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Part - I

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The National Anthem of Sri Lanka

Sri Lanka Matha
Apa Sri Lanka Namo Namo Namo Namo Matha
Sundara siri barinee, surendi athi sobamana Lanka
Dhanya dhanaya neka mal palaturu piri jaya bhoomiya ramya
Apa hata sepa siri setha sadana jeewanaye matha
Piliganu mena apa bhakthi pooja Namo Namo Matha
Apa Sri Lanka Namo Namo Namo Namo Matha
Oba we apa vidya
Obamaya apa sathya
Oba we apa shakthi
Apa hada thula bhakthi
Oba apa aloke
Apage anuprane
Oba apa jeevana we
Apa mukthiya oba we
Nava jeevana demine, nithina apa pubudukaran matha
Gnana veerya vadawamina regena yanu mana jaya bhoomi kara
Eka mavakage daru kela bevina
Yamu yamu vee nopama
Prema vada sema bheda durerada
Namo, Namo Matha
Apa Sri Lanka Namo Namo Namo Namo Matha

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ආනන්ද සමරකෝන්

ஒரு தாய் மக்கள் நாமாவோம்
ஒன்றே நாம் வாழும் இல்லம்
நன்றே உடலில் ஓடும்
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நலமே வாழ்தல் வேண்டுமன்றோ

யாவரும் அன்பு கருணையுடன்
ஒற்றுமை சிறக்க வாழ்ந்திடுதல்
பொன்னும் மணியும் முத்துமல்ல - அதுவே
யான்று மழியாச் செல்வமன்றோ.

ஆனந்த சமரக்கோன்
கவிதையின் பெயர்ப்பு.

Being innovative, changing with right knowledge,
Be a light to the country as well as to the world.

Message from the Hon. Minister of Education

The past two decades have been significant in the world history due to changes that took place in technology. The present students face a lot of new challenges along with the rapid development of Information Technology, communication and other related fields. The manner of career opportunities are liable to change specifically in the near future. In such an environment, with a new technological and intellectual society, thousands of innovative career opportunities would be created. To win those challenges, it is the responsibility of the Sri Lankan Government and myself, as the Minister of Education, to empower you all.

This book is a product of free education. Your aim must be to use this book properly and acquire the necessary knowledge out of it. The government in turn is able to provide free textbooks to you, as a result of the commitment and labour of your parents and elders.

Since we have understood that the education is crucial in deciding the future of a country, the government has taken steps to change curriculum to suit the rapid changes of the technological world. Hence, you have to dedicate yourselves to become productive citizens. I believe that the knowledge this book provides will suffice your aim.

It is your duty to give a proper value to the money spent by the government on your education. Also you should understand that education determines your future Make sure that you reach the optimum social stratum through education.

I congratulate you to enjoy the benefits of free education and bloom as an honoured citizen who takes the name of Sri Lanka to the world.

Akila Viraj Kariyawasam
Minister of Education

Foreword

The educational objectives of the contemporary world are becoming more complex along with the economic, social, cultural and technological development. The learning and teaching process too is changing in relation to human experiences, technological differences, research and new indices. Therefore, it is required to produce the textbook by including subject related information according to the objectives in the syllabus in order to maintain the teaching process by organizing learning experiences that suit to the learner needs. The textbook is not merely a learning tool for the learner. It is a blessing that contributes to obtain a higher education along with a development of conduct and attitudes, to develop values and to obtain learning experiences.

The government in its realization of the concept of free education has offered you all the textbooks from grades 1-11. I would like to remind you that you should make the maximum use of these textbooks and protect them well. I sincerely hope that this textbook would assist you to obtain the expertise to become a virtuous citizen with a complete personality who would be a valuable asset to the country.

I would like to bestow my sincere thanks on the members of the editorial and writer boards as well as on the staff of the Educational Publications Department who have strived to offer this textbook to you.

W. M. Jayantha Wickramanayaka,
Commissioner General of Educational Publications,
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2019.04.10

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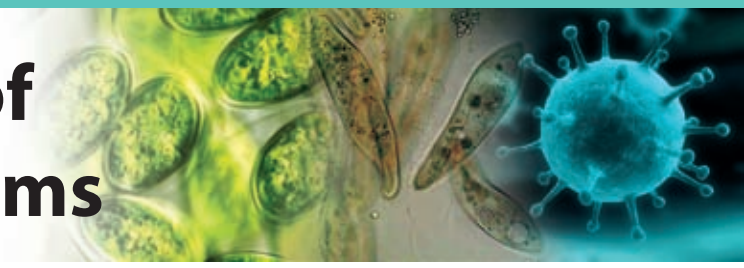
1 Importance of Microorganisms



1.1 Microorganisms

There are living organisms which are visible and also invisible to the naked eye in our environment. Let us do Activity 1.1 to observe the invisible living organisms.

Activity 1.1

You will need: - A sample of coconut water, a glass slide, a cover slip, light microscope

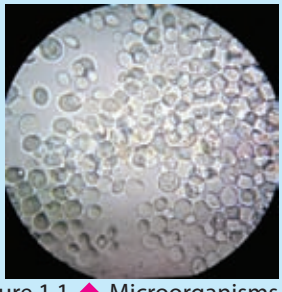


Figure 1.1 ▲ Microorganisms in a sample of aged coconut water

Method: -

- Put the coconut water into a clean container and keep it for three days.
- Then put a drop of coconut water on to the glass slide and cover it with a cover slip.
- Observe the prepared slide through the light microscope under low power. (Get the help of your teacher)
- Present your observations through diagrams.

It is obvious that the unicellular fungal variety called 'yeast' can be observed mainly in the above sample. This organism cannot be examined to the naked eye in isolation, but can be observed through a microscope. Therefore, yeast is a microorganism.

The uni-cellular (single celled) or multi cellular organisms which cannot be observed clearly by naked eye are called microorganisms.

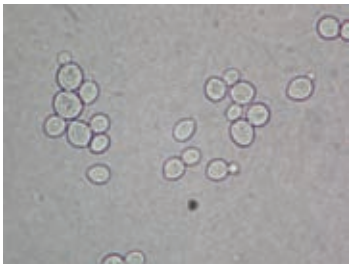
These microorganisms can be observed clearly through microscopes.

Microorganisms are found in every habitat on the earth. They live and thrive in all environments such as atmosphere, water, soil, in and on living organisms including hostile environments (glaciers, deserts, hot springs, deep sea and saline environments). There is a tremendous biological diversity among microorganisms. They differ in their morphological characters as well as in their physiological mechanisms.

e.g.:- bacteria, some algae, some fungal species, protozoans like *Amoeba* and *Paramecium*

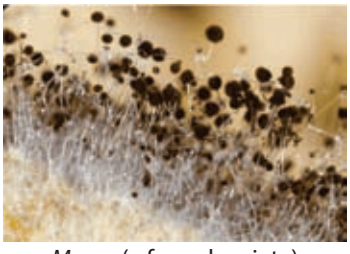
You can observe some permanent slides of microorganisms in your laboratory.

Bacteria



Yeast

Chlamydomonas (Algae species)



Mucor (a fungal variety)

Amoeba

Paramecium

Figure - 1.2 ▲ Microscopic appearance of some microorganisms

Use Figure 1.2 to identify different species of microorganisms.

For extra knowledge

Viruses show living features as well as non-living features. Although viruses are discussed under microorganisms, there is no conclusion yet as to whether they are living or non-living. Viruses can be observed through electron microscope.

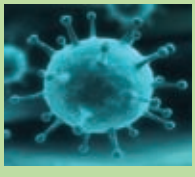


Figure 1.3 ▲ Antonie van Leeuwenhoek

The Dutch scientist Antonie van Leeuwenhoek observed microorganisms for the very first time in 1674, using a simple microscope that he invented. Exploration of microorganisms was possible with further developments in microscopy.

1.2 Effects of microorganisms on food

The growth of some microorganisms on foods make them not suitable for human consumption.

Do Assignment 1.1 and Activity 1.2 to observe the effects of microorganisms on food.

Assignment 1.1

- Get some food samples of bread, vegetables, fruits, milk, meat/fish, rice, butter in fresh condition.
- Observe their nature carefully.
- Again observe the nature of these samples after 24 hours, 48 hours and 72 hours.
- Tabulate your observations.

Table 1.1- Effect of microorganisms on food

Food item		Fresh food	After 24 hours	After 48 hours	After 72 hours
1. Bread	colour				
	texture				
	odour				
	appearance				
2.					

The microbial activities change the colour, texture, odour and appearance of food. The taste and the nutritional value of food also change. Food become unfavourable for consumption due to the changes of properties. This is known as spoilage of food. The main reason for food spoilage is the growth of microorganisms on food.

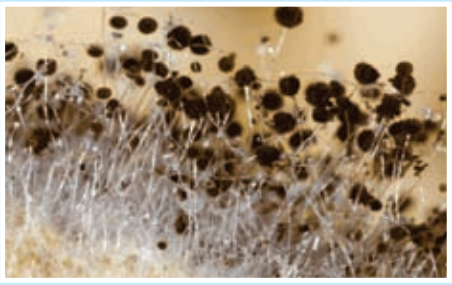
Activity 1.2

You will need: - A slice of bread, some water, a glass slide, a cover slip, microscope

Method: -

- Spray some water on the slice of bread and keep it for three days.
- Take some of the substance grown on the slice of bread and place on the glass slide. Put a drop of water on it.
- Cover the slide with a cover slip.
- Observe the slide through the microscope under the low power.
- Draw what you observed.

Slice of bread with fungi



Microscopic view of fungi

Figure 1.4

You will observe that there are some fibres and black structures on bread. They are a kind of fungi which spoils bread.

So, you can observe that microbial growth causes food spoilage.

The main reason for food spoilage is the growth of microorganisms on food and release of their byproducts.

Let us do Activity 1.3 to study microbial activity.

Activity 1.3

You will need: - Sugar, yeast, a balloon, warm water (40 °C), a bottle (500 ml), a beaker/suitable container

Method: -

- Dissolve two teaspoons of sugar in 200 ml of warm water.
- Add one teaspoon of yeast into the above sugar solution.
- Leave it for about 20 minutes and observe (Figure 1.5 a).

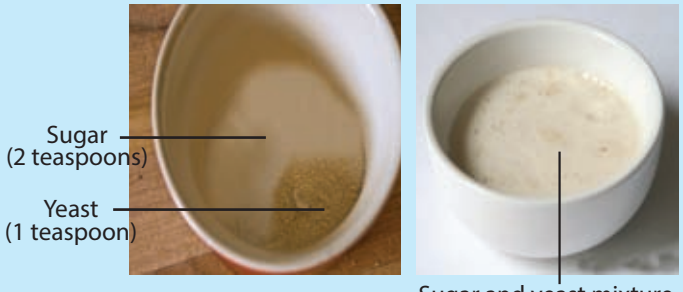


Figure 1.5 (a)

- Next pour a newly prepared solution into the bottle.
- Then fix a balloon to the mouth of the bottle.
- Record your observations after about 20 minutes. (Figure 1.5 b).

Figure 1.5 (b)

When sugar and yeast are mixed in a solution, it will bubble and become warm (Figure 1.5a/1.5b). You will smell the odour of alcohol. It is because ethyl alcohol is produced due to the activity of yeast in sugar solution.

As shown in Figure 1.5 b you will see that the balloon has been inflated. This is because a gas is produced due to the activity of yeast in sugar solution. The gas produced here is carbon dioxide.

Yeast is a key ingredient in bakery products. The activity of yeast forms carbon dioxide and makes the dough rise. Ethyl alcohol evaporates during the process of baking.


Figure 1.6 Rising of bread due to the activity of yeast

When food is exposed to air, microbes act on it very easily. This is because the environment provides suitable moisture and temperature for their growth.

Microorganisms start to grow rapidly when a moist food item is exposed to an environment with favourable temperature.

But if the food is refrigerated the microbial activity is minimized because the amount of moisture and temperature are controlled in a refrigerator.

Moisture and **temperature** are the main factors that contribute to microbial activity. Food spoils rapidly at room temperature (25°C - 30°C). This is because room temperature is favourable for microbial growth. The enzymes produced by these microbes change the taste, odour, colour, texture and the nutritional value of the food.

Microbial activities depend on the type of food.

- **Fermentation** :- Microbial activity on food high in sugars leads to fermentation.
- **Putrefaction** :- Microbial activity on food high in protein leads to putrefaction.
- **Rancidity** : - Microbial activity on food high in fats leads to rancidity.

A substrate, suitable temperatures and pH ranges are the factors for the growth of different microbes. Therefore, microbial activity can be controlled by controlling these factors.

1.3 Impact of microorganisms on humans and their activities

Some microorganisms are beneficial to humans while some are harmful.

Let us do Assignment 1.2 to understand the importance of microorganisms.

Assignment 1.2

- Collect information about beneficial and harmful effects of microorganisms and present them to the class.

Beneficial effects of microorganisms

Beneficial effects of microorganisms are of several types. Some of the advantages are, usage of microorganisms in different industries, microbial decomposition of dead plant and animal matter, biological pest control.

- Since ancient times man has been using microorganisms in different industries. Some examples are given in Figure 1.7.


producing curd


producing yoghurt


producing cheese


bakery products


producing antibiotics


producing vaccines


producing vinegar & alcohol


food (mushrooms)


making compost


producing bio gas


coir industry

Figure - 1.7 ▲ Applications of microorganisms in different industries

- Microorganisms decompose dead plant and animal matter. If not these matter get collected and it affects the balance of environment. Therefore, microorganisms contribute to the well-being of the environment.
- Microorganisms are also used to control pests. This is one of the biological control methods of pests.

Next let us consider harmful effects caused by microorganisms.

Harmful effects of microorganisms

Harmful effects of microorganisms are of several types. Food spoilage, causing infectious diseases for man, animals and crops, cause economical damage to clothes and wooden furniture are some of them.

- **Microbial activity causes food spoilage (This was discussed in section 1.2).**

growth of microorganisms on vegetables

growth of microorganisms on bread

growth of microorganisms on fruits

Figure - 1.8

- **Microorganisms cause various infectious diseases for man, animals and crops.**

Infectious diseases caused to man

Virus - common cold, dengue, AIDS (Acquired Immuno Deficiency Syndrome)

Bacteria - tuberculosis, leprosy, typhoid fever

Protozoa - malaria, leishmaniasis, amoebisis

Fungi - pityriasis, sore

dengue haemorrhogic patient

deformity due to leprosy

fungi on skin (Pityriasis)

Figure - 1.9

Infectious diseases caused to animals

Animals get infectious diseases due to microorganisms. Figure 1.10 shows some of the examples for such diseases.

a dog suffering from Rabies

a bull suffering from foot and mouth disease

a cow suffering from mastitis

Figure 1.10

Infectious diseases caused to plants

Plants get infectious diseases due to microorganisms. Figure 1.11 shows some of the examples for such diseases.

a potato plant with blight

papaw leaves with mosaic disease

chillie plant with leaf curled disease

Figure 1.11

- **Damage caused due to the growth of microorganisms, on surfaces of objects.**

Growth of microorganisms on clothes, walls of buildings and wood has been caused adverse effects on the economy. These effects are mostly caused by fungi.

fungi on clothes

fungi on walls

fungi on wooden surfaces

Figure - 1.12 Growth of microorganisms on different surfaces

Summary

- The organisms which cannot be observed by naked eye are called microorganisms.
- Microorganisms cause beneficial effects as well as harmful effects.
- Usage in various industries, decomposition of dead plant and animal matter and pest control are beneficial effects.
- Food spoilage, cause infectious diseases for man, animals and crops and damage to economically important surfaces are harmful influences caused by microorganisms.
- Nutrients, moisture, favourable temperature and favourable pH values are necessary for microbial growth.
- Food can be preserved by implementing necessary methods to control microbial activities.

Exercise

1) State whether the following statements are true (√) **or** false (×)

i) Bacteria belong to the category of microorganisms. ( )

ii) A virus causes Tuberculosis. ( )

iii) Refrigerating food helps to control the temperature suitable for microorganisms. ( )

iv) Moisture and warmth are necessary factors for the growth of fungi. ( )

v) The scientist Antonie van Leeuwenhoek observed microorganisms for the first time. ( )

2) Select the correct answer

I. A disease **not** caused by a virus is

1) AIDS 2) Measles 3) Leprosy 4) Rabies

II. The food type that undergoes fermentation in the presence of microorganisms is

1) Food with proteins 3) Food with sugars
2) Food with lipids 4) All three types

III. Environmental conditions, suitable for microbial growth are given below.

a)Temperature b) Moisture c) pH

which of the above conditions are controlled by refregerating food?

1) a and b 2) a and c 3) b and c 4) a, b and c

IV. The microbial activity on lipid food such as 'dodol'/'dothal' and 'kavum'/ 'paniyaram' is known as,

1) Fermentation 2) Putrefaction 3) Rancidity 4) All the above

V. A favourable impact for humans by microorganisms,

1) Decomposition of dead plant and animal matter

2) Cause diseases to humans, animals and crops

3) Make food unsuitable for consumption

4) Cause economical impact by growing on non living surfaces

3) Give short answers.

I. Write four examples for microorganisms
II. Mention two factors required for microbial activity
III. Name three products in which microorganisms are used.
IV. What factor needed for microbial growth is controlled when food is stored in sugar/honey ?
V. Mention two microbial applications in the field of medicine

Technical Terms

Microorganisms	-	ක්ෂුද්‍ර ජීවීන්	-	நுண்ணங்கிகள்
Microscopic	-	අණ්වීක්ෂීය	-	நுணுக்குக்காட்டி
Food spoilage	-	ආහාර නරක් වීම	-	உணவு பழுதடைதல்
Microbial degradation	-	ක්ෂුද්‍ර ජීවී හායනය	-	நுண்ணங்கிப் பிரிகையாக்கம்
Application of microbes	-	ක්ෂුද්‍ර ජීවී භාවිත	-	நுண்ணங்கிகளின் பிரயோகம்
Infectious diseases	-	බෝවන රෝග	-	தொற்று நோய்கள்

2 Animal Classification

There is a vast diversity among animals that live in our environment.

