What pulls it to the ground? We would have heard of the 'force of gravity' of Earth. Gravity pulls the ripen coconut from the tree to the ground.

Bring a magnet near the small iron nail. Suddenly the nail jumps into the air and sticks with the magnet. Observe that the magnet and the nail did not touch each other. Still, there was a pulling force that made the nail to jump towards the magnet. In these two examples, the force is applied without touching the object. Such forces are known as "non-contact forces"

Forces can be classified into two major types; contact and non-contact forces. Wind is making a fag flutter, a cart pulled by a bullock are contact forces. Magnetism, gravity are some examples of non-contact forces.

What happens when we apply a force on an object?

What happens when you apply a force on an object? Say you push a book on the table. The book moves. Application of force in an object results in motion from a state of rest.

What happens when a batsman hit a ball? The ball is already in motion, but with the strike, the speed of the ball increases. Moreover the direction of the ball changes. Application of force on object results in a change in its speed and change in its direction.

Crush a balloon, apply force on roti dough, pull a rubber band. In these cases the shape of the object change on application of force. Application of force in object results in expansion or contraction.

Look at this picture. The person is applying force to stop the cart from moving. When the force is applied against the direction of the motion, the speed can be reduced, or even the motion stopped completely. Break in a speeding bicycle.
In a nutshell, the applied force is an interaction of one object on another that causes the second object to move from rest, or speed up, slow down, stop the motion, change the direction, compress or expand.
Forces can

Change the states of body from rest to motion or motion to rest.
Either change the speed or direction or both of the body.
Change the shape of the body.

That is its motion was 'rotational' and then 'circular' 'straight line or linear' and later 'oscillatory'.

Throw paper aeroplanes or paper dart. Watch its f ight path when you throw it at an angle. The path curves i.e the paper f ight is moving ahead but direction is changing while moving such paths are called curvilinear.

Periodic and non- periodic motions

A fly buzzing around the room is a combination of all these and flight path is zigzag.

You can classify the motion according to the path taken by the object.
Linear- moving in a straight line, like a person walking on a straight path, free fall.
Curvilinear - moving ahead but changing direction, like a throwing ball.
Circular -moving in a circle, swirling stone tied to the rope.
Rotatory -The movement of a body about its own axis, like a rotating top.
Oscillatory -coming back to the same position after a fixed time interval, like a pendulum.
Zigzag (irregular)- like the motion of a bee or people walking in a crowded street.

Oscillations at Greater Speed
Ask your friend to hold the two ends of a stretched rubber band. Strike it in the middle. Do you see it oscillates very fast? When the oscillation is very swift, it is called as vibration

Fast oscillations are referred to as vibrations.

Speed Vs Slow?

Take the case of the hour-hand of a clock. In one day it makes two rounds. Look at a bouncing ball. It bounces a certain number of times for a given time interval or period. Look at the water waves, in a given period that is a time interval; a fixed number of waves hit the shore.

Motion repeated in equal intervals of time is called as periodic motion.
Let us take the example of sabing swing in wind. This motion is not in uniform interval. Such Motions are called non-periodic motion.

Revolution of the moon around the earth is periodic but not oscillatory. However, the children playing in a swing is both periodic and oscillatory.
Look at the tall tree. When the wind is gentle, its branches are dancing slowly; but if the gentle wind becomes strong, the branches shake violently, and if the speed increases further, the branch may even break and fall. That is the motion can be slow or fast.

Can we say a motion is slow or fast without comparing anything?
Compared to walking, cycling is fast, but a bus is faster than a cycle. The aeroplane is much faster than a bus. So, slow or fast is a relative concept which depends upon the motions we are comparing.

Then how to we say a body moves in a particular Speed?

How do we say? Let us calculate how long they travelled in One Hour?
Distance travelled by the Car in One Hour = ____ 80____ Km (160/2)
Distance travelled by the Bus in One Hour = __________ Km
Distance travelled by the Truck in One Hour = ________ Km
Have you found out? say now.
Fastest _______ , Slowest __________
Have you noticed that saying who is fast and slow? is easy when we calculate the distance they travelled in one hour.

The distance travelled by an object in unit time is called average speed of the object.
If an object travelled a distance (d) in time (t) then its Average speed (s) is = distance travelled / time taken = d/t.

In other words, you divide the distance travelled by the time taken to get the speed.

Suppose a car travels 300 km in one hour. Then we say the speed of the car is '300 kmph' (we read it as 'three hundred kilometres per hour').

If an object travelled 10 metre in 2 seconds, then

Average speed (s)

= distance travelled (d) / time taken (t)
= 10 metre/ 2 second
= 5 metre / second

bus takes three hours to cover this distance of 180 kilometres. Then its Average speed is

Average speed (s)

= distance travelled (d) / time taken (t)
= 180 kilometre/ 3 hour
= 60 kilometre / hour

Please note that metre/second or kilometre/hour comes next to our answer for average speed. What is it? Observe the formula for average speed. If we denote the distance in metre and time by seconds then the unit of average speed is metre/second.

If we denote the distance in kilometre and time in hour then the unit of average speed is kilometre/hour. Sometimes we use units like centimetre/second. In science we generally use SI units. In SI units the unit of distance is metre and the unit of time is second. So, the SI unit of average speed is metre/second.

Let us Calculate

A cat travelled 150 metres in 10 seconds, what is its average speed?
Priya ride her bicycle 40 km in two hours. What is her average speed?

Our Speed...

Let us play a small game. Go to the playground with your friends. Mark 100 metre distance for a race. Conduct a friendly running race and calculate the time they taken to complete the distance by stopwatch. Now fill up the following table.

S. No	Name of the student	distance	Time taken (in seconds)	average speed = distance travelled/ time taken	average speed (m/s)
1	Murugesan	100 m	12 sec	100 metre / 12 sec	8.3 m/s
2		100 m			
3		100 m			
4		100 m			
5		100 m			

If you know the speed and the time taken by the object travelled, then we can compute how much distance it had travelled?

Speed = distance travelled / time taken (s = d/t)

s = d/t or st = d

therefore the distance travelled is speed × time.

If a ship travelled at a speed of 50 kmph and it sailed for five hours, how much distance it had travelled.

s = 50 kmph; t = 5 therefore
s × t = 50 kmph × 5 h = 250 km

If we know the speed and distance travelled we can compute the time taken.
s = d/t that is t = d/s time taken = distance travelled / speed

Suppose a bus travels at a speed of 50 kmph and has to cover a distance of 300 km. How much time will it take?
t = d/s that is 300 km/50 kmph = 6 h.

Compute the following Numerical Problems.

If you travel 10 kilometres in 2 hours, your speed is ______ km per hour.
If you travel 15 kilometres in 1/2 hour, you would travel km in one hour, and your speed is______ km per hour.
If you run fast at 20 kilometres per hour for 2 hours, you will cover ________ km

A cheetah is the fastest land animal running with an average speed of 112 km/h

Uniform and non-uniform motion

Suppose a train leaves Thiruchirapalli and arrives at Madurai. Is the train travelled in an uniform speed? First, the train was stationary. When the train left the station, the motion was slow and only after it left some distance that it gathered speed. After that it slowed down while crossing bridges and stop at intermediate stations for passengers. Finally, as the train approached Madurai, again, it slowed and finally came to a halt. That is the speed was not same all through the journey time. That is the speed was non-uniform. This motion is said to be non-uniform motion.

In a nutshell, we can classify the motion in terms a) path b) if it is periodic or not c) if the speed is uniform or not. However, in real life, the motions are combinations many types.		
Motion		
Based on PATH	**Based on DUEATION**	**Based on SPEED**
Linear Motion	Periodic Motion	Uniform Motion
Curvilinear Motion	Non- Periodic Motion	Non Uniform Motion
Circular Motion		

Rotatory Motion
Oscillatory Motion
Zigzag (Irregular) Motion

However, in between the journey, there may have a stretch where in the train might have been going at a constant speed. During that interval the train was moving at uniform speed, that is uniform motion.

If an object covers uniform distances in uniform intervals then the motion of the object is called Uniform Motion. Otherwise the Motion is called Non-Uniform Motion.

Many motions we see in our day to day life are non-uniform. We will learn more about uniform and non-uniform motion in later classes.

Multiple Motions.

Look at the bicycle. What type of motion does the wheel perform? What type of motion does the cycle in total perform?

The tyres rotate and make a rotatory motion, but the cycle as such moves forward in a linear path.

Multiple Motion in a sewing Machine Motion of the needle ________ ______ Motion of the Wheel ________________ Motion of footrest _______________	**A bipedal humanoid robot.**

Robots are automatic machines. Some robots can perform mechanical and repetitive jobs faster, more accurately than people. Robots can also handle dangerous materials and explore distant planets. The term comes from a Czech word, 'robota' meaning 'forced labour'. Robotics is the science and study of robots.

What Can Robots Do?

Robots can sense and respond to their surroundings. They can handle delicate objects or apply great force-for example, to perform eye operations guided by a human surgeon, or to assemble a car. With artificial intelligence, robots will also be able to make decisions for themselves.

How Do Robots Sense?
The quadruped al military robot

Electronic sensors are a robot's eyes and ears. Twin video cameras give the robot a 3-D view of the world. Microphones detect sounds. Pressure sensors give the robot a sense of touch, to judge how hard to grip an egg. Heavy luggage built-in computers send and receive information with radio waves.

Artificial Intelligence

Artificial intelligence attempts to create computer programs that think like human brains. Current research has not achieved this, but some computers can be programmed to recognize faces in a crowd.

Can Robots Think?

Articulated welding robots (Industrial) Robots can think. They can play complex games, such as chess, better than human beings. But will a robot ever know that it is thinking? Humans are conscious-we know we are thinking-but we don't know how consciousness works. We don't know if Robots can ever be conscious.

Nano robotics

Future of Nano robotics
Nano-robots or Nano bots are robots scaled down to microscopic size in order to put them into very small spaces to perform a function. Future Nano bots could be placed in the blood stream to perform surgical procedures that are too delicate or too difficult for standard surgery. Imagine if a Nano bot could target cancer cells and destroy them without touching healthy cells nearby.

Heat

6^{th} Standard - Term-II
Unit 1: Heat

Introduction

- We are all familiar with heat. We feel it on our body when the sun shines, we use heat for cooking our food, We reduce the heat by adding ice cubes while preparing fruit juice. Let us learn about sources of heat.

Sources Of Heat

♦ **Sun**

- We all know that the sun gives us light. Does it give us heat? After standing under the sun light for some time, touch your head. Does it feel hot? Yes, it feels hot because the sun gives out heat besides light. Now, You can understand why it is diff cult to walk bare-footed on sunny days in the afternoon.

♦ **Combustion (Burning)**

- Heat energy can be generated by the burning of fuels like wood, kerosene, coal, charcoal, gasoline/petrol, oil, etc., In your home, how do you get heat energy to cook food?♦ **Friction**
- Rub your palms for some time and then hold them to do you feel? We can generate heat by rubbing two surfaces of some substances. In the past people used to rub two stones together to light f re.

♦ **Electricity**

- When electric current fows through a conductor, heat energy is produced. The water heater, iron box, electric kettle etc., work on this principle.

Heat

Molecules in objects are constantly vibrating or moving inside objects. We cannot see that movement with our naked eye. When we heat the object this vibration and movement of molecules increases and temperature of the object also increases.

Thus, Heat is an energy that raises the temperature of a thing by causing the molecules in that thing to move faster.

Heat is not a matter. It doesn't occupy space. It has no weight. Like light, sound and electricity, heat is a form of energy.

In short, Heat is the total kinetic energy of constituent particles of objects. **SI Unit of Heat is joule**. The unit calorie is also used.

Hot and cold objects

- In our day-to-day life, we come across a number of objects. Some of them are hot and some of them are cold. How do we decide which object is hotter than the other?

- use the tip of our finger to find out whether the tea in a cup has enough heat to drink or whether milk has been cooled enough to set for making curds. We often determine heat by touching the objects. But is our sense of touch reliable?

Temperature

Definition of Temperature

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

v SI unit of temperature is kelvin. Celsius and Fahrenheit are the other units used. Celsius is called as Centigrade as well.

v It determines the direction of flow of heat when two bodies are placed in contact

Is Neela correct?

- Beaker A and B has water at 80o C.

- Then pour the water of A and B to an empty beaker C. Now, What is the temperature of the water in the beaker C? Neela says it will be 160°C.

- What is your opinion? Does Neela say correctly? Make a guess and verify it experimentally

- One day in 1922, the air temperature was measured at 59°C in the shade in Libya, Africa. The coldest temperature in the world was measured in the Antarctic continent. It was approximately – 89oC. The minus sign (–) is used when the temperature falls below the freezing point of water, which is 0°C. If water becomes ice at 0°C, you can imagine how cold – 89°C would be. Our normal body temperature is 37°C. Our body feels cool if the air temperature is around 15 to 20 degree Celsius. Can you estimate the night temperature in your village or city during winter

Heat and Temperature

- Heat and temperature are not the same thing, they in fact mean two different things;

- Temperature is related to how fast the atoms or molecules move or vibrate within the substance.

- 2. Heat not only depends on the temperature of the substance but also depends on how many molecules are there in the object.

- 3. Temperature measures the average kinetic energy of molecules. Heat measures the total Kinetic Energy of the molecules in the substance.

- Total heat is measured by calorie, the amount of heat needed to raise one gram of water by one degree centigrade.

Flow of Heat

An analogy between temperature and water level:

- Water **'flows'** when there is a difference in the 'levels' of water in different places. It does not matter if there is more water in one place or another. Water from a puddle can flow into a reservoir or the other way around. The **'temperature'** of an object is like the water level – itdetermines the direction in which 'heat' will flow. Heat energy flows from higher temperature to lower temperature.

Thermal contact and Thermal equilibrium

- Consider two bodies A and B. Let the temperature of A be higher than that of B. On bringing bodies A and B in contact , heat will flow from hot body A to the cold body B. Heat will continue to flow till both the bodies attain the same temperature.

The temperature determines the direction of flow of heat.

1. You are holding a hot cup of coffee. Would the Heat energy transfer from

- Your body to the coffee, or
- The coffee to your body?

2. You are standing outside on a summer day. It is 40°C outside (notethat normal body temperature is 37°C). Would the Heat energy transfer from.

- Your body to the air particles, or
- The air particles to your body?

3. You are standing outside on a winter day. It is 23°C outside. Would the heat energy transfer from:

- Your body to the air particles, or

- v The air particles to your body?

- Two objects are said to be in **thermal contact** if they can exchange heat energy. **Thermal equilibrium** exists when two objects in thermal contact no longer affect each other's temperature. For example, if a pot of milk from the refrigerator is set on the kitchen table, the two objects are in thermal contact. After certain period, their temperatures are the same, and they are said to be in thermal equilibrium.

Expansion in solids

- Sam is trying to open a tight jar, but he cannot open it. He asks his uncle to help. His uncle says that pour some hot water on the lid of the jar. Sam does so and tries to open it now. Wow! The jar is opened easily! Do you have such experience? How do you open a tightly closed cap of thepen which could not be opened by you normally?

- Most substances expand when heated andcontract when cooled. The change in length / area or volume (due to contraction / expansion) is directly related to temperature change.

- The expansion of a substance on heating is called, the thermal expansion of that substance.

Linear and Cubical Expansion

- v A solid has a definite shape, so when a solid is heated, it expands in all directions i.e., in length, area and volume, all increase on heating.

- v The expansion in length is called linear expansion and the expansion in volume is called cubical expansion.

- v Why is the iron rim of a bullock cart wheel heated before it is fitted onto the wheel? Why is a small gap left between two lengths of railway lines?

- v We can perform an interesting experiment to find out an answer to these questions. All we need to do is to heat a cycle spoke.

Uses of Thermal Expansion
Fitting the iron rim on the wooden wheel

- The diameter of the iron ring is slightly less than that of the wooden wheel. Therefore, it cannot be easily slipped on from the rim of wooden wheel. The iron ring is, therefore, fi rst heated to a higher temperature so that it expands in size and the hot ring is then easily slipped over to the rim of the wooden wheel. Cold water is now poured on the iron ring so that it contracts in size and holds the wooden wheel tightly.

Rivetting

- Rivets are used to join two steel plates together. Hot rivet is driven through the hole in the plates. One end of the rivet is hammered to form a new rivet head. When cooled, the rivet will contract and hold the two plates tightly together.

Thermal Expansion Examples

Give Reasons for the following

- Gaps are left in between rails while laying a railway track.
- Gaps are left in between two joints of a concrete bridge.

Cracking of a thick glass tumbler

- Glass is a poor conductor of heat. When hot liquid is poured into the tumbler, the inner surface of the tumbler becomes hot and expands while the outer surface remains at the room temperature and does not expand. Due to this unequal expansion, the tumbler cracks. Electric wires Electric wires between electric posts contract on cold days and sag in summers. To solve this problem, we leave wires slackso that they are free to change length.

- Glassware used in kitchen and laboratory are generally made up of Borosilicate glass (pyrex glass). The reason is that the Borosilicate glass do not expand much on being heated and therefore they do not crack.

Numerical problems

- I put a kettle containing 1 litre of cold water on the gas stove, and it takes 5 minutes to reach the boiling point. My friend puts on a small electric kettle, containing ½ litre of cold water, and it takes 5 minutes to get up to boiling point. Which gives more heat in 5 minutes?

  the gas supply; or
  the electricity supply?

  Can you say how many times as much?

1. One calorie heat energy is needed to raise the temperature of the water from 30oC to 31oC. How much heat energy is needed to raise the temperature of the water from 30oC to 35oC.

   - The main source of heat is sun, we can obtain heat from combustion, friction, and electricity.

   - Heat is an energy that raises the temperature of a thing by causing the molecules in that thing to move faster

- Heat is the total Kinetic energy of constituent particles of objects.
- SI unit of Heat is joule (J).
- The measurement of warmness or coldness of a substance is known as its temperature.
- SI unit of temperature is kelvin.
- Temperature determines the direction of flow of heat when two bodies are placed in contact.
- Two objects are said to be in thermal contact if they can affect each other's temperature.
- Thermal equilibrium exists when two objects in thermal contact no longer affect each other's temperature.
- Most substances expand when heated and contract when cooled. The expansion of a substance on heating is called the thermal expansion of that substance.
- A solid has a definite shape, so when a solid is heated, it expands in all directions i.e., in length, area and volume, all increase on heating. Summer day Winder day

6th Std (Term- II)
Unit – 2 . Electricity

Introduction

- We use electricity in our day to day life. Have we ever wondered from where do we get this electricity? How does this electricity work? Can we imagine a day without electricity? If you ask your grandfather, you can come to know a period without electricity. They used oil lamps for light, cooked on fires of wood or coal. By the advent of electricity, our day to day works are made easy and the world is on our hands. What are the appliances those work on electricity? What are the materials those allow electricity to flow through? What are electric circuits? What are electric cells and batteries? Come on, let us descend into this lesson to know more about electricity.

Sources of Electricity

- Selvan and Selvi are twins. They are studying in sixth standard. They visited their grandparent's village during summer vacation. At 6 O'clock in the evening Selvan's Grandfather switched on the light. The whole house was illuminated. Seeing this Selvan asked his grandfather "How do we get light by switching on the switch?" So, his grandfather took him to the nearest electricity board and enquired about the electricity.

- The Major Electric power stations in Tamilnadu are: Thermal stations (Neyveli in Cuddalore District, Ennore in Thiruvallur District), Hydel power stations (Mettur in Salem District, Papanasam in Tirunelveli District), Atomic power stations (Kalpakkam in Kanchipuram District, Koodankulam in Tirunelveli District), and Wind mills (Aralvaimozhi in Kanyakumari District Kayatharu in Tirunelveli District). Apart from these Solar panels which are prevalent in many places are used to produce electricity.

- Let us discuss in shortly about working power stations.

Thermal Power stations

- In thermal power stations, the thermal energy generated by burning coal, diesel or gas is used to produce steam. The steam thus produced is used to rotate the turbine. While the turbine rotates, the coil of wire kept between the electromagnet rotates. Due to electromagnetic induction electricity is produced. Here heat energy is converted into electrical energy.

Hydel power stations

- In hydel power stations, the turbine is made to rotate by the flow of water from dams to produce electricity. Here kinetic energy is converted into electrical energy. Hydel stations have long economic lives and low operating cost.

Atomic power stations

- In atomic power stations, nuclear energy is used to boil water.The steam thus produced is used to rotate the turbine. As a result, electricity is produced. Atomic power stations are also called as nuclear power stations. Here nuclear energy is converted into mechanical energy and then electrical energy.

Wind mills

- In wind mills, wind energy is used to rotate the turbine to produce electricity. Here kinetic energy is converted into electrical energy.

Cell

A device that converts chemical energy into electrical energy is called a cell.

- A chemical solution which produces positive and negative ions is used as electrolyte. Two different metal plates are inserted into electrolyte as electrodes to form a cell. Due to chemical reactions, one electrode gets positive charge and the other gets negative charge producing a continuous flow of electric current.

Depending on the continuity of flow of electric current cells are classified in to two types. They are primary cells and secondary cells.

Primary Cells

- They cannot be recharged. So they can be used only once. Hence, the primary cells are usually produced in small sizes.

Examples

- cells used in clocks, watches and toys etc., are primary cells.

Secondary Cells

- A cell that can be recharged many times is called secondary cell**.** These cells can be recharged by passing electric current. So they can be used again and again. The size of the secondary cells can be small or even large depending upon the usage. While the secondary cells used in mobiles are in the size of a hand, the cells used in automobiles like cars and buses are large and very heavy.

Examples

- Secondary Cells are used in Mobile phones, laptops, emergency lamps and vehicle batteries.

Battery

- Often, we call cells as 'batteries'. However only when two or more cells are combined together they make a battery. A cell is a single unit that converts chemical energy into electrical energy, and a **battery is a collection of cells.**

Electric Circuits

- Grandfather asked Selvi to bring torchlight. While taking the torchlight, it fell down and the cells came out. She puts the cells back and switched it on (Fig. A)

- The torchlight did not glow. She thought the torchlight was worn out. She was afraid that grandfather might scold her. She started crying. Her uncle came there and asked the reason for crying. She conveyed the matter. Her uncle removed the cells and reversed them (Fig B)

- Now, the torch glows. Selvi's face also glows. Uncle told her the reason and explained her about electric circuits.

Inside view of torch

- An electric circuit is the continuous or unbroken closed path along which electric current flows from the positive terminal to the negative terminal of the battery. A circuit generally has:

  - A cell are battery- a source of electric current
  - Connecting wires- for carrying current
  - A bulb- a device that consumes the electricity
  - A key or a switch- this may be connected anywhere along the circuit to stop or allow the flow of current.

a. Open Circuit

- In a circuit if the key is in open (off) condition, then electricity will not flow andthe circuit is called an open circuit. The bulb will not glow in this circuit.

b. Closed Circuit

- In a circuit if the key is in closed (on) condition, then electricity will flow and the circuit is called a closed circuit. The bulb will glow in this circuit.

- Can you make a simple switch own by simple things available to you?

Types of Circuits

- v **Simple Circuit**
- v **Series Circuit**
- v **Parallel Circuits**

1. Simple Circuit

- A circuit consisting of a cell, key, bulb and connecting wires is called a simple circuit.

2. Series Circuit

- If two or more bulbs are connected in series in a circuit, then that type of circuit is called series circuit. If any one of the bulbsisdamaged disconnected, the entire circuit will not work.

3. Parallel Circuit

- If two or more bulbs are connected in parallel in a circuit, then that type of circuit is called parallel circuit.

Symbols of Electric Components

- In the circuits discussed above, we used the figures of electric components. Using electric components in complicated circuits is difficult. So, symbols of the components are used instead of figures. If these symbols used in electric circuits, even complicated circuits can be easily understood.

- If any one of the bulb is damaged or disconnected the other part of the circuit will work. So parallel circuits are used in homes.

- Electric Eel is a kind of fi sh which is able to produce electric current. This fish can produce an electric shock to safeguard itself from enemies and also to catch its food.

More to Know

- Ammeter is an instrument used in electric circuits to find the quantity of current flowing through the circuit. This is to be connected in series.

Conductors and Insulators

Will electric current pass throw all materials?

- If an electric wire is cut, we could see a metal wire surrounded by another material. Do you know why it is so?

Conductors

- The rate of flow of electric charges in a circuit is called electric current. The materials which allow electric charges to pass through them are called conductors. Examples: Copper, iron, aluminium, impure water, earth etc.

Insulators (Non-Conductors)

The materials which do not allow electric charges to pass through them are called insulators or non- conductors.

Safety measures to safeguard a person from electric shock

- Switch off the power supply.
- Remove the connection from the switch.
- Push him away using non - conducing materials.
- Give him first aid and take him to the nearest health centre.

More to Know
Thomas Alva Edison (February 11, 1847 – October 18, 1931) was an American inventor. He invented more than 1000 useful inventions and most of them are electrical appliances used in homes. He is remembered for the invention of electric bulb.