It is easy to study about them by classifying organisms, based on different criteria. **Grouping of animals in a systematic way by considering their common features is known as animal classification.**

Animals can be classified on different criteria.

In grade 7 you learnt how to classify animals based on presence or absence of a vertebral column (backbone).

Let us do Activity 2.1 from the knowledge and facts you learnt in grade 7.

Activity 2. 1

Method:-

- Observe given pictures of the animals living in your surroundings.
- Divide and tabulate them into two groups using the feature, presence or absence of a vertebral column.

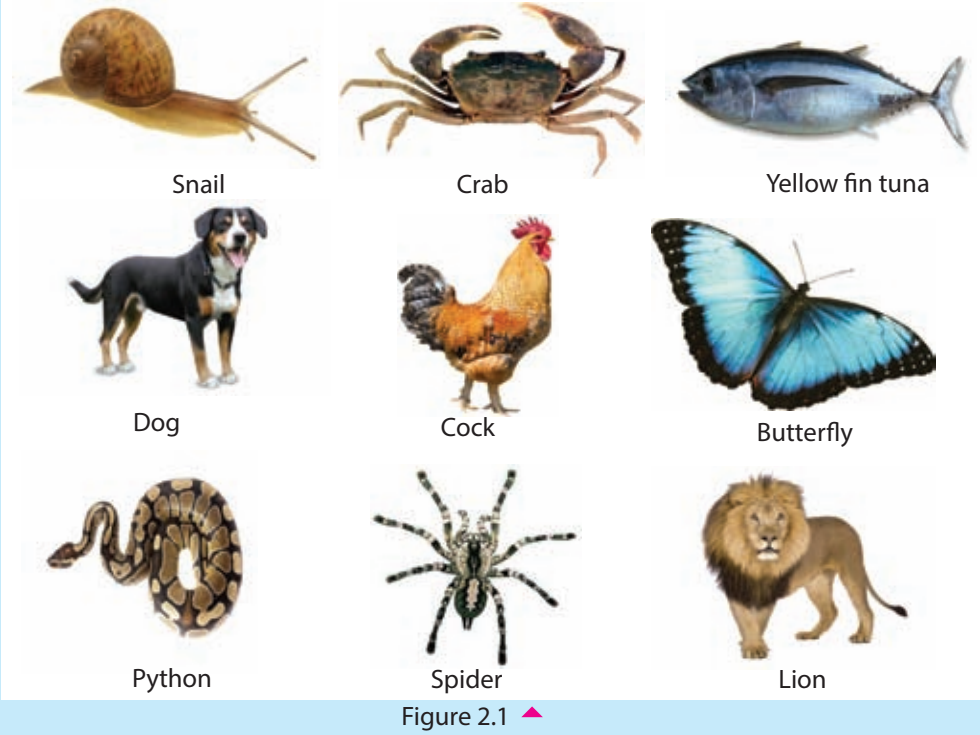


Figure 2.1

Among those animals, yellow fin tuna, dog, cock, python and lion have a backbone. Snail, crab, butterfly and spider do not have a backbone.

The animals without a backbone / vertebral column are known as **invertebrates** while the animals with a backbone / vertebral column are known as **vertebrates** Therefore, animals can be classified into two groups;

- Invertebrates
- Vertebrates

2.1 Main invertebrate groups

Engage in Assignment 2.1 to study about invertebrates.

Assignment 2.1

- Observe given diagrams of the invertebrate animal species.
- Classify them based on different criteria.

Figure 2.2

You have already classified the animals based on different criteria.

Invertebrates are scientifically classified by using their common features.
Some of the groups are given below.

1. Cnidaria
2. Annelida
3. Mollusca
4. Arthropoda

Let us consider the features of each of the above groups.

Cnidaria

The animals belong to Cnidaria are predators and they live in water. Hydra, sea anemone, jellyfish are some examples for the group of Cnidaria.


Hydra


Sea anemone


Jellyfish

Figure 2.3 ▲ Some Cnidarians

The features of Cnidaria are given below.

- Cnidarians have radially symmetrical body (If the body of an animal can be divided into two equal halves along several axes we call it a radially symmetrical animal).
- There are two forms as Polyps and Medusa. (Polyps are fixed to the substrate and lead a sedentary life while Medusa are free floating organisms)
- They cripple small creatures with their special tentacles having cnidocytes and use them as food.

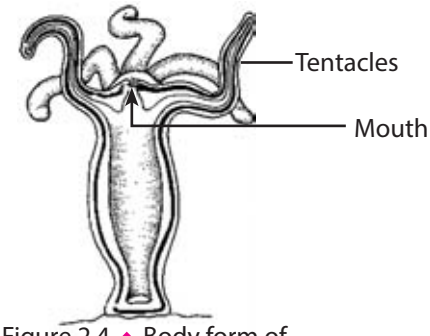


Figure 2.4 ▲ Body form of Cnidarian (Hydra)

For extra knowledge

The coral polyps belong to the Cnidaria group build up coral reefs.

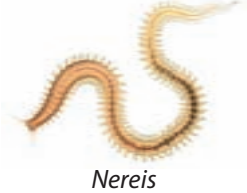
Annelida

Annelids live in both marine and fresh water environments as well as in wet terrestial environments.

Earthworm, leech, *Nereis* are some examples for Annelids.

Earthworm

Leech



Nereis

Figure 2.5 ▲ Some Annelids

Common features of Annelids are given below.

- Body is bilaterally symmetrical (If the body of an animal can be divided into two equal halves along one axis we call it a bilaterally symmetrial animal).
- They are vermiform (worm-like body shape).
- Body is divided into segments. Therefore, known as **segmented worms**.

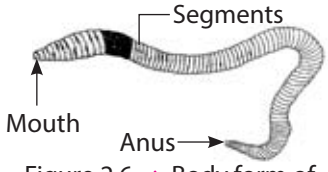


Figure 2.6 ▲ Body form of an Annelid (earthworm)

Mollusca

Molluscs live in terrestial, marine and fresh water environment. Snail, bivalve, chiton, slug, cuttle fish, octopus are some examples for Molluscs.

Snail

Bivalve

Octopus

Figure 2.7 ▲Some Molluscs

The features of Molluscs are given below.

- They are bilaterally symmetrical.
- Soft bodied animals.
- Possess a muscular foot.
- Possess a skin moistened with mucus.
- Some Molluscs bear shells.

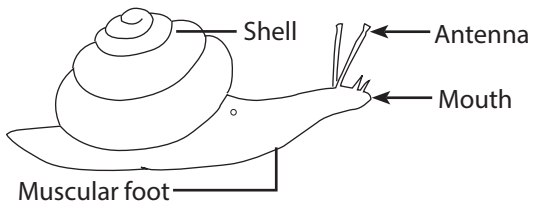


Figure 2.8 ▲ Body form of a molluscs (Snail)

Arthropoda

Arthropods live in terrestial as well as in aquatic environments. Arthropoda is the group to which the highest number of animals belongs. Insects, spiders, scorpions, millipedes, centipedes, prawns, crabs are some organisms that belong to the group Arthropoda.

Butterfly Scorpion Centipede Prawn

Figure 2.9 ▲ Some Arthropods

Features of Arthropods are given below.

- Arthropods are bilaterally symmetrical.
- Their body possesses an external skeleton/ exoskeleton.
- Some species possess wings.
- Arthropods have externally segmented body.
- All Arthropods have jointed appendages.

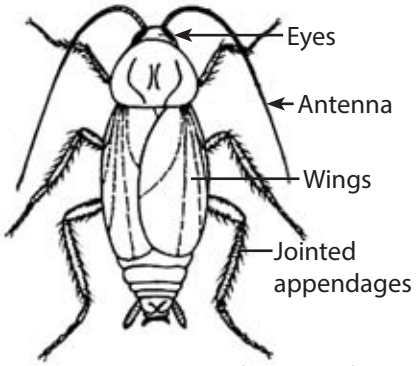


Figure 2.10 ▲ Body features of an Arthropoda (Insects)

Assignment 2.2

- Collect the bodies of dead insects.
- Get a box (wood, metal or card board) and fix a piece of styrofoam to the bottom of the box.
- Fix the bodies on the styrofoam using long pins.
- Paste a name tag for each insect. (Discuss with your teacher how to keep the bodies of insects without decaying)

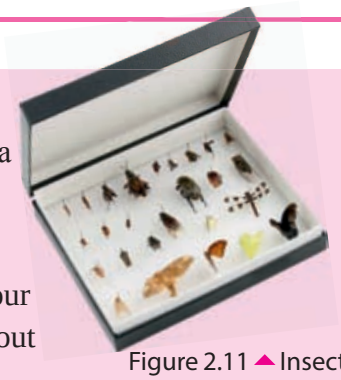


Figure 2.11 ▲ Insect box

2.2 Main vertebrate groups

Engage in Assignment 2.3 to study about vertebrates.

Assignment 2.3

- Observe the given pictures of different vertebrate animal species.
- Classify them using different criteria.

Blue fin tuna

Turtle

Crocodile

Common commorant

Toad

Hawk

Bat

Chimpanzee

Salamander

Figure 2.12 ▲

Now you can classify vertebrates based on different criteria.
Vertebrates can be scientifically classified depending on their common features.
Let us discuss the features of each of these groups.

1. Pisces
2. Amphibia
3. Reptilia
4. Aves
5. Mammalia

Pisces

Fish, the group of animals well adapted to live in water belong to Pisces. Tilapia, skate, shark, blue fin tuna, sear, gold stripped sardine, sprat are some fish that belong to Pisces.

Tilapia Skate Shark Blue fin tuna

Figure 2.13 ▲ Some Pisces

Features of Pisces are given below.

- Body is invariably streamlined. This feature helps them to swim through water.
- The body is covered with scales.
- Has fins to swim through water and to balance while swimming.
- Respiration through gills
- Possess eyes without eye lids.

Amphibia

Amphibians spend part of their life cycle in water. Frogs, toads, salamanders, *Ichthyophis* are some animals that belong to the group Amphibians.

Frog Toad Salamander *Ichthyophis*

Figure 2.14 ▲ Some Amphibians

Features of Amphibians are given below.

- Undergo metamorphosis.
- Skin is thin, moist and glandular. No scales in the skin.
- Some species use limbs for locomotion.
- Respiration is carried out by lungs, through wet skin or mouth.

Reptilia

Reptiles belong to this group. They are well-adapted for the terrestrial environment. Tortoise, turtle, cobra, python, viper, krait, lizard, monitor, iguana, crocodile belong to this group.

Tortoise Crocodile Cobra Viper

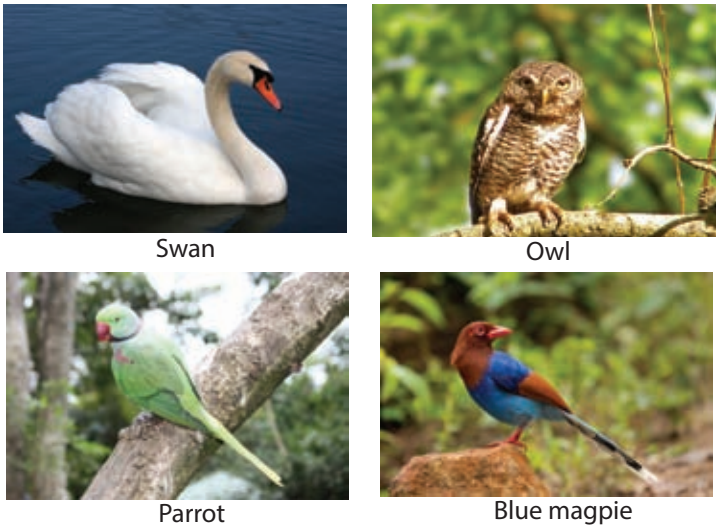
Figure 2.15 ▲ Some Reptiles

Features of Reptilia are given below.

- Possess a dry skin with scales. No glands are present in the skin.
- Use limbs for locomotion. But some reptiles are limbless. They are adapted for crawling
- Respiration through lungs

Aves

Birds belong to the group Aves. They are well-adapted for flying. Blue magpie, swan, owl, parrot are some examples for Aves.



Swan Owl

Parrot Blue magpie

Figure 2.16 ▲ Some Aves

Features of Aves are given below.

- Streamlined body is designed for flying.
- Body is covered with feathers.
- Possess limbs for locomotion. Forelimbs are adapted as wings.
- They do not have teeth but the beak is adapted for feeding.
- Breathe using lungs.

For extra knowledge

There are some birds that cannot fly. Some examples are given below.

Ostrich

Cassowary

Emu

Rhea

Penguin

Kiwi

Mammalia

These animals feed on mother's milk. Man, rat, loris, orangutan, gorilla, chimpanzee, bat, whale, dolphin, stag, deer are some examples for mammals.

Gorilla

Dolphin

Deer

Loris

Figure 2.17 ▲ Some Mammals

Features of Mammalia are given below.

- Has mammary glands.
- Skin has sweat glands, sebaceous glands and hair.
- Possess an external ear with ear lobe.
- Mammals have lungs to breathe.

Assignment 2.4

- Collect some pictures of mammals.
- Collect information about them.
- Prepare a booklet allocating one page for each animal. (Consider about the cover page, foreword, contents, acknowledgement etc.)

By studying this lesson, you have identified that there is a wide diversity among animals. You can further study about them by visiting zoological gardens and wildlife parks. All animals contribute immensely to maintain the balance of the environment.

Summary

- There is a vast diversity among animals in the environment.
- Animals with a backbone / vertebral column are known as Vertebrates and animals without a backbone / vertebral column are known as Invertebrates.
- Considering the common features, invertebrates can be classified into different groups. Cnidaria, Annelida, Mollusca and Arthropoda are some groups of Invertebrates.
- Considering the common features, vertebrates can be classified into different groups as Pisces, Amphibia, Reptilia, Aves and Mammalia.

Exercise

1. Select the most suitable answer.

i. The group of animals, **not** belonging to invertebrate is,

1. Annelida
2. Cnidaria
3. Amphibia
4. Arthropoda

ii. The group with highest number of animals is,

1. Aves
2. Athropoda
3. Mollusca
4. Mammalia

iii. An animal belonging to Reptilia group is,

1. shark
2. salamander
3. whale
4. turtle

2. Fill in the blanks.

i. Sea anemone belongs to ..... group.

ii. Possessing segmented appendages is a feature of ..... group.

iii …….. breathe using lungs, wet skin and the mouth.

3. Name the invertebrate group that bears each of the features given below.

   i. Muscular foot - .....

   ii. Worm-like segmented body - .....

   iii. Jointed appendages - .....

   iv. Radial symmetry - .....

4. Write down the answers.

i. Name two forms of Cnidaria with an example for each form.

ii. Name four Arthropods that can fly.

iii. Give three basic features of Mammalia.

iv. Give three basic features of Aves.

Technical Terms

Classification	-	වර්ගීකරණය	-	பாகுபாடு
Radial symmetry	-	අරීය සමමිතිය	-	ஆரைச் சமச்சீர்
Bilateral symmetry	-	ද්විපාර්ශ්වික සමමිතිය	-	இருபக்கச் சமச்சீர்
Morphological features	-	රූපීය ලක්ෂණ	-	உருவவியல் இயல்புகள்
Invertebrates	-	අපෘෂ්ඨවංශීන්	-	முள்ளந்தண்டிலிகள்
Vertebrates	-	පෘෂ්ඨවංශීන්	-	முள்ளந்தண்டுளிகள்
Cnidaria	-	නිඩාරියාවන්	-	நிடாரியா / குழிக்குடலிகள்
Annelida	-	ඇනෙලිඩා	-	அனலிடா / துண்டப் புழுக்கள்
Mollusca	-	මොලුස්කා	-	மொலஸ்கா / மென்னுடலிகள்
Arthropoda	-	ආත්‍රොපෝඩා	-	ஆத்திரப்போடா / மூட்டுக்காலிகள்
Pisces	-	පිස්කේස්	-	பிஸ்ஸஸ் / மீன்கள்
Amphibia	-	ඇම්ෆිබියා	-	அம்பியா / ஈருடகவாழிகள்
Reptilia	-	රෙප්ටීලියා	-	ரெப்ரீலியா / ஊர்வன
Aves	-	ආවේස්	-	ஆவேஸ் / பறவைகள்
Mammalia	-	මැමේලියා	-	மமேலியா / பாலூட்டிகள்

3 Diversity and Functions of Plant Parts

Plants in our environment show an enormous diversity as animals. Observe the diversity of plants in the forest shown in Figure 3.1.

Figure 3.1▲ A rain forest

The major reason for the beauty and the wonder of a forest is the diversity of plants. Plants differ each other in its size and morphological features. The reason for this vast diversity is the adaptations of plants to survive in different environments.

You have already learnt the parts of a plant in grade 7.

Recall what you have learnt and engage in Activity 3.1 to study further about the parts of a plant.

Activity 3.1

You will need : - 'Kuppameniya'/'kuppaimani' or a 'monarakudumbiya'/ 'seethaviyar selugkaluner' plant.

Method : -

- Uproot the plant from the soil without damaging the root system, and wash properly.
- Observe the plant and identify its parts.
- Draw a diagram and name the parts.

Figure 3.2 shows the main parts of a plant.

Compare your diagram with the given figure.

Every flowering plant consists of fruits, leaves, stem and roots. But they do not appear same in every plant. They have an extensive diversity. Let us have a review about the diversity and the functions of leaves, stem and roots of a plant.