3.Changes Around Us

Introduction
What is a change?

he process in which something becomes different from what it was earlier? It is the observable difference between initial state and the final state of any substance. Change is the Law of Nature. In our day - to - day life we see many changes around us. Weather changes periodically (daily/seasonly), Seasons changes periodically. A paper burns readily while it takes a few days for an iron nail to rust. It takes a few hours for milk to turn into curd but vegetables get softened in a few minutes when cooked. The said changes are accompanied by change in properties like shape, colour, temperature, position and composition. Some changes can be observed while some are not possible to notice. Can you observe some changes and write about it?

Classification of Changes

There are different types of changes observed in nature that occurs around us. Some changes take place very quickly while others take hours, days or even years. Some changes are temporary while some others are permanent. Some changes produce new substances while others do not. Some changes are natural while others are made by human beings. Some changes are desirable to us but some changes are not desirable. We shall now try to classify changes on the basis of certain similarities and differences.

- slow and fast
- reversible and irreversible
- physical and chemical changes
- desirable and undesirable
- natural and man – made

Slow and Fast changes

Slow changes

Changes which take place over a long period of time (hours/days / months / years) are known as Slow changes.

Examples:

growth of nail and hair, change of seasons, germination of seed.

F**ast Chang**es

Changes which take place within a short period of time (seconds or minutes) are known as fast changes.

Examples:

Bursting of balloon, breaking of glass, bursting of fire crackers, burning of paper.

Reversible and Irreversible changes

Reversible change

Changes which can be reversed (to get back the original state) are known as reversible changes.

Examples:

Touch me not plant (Responding to touch), stretching of rubber band, melting of ice.

Irreversible change

Changes which cannot be reversed or to get back the original state are known as Irreversible changes.

Physical and Chemical Changes

Physical changes

Physical changes are the temporary changes in which there is change in the physical appearance of the substance but not in its chemical composition. Here no new substance is formed.

Example:

Melting of ice, the solution of salt or sugar, stretching of rubber band.

Let us now understand the physical changes that take place in water. You already know that water exists in three states as solid, liquid and gas. Change of state takes place either by heating or cooling. By heating energy is supplied and by cooling energy is taken away. These are the reasons for the changes.

Let us name a few processes connected with the changes in states of water.

Change	**Process**
ice into water on heating	melting
water into steam on heating	vapourisation
steam into water on cooling	condensation

water into ice on cooling	freezing

Let usunderstand one more physical change

More to Know
The change of state from solid to gas directly is called Sublimation.
Example : Camphor

Dissolution

The spreading of the solid particles (broken into individual molecules) among the liquid molecules is called as dissolution.

- Solvent is a substance that dissolves the solute.
- Solute is a substance that is dissolved in a solvent to make a solution.
- When solute is dissolved in a solvent it forms a solution.

Solute + Solvent   Solution

Water is known as the universal solvent. It dissolves a wide range of substance.

Chemical changes

Chemical changes are the permanent changes in which there is change in the chemical composition and new substance is formed.

Examples:

Burning of wood, Popping of popcorn, Blackening of silver ornaments, and Rusting of iron.

Physical Change	**Chemical Change**
No new substance formed	New substance formed
No change in the chemical composition	There is change in the chemical composition
It is a temporary change	It is a permanent change
It is reversible	It is irreversible

Desirable and Undesirable Changes

Desirable changes

The changes which are useful, not harmful to our environment and desired by us are known as desirable changes.

Examples:

Ripening of fruit, growth of plants, cooking of food, milk changing to curd.

Undesirable changes

The changes which are harmful to our environment and not desired by us are known as Undesirable changes.

Examples:

Deforestation, decaying of fruit, rusting of iron.

Natural and human made changes

Natural changes

Changes which take place in nature on their own and are beyond the control of human beings are known as Natural changes.

Examples:

Rotation of the earth, Changing phases of the Moon, Rain.

Human made or artificial changes

The changes which are brought about by human beings are known as human made or artificial changes. They will not happen on their own.

Examples:

Cooking, Deforestation, Cultivating crops, construction of buildings.

Points to remember

- Everything in this world undergoes changes. Changes occur in position, shape, size, state, colour, temperature, composition etc.,
- Fast change – short period of time Slow change – long period of time

- Reversible change – can go back to its original state Irreversible change – cannot go back to its original state
- Desirable change - changes that are useful and harmless to our environmental Undesirable change - changes that are harmful to our environment.
- Natural change - changes that take place in nature on their own Human made change - changes that are brought about by human beings
- A solute when dissolved in a solvent makes a solution.
- The process of dissolving the solute in solvent is called dissolution.

4.Air

Introduction

Air is present everywhere around us. We cannot see air. But we can feel its presence in so many ways. For example, we feel air when the trees rustle, clothes hanging on a clothes-line sway, pages of an open book flutters when the fan is switched on, when kites fly in the sky. We cannot see, touch or taste air but we can feel it. It is the air that makes all these movements possible. Thus, we can understand that air is present all around us.

Air is necessary for us to live. We can live without food for some days, without water for a few hours, but cannot survive without air for more than a few minutes. So, air is very important for all living beings to survive.

When air is moving it is called wind. It is cool and soothing as breeze. When air moves with force it can even uproot trees and blow off the roof tops. Air is necessary for breathing and also for combustion. Shall we do an activity?

Atmosphere

Our earth is surrounded by a huge envelope of air called the atmosphere. Atmosphere extends to more than 800km above the surface of earth and is held in place by the earth's gravity. The atmosphere protects us from many harmful rays coming from the sun. The air envelope is thicker near the earth's surface and as we go higher the density and the availability of air gradually decreases. This is because, as we go higher, the force of gravity decreases, so it is not able to hold large amount of air.

The atmosphere is made of five different layers – the troposphere, the stratosphere, the mesosphere, the ionosphere and the exosphere.

The troposphere is the layer closest to the earth. It is the layer in which we live. It extends upwards for about 16km above the surface of the earth. Movement of wind takes place in this layer. It also contains water vapour, which is responsible for making clouds. This layer is responsible for the weather we experience on earth.

Aircrafts usually fly above this layer to avoid strong winds and bad weather

The stratosphere lies above the troposphere. This layer has the ozone layer in it. The ozone layer protects all life on earth from the harmful ultraviolet rays of the sun.

> A weathercock shows the direction in which the air is moving at a particular place. You can also make a wind sock to find the direction of the wind. Can you try it yourself?

Experimental verification of presence of Oxygen, Carbon-di-oxide and Nitrogen in Air
Is air a thing or a composite mixture?

For long time, that is, until eighteenth century, human thought 'air' as a fundamental constituent of matter. However an ingenious experiment conducted by Joseph Priestley in 1774 showed that "air is not an elementary substance, but a composition," or mixture of gases. He was also able to identify a colourless and highly reactive gas which was later named 'oxygen' by the great French chemist Antoine Lavoisier.

Priestley took a tub of water and made a float and placed a candle on it. He coveredthe candle with a glass jar. [As the bottom portion of the jar was filled with water, no air can enter or exit and hence the jar was completely sealed (Fig-1)]. As you would have guessed the candle flame was extinguished in a very short time. He used a magnifying glass to focus the sun rays to light the candle. Thus he tried to to relight the candle many times without opening the sealed jar (Fig-2). The candle could not be relit. What can we make out of it?

It was clear that something in the air was being used for burning and being converted into another substance. Once the substance in the air that was aiding the burning was completely used by the burning flame and converted into another substance, the flame went out.

[Later chemist named the substance necessary for burning as oxygen and during the process of burning oxygen is converted mostly into carbon dioxide.]

Now as the jar was inside the water, Priestley could gently lift the jar and place a live mouse inside it without allowing outside air to enter the jar (Fig-3). Without oxygen, as you would have guessed, the mouse died (Fig-4). It was clear that oxygen was necessary for the survival of the mouse.

In the next step, he gently lifted the jar and placed a mint plant (Fig-5). (Note: Look at the Figure- 5; you could see that the plant is inserted into the bell jar when the jar is very much inside the water. This is done to ensure that the outside air is not entering into the bell jar.) Plant being a living thing like mouse, perhaps he thought, would die. Instead, the plant survived. After placing the mint plant, he lit up the candle and it continued to burn (Fig-6).
In fourth experiment, he took a jar, burned a candle and converted all oxygen into carbon dioxide. He placed a mint plantand a mouse into this jar. Both the plant and the mouse survived (Fig-7). He found that plants and animals have a synergy. Animals consume oxygen and release carbon-di-oxide and plants take up carbon dioxide and release oxygen.

During 1730 – 1799, Jan Ingenhousz showed that sunlight is essential to the plant to carry out photosynthesis and also to purify air that is fouled by breathing animals or by burning candles.

From these experiments i**t was clear that "air" was a composite mixture of many gases like oxygen and carbon-di-oxide.**

More to Know!

Daniel Rutherford, a Scottish chemist, discovered nitrogen. He removed oxygen and converted it into carbon-di-oxide using an inverted bell jar using a burning candle. He passed this air without oxygen through lime water and removed carbon-di-oxide also.

Once the carbon-di-oxide was removed in that air, neither a candle burned nor a plant breathed. Hence he was sure that the remaining air he had did not have oxygen and carbon-di-oxide. He was able to produce a gas, which showed the same property of the air without oxygen and carbon-di-oxide. Hence this gas was named 'nitrogen'.

Test for Carbon-di-oxide in air

Pour some lime water in a glass tumbler. Bubble some air using a straw through thelimewater. After a few minutes, look at the lime water carefully. The lime water will produce a white precipitate and that the lime water will eventually turn to a milky white solution. This shows the presence of carbon-di-oxide in air.

Composition of Air

From Priestley's experiment which was followed by Ingenhousz and Rutherford, we came to know that air was not just one substance. We will now describe what air is made up of. This is called composition of air.

The major component of air is nitrogen. Almost four – fifth of air is nitrogen. The second major component of air is oxygen. About one – fifth of air is oxygen. In addition to nitrogen and oxygen gases, air also contains small amount of carbon–di– oxide, water vapour and some other gases like argon, helium etc. The air may also contain some dust particles.

The composition of air in terms of percentage of its various components can be written as follows:

The composition of air changes slightly from place to place and also from season to season. For example,

- Air over industrial cities usually has a higher amount of carbon-di-oxide in it than the air over open spaces.
- Air in coastal areas may have more water vapour than inland areas.
- Air also contains more water vapour in rainy season.
- The amount of dust in the air is more in windy places than other areas.

Test for the presence of dust particles in air

You might have seen the sunlight entering into a dark room through a narrow slit and making shiny dust particles dancing merrily on the path of sunlight. Actually, the air in a room always contains some dust particles, but they are so small that normally they are not visible to us. When a beam of sunlight falls on them, the tiny dust particles become visible.

Shall we do an activity to calculate the amount of dust particles in air from our area?

Take a graph sheet. Using marker pens draw a 5x5 cm square on the graph. Apply a thin film of grease on the graph sheet. This sheet will serve as dust collector. Make four or five graph sheets.

Discuss in the whole class, as where to place the dust collectors, how long to collect dust particles and place the dust collectors in agreed positions.

Ensure that the dust collectors do not get blown away. After the time scheduled for performing this activity is reached, remove the paper and count the number of collected dust particles in the marked area in all the sheets, using a magnifying glass at the dust collector. We can see something similar to the diagram below:-

Then, calculate the mean number of dust particles in the marked area.

$$Mean = \frac{total\ number\ of\ dust\ particles\ on\ collector}{number\ of\ squares\ on\ collector}$$

The range of the dust can also be calculated as given below:-
Range = Maximum value – minimum value

Collect details from all the areas where we have kept the dust collector sheets. Tabulate the recordings in the table given below:-

Test for water vapour in air

Take a few ice cubes in a glass. Keep it on the table for a few minutes. Observe what happens. You could see tiny droplets of water all over the outer surface of the glass. From where do these droplets come? The water vapour present in the air condenses on the cold surface of the glass. This shows that air contains water vapour.

Burning and Combustion

When we burn a candle, paper, kerosene, coal, wood or cooking gas (LPG), oxygen is needed. The oxygen needed for the burning of candle, paper, kerosene, coal, wood and cooking gas comes from the air around us. Thus, for burning a substance continuously so as to make fire, a continuous supply of fresh air is needed. If we cut off the supply of fresh air to a burning substance, then the burning substance will not get oxygen necessary for burning to continue and hence the substance will stop burning. In rockets, as they go high in the atmosphere, the availability of oxygen is considerably reduced. Therefore in rockets along with the fuel, oxygen is also carried for combustion.
The process of burning of a substance in the presence of oxygen and releasing a large amount of light and heat is called burning. If the process does not emit flame then it is called combustion.

Importance of air for survival of plants and animals
Respiration in plants

Plants require energy for their growth and hence respiration also occurs in plants. During respiration, plants take in oxygen and release carbon–di–oxide, just as animals do. Gaseous exchange with air in atmosphere takes place in plants with the help of tiny holes called stomata present on their leaves.

Photosynthesis

Plants manufacture food by a process called photosynthesis. During photosynthesis, Carbon-di-oxide from the air and water from the soil react in the presence of sunlight to produce food. Most plants possess a green pigment called chlorophyll and it is also used-up in the process of photosynthesis. The word equation given below explains the process of photosynthesis.

Sunlight

Carbon-di-oxide +water → Food + Oxygen

Chlorophyll

Plants release oxygen during photosynthesis which is much more than the oxygen consumed by the plants, during respiration.

Respiration in Animals

When we breathe in air, the oxygen present in the air reacts chemically with digested food within the body to produce carbon-di-oxide gas, water vapour and energy.

This energy is required to carry out many processes in the body such as movement, growth and repair. This process by which oxygen reacts with digested food to form carbon-di-oxide, water vapour and energy is called respiration. The process can be represented by a word equation as given
below :-

Food + Oxygen → Carbon-di-oxide
+ water + Energy

Carbon-di-oxide formed during respiration dissolves in the blood and is exhaled out of the body through the lungs. The inhaled and exhaled air thus contain the same substances but in different proportion, except nitrogen which is present in the same amount. Inhaled air contains more oxygen while the exhaled air contains more carbon-di-oxide.

Let us have a look at the following table to compare the composition of air in inhaled and exhaled air.

Component	Inhaled air	Exhaled air
Nitrogen	78%	78%
Oxygen	21%	16%
Carbon-di -oxide	0.03%	4%
Water vapour	Variable amount	amount increases in exhaled air
Noble gases	0.95%	0.95%
Dust	Variable amount	none
Temperature	Room temperature	Body temperature

Respiration of plants and animals in water

The water of ponds, lakes, rivers and seas have some amount of dissolved air containing oxygen in it. The plants and animals that live in water use the oxygen dissolved in water for breathing. For example, frogs respire through their skin, fish respire using their gills.

When carbon-di-oxide is cooled to -570 C, it directly becomes a solid, without changing to its liquid state. It is called dry ice and is a good r e f r i g e r a t i n g agent. Dry ice is used in trucks or freight cars for refrigerating perishable items such as meat and fish while transporting them.

Uses of Air

- Air is used by plants and animals for breathing.
- Air is used for burning fuels like wood, coal, kerosene, LPG etc.
- Compressed air is used to fill tyres of various kinds of vehicles.
- Air plays an important role in maintaining the water cycle in the nature.
- Ozone layer, present in the atmosphere, helps in preventing harmful radiations of the sun from reaching the earth's surface.
- Under extra – ordinary conditions such as:
- Blowing air is used to turn the blades of wind mills.

The wind mills are used to draw water by running pumps, run flour mills and to generate electricity.

6th term III
Unit – 1 Magnetism

Introduction

You might have seen magnets. Have you ever enjoyed playing with them?

Take a steel glass. Take a needle through which thread is passed. Press the thread with a finger near the hole of the needle as shown in the figure and raise the glass upward slowly.

'Magnetite' after the name of the boy Magnus. The name is also supposed to come after the name of the place (Magnesia) in which it was found.

Magnetite was the ore with attracting property found in that region. Magnetites are natural magnets. They are called magnetic stones.

Natural magnets do not have a definite shape. Since, they are used for finding direction, they are also called 'leading stones' or 'lode stones'.

Magnet of different shapes

After learning the method of changing the piece of iron into magnet (magnetization) we have been making and using several kinds of magnets. Such man-made magnets are called artificial magnets.

Bar-magnet, Horseshoe magnet, Ring magnet and Needle magnet are generally used artificial magnets.

Magnetic and Non Magnetic Materials

Substances which are attracted by magnet are called magnetic substances. Iron, cobalt, nickel are magnetic substances. Substances which are not attracted by magnet are called non-magnetic substances. Paper, plastic are called nonmagnetic substances.

Magnetic Poles

Place some iron filings on a paper. Place a bar magnet horizontally in the filings and turn it over a few times. Now lift the magnet. What do you see? Which part of the magnet has more iron filings sticking to it?

The parts of the magnet those attract the largest amount of iron filings are called as its poles. The attractive force of the magnet is very large near the two ends. These two ends are called its poles.

If you have a horseshoe magnet, or any other type of magnet at home, find the position of its poles by this experiment.

In experiments with magnets you will need to use iron filings again and again. You can do this by placing a magnet in a pile of sand and turning it around in the sand. The small pieces of iron present in the sand will stick to the magnet. If you cannot find sand you can look for iron pieces in clayey soil as well.

If you don't have iron filings, you can collect small pieces of iron and they will serve the purpose as well.

Finding directions with a magnet

Tie a piece of thread to the centre of a bar magnet and suspend it. Note, in which direction the magnet stops. Draw a line on a sheet of cardboard or the table along the direction in which the bar magnet stops (i.e) a line parallel to the bar magnet). Turn the magnet gently and let it come to stop again. Repeat it three or four times.

This is roughly the north-south direction. The end of the magnet that points to the north is called the North Pole. The end that points to the south is called the South Pole.

A freely suspended magnet always comes to rest in north-south direction.

The directive property of magnets has been used for centuries to find directions. Around 800 years ago, the Chinese discovered that a suspended lode stone stops in the north-south direction. Chinese used these lode stones to find directions.

The navigators of that country used to keep a piece of lode stone suspended in their boats and during a storm or mist, they used the lode stone to locate directions.

Magnetic compass

A compass is an instrument which is used to find directions. It is mostly used in ships and airplanes. As a rule, mountaineers also carry a compass with them so that they do not lose their way in unknown places.

The compass has a magnetic needle that can rotate easily. The marked end of the needle is the North Pole of the magnet.

Properties of Magnets

Attraction or Repulsion

Take two similar magnets, place them in four different ways. Unlike poles (S-N, N-S) attract each other. Like Poles (N-N, S-S) repel each other.

Do magnets lose their properties? When?

Magnets lose their properties if they are heated or dropped from a height or hit with a hammer.

Magnets lose their properties when they are placed near Cellphone, Computer, DVDs. These objects will also get affected by magnetic field.

Storage of Magnets

Improper storage can also cause magnets to lose their properties. To keep them safe, bar magnets should be kept in pairs with their unlike poles on the same side. They must be separated by a piece of wood and two pieces of soft iron should be placed across their ends.

For a horse-shoe magnet a single piece of soft iron can be used as a magnetic keeper across the poles.

Usage of Magnets

We use various equipment with magnets in day to day life.

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Science Today – Bullet Trains

We know that like poles of the magnet repel each other. By using repulsion we can levitate a magnetic object.

Electromagnetic train is called as suspension train and also called as flying train. It does not require diesel or petrol. This technology uses the property of magnetic attraction and repulsion to run these super fast electromagnetic trains.

How does the electromagnetic train work?

Electromagnets are used in Electromagnetic train. Electromagnets are magnetised only when current flows through them. When the direction of current is changed the poles of the electromagnets are also changed. Like poles of the magnets which are attached at the bottom of the train and rail track repel each other. So, the train is lifted from the track up to a height of 10 cm.

We Know that we can move any magnetic object with the force of attraction or repulsion properties of magnets. This train also moves with the help of the magnets attached on the sides of track and the magnets fitted at the bottom sideway of the train. By controlling the current we can control the magnets and movement of the train.

As there are no moving parts, there is no friction. So, the train can easily attain a speed of 300 km per hour. These trains are capable of running up to 600 km/ hour. They do not make any noise. They require less energy and they are eco-friendly.

Even though, many countries have taken effort to use these trains, such trains are used for public transport only in China, Japan and South Korea. In India the possibilities of introducing these trains are under consideration.

Points to remember

i. Magnetites are natural magnets. They are called magnetic stones.
ii. Man-made magnets are called artificial magnets.
iii. Substances which are attracted by magnet are called as magnetic substances.
iv. Substances which are not attracted by magnet are called non-magnetic substances.
v. A freely suspended magnet always comes to rest in north-south direction.
vi. The end of the magnet that points to the north is called the North Pole. The end that points to the south is called the South Pole.
vii. A compass is an instrument which is used to find directions.
viii. Like Poles (N-N, S-S) repel each other and unlike poles (N-S, S-N) attract each other.
ix. Magnets lose their properties if they are heated or dropped from a height or hit with a hammer.

Unit 2 Water

Introduction

Water is one of the basic substancepresent in the earth. It plays a vital rolein the evolution and survival of life. It isimpossible to imagine life on the earthwithout water. Water helps to regulate thetemperature of our planet. It also helps tomaintain the temperature in organisms.

Where do we get water from?

We need water to perform several dayto day activities like cooking food, washingclothes, cleaning utensils etc.We get water from different watersources in our surroundings. In villages /towns wells, canals, tanks, ponds, rivers,water tanks, hand pipes are the mainsources of water.

List out the sources from where youget water in your village/town.For example Ramu says he and his familyget water from the pipes in washroomsand kitchens. Sankar says he has to usehandpump daily both in the morning andevening to collect the water. Raja says hismother used to get up early and walks topond to get water.

Where do you get water for yourhousehold uses?

Where and how water is found on the earth?

Water is available in nature in threeforms – Solid, Liquid ,Vapour.

- Solid form of water - Ice - It is present in ice bergs and ice caps on top of tall mountains, galaciers and polar regions.
- Liquid form of water – Water – Itis present in oceans, seas, lakes, riversand even underground.
- Gaseous form of water – Vapour –It is present in the air around us.

Availability of water

We know thatnearly ¾th of the surfaceof the earth is occupied by water. Most ofthe water, that is 97% of the total amountof water that exits on earth is found in seasand oceans.

Can we drink the water available in thesea?

Sea water is salty. But water used forour daily purposes is not salty. It is knownas fresh water. Water obtained from ponds,puddles, river, tube-wells and taps at homeis usually fresh water.

If the total water on earth be 100%, let'ssee what percent would be the availabilityof fresh water.

Image

From the pie chart, it can also be notedthat 97% water is saline water. Only 3%found is the freshwater and that too inpolar ice caps and glaciers. So this portionof water is not readily available for drinking.

The distribution of the totallyavailable (3%) freshwater is asfollows:
Polar ice caps and glaciers 68.7%
Ground water 30.1%
Other sources of water 0.9%
Surface water 0.3 %

The distribution of total 0.3% ofsurface water is as follows:
Lakes 87%
Rivers 2%
Swamps 11%

Thus the above pie chart explainsthat we have a very small amount of freshwater available for human usage andso maintaining the water table and theconservation of water is very essential. Isn't it?

Water while passingthrough layers of soildissolves salts andminerals to a maximum extent. These salts and minerals havebeen deposited in seas and oceansfor millions of years and are still beingdeposited. In addition, the oceanicvolcanoes which are present inside, alsoadd salts to the sea. Water with largeamounts of dissolved solids is not potableor suitable for drinking. Such water iscalled saline water.

Composition of water

Water is a transparent, tasteless,odourless and nearly colourless chemicalsubstance. It is composed of two atomsof hydrogen combined with one atom ofoxygen. The molecular formula of water isH_2O.

However, the physicalcomposition of waterchanges from place to place.

It can be clear or cloudy,oxygenated or not very oxygenated and itcan be fresh or salty. The amount of saltin water is termed as salinity. Based on itssalinity water is classified into three maincategories such as freshwater, brackishwater and sea water. Fresh water contains0.05% to 1% of salt. Brackish water containsupto 3% of salt and seawater contains morethan 3% of salt. Ocean water is composedof many substances. The salts includesodium chloride, magnesium chloride andcalcium chloride.

Water freeze at 0^{o}Celsius at normalpressure.

Every year march $22^{nd}$is observed as the world water day.

Water cycle

The water on theearth evaporates into the atmosphere due to the heat of the sun. The watervapour in the atmosphere forms clouds. From the clouds water falls on the earth in the form of rain or snow. Bythis natural process, water gets renewed.This is called **water cycle**.
Water cycle is a continuous process.
It involves three stages - **evaporation, condensation and precipitation**. It is also called the **hydrological cycle**.

Evaporation: Water from oceans,lakes,ponds and rivers evaporates due tothe heat of the sun.

Condensation: Water vapour whichenters into the atmosphere by evaporation moves upward with air, gets cooled andchanges into tiny water droplets that formclouds in the sky.

Precipitation: The millions of tinydroplets collide with one another to form larger droplets. When the air around the clouds is cool these drops of water fall inthe form of snow or rain.

Have you heard of transpiration?

It is the process of loss of water fromthe aerial parts of a plant in vapour form.

There is a continuous cycling of waterand it exists in three forms in nature.

Water evaporating from lakes, riversand oceans forms the gaseous state. Rainwater forms the liquid state. Snow onmountains and polar ice caps forms thesolid state.

These three states occur in nature, keep the total amount of water on the earth constant even when the whole world is using it!

Natural Sources of fresh water

Three types of natural sources of fresh water are available on the earth.

Surface water

Water present on the surface of theearth such as river,lake,ponds, streams orfresh water wetland is called surface water.

Frozen water

Water that is present in the frozen formas polar ice-caps and glaciers are calledfrozen water. A larger portion of water is68.7% of the total available fresh water isin frozen state.

Ground water

Ground water is the water presentbeneath Earth's surface in soil. This water isobtained through springs, open wells, tubewells, or hand pumps etc.,

The Himalayas

The Himalayas,contain ice caps, icebergs and glaciers.Ten of Asia's largest rivers flow fromthe Himalayas and more than a billionpeople's livelihoods depend on thoserivers.

More to know: Water, is measuredin litre and millilitre. Gallon is also ameasure of volume of liquids.

1 Gallon = 3.785 litre

Water level in the reserviors is measuredin TMC/feet. Water released from damsis measured in cusec (cubic feet/sec).

Aquatic animals

During winter, water inlakes and ponds in thecold countries will befrozen and a solid layer of ice is formedon the surface of water. Still aquaticanimals living under the ice do not die.This is because the floating layer of iceacts as a protective coat, and doesn'tpermit heat to escape from water. So asthe water at the surface alone turns toice, it the existence of aquatic animals.

Conservation of water

There is no change in the total quantity of water available on the earth. It remains the same. But the water useful for plants, animals and man is decreasing day by day. It is called scarcity of water.

What are the reasons for scarcity of water?

The main reasons for water scarcity

1. Population explosion
2. Uneven distribution of rainfall
3. Decline of ground watertable
4. Pollution of water
5. Careless use of water

We should take care to prevent scarcity of water. Otherwise,it is impossible for organisms to live on the earth. The only method of preventing scarcity of water is conservation of water. Saving water for the future generations by using water carefully and in a limited way is conservation of water.

Methods of water conservation:

Mainly, two methods can be followed for the conservation of water.

1. Water management

Water management consists of the following factors:

a. Bringing awareness about the bad effects of throwing wastes into the water bodies

b. Recycling of water by separating pollutants.

c. Minimizing the use of chemical fertilizers in agriculture. It reduces the pollution of underground water.

d. Controlling deforestation

e. Adopting drip irrigation and sprinkler irrigation in agriculture. By this way lesser amount of water can be used for the irrigation

2. Rainwater harvesting

Direct collection and use of rain water is called rainwater harvesting.
There are two types of rainwater harvesting.

a. Collecting water from where it falls.

(e.g): Collecting water from the roof tops of the houses or buildings (Roof water harvesting).

b. Collecting flowing rain water

(e.g): Collecting rainwater by constructing ponds with bund.

Coovam is an estuary!

Estuaries are wetlands where water bodies meet the sea. It is a combination of fresh water from land meeting the salty seawater. Estuaries are home to unique plants and animal species.

Importance of water

Human body: Our body uses water in all its cells, organs and tissues to help regulate its temperature and maintain other bodily functions. On an average, the human body requires 2 – 3 litres of water per day for proper functioning. Water helps in digestion of food and removal of toxins from the body.

Domestic: Apart from drinking, people use water for many other purposes. These include: cooking, bathing, washing clothes, washing utensils, keeping houses and common places clean, watering plants, etc.

Swamps are wetlands that are forested. They occur along large rivers or on the shores of large lakes. The water of a swamp may be freshwater, brackish water or seawater. Swamps are important for providing fresh water and oxygen to all life. Pichavaram Mangroves in Chidambaram, Muthupet mangrove wetland. Pallikkaranaiwetland in Chennai, Chembarambakkam in Kancheepuram are a few examples of swamps in Tamilnadu.

Agriculture: Water is also essential for the healthy growth of farm crops and farm stock and is used in the manufacture of many products.

Industry: Industry depends on water at all levels of production. It is used as a material, a solvent and for generating electricity.

Water distribution and treatment system

We know that water is distributed by local bodies. In some areas which water is obtained from river, lake and ground water is treated and distributed. Model of water distribution and treatment plant is shown in figures.

Unit 4 Our Environment

Introduction

The surroundings or space in which a person, animal, or plant lives, is known as on**environment**. Environment is everything that is surround us. It can have both living (biotic)
and non-living things (abiotic). **Abiotic** factors are non-living parts such as sunlight, air,water and minerals in soil. **Biotic** factors are living things of our environment such asplants, animals, bacteria and more. Organisms live, constantly interact with one another andadapt themselves to conditions to their environment.

The Ecosystem

Ecosystem is a community of living and non-living things that work together. Eachpart of an ecosystem has a role to play. Any changes in the environment such as increasedtemperature or heavy rains, can have a big impact on an ecosystem.
Ecosystems can be either natural or artificial.

Natural ecosystem

Ecosystem originated without humanintervention is called a **natural ecosystem.**This can be an aquatic ecosystem or aterrestrial ecosystem.

The ecosystem in water is called**aquatic ecosystem**. Sea, river, lake, pondand puddle are some examples of naturalaquatic ecosystem.

Ecosystems outside the water body andon land are called **terrestrial ecosystems.**Forests, Mountain regions, deserts etc., areexamples of natural terrestrial ecosystems.

Artificial ecosystem

Artificial ecosystems are created andmaintained by human. They have some ofthe characteristics of natural ecosystems. They are much simpler than the naturalecosystems.

These can be the terrestrial ecosystems such as paddy fields, gardens etc. or theaquatic ecosystem such as fish tank.

Aquarium:

Aquarium is a place in which fish and other water creatures and plants are maintained. An aquarium can be a small tank, or a large building with one or more large tanks.

Terrarium:

Terrarium is a place in which live terrestrial animals and plants are kept. Plants and animals are kept in a terrarium with controlled conditions that copy their natural environmentAquariums and Terrariums are used to observe animals and plants more closely. They are also used for decorations.

Food Chain and Food Web

Living organisms need food to perform their life processes. Some organisms can produce their own food, such as plants, while other organisms cannot do this and need to feed on other organisms to obtain their energy.

We can therefore identify different feeding types in an ecosystem, based on how the organism obtain (gets) its food. They are **producers and consumers**.

Producers

Producers are organisms that are able to produce their own organic food. They do not need to eat other organisms to do this. Producers are also called **autotrophs.** Can you name an organism that prepare it's own food?

Plants are producers because they make their own food by photosynthesis.

What do plants need in order to photosynthesis?

Consumers

Organisms which cannot produce their own food, need to eat other organisms as food. These organisms are called **consumers**. All animals are consumers as they cannot produce their own food. Consumers are also called **heterotrophs.**

There are many types of consumers and we can classify them into specific groups depending on the food that they consume. These are:

- **herbivores**
  Animalswhich eat plants or plant products e.g: cattle, deer, goat and rat.
- **carnivores**
  Animalsthat eat other animalse.g: Lion, tiger, frog and owl.
- **omnivores**
  Animalsthat eat both plants and animals e.g: Humans, dog and crow
- **decomposers**
  Micro-organisms that obtain energy from the chemical breakdown of dead organisms (both plants and animals). They break complex organic substances into simple organic substances that goes into the soil and are used by plants. (e.g) Bacterium, Fungi

Food chain

In a forest, deer eats grass; and in turn we know tiger eats deers. In any ecosystem there is a chain like relationship between the organisms that live there. **This sequence of who eats whom in an ecosystem is called as food chain.**

It describes how organisms get energy and nutrients by eating other organisms.

A food chain shows the relationship between producers (e.g. grass) and consumers (e.g. deer, goats, cows and tiger).

Energy flow

The food chain begins with the energy given by the Sun. Sunlight triggers photosynthesis in plants. The energy from the Sun is stored in the plant parts. When the grasshopper eats the grass, the energy flows from grass to grasshopper. Frog gets energy by eating grasshopper. This energy is transferred to a crow, when the frog is eaten by a crow. Thus we conclude the primary energy production in the world of living things is made by plants; that is by photosynthesis.

The micro organism reduce the excreata and the dead bodies of animals into primary simple components and puts them back into soil. It is this material that help the plants to grow. Thus we can see that there is a cycle of materials from primary producers to highest level predators, then back to soil.

Trophic levels

We see that the energy is passed along from the producer to the consumers. But, there are three different consumers in any food chain. How can we distinguish different consumers?

Animals that eat plants are **primary consumers**.

Animals that eat primary consumers are called **secondary consumers.**

Animals that eat the secondary consumers (mostly predators) are the **tertiary consumers**.

There may even be large predators that eat tertiary consumers. They are called as **quaternary consumers**.

Each of these levels in the food chain is called a **trophic level.**

Organism uses up to 90% of its food energy for its life processes. Only about10% of energy goes into new body cells and will be available to the next animal when it gets eaten. This loss of energy at each trophic level can be shown by an **energy pyramid.**

A rat eats grains; and in turn we know snake eats rat. Now snake is a prey for peacock and in turn peacocks are easy prey for tigers and leopards. Now think? Do tigers have any natural predators?

In all food chain there is a top level predator that has no natural predators. In an aquatic ecosystem there are no natural predator for alligator; in a forest there are no natural predators for tigers.

Importance of food chain

1. Learning food chain help us to understand the feeding relationship and interaction between organisms in any ecosystem.
2. Understanding the food chain also helps us to appreciate the energy flow and nutrient circulation in an ecosystem. This is important because pollution impacts the ecosystem. The food chain can be used to understand the movement of toxic substances and their impacts.

Food web

Consumers have different sources of food in an ecosystem and do not rely on only one species for their food. If we put all the food chains within an ecosystem together, then we end up with many interconnected food chains. This is called a food web.

A food web is very useful to show the many different feeding relationships between different species within an ecosystem.

Waste Management and Recycling

To protect our environment, it is very important to reduce waste, manage it properly and maximise recycling. Waste is any substance or material that has been used but is not wanted anymore. This is either because it is worn out, broken or no longer has any purpose. Everyone produces waste and our waste has an impact on all ecosystems. However, most of us do not know where our garbage goes. There are many types of waste. There is liquid waste (in our drains), there are gases hiding in the air (like pollutants from factories), and there is solid waste (garbage) we put in our waste bins.

Biodegradable and Non- biodegradable Waste

Solid waste we generate can be classified into two major types:

1. Biodegradable waste
2. Non-biodegradable waste

Biodegradable waste

The term **'Biodegradable'** is used for those things that can be easily decomposed by natural agents like water, oxygen, ultraviolet rays of the sun, micro-organisms, etc.

One can notice that when a dead leaf or a banana peel is thrown outside,it is acted upon by several microorganismslike bacteria, fungi or smallinsects in a time period. Biodegradablewaste includes vegetable and fruit peels,leftover food and garden wastes (grass,leaves, weeds and twigs).

Natural elements like oxygen,water, moisture, and heat facilitatethe decomposition thereby breakingcomplex organic forms to simpler units.Decomposed matter eventually mixesor returns back to the soil and thus thesoil is once again nourished with variousnutrients and minerals.

Non-biodegradable waste

Those materials which cannot bebroken down or decomposed into the soilby micro-organisms and natural agentsare labeled as **non-biodegradable**.These substances consist of plasticmaterials, metal scraps, aluminum cansand bottles, etc.

These things are practically immuneto the natural processes and thus cannotbe fed upon or broken down even afterthousands of years.

Rani and her garbage

Rani gets home from school. She ishungry. She eats a banana and a packet ofchips. She puts the banana peel and plasticchips packet into the waste bin. In thewaste bin, the waste mixes together andthe banana peel makes the plastic chipspacket dirty. The waste bin starts to smelland Rani's mother puts the waste outsideon the street. The municipality collects thewaste from outside Rani's house and manyother houses ina tractor. Thetractor drives toa big open dumpand leaves allmixed wastesthere.

Sometimes, there are fires in theopen dump. When waste like Rani'schips packet burns, unhealthy chemicalspollute the ecosystem. These chemicalsare present in the air we breathe. Theleftover ash from burning waste pollutesthe soil.

When it rains, some of the dangerouschemicals goes into the ground. Someof the rain never reaches the ground asit collects in the plastic garbage at thedump. Little pools of water let mosquitoesto breed and they can spread unwanteddiseases like dengue and malaria. Cowsand dogs go into the open dump lookingfor food. As the waste is mixed, manythings that are not good to eat such asplastics, smell like food. The animalsget confused and eat some plastics byaccident. This makes them sick.

Rani is a student like you. She doesnot want to make animals sick. She doesnot want to pollute beautiful Town. Shedoes not like mosquitoes and wishes thatno one ever gets sick from them. So Ranitakes this decision "I plant trees andreduce all type of pollution".

Do you want the same as Rani does?Become a detective. Learn about the3R's and how you can start to solve theseproblems.

4.5 Solid Waste Management

It is our duty to reduce creatingwaste and protect environment. 3R's areimportant in protecting environment. Thefirst R is reduce and the second R is reuseand the last R is recycle.

The waste hierarchy or pyramid showsthe bestwaysto manage solid waste.

1. Avoid

Avoid the usage of unwanted materialswhich create more debris. Before you buyanything, think that "Do I really need it?"(e.g) Avoid buying packaged foods. Refuseto buy use and throw plastic products.

2. Reduce

We can reduce the waste by usingdurable goods that last longer instead ofthings that are used once and thrown away.

(e.g) Write on both sides of papers. Insteadof unnecessary printing, use electronicfacilities. Share newspapers, magazines
and other things with others.

3. Reuse

Reusing means using a thing again andagain, rather than using and throwing aftera single use. (e.g) Instead of using plasticbags, use and throw pens and batteries, usecloth bags, fountain pens and rechargeablebatteries. Reuse glass bottles for otherpurposes. Repair foot wears and use them.

Creative reuse

Creative reuse or Up-cycling is the processof converting wastematerials or useless products into newmaterials or products of better qualityor for better environmental value. Whenyou upcycle, you are giving an item anew purpose. (e.g) Used tyres intochairs.Used PET bottle into penstand.

4. Recycle

The process by which waste materialsare used to make new products is calledrecycling.(e.g) Using old clothes to make
paper and melting some plastics to makefloor mats, plastic boards and hose pipes.

5. Compost

The process of degradation of organicwastes into manure by the action ofmicroorganism is called **composting.** Themanure thus obtained becomes naturalfertilizer for the plants as well as increasesthe soil fertility.

6. Incinerate

The burning of solid waste in incinerator is called incineration. Human anatomical wastes (discarded medicines, toxic drugs, blood, pus) are disposed by means of incineration. During incineration, the enormous heat kills all contagious disease-causing germs. We can also produce electricity with the help of this heat.

7. Landfill

Landfilling is a method in which wastes are dumped into naturally occurring or man-made pits and covered with soil. Garbage buried inside landfills remain here for a long time as they decompose very slowly and become manure. These places can be converted into parks, gardens, etc.,

Earlier in the chapter, you learn about Rani and how she did not want to causepollution. Simple steps in your daily life can make big differences. There are two steps you should remember.

1. The first step should always be to reduce waste. Think of the 3R's and the waste pyramid and remember the order of the levels.
2. The second step is to keep waste separate. This way the waste will remain clean and can be easily reused or recycled. Mixing different types of waste together (e.g. biodegradable and non-biodegradable) makes waste dirty. Dirty waste gets sent to a landfill or open dump.

Waste separation exercise

The Solid Waste Management (SWM) rules, 2016 say that,

1. Every Household should segregate and store the waste generated by them in **three separate streams – namely bio-degradable, non bio-degradable and domestic hazardous waste** in suitable bins and handover segregated wastes to authorised waste pickers or waste collector as per the direction or notification by the local authorities from time to time.

2. No body shall throw, burn, or bury the solid waste on streets, open public spaces outside his premises or in the drain or water bodies.

Domestic hazardous waste means discarded paint drums, pesticide cans, CFL bulbs, tube lights, expired medicines,broken mercury thermometers, used batteries, used needles and syringes and contaminated gauge, etc., generated at the household level.

Learn how to separate waste correctly into 3 waste bins so you can keep Tamilnadu clean and beautiful!

How much waste does each person make around the world every day?

The average person in India produces 0.45kg of waste every day. It may be small amount of waste. But, India has a large population and imagine you collected all the waste today and put it into tractors. You would fill so many tractors that you could create a traffic jam approximately 2,800 kilometres long. Imagine, a road all the way from Kanyakumari to New Delhi completely blocked with tractors carrying garbage and no space to walk in between. This is how much waste we create in India each day! If we reduce the waste, we reduce the pollution.

India produces 532 million kilos of solid waste every day.

Pollution

Pollution occurs when the environment gets contaminated by waste, chemicals and harmful substances.

Pollution is the damage caused to the environment mainly because of human activities. Any substance that causes pollution is known as a **pollutant**. Pollution is an unwanted change in the physical, chemical and biological characteristics of our land, air and water.

Types of Pollution

There are four major kinds of pollution:

1.Airpollution
2.Water pollution
3.Land (soil) pollution

4. Noise pollution

4.6.1 Air pollution

Most air pollution is caused by the burning of fossil fuels (e.g. oil, petrol, coal and natural gas). These fossil fuels are used in factories (industries), power plants and motor vehicles. Burning these fossilfuels release toxic gases and fine particles (such as ash and soot) into the air causing air pollution. Air pollution is also caused by burning solid waste (especially some plastics), gases or chemicals released from factories and fumes from aerosols (like deodorant spray cans) or paints.

Certain toxic gases produced by industries mix with raindrops high in the atmosphere and make rain unusually acidic. This is called acid rain. It damages plants, washes the nutrients out of soils and kills fish. Air pollution is harmful to all living organisms including humans. Polluted air affects skin, eyes and respiratory system.

How can we reduce air pollution?

1. Cycle or walk short distances instead of using a motor vehicle.
2. Travel by public transport (bus or train)
3. Do not burn solid waste.
4. Avoid fireworks.

4.6.2 Water pollution

Water pollution occurs when wastes from factories, houses and farms mixes with the water in rivers, lakes, ponds, the ocean or even groundwater. Contaminated or polluted water can spread diseases and chemicals which are not good for our health.

The most significant sources of water pollutants are

1. Sewage (water we use at home forbathing, cleaning, cooking).
2. Industrial effluents (liquid wastes from
factories).
3. Agricultural pollutants (chemicalpesticides and fertilisers that getwashed from farms).
4. Solid waste (when waste gets dumpedinto water bodies).

How can we reduce water pollution?

1. Do not pour leftover oil, old medicinesor waste down the drain or into thetoilet.
2. Reduce the use of chemical pesticidesand fertilizers to grow crops.
3. Use waste water for garden in home.
4. Do not litter or dump waste – alwaysuse a waste bin.

4.6.3 Land (soil) pollution

In the same way as water and air getpolluted, land or soil pollution happenswhen toxic chemicals change the naturalbalance in soil. Land pollution comes fromfarming (Excess use of chemical pesticidesand fertilisers), mining (digging up metalsand other materials), factories (industrialwaste) and the solid waste from our ownhomes like plastics and broken electronics.Soil pollution affects animals, humans andeven plants because soil or land acts like asponge. When it rains, pollutant sinkss intothe soil. If we grow plants to eat in pollutedsoils, these dangerous chemicals can getinto our food.

How can we reduce land pollution?

1. First try to reduce waste, then recyclethe rest.
2. Always use a waste bin and never litter.
3. Do not burn waste, the ash mixeseasily with soil.

Noise pollution

Noise pollution affects the environment.We all like a quiet and peaceful place sinceunpleasant or loud sounds disturb us. Loudmusic, the sounds of motor vehicles, fireworks and machines cause noise pollution.Continuous noise disturbs our sleep anddoes not let us to study. Noise pollution hasbeen directly linked to stress and healthimpacts such as high blood pressure andhearing loss. Loud noise or even loud musiccan damage our ears. Noise pollution alsodisturb animals. Birds have to communicate(talk) louder so that, they can hear eachother in noisy areas. Even underwater noisepollution from

6th term 3

Unit -3 Chemistry in Everyday life

Introduction

We have studied earlier about the physical changes and chemical changes. Can you identify, from the following list which are physical changes and which are chemical changes?

- breaking of a stick into two pieces
- burning of a paper
- tearing paper into small pieces
- dissolving of sugar in water
- burning of petrol or LPG gas
- water boiling into water vapour
- coconut oil becoming solid during winter

Can you see the important difference between the chemical change and physical change? When you cut a paper into two, both are still paper pieces, but once you burn it, there is no longer the paper, only some ash and the smoke is mixed with the air.

Chemical change results in the change of the substance; In**physical change** only the shape, size or volume changes; the state of the matter may also change, from liquid to gas or from liquid to solid, however the substance remains, chemically as it is.

Let us do the following experiment. Add a pinch of turmeric powder to water; water turns yellow. Take a small quantity of soap water in a beaker and add a pinch of turmeric powder to it. Now, Whathappens? Is there any change in colour of the solution? Is it also turning to yellow or to some other colour?

Try adding turmeric powder to various household liquids and observe the result. Try it on, say, tamarind extract. Try it on with cleaning liquids in the house. Does it change the colour?

Chemists identify turmeric powder as a **'natural indicator'.** The change in colour indicates that the material is either acid or base medium.

Find answer for the following questions with the help of your teacher. This will help you to understand how chemistry plays vital role in our life.

v How does milk change into curd?
v How can you remove stain on the copper vessels?
v Idli is a little bit hard while we cook by using newly grinded idli dough but it is soft with old dough. Why?
v How does rusting of iron happen?
v Why does white sugar change into black when heating?

- We can understand the chemical changes that happen around us by knowing the answers for the above questions.

We use chemical changes in various forms in our daily life. **Chemistry** is the branch of science which deals with the study of particles around us. The beauty of chemistry is that, it explains the properties of the basic components of particles such as atoms and molecules and the effects of their combination.

We can consider all the particles around us as chemicals. The water (H_2O) we drink is the combination of hydrogen and oxygen. The salt (NaCl) we use in our kitchen is a combination of the chemicals, sodium and chlorine. Even our body is made up of a lot of chemical particles.

We could prepare soft idly as a result of a chemical change named fermentation takes place in the idly batter. During fermentation the idly batter undergoes a chemical change by bacteria. While cooking, the food products undergo so many chemical changes. As a result there are favourable changes in colour, flavour and taste in the food.
We can use chemical changes to produce certain materials. For example, some of the objects such as soaps, fertilizers, plastics and cement which we use in our daily life can be prepared by making chemical changes in some naturally occurring objects.

When we cut onion, we get tears in the eyes with irritation, because of the presence of a chemical, propanethial s-oxide in onion. This is easily volatile. When we cut onion some of the cells are damaged and this chemical comes out. It becomes vapour and reach our eyes result in irritation and tears in eyes. When we crush the onion, more cells will be damaged and more chemicals come out.

We can study about the manufacturing processes and usages of certain materials we use in our daily life such as soaps, fertilizers, cement, gypsum, Epsom, plaster of paris, phenol and adhesives in this lesson.

Soaps and Detergents

Bathing soap and washing detergents are kinds of soaps which we use in our daily life. In addition to this, we are using wash powder to remove strong stains on the clothes.

The detergent molecules have two sides, one side water loving, other water hating. Water hating goes and joins with dirt and oil in the cloth while the water loving joins with the water molecules.

When you agitate the cloth the dirt is surrounded by many molecules and is taken away from the cloth. The cloth becomes clean, and the dirt surrounded by the detergent molecules float in the water making it dirty.

Different soaps for different purposes are prepared with various raw materials. We can understand this by doing the following activity.

Fertilizers

Apart from water, sunlight and air, certain nutrients are also needed for the growth of plants. We know that the plants get their nutrients from the soil.

Nitrogen (N), Phosphorous (P) and Potassium (K) are the three important nutrients among the various nutrients needed for the growth of plants. These three are called as Principal Nutrients.

The table given below depicts the quantity of elements absorbed by certain common plants.

Crop	**Yield per hectare (kg) (Approximate)**	**Nitrogen (kg)**	**Phosphorous (kg)**	**Potassium (kg)**
Rice	2240	34	22	67
Corn	2016	36	20	39
Sugarcane	67,200	90	17	202
Groundnut	1904	78	22	45

Fertilizers are organic or inorganic materials that we add to the soil to provide one or more nutrients to the soil.

Fertilizers given to plants can be classified into two. They are organic and inorganic fertilizers.

Organic fertilizers

Fertilizers containing only plant or animal-based materials or those synthesized by micro-organisms are called organic fertilizers.
These fertilizers can be prepared easily. This type of fertilizers are economical. **(e.g) Vermi compost, compost.**

Inorganic fertilizers

The fertilizers prepared by using natural elements by making them undergo chemical changes in the factories are called inorganic fertilizers. **(e.g) Urea, Ammonium sulphate and Super phosphate.**

The table given below lists the nutrients in inorganic fertilizers

Name of fertiliser	**Nitrogen(%)**	**Phosphorus(%)**	**Potassium (%)**
Urea	46	0	0
Super phosphate	0	8-9	0
Ammonium	21	0	0

sulphate			
Potassium nitrate	13	0	44

If we use 50 kg of urea, then according to the table, 23 kg of nitrogen (46 percent) will be added to the soil.