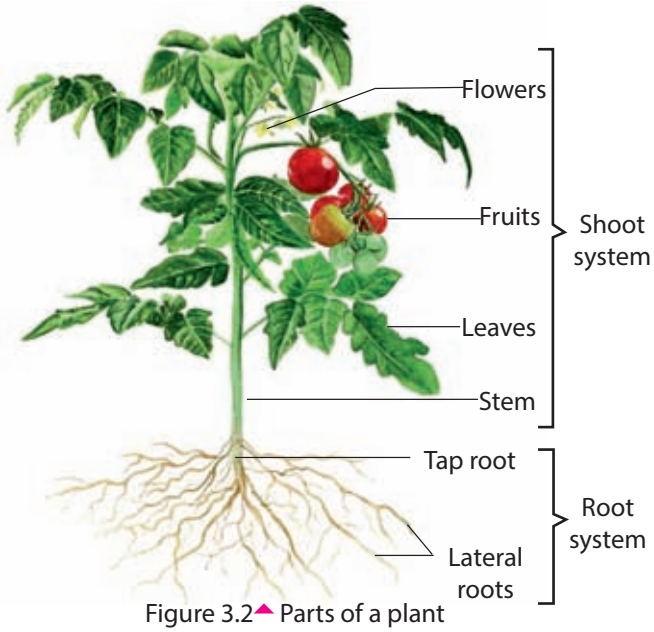


Figure 3.2 Parts of a plant

3.1 Diversity and functions of plant leaves

Leaves are considered as the most significant part of a plant. Most of the leaves are green in colour. The main function of a leaf is **photosynthesis**. Food is produced in plants having chlorophyll by using carbon dioxide, water and light energy. This process is known as photosynthesis.

Plant leaves are well adapted for efficient photosynthesis. Let us do Activity 3.2 to study about this.

Activity 3.2

You will need : - Some leaves of jak, mango, temple flower and manioc

Method : -

- Observe the leaves well.
- Compare the thickness of the leaves.
- Draw the area of the leaves on a square ruled sheet and compare them.

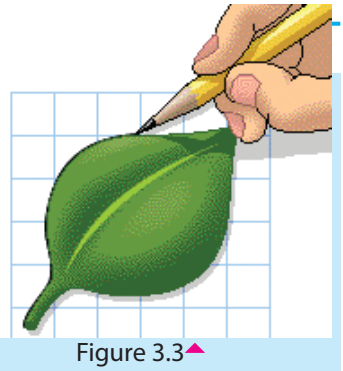


Figure 3.3

For the purpose of photosynthesis a leaf is typically flat and thin to expose to light over a broad area and allow light to penetrate fully into the tissues.

Thick and fleshy leaves can also be seen as an adaptation to adverse (arid) environmental conditions.

e.g:- Aloe, temple flower, yellow oleander (kaneru)

Figure 3.4 shows the parts of a leaf.

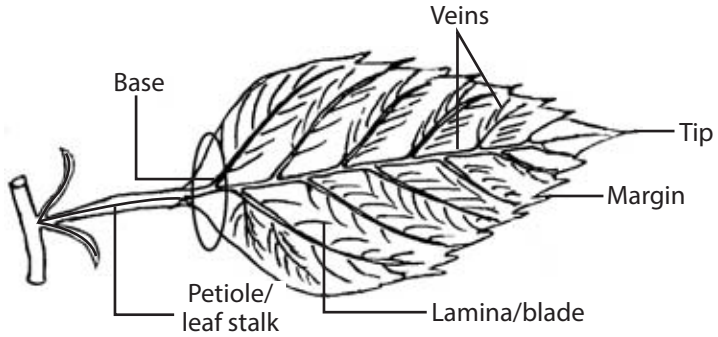


Figure 3.4 Parts of a leaf

Does every leaf have the same shape of petiole, margin, base and tip? Do Activity 3.3 to study about it.

Activity 3.3

You will need : - Some leaves that can be found in your environment (e.g: mango, papaw, rose, temple tress, 'Bo leaf'/'arasa illai')

Method: -

- Obtain leaves from different plants in your environment.
- Observe the leaves and draw pictures having different blades, bases, margins and tips.

When you observe the blades of these leaves you will understand that they have different shapes (Figure 3.5).

Figure 3.5 Diversity of leaf blades

You would have observed that there is a wide variation in leaf structure. That is due to their adaptations for the main function as well as various other functions.

Study the following diagrams and identify further the diversity of leaves. If you observe the tips of those leaves you will notice that the tips are different as sharp, curved, pointed, divided etc (Figure 3.6).

Figure 3.6 ▲ Diversity among leaf tips

The margins can be serrate or smooth. (Figure 3.7)

Figure 3.7 ▲ Diversity among leaf margins

The bases and the petiole of leaves too have different forms (Figure 3.8).

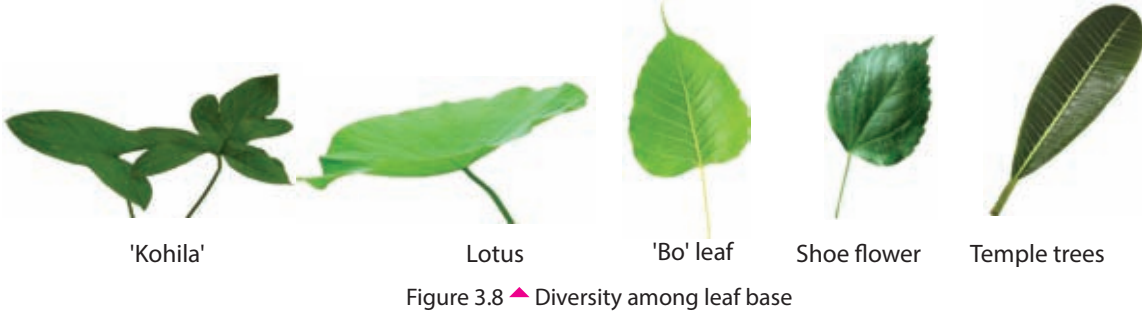


Figure 3.8 ▲ Diversity among leaf base

When you observe the environment you will be able to study more about other adaptations of leaves.

Leaf arrangement

The leaves are fixed to the stem in a way to expose all the leaves to the sun light. The pattern of fixing the leaf to the stem of a plant is known as **leaf arrangement**. Leaf arrangment supports efficient photosynthesis. Some leaf arrangements are given below.

- Leaves are on alternate sides of the stem.

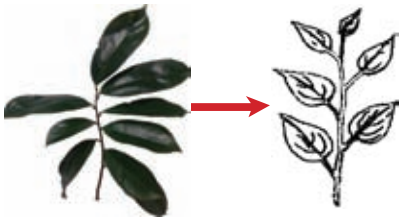


Figure 3.9 'Anona' ('Katu Anoda')/ 'Annamunna'

- Leaf attachments paired at nodes and in opposite directions.

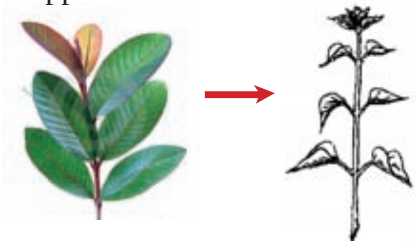


Figure 3.10 Guava

- Three or more leaves attach at each node on the stem in a whirl.

Figure 3.11 'Rukkaththana'/ 'Earlilaippalai'

- Leaves are attached in a spiral manner around the stem.

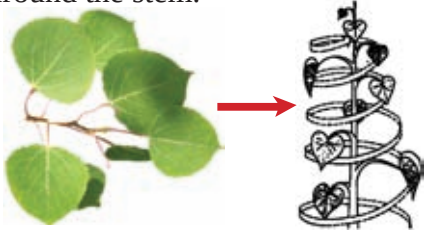


Figure 3.12 'Kanda'/'Vattakkanni'

Assignment 3.1

- Observe the environment and identify the leaf arrangements as much as possible.
- Complete the given table using your observations.

Table 3.1

Leaf arrangement	Examples of trees
Leaves are on alternate sides of the stem.	.....
Leaf attachments paired at nodes and leaves in opposite directions.	.....
Three or more leaves attach at each node on the stem in a whirl.	.....
Leaves are attached in a spiral manner around the stem.	.....

Let us now consider the other functions of leaves.

- Transpiration is the process of evaporation of water from plants (Figure 3.13). It mainly takes place through stomata in leaves. Transpiration helps to transport water to the upper parts of the plant.

Figure 3.13 ▲ Internal structure of a leaf

The leaves of plants in arid environments, are adapted to minimize transpiration.

Some adaptations are given below.

- Thick, waxy cuticle — e.g. - temple trees, oleander
- Leaves reduced to spines — e.g. - cactus
- Thin leaves — e.g. - 'kasa' / 'savukku'
- Reduced number of leaves — e.g. - 'navahandi' / 'kally', 'heerassa'/'pirattai'

Temple trees

Cactus

'Kasa'

Figure 3.14 ▲ Adaptations to minimize transpiration

- Some leaves are adapted to store water. They have become fleshy because they have specialized tissues to conserve water (Figure 3.15).

'Akkapana'

Aloe

Figure 3.15 ▲ Plants with water storage leaves

- Some leaves produce new plants through asexual reproduction.
  e.g. :- 'Akkapana', 'begonia'

Let us do Activity 3.4 to study how some plant leaves produce new plants.

Activity 3.4

You will need : - some leaves of plants such as akkapana, begonia, peparomia
Method : -

- Make a small cut at the veins of the above mentioned leaves and cover the place with soil.
- Keep them watering for several days.
- After 3-4 days observe the roots near the veins of the leaves.
- Find other ways of getting plants from leaves.


'Akkapana'


Begonia


Peparomia

Figure 3.16

3.2 Diversity and functions of plant stems

The basic functions of a stem are supporting and bearing leaves, buds, flowers, fruits, seeds of the plant and keeping the plant upright. Also the stem transports water and minerals throughout the plant. Most stems are found above the ground. Some stems grow underground and are known as **underground stems**.

In addition to the basic functions, stems have adapted to fulfill other functions. Let us study the diversity of stems based on their adaptations.

- Most stems produce new living tissues allowing plants to grow and reproduce. **These stems are known as propagative stems.** Given below are some examples for propagative stems (Figure 3.17, 3.18).


'Gotukola'


'Undupiyaliya'/ 'Sirupulladi'


'Ambul ambiliya'/ 'Puliyarai'

Figure 3.17 Some plants reproduced by runners/ stolon

Banana

'Kalanduru'/ 'Paalargu'

Paddy

Figure 3.18 ▲ Some plant species re-produced by Suckers

- Some plants store food in aerial stems (Figure 3.19).

Sugarcane

'Kithul'

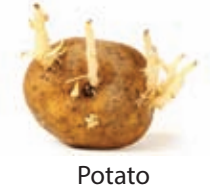
Figure 3.19 ▲ Some plants with storage stems

- Some underground stems serve the functions of storage of food perennation and sexual propagation. During the adverse seasons the aerial parts get destroyed but the underground stem survives. During favourable seasons new sprouts come out from the underground stem using stored food (Figure 3.20).

Turmeric

Ginger

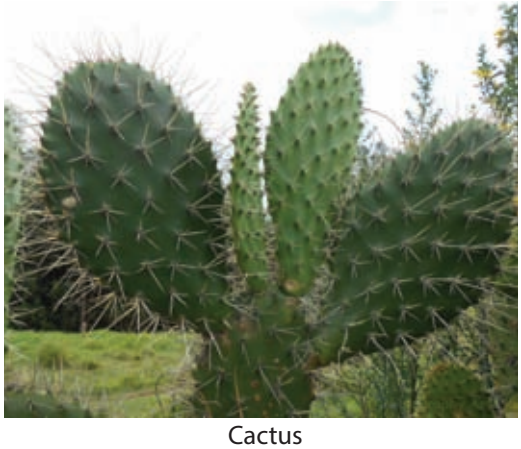
Onion



Potato

Figure 3.20 ▲ Some plants reproduced by underground stem

- Some stems are green and photosynthetic. Such stems are called **photosynthetic stems** (Figure 3.21).



Cactus

'Daluk' / 'Sathurakkalli'

Figure 3.21 ▲ Some photosynthetic stems

- Some plants fix to a support to climb up and absorb sunlight efficiently. Such stems are called **climbing stems** (Figure 3.22).

'Venival/ Maramanjal'

Beans

Figure 3.22 ▲ Some plants with climbing stems

Assignment 3.2

- Complete Table 3.2 using examples for each type of stems which have adapted to carry out the functions given below.

Table 3.2

Propagative stems	Aerial stems with food storage	Underground stems	Photosynthetic stems

3.3 Diversity and functions of plant roots

The basic function of root is to anchor the plant in the soil, absorb water and minerals. There are some roots adapted to satisfy other functions.

Other than the tap root and its branches, there are roots which arise from other parts of the plants. These roots are known as adventitious roots.

There are roots that adapted to fulfill many other functions. They are given various names.

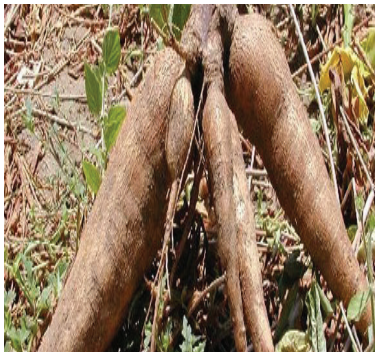
- **Tuberous roots** - The roots that are swollen due to storage of food are known as tuberous roots. Some tuberous roots allow the plant to survive in unfavourable seasons. Food can be stored either in the tap root or in adventitious roots.

  - Storage of food in tap root

Carrot Radish Beet

Figure 3.23 ▲ Some plants that store food in tap root

- Storage of food in adventitious roots


Manioc


Sweet potato


Dahlia

Figure 3.24 ▲ Some plants that store food in adventitious roots

- **Prop roots -** Adventitious roots that arise from branches. They penetrate the soil and helps to support branches.


Banyan Tree


'Rath kadol '/ 'Sen kandal'

Figure 3.25 ▲ Some plants with prop roots

- **Stilt roots -** Adventitious roots arise from the stem, grow below the ground and support the stem.


'Vetakeyya'/'Thalai'


'Rampa'


'Maha kadol'/'Perung kandal'

Figure 3.26 ▲ Some plants with stilt roots

- **Climbing /Clasping roots -** Roots that help the climbing stem/ creepers to fix to a surface/support.

Betel Pepper

Figure 3.27 ▲ Some plants with climbing roots

- **Aerial roots -** These roots absorb moisture from the atmosphere and supply the plant. These specialized roots can be found mostly in epiphytes.

Orchid Vanilla

Figure 3.28 ▲ Some plant with aerial roots

- **Respiratory roots -** These roots absorb air from the atmosphere and supply to the plant. They are specialized roots which can be found mostly in mangroves.

Sonneratia 'Maha kadol'

Figure 3.29 ▲ Some plants with respiratory roots

- **Propagative roots -** These roots produce new plants.

Curry leaves | Guava | 'Beli/Vilvam'

Figure 3.30 ▲ Some plants with propagative roots

Assignment 3.3

Collect some root specimens and study them. Consider the necessary steps that should be taken to conserve these roots.

Assignment 3.4

Plan a field visit to observe the nature and the diversity of plants. Study the adaptations of plants and relate them to their functions.

Plants play a vital role in the environment. Therefore, it is your duty to explore and collect specimens with minimum damage to the environment.

Summary

- The major parts of a plant are roots, stem, leaves, fruits and flowers.
- There is vast diversity among parts of the plants. Adaptation of plant parts to their functions is the reason for this vast diversity. There are some plant parts that exhibit special adaptations.
- The basic function of a leaf is photosynthesis. Some leaves are adapted to store food and water and also for propagation.
- The basic function of a stem is to hold leaves, flowers, fruits and transport water and minerals throughout the plant.
- Some stems are adapted for photosynthesis, to climb up, propagation and to store food.
- The basic function of roots is to anchor the plant in the soil, absorb water and minerals.
- Tuberous roots, prop roots, stilt roots, climbing roots, aerial roots and respiratory roots are adapted for special functions.
- The reason for vast diversity among plants is their functions and adaptations to survive in different environments.

Exercise

1) Write the main function of the given plant parts.

a) Plant leaves .....

b) Stem .....

c) Roots .....

2) Write the special adaptations of the following plant roots/stems/leaves.

i. Cactus
ii. Carrot
iii. Banyan
iv. Aloe
v. Sweet potato
vi. Pepper
vii. Begonia
viii. 'Navahandi'
ix. 'Niyangala'
x. Orchid
xi. Guava
xii. 'Rampa'

3) Fill in the blanks.

i) The pattern in which leaves grow on the stem is known as ……..

ii) Sugarcane, palmyrah are examples for ……. stems.

iii) The leaves of the cactus tree reduced to spines is an adaptation to minimize …….

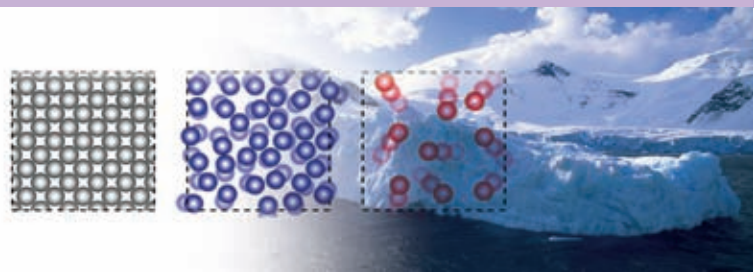
iv) Curry Leaves, beli, bread fruit trees often use the ……. for propagation.

v) Respiratory roots are specialized roots that can be seen in ……..…… plants.