Earthworms take organic wastes as food and produce compost castings. So earthworms are known as **Farmers' f r i e n d s** because of the multitude of services they provide to improve soil health and consequently plant health.

Cement

In ancient period, the houses were constructed by using the mixture of lime, sand and wood. At present, the people are widely use the cement for construction of houses, dams and bridges. The cement is manufactured by crushing of naturally occurring minerals such as lime, clay and gypsum through milling process.

Cement becomes hardened when it is mixed with water. Gypsum plays a very important role in controlling the rate of hardening of the cement. During the cement manufacturing process, a small amount of gypsum is added at the final grinding process. Gypsum is added to control the “setting of cement”.

Uses of cement

Cement is used as **mortar, concrete and reinforced cement concrete.**

Mortar

Mortar is a paste of cement and sand mixed with water. In houses, mortar is used to bind building blocks for constructing walls, to apply coating over them and to lay floor.

Concrete

Concrete is a mixture of cement, sand and gravel. It is used in the construction of buildings, bridges and dams.

In 1824, Joseph Aspdin invented Portland cement by burning finely ground chalk and clay in a kiln. It was named “Portland” cement because it resembled the high-quality building stones found in Portland, England.

Uses of cement

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Mortar

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Concrete

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Reinforced Cement Concrete

Reinforced cement concrete is a composite material by mixing iron mesh with cement. This is very strong and firm. It is used in the construction of dams, bridges, centering works in houses and construction of pillars. Huge water tanks, water pipes and drainages are built with this.

Gypsum

Gypsum is a soft white or grey, naturally available mineral. The chemical name of gypsum is calcium sulphatedihydrate.molecular formula of gypsum is $CaSO_4 \cdot 2H_2O$.

Uses

Used as fertilizers.

- Used in the process of making cement.
- In the process of making Plaster of Paris.

Epsom

Epsom salt is magnesium sulphate hydrate. The molecular formula of Epsom is $MgSO_4 . 7H_2O$. It offers a wide range of uses.

Uses

- Eases stress and relaxes the body
- Helps muscles and nerves function properly
- Medicine for skin problems
- Improving plant growth in agriculture

Plaster of Paris

Plaster of Paris consists of fi ne white powder (calcium sulphate hemihydrate) Themolecular formula of Plaster of Paris is $CaSO_4 .1/2H_2O$. Known since ancient times, plaster of paris is so called because of its preparation from the abundant gypsum found near Paris, capital of France. Plaster of paris is prepared by heating gypsum, where it gets partially dehydrated.

Uses

- In making black board chalks.
- In surgery for setting fractured bones.
- For making casts for statues and toys etc.
- In construction industry.

Phenol

Have you ever observed the oily material which is used to clean your house? Do you know what it is? It is a chemical named as Phenol. Phenol is a **carbolic acid** of an organic compound. It is a necessary ingredient for preparing variety of phenol products. The molecular formula of phenol is C6H5 OH, it is a weak acid. It is a volatile, white crystalline powder.

It is a colorless solution, but changes into red in the presence of dust. It irritates when exposed on human skin. It is widely used for industrial purposes. Phenol itself is used (in low concentrations) in mouthwash and as a disinfectant in household cleaners. Phenol used as surgical antiseptic since it kills micro organisms.

Adhesives

What will you do when a page of your book is torn accidentally? It can be fi xed by using a cello tape. How cello tape works? There is a paste like material in one surface of the cello tape. Have you ever discussed about this material? The paste like substance is called adhesive. It is commonly known as glue, mucilage, or paste. The substances applied to one surface, or both the surfaces of two separate items that binds them together and resists their separation are called **adhesives**.

Adhesives are substances that are used to join two or more components together through attractive forces acting across the interfaces.

A practical experience

Do you notice how puncture of your bicycle is repaired by the shop keeper? He ensures the punctured surfaces are clean, dry and free of dust, and roughens the area around the hole using a metal scraper. He takes an appropriate patch of tyre-tube and applies a suitable adhesive to both the roughened area and to the underside of the patch, apply fi rm pressure and allows drying completely. Why does he apply pressure? This increases the adhesive capacity at both the surfaces and ensures proper binding.

Types of adhesives

There are two kinds of adhesives, one is natural made from starch and another one is artificial made from chemicals. The one used in puncture shop is an artificial adhesive. Artificial adhesives may be classified in a variety of ways depending on their utilities. Their forms are paste, liquid, fi lm, pellets, tape. It is used in various conditions such as hot melt, reactive hot melt, thermo setting, pressure sensitive, and contact.

Unit1. Measurement

Introduction:

How are the various articles and materials shown in the picture measured?

In day to day life, we measure many things such as the weight of fruits, vegetables, food grains, volume of liquids, temperature of the body, speed of the vehicles etc., Quantites 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 Suresh walks 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.

Fundamental and derived quantities:

Generally, physical quantities are classified into two types, namely, (i) Fundamental quantities and (ii) Derived quantities.

Fundamental quantities:

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".

There are seven fundamental physical quantities in SI Units (System of International Units).

S. No.	Fundamental quantity	Fundamental unit
1.	Length	Metre (m)
2.	Mass	Kilogram (kg)
3.`	Time	Second
4.	Temperature	Kelvin (K)
5.	Electric current	Ampere (A)
6.	Amount of substance	Mole (Mol)
7.	Luminous (light)intensity	Candela(cd)

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".

Their corresponding units are called "Derived units". Some of the derived quantities and their units are given in table 1.1.

Area:

The area is a measure of how much space there is on a flat surface.

The area of the plot of land is derived by multiplying the length and breadth

Area = length × breadth

The unit of the area is = metre × metre

= $metre^2$

= m^2 (Read as square metre)

S. No.	Derived quantity	Unit
1.	Area = length × breadth	m × m = square metre (or) m2
2.	Volume = length × breadth × height	m × m × m = cubic metre (or) m^3
3.	Speed = distance / time	m / s (or) m s-1
4.	Electric charge =electric current × time	A ×s = (or) Coulumb (C)
5.	Density = mass / volume	Kg / m3 (or) kg m-3

Area is a derived quantity as we obtain are by multiplying twice of the fundamental physical quantity length.

Problem

What is the area of a 10 squares each of side of 1 m.

Area of a square = side × side

= 1 m × 1 m

= 1 m2 or 1 square metre

Area of 10 squares = 1 square metre × 10

= 10 square metre

(Even though the area is given in square metre , the surface need not to be square in shape)

Area of regularly shaped figures

The area of regularly shaped figures can be calculated using the relevant formulae. In the table 1.2, the formulae used to calculate the area of certain regularly shaped figures are given.

Problem

Find the area of the following regular shaped figures: (Take π = 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 × 4
= 48 m^2
(b) Area of circle = π × r2 = (22/7) × 7 × 7
= 154 m^2

Area of some regularly shaped figures

S. No.	Plane figure	Diagram of figure	Area
1.	Square		side × side a × a = a^2
2.	Rectangle		length x breadth lx b=lb
3.	Circle		π × $(radius)^2$ π ×r2 πr2
4.	Triangle		(1/2) × base × height 1/2 × b × h

(c) Area of triangle = (1/2) × base × height
= (1/2) × 6 × 8
= 24 m^2

Area of irregularly shaped figures

In our daily life, we encounter many irregularly shaped figures like leaves, maps, stickers of stars or flowers, peacock feather etc. The area of such irregularly shaped figures 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.

The graphical method explained above can be used to find the area of regularly shaped figures also. In the case of square and rectangle, this method gives the area accurately.

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 m3.

Volume of regularly shaped objects

As in the case of area, the volume of the regularly shaped objects can also be determined using an appropriate formula.

Table 1.3 gives the formulae used to calculate the volume of these regularly shaped objects.

Problem

Find the volume of (Take π = 22/7)
i. a cube whose side is 3 cm.
ii. a cylinder whose radius is 3 m and height is 7 m.

Solution:
(a) Volume of a cube = side × side × side = 3 cm × 3 cm × 3 cm = 27 cubic cm or cm^3.
(b) Volume of a cylinder = π × r2 × height = (22/7) × 3 × 3 × 7 = 198 m3.

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.

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 can understand 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 cm3
1000 ml = 1 litre

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

Volume of regularly shaped objects

S. No.	Objects	Figure	Volume
1.	Cube		side × side × side a× a ×a

			a^3
2.	Cuboid		length × breadth × height l× b ×h $l$bh
3.	Sphere		4/3 × π × (radius)3 4/3 × π ×r3 4/3 π r3
4.	Cylinder		π × (radius)2 × height π ×r2×h π r2h

Volume of irregularly shaped objects

As we discussed earlier for the case of area, there are no formulae to determine the volume of irregularly shaped objects. For such cases, their volume can be determined using a measuring cylinder and water.

Density

Take water in a beaker and drop an iron ball and a cork bowl into the water. What do you observe? The iron ball sinks and the cork floats as shown in figure. Can you explain why? If your answer is "heavy objects sink in water and lighter objects float is water", then, why does a metal coin sink in water whereas a much heavier wooden log floats? These questions can be answered when we understand the concept of density.

From the 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 the same 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.

Definition of density:

Density of a substance is defined as the mass of the substance contained in unit volume (1 m3).

If the mass of a substance is "M" whose volume is "V", then, the equation for density is given as

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

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

Unit of density

SI unit of density is kg/m3. The CGS unit of density is g/cm^3.

Density of different materials

Different materials have different densities. The materials with higher density are called "denser" and the materials with lower density are called "rarer".
The density of some widely used materials are listed in the following table

Density of some common substances, at room temperature

S. No.	Nature	Materials	Density(kg/m^3)
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

Suppose you have one Kg of iron and gold, which of them would have more volume than the other? Give your reason.

Problem

A solid cylinder of mass 280 kg has a volume of 4 m^3. Find the density of cylinder.

Solution:

Density of cylinder = $\frac{Massofcylinder}{volumeofcylinder}$

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

Problem

A box is made up of iron and it has a volume of 125 cm3. Find its mass. (Density of iron is 7.8 g / cm3).

Solultion:

Density = Mass / Volume
Hence, Mass = Volume × Density
= 125 × 7.8 = 975 g.

Problem

A sphere is made from copper whose mass is 3000 kg. If the density of copper is 8900 kg/m3, find the volume of the sphere.

Solution:

Density = Mass / Volume

Hence, Volume = Mass / Density

= 3000 / 8900 = 30 / 89

= 0.34 m^3

The relationship between Mass, density and volume are represented in the following density triangle:

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

Relationship between density, mass and volume

Measuring distance of celestial bodies

Normally, we use centimeter, metre and kilo metre 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

> **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/m^3. If we put one drop of water in oil, water drop sinks. But, if we put one drop of oil in water, oil fl oats and forms a layer on water surface. However, some oils are denser than water.

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 (Perihelion is position of the shortest distance between the earth and the sun), the distance between the earth and the sun is about 147.1 million kilometre. When the earth is in its farthest position, that is when the distance between Earth and Sun is the largest (called aphelion position) the distanceis 152.1 million kilometer. Th e average distance between the earth and the sun is about 149.6 million kilometer. Th is 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 × 106 km = 1.496 × 1011 m.

Light year

The nearest star to our solar system is Proxima Centauri. It is at a distance of 2,68,770 AU. We can clearly see that using the AU for measuring distances of stars would be unwieldy. Th erefore, 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 × 108 m/s. Th is means that light travels a distance of 3 × 108 m in one second. In a year (non-leap), there are 365 days. Each day has 24 hours; Each hour has 60 minutes; Each minute has 60 seconds. Th us, the total number of seconds in one year

= 365 × 24 × 60 × 60

= 3.153 × 107 second

If light travels a distance of 3 × 108 m in one second, then the distance travelled by light in one year = 3 × 108 × 3.153 × 107 = 9.46 × 1015 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 × 10^{15} m.

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

2. Force and Motion

Introduction

As shown in the above picture, Kavitha can reach her school in two ways. Can you tell, by choosing which path she could reach the school early.
Road A
Road B
Look at the nearby picture

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. Oneday Uma told that she would reach the playground after visiting her grandmother's house . The path in which they took reached the playground is shown here.

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

From the above examples, we could conclude that when an object travel 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.

Distance and Displacement

Distance - The total length of a path taken by an object to reach one place from the other is called distance.

Displacement – The shortest distance from the initial to the final position of an object.

Both the distance and displacement posses the same unit. The SI unit is meter (m).

He travels 10 km in first path. In the second path, he travels 7 km.

The distance between A and B via first path is 10 km. In the second path the distance is 7 km. The shortest distance between the two places is 5 km represented as 2. So the displacement is 5 km. (In east direction)

The path of an object travelling from A to B is shown in 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 figure. Find the distance and displacement of it in the two figures. 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.

When will the distance and displacement be equal. Explain. But the starting and finishing points should be different.

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

A ____________________B

Here we can consider the starting point as A and while the object moves from A to B the displacement is considered to be positive and from B to A it is negative.

Answer the following questions:

- Subha goes to the nearby playground from her home.

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

- The distance travelled by an object is 15 km and its displacement is 15 km. What do you infer from this?
- The distance of 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. One knot is the speed taken to travel one nautical mile in hour.

Speed - Velocity

Speed

Recapitulation

In sixth standard we already studied about the speed in detail.

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

Speed is the rate of change of distance .

Speed = distance /time

Unit is metre/second (m/s)

We can classify speed into two types.

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.
Average speed = total distance travelled / time taken to travel the distance.

Velocity

Velocity is the rate of change in displacement.
Velocity (v) = displacement / time
SI unit of velocity is meter / second (m/s).

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

If an athlete in the diagram takes 25 s to complete a 200 m sprint event. Find her speed and velocity.
Speed = distance / time
= 200 / 25
= 8 m/s
velocity = displacement /time
= 50 / 25
= 2 m/s

Uniform velocity

A body has uniform velocity, if it covers equal displacement in the same direction in equal intervals of time. 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

Average velocity = total displacement / total time taken
E.g. Figure shows a car that 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.
Average velocity = total displacement/time taken. (taking the direction due east of point O as positive)
= (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 distance in 4 seconds.
- Usain Bolt covers 100 m distance in 9.58 seconds. Calculate his speed. Who will be the winner if Usain Bolt comepetes with a Cheetah running at a speed of 30 m/s?
- You are walking along east 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?

Acceleration

Acceleration (a)

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

Acceleration = change in velocity/ time
= [final velocity (v) – intial velocity (u)] / time (t)
a = (v–u) / t
SI unit of acceleration is m/s_2

In other words, the object undergoes acceleration when its speed and/or direction change(s).

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

A car at rest starts to travel in a straight path. It reaches a velocity of 12 m/s in 4 s . What is its acceleration. Assuming that it accelerates uniformly? Initial velocity u = 0 m/s (since the car starts from rest)
Final velocity (v) = 12 m /s
Time taken (t) = 4 s acceleration (a)
= (v – u) / t
= (12 – 0) / 4
= 3 m / s^2

Tell me

From the above information, can you calculate the acceleration of the cheetah?

Positive acceleration

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

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) = (v – u)/t

= (2 – 8)/10

= –0.6 m/s^2

The deceleration is –0.6 m/s^2

Uniform acceleration

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

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.

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
Change in Velocity(m/s)	0	10	30	20	10	20

Note that the change in velocity is not the same for every second. The moving object is undergoing non uniform acceleration.

Distance – Time Graphs

Figure shows a car travelling along a straight line away from the starting point O. 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.

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

The graph has zero gradient. The distance is a constant for every second.

(b) Car travelling at uniform speed of 10 m s^{-1}

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

The graph has a zero constant gradient. The distance increases 10 m every second.

(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. The speed increases The instantaneous speed of the car at t = 3 s is given by the gradient of the tangent at the point.

(D) Car travelling at decreasing speed

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

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. The results for four possible journeys are shown.

1. Bus at rest

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

2. Bus travelling at uniform speed of m/s

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

3. Bus travelling with uniform acceleration

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

4. Bus travelling with uniform deceleration

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

5. Bus travelling with increasing acceleration (non – uniform acceleration)

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

6. Bus travelling with decreasing acceleration (non – uniform acceleration)

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

Comparisons between distance – time and speed – time graphs

Speed – time graphs and Distance – time graphs look very similar, but they give different information. We can differentiate them by looking at the labels.

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.

Centre of Gravity and Stabilty
Centre of gravity

Try to balance a cardboard on your figure tip. What do we observe. We observe there is only one point which the cardboard is balanced. The point which the cardboard is balanced is called the cenre of gravity of the cardboard.

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

Centre of gravity for Regular – shaped objects

Generally the centre of gravity of the geometrical shaped object lie on the geometric centre of the object.
Examples of centre of gravity for Regular-shaped objects. 1. Weight of Card,
2. Weight of Triangle, 3. Weight of Disc, 4. Weight of Ring.

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.
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 holes.

6. Label the intersection of the three lines as X, the position of the centre of gravity of the lamina.

Meter Rule

The ruler is in equilibrium when supported at its centre of gravity.
For a regular object such as a uniform meter rule, 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.

Stability

Stability is a measure of the body’s ability to maintain its original position.
The three types of stability are
(a) Stable equilibrium
(b) Unstable equilibrium
(c) Neutral equilibrium

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 orginal positionl.

Unstable Equilibrium

The frustum will topple with the slightest tilting. Its centre of gravity is lowered when it is displaced.

Neutral Equilibrium

(d) It causes frustum to topple.
(e) The frustum will rolls about but does not topple.
(f) Its centre of gravity remains at the same height when it is displaced.
(g) The body will stay in any position to which it has been displaced.

Condition for Stability

- To make a body more stable.
- Lower its centre of gravity.
- Increase the area of its base.
- This box is at the point of tipping over.
- A heavy base lowers at the centre of gravity So the box does not tip over.
- A brode base makes the box more difficult to tip over

The Thanjavur Doll

It is s type of traditional Indian toy made of 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.

Real Life Applications of Centre of Gravity

It is for the reasons of stability that 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. Racing cars are built low and broad for stability. Table lamps and fans are designed with large heavy bases to make them stable.

Science Today Typical Speeds

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

3. Matter Around Us

We knew that everything we see around, that occupy space and have mass, is called matter. Heat, light and sound occupies space, but does not have mass. Hence these are not matter. Do you know what is matter is composed of? We studied earlier that matter is composed of tiny little particles, which cannot be seen with naked eye. Let us understand what these particles are?

Atoms

The graphite refill used in pencil is made up of element called Carbon. We can break the graphite into smaller and smaller pieces. In fact, if we have an even finer knife, we can break it even smaller. If keep cutting the minuscule graphite into smaller and smaller particle, we will reach a point where we reach smallest constituent of graphite- carbon atom. If we break that carbon atom apart, then it will no longer exhibit the properties of carbon.

The smallest unit of an element that exhibits the properties of the element is called as 'atom'. All the matter is composed of tiny particles called atom. Water,rice, in short everything we see around is made up of atoms.

Even with the best of optical microscope we cannot see atoms. However there are advanced instruments that help us to image the atoms on the surface of a material.

For example the following figure shows an image of the surface of silicon.

Do You Know?

The most abundant type of atom in the universe is the hydrogen atom. Nearly 74% of the atoms in the universe are hydrogen atoms. However on Earth the three most abundant atom are iron, oxygen, and silicon.

Molecules

When an atom combines with another atom (or atoms) and forms a compound it is called as molecule. A molecule is made up of two or more atoms chemically combined.

- Oxygen gas in the air that we breathe is made up of two oxygen atoms chemically combined.
- Ozone is a substance that is made up of three oxygen atoms chemically combined.

An atom of oxygen (O) and two atoms of hydrogen (H2) combine to form a molecule of water (H_2O).

Molecules also exhibit properties of matter and have individual existence. A molecule can be formed by the same or different kinds of atoms.

Molecules can be classified as follow:

- A molecule which contains only one atom is called monatomic molecule (inert gases)

- A molecule which contains two atoms is called diatomic molecule (oxygen, nitric oxide, hydrogen, etc.)
- A molecule containing three atoms is called a triatomic molecule (ozone, sulphur dioxide, carbon dioxide, etc.)
- A molecule containing more than 3 atoms are known as polyatomic molecule (phosphate, sulphur, etc.)

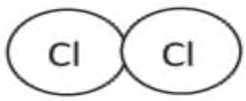
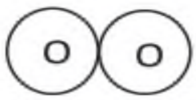
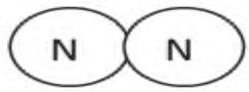
Molecules of Elements

A molecule of an element consists of a fixed number of one types of atom chemically combined.

The table below shows gases that are made up of two atoms of the same type of element.

Molecules of Compounds

Molecule of a compound consists of a fixed number of different types of atoms chemically combined.

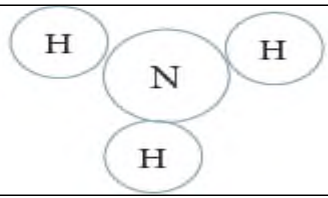
Molecule	**Chlorine Gas**	**Oxygen Gas**	**Nitrogen Gas**
Molecule Diagram			
Molecule Model (Ball-and-Stick)	Chlorine Molecule	Oxygen Molecule	Nitrogen Molecule

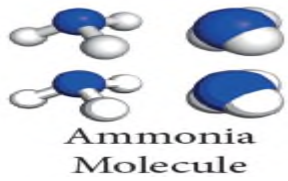
For example, let us look at the model of a water molecule below:

Each molecule of water consists of one oxygen atom and two hydrogen atoms. This ratio of oxygen and hydrogen atom remains fixed whether water is in liquid, solid or gaseous state. This principle applies to the molecules of all compounds.

> **Do You Know?**
> **Bismuth in diarrhea medicine**
> Bismuth is an element that occurs naturally. It is combined with other elements to make medicine for treating diarrhea.

Molecules of some compounds

Molecule	**Carbon-di-oxide**	**Ammonia**	**Hydrogen Chloride**
Molecule Diagram			

Molecule Model (Ball-and-Stick)			

Classification of Matter

Matter is classified into two broad categories, namely, pure substances and mixtures. Pure substances are further divided into categories as elements and compounds.

Elements

Matter in its simplest form is called an element. We are using many elements in our daily life. The common salt is consisting of elements of Sodium and Chlorine. Water consists of Hydrogen and Oxygen. Magnesium and Phosphorus used for making crackers. Sulphur is used as manure in agriculture. Gallium is used for making mobile phones and silicon is used for making computer chips.

There are 118 known elements till date. 94 of these elements occur naturally while 24 elements have been created artificially in the laboratory.

Classification of Elements

We can classify the elements broadly into metals, non-metals and metalloids based upon their chemical properties.

> **Do You Know?**
> The Robert Boyle is the first scientist used the term element. An early proponent of the elemental nature of matter and the nature of vacuum. He was known best for Boyle's Law.

Metals

We have tools, utensils and jewelry made from silver, copper, iron, gold, Aluminum. Using pressure like hammering or rolling we can deform these materials into various shapes. Such elements that are malleable (a material may be flattened into thin sheets or various shapes) is called as metals.

Metals are generally hard and shiny elements. Sodium is one of the exceptions as it is soft. All metals, except mercury are solids at room temperature. Mercury is the only metal that is liquid at room temperature . Metals are malleable, can be bent or beaten into sheets. They can be drawn into wires. They are good conductors of heat and electricity. Copper, Lead, tin, nickel, iron, zinc, gold, magnesium and calcium are examples of metals.

Non-Metals

Non-metals are generally dull and soft. However, diamond is shiny and also the hardest natural substance on earth. Non-metals can be gases, solids, liquids. Non metals such as oxygen, hydrogen and chlorine are gases at room temperature. Non metals such as carbon, iodine, sulphur and phosphorus are solids at room temperature. Bromine is the only non-metal that is liquid at room temperature. Non-metals are poor conductors of heat and electricity. However, graphite (a form of the non-metal carbon) is a good conductor of electricity.

The difference between metals and non-metals

Metals	Non-Metals
Metals are lustrous. They have a shiny surface	Non metals are non lustrous. They have non- shiny surface
Metals are generally hard	Non-metals are generally soft
Most metals are bendable	Non-metals are non bendable
Most metals can be bent, beaten into sheets and they can drawn into wires	Non-metals are non ductile
Most metals are good conductors of electricity	Non-metals are bad conductors of electricity
Most metals are good conductors of heat	Non-metals are bad conductors of heat
Most metals are making ringing sound when struck. Hence, they are used to make objects like bells	Non-metals does not make any sound when they struck

Metalloids

Metalloids exhibit the properties of both metals and non metals. Silicon, arsenic, antimony, and boron are some examples of metalloids.

Compounds

A compound is a pure substance that is formed when the atoms of two or more elements combine chemically in definite proportions.