Technical Terms

Diversity of leaves	-	පත්‍රවල විවිධත්වය	-	இலைகளின் பல்வகைமை
Diversity of stems	-	කඳන්වල විවිධත්වය	-	தண்டுகளின் பல்வகைமை
Diverstiy of roots	-	මුල්වල විවිධත්වය	-	வேர்களின் பல்வகைமை
Photosynthetic stems	-	ප්‍රභාසංශ්ලේෂක කඳන්	-	இலைத்தொழில் தண்டுகள்
Climbing stems	-	ආරෝහක කඳන්	-	ஏறும் தண்டுகள்
Propagative stems	-	ප්‍රචාරණ කඳන්	-	இனம்பெருக்கும் தண்டுகள்
Underground stems	-	භූගත කඳන්	-	நிலக்கீழ்த் தண்டுகள்
Tuberous stems	-	ආකන්දී කඳන්	-	முகிழுருவான தண்டுகள்
Tuberous roots	-	ආකන්දී මුල්	-	முகிழுருவானவேர்கள்
Prop roots	-	කරු මුල්	-	தாங்கும்வேர்கள்
Stilt roots	-	කයිරු මුල්	-	மிண்டிவேர்கள்
Aerial roots	-	වායව මුල්	-	காற்றிற்குரிய வேர்கள்
Respiratory roots	-	ශ්වසන මුල්	-	மூச்சுவேர்கள்
Storage roots	-	සංචිත මුල්	-	சேமிப்பு வேர்கள்
Propagation	-	ප්‍රචාරණය	-	இனப்பெருக்கம்

4 Properties of Matter



4.1 Discontinous nature of matter

The environment around us is composed of matter and energy. Recall the facts you learnt in grade 6 about matter and energy. To validate that knowledge further, do Assignment 4.1.

Assignment 4.1

Classify and tabulate following items as matter and energy.

Air, water, ball, light, bulb, sound, table, chair, electricity, heat, magnet

Table 4.1

Matter	Energy
air	light

Of the above, air, water, ball, bulb, table, chair and the magnet require space and have a mass. Such things are known as **matter**. When considering light, sound, heat and electricity, they do not occupy space and have no mass. They are considered **energy**. Components of the environment such as soil, water and rocks and the man made structures and various equipments are examples for matter.

Evidence for discontinuous nature of matter

An acceptable notion about the nature of matter was first put forward by the Greek philosopher Democritus who lived in the era 460-370 B.C. According to him, matter is made of very small particles. Later, the Greek philosopher Aristotle (384-270 B.C.) stated that matter is not composed of particles. It is said that in Athens of Greece, a public debate was held between the proponents of Aristotle and Democritus. The idea that "matter is particulate in nature" became victorious at that debate and later modern scientists confirmed experimentally the fact that matter is made up of particles. **The status matter exists as a collection of particles with spaces among them is known as discontinuous nature or particulate nature of matter.**

Matter can be classified as **solid**, **liquid** and **gas** according to its physical nature.

Various activities can be done to confirm the discontinuous nature of solid, liquid and gaseous matter.

Discontinuous nature of solid matter

Take a piece of chalk and break it into two pieces. Break one of those pieces again into two pieces. Likewise, break the pieces you get successively till you obtain the smallest possible particle.

When the initial piece was broken into two, you would have got two smaller pieces. When the chalk is broken again and again we get more and more smaller pieces. The smallest piece of chalk that we obtain like this without changing the properties of chalk is called a chalk particle. Accordingly, you would be able to imagine that a piece of chalk is formed by the union of a large number of chalk particles. The piece of chalk which is a collection of small particles has a particulate nature. There are spaces among those particles.

Let us do Activity 4.1 to investigate the discontinuity of solid matter.

Activity 4.1

You will need:- A container of water, a watch glass, blue or red ink, a few crystals of potassium permanganate, a piece of white chalk

Method:-

- Add a small amount of blue/red ink or a potassium permanganate solution to a watch glass. Take a piece of chalk and place one end of it on ink or the solution. Record your observations.

ink chalk chalk on ink

Figure 4.1

When the piece of chalk is placed on the blue/red ink or the potassium permanganate solution in the watch glass, you can see the colour soaking up through the piece of chalk. The ink is able to move up because the piece of chalk is discontinuous. It is because the piece of chalk consists of a large number of very small particles, each with the properties of chalk, and a large number of spaces through which the coloured particles can move. This activity confirms that solid matter is discontinuous.

Have you heard what happens when mercury comes into contact with items made of gold? In such an event, we will be able to observe mercury particles in the item of gold. The reason for this is the movement of mercury particles through the gold particles because gold is discountinuous. Because of this, when gold objects come into contact with mercury they get damaged.

Figure 4.2 ▲ A gold ring that came into contact with mercury

Assignment 4.2

- Plan and implement simple activities to show that solid matter is particulate in nature.

Let us next consider about the discontinuous nature of liquid matter.

Discontinuous nature of liquid matter

Take a small volume of water and divide into two portions. Divide one of them again into two portions. Likewise, divide one half again and again until you get the smallest possible volume.

Even though the small volume of water was divided into two, both volumes contain water. Even at the moment when the volume becomes extremely small after repeated divisions, water is the substance which occupies that volume. In such a way, the smallest volume of water that can be obtained while retaining the properties of water can be called a water particle. Hence, water is formed by the assembling of a large number of water particles with one another.

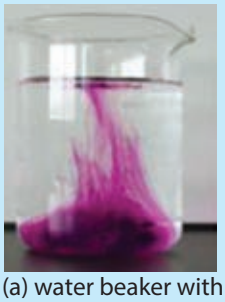
Let us engage ourselves in Activity 4.2 to look into the discontinous nature of liquid matter.

Activity 4.2

You will need:- A watch glass, a beaker with water, potassium permanganate/ coloured ink

Method:-

- Fill a beaker in half with water and put a crystal of potassium permanganate into it. Record the observations after about five minutes. Then, shake the water in the beaker gently. State the observations.
- Add a drop of coloured ink to a beaker containing water. Record the observations.



(a) water beaker with potassium permanganate

(b) water beaker with coloured ink

Figure 4.3 ▲

It can be observed that the colour of the potassium permanganate crystal placed in the beaker of water gradually spreads in water. It happens because the potassium permanganate particles move into spaces among the water particles. When a drop of ink is added to a beaker of water, the water gradually becomes coloured due to the movement of ink particles among water particles. Hence, it is clear that liquid matter also has a particulate nature.

Assignment 4.3

Plan and implement some simple activities to demonstrate that liquid matter is particulate in nature.

Discontinuous nature of gaseous matter

Let us conduct Activity 4.3 to verify that gases are discontinuous.

Activity 4.3

You will need:- Two gas jars, nitrogen dioxide gas, joss stick, a few drops of perfume

Method:-

- Fill a gas jar with brown-coloured nitrogen dioxide gas and close it with another gas jar. Record your observation after two minutes. (Do this as a teacher demonstration.)
- Light a joss stick.
- Place some perfume in a watch glass and leave for some time.
- Record observations.

When a gas jar is filled with brown nitrogen dioxide gas and an inverted gas jar containing air is placed over it, mixing of the two gases can be observed.

The reason for this movement of the nitrogen dioxide particles is the existence of spaces among the air particles.

The scent of the lighted joss stick spreads throughout the classroom. While the smell of perfume diffuses across the classroom, you would be able to see that the perfume had got removed from the watch glasses. We get its smell because its particles have moved through air and entered our nose during the spread of particles.

This leads to the explanation that gaseous matter too is particulate in nature.

Figure 4.4 ▲ Spread of nitrogen dioxide gas in gas jars

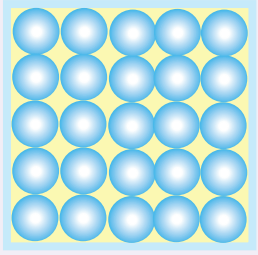
Assignment 4.4

Plan and implement with your teacher simple activities to support the fact that gaseous matter has a particulate nature.

Based on the above, we can conclude that all matter (solid, liquid or gas) is composed of particles and there are spaces among those particles. Thus, we can conclude that matter is discontinous.

4.1.1 Physical properties of matter in relation to its particulate nature

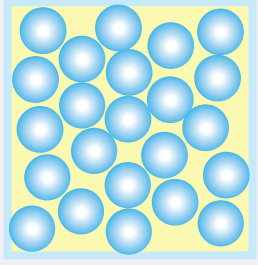
It is the difference in the organisation of particles that leads to the variation of the specific characteristics of the three states in which matter exists. This can be illustrated as follows.



Organisation of particles in a solid

Solid

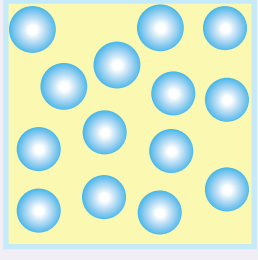
- Particles are orderly arranged.
- Particles are strongly bound to each another.
- Particles do not move relative to one another, but can vibrate in the same positions.
- Space among particles is less.



Organisation of particles in a liquid

Liquid

- Particles are not orderly arranged.
- Though, the particles are close to one another, the binding forces are not as strong as in a solid.
- The particles can move within the liquid.
- Space among particles is less, but higher than that of a solid.



Organisation of particles in a gas

Gas

- Particles are not orderly arranged.
- Binding forces among the particles are very weak.
- Particles move freely and randomly.
- Much space is left among the particles.

The reason for the variety of physical properties of solid, liquid and gaseous matter is the diversity of their prticular arrangement. Let us have a look at Table 4.2 which presents these differences.

Table 4.2

Property	Solid	Liquid	Gas
Shape	Has a definite shape	No definite shape. (Takes the shape of the occupied part in the container)	No definite shape. (Takes the shape of the occupied part in the container)
Volume	Has a fixed volume	Has a fixed volume.(Does not spread throughout the entire volume of the container)	No fixed volume. (Spreads throughout the entire volume of the container)
Compressibility	Connot be compressed easily.	Cannot be compressed easily.	Can be compressed easily.
Density	Has a high density	Has a high density	Density is low

A solid has a definite shape because the particles forming it are organised in a regular pattern and are strongly bonded. Liquids and gases lack a definite shape because their particles are not arranged orderly.

Solids and liquids have a definite volume, but gases do not have a definite volume. This is because the gas particles spread freely and occupy the entire volume of the container as the binding forces among gaseous particles are very weak.

Compression means the decrease in volume of matter by increasing pressure. Solid and liquid matter cannot be compressed easily. However, gaseous matter can be compressed easily. In order to compare the compressibility of liquids and gases let us do Activity 4.4.

Activity 4.4

You will need:- Two identical syringes, water, nitrogen dioxide gas

Method:-

- Draw water into one syringe until half of it is filled with water.
- Take an equal volume of nitrogen dioxide gas to the other syringe. (Do this as a teacher demonstration.)
- In both syringes close the open end and push the piston forward.
- In both cases compare the ability to move the piston forward.

You will note that the piston in the syringe with water cannot be pushed forward whereas the piston in the syringe with air can be pushed forward. This shows that it is difficult to compress water but air can be compressed easily. Let us find out the reason for this.

Water is a liquid. As the particles of a liquid are closely packed they cannot be brought closer by applying a force. Therefore, they are relatively difficult to compress. In a gas there are wider spaces among the particles, therefore, by applying a force the particles come closer. That is why the gases can be compressed easily.

When comparing the densities of solids, liquids and gases it is seen that solid and liquid matter have a high density but gases have a low density. Density will be studied further in a future lesson.

Solids, liquids and gases are used for various purposes depending on their properties. Some examples for the instances in which they are used are given below.

- Solids - parts of machinery, parts of vehicles, building materials, weapons
- Liquids - mercury thermometer, hydraulic jack, as a medium of transport
- Gases - inflating tyres, in pressure cookers, in hydrogen balloons, in liquid petroleum gas (LP gas) cylinders

Assignment 4.5

Make models to demonstrate the particulate nature (discontinuity) of the three states of matter.

4.2 Utilizing physical properties of matter

4.2.1 Pure substances and non pure substances

Consider a cylinder containing nitrogen gas and a cylinder containing ordinary air. The cylinder of nitrogen gas contains only nitrogen gas. The cylinder of air contains several gases such as nitrogen, oxygen, argon and carbon dioxide. On the otherhand potable water contains gases and various salts dissolved in it. But, pure water contains only water.

Let us do Assignment 4.6 to explore this further.

Assignment 4.6

- Pay your attention to the substances given in Table 4.3.
- Find out about the components in those substances and complete the table.

Table 4.3

Substance	Components	Contains one component only	Contains more than one component
air	hyrogen, oxygen, argon, carbon dioxide		✓
pure water	water	✓	
drinking water	water, various gases, dissolved in water, salts		
sugar	sugar		
salt solution	salt, water		
a piece of copper	copper		
tea	tea, water, sugar		
aluminium			
iron			
silver			

Of the substances given in the table, if you focus your attention to sugar, silver, pure water, aluminium, iron and copper, it is clear that they are composed of only one component. You may also be able to identify that the salt solution, tea and potable water contain more than one component.

Thus, on the basis of the components contained, matter can be divided into two main categories as follows.

- Pure substances - Matter that contains only one component.
- Non pure substances - Matter that contains two or more components.

Pure substances

Substances having a constant composition, that is, substances containing only one component with definite properties, are called pure substances.

Hence, sugar, copper, pure water, aluminium, silver and iron given in Table 4.3 are pure substances.

Based on the nature of the pure substances, they can be classified into two groups, **elements** and **compounds**.

Elements

Let us consider copper, aluminium, silver and iron classified under pure substances. These cannot be divided further into simpler substances.

Pure substances with definite properties which cannot be further divided by physical or chemical methods into substances are known as elements.

As at now, scientists have identified nearly 120 elements. Each of these elements has unique properties of its own.

Iron, aluminium, sulphur, carbon, oxygen, nitrogen, mercury, copper, gold, silver, lead, hydrogen and chlorine are a few examples for elements.


Sulphur


A bottle filled with chlorine gas


Iron


Copper


Carbon


Mercury


Aluminium


Zinc

Figure 4.5 ▲ Some commonly used elements

Compounds

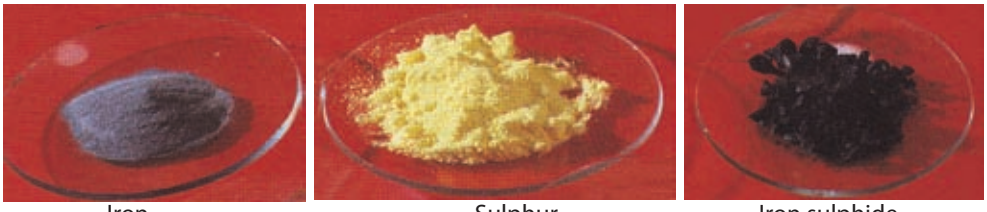
Let us consider about sugar and pure water you classified under the pure substances above. They are formed by the combination of two or more elements.

Compounds are homogeneous, pure substances in which two or more elements are chemically combined in a fixed ratio. The properties of a compound are different from the properties of the elements that contributed to form that compound.

Although, there are only 120 elements, there are millions of compounds in existence. The reason for this the possibility of combining elements in a vast multitude of ways with one another.

Let us inquire into the formation of compounds by the combination of elements chemically through the following example.

- Iron powder is a greyish black solid substance.
- Sulphur powder is a yellow coloured solid.
- When these two are mixed and heated till the solid mass melts, a black solid is formed.



Iron | Sulphur | Iron sulphide

Figure 4.6

It can be observed that the substance formed finally is different in properties from the substances that were used initially.

Now, it may be clear to you that here, the element iron has combined chemically with the element sulphur to form the black coloured compound, iron sulphide.

Given below are some compounds used in everyday life.

A fire extinguisher filled with carbon dioxide | Copper sulphate | Sodium chloride | Calcium carbonate | Sodium hydroxide | Glucose

Figure 4.7

Oxygen, nitrogen and argon present in ordinary air are elements. Nevertheless, carbon dioxide is a compound. The compound carbon dioxide is formed by the combination of the elements carbon and oxygen chemically.

Table 4.4 shows the elements contained in some compounds.

Table 4.4

Compond	Elements present
copper sulphate	copper, sulphur, oxygen
sodium chloride	sodium, chlorine
sodium hydroxide	sodium, hydrogen, oxygen
calcium carbonate	calcium, carbon, oxygen
carbon dioxide	carbon, oxygen
water	hydrogen, oxygen

You will study about non pure substances/ mixtures in a higher grade.

4.2.2 Various physical properties of matter

Different substances have different physical properties. There are a number of physical properties in matter that help to identify and distinguish them. Some of these are presented in Table 4.5

Table 4.5

Physical property	Simple introduction to the physical property
Lustre	Shiny suface due to reflection of light falling on it.
Hardness	Resistance of the material to wear and tear and scratching
Brittleness	Being subject to breaking / crushing into pieces when a force is applied
Thermal conductivity	Ability to conduct heat through the substance
Electrical conductivity	Ability to conduct electricity through the substance
Sonority	Emitting a lasting sound when struck with an object
Colour	The visual quality of the substance
Elasticity	Ability to stretch upon pulling and returning to the initial state when the force is released
Density	Mass of a unit volume
Malleability	Ability to be hammered into sheets without breaking into pieces
Ductility	Ability to be drawn into a wire without breaking
Smell	Sensation caused in the nose due to the volatility of the substance
Expansivity	Increase in volume without an increase in the mass upon increasing temperature
Texture	The rough or smooth nature felt to the touch
Melting point/ temperature	The temperature at which a substance turns from the solid state to the liquid state
Boiling point/ temperature	The temperature at which a substance turns from the liquid state to the gaseous state

Some of the physical properties of a substance can be used to examine its purity.

e.g.:- Density, melting point, boiling point

Density

What can you observe if you put a piece of iron, a cork stopper and a candle to water ? The piece of iron sinks while the cork and the candle float. The reason for this is the fact that the density of iron is greater than that of water wheres the density of cork and candle wax is less than that of water. Density is a property unique for a particular substance. **Density is the mass of a unit volume of a given substance.**

Let us do Activity 4.5 to find out whether the density of water has a constant value.

Activity 4.5

You will need:- Density bottle, distilled water, triple beam balance, fresh water, brackish water, hard water

Method:-

- Fill the density bottle (specific gravity bottle) with water, blot it and weigh using the triple beam balance.

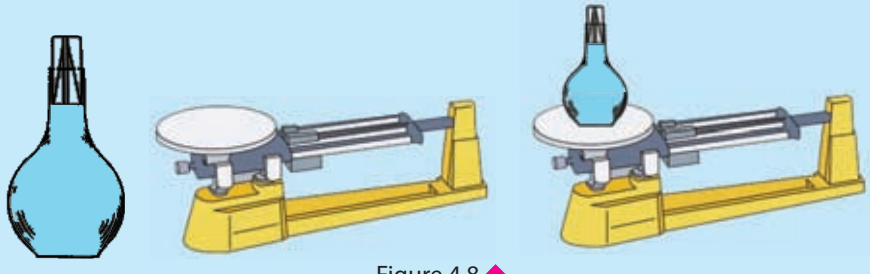


Figure 4.8

- Remove the water, refill the density bottle with distilled water, blot it and weigh.
- Compare the masses obtained.
- Repeat same experiment using the same density bottle but filling it with samples of water obtained from different environments such as fresh water, brackish water, brine and tank water and compare the masses.

Even if the masses are taken by repeating weighing several times, you will be able to see that the mass of an equal volume of distilled water takes a constant value. But the masses of equal volumes of fresh water, brine and brackish water will not be equal.

Distilled water is the water free from dissolved solids. Since, the density of pure water always takes the same value, pure water can be identified by measuring the density.

Similarly, for other pure substances, the density is a fixed value. Therefore, the purity of solids, liquids and gases can be determined by finding their densities.

Table 4.6 gives densities of some pure substances.

Table 4.6

Substance	Density/kg m^{-3}
Gold	19300
Mercury	13600
Lead	11300
Copper	8900
Iron	7700
Aluminium	2700
Water	1000

Melting point

There is a fixed temperature at which a solid turns into a liquid. This temperature is known as its melting point. Pure substances have a fixed melting point.

Let us conduct the following experiment to find out whether the melting point of pure substances has a constant value.

Activity 4.6

You will need:- A boiling tube, a beaker, some ice chips, water, a thermometer, a burner, a stand, a stirer

Method:-

- Fill about one fourth of a boiling tube with ice chips.
- Arrange the apperatus as in Figure 4.9.
- Heat till the ice melts.
- Stir the water well, using a stirer.
- Tabulate temperature against time.

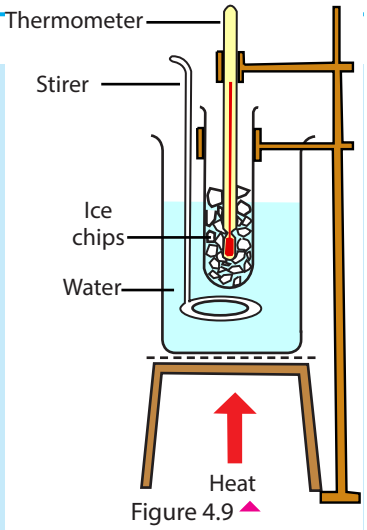


Figure 4.9

Table 4.7

Time	Temperature

You would have observed that the temperature remains constant until all the ice melts.

When heat is supplied, matter turns from the solid state to liquid state without changing its temperature. The specific temperature at which this change in state occurs is called the melting point.

In the above experiment the temperature remained at 0 °C until all the ice turned into liquid water. So, the melting point of pure water at normal atmospheric pressure is 0 °C.

Table 4.8 indicates melting points (at standard atmospheric pressure) of some pure substances.

Table 4.8

Substance	Melting point/ (°C)
Ice	0
Sulphur	132
Lead	317
Aluminium	660
Copper	1083
Iron	1539

The melting point of pure substances is a constant. Therefore, the purity of a substance can be determined by measuring its melting point.

Boiling point

There is a definite temperature at which a liquid turns into a gaseous state. That temperature is known as its boiling point. Pure substances have a constant boiling point.

In order to find out whether there is a constant value for the boiling point of pure substances let us conduct Activity 4.7.

Activity 4.7

You will need:- A boiling tube, water, a thermometer, a stand, a burner

Method:-

- Add water to a boiling tube and fix a thermometer as shown in Figure 4.10.
- Heat the water with the burner.
- Tabulate the change in temperature with time.

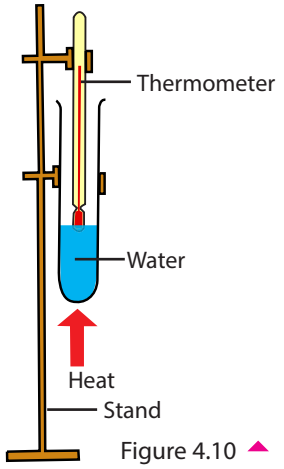


Figure 4.10

Table 4.9

Time	Temperature

When water is heated temperature rises gradually. At a certain moment, the rise in temperature stops and water turns into the vapour state from the liquid state. That temperature remains unchanged till all the water is vapourised. That temperature is called the **boiling point** of water. The boiling point of pure water at standard atmospheric pressure is 100 ^{o}C (The boiling point of a liquid depends on the surrouding pressure. If the surrounding pressure falls, the boiling point falls. The boiling point of water on a high mountain is lower than 100 ^{o}C).

If water is not pure due to the dissolving of foreign substances the boiling point (100 ^{o}C) may be elevated or lowered. From this it is clear that the boiling point is also a physical characteristic that can be used to probe the purity of a compound.

Table 4.10 shows boiling points of some substances under normal atmospheric pressure.

Table 4.10

Substance	Boiling point (^{o}C)
Ethyl alcohol	77
Water	100
Sulphur	444
Lead	1744
Iron	2900

Now let us see whether we can classify the elements that we identified as pure substances based on their physical properties.

Activity 4.8

You will need:- Iron, copper, sulphur, carbon (graphite), magnesium, aluminium, lead, zinc

Method:-

- Identify observations or simple activites appropriate to examine the properties such as metallic lustre, sonority, thermal conductivity, electrical conductivity, malleability and brittleness. You can have an understanding about this by reading the paragraph coming after this activity.
- Do the relevant activities and record the observations using a table such as Table 4.11. Place a tick (√) when the element has the relevant property and a cross (×) if it does not.

Table 4.11

Substance	Lustre	Sonority	Thermal conductivity	Electrical conductivity	Malleability	Brittleness
Iron	√	√	√	√	√	×
Copper						
Sulphur						
Graphite						
Magnesium						
Aluminium						
Lead						
Zinc						

Some methods which you can adopt to examine each physical property are described below. To investigate the physical properties you can use either those methods or other methods after discussing with your teacher.

To examine the **lustre**, you can scratch the surface of the substance with a knife or clean it with a sand paper.

The material used to examine **sonority** should be at least one millimetre thick. It can be done by striking with a metal rod or dropping on the cement floor from a suitable height.

To inquire into the **thermal conductivity** a change that can be observed during the transmission of heat has to be used. For example, drops of candle wax can be placed on rods made of different materials and melting of the wax during conduction of heat can be done.

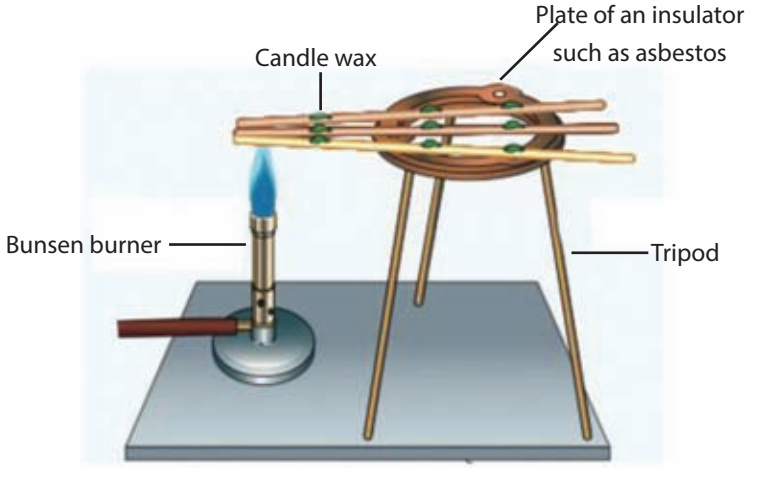


Figure 4.11 ▲ Examine thermal conductivity

In order to examine **electrical conductivity** a simple circuit should be constructed. It could be constructed on a circuit board or made by connecting the pieces of equipment using crocodile clips.

If the substance to be tested placed between A and B, conduct electricity, the bulb will light. If the substance does not conduct electricity the bulb will not light.

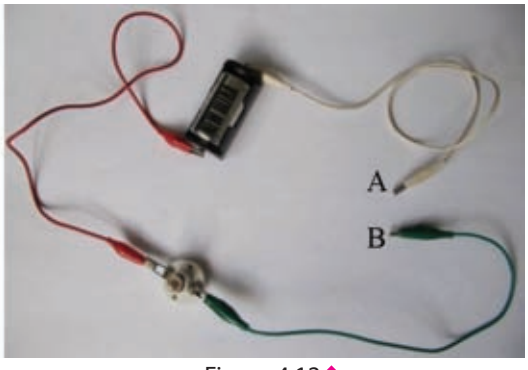


Figure 4.12

To observe malleability and brittleness a piece of the relevant substance can be struck lightly with a hammer after placing it on a fairly thick surface. If it turns into a sheet on hammering, it shows malleablilty. If it crumbles, it is a brittle substance.

Based on the results of the above experiment and other characteristics, elements can be divided into two classes, metals and non metals. The diversity of the physical properties of metals and non metals can be illustrated as follows.

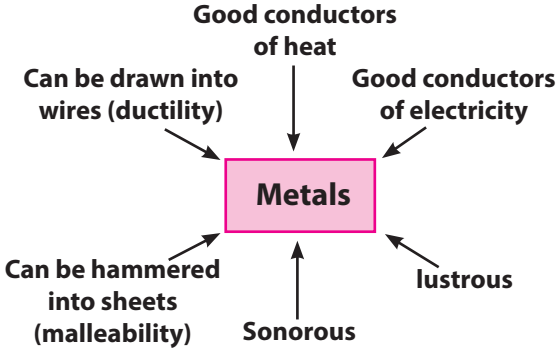


Figure 4.13

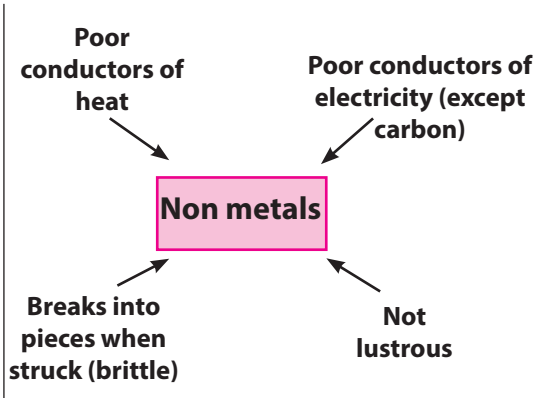


Figure 4.14

Assignment 4.7

Classify the substances given in Table 4.11 in Activity 4.8 as metals and non metals.

Based on their physical properties, elements can be classified as metals and non metals. Moreover, based on the physical state of matter they can be classified as solid, liquid and gas. Study Table 4.12 well and get to know the diversity of elements.

Table 4.12

Element	Metallic/Non metallic nature	Physical state (solid, liquid, gas)
Sodium	Metal	Solid
Aluminium	Metal	Solid
Calcium	Metal	Solid
Iron	Metal	Solid
Copper	Metal	Solid
Magnesium	Metal	Solid
Zinc	Metal	Solid
Lead	Metal	Solid
Mercury	Metal	Liquid
Carbon	Non metal	Solid
Silicon	Non metal	Solid
Phosphorus	Non metal	Solid
Sulphur	Non metal	Solid
Iodine	Non metal	Solid
Hydrogen	Non metal	Gas
Nitrogen	Non metal	Gas
Oxygen	Non metal	Gas
Chlorine	Non metal	Gas
Argon	Non metal	Gas
Bromine	Non metal	Liquid

4.2.3 Day-to-day applications of various physical properties of matter

The physical properties of matter can be usefully applied in various ways in our everyday life. Table 4.13 presents a few such instances.

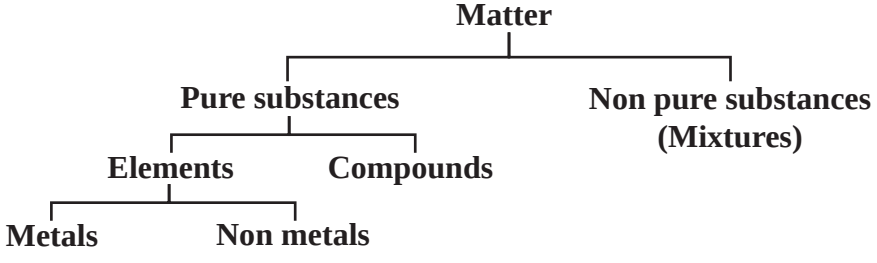
Table 4.13

Physical property of matter	Instances of application	Substance
Metallic lustre	making jewellery	gold, silver
Hardness	withstanding weight	steel rails
	cutting glass	diamonds stylets
Compressibility	storing gases in cylinders	oxygen, LP gas
Odour	detecting gas leakages	LP gas
	spreading the scent	perfumes, sweet smelling smoke
Thermal conductivity	cooking pans	aluminium
	soldering	lead
Electrical conductivity	conducting electricity	copper, aluminium cables
Elasticity	Tyres and tubes	rubber
Expansivity	measuring temperature	mercury/ alchol theremometers
	automatic electrostats	electrical appliances with a bimetallic strip
Brittleness	breaking larger pieces into smaller pieces	chemical compounds, cereals, granite, egg shells
Texture (smooth)	applying talcum powder chalk	talc (a mineral)
Texture (rough)	smoothening the surface of wood, walls etc	sand paper

Assignment 4.8

Explore information relating to the instances where the properties of matter are exploited in real life and present the information in a creative manner.

At the end of the chapter, a schematic diagram such as one given below can be constructed.



Summary

- The things that have a mass and that occupy space are known as matter.
- The making of matter from particles and the existence of spaces among them is referred to as the discontinous nature of matter.
- All three states, solid, liquid, and gas are discontinuous.
- The reason for the specific features of matter in solid, liquid and gaseous state is the diversity of the arrangement of particles in them.
- The different properties of solids, liquids and gases make them applicable for different purposes.
- Based on composition, matter can be classified as pure substances and non pure substances.
- Pure substances can further be classified into two catergories; elements and compounds.
- Pure substances with definite properties and indivisible by physical or chemical methods into substances with different properties are called elements.
- The pure substances formed by the chemical combination of two or more elements in a constant ratio are known as compounds.
- Sonority, thermal conductivity, electrical conductivity, malleability, ductility, density, melting point, boiling point, hardness, elasticity, expansivity, lustre, etc are physical properties of matter.
- In pure substances the physical properties such as density, boiling point and melting point have a constant value.
- Based on the physical properties, elements can be classified as metals and non metals.
- Various physical properties of substances are used for daily activities in life.

Exercise

01) For the following questions, select the correct answer or the most suitable answer from the responses given

01. Which of the following response contains only matter?
    1. Air, water and light
    2. Water, heat and a brick
    3. Electricity, a brick and ink
    4. A brick, ink and air

02. A property only common to solids and liquids is,
    1. having a definite shape
    2. having a definite volume
    3. the ability to compress
    4. the free movement of particles

03. When a drop of ink is added to a vessel of water, the colour of ink spreads throughout water. Which of the following response explains this observation best ?

1. Water is discontinuous
2. Ink is discontinuous
3. Water and ink are discontinuous
4. Ink is discontinous and water is continuous

04. Which of the following is a pure substance?

1. Bottled water
2. Fizzy drinks
3. Colourless toothpaste
4. Crystals of sodium hydroxide

05. The property of crumbling upon the application of a small force is called the,

1. Hardness
2. Brittleness
3. Elasticity
4. Ductility

06. Given below are three ideas expressed by three students about the masses of equal volumes of water and kerosene.

A) Their masses are equal

B) Mass of kerosene is less

C) Mass of water is greater

The correct response of these is /are

1.only A 2. only B 3. only C 4. only B and C

07. Which of the following substance is an electrical conductor?

1. Iron 2. Wood 3. Sand 4. Wax

08. What is the boiling point of pure water at standard atmospheric pressure?.

1. 0 ^{0}C 2. 30 ^{0}C 3. 100 ^{0}C 4. Between 30 ^{0}C - 100 ^{0}C

09. What is the liquid metal that conducts electricity?

1. Water 2. Mercury 3. Alcohol 4. Wine spirit

10. Some ideas expressed by students about the boiling point of a liquid are as follows.

A) It is the temperature at which a change in state occurs

B) It is the temperature at which a solid turns into a liquid without changing temperature upon heating

C) It is the temperature at which a liquid turns into a gas without changing temperature on heating.

The correct statements of the above are;

1. only A 2. only B 3. only C 4. only A and C

11. Which of the following is correct about the density of a metal?

1. It always takes a high value
2. Mostly it takes a low value
3. It takes a definite value
3. Densities of all the metals are equal

02) Place the mark √ if each of the following statements is correct and mark × if it is wrong.