Compounds exhibit properties entirely different from the properties of their constituent elements. For example, the atoms of the elements hydrogen and oxygen combine chemically in a fixed ratio to form the compound water. However, water does not have the exact same properties as hydrogen and oxygen. For example, at room temperature water exist as liquid while hydrogen and oxygen exist as gases. Also, oxygen supports fire whereas water is used as a fire extinguisher.
Similarly, common salt (sodium chloride) is a compound made up of elements sodium and chlorine. It is used in our food, whereas sodium and chlorine are poison, are both unsafe for consumption.

Properties of Compounds

- A compound is formed only when the constituent elements combine in a fixed proportion.
- The properties of a compound are different from those of its constituent elements
- A compound cannot be broken down by physical methods. This is because a compound is made up of different elements that are chemically combined. Sodium chloride cannot be separated by physical methods such as filtration.
- A compound can be separated into its constituent elements by chemical methods only.

Difference between an element and a compound

Elements	Compounds
An element is the simplest substance	A compound is a chemical substance formed by the combination of two or more elements
Elements combine to form compounds	Compounds can be split into elements
Atoms are the fundamental particle of an element	Molecules are the fundamental particles of a compound

Symbol of an element

A symbol is an abbreviation or short representation of a chemical element. There is a unique symbol for each element. It represents one atom of the element. The symbol is usually derived from the name of the element, which is either in English or Latin. These symbols are allocated by the International Union of Pure and Applied Chemistry (IUPAC).

Dalton was the first scientist to use the symbols for elements in a very specific sense. When he used a symbol for an element he also meant a definite quantity of that element, that is, one atom of that element. Berzelius suggested that the symbols of elements be made from one or two letters of the name of the element.

The following rules are followed while assigning symbol to an elements:

Chemical symbols usually consist of one or two letters

The symbols of most elements correspond to the first letter (which is capitalized) of their English name. For example, the symbol for oxygen is "O" and that for hydrogen is "H".

Elements represented by single letter symbols

Element	Symbol	Element	symbol
Hydrogen	H	Phosphorus	P
Fluorine	F	Sulphur	S
Oxygen	O	Potassium	K
Carbon	C	Uranium	U

When there is more than one element that begins with the same letter, their symbols take two letters. The first letter is capitalised while the second letter has a lower case. For example, the names of both hydrogen and helium begin with H. So, hydrogen is represented by the symbol H and Helium by He. Similarly, the symbol for carbon is C while the symbols for calcium, chlorine and chromium are Ca, Cl and Cr, respectively.

Elements represented by symbols of two letters

Element	Symbol	Element	Symbol
Aluminium	Al	Chromium	Cr
Argon	Ar	Cobalt	Co
Arsenic	As	Helium	He
Barium	Ba	Magnesium	Mg
Nickel	Ni	Calcium	Ca
Bromine	Br	Chlorine	Cl

The symbols for some elements are derived from their Latin names. For example, the symbol for gold is Au after its Latin name Aurum. Similarly, the symbols for copper is Cu after its Latin name Cuprum.

Element	Latin Name	Symbol
Copper	Cuprum	Cu
Lead	Plumbum	Pb
Potassium	Kalium	K
Iron	Ferrum	Fe
Mercury	Hydrargyrum	Hg
Sodium	Natrium	Na

Do You Know?

In the beginning, the names of elements were derived from the name of the place where they were found for the first time. For example, the name copper was taken from Cyprus. Some names were taken from specific colours. For example, gold was taken from the English word meaning yellow. Now-a-days, IUPAC approves names of elements. Many of the symbols are the first one or two letters of the element's name in English. The first letter of a symbol is always written as a capital letter (uppercase) and the second letter as a small letter (lowercase).

Chemical Formulae

Often we hear that water is H_2O. This is the chemical formula for water molecule. This means that each molecule of water has two hydrogen atoms combined with one oxygen atom. A chemical formula is a symbolic representation of one molecule of an element or a compound. It provides information about the elements present in the molecule and the number of atoms of each element. Can you guess the types of atoms and number of each of the atoms in NaCl, which is the chemical formula for cooking salt?

The chemical formula tells us the types of atoms and the number of each type of atom in one molecule of substance

Here are some examples of chemical formula

Sodium Chloride

Nacl

1 atom of Sodium and 1 atom of chlorine

Ammonia

NH3

1atom of Nitrogen and 3 atoms of Hydrogen

Glucose

$C_6H_{12}O_6$

6 carbon atoms, 12 Hydrogen atoms 6 oxygen atoms

Common compounds and their chemical formula

Examples Compounds	
Examples of Formulas for compounds	Examples of names of common compounds
H_2O	Water
$C_6H_{12}O_6$	Glucose
NaCl	Salt (Sodium Chloride)
C_2H_6O	Ethanol
NH_3	Ammonia
H_2SO_4	Sulphuric Acid
CH_4	Methane
$C_{12}H_{22}O_{11}$	Sucrose

Atomicity

In chemistry we usually understand atomicity to imply the total number of atoms present in one molecule of an element, compound or a substance.

Let we see how to calculate the atomicity of elements. For example, Oxygen exists as a diatomic molecule which means that a molecule of oxygen contains two atoms hence its atomicity is 2.

O + O O2

(Oxygen atom + Oxygen atom) Oxygen Molecule)

Similarly a phosphorus (P4) molecule contains 4 atoms; a sulphur (S8) molecule contains 8 sulphur atoms. Hence their atomicity is 4 and 8 respectively. For molecule containing more than one types of atoms, simply count the number of each atom and that would be its atomicity.

For example, a molecule of sulphuric acid (H_2SO4) consists of 2 hydrogen atom, 1 sulphur atom and 4 oxygen atoms. Hence e its atomicity is 2+1+4=7.

One molecule of water (H_2O) contains two atoms of hydrogen and one atom of oxygen, the atomicity of water is three.

Element	Atomicity	Elements	Atomicity
H	2	F	2
He	1	Ne	1
Li	1	Na	1
N	2	P	4
O	2	S	8

Elements in human Body

Nearly 99% of the mass of our human body consists of just 6 chemical elements: oxygen, carbon, hydrogen, nitrogen, calcium, and phosphorus. Another 5 elements make up most of the least percentage point: potassium, sulphur, sodium, chlorine, and magnesium.

Elements in air

Air is a mixture of gases. The molecules of two different elements, nitrogen and oxygen, make up about 99% of the air. The rest includes small amounts of argon and carbon dioxide. (Other gases such as neon, helium, and methane are present in trace amounts.) Oxygen is the life- giving element in the air.

Effect of temperature on Solid, Liquid and Gas
What happens to matter during heating?

The following are models of particles in solids during heating. These models can be modified to represent heating in Solids, Liquids and Gas. When solid is heated, the particles gain energy and vibrate vigorously. The particles move slightly further apart from one another.

This causes the volume of matter to increase. This process is called expansion. How it is happens? The matter begun to expand when heated. The volume increases due to the greater distance between the particles. But the size of the particles remains in same size.

During heating or expansion, the mass of matter does not change. This is explained in the following way. During heating, the distance between the particles of the iron locks change. Mass is conserved when matter expands.

Although the volume of the matter changes the size and number of the particles of matter do not change. Hence, during heating, the mass of a matter is conserved. For example, in an iron lock the distance between the iron particles increases when they gain enough heat. However, the number of iron particles does not change. Hence the mass of the iron lock is conserved.

The melting of ice is an example of a change in the states of matter. The change in the states of matter occurs during melting, boiling and freezing and condensation.

When the particles possess enough energy, they overcome the strong forces of attraction between one another. The particles break free from one another and move randomly. For example, when solid ice is heated to 00C, it melts to become liquids water. In the same way, liquid water is heated to 1000C, it boils to become steam.

4. Atomic Structure

Introduction

In the last chapter we have studied anything around us is matter and is made up of molecules. The molecules are combination of atoms of different elements or the same element.

How small is an atom?

An atom is one and thousand times smaller than the thickest human hair. It has an average diameter of 0.0000000001m or 1×10^{-9} m. To understand atom's size with the familiar things we know, now let us find what is the size of pencil, red blood cell, virus and dust particle.
1×10^{-2} m 1×10^{-4} m 1×10^{-6} m
1×10^{-7} m 1×10^{-10} m
Now you could imagine how small an atom would be.

Evolution of idea of an atom

Many scientists have studied the structure of the atom and advanced their theories about it. The theories proposed by Dalton, Thomson and Rutherford are given below.

Dalton's atomic theory

John Dalton proposed the atomic theory in the year 1808. He proposed that matter consists of very small particles which he named atoms. An atom is smallest indivisible particle, it is speherical in shape. His theory does not propose anything about the positive and negative charges of an atom.
Hence, it was not able to explain many of the properties of substances.

Nanometer is the smallest unit used to measure small lengths. One metre is equal to 1×10^{-9} nm or one nanometer is equal to 1×10^{-9} m

Thomson's theory

In 1897 J.J Thomoson proposed a different theory. He compared an atom to a watermelon.

His theory proposed that the atom has positively charged part like the red part of the watermelon and in it are embedded , like the seeds, negatively charged particles which he called electrons. According to this theory as the positive and negative charges are equal, the atom as a whole does not have any resultant charge.

Thomson's greatest contribution was to prove by experimentation the existence of the negatively charged particles or electrons in an atom. For this discovery, he was awarded the Nobel Prize in 1906. Although this theory explained why an atom is neutral , it was an incomplete theory in other ways.

Rutherford's theory

There were short comming in Thomson's theory, Earnest Rutherford gave a better understanding. Earnest Rutherford conducted an experiment. He bombarded a very thin layer of gold with positively charged alpha rays. He found that most of these rays which travel at a great velocity passed through th gold sheet without encountering any obstacles. A few are, however, turned back from the sheet.

Rutherford considered this remarkable and miraculous as if a bullet had turned back after colliding with tissue paper.

Based on this experiment, Rutherford proposed his famous theory. In his opinion,– 1. The fact that most alpha particles pass through the gold sheet means that the atom consists mainly of empty space. 2. The part from which the positively charged particles are turned back is positively charged but very small in size as compared to the empty space.

From these inferences, Rutherford presented his theory of the structure of atoms. For this theory, he was awarded the Nobel prize for chemistry.

Rutherford's theory proposes that
The nucleus at the centre of the atom has the positive charge. Most of the mass of the atom is concentrated in the nucleus.
The negatively charged electrons revolve around the nucleus in specific orbits.
In comparison with the size of the atom, the nucleus is very very small

Do You Know?
You have around 7 billion atoms in your body, yet you replace about 98% of them every year!

The subatomic particles

The discoveries made during the twentieth century proved that atoms of all elements are made up of smaller components - electron, proton and neutron. An electron from hydrogen atom is no different from electron of a carbon atom. In the same manner, protons and neutrons of all elements also have same characteristics. These particles that make up the atom are called Subatomic Particles.

Proton (p)

The proton is the positively charged particle and its located in the nucleus. Its positive charge is of the same magnitude as that of the electron's negative charge.

Neutron (n)

Neutron is inside the nucleus. The neutron does not have any charge. Excepting hydrogen (protium), the nuclei of all atoms contain neutrons.

Electron (e)

This is a negatively charged particle. Electrons revolve around the nucleus of the atom in specific orbits. The mass of an electron is negligible as compared to that of a proton or neutron. Hence, the mass of an atom depends on the number of protons and neutrons in the nucleus.

Protons and Neutrons are the two types of particles in the nucleus of an atom. They are called nucleons. The total negative charge of all an electrons outside the nucleus is equal to the total positive charge in the nucleus. That makes the atom electrically neutral.

Charge and mass of the sub atomic particles:

Particle	**Discoverer**	**Symbol**	Charge	Mass (kg)
Proton	Ernest Rutherford	p	+1	1.6726×10^{-27}
Electron	Sir Jonh Joseph Thomson	e	-1	9.1093×10^{-31}
Neutron	James Chadwick	n	0	1.6749 x 10-27

Atomic number and Mass number

If all elements are made up of same type of electrons, protons and neutrons how does a carbon atom differ from a iron atom? Further investigations led to the discovery that the number of the protons inside the nucleus of an atom determines what element it is. For Example if the nucleus has only one proton, then all such atoms are hydrogen atom. If there are eight protons then that atom is oxygen.

Atomic number (z)

The number of electrons or protons in an atom is called the atomic number of that atom. It is represented by the letter Z. if we know the atomic number of an atom, we know the number of electrons or protons in it.

Look at the figures. The hydrogen nucleus has one proton around which revolves one electron. It means that its atomic number z=1.

In the helium atom there are two protons and two electrons in orbit around the nucleus, so the atomic number of helium is z=2.

Look at the atomic structure of oxygen shown in the figure. What is its atomic number?

Mass number (A) or Atomic mass:

We have seen that the mass of an atom is concentrated in its nucleus. From this, we can get the atomic mass number. mass number (A) is equal to the sum of the number of protons(p) and neutrons (n) in the nucleus.

Automic mass or mass number = Number of
Protons + Number of Neutrons

$$A = p+n$$

A lithium atom contains 3 Protons and 4 neutrons . Its atomic mass number A = 3+4 = 7.

In a sodium atom, there are 11 Protons and 12 neutrons. Hence , its atomic mass number A = 11 + 12 = 23.
When writing the symbol of an element, its atomic number and atomic mass number are also written. For example, the symbols of hydrogen, carbon and oxygen are written as $1H^{1}$, $_{6}C^{12}$, $_{8}O^{16}$ respectively.

Elements and their symbols with their atomic number and mass number.

Element	Symbol	Atomic number	Protons (p)	Neutrons (n)	Mass number(p +n)
Hydrogen	H	1	1	0	1
Helium	He	2	2	2	4
Aluminium	Al	13	13	14	27
Oxygen	O	8	8	8	16
Sodium	Na	11	11	12	23

Valency

Imagine there are various people having different pattern of hands. Some have no hands and some have one, some two and others three. Few have four and no one has more than four. The person with four hands can hold hands of four others at a same time, while the one with no hands can never hold any hand. In this manner some atoms can hold one electron, some can hold two, some can hold three, some can hold four and some cannot hold any electron. This property is called valency.

This combining property of an atom is called as Valency. It is a measure of how many hydrogen atoms it can combine with. For example: oxygen can combine with two hydrogen atoms and create water molecule, the valency of oxygen atom is two. In case of chlorine, it can combine with only one hydrogen to create HCl (hydrochloric acid) here the valency of chlorine is one. Methane has one carbon atom combining with four hydrogen atoms to form carbon molecule is methane (CH4). Can you guess the valency of Carbon in methane? In ammonia molecule, Nitrogen combines with three hydrogen atoms. What is the valency of Nitrogen in ammonia?

Valency is defined as the combining capacity of an element. Atoms of different elements combine with each other to form molecules. Valency determines the number of atoms of an element that combines with atom or atoms of another type.

Elements and their symbols with their atomic number and mass number and valency.

Element	symbol	atomic number	mass number	valency
Hydrogen	H	1	1	1
carbon	C	6	12	4
Oxygen	O	8	16	2
Sodium	Na	11	23	1
Calcium	Ca	20	40	2

The element having valency one is called monovalent. For example: Hydrogen and Sodium. The elements having valency two are called divalent. For example: Oxygen and Beryllium. The elements having valency three are called trivalent. For example: Nitrogen and Aluminium. Some elements exhibits more than one valency. For example: Iron combines with oxygen to form two types ferrous oxide (exhibits valency 2) and ferric oxide (exhibits valency 3), however we will study about them later.

When atoms of different elements combine with each other then molecules of compounds are formed. In these instances, it is necessary to know the valancies of those elements. For example:

1 2Na + Cl2 ---------- 2NaCl
Valency 1 + 1
Here, the valancies of both sodium and chlorine are 1.
Remember The valency of element Na is 1
The valency of element Cl is 1

Then, the molecular formula will be
Symbol of Elements Na Cl Molecular Formula
Radicals and ions 1 1
NaCl
2 Mg + Cl2 ---------- Mg Cl_2
Valency 2 1
Here, the valency of magnesium is 2 and that of Cl is 1.

1. Heat and Temperature

Introduction

You shiverwhen it is coldoutside andsweat when itis hot outside,but how canyou measure those weather temperatures?Temperature isinvolved in many aspects of ourdaily lives, including our own bodies and health;theweather; and how hot the stove must be inorder to cook food.Themeasurement of warmness or coldness ofa substance is known as itstemperature.It is a measure of the average kinetic energyof the particles in anobject. Temperature isrelated to how fast the atoms within a substance

Temperature Units:

There are three units which are used tomeasure the temperature: DegreeCelsius,Fahrenheit and Kelvin.

Degree Celsius: Celsius is written as°C andreadas degree. For example 20°C; it is read as twentydegree Celsius. Celsiusis called as Centigrade aswell.

Fahrenheit: Fahrenheit is written as °F forexample 25°F; it is read as twentyfive degreeFahrenheit.

Kelvin: Kelvin is written as K. For example100K; it is read as hundred Kelvin.
The SI unit of temperature is kelvin (K).

Measuring Temperature

The temperature of theobject is well approximatedwith the kinetic energy ofthe substances. The hightemperature means that themolecules within the objectare moving at a faster rate.But the question arises, how to measureit? Molecules inany substance are very smallto analyze and calculate its movement (Kineticenergy)in order to measure its temperature.You must use an indirect method to measure thekinetic energy of the molecules of a substance.We studied that solids expandswhen heat issupplied to it. Like solid substances, liquids arealso affected by heat.To know this let us do theactivity 1.

In a thermometer, when liquid gets heat,it expands and when it is cooleddown, itcontracts. It is used to measure temperature.Like solid and liquid objects,the effect ofheat is also observed on gaseous objects.

Thermometer:

Thermometer is the most common instrumentto measure temperature.Thereare various kinds of thermometers.Some of them are like glass tubes which lookthin and are filled with some kind of liquid.Why Mercury or Alcohol is used inThermometer?Mostly Alcohol and Mercury are used inthermometers as theyremain in liquid formeven with a change of temperature in them.A small change inthe temperature causeschange in volume of a liquid. We measure thistemperatureby measuring expansion of a liquidin thermometer.

Properties of Mercury:-

- Its expansion is uniform. (For equal amountsof 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 lowfreezing point (−39°C). Hence a wide rangeof temperatures can be measured using amercury thermometer

Properties of Alcohol

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

Types of Thermometers

There are differenttypes of thermometers formeasuring the temperaturesofdifferent things like air,our bodies, food and manyother things. Among these,thecommonly used thermometers are clinicalthermometers and laboratorythermometers.

Clinical Thermometer

These thermometers are used to measurethe temperature of a human body, athome,clinics and hospitals. All clinical thermometershave a kink that prevents themercury fromflowing back into the bulb when thethermometer is taken out of thepatient'smouth, so that the temperature can benoted conveniently. There aretemperaturescales on either side of the mercurythread, one in Celsius scale and theotherin Fahrenheit scale. Since the Fahrenheitscale is more sensitive than theCelsiusscale, body temperature is measured inF only. A clinical thermometerindicatestemperatures from a minimum of 35°C or94°F to a maximum of 42°C or108°F.

Precautions to be Followed While Using aClinical Thermometer

- The thermometer should be washed beforeand after use, preferably with anantisepticsolution.
- Jerk the thermometer a few times to bringthe level of the mercury down.
- Before use, the mercury level should bebelow 35°C or 94°F.
- Do not hold the thermometer by its bulb.
- Keep the mercury level along your line ofsight and then take the reading.
- Handle the thermometer with care. If it hitsagainst some hard object, it may break.
- Do not place the thermometer in a hot flameor in the hot sun.

Laboratory Thermometers

Laboratory thermometers are used tomeasure the temperature in school andotherlaboratories for scientific research. They arealso used in the industry as theycan measuretemperatures higher than what clinicalthermometers can record. Thestem and thebulb of a lab thermometer are longer whencompared to that of aclinical thermometer andthere is no kink in the lab thermometer.A laboratorythermometer has only theCelsius scale ranging from −10°C to110°C.

Precautions to be Followed While Using a Laboratory Thermometer

- Do not tilt the thermometer whilemeasuring the temperature. Place itupright.
- Note the reading only when thebulb has been surrounded by thesubstance from all sides.

Do you know?

In humans, the averageinternal temperature is37°C (98.6°F), though itvariesamong individuals.However, no person always has exactlythe same temperature atevery moment ofthe day. Temperatures cycle regularly upand down through theday according toactivities and external factors.

Clinical Thermometer	Laboratory Thermometer
Clinical Thermometer is scaled from 35°C to 42°C or from 94°C to 108°F.	Laboratory thermometer is generally from -10°C-110°C.
Mercury level does not fall on its own, as there is a link 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

Digital Thermometer

Here is a lot of concernover the use of mercury inthermometers. Mercuryis atoxic substance andis very difficultto dispose of if athermometer breaks. These days, digitalthermometers are available which donot use mercury. Instead, it has asensorwhich can measure the heat coming outfrom the body directly and from thatcan measure the temperature of thebody.Digital thermometers are mainlyused totake the body temperature.

Caution

Alex wanted to measure the temperatureof hot milk using a clinicalthermometer. Histeacher stopped him from doing so.We are advised not to use aclinicalthermometer for measuring the temperature ofany object other than humanbody. Also we areadvised to avoid keeping it in the sun or near aflame. Why?A clinical thermometer has smalltemperature range. The glass will crack/ burstdue toexcessive pressure created by expansionof mercury.

Do you know?

Maximum - Minimum thermometer

The maximum andminimum temperatures ofthe previous day reported inweatherreports are measured by a thermometercalled the maximum – minimumthermometer.

Scales of thermometers
Celsius scale

Celsius is the common unit of measuringtemperature, termed after Swedishastronomer,Anders Celsius in 1742, before that it wasknown as Centigrade asthermometers usingthis scale are calibrated from (Freezing pointof water) 0°C to 100°C (boiling point of water).

In Greek, 'Centium' means 100 and 'Gradus'means steps, both words make itcentigrade andlater Celsius.

Fahrenheit Scale

Fahrenheit is a Common unit to measurehuman body temperature. It istermed after thename of a German Physicist Daniel GabrielFahrenheit. Freezingpoint of water is taken as32°F and boiling point 212°F. Thermometers withFahrenheit scale are calibrated from 32°F to 212°F.

Kelvin scale

Kelvin scale is termed after Lord Kelvin.It is the SI unit of measuringtemperature andwritten as K also known as absolute scale as itstarts from absolutezero temperature.

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

Relation between Fahrenheit scale and Celsius scales is as under.

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

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

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

Do you know?

Most of the people in theworld use the Celsius scaleto measure temperatureforday to day purpose. TheKelvin scale has been designed in such away, it is notonly an absolute temperaturescale, but also 1°C change is equal to a 1Kchange. Thismakes the conversion fromCelsius to absolute temperature scale(Kelvin scale) easy,just the addition orsubtraction of a constant 273.15

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

To sort out this problem they useThe Rankine scale. It named after theGlasgow University engineer and physicistRankine, who proposed it in 1859. It isanabsolute temperature scale, and has theproperty of having a 1°R change is equaltoa 1°F change. Fahrenheit users who needto work with absolute temperature canbeconverted to Rankine by

$$R= F+ 459.67$$

2. Electricity

Introduction

In 1882, when it was sun set in the west thatmiracle happened in New yorkcity. WhenThomas Alva Edison gently pushed the switchon 14,000 bulbs in 9,000houses suddenly gotlighted up. It was the greatest invention tomankind. Fromthen the world was under thelight even in the night.

Many countries began using electricityfor domestic purposes. Seventeen yearsafterthe New York, in 1899 electricity first came toIndia. The Calcutta ElectricSupply CorporationLimited commissioned the first thermal powerplant in India on17 April 1899Around 1900s, a thermal power stationwas set up at Basin Bridge inMadras city andpower was distributed to the government press,general hospital,electric tramways and certainresidential areas in Madras. Today electricity isacommon household commodity.

In your class 6, we learned about electricityand their sources. From operatingfactories,running medical equipment's like ventilator,communications like mobile, radio and TV,drawing water to the agricultural field andlight up homes electricityis important. Whatis electricity? We can see that. it is a form ofenergy, like heat andmagnetism.We have learnt that all materials are madeup of small particles calledatoms. The centre of the atom is called the nucleus. The nucleus consists of protons and neutrons. 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

Electric charge is measured in a unit calledcoulomb. One unit of coulomb ischarge ofapproximately 6.242×10^{18} protons or electrons.Electrical charges aregenerally denoted bythe letter `q`

Electric Current

The flows of electric charges constitute anelectric current. For an electricalapplianceto work, electric current must flow through it.An electric current ismeasured by the amountof electric charge moving per unit time at anypoint in thecircuit. The conventional symbolfor current is 'I'.

Unit of Electric Current

The SI unit for measuring an electric current isthe ampere, which is the flowof electric chargeacross a surface at the rate of one coulomb persecond.

$$I = q / t$$

Where	I	⇒	current (in Ampere - A)
	q	⇒	charge (in coulomb - c)
	t	⇒	time taken (in seconds - s)

Conventional Current and Electron Flow

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

This movement of positive charges is calledconventional current.After the electrons were discovered, itwas known that electron flow actuallytakesplace from the negative terminal to the positiveterminal of the battery. Thismovement isknown as electron flow.Conventional current is in thedirection opposite to electron flow.