01. Air does not belong to the category of matter. ( )
02. All matter has a particulate arrangement. ( )
03. Gas particles move freely. ( )
04. Sun contains only energy. ( )
05. Solids, liquids and gases can be compressed easily. ( )
06. A liquid has a fixed shape as well as a fixed volume. ( )
07. Copper is a brittle metal. ( )
08. Sulphur is an electric conductor and a non metal. ( )
09. Sonority is a property seen in most of the metals. ( )
10. All metals have malleable and ductile properties. ( )

Technical Terms

Energy	-	ශක්තිය	-	சக்தி
Matter	-	පදාර්ථය	-	சடம்
Discontinous nature	-	අසන්තත ස්වභාවය	-	தொடர்ச்சியற்ற தன்மை
Shape	-	හැඩය	-	வடிவம்
Volume	-	පරිමාව	-	கனவளவு
Compressibility	-	සම්පීඩනය	-	நெருக்கற்றகவு
Density	-	ඝනත්වය	-	அடர்த்தி
Pure substances	-	සංශුද්ධ ද්‍රව්‍ය	-	தூய பதார்த்தம்
Elements	-	මූලද්‍රව්‍ය	-	மூலகம்
Compounds	-	සංයෝග	-	சேர்வைகள்
Metals	-	ලෝහ	-	உலோகங்கள்
Non metals	-	අලෝහ	-	அல்லுலோகங்கள்
Mixtures	-	මිශ්‍රණ	-	கலவைகள்
Lustre	-	දිස්නය	-	பளபளப்பு
Hardness	-	දෘඪතාව	-	வன்மை
Brittleness	-	භංගුර බව	-	நொருங்குமியல்பு
Thermal conductivity	-	තාප සන්නායකතාව	-	வெப்பக்கடத்துத் திறன்

Electrical conductivity	-	විද්‍යුත් සන්නායකතාව	-	மின்கடத்து திறன்
Sonority	-	රැව් දෙන හඬ	-	கணிர்ஒலி
Colour	-	වර්ණය	-	நிறம்
Elasticity	-	ප්‍රත්‍යස්ථතාව	-	மீள்தன்மை
Malleability	-	ආහන්‍යතාව	-	வாட்டத்தகுமியல்பு
Ductility	-	තන්‍යතාව	-	நீட்டற்றகுமியல்பு
Smell	-	ගන්ධය	-	மணம்
Expansivity	-	ප්‍රසාරණතාව	-	விரிவு
Texture	-	වයනය	-	இழையமைப்பு
Melting point	-	ද්‍රවාංකය	-	உருகுநிலை
Boiling point	-	තාපාංකය	-	கொதிநிலை

5 Sound

Sound, we hear constantly in the environment is produced by vibrating various things. Instruments, that produce sound are called **sources of sound.**

It can be concluded that various musical instruments produce sound in various ways.

Sources of sound can be divided into three categories according to the part that vibrates when producing sound.

Figure 5.1

Some of the sounds we hear in the environment occur naturally while some others occur artificially.

Birds call

Cats mew

Figure 5.2 ▲ Several natural sounds

Sound of machines in factories

Sound of vehicles

Figure 5.3 ▲ Several artificial sounds

Artificial sounds, as well as natural sounds are produced by vibrating strings/ bars, membranes or air columns.

Assignment 5.1

- List out separately some naturally produced sounds and artificially produced sounds in the environment.
- Identify and name the part that vibrates when those sounds are produced.

Humming of bees comes from fast motion of their wings. Grass hoppers and cicadas generate their characteristic sound by rubbing the bristles on their legs

Assignment 5.2

- Make a list of some animals that generate sounds.
- Investigate the methods that they generate sounds and make a report.

Frequency of vibrations

Let us do Activity 5.1 to study further, the nature of sounds.

Activity 5.1

You will need:- An organ, a piano or a xylophone

Method:-

- Play two keys of the organ, the piano or xylophone, which are apart from each other.
- Listen to the sound and you will realise that the two sounds are different to each other.
- Now play the seven relevent keys to seven notes, which are cosecutive one at a time.
- Listen to the sound and you will realise that there is a slight difference between each note.
- Discuss the reason for that difference, you observed.

The difference in the sound you realised in the above activity is due to a quantity called frequency of vibration.

The number of vibrations of an object per unit time is referred to as the frequency of that object.

If an object vibrates 50 times a second, then it is said that, the frequency of that object is 50 Hz.

Frequency of vibrations is measured by the international (SI) unit Hertz (Hz).

Let us do Activity 5.2 to study further, the frequency of vibrations.

Activity 5.2

You will need:- Two tuning forks of long arms and short arms

Method:-

- Vibrate the tuning fork of long arms and listen to the sound carefully.
- Then vibrate the tuning fork of short arms and listen to that sound carefully (Both tuning forks should be vibrated in the same manner. Get the support of your teacher for this purpose.)
- Repeat vibrating the tuning forks several times and identify the difference of sounds.
- Record your observations.

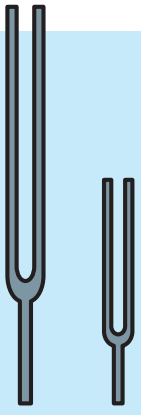


Figure 5.4
Tuning forks

Now it is clear to you that, the sound generated by a tuning fork differs according to its arm length. It is the frequency of sound that changes here.

Observe the tuning forks of different length. The frequency differ according to the length of them. The longest tuning fork has the minimum frequency. Frequency increases gradually with decreasing length. There are mechanisms in every musical instrument to change the frequency. The seven notes in music are produced by changing the frequency of vibration.

5.1 Musical instruments that produce sound by vibrating membranes

Let us construct a simple instrument that produce sound by vibrating membranes.

Activity 5.3

You will need :- A large balloon, a small plastic cup, rubber bands

Method :-

- Cut the neck of the balloon as shown in the Figure 5.5.
- Insert the plastic cup into the balloon and make it like a drum as shown in the figure. Use rubber bands where necessary to tighten the balloon membrane. Strengthen the upper edge of the cup also with a rubber band.
- Tap the drum, thus made and listen to the sound produced.
- Tighten the balloon membrane by pulling the balloon down. Tap again and listen to the sound. (Tapping should be done in the same manner at each instance.)
- Listen to the sound produced by increasing the tightness of the balloon membrane.

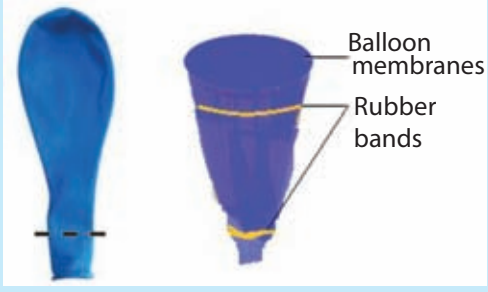


Figure 5.5

It is clear that the sound is sharp and high when the tightness of the balloon membrane is increased. The frequency of the sound produced has increased when the membrane is stretched more.

Assignment 5.3

- Make an instrument that produces sound by vibrating a membrane.
- Design a suitable way to adjust its sound and present it to the classroom.

Let us find out how the sound of a membrane vibrating instrument can be adjusted.

Activity 5.4

You will need :- A thabla

Method :-

Figure 5.6

- Play the thabla that you are provided with.
- Listen to the sound of it carefully.
- Tighten the thabla strap well by tapping gently to the pieces of wood fitted for that purpose. This will stretch the membrane to the thabla. (Get the music teacher's assistance for this)
- Play the thabla again and listen to the sound well.
- Notice the difference between the sounds in two instances.
- Identify the change of sound by playing the thabla several times, while changing the tension of its membrane.
- Record your observations.

Stretching of the membrane of thabla can be adjusted by tightning or loosening its strap. You may understand that the sound produced by the thabla is different when its skin is stretched and not stretched. It is the frequency of the sound that changes here. When the membrane is stretched, the frequency of the sound produced is high.

Assignment 5.4

- Find another instruments which produce sound when a membrane is vibrated.
- Plan and present a method to adjust their sound.
- Adjust membranes of the instruments and hear the sound well.
- Identify the difference between them and record them.

5.2 Musical instruments that produce sound by vibrating air columns

Let us do Activity 5.5 to study about the instruments that produce sound by vibrating an air column.

Activity 5.5

You will need :- Three pen tubes in different length with a close end

Method :-

- First blow the shortest pen - tube (A) and listen to the sound carefully.
- Then, blow the longer one (B) and listen. Finally, blow the longest one (C). Listen and identify the difference of sounds.
- Repeat this activity several times to identify the difference of sounds well.

Figure 5.7

You may hear that the sound produced by pen tubes of different lengths are different. Thus, it is clear that the frequency of the sound produced differs according to the length of air column vibrated.

Assignment 5.5

- Make a whistle using six one end closed pen tubes as shown in Figure 5.8.
- Blow the whistle you made rhythmically.

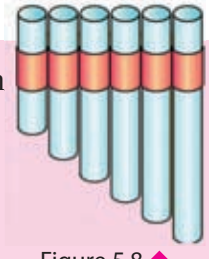


Figure 5.8

Activity 5.6

You will need :- Six tall glass tumblers of the same size, a metal spoon, water

Method :-

- Fill the six glass tumblers with water to varing heights as shown in the figure.
- Tap the edge of each tumbler with a spoon gradually, starting from the one with less water.
- Listen to the sound carefully.

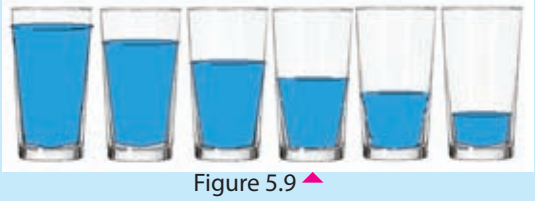


Figure 5.9

Assignment 5.6

- Make a whistle using a tender coconut leaf. Blow it while changing the length of its reeds and listen to the sound carefully.
- Record the change of sound according to change of length of the reed.

Let us find some more facts about the instruments that produce sound by vibrating a column of air.

Activity 5.7

You will need :- A flute

Method :-

- Close all the holes of the flute provided to you and play it.
- Listen to the sound carefully.
- Then, open the holes B,C,D,E,F and G gradually one at a time and blow the flute.
- Listen carefully to find whether there is a change in the sound when each hole is opened and closed.
- Record your observations

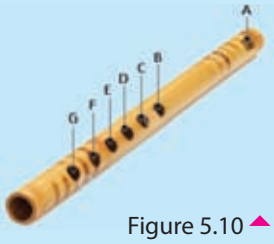


Figure 5.10

When the holes B,C,D,E,F and G are opened gradually one at a time, the length of the vibrating air column increases.

Thus, flute is a musical instrument that changes the sound with the change of the length of air column vibrated. It is played with the blow of air that vibrates the air colomn in the flute. The air pores are closed and opened with the fingers to produce different sounds in music.

Assignment 5.7

- Make a flute using a piece of PVC pipe or a piece of bamboo. Use a cork stopper to close the end of the flute.
- Try to play it rhythmically by opening and closing the holes.

5.3 Musical instruments that produce sound by vibrating strings/rods

Let us construct a musical instrument that produces sound by vibrating strings.

Activity 5.8

You will need :- A piece of plank which is about 2 feet long and 6 inches wide, empty fish can, 4 iron nails, 4 bolts, a small thin plastic sheet, 4 pieces of wire of the same metal which are 45 cm long and have different diameters.

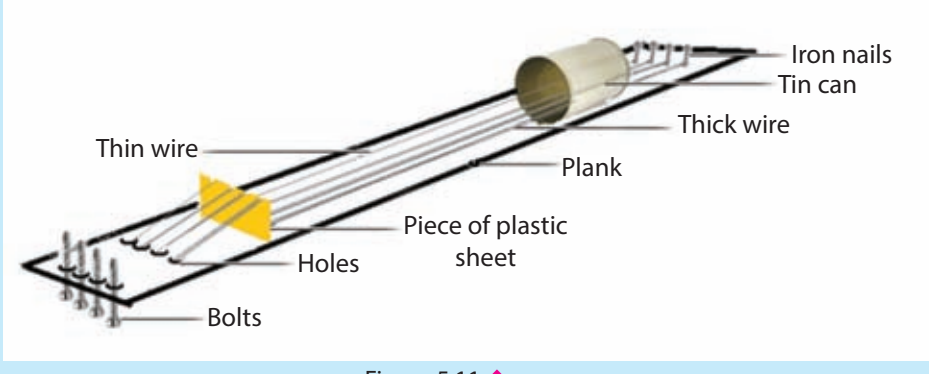


Figure 5.11

Method:-

- Fix the iron nails to the plank as shown in Figure 5.6 and tie the wires to them. Take the other ends of the wires through the holes of the tin can, fixed to the plank.
- Pass the wires through the slots made on the plastic sheet, which is placed on the plank. Send the wires through the holes, made on the plank.
- Wind the wires around the bolts which are fixed to the plank. (Ask the assistance of your teacher for this)
- Make sure that the lengths of the vibrating part of the wires and their tension can be adjusted.
- Play the instrument, you made adjusting wires and identify the change of sound.
- Record your observations.

Let us do Activity 5.9 to investigate the methods of changing the sound produced by the musical instruments with strings.

Activity 5.9

You will need :- A guitar

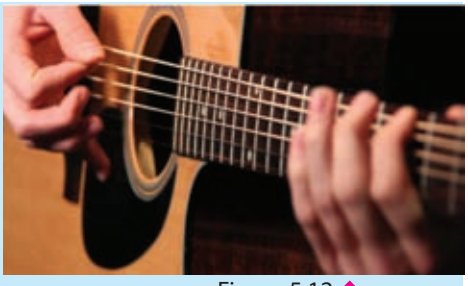


Figure 5.12

Method :- (Get the assistance of your teacher for the activity)

- Observe well, the way that wires are fixed in a guitar and the thickness of those wires.
- Then, vibrate the wires one by one starting from the thick wire.
- Listen carefully to the sound produced, when each wire is vibrated.
- Listen to the sound produced, when length and the tension of wires are gradually changed. Identify the differences.
- Repeat this procedure several times.
- Record your observations.

A sharp (high) sound is produced when short, tight, thin wires are vibrated. Sound produced by the vibration of long, loose and thick wire is not that sharp. When a guitar or a violin is being tuned, the length and the tension of the wires are changed. Sound may also be changed by the way and the speed of vibrating the strings.

Assignment 5.8

- Plan to construct a musical instrument that produces sound by vibrating strings.
- Construct the instrument planned, and play it.

Assignment 5.9

- Investigate the methods of tuning some other musical instruments that produce sound by vibrating strings.
- Tune those instruments, identify the change of sound and record the methods of tuning.

Xylophone is a musical instrument with vibrating bars. Let us study more about the sound produced by a xylphone.

Activity 5.10

You will need :- Xylophone

Method :-

- Tap gradually, one by one on the plates of the xylophone, you are provided with, (starting from the longer plate to the shorter one). Listen to the sound carefully.
- Repeat playing the xylophone by tapping the plates.
- Record your observations.

Figure 5.13

Xylophone produces sound because of the vibration of plates. Here, tapping to the shorter plates, gives higher (intense) sound than tapping to the longer plates. It is clear that the sound produced by tapping shorter plates is different to the sound produced by tapping longer plates. The frequency is changed by the change of the length of plates. As in the set of tuning forks, in the xylophone also, the frequency is highest in shortest plate and it is lowest in the longest plate.

Assignment 5.10

- Try to construct a xylophone and play it.
- Prepare a list of musical instruments that produce sound by vibrating bars or plates.
- Find and record how the sound is produced in them.

Figure 5.14

Assignment 5.11

- Construct various musical instruments with your class mates.
- Adjust the sound of those musical instruments well.
- Present a group display, using those musical instruments in your science or literary society.

Musical tones and noises

Figure 5.15 ▲ Instances where noises are produced

It is joyful to listen to playing guitar or violin or to listen to a song. Such sounds are pleasant to our ears. But the sounds coming from factories and vehicles are not pleasant. Such sounds are a nuisance to our ears.

Rhythmical sounds which are pleasant to our ears are musical tones. Such sounds are produced by methodical or formal vibrations of objects. Sounds which are unpleasant to our ears are called noises. They are produced by non formal vibrations of objects.

Even a musical tone may be unbearable to our ears, when the sound of which is very high. It depends on the relevant person.

High and noisy sounds may be harmful to ears. They disturb our day-to-day activities. It is our duty to use instruments that produce sounds without disturbing others.

Assignment 5.12

- List out some instances, where noises are produced.
- Mention the source of noise, infront of the instances you identified.
- Investigate and record the part of the source which vibrate to produce the noise.

Ancient, traditional and modern musical instruments

It is said that musical instruments had been used for the services in religious places in ancient Sri Lanka. Large drum ('daula'), double drum ('tammattama'), and trumpet are prominent among those instruments. From the ancient times, till today, those instruments are in use for the life activities of common folk, like devil dancing, chanting good will and religious worships.

Figure 5.16 ▲ Several ancient musical instruments

Low country drum, up country drum 'udekkiya', large drum ('daula'), double drum ('tammettama'), trumpet and "geta beraya" are main items in traditional musical instruments. These are used in cultural festivals.

Figure 5.17 ▲ Several traditinal musical instruments

Guitar is a very popular musical instrument among younger generation. It is used in local popular music as well as in North Indian "Ragadari " music.

There are instances in the modern world where ancient and traditional musical instruments are used along with instruments like electric organ, guitar and thabla.

Figure 5.18 ▲ Several modern musical instruments

Special importance of modern musical instruments is that a single person can fulfil the necessity of a full orchestra or a number of instruments by using a computer and a keyboard. Octopad is commonly used for rhythm playing and organ is used as a permanent keyboard instrument.

Assignment 5.13

- Collect information on ancient traditional and modern musical instruments and prepare a booklet.

Musical therapy

Music can be used to improve the quality of life. Music has an ability to heal the mental stress and give spiritual happiness to the people spending busy life. Thus, the treatment given using music is known as musical therapy.

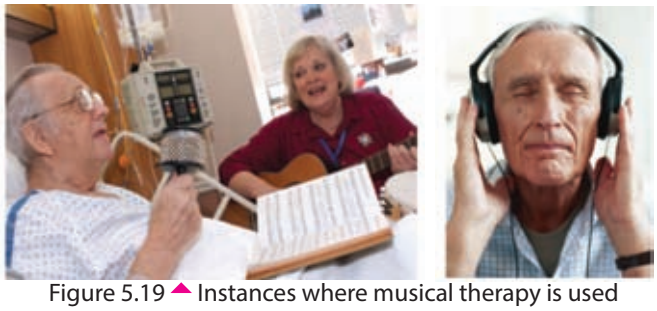


Figure 5.19 ▲ Instances where musical therapy is used

Musical therapy can be used as a method of treatment to improve physical fitness and mental integrity. It is discovered that diseases and disorders of brain and nervous system, heart failures, mental depression so on, can be cured by using this therapy.

So, training a person from his childhood to enjoy music will be helpful to develop a healthy mind.

For extra knowledge

Nowadays musical therapy is used in many countries of the world to coordinate muscle movements in sport activities like running and cycling to prepare patients for surgeries and as a healing method after surgeries.

Assignment 5.14

- Prepare a letter to a wall paper on musical therapy which can be used to develop the quality of life.

Limits of hearing

Can we hear a vibration of any frequency?

Let us do Activity 5.11 to find out about this.

Activity 5.11

You will need :- A long hacksaw blade, a G-clamp

Method :-

- Clamp the hacksaw blade to the table. Keep the free end of the blade longer. (Figure 5.20)
- Vibrate the blade and listen.
- Then reclamp the blade making its free end shorter.(Figure 5.21)
- Vibrate it again and listen.
- Discuss your observations with the teacher.

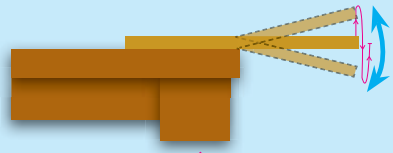


Figure 5.20

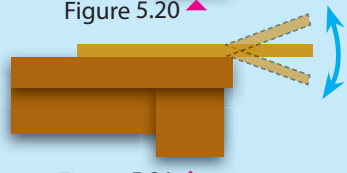


Figure 5.21

You may have experienced that no sound is heard though the longer blade is vibrating. The reason is that the human ear is not sensitive to the sound produced by the vibration of that blade.

We cannot hear the sound of any frequency. We can hear only the sound of a certain range of vibrations. That range we can hear is known as the **limits of hearing**.

The limits of hearing or the range of frequency of sound that human ear can hear is 20 Hz to 20 000 Hz. Man cannot hear the sounds of frequency which is less than 20 Hz or more than 20 000 Hz.

Dog can hear the sounds of the frequency which is less than 20 Hz or more than 20000Hz. Bat can hear the sounds of higher frequencies up to 70 000 Hz.

Summary

- Instruments that produce sound are called sources of sound.
- All natural and artificial sounds are produced by vibrations of strings/rods, membranes, bars or air columns.
- Number of vibrations of a sound source, produced in unit time is called the frequency.
- International (SI) unit of frequency is Hertz.

- Man cannot hear the sound of any frequency. There is a limited range of frequency of sound that man can hear.
- The limits of hearing of human is 20 Hz - 20 000 Hz.
- There are three categories of musical instruments, according to the part that vibrates when producing sound.
- Sound produced can be changed by adjusting the vibrating parts of musical instruments.
- Sound can be used to improve the quality of life.

Exercise

1. Select the appropriate words from those given in the brackets to fill in the blanks.

   II. Sound of high frequency can be obtained, when the wires of a violin are ..... (longer/ shorter).

   III. Sound of high frequency can be obtained, when the membrane of a drum is ..... (thinner/ thicker).

   IV. Human ear is ..... (sensitive/ not sensitive) to any range of sound.

   V. Vibrations of an object are ..... (regular/ irregular) when musical tones are produced.

2. Categorize the musical instruments given below, into three groups according to the way they produce sound.

   Double drum ('Tammattama'), 'Udekkiya', 'Horanewa', 'Sitar', 'Trumpet', 'Conch shell' ('Hak gediya'), 'Violin', 'Cello', 'Mandolin', 'Large drum' ('Daula')

3. If the statements given below are correct, put a (√) and if they are wrong put a (×) in the brackets.

IV. When the wires of a violin are tightly stretched, it gives a low tone. ( )

V. When the length of the vibrating air column is less, it gives a sound of low frequency. ( )

VI. Xylophone is an instrument that produces sound by vibrating bars. ( )

VII. Some mental depressions/conditions of patients can be cured by musical therapy. ( )

Technical Terms

Sources of sound	-	ධ්වනි ප්‍රභව	-	ஒலி முதல்
Vibration	-	කම්පනය	-	அதிர்வு
Artificial sounds	-	කෘත්‍රිම ශබ්ද	-	செயற்கை ஒலி
Natural sounds	-	ස්වාභාවික ශබ්ද	-	இயற்கை ஒலி
Adjusting	-	සීරුමාරු කිරීම	-	சுரத்தை மாற்றுதல்
Limitation of hearing	-	ශ්‍රව්‍යතා සීමාව	-	கேள்தகு எல்லை
Tuning fork	-	සරසුල	-	இசைக்கவை
Musical sounds	-	සංගීත නාද	-	சங்கீத ஒலி
Noises	-	ඝෝෂා	-	இரைச்சல்
Musical therapy	-	සංගීත චිකිත්සාව	-	இசைச் சிகிச்சை

6 Magnets

There are instances where magnets are used in our day-to-day life. Recalling what we have learnt about magnets in grade 6, let us do Activity 6.1 to identify materials that show magnetic properties.

Activity 6.1

You will need:- A permanent magnet, a piece of thread, a stand, various types of coins, an iron nail, a brass nail, a pebble, a plastic ruler, several other things that you like to test for magnetic properties.

Figure 6.1

Method:-

- Hang the magnet on the stand using the piece of thread as shown in Figure 6.1
- Bring each substance, one at a time, close to the magnet, when the magnet remains still. Enter the observations in Table 6.1

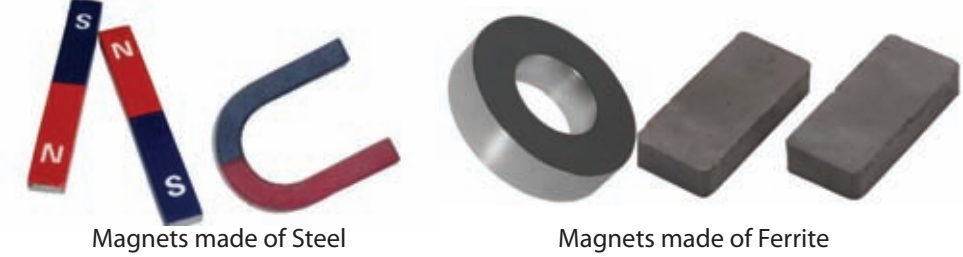
Table 6.1

Material	Attract / does not attract to the magnet
1. Plastic ruler	Does not attract.

It will be clear to you that only certain materials attract towards magnets. **Materials which attract towards magnets are known as magnetic materials.**

Metals such as iron, nickel, chromium and alloys like steel and ferrite are magnetic materials.

Alloy ferrite is used to make more powerful magnets.



Magnets made of Steel Magnets made of Ferrite

Figure 6.2 Magnets made of various materials

Magnetic property or magnetism is a property of some materials.

6.1 Poles of a magnet

Let us do Activity 6.2 to study further how magnetic power exists around a magnet.

Activity 6.2

You will need :- A bar magnet, iron filings, a thin polythene sheet or a polythene bag, a sheet of paper

Method:-

- Cover the bar magnet completely with the polythene bag.
- Heap iron filings on the sheet of paper.
- Dip the magnet on the heap of iron filings.
- Take the magnet out of the heap of iron filings and observe the pattern of iron filings attracted to the magnet.

Regions where iron filings are thickly attracted can be easily identified. Magnetic power is concentrated in these regions.

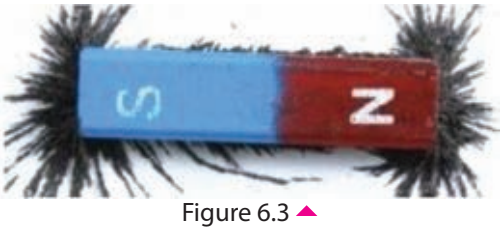


Figure 6.3

Regions of a magnet, where magnetic power is concentrated are called magnetic poles. There are two of them.

- North pole (N)
- South pole (S)

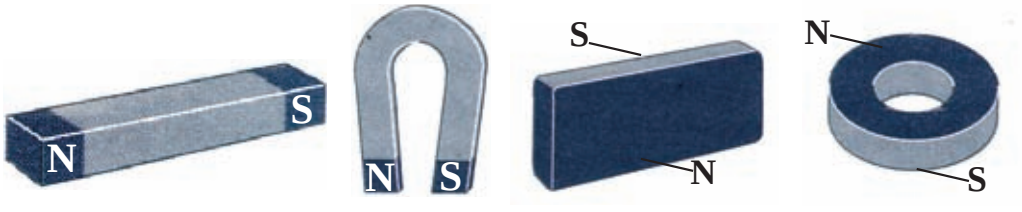


Figure 6.4 How poles are located in different types of magnets

Identifying magnetic poles

We have learnt earlier that north and south poles are marked in most of the magnets. Now, let us consider how the poles of a magnet can be identified when they are not marked.

Figure 6.5 ▲ Magnets with poles marked

Figure 6.6 ▲ A magnet on which poles are not marked

Let us do Activity 6.3 to study the methods of identifying the poles of a magnet.

Activity 6.3

You will need : - A magnet on which poles are not marked, a magnet on which poles are marked, a compass, a piece of thread, a stand, a piece of cork or a piece of styrofoam, a basin of water, two watch glasses

Method : -

- Let us find out various methods to identify the poles of a magnet using given materials. Following methods can be tried out for this.

Figure 6.7 ▲ Using a compass

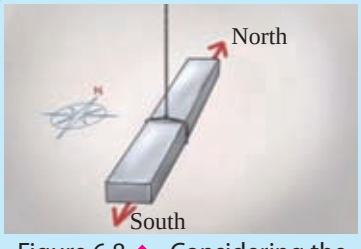


Figure 6.8 ▲ Considering the direction that a magnet turns, when it is hung by a thread.

Figure 6.9 ▲ Considering the direction, that magnet turns, when it is floated on water using a piece of cork or styrofoam.

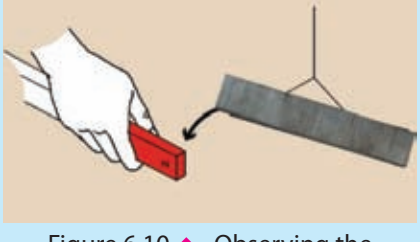


Figure 6.10 ▲ Observing the attraction or repulsion when a magnet with known poles is brought closer

Figure 6.11 ▲ Observing the direction that the magnet turns when it is kept on a watch glass and moved freely on another watch glass

Investigate whether there are methods, other than those mentioned, to identify the poles of a magnet.

6.2 Magnetic field of a magnet

Let us do Activity 6.4 to find out about the area that magnetic power is distributed around a magnet.

Activity 6.4

You will need : - A bar magnet, iron filings, a piece of cardboard

Method : -

- Spread a thin layer of iron filings on the sheet of cardboard.
- Gently place the sheet of cardboard on the bar magnet.
- Tap on the sheet of cardboard gently.
- Observe the pattern in which iron filings are arranged.
- Can you suggest the reason for the arrangement of iron filings on the sheet of cardboard, according to a pattern?

Let us do Activity 6.5 to study the magnetic field around a bar magnet.

Activity 6.5

You will need : - A bar magnet, iron filings, A test tube of the size to insert the magnet, a beaker of tall form, glycerine or coconut oil

Method : -

- Fill the beaker with glycerine or coconut oil mixed with iron filings.
- Insert the bar magnet into the test tube and dip it slowly in the beaker.
- Observe the pattern of iron filings arranged around the magnet.

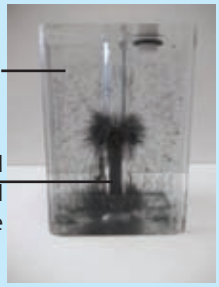


Figure 6.12 ▲ A bar magnet dipped in glycerine mixed with iron filings

It can be observed that iron filings are arranged in a pattern, within a certain area around the magnet.

Area that the magnetic power is spread around a magnet is called the magnetic field of that magnet.

Imaginary lines used to denote the magnetic power around a magnet are known as magnetic field lines.

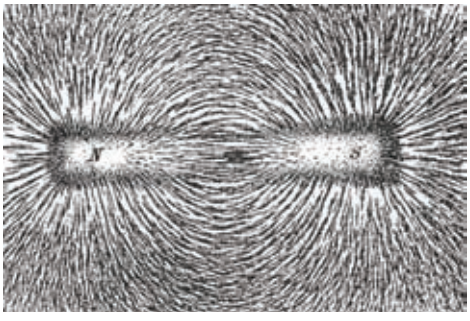


Figure 6.13 ▲ How iron filings are arranged around a bar magnet

Let us do Activity 6.6 to demonstrate the magnetic fields between magnetic poles.

Activity 6.6

You will need : - Two short bar magnets, a styrofoam board of A4 size, 4 pieces of cardboard of A4 size, binder gum, iron filings

Method : - • Carve two grooves in the styrofoam board.

- Insert two short bar magnets into the grooves, so that like poles are directed against each other, as shown in Figure 6.14.

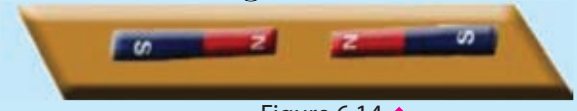


Figure 6.14 ▲

- Place one piece of cardboard on the styrofoam board.
- Spread a thin layer of iron filings on the cardboard.
- Tap gently to a corner of the cardboard sheet.
- Observe the pattern in which iron filings are arranged.
- Apply a layer of binder gum on another cardboard sheet and allow it to dry.
- Place the side of the cardboard applied with gum, on the pattern of iron filings and press gently.
- Take away the cardboard sheet applied with gum and observe. The pattern of magnetic field lines are imprinted on it.
- Now change the poles of one magnet so that the set-up is changed to demonstrate the magnetic field between unlike magnetic poles. (Figure 6.15)

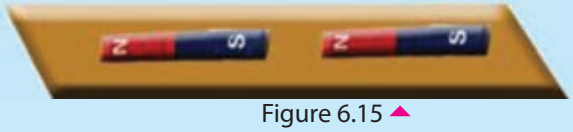
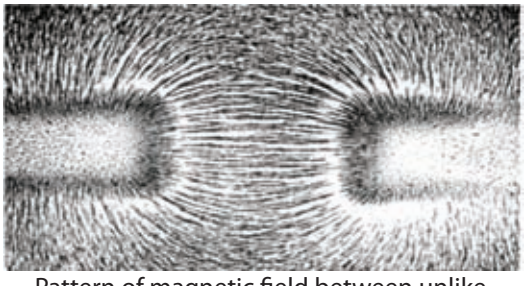


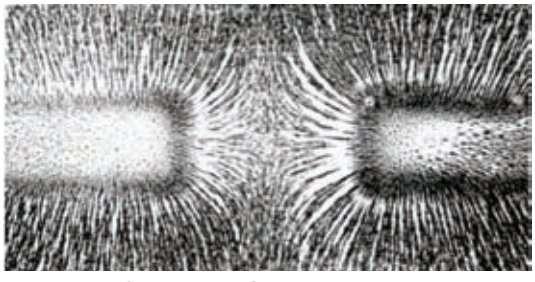
Figure 6.15 ▲

- Repeat the above steps and obtain the pattern of iron filings corresponding to the magnetic field between two unlike poles.
- Exhibit your creations in the classroom.

It may be clear to you that iron filings are arranged around a magnet along the patterns of magnetic field lines.



Pattern of magnetic field between unlike poles.



Pattern of magnetic field between like poles.

Figure 6.16 ▲ Pattern of magnetic field lines between magnetic poles

6.3 Compass

You may have heard that an instrument called compass is used to find the direction. Compass was invented by Chinese about thousand years ago. Today various types of compasses are in use. A compass is made from a magnetic needle (this is like a small magnet) which can freely float on a liquid or turn round on a pivoted point.

Figure 6.17 ▲ Types of compasses

Let us do Activity 6.7 to make a simple compass.

Activity 6.7

You will need : - A large needle, a cork bung, a small knife, a bar magnet, a plastic basin full of water, red paint.

Method : -

- Magnetize the needle by contact method using the bar magnet.
- Cut a thin slice of the cork bung and fix the needle on it. (Figure 6.17)
- Float the slice of cork, with the needle on the basin of water.
- Test whether the floating needle is always turned in the same direction.
- Colour the end of the needle, which always turns to the geographical north with red paint.
- What you have constructed is a simple compass.
- Modify your compass to make it more attractive.

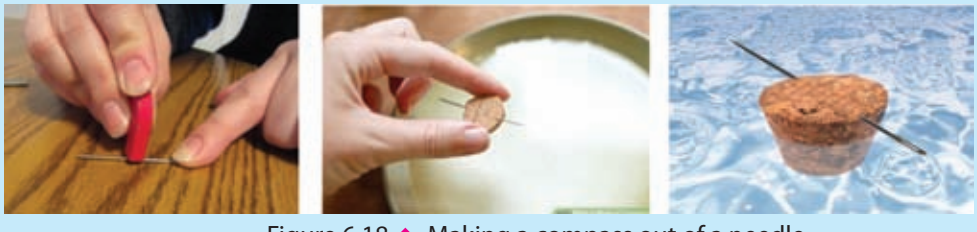


Figure 6.18 ▲ Making a compass out of a needle.

Figure 6.19 ▲ Several compasses constructed in various ways

When a compass is kept near a magnet, the needle turns along the direction of the magnetic field. Therefore, the magnetic field of a magnet can be identified, using a compass.

Let us do Activity 6.8 to identify the direction of magnatic field using a compass.

Activity 6.8

You will need : - A bar magnet, a compass, a sheet of white paper

Method : -

- Place the bar magnet on the sheet of white paper.
- Draw the outline of the magnet on the paper, using a pencil.
- Label the north and south poles of the magnet on the paper.
- Place the compass on the paper as shown in Figure 6.20 and mark the positions of the compass needle.
- If you are unable to find several compasses, you can use the same compass for each location.
- Try to build up the pattern of the magnetic field by connecting the positions of the compass needle.

Figure 6.20 ▲ Positions of a compass needle around a bar magnet at various locations

Magnetic field lines of a permanent magnet direct from North pole to South pole.