Measurement of electric current

Electric current is measuredusing a device called ammeter.The terminals ofan ammeterare marked with + and -sign. An ammeter must beconnected in seriesin a circuit.Instruments used to measure smallercurrents, in the milli ampere ormicro ampererange, are designated as milli ammeters ormicro ammeters.

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

Potential difference (v)

Electrical charges need energy to push themalong a circuit.Water alwaysflows fromhigher to lower ground.Similarly an electric chargealways flows from apoint athigher potential to a point atlower potential.

An electric current can flow only when there isa potential difference (V) or P.D.
The potential difference between anytwo points in the circuit is the amount ofenergy needed to move one unit of electriccharge from one point to the other.

Unit of potential difference

Did you ever notice the precautionaryboard while crossing the railway trackand the electrical transformer? What does theword high voltage denotes?

The term mentioned in the board volt isthe measurement for the electricpotentialdifference.

The SI unit of potential difference is volt (V).Potential difference between twopoints ismeasured by using a device called voltmeter.

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

Electrical conductivity and Resistivity
Resistance (R)
An electrical component resists or hinders theflow of electric charges, when itis connected ina circuit. In a circuit component, the resistanceto the flow of chargeis similar to how a narrowchannel resists the flow of water.

The higher the resistance in a component, thehigher the potential difference neededto moveelectric charge through the component. We canexpress resistance as a ratio.

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

The S.I unit of resistance is ohmGreater the ratio of V to I, the greater is theresistance

Electrical conductivity (σ)

Electrical conductivity or specific conductanceis the measure of a material'sability to conductan electric current. It is commonly representedby the Greek letterσ (sigma) The S.I Unit ofelectrical conductivity is Siemens/meter(S/m)

Electrical resistivity (ρ)

Electrical resistivity (also known as specificelectrical resistance or volumeresistivity)is a fundamental property of a material thatquantifies how strongly thatmaterial opposesthe flow of electric current. The SI unit ofelectrical resistivity is the ohm-metre (Ω m).

Material	**Resistivity (ρ) (Ω m) at 20°C**	**Conductivity (σ) (S/m) at 20°C**
Silver	$1.59x10^{-8}$	$6.30x10^{7}$
Copper	$1.68x10^{-8}$	$5.98x10^{7}$
Annealed copper	$1.72x10^{-8}$	$5.80x10^{7}$
Aluminium	$2.82x10^{-8}$	$3.5x10^{7}$

Analogy of Electric Current with Water Flow

An electric current is a flow of electrons througha conductor (like a copperwire). We can't seeelectrons; however, we can imagine the flow ofelectric current ina wire like the flow of waterin a pipe.

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.

Sources of Electric current -Electro chemical cells or electric cells

An electric cell is something that provideselectricity to different devices thatare not fed directly or easily by the supplyof electricity.

In addition to electro chemical, we use electrothermal source for generatingelectricity forlarge scale use.It has two terminals. When electric cells areused, achemical reaction takes place inside thecells which produces charge in the cell.

Types of cell – primary cell and secondary cell

In our daily life we are using cells and batteriesfor the functioning of aremote, toys cars, clock,cellphone etc. Event Hough all the devicesproduceselectrical energy, some of the cellsare reusable and some of them are of single use.Do you know the reason why? Based on theirtype they are classified into two types namely –primary cell and secondary cell.

Primary cell

The dry cell commonly used in torches is anexample of a primary cell. Itcannot be rechargedafter use.

Secondary cells

Secondary cells are used in automobiles andgenerators. The chemical reactionin themand be reversed, hence they can be recharged.Lithium cylindrical cells,button cells andalkaline cells are the other types that are in use.

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 Nickle – Iron accumulator	It is used to operate devices such as mobile phones, cameras, computers and emergency lights

4. Example – Simple Voltalic cell, Daniel cell, and Lechananche cell and dry cell	Examples of secondary cells are lead accumulator, Edison accumulator and Nickle – Iron accumulator.

Primary cell – simply Dry cell

A dry cell is a type of chemical cellcommonly used in the common formbatteriesfor many electrical appliances. It is a convenientsource of electricityavailable in portable andcompact form. It was developed in 1887 by YeiSakizo ofJapan.

Dry cells are normally used in small devicessuch as remote control for T.V., torch, cameraand toys.

A dry cell is a portable form of a leclanche cell.It consists of zinc vessel whichacts as a negativeelectrode or anode. The vessel contains a moistpaste of saw dustsaturated with a solution ofammonium chloride and zinc chloride.The ammoniumchloride acts as an electrolyte.Electrolytes are substances that becomeions insolution and acquire the capacityto conduct electricity.

The purpose of zinc chloride is to maintainthe moistness of the paste beinghighlyhygroscopic. The carbon rod covered with abrass cap is placed in the middleof the vessel. Itacts as positive electrode or cathode.

It is surrounded by a closely packed mixtureof charcoal and manganese dioxide (MnO2) ina muslin bag. Here MnO2 acts as depolarizer.The zinc vessel issealed at the top with pitch orshellac. A small hole is provided in it to allowthegases formed by the chemical action toescape. The chemical action inside the cell is thesame as in leclanche cell.

Batteries

Batteries are a collection of one or more cellswhose chemical reactions create aflow ofelectrons in a circuit. All batteries are made upof three basic components: ananode (the '+'side), a cathode (the '–' side), and some kindof electrolyte. Electrolyteis a substance thatchemically reacts with the anode and cathode.

Invention of the Battery

One fateful day in 1780,Italian physicist, physician,biologist, andphilosopher, LuigiGalvani, was dissecting a frogattached to a brass hook. As hetouched the frog's leg with an iron scapel, theleg twitched.

Galvani theorized that the energy came fromthe leg itself, but his fellow scientist,AlessandroVolta, believed otherwise.Volta hypothesized thatthe frog's legimpulses wereactually caused by differentmetals soaked in a liquid.He repeated the experiment using cloth soakedin brine instead of a frog corpse, whichresultedin a similar voltage. Volta published his findingsin 1791 and later createdthe first battery, thevoltaic pile, in 1800.The invention of the modernbattery isoften attributed toAlessandro Volta. It actuallystarted with a surprising accidentinvolving the dissection of a frog.

ELECTRIC SWITCH

Our country faces a shortage of electricity. Sowastage of electricity means youare deprivingsomeone else of electricity. Your electricitybill goes up. So, we mustuse electricity verycarefully and only when it is needed we mustuse the electricityas long as we need it in ourhouse hold activities.Can you remember what you didlast year toturn the current on or off?This time, we shall usea switch to turn thecurrent on or off. Youmay have used differentkinds of switches to turnyourhousehold electricappliances on or off. Switches help us to start orstop theappliances safely and easily.

Electric circuit

It is difficult to draw a realistic diagram of thiscircuit. The electricalappliances you use at homehave even more difficult circuits. Can you drawrealisticdiagrams of such circuits which containmany bulbs, cells, switches and othercomponents?Do you think it is easy? It is not easy.Scientists have tried to make thejob easier.They have adopted simple symbols for differentcomponents in a circuit.We can draw circuitdiagrams using these symbols.

Do you know?

All muscles of our bodiesmove in response to electricalimpulses generatednaturallyin our bodies

Types of electrical circuits

In the above experiment, we make a circuit witha bulb and a cell. We makeonly one kind of thecircuit with a cell and a bulb. But we can makemany types ofcircuits if we have more than onebulb or cells by connecting these components indifferent ways.

Series circuit

Two kinds of circuits can be made with twobulbs and a cell. In thisexperiment we shallmake one of them and study it.

Parallel Circuit

Figure - shows a circuit in which two bulbsare connected indifferent places.Thisis a second type ofcircuit. Two bulbs inthis circuit are said tobe connected inparallel and such circuits arecalled parallel circuits.

Do you know?

Short circuit

You mighth a v eobserved thespark in the electric polelocated nearby yourhouse. Do you knowthe cause of this electric spark? This is dueto the shortcircuiting of electricity along itspath.A short circuit is simply a low resistanceconnection between the two conductorssupplying electrical power to any circuit.Arc welding is a common example of thepractical application of the heating due toashort circuit.

Conductors and Insulators

Based on the property ofconductance of electricity,substances are classifiedinto two types, namely,Conductors and Insulators(or) bad conductors of electricitythe electrons of different types of atoms havedifferent degrees of freedom to movearound.With some types of materials, such as metals,the outermost electrons in theatoms are looselybound and they chaotically move in the spacebetween the atomsof that material. Becausethese virtually unbound electrons are free toleave theirrespective atoms and float aroundin the space between adjacent atoms, they areoften called as free electrons.

Let's imagine that we have a metal in the form ofa wire. When a voltage isconnected across theends of the metal wire, the free electrons drift inone direction.

So, a really good conductor is one that has lots offree charges while those whodon't have enough'free charges' would not be good at conductingelectricity or wecan say that they would be'poor conductors' of electricity.

Conductors

Conductors are the materials whose atoms haveelectrons that are looselybound and are free tomove through the material. A material that is agoodconductor gives very little resistance to theflow of charge (electron) on theapplication ofexternal voltage. This flow of charge (electron)is what constitutes anelectric current. A goodconductor has high electrical conductivity inthe aboveactivity.In general, more the free electrons, the betterthe material will conduct (for acertain appliedvoltage).

Insulators

Those materials which don't have enough'free electrons' are not good atconductingelectricity or we can say that they would be'poor conductors' ofelectricity and they are called insulators

Do you know?

This is the material usedin SIM Cards, Computers,and ATM cards. Do youknow by which material Iam made up off?

The chips which are used in SIM Cards,Computers, and ATM cards are madeupof semiconductors namely, silicon andgermanium because of their electricalconductivity lies between a conductor andan insulator.

An insulator gives a lot of resistance to the flowof charge (electron). Duringthe drift of theelectrons in an object when an external voltageis applied, collisionsoccur between the freeelectrons and the atoms of the material alsoaffect themovement of charges. These collisionsmean that they get scattered. It is acombinationof the number of free electrons and how muchthey are scattered thataffects how well themetal conducts electricity. The rubber eraserdoes not allowelectric current to pass throughit. So rubber is a non-conductor of electricity.Rubber is an insulator 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, anelectrical conductor, havevery low resistance. Copperwires are used to carrycurrent in households. These wires are inturn enclosed inelectrical insulators, ormaterials of highelectrical resistance.These materials areusually made offlexible plastic.

Effects of Electric Current

You performed manyexperiments with electricityin Class 6 and learned quitea few interesting facts. Forexample, you saw that abulb can be made to light up bymakingelectricity flow through it. The light of thebulb is thus one of the effects ofelectricity.There are several other important effectsof electricity. We shall studysome of theseeffects in this chapter. There are 3 maineffects of electricity as,

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

Heating effect

When an electric current passes through a wire,the electrical energy is converted to hear. Inheating appliances, the heating element is madeup ofmaterials 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 manypractical applications. Theelectric bulb, geyser,iron box, immersible water heater are based onthis effect.These appliances have heating coilsof high resistance.Generation of heat due toelectriccurrent is known as the heating effect ofelectricity.

Factors affecting Heating Effect of current

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

Electric Fuse

Electric fuse isa safety devicewhich is usedin householdwiring andin manyappliances. Electric fuse has a body made ofceramic and two points for connectingthe fusewire. The fuse wire melts whenever there isoverload of the current in thewire. This breaksthe circuit and helps in preventing damage tocostly appliancesand to the wiring. In electricaldevices, a glass fuse is often used. This is a smallglasstube, in which lies the fuse wire.

MCBs (Miniature Circuit Breaker)

MCBs have been replacing electric fuse fromwirings at most of the places. Theelectric fusehas a big practical problem. Whenever the wirefuses, one needs toreplace the wire to resumeelectric supply. More often than not, this provesto be acumbersome task. Miniature circuitbreakers break the circuit automatically. Onejust needs to switch it on to resume the electricsupply. Many models of MCBs havea built inmechanism by which the electric supply isautomatically resumed.

Magnetic Effect of electricity

The next effect of electric current is Magnetism.In 1819, Hans ChristianOersted discoveredthe electricity that has a magnetic effect.The experiment inactivity-5 will help youunderstand the magnetic effect of electriccurrent.

Application of magnetic effect ofelectric current - Electromagnet

Magnetic effect of electric current has beenused in making powerfulelectromagnets.Electromagnets are also used to removesplinters of steel or iron inhospitals dealingwith eye injuries.Electro magnets are used in many appliancesthat we use in our day to day life, namely, electricbell, cranes and telephone. Let usknow how themagnetic effect of electric current is applied intelephones.

Telephone

In telephones, a changing magnetic effect causesa thin sheet of metal(diaphragm) to vibrate.The diaphragm is made up a metal that can beattracted tomagnets.

1. The diaphragm is attached to spring that isfixed to the earpiece.
2. When a current flows through the wires, thesoft – iron bar becomes anelectromagnet.
3. The diaphragm becomes attracted to theelectromagnet.
4. As the person on the other end of the linespeaks, his voices cause the current inthecircuit to change. This causes the diaphragmin the earpiece to vibrate,producing sound.

Chemical Effects of Electricity

Chemical reactions happen, when electricitypasses through variousconducting liquids. Thisis known as chemical effects of electricity. Youwill learnchemical effect of electricity in yourhigher classes.

3. Changes around us

Introduction

Changes take place around us all the time. A change refers to an alteration in physical properties or alteration in the composition of matter. For example, ice melts on heating, that is, it changes from a solid to liquid. On further heating, water starts evaporating; it changes from a liquid to gas. Here, there is a change in the physical state of the substance. Let us look at another change, that is, when objects made of iron are exposed to moist conditions, a reddish-brown new substance called rust forms on the surface of these objects. In this instance of rusting, there is change in the composition of the substance. Thus, the change involves an alteration in the properties such as colour, texture and the state of the substance since there is formation of a new substance.

Let us go for another set of example. Heat a cup of water and a paper. The water upon heating become just hotter and hotter and at some point will become water vapour. It remains water at all times; that is, water remains the same, only its volume changes and hence it is called as physical change. Whereas in case of burning of paper, changes to carbon dioxide and other substances. Now we cannot get back the paper after burning. As there is a change in the chemical nature, it is called as chemical change.

When you mix sugar in water, is it a chemical change or physical change? Look at the following list. Identify the physical and chemical changes and fill in the given table.

(Rusting of iron, digestion of food, boiling egg, rotting banana, mixing sand and water, chopping wood, crushing a can, mixtures of different coloured buttons, burning of wood)

In class six, we read that matter is classified as solid, liquid and gas based on the physical state. We know that matter is made up of tiny particles, atoms and molecules; particles are in constant and random movement. Let us have a look at the summary of the characteristics of solid, liquid and gas.

When the arrangement of the particles in a substance change for any reason (applying pressure, altering temperature and other different reasons) the physical state of the substance gets changed. Let us see what happens when we apply heat to the substances.

Effect of heat on solid, liquid and gases

Upon heating, particle arrangement within the state of matter gets disturbed. The disturbance is seen either as expansion or contraction. When heated or cooled, the object may expand or contract, but the mass remains the same. That is, the number of particles that was inside the object does not undergo any change, only the arrangement of the particle changes. When a glass of water is heated, its volume increases and if a glass of water is cooled its volume decreases.

Solid:

In which particles are very close together. Particles are arranged in a fixed regular pattern. Particles can vibrate about their fixed positions.

Liquid:

In which particles are close together. Particles are not arranged in a fixed regular pattern. Particles are able to slide past one another.

Gasses:

Particles are far apart from each other. Particles are not arranged in a fixed regular pattern. Particles moving freely over long distances

Such changes where there is change in volume but mass remaining the same are called physical changes and they can be pictorially depicted as follows:

There are other possibilities that can occur upon heating the solids, liquids and gases. The possible changes are due to melting, boiling, freezing and condensation during which there is change in the physical state of the particles of the matter. Let us discuss about them in detail in a short while.

Let us now see some physical changes and the underlying reasons as why they are simply physical changes.

Physical changes

Physical changes are the changes in which only physical properties of a substance undergo a change and there is no change in its chemical composition. There is no new substance formed in a physical change. Physical properties include lustre, malleability (flexibility), and ductility (ability to be drawn into a thin wire), density, viscosity, solubility, mass, volume and so on. Any change in these physical properties is referred to as a physical change. For example, when a rubber band is stretched, it elongates. However, when then stretching is stopped, the rubber band comes back to its original state and shape. In this example, there is no new substance formed but the rubber band remains the same before and after elongation.

Characteristics of a physical change

A physical change has following characteristics:

- During a physical change, no new substances are formed. In a physical change, the chemical properties of a substance do not change. For example, when ice cube melts, water is formed. In this change, there is no new substance, but water is same both in ice and in water.

- A physical change is usually temporary and reversible in nature. For example, when water is heated, water vapours are formed, once water vapours are cooled, water can be obtained again.

- In a physical change, the chemical properties of a substance do not change. For example, when a piece of gold is melted, its chemical composition remains the same in the solid form and also in the liquid form.

- In a physical change, the physical properties such as colour, shape and size of a substance may undergo a change. For example, cutting of vegetables and inflating a balloon are some examples of physical changes in which size and shape of a substance undergoes a change. we know it is not

Changes of state

Change of state of a substance is one of the major physical changes we encounter in daily lives. We have read about simple changes of physical state such as melting of ice in our previous classes.

The following are some of the changes of state: from Solid → to Liquid is Melting from Liquid → to Gas is Vaporization from Liquid → to Solid is Freezing from Gas → to Liquid is Condensation from Solid → to Gas is Sublimation

Melting, vaporization, and sublimation occur when heated and hence it is called as endothermic process. In an endothermic process, the speed of the molecules is increased hence they move faster.

In contrast, such as in freezing and condensation, heat is removed, resulting in the decreasing the speeds of the molecules causing them move slower. Such processes are called as exothermic process. In the next section we will look at each of these physical changes.

Melting

You have seen a puddle of water getting pooled around the glass of ice-cream or a glass of ice cubes when it is kept in room temperature. The ice cubes / ice-cream melt. Right! Can you give reason for that? The ice kept in the beaker receives heat from the surrounding air, to melt and form water.

Melting is the changing of a solid into its liquid state and it happens by heating, whereas Freezing is the changing of a liquid into its solid state and it happens by cooling.

Vaporization

Look at a kettle kept on the fire. The bubbles form and the liquid water becomes water vapour, if you heat it sufficiently. However, when you put a wet cloth to dry, the water evaporates into air, leaving the clothes dry. That is there are two types of vaporization:

boiling and evaporation, the first one is by heating and the second type of vaporization is natural.

Boiling is the process of conversion of a liquid into vapours on heating. In gaseous state, only the arrangement of molecules changes, there is no change in their chemical composition. So, boiling is a physical change.

Upon heating a liquid, the particles gain energy and vibrate more vigorously. When the particles possess enough energy, they overcome the strong forces of attraction between one another. The particles break free from one another and move randomly. For example, when liquid water is heated to 100^{o}C, it boils to become steam. Boiling occurs when the boiling point is reached. The liquid changes to its gaseous state.

Evaporation

Take a glass of water. All the water molecules are moving here and there at different velocities (shown as arrows of different lengths). Some of the molecules, especially at the surface, could be moving in a direction away from the liquid, and have adequate energy to overcome the attractive force (surface tension) of the liquid, then that molecule will escape into the air. Thus slowly and steadily the water molecules escape, or said to evaporate, and the water level in the glass decreases as the time passes. Note that the temperature of the water did not rise to the level of boiling point of water. Nor were there any bubbles formed like boiling.

Evaporation is the technique used to separate dissolved solids from a solid-liquid mixture. This is the technique used to extract salt from sea water in salt pans. Shallow level of sea water is impounded. Slowly the water evaporates due to action of Sun. Ultimately salt deposits over the ground we can understand. Evaporation makes use of the fact that the solvent in a solution can vaporise at any temperature, leaving behind a residue of the solid that was dissolved in the liquid.Evaporation is a slow process and occurs only at the surface of the liquid.

Freezing

Water in the freezer compartment of a refrigerator gets cooled and solidifies to form ice. In this case, the liquid water changes into solid water called ice.

Only a change in state (from liquid to solid) takes place during the freezing of water to form ice, but no new substance is formed. So, the freezing of water is a physical change.

Upon cooling a liquid, the particles loose energy and vibrate less vigorously. When the particles possess less energy, they can experience strong forces of attraction between one another. The particles move closer to each other and movement of particles is also restricted. For example, when liquid water is cooled to 0^{o} C, it freezes to become ice. Freezing occurs when the freezing point is reached. The liquid changes to its solid state.

Condensation

We would have observed that the plate that covers the cooked food items have water droplets inside. Why?

The water vapour emerges from the hot food and goes up. The plate covering the food item is in relative less temperature than the hot food. Thus the more energetic molecules loose energy once they touch the cooler plate. As the molecules lose heat, they lose energy and slow down. They move closer to other gas molecules. Finally these molecules collect together to form a liquid. Condensation happens when molecules in a gas cool down.

In class six, you learnt about water cycle in which you already know how the clouds are formed from water vapour. Water vapourcondenses to form clouds.

Condensation is the conversion of gas into its liquid state. The liquid obtained after condensation can be converted back into gas on heating. So, condensation is also a physical process. During this process, only the arrangement of molecules changes from the gaseous state to liquid state. So, condensation is a physical change.

$$\text{Gas} \xrightarrow{\text{Cooling}} \text{Liquid}$$

$$\text{Liquid} \xrightarrow{\text{Heating}} \text{Gas}$$

Condensation is the changing of a gas into its liquid state and it happens by cooling, whereas Evaporation is the changing of a liquid into its gas state and it happens by heating

Sublimation

We have seen camphor being burnt at home, kept in rooms to prevent entry of mosquitoes. Have you ever noticed camphor becoming liquid at any point of time? ___________ It will not. There are certain solid substances like camphor, naphthalene that get converted into gas directly upon heating without becoming liquid. This process in which a solid is converted directly into gas is called sublimation.

In each of the above said processes, there is a change of state due to change in temperature. But there is no change in chemical composition. By changing the temperature all these changes can be reversed. We know that change of a physical state is only a physical change. So, evaporation, boiling, condensation, melting and freezing are all physical processes

Crystallization

Though not mentioned earlier, crystallization is also a special form of physical change. The soluble impurities get removed from certain solids by crystallization. The process of cooling a hot, concentrated solution of a substance to obtain crystals is called crystallization.

We also know that sea-water contains salts dissolved in it and the salt can be separated from sea-water by the process of evaporation. The process of evaporation is not a good technique because the soluble impurities do not get removed in the process of evaporation

Further the crystals of salts obtained by the process of evaporation are small. The shape of crystals cannot be seen clearly. So the solid substances are usually purified by the process of crystallization. Large crystals of pure substances can be obtained from their solutions by the process of crystallization. Crystallization is a method of separation as well as a method of purification.

Chemical changes

Changes that occur with the formation of new substance with different chemical composition or transformation of a substance into another substance with the evolution or absorption of heat or light energy are termed as chemical changes. Rusting of iron, burning, curdling of milk, reaction of baking soda with lemon juice, fermentation are some examples of chemical changes.

Chemical changes are very important in our lives. All the new substances which we use in various fields of our life are produced as a result of chemical reactions. Some of the examples of the importance of chemical changes are given below:

1. Metals are extracted from their naturally occurring compounds called 'ores' by a series of chemical changes.
2. Medicines are prepared by carrying out a chain of chemical changes.
3. The materials such as plastics, soaps, detergents, perfumes, acids, bases, salts etc. are all made by carrying out various types of chemical changes.
4. Every new material is discovered by studying different types of chemical changes.

In addition to new products, the following may also accompany a chemical change:

Heat, light or any other radiation may be given off or absorbed.
Sound may be produced
A change in smell may take place (or) a new smell may be given off.
A colour change may take place.
A gas may be formed.

Explosion of a firework is a chemical change. We know that such an explosion produces heat, light, sound and unpleasant gases that pollute the atmosphere. That is why we are advised not to play with fireworks.

You must have noticed that a slice of an apple acquires a brown colour if it is not consumed immediately. Colour of the potato remains the same when stored in water but there is change in colour with the piece kept in air. Look at the cut brinjal kept in air. The change of colour in these cases is due to the formation of some new substances which you will learn in higher classes. Are these not chemical changes?

Rusting of iron

In class six, we have already studied that rusting is an example of a chemical change. Now, shall we read why the process of rusting is called a chemical change.

Do you know?

The Iron Pillar at Delhi

Amazingly there is an iron that did not rust! There is an iron pillar at the Qutub complex in Delhi which is more than 1600 years age. Even after such a long period, the iron pillar kept in open spaces has not rusted at all. This shows that Indian scientists made great advances in metal making technology even at 16th century which enabled them to make this iron pillar having the quality of great rust resistance.

Rusting is one change that affects iron articles and slowly destroys them. Since iron is used in making bridges, ships, cars, truck bodies and many other articles, the monetary loss due to rusting is huge. The process of forming rust is represented as follows:

Iron + oxygen + water → rust

$2Fe + 2O_2$ from air $+ 2H_2O \rightarrow 2Fe_2O_3 . H_2O$

For rusting to take place both oxygen and water (or even water vapour) is essential. In fact, if the content of moisture in air is high, the air is said to be more humid and eventually rusting is faster.

How can we prevent rusting?

Iron articles can be prevented from making contact with oxygen, water/water vapour. A simple way is to apply a coat of paint or grease. These coats should be applied regularly to prevent rusting

Do you know?

Another way of preventing rusting is to deposit a layer of a metal like chromium or zinc on iron. This is called galvanization and you will learn about this detail in higher classes.

Burning

We have already studied that burning of paper is a fast change. Burning a piece of paper gives entirely new substances such as carbon-dioxide, water, water vapour, smoke and ash. Heat and light are also given out during the burning ofpaper. We cannot combine the products of burningof paper to form the originalpaper again. So, it isa permanent change. Now, shall we perform anactivity ofburning a piece of magnesium ribbonand find what type of change is it?

What do you observe?

You can see that the magnesium ribbonstarts burning with a dazzling whitelight. Holdthe burning magnesium ribbon over a watchglass so that the powderyash being formed bythe burning of magnesium collects in the watchglass.

When magnesium ribbon burns in air,then the magnesium metal combineswith theoxygen of air to form a new substance calledmagnesium oxide.

Magnesium+Oxygen→ Magnesium oxide
$2Mg \quad +O_2 \rightarrow \quad 2MgO$

Magnesium oxide compound appears as a whitepowdery ash.

The burning of magnesium ribbon is a chemicalchange, because a newsubstance, magnesiumoxide, is formed during this change.

Curdling of milk

We know that curdling of milk is anexample of irreversible change since wecannotget back the milk after curdling occurs. It is alsocalled as a chemical change.Shall we clarify theprocess of curdling?

Curdling is a process in which liquidgradually turns into solid, formingclumpsalong the way. Take hot milk in a pan and addfew drops of curd, in fewminutes milk curdlesforming lumpy solid masses. We can even addlemon extractto the hot milk to effect curdlingimmediately, but the taste and texture of thecurdwill not be the same as that of the curdlingoccurring in a few hours. You can try totastethe curd formed by immediate curdling andgradual curdling.

Fermentation

In class six, we saw anexample that preparation ofbatter to produce idly is anexample for irreversible change.

Fermentation is the process in whichmicroorganisms such as yeast and certainbacteria break down sugar solution into alcoholand carbon-di-oxide.
It is an irreversible process as the alcoholformed cannot be turned back intosugar. Thus,fermentation is a chemical change.

Do you know?

Louis Pasteur (1822-1895), a Frenchchemist andmicrobiologistwas the first person to describethe process of fermentation.He described that fermentationoccurs in theabsence of air and in thepresence of micro-organisms such as yeast.He discoveredthe cure for rabies.

Chemical reaction of baking soda with lemon

Baking soda is sodium hydrogen carbonateand lemon juice contains citricacid. So, whenthese two substances are mixed together, thena chemical changetakes place between sodiumhydrogen carbonate and citric acid to formthree newsubstances: sodium citrate, carbondi-oxide and water. The chemical change canbewritten in the form of a word equation asfollows:-

Sodium hydrogen carbonate + citric acid $\rightarrow$ Sodium citrate + carbon dioxide + water

Conditions needed for a chemical change

We know that firing of crackers is a chemical change. Some crackers explode only when thrown against a wall or struck with a hard substance. Thus, we could see that change in pressure may also bring about a chemical change.

When lemon juice is mixed with soda water, they produce brisk effervescence which is otherwise not possible when they are separate. So we can say that may chemical changes occur only when the substances are made to physically contact with each other.

We have raw rice and cooked rice, have not we? They are different in their taste. Cooking is a process that is involved in the stated example, when in rice is boiled with sufficient water. It is the heat and the water that had brought the change in texture and taste of the rice before and after cooking. Thus we can say that heating is a condition needed for a chemical change to occur.

We know the use of Vanaspathiin cooking Vanaspahti is obtained from vegetable oils by addition of hydrogen to the oils, nickel, platinum or palladium are used as catalyst during the process of hydrogenation od oils.

Do you know?

Catalysts are substances that speed up the chemical change and it will not undergo any change during the course of the reaction. For example, yeast acts as the catalyst in the fermentation of sugar. You will learn more about catalyst in your higher classes

Water is a chemical compound thatremains as water when undisturbed. But ifa fewdrops of an acid is added to water and subjectedto electrolysis by passingelectric current, itdecomposes into hydrogen and oxygen. So, wecan understandthat electric current is also acondition that is needed for effecting a chemicalchange.

Thus we can conclude that physical contactof the substances, heat, light,electricity, applyingpressure are some of the different conditionsneeded forchemical changes to occur.

Indicators of a chemical change

Take some broken pieces of egg shell in atest tube and add lemon juice to it.You couldsee bubbles of carbon-di-oxide evolving inthe test tube. This is because ofthe chemicalchange between the two. Hence, we can saythat evolution of bubblesserve as an indicatorthat of a chemical change.

When water is added to quicklime (calciumoxide) there will be evolution oflot of heat alongwith the formation of slaked lime (calciumhydroxide). This is achemical change and itis indicated by the evolution of heat when thereaction sets inbetween quicklime and water.

Every day we cook food stuffs and clean theempty cooking utensils. Supposewhen we leavethe cooked utensils with some cooked food andleave them withoutwashing for a day, we couldsense a foul-smell coming from the vessels thenextday. This is because the food stuff hadbecome rotten and produces a foul-smell. Herespoilage of food is a chemical change and it isindicated by the foul smell. So,change of odouris also an indicator of a chemical change.

When an iron nail is kept in water for a fewdays and taken out, the nail willbecome reddishbrown in colour indicating that it has rusted.We know that rustingis a chemical change andit is indicated by a change in colour of the ironnail.

We know that hot milk curdles to formwhite lumps of curd when mixed withlemonjuice. A lump of curd is the precipitate that isobtained by the chemicalreaction betweenhot milk and lemon juice. So, formation ofprecipitate is also anindication of a chemicalchange.

To conclude, there can be evolution of bubbles,evolution of heat, change ofodour, change incolour or formation of a precipitate that serve asindicators for usto understand that a chemicalchange had taken place.

Exothermic and Endothermic chemical changes

Just as the physicalchange, Chemical reactionwill be either endothermic orexothermic.Similarly, burning of wood also releases heat and light. Such changes in which heat is released are known as exothermic changes.

There are some changes in which heat isabsorbed. For example, water absorbsheat whenit evaporates to form water vapours. Similarlyice absorbs heat when itmelts to form water.Such changes in which heat is absorbed areknown asendothermic changes. Dissolution ofglucose in water is also an endothermic change.

Periodic and non-periodic change

Depending on whether or not a changerepeats itself after a definite period oftime, itcan be classified as periodic change or a non-periodicchange.

Periodic changes

Changes that repeatthemselves after a definiteinterval of time are calledperiodic changes.

Rotation and Revolution of earth, beatingof the heart, clock striking everyhour, motionof the seconds-hand / minute-hand / hour-handof a clock are someexamples of periodicchanges.

Every year we observe that seasons changes. Wego from rains to winter andwinter to summerand so on.If the winter season changes into summer,we observechange in the texture type of clotheswe wear. We wear woolen clothes in winter andcotton clothes in summer. Similarly, we observethat the winter season is cooland summerseason is hot. In winter, duration of night islonger than in summer. Wetake cold drinksin summer but prefer hot tea, coffee or milk inwinter. Thesechanges that we observe show thechange of seasons.

The seasons and changes in weather occurbecause earth rotates on its fixedaxis. Changingseasons are almost periodic in nature.

Non-periodic changes

Changes that do not repeat themselves aftera definite interval of time andoccur randomlyare called non-periodicchanges. Eruption ofa volcano, occurrenceof an earthquake, astreak of lighting flashacross the sky during athunderstorm,running of a batsman betweenthe wickets, movement of legs while dancing areafew examples of non-periodic changes.

Unit1. Light

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

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.

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?

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'.

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

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 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 fi gure above. Th e line 1 is at 60O from BD, 2 at 30O from BD. Now , the line 4 at
60O from BD and line 3 at 30O from BD. Th e 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. Th e 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: Th e ray of light that falls on the surface of the refl ection materials. In figure, PO is the incident ray.

Reflected ray: Th e 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: Th e point of which are incident ray strikes the reflecting surface is the point of incidence. In the figure 'O' point of incidence.

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

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) $x = 90 - r = 90 - 47 = 43°$

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.

Th e 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. Th e diagram below depicts the case. Five incident rays labelled as A, B, C, D and E approach a surface. Th e 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 fiver flected 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. Th e result is that the rays of light are incident upon the surface in a concentrated bundle and are diff used 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 diff used 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 diff used reflection. Suppose walls 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 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.

Shadows
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

Opaque Material:

Materials that are not able to allow light to pass through, are called opaque material.

Example: Wall, thick card board, stone, etc. 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
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 lighter bulb in front of are 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.

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.

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

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

Plane Mirror and Reflection

A polished (or) smooth surface (like glass) which forms image by refl ection 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.

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.

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. Th is 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

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 90O degrees).

Difference between the images formed in Pinhole camera and Plane mirror	
Images formed by 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

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

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.
- Equal proportions of all three primary colour create white.

Unit.2 Universe and Space

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.

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 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.

Likewise 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 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 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 geocentric 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 the 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 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

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 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.

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.

Galaxies.

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 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.

Milky Way

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.

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 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."

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 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.

Unit3. Polymer Chemistry

Introduction

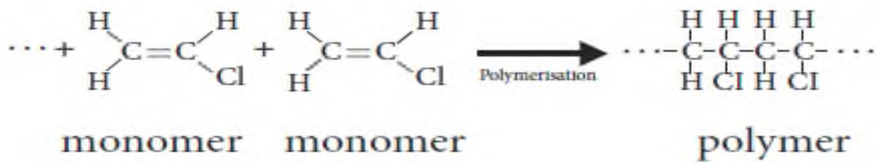
Polymer chemistry has a positive impact on your everyday life. Many of the materials you use are linked to polymer chemistry. When you get ready for school, you wear clothes, shoes, brush your teeth and take a school bag. Did you ever ask yourself what these items are made of? They are created from fibres. Fibres are made up of long chains of natural or synthetic polymers.

As a society, we are consuming more and more. Th e more things we buy the more things we throw away. 30 years ago, most of the waste in Tamil Nadu was biodegradable or easily recyclable. Today it is more complex. Many of the materials we use are non-biodegradable and difficult to recycle. For example, in the past people used many natural materials such as cotton, silk and jute fi bres. Today we use a lot of synthetic materials such as plastics. In this lesson you will learn about polymers, different types of fi bres, plastics and the waste we produce and how we should manage it.

What Are Polymers?

Th e word 'Polymer' is of Greek origin. 'Poly' means many and 'mer' means basic smaller unit. Polymers are very long chains made of repeating smaller molecules called 'monomers' that are joined together by covalent bonds and the process is called polymerization. Th e diagram below shows how repeating monomers join to form a polymer:

Polyvinyl Chloride (PVC) is a common plastic used for water pipes. Th e monomer and polymers of PVC is shown below.



Polymer

Polymers can be classified into natural and synthetic polymers. Can you imagine that your body produces and you are made up of natural polymers? Th e most familiar polymers that we use in our daily life are man-made and synthetic.

Natural Polymers

Natural polymers are found in living systems that include proteins and carbohydrates in our bodies and cellulose in wood and paper. They play a very important role in living things to provide structural materials and molecules needed for life processes.

Protein polymers are made from amino acid monomers (20 different kinds of amino acids). Different combinations of the amino acid monomers create many different protein polymers. Examples of protein polymers include DNA, enzymes, silk, skin, hair, fingernails, feathers and fur.

Examples of carbohydrate polymers include cellulose, chitin and lignin found in plants. Cellulose is made of sugar molecules and is the main component of cotton used in clothing. Chitin is found in the cell walls of fungi such as mushrooms and exoskeletons of insects such as crabs and spiders. Lignin consists of a network of polymers and is important in giving structure to plants.

Synthetic Polymers

Synthetic polymers are man-made polymers produced by using raw materials from petroleum oil and gas. Plastics are synthetic polymers. When oils and gases are processed to make petrol, ethylene and propylene monomers are removed as byproducts byproducts. We have already seen that polymer such as the Poly Vinyl Chloride (PVC) is made up of many monomers joined together. Ethylene and propylene are the building block monomers that make up many different types of plastics.

Based on the nature of the monomers, the way they are arranged in the polymer and the characteristics of final polymer.

There are grouped into different categories such as fibres, plastics, proteins. Let us study about few of them in the following sections.

Fibres

We wear clothes, use bags, rope, blankets, etc. in our daily life. They are made of fibres. Once upon a time, people used natural fibres such as cotton and wool. Nowadays, we use a lot of synthetic fibres. All natural and synthetic fibres are polymers.

Observe the difference between the natural and synthetic fibres:

Natural Coconut Rope vs. Nylon Fishing rope

Natural and Synthetic Fibres

Fibres are long strands of polymers interwoven to form linear, string-like structures. Fibres that are obtained from plant or animal sources are called natural fibres. Examples include cotton, coconut fibre, hair, wool and silk. Fibres that are made using raw materials from petroleum are synthetic fibres. Examples include polyester, acrylic and nylon. Historically, humans used natural plant fibres and animal fur for shelter, clothing and protection from the weather. Today, a large variety of natural fibres are still grown and processed such as cotton, silk, and wool. Natural fibres can be spun into filament, thread or rope. Then they can be woven, knitted, matted or bonded and are used to make clothing, containers, insulation material and many other products we use in our daily life. Three main sources of natural fibres are: (i) Animal (e.g.) wool and silk.

The discovery of making synthetic fibres out of petrochemicals has replaced the use of many natural fibres. Synthetic fibres such as nylon, polyester and acrylic are used to make many different plastic items you use in your daily life such as clothing, blankets, tooth brushes and stuffing in cushions.

Types and Uses
Silk: Natural Fibre

Natural silk fibres are obtained from boiling the cocoons of silk worms from specific species of moths. There are four types of natural silk: Mulberry silk, Tasar silk, Muga silk and Eri silk. Most of the mulberry silk worldwide is produced in India. Silk is one of the strongest natural fibres and has many uses such as clothing, carpets and parachutes.

Rayon: A Semi-synthetic Fibre

In the 19th century scientists were successful in producing the first artificial silk known as rayon. The first rayon factory in India was established in Kerala in 1946. Rayon is a man-made fibre, but it is not considered fully synthetic as it is made out of natural cellulose collected from wood pulp. The cellulose that is collected from wood or bamboo pulp is treated with several chemicals. First sodium hydroxide is added followed by carbon disulphide. The cellulose dissolves in the chemicals added to it and produces syrup called Viscose. Viscose is forced through a spinneret (a device made of metal plates with very tiny holes) into a solution of dilute sulphuric acid. This produces silk-like threads that are cleaned with soap and dried. This new fibre is called rayon.

Some types of rayon are made from the short cotton fibres left on cottonseeds after ginning. Rayon is cheaper than silk, can be woven like natural silk fibre and can be dyed in a wide variety of colours. It can be mixed with cotton to make bed sheets or with wool in the production of carpets and home furnishing products. Rayon is also found in sanitary products, diapers, bandages and gauze for dressing wounds.

Nylon: Synthetic Fibre

Nylon is the first fully processed synthetic fibre. It was popular during the Second World War for the use of parachutes and rope materials for climbing. Nowadays, nylon has replaced natural silk in many textiles, and has become one of the most commonly used synthetic fibres.

Nylon fibre is strong, elastic and light. It islustrous and easy to wash, which has made it popular for the clothing industry We use many products made from nylon such as socks, ropes, tents, toothbrushes, car seatbelts, sleeping bags, curtains, etc. Nylon thread is actually stronger than a steel wire.

Do You Know?
Nylon is very strong and can be used for rock climbing!
Nylon is a plastic polymer made of chemical units called polyamides. olyamides are

made with monomers – hexamethy lenediamine and adipic acid. Solid chips of these polyamides are melted and forced through a heated spinneret which has very, very tiny holes.

Polyester and Acrylic:
Synthetic Fibres

Polyester is another synthetic fibre. It can be drawn into very fine fibres that can be woven like any other yarn. Polyester is sold in the name of polycot, polywool, terrycot, etc. Polycot is a mixture of polyester and cotton; Polywool is a mixture of polyester and wool. PET (Polyethylene Terephthalate) is a very familiar form of polyester. It is used for making water and soda bottles, utensils, films and wires amongst many other useful products. Many of the clothes we wear are made out of polyester fibres. Fabrics made from this fibre do not get wrinkled easily and are easy to wash making polyester fabrics suitable for dress materials.

We wear sweaters and use shawls and blankets in the winter. Many of these are not made from natural wool although they appear to resemble wool. These are prepared from another type of synthetic fibre called acrylic. The wool obtained from natural sources is quite expensive, where as clothes made from acrylic are relatively cheap because they are a byproduct of the production of plastics. They are available in a variety of colours. Synthetic fibres are more durable and affordable which has contributed to their widespread use.

Advantages of Synthetic Fibres

Do you ever think about why some of your clothing does not need ironing and looks bright and colourful for many years? This is because they are made from synthetic fibres such as polyester and the advantages are that they do not wrinkle easily and they keep their colour and brightness for a much longer time than natural fibres such as cotton.

A lot of materials such as fishing nets are made from synthetic fibres. One of the main advantages of using synthetic fibres such as nylon, is that they are stronger than many natural fibres such as silk or wool. For example a trampoline is made of woven synthetic fibres. These fibres are strong and elastic which gives it the properties to bounce.

Drawbacks of Synthetic Fibres

We have already learned that it is safer to use cotton clothing instead of synthetic clothing when a person is cooking or working in a laboratory. This is because one disadvantage of synthetic fibres such as polyester is that they are not heat resistant and catch fire easily. In summer it is better to wear clothing that is made out of cotton materials rather than synthetic.

This is because most synthetic fibres absorb very little moisture and do not allow air circulation making them hot and uncomfortable to wear.

If you could recall that we already found out that synthetic fibres are made out of petrochemicals and last in the environment for a very long time. The disadvantage is that they break down into very small pieces called microplastics which cause pollution to soil and water bodies such as rivers, lakes and oceans.

Plastics

Ask yourself what is the first plastic thing you touched today! Maybe it was your alarm clock or the filling in your pillow or the synthetic clothes that you were wearing. Almost everything around us today is plastic. You have seen water and oil in polythene pouches. Right! In the past, people used to bring milk, oil and other liquids from a shop in vessels made of materials such as metal and glass. Think about what the containers, buckets, mugs, chairs and tables used in the past were made of? What do we use today to make many of these products?

Plastic as a material has taken over and replaced metal and wood which were previously used. Plastics have also replaced many glass items. If we continue to write the list of everyday items that are made of plastic, it will be endless! Why is plastic so popular? What are the different uses of plastic? What are the various types of plastics? Let us now learn about plastics:

Plastics have helped us to make advancements in technology, building, healthcare, transport and food safety. Plastics have completely occupied our life because of their characteristic qualities. Plastics have many positive qualities such as lightweight, strong and they can be moulded into complex shapes. They are also flexible and waterproof and some plastics are even UV resistant. Plastics are also cheap and convenient for us to use. Now that you have discovered why plastics are so popular, let us find out more about the different uses of plastics.

Uses of plastics

There are different types of plastics that are excellent materials when they are used for the right application. For example, let us take a syringe that is made from a type of plastic called polypropylene. These syringes do not have to be sterilized and reused; hence they provide a high standard of hygiene and eliminate the risk of spreading diseases.

Just as plastic is a material that can be used for a good application, it can also be used for the wrong application. Think about the different items you use that are plastic. For example, a You use this bag for a very short time and then throw it in a dustbin. Many of these carry bags do not get recycled and they litter and pollute our environment for a long time.

If you want to learn more about plastic which is used for the wrong application then you can refer to the Government of Tamil Nadu's ban on one-time use and throwaway plastics (Environment and Forests Department, T.N. G.O. No: 84, dated 25/06/2018, with effect from 1st January 2019).

Types of plastics

Th e plastics we use in our daily life are also made up of polymers. All plastics do not have the same type of arrangement of units. In some articles, the arrangement of a monomer is linear, and in some other items, the arrangement of articles is cross-linked. Depending on the type of arrangement, we have two main types of polymers – thermoplastics and thermoset. Let us see what these are!

Thermoplastics: Polyethylene (also called polythene) is an example of a plastic. It is used for making polythene carry bags which are commonly used. When you burn a polythene carry bag, it melts and turns into liquid along with the production of an offensive odour, a bright flame and soot. Another example is a **PET (Polyethylene Terephthalate)** bottle, when we fill it with boiling water, it gets deformed. Plastics which can be easily softened and bent when heated are known as thermoplastics. These plastics can be modified and turned into another plastic item through the process of recycling.

Thermoset: On the other hand, there are some plastics, which once they are moulded, cannot be softened through heating them. These are called thermosetting plastics. Bakelite and melamine are some examples of thermosetting plastics. Bakelite is a poor conductor of heat and electricity. It is used for making electrical switches and handles of various utensils. Melamine resists fi re and can tolerate heat. It is used for making floor tiles and fabrics that resist fire.

Resin code of plastics

Now that you have learnt about the differences between Thermoplastic and Thermosetting polymers, let us find out more about the different types of plastics that you use in your daily life. Plastics are very useful in our daily life but some types contain dangerous chemicals. Did you know that there are many different types of plastics?

You can tell these plastics apart by searching for a resin code. Th e resin codes are a universal way of categorising different types of plastic, which helps us separate plastics so that it is easier to recycle them. How can you identify the resin code? Where can you find the resin code on a plastic item?

Look at the chasing arrow triangle-shaped symbol on the bottom of a bottle, on the brand label sticker or on the lid of a container. What number is marked in the centre of the triangle? What letters (acronym) are below this? Th is is what we call a resin code.

If the number is 1 within the chasing arrow triangle and/or has the acronym PET or PETE, then it is a type of plastic which is called PET. Now that you have found out that the bottle has a specific resin code, let us see what gives the bottle and other plastic products certain qualities. Different chemicals (additives) are added to plastic to give them various qualities and characteristics, for example flexibility, strength, soft ness or transparency. There are some chemicals that are used in plastics that are dangerous for our health, animals and the environment. For example, Polyvinyl Chloride- PVC resin code #3 has heavy metals such as cadmium and lead which are toxic chemical which are harmful to your health. Polystyrene- PS resin code #6 has styrene which is a toxic chemical known to cause cancer.

Look at the resin code chart on the previous page to find out more about the different types of plastic, what are common items and which plastics are safe and unsafe for us, animals and the environment.

Look at the resin code chart to find out more about the different types of plastic, the common items and the plastics that are safe and unsafe for us, animals and the environment.

Impacts of plastics

Plastics are cheap, light weight, strong and durable and have contributed to a range of advances and benefits to our modern life. But the increase in the use of plastics, particularly the one-time use and throwaway plastics has serious impacts on the environment, animals and our health.

We have seen garbage dumps with different plastics. One big problem with plastics is that they do not decompose or biodegrade. This leads to large amounts of waste that will not disappear and end up accumulating and polluting the environment.

A lot of one-time use plastic such as polythene bags and food packaging that are thrown away are responsible for littering the environment and clogging drains. Standing water breeds mosquitoes that can spread diseases such as malaria, dengue and chikungunya and also lead to flooding.

Why do you think some animals eat plastic? Many animals confuse plastic for food and eat it by accident. When left over food is thrown away it is often packed in plastic. Animals smell the leftover food and eat the plastic by accident. For example animals in urban areas, particularly cows, often eat polythene plastic bags by accident as they contain food waste. Can you imagine the consequences?

A lot of the plastic waste we use such as plastics bags, bottles and straws end up in the oceans. Plastics in the ocean are exposed to sunlight, water and the physical movement of the waves, which breaks it down in tiny pieces called microplastics. Some microplastics are also found in household products. Examples are microbeads that can be found in toothpaste, face wash and body scrubs. Microbeads are washed down in drains and end up in the soil, rivers, lakes and the ocean Microbeads are washed down in drains and end up in the soil, rivers, lakes which cause pollution.

Many birds eat plastic items and small pieces of plastic, which are covered in algae. Once in the stomach of animals, plastics cannot be digested and this decreases the amount of space for food and can lead to starvation. In
2015, plastics were found in 90% of seabirds.

We have already read that Government of Tamil Nadu has banned one-time use and throwaway plastics such as plastic carry bags, plates, straws and water pouches. This is an indication that important efforts are taking place to reduce negative consequences of plastics on the environment.

PLA Plastics

Can you see how much plastic litter pollutes our environment? How nice would it be if a material that had similar qualities to plastic could be biodegradable, be absorbed by the soil and give nutrients to the soil!

Yes, scientists have thought about alternatives to synthetic plastics and have found Poly Lactic Acid (PLA) –a substitute for some types of plastics. Poly Lactic Acid or polylactide is compostable and bioactive thermoplastic.

This polymer is obtained from plant starch such as corn, sugarcane and pulp from sugar beets. PLA is a biodegradable material. It is useful for making food packaging, garbage bags and disposable table ware.

Various methods of disposing plastics

Plastics are everywhere! Our increasing consumption and production of plastic waste needs a solution. Let us find out more about how and where plastic waste is disposed of and the better methods of disposing plastics.Organic waste such as the peels of vegetables, fruits and food remains can get broken down by bacteria in the soil to create a rich source of nutrients in the form of compost. A material that gets decomposed through natural processes and action by bacteria is called biodegradable.

Plastics do not decompose by natural processes and action of bacteria and are therefore not biodegradable. It is important for us to separate our biodegradable and non-biodegradable waste and dispose of them separately. A lot of the plastic produced globally is designed to be used only once and thrown away, creating a large amount of plastic waste. Plastic waste ends up being recycled, incinerated, landfilled, dumped or ends up littering our environment. It is estimated that from all the plastic waste ever produced, 79% is in landfills, dumps or in the environment, 12% has been incinerated and only a small 9% is recycled.

Let us learn more about what happens with the plastic waste. One way to look at plastic disposal is the 5R Principle – Refuse, Reduce, Reuse, Recycle and Recover. We have already learned about the waste pyramid and how the different methods of waste disposal can be seen in terms of the best option to the least favourable in this order: Refuse (Avoid), Reduce, Reuse, Recycle, Recover (Compost and Incinerate) and Landfill.

Refuse (Avoid)

The best thing to do is to avoid using plastic products. One-time use throwaway plastics can often be avoided. For example, we can carry cotton or jute bags when we go shopping and say no when a shopkeeper offers us a plastic bag.

Reduce

Reducing the amount of plastic we use is important. Before buying a plastic product we can check to see if there are any substitutes or alternatives that can be used. If we use fewer plastics, we will create less plastic waste.
However, even if we try to reduce the amount of plastics we use and throw away, it is impossible to stop using plastics completely.

Reuse

If possible products made of plastics can be used again and again. For example, if we have a plastic bag in good condition, instead of throwing it away we can use it again the next time we go for shopping. If we have a plastic product and if you do not feel like using it again, we can give it to others instead of throwing it out.

Recycle

It is better to recycle plastic waste. Separating plastic waste and making sure it gets recycled is good as it turns waste materials into something new. Then it will not be thrown away in landfills, open dumps or ending up as litter in the environment. Many thermoplastics can be recycled. They can be softened by heating and can be made into another article by recycling, but thermosetting plastics cannot be recycled. Recycling of plastics is challenging and it is important to know that plastics cannot be recycled forever. There are so many different types of plastics, which are often mixed together making it difficult to separate them back into the original material. Every time plastic is melted and recycled it loses quality, this is called 'downcycling'. Recycling of plastic waste cannot be the only solution to plastic pollution.

Recover (Compost And Incinerate)

Solid waste can be converted into resources such as electricity and compost through thermal and biological means. Burning plastics in a large furnace or in the open is bad for the environment. Open burning releases toxic pollutants into the air and soil, which are harmful to our health, animals and the environment. Burning plastics at high temperatures in incinerators and trapping the gases and collecting the toxic ash is widely used to produce energy. This is often seen as a positive way to deal with plastic waste. However, burning plastics releases super toxic gases, and the remaining ash contains toxic chemicals and heavy metals. Burning of plastics is not a good solution, as we end up wasting non-renewable resources and produce super toxic chemicals that are difficult to store or dispose safely.

Landfill

Plastic waste often ends up in landfills that are huge holes where waste is buried to keep it separate from the environment. This is the most common way for plastics to be disposed of around the world. Plastics make up 7-13% of waste that is sent to landfills on a global scale. Plastics in landfills can still lead to pollution of the air, soil and groundwater. Over time landfills can degrade, and the toxic chemicals in certain plastics can leak out into the environment.

Biodegradable plastics

The concept of biodegradable plastics or bio-plastics was first introduced in the 1980s. Based on the nature of degradation, there are two main types of plastics: degradable plastic and compostable plastic.

Degradable plastics are made from petroleum oil or gas which is the same as conventional plastics. The difference is that they have a chemical or additive added to them to make them breakdown faster than conventional plastics when they are exposed to sunlight, oxygen or water. What do you think will happen to degradable plastics? Degradable plastics breakdown into tiny pieces called microplastics and these stay in our environment for a very long time. It is very important to understand that degradable plastics do not breakdown completely in the environment! Scientists have found that microplastics in the ocean are really bad and it is likely that these tiny pieces in the soil are also harmful.

Compostable plastics are derived from renewable resources such as corn, sugar cane,

Do you Know?

A recipe for PLA a compostable plastic!

What you need

i) 1 tablespoon of corn starch
ii) 1 teaspoon of vegetable glycerin (available at the pharmacy)
iii) 1 teaspoon of vinegar (5% acidity)
iv) 4 Tablespoons of water.
v) Cooking spoon
vi) Cooking pot
vii) Stove
viii) Aluminium foil

Method

Mix the water with the starch in a cooking pot. Add the vinegar and the glycerin. Mix all the ingredients on medium heat. Make sure you continuously stir. The mixture should turn from liquid white into a clear gel. When it begins to bubble, then it is ready and should be taken off the stove.

Spread the gel onto the aluminium foil. Let it cool down for one hour. You can then shape the material to form a cup or bowl. Let the article you made cool for another 24 hours before you try and use it.

avocado seeds or shrimp shells. Compostable plastics can be broken down completely by microbes and turned back into food for plantscarbon dioxide, methane, water and other natural compounds.

Plastic Eating Bacteria

In 2016, scientists from Japan tested different bacteria from a bottle recycling plant and found that Ideonellasakaiens is 201-F6 could digest the plastic used to make single-use drinks bottles that are made of polyethylene terephthalate (PET). The bacteria works by secreting an enzyme known as 'PETase', that breaks down plastic into smaller molecules. These smaller molecules are then absorbed by the bacteria as a food source. The working of the enzyme is diagrammatically shown below:

Although the discovery of the bacteria breaking down plastics is seen as a potential solution to the plastic pollution – it is still very complex! A big issue is the scale of the plastic pollution problem. We consume and produce such large quantities of plastics and this is only increasing. The scale of the bacteria breaking down plastics is much slower and will therefore not solve the crisis we are facing.

Another limitation is that it is restricted to PET resin code #1 plastics, which currently is one of the most recyclable plastics worldwide. It will not be a feasible solution to the issue of the large quantities of non-recyclable low-grade plastics which are polluting the environment. That is why it cannot be the solution to plastic pollution on its own!

Glass – Types And Uses

Glass can be found wherever we look; a glass window or glass mirror or glass light bulb. Glass is one of the world's oldest and most versatile human created materials. Glass is the only material that can be recycled over and over again without losing its quality. Glass is bit of a riddle. It is hard enough to protect as, but it shatters with incredible ease. It is made from opaque sand, yet, it is completely transparent. Most surprisingly, it behaves like a solid material, but it is also a sort of weird liquid in disguise!

Glass is prepared by heating (SiO_2) silicondi- oxide until it melts, say to about 1700◦C and Sodium Carbonate is added to it. Then it is cooled down really fast. When SiO_2 silicondi-oxide melts, the silicon and oxygen atoms break out of their crystal structure. If we cooled it slowly, the atoms would slowly line up back into their crystalline arrangement. But if we cool the liquid fast enough, the atoms of the silica will be halted in their tracks, they won't have time to line up, and they will be stuck in any old arrangement, with no order to the arrangement of the atoms. We call materials like this as amorphous. At this stage, glass is linear in arrangement inorganic in nature and has a structure very similar to glass and they are considered as polymers.

In a commercial glass plant, sand is mixed with waste glass (obtained from recycling collections), soda ash (sodium carbonate) and limestone (calcium carbonate) and heated in a furnace. The soda ash reduces the sand's melting point and produces a kind of glass that would dissolve in water. The limestone is added to stop that happening. The end product is called soda-lime-silica glass. It is the ordinary glass we see all around us.

Usually, other chemicals are added to change the appearance or properties of the finished glass. For example, iron and chromium based chemicals are added to the molten sand to make green-tinted glass.

Oven-proof borosilicate glass (widely sold under the trademark PYREX) is made by adding boron oxide to the molten mixture.

Adding lead oxide makes from a sandwich or laminate of multiple layers of glass and plastic bonded together.

Toughened glass used in car winds hields is made by cooling molten glass very quickly to make it much harder.

Unit4. Chemistry in Daily Life

Introduction

During the Bangladesh liberation war, Therapy with Oral Rehydration Solution (ORS) in 1971 reduced cholera death rates from 50% to 3% among thousands of refugees. An Indian doctor, Dilip Mahalanabis, had to manage the shortage of saline bottles and coup up with the dehydration faced by the refuges. Dr. Dilip

Mahalanabis showed the efficacy of ORS in cholera cases among Bangladeshi refugees (1971-72). Further field trial during the cholera epidemic in Manipur attested to its efficacy, ORS has since saved the lives of millions of children around the world.

Look at the above information. What do you infer from this? Now you get the curiosity to know about ORS and its function. Don't you? In addition to this, let us know about some of the common medicines and how do they work.

In the normal healthy intestine, there is a continuous exchange of water through the intestinal wall. Up to 20 liters of water is secreted and very nearly as much is reabsorbed every 24 hours. This mechanism allows the absorption of soluble metabolites into the bloodstream from digested food. However when a person becomes sick, due to diarrhea, water is expelled and the body is not able to retain the liquid balance. This is called as 'dehydration'. It is not the diarrhea that kills, but the dehydration' resulting from the infection that kills. If more than 10% of the body's fluid is lost death occurs.

Do you Know? UNICEF / WHO norms the O.R.S should be prepared as follows					
S. No	**New ORS**	**grams / Litre**	**%**	**New ORS**	**mmol / litre**
	Sodium choride	2.6	12.683	Sodium	75
	Glucose, anhydrous	13.5	65.854	Choride	65
	Potassium choride	1.5	7.317	Glucose, anhydrous	75
	Trisodium citrate, dehydrate	2.9	14.146	Potassium	20
				Citrate	10
	Total	20.5	100.00	Total Osmolarity	245

Oral Rehydration Solution (ORS)

ORS (Oral Rehydration Solution) is a special combination of dry salts that is mixed with safe water. It can help to replace the fluids lost due to diarrhea. In a state of diarrheal disease there is imbalance and much more water is secreted than reabsorbed causing a net loss to the body which can be as high as several liters a day. In addition to water loss, sodium and potassium are also lost.

Certain concentration of sodium (Na) is needed for proper functioning of the body. For example, only with adequate sodium concentration in the intestinal wall, water can be absorbed by it through a process known as osmosis. If there is inadequate salt in the intestinal wall the body will not be able to absorb water.

The saline bottle directly transfers water and sodium into the blood stream. However, for the saline water is administered through mouth, intestinal wall, is a not able to absorb neither water nor sodium. Dr. Dilip Mahalanabis found that if glucose (sugar) is added to the salt solution, then all the three- water, sodium and glucose are absorbed by the body.

During diarrhea the intestine is still able to absorb glucose molecules. Thus, the ORS solution uses the glucose molecules to enable the sodium to be is carried through by a cotransport coupling mechanism. ORS is an effective treatment for 90 – 95% of patients suffering from diarrhea, regardless of the cause. As the water is replaced balance is attained saving the patience in most cases.

Let us see homely made of ORS, be very careful to mix 6 level teaspoons of sugar and 1/2 level teaspoon of salt dissolved in 1 litre of clean water. Too much sugar can make diarrhea worse. Too much salt can be extremely harmful to the child. Making the mixture a little too diluted (with more than 1 litre of clean water) is not harmful.

Through the process of osmosis, the salts and sugars pull water into your bloodstream and speed up rehydration.

Antacid

Acidity is a set of symptoms caused by excess production of acid by the gastric glands of the stomach. Your stomach naturally produces gastric or hydrochloric acid (HCl) to help digest and break down food. Acidity issues arise when there is excess production of this acid due to triggers such as acidic foods, spicy food, alcohol, dehydration and stress. When acidity occurs, the excess acid may move up from your stomach to your esophagus.

The lining of your stomach with a pH of 1 to 3 is designed as such to withstand a high acidic environment.

When we have acidity or heartburn, we are administered a class of medicines known as antacids. They are actually weak bases. As learned in chemistry, when a base is mixed with an acid a neutralization reaction occurs. When antacids are consumed, it creates a chemical reaction in the stomach lowering the acidity and makes the digestive acids less corrosive and damaging.

Most of the common antacids are Sodium Bicarbonate ($NaHCO_3$), Calcium Carbonate ($CaCO_3$), Magnesium Hydroxide ($Mg(OH)_2$), Magnesium Carbonate ($MgCO_3$) and Aluminium Hydroxide $Al(OH)_3$.

The chemical reaction created when Magnesium Hydroxide neutralizes HCI in the stomach and intestine

Antibiotics

Ages ago, there was a time where even a small infected wound can cause death in human beings. The discovery of antibiotics changed all. Now armed with antibiotics, many deadly infectious diseases can be tackled, which once meant to cause serious illness and death.

The discovery of antibiotics was an accident, which happened in 1928 while a British bacteriologist, Dr. Alexander Fleming was involved in research on staphylococcus bacteria. This bacterium was meant to cause deadly diseases such as pneumonia, sour throat, etc. The discovery happened while he was culturing the bacteria on a nutrient agar media in a Petri dish. He went on a holiday carelessly leaving the dish in his laboratory table without cleaning and sterilization.

After several days, when he returned back, he observed the growth of mould (kind of common fungus, which grows on stale bread/ cheese) on a part of the Petri dish. He also observed that there was no bacterial growth surrounding the mould, which indicated that something in the mould had prevented the growth of bacteria in the culture medium. On further research, Fleming identified that the "mold juice" was capable of killing a wide variety of harmful bacteria, such as streptococcus, meningococcus and diphtheria bacillus.

And that was how the world's first antibiotic – penicillin – was discovered. Fleming named the mould penicillum notatum, from which the antibiotic penicillin was isolated. However, Fleming was not the first using moulds and other living micro organisms to treat infections. Thousands of years ago, the ancient Egyptians, had used mouldy bread to treat infected wounds. Similar practices were observed among ancient Greeks, Serbians and even among Indians. While these were perhaps partially effective, their efficacy is nowhere near the modern antibiotics.

Naturally, many microorganisms and plants synthesize chemicals which are toxic in nature to protect them from invading organisms. The biosynthesized chemicals isolated from the plants/micro organisms and used as medicines against infectious diseases. These substances were called as antibiotics. Ex: Chloramphenicols, tetracyclines, Penicillin derivatives, cephalosporin's and their derivatives. Today, many infectious diseases in the world are rare due to the advancement in antibiotic research.

However, the overuse of antibiotics makes it inactive or less effective. Antibiotic resistance is defined as the ability of the microorganisms to resist the effects of an antibiotic to which they were once sensitive. Th us the antibiotics become less effective and we are forced to either consume a larger dose or shifting towards the use of other virulent variants of antibiotics. Thus the research on antibiotics is of great importance to combat the virulent and mutated microorganisms.

Analgesics:

Injury, burn, pressure from sharp objects and other conditions cause pain in our body. Th e unpleasant feeling may be a burning sensation in the tissue around the injury, throbbing headache or ache of arthritis. Back pain, neck pain, joint pain, headaches, pain from nerve damage, pain from an injury and pain related to diseases are some of the most common pains.

The unpleasant emotion of 'pain' is created in the brain and not at the spot of the injury. If the pain is severe, say from burn, the impulse sent to brain trigger immediate response. Reacting to the signal from the brain, muscle pull our hand from the fi re.

Reacting to the message received from the pain spot, the brain sends back messages that initiate healing process. It can trigger to release pain suppressing chemical and additional flow of additional white blood cells and platelets to help repair tissue at an injury site.

Analgesics or pain killers are the pain suppressing chemicals released by the body. They suppress the feeling of 'pain'. Th is analgesics drug selectively relieves pain by acting either in CNS (Central Nerves System) or on peripheral pain mechanism, without significantly altering consciousness.

When we are affected by fever, oft en we are administered Paracetamol. Paracetamol interact with the receptors and reduce the intensity of pain signals to the brain, also suppresses the release of substances, called prostaglandins that increase pain and body temperature.

Traditional an ti inflammatory agents

These are classified as follows,
i) Non – narcotic (Non – additive) analgesics
Eg.Aspirin
ii) Narcotic drugs. E.g. codeine

Antipyretic:

In normal course our body temperature is ranges from 98.4 to 98.6 degrees Fahrenheit. When the temperature goes above this level it is called fever. Most common cause of fever is infection. Bacteria and virus cannot thrive above a certain temperature. To defend the invading virus and bacteria the immunity system increases the body temperature.

Once infection is sensed, the immune system releases a chemical called pyrogen. These pyrogens released into bloodstream reaches the hypothalamus, present at the basal part of the brain. The function of Hypothalamus is to control the body temperature. Sensing the pyrogens, hypothalamus increases the body temperature by releasing a chemical called prostaglandin.

Normally little fever is good as it helps to arrest the growth of infection. However if the internal body temperature exceeds 105°F, this may cause damage to our body protein and the brain may experience seizures and delirium. The prolonged high fever may also cause death.

Antipyretics (anti - against and pyretic -Feverish) are chemical substances that reduce fever. They suppress the release of prostaglandin and reduce fever. The most common and well known anti pyretic is paracetamol. Other antipyretics and anti inflammatory agents include Aspirin, Ibuprofen, Diclofenac.

Antiseptic

Antiseptics are substances applied to the exterior of a body that kill or inhibit microbes and infective agents. Antiseptics can be effective against one or a combination of bacteria, fungi, viruses or other microorganisms.

Difference between Antiseptic and Disinfectants	
Antiseptic	Disinfectants
1. All antiseptic are disinfectants.	All disinfectants are not antiseptic
2. It can be applied on the live tissues	It can be apply on in animate object
For example, skin/ Mucous	For example, Surface, lab working tables, floor.

Antihistamine

Anti histamines are defined as drugs that combat the histamine in the body that are used for treating allergic reactions and cold symptoms. Histamine is a chemical messenger involved in number of complex biological reactions. When a foreign body such as pollens enters the body, the immune system believes those substances to be harmful and generates the release of histamine. When histamine is released, it will interact with the histamine receptors on the cell surface or within a target cell and cause changes in the bodily functions. This stimulates many smooth muscles to contract,\ such as gastrointestinal tract and bronchi. In certain smooth muscles, they cause relaxation of blood capillaries which increase the flow of lymph and its protein content and lead to the formation of edema (redness and rashes).

Antihistamines or histamine receptor antagonists oppose selectively all the pharmacological effects of histamines. For, Ex. Diphenhydramine, chlorpheniramine, cimetidine. The adverse effects of antihistaminics are mouth dryness and sleepiness.

Medicine:

Medicines are used to treat the disease and to improve our health.

Nehaeh;hbNehaKjy;eh;bMJjzpf;Fk;
thaeh;bthaggr;nray-jpUts;Stu;

There is a Kural,
“Diagnose the disease and understand its seeds;
Identify the cause and make sure it succeeds”

The science or practice of the diagnosis, treatment, and prevention of disease. There are many ways to intake the medicine.

1. Oral use
2. External use
3. Injections (Intra muscular/Intra venous)

The medicines we take treat our disease and lead us to a good health.

Combustion

Can you guess what is common in rusting or iron, burning coal and the flame of candle? They all undergo a chemical reaction known as combustion. Combustion is a chemical reaction that occurs in the presence of a fuel and an oxidizing agent that produces energy, usually in the form of heat and light.

What we call as 'burning' is really a combustion reaction. In fact combustion is one of the first chemical reactions intentionally harnessed by humans. Any reaction that involves reaction with oxygen is called oxidation reaction. In the combustion of hydrocarbon with oxygen, typically carbon dioxide and water are produced.

$CH_4 + 2O_2 \rightarrow CO_2 + 2H_2O$ + Heat energy
(Hydrocarbon) (Oxygen) (Carbon dioxide) (Water)

All combustion reactions are exothermic; that is they release heat.

Ignition Temperature:

The minimum temperature at which a substance catches fire and burns is called its ignition temperature.

A substance will not catch fire and burn if its temperature is lower than its ignition temperature. Different substances have different ignition temperatures.

Substances which have very low ignition temperature and can easily catch fire with a flame are called inflammable substances. E.g. Petrol. Alcohol, LPG (Liquefied Petroleum Gas), CNG (Compressed Natural Gas), etc.

Flame

Flame is actually a chemical reaction. To be specific, the flame is a mixture of gases (vaporized fuel, oxygen, carbon dioxide, carbon monoxide, water vapor, and many volatile materials) and so is matter. The light and heat produced by the flame is energy, not matter. But fire is a matter.

Flame and its structure

Which is the festival of light? What is the specialty of that festival? Yes. We will light more lamps to decorate the houses. Won't we? Now how do the lights glow? Yes, with flame.

Here is an experiment with colorful flame

• White flame – Epsom salt ($MgSO_4$)
• Violet flame – Lithium Chloride
• Indigo flame – Potassium Chloride
• Blue flame – Bleaching powder
• Green flame – Borax powder
• Yellow flame – Calcium chloride
• Orange flame – Table salt
• Red – Strontium chloride

Teacher shows the experiment with these salts soaked in alcohol and makes fire.

Flame:

Flame is a zone of combustions of a combustible substance. Substances which vaporize during burning produce flames. E.g. Wax, Kerosene etc.

Substances which do not vaporize during burning do not produce flames e.g. coal.

Structure of a Candle flame

A candle flame has three main zones, they are
i. The outer zone – complete combustion of the fuel takes place and the colour of the flame is blue and is the hottest part of the flame. It is the non-luminous part of the flame.
ii. The middle zone -partial combustions of the fuel takes place and the colour of the flame is yellow and is moderately hot part of the flame. It is the luminous part of the flame.
iii. The inner zone: There are unburnt vapours of the fuel and the colour is black and is least hot part.
Calorific value of different fuels

Fuel	Calorific Value (kJ/kg)
Cow dung cake	6000-8000
Wood	17000-2000
Coal	25000-33000
Petrol	45000
Kerosene	45000
Diesel	450000
Methane	500000
CNG	50000
LPG	55000
Biogas	35000-40000
Hydrogen	150000

The amount of heat energy produced on complete combustion of 1kg of fuel is called its calorific value. The calorific value of a fuel is expressed in a unit called kilo joule per kg (kJ/kg)
Calorific value = Heat produced / Amount of fuel used for burning in kJ/kg

If 4.5kg of fuel is completely burnt and the amount of heat produced stands measured at 1,

80,000 kJ what is its calorific value.
Calorific value = 1, 80,000 / 4.5 = 40,000 KJ/Kg

Types of combustion

There are three main types of combustion.
They are,

Rapid combustion: It is a combustion process in which a substance burns rapidly and produces heat and light with the help of external heat. E.g. Burning of LPG.

Spontaneous combustion: Is combustion process in which a light without the help of external heat.eg. Phosphorus burns spontaneously at room temperature.

Explosion: It is a type of combustion in which a substance burns suddenly and produces heat, light and sound with the help of heat or pressure. E.g. Explosion of crackers.

CO- Leads to respiratory problem
CO_2- Global warming
SO_2/NO_2 – Acid Rain

Characteristics of good fuel

- Readily available
- Cheap
- Easy transport and store
- Burns at moderate rate
- Produce large amount of heat
- Do not leave behind any undesirable substances.
- Does not cause pollution.

Slow combustion:

Slow combustion is a form of combustion which takes place at low temperatures. Respiration is an example of slow combustion.

The conditions necessary for producing fi re are,
Fuel
Air (to supply oxygen)
Heat (to raise the temperature of the fuel beyond its ignition temperature)
Fire can be controlled by removing any one or more of these conditions.

Fire extinguisher:

A fire extinguisher cut off the supply of Air or bring down the temperature of the fuel or both and controls the fi re.
How do fire extinguishers work?

Portable fire extinguishers apply an extinguishing agent that will either cool burning fuel, displace or remove oxygen, or stop the chemical reaction so fire cannot continue to burn. When the candle of an extinguisher is compressed, it opens and inner canister of high pressure gases forces the extinguishing agent from the main cylinder through a siphon tube and out the nozzle. A fire extinguisher works much like a can of hair spray.

Fire extinguishers can be broadly classified into five types:
1. Water, 2.Foam, 3.Dry Powder, 4.CO2, 5.Wet Chemical.
The classes of fire
There are five classes of fire: Class A, Class B, Class C, Class D, and Class E.

Class A fires	- **Combustible materials:** caused by flammable solids, such as wood, paper, and fabric
Class B fires	- **Flammable liquids:** such as petrol turpentine or paint
Class C fires	-**Flammable gases:** like hydrogen, butane or methane
Class D fires	-**Combustible metals:** chemicals such as magnesium, aluminum or potassium
Class E fires	-Typically a chip pan fire
Electrical fires	-**Electrical equipment:** once the electrical item is removed, the fire changes class

Types of fire extinguisher:
The most common types of fire extinguishers are,
- Air pressurized water extinguishers,
- Carbon-di-oxide extinguishers.
- Dry chemical powder extinguishers.