Hence, **the direction of magnetic field is from North pole to South pole.**

The Figure 6.21 illustrate the arrangement of magnetic field lines around a bar magnet.

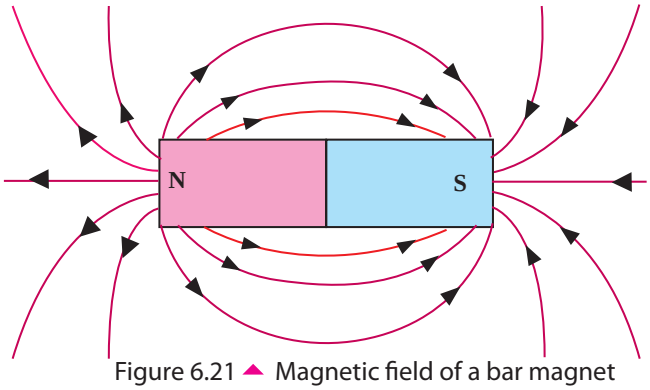


Figure 6.21 ▲ Magnetic field of a bar magnet

6.4 Geomagnetism

You know that north - south directions of the earth can be identified using a compass. When a compass is kept horizontally near the surface of the earth, its needle turns along the north-south direction.

Let us do Activity 6.9 to find the direction of the magnetic field of the earth.

Activity 6.9

You will need : - Two compasses, a bar magnet, a piece of thread, a stand

Method : -

- Hang one bar magnet horizontally on the stand, using the piece of thread.
- Keep the bar magnet, hung on the stand, and two compasses about two meters apart from each other.
- Take another bar magnet and bring one of its poles closer to each compass and to the magnet hung on the stand.
- Record your observations.
- Take away the bar magnet and observe the directions of the poles of compass needles and the bar magnet which is hung.
- Repeat the activity, changing the locations of compasses.
- Discuss the reasons for the observations in the classroom.

Figure 6.22 ▲

The compasses and the magnet which is hung turned when another magnet is brought closer to them. Thus it is clear that magnets and compasses turn, when they are under the influence of a magnetic field.

When bar magnets and compasses are free from the influence of other magnets, their north poles always turn to one direction and south poles to the opposite direction.

Though the position of bar magnets and compasses are changed, their poles turn to the same directions. The reason for this is the existence of a large magnetic field around the earth through north and south poles.

This magnetic field existing near the earth is known as geomagnetism.

Liquified metal currents circulate around the axis of the earth, because of the high temperature at the core of the earth. The magnetic field of the earth is the result of the electric currents thus generated.

When a compass or a magnet is kept freely near the earth, its north and south poles are directed along the magnetic field of the earth.

The direction that the north pole of a magnet or a compass, kept in that manner is known as the magnetic north of the earth.

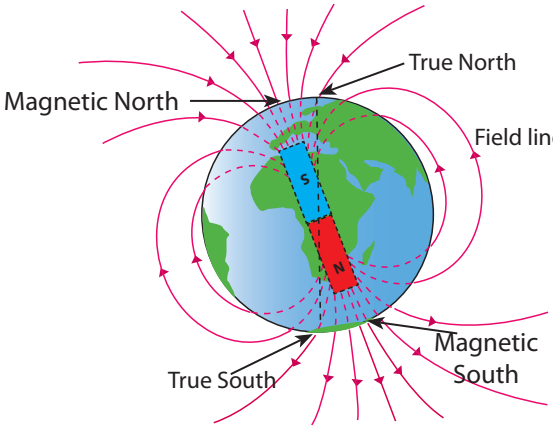


Figure 6.23 ▲ How earth's magnetic field is located

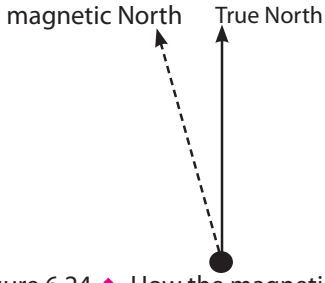


Figure 6.24 ▲ How the magnetic North and real North are denoted on a map

There is a little difference between the real north and the magnetic north of the earth. The magnetic north lies a few degrees north west from the real north.

6.5 Temporary magnets and permanent magnets

Two types of magnets can be identified when considering the uses of magnets.

- Permanent magnets
- Temporary magnets

Let us do Activity 6.10 to understand more about permanent magnents and temporary magnets.

Activity 6.10

You will need : - Iron nail or iron rod of about 2 inch length, two meters of insulated copper wire of 32 SWG, two dry cells, cellotape, a bar magnet, few file clips or pins, a switch

Method : -

- Wind the insulated copper wire of 32 SWG, around the iron nail or iron rod, to make a coil.
- Scrape both ends of the coil and connect it to the dry cells.
- Bring the coil close to the file clips while supplying electrcity and see what happens.
- Disconnect the electrical supply and bring the coil close to the clips, again
- Bring the bar magnet close to the clips and see what happens.
- Discuss your observations in the classroom.

Figure 6.25 ▲ File clips are attracted when electricity is supplied

Figure 6.26 ▲ File clips fall off (do not attract) when electrical supply is disconnected

Figure 6.27 ▲ File clips are attracted to a permanent magnet

A set-up that becomes a magnet, only when electricity is supplied is known as an **electromagnet.**

In an electromagnet, magnetic power remains only when electricity is supplied. Therefore, they are called **temporary magnets.**

Magnetic power remains for a long time in bar magnets. Therefore, they are called **permanent magnets.**

Making a permanent magnet

Magnets of various shapes and sizes are used for various purposes. Let us consider how these magnets are constructed.

Materials that show magnetic properties are used to make magnets. Steel, ferrite and soft iron are some magnetic materials which are used to make magnets. Various materials are used to produce various types of magnets.

Magnetic power is not retained in soft iron for a long time. Therefore, soft iron is used to make electromagnets and other temporary magnets.

Magnets, in which magnetic power is retained for a long time, are known as permanent magnets. Steel or ferrite is used to make permanent magnets. Ferrite is used to make more powerful permanent magnets.

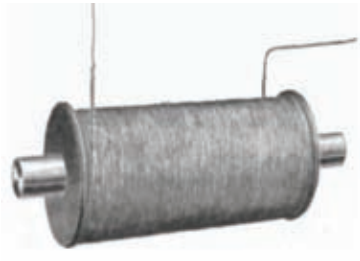


Figure 6.28 ▲ An electromagnet

Figure 6.29 ▲ Permanent magnets made of steel

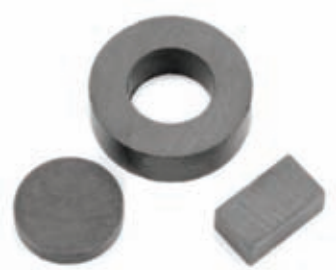


Figure 6.30 ▲ Permanent magnets made of ferrite

Construction of permanent magnets using magnetic materials can be done in two ways.

1. Electrical method
2. Contact method

Let us do Activities 6.11 and 6.12 to make magnets using electrical method and contact method.

Activity 6.11

You will need :- Iron nail or iron hacksaw blade of 2 inches, two meters of insulated copper wire of 32 SWG (Standard Wire Gauge), two dry cells, cellotape, a piece of cardboard, few file clips

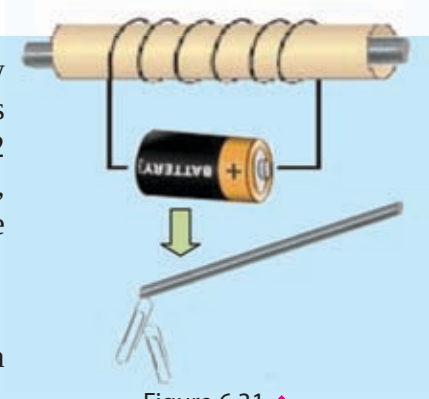


Figure 6.31 ▲

Method : -

- Make a 5 cm long tube (about the size of a pencil) using the piece of cardboard.
- Wind the copper wire of 32 SWG, around that tube to make a coil.
- Bring the iron nail close to the file clips to check whether it has magnetic power.
- Then insert the iron nail into the cardboard tube.
- Scrape both ends of the coil and connect it to the dry cell and supply the current several times to the circuit.
- Take the iron nail/ iron hacksaw blade away and observe while bringing it close to the file clips.
- Discuss your observations in the classroom.

The electric current should be supplied several times to the circuit for a long time until permanent magnetism is observed.

Activity 6.12

You will need : - A steel needle or steel hacksaw blade of two inches, a few file clips, a bar magnet

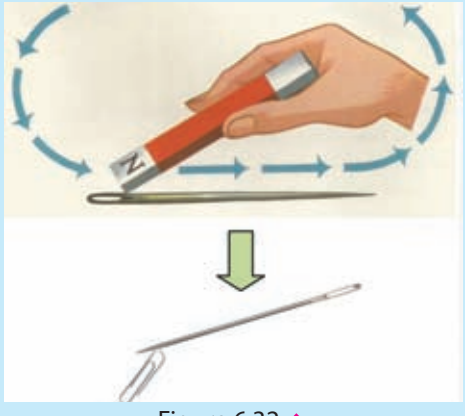


Figure 6.32

Method : -

- Bring the needle/hacksaw blade close to the file clips to check whether it has magnetic power.
- Now, place the needle horizontally on a table.
- Place one end of the bar magnet on the needle and drag it along the same direction as shown in Figure 6.32.
- Repeat this process several times.
- Now bring the needle/hacksaw blade close to the file clips and see what happens.
- Discuss your observations in the classroom.

It will be clear to you that a permanent magnet can be made using electrical method and contact method according to Activities 6.11 and 6.12.

Does the magnetic power of permanent magnets retain forever ? The answer is 'No'. The magnetic power of permanent magnets are lost due to various reasons. Some of the reasons are given below.

- Ageing
- Being subjected to high temperatures
- Being subjected to strong magnetic fields
- Being subjected to vibrations

Let us do Activity 6.13 to test how magnetic power is lost.

Rubbing should be continued for a longtime until permanent magnetism is observed.

Activity 6.13

You will need : - Three identical iron nails magnetized by a permanent magnet, a few pins, a bunsen burner, a hammer, a pair of crucible tongs, a strong permanent magnet

Method : -

- Bring the pins close to each magnetized iron nail, separately, and note down the maximum number of pins attracted to each nail.
- Subject each nail to each of the following treatments.
  - (a) Vibrate by hammering.
  - (b) Heat to a high temperature.
  - (c) Move to and from close to the strong magnet.
- Bring the pins close to each nail again and count the number of pins attracted to each nail. Fill Table 6.2.

Figure 6.33 ▲ Heating strongly

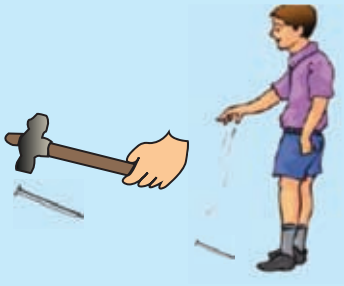


Figure 6.34 ▲ Subjected to vibrations

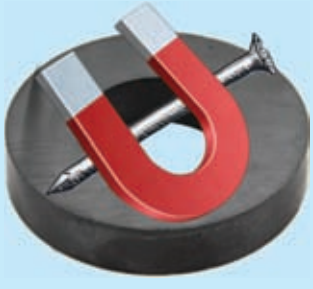


Figure 6.35 ▲ Subjected to strong magnetic fields

Table 6.2

Action done	Number of pins attracted before action	Number of pins attracted after action
Hammering		
Heating		
Subjecting to strong magnetic fields		

It may be clear to you that magnetic power fades off because of vibrations, temperature and being subjected to strong magnetic fields. Magnetic power also fades due to ageing. Magnets should be stored in an orderly manner without being subjected to vibrations, temperature and strong magnetic fields to maintain magnetic power for a long time.

Storage of permanent magnets

Magnetic power of a permanent magnet can be protected for a long time, if it is stored in such a way that its magnetic field does not scatter.

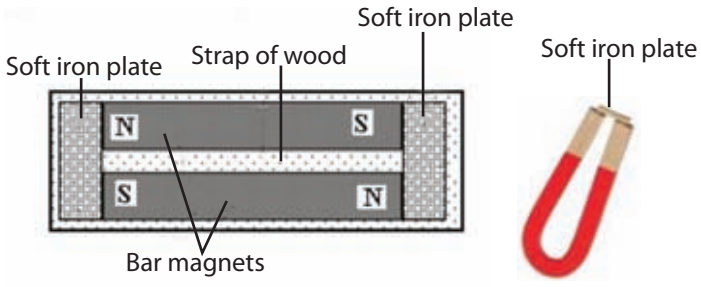


Figure 6.36 ▲ How magnets are stored

Use of permanent magnets

There are various equipments found in day-to-day life, where permanent magnets are used.

Assignment 6.1

List out instances where permanent magnets are used.

Check whether permanent magnets are used in the following instances.

In loud speakers and speakers

In small electric motors

In some door locks

Bags

In some toys

In compasses

In pencil boxes

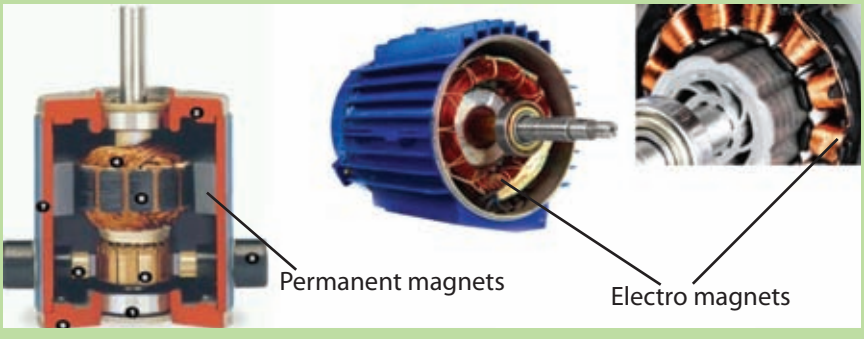
Stickers on refrigerators

Phone covers

Figure 6.37 ▲ Some applications of permanent magnets

For extra knowledge

There are permanent magnets as well as electro-magnets found in most of the small electric motors. But there are some motors only with electro-magnets.



Summary

- Magnetism is a property of some materials.
- Materials which attract to magnets are magnetic materials.
- Iron, nickel, chromium, steel and ferrite are some examples for magnetic materials.
- The area that the magnetic force exists around a magnet is called the magnetic field.
- Imaginary lines used to denote the influence of magnetic field are known as magnetic field lines.
- The direction of magnetic field is from the north pole to the south pole.
- A compass is important to detect magnetic fields.

- Terminals of a magnet, where magnetic force is concentrated are called magnetic poles.
- There is a magnetic field on the earth. It is known as geomagnetism. When a compass is placed near the earth the direction that its pointer indicates is the direction of earth's magnetic field.
- The direction indicated by the compass is the magnetic north. It lies a little north-western to the real north.
- Permanent magnets are made of steel and ferrite, and temporary magnets are made of soft iron.
- Contact method and electrical method are used to make permanent magnets.
- Power of a magnet may wear off with time, because of high temperature, strong vibrations and the influence of strong magnetic fields.
- Power of a magnet can be retained for a long time by proper storage.
- Permanent magnets and electromagnets are widely used in day-to-day life.

Exercise

1. Select the appropriate words from the brackets and fill in the blanks of the paragraph given below.

(Soft iron, magnetic materials, magnetic poles, magnetic field lines, ferrite, magnetic field).

Materials that show magnetic properties are called ..... . The best material to make permanent magnets is ..... . To make temporary magnets, ... is commonly used. The area in which magnetic forces exist is called ..... . Influence of a magnetic field can be observed using ..... . The area on a magnet, where the magnetic forces are concentrated is known as the ..... .

2. Given below is a rough sketch of a pencil box that closes with the help of a magnet. Suggest a method to test whether the magnet is fixed on the box or on the lid.

3. A student who checked some magnets in the school laboratory found out that their magnetic force is worn out. Give three reasons for that.

4. Explain scientific reasons for the following.

(a) North pole of a bar magnet, hung freely by a thread is directed towards north.

(b) A piece of iron is attracted towards a magnet, but a piece of copper is not.

5. An iron rod, placed on a table was contacted several times with a bar magnet. Then, it was observed that pins and small pieces of wire are attracted to the iron rod.

(a) Give reasons for the above incident.

(b) What is the term used for the above process?

(c) Suggest another method to get the same result without using a permanent magnet.

Technical Terms

Magnet	-	චුම්බක	-	காந்தம்
Permanent magnet	-	ස්ථිර චුම්බක	-	நிலையான காந்தம்
Magnetic field	-	චුම්බක ක්ෂේත්‍රය	-	காந்தப்புலம்
Geomagnetism	-	භූ චුම්බකත්වය	-	புவிக்காந்தவியல்
Compass	-	මාලිමාව	-	திசைகாட்டி
Electromagnet	-	විද්‍යුත් චුම්බක	-	மின்காந்தம்
Magnetic pole	-	චුම්බක ධ්‍රැව	-	காந்தமுனைவு
Magnetic materials	-	චුම්බක ද්‍රව්‍ය	-	காந்தத்திரவியம்
Steel	-	වානේ	-	உருக்கு
Ferrite	-	ෆෙරයිට්	-	பெரைற்று
Soft iron	-	මෘදු යකඩ	-	மென்னிரும்பு
North pole	-	උත්තර ධ්‍රැවය	-	வடமுனைவு
South pole	-	දක්ෂිණ ධ්‍රැවය	-	தென்முனைவு

7 Measurements Associated with Electricity

Electricity is one of the main sources of energy used in day-to-day life. Recalling what we have studied about electricity in lower grades let us do Activity 7.1.

Activity 7.1

You will need:- Two dry cells, a torch bulb, a switch, a bulb holder, connecting wires

Method:-

- Prepare a circuit to light the torch bulb using the given items.
- Switch on your set-up and observe what happens.
- Draw the set-up you prepared using circuit symbols.
- Mention the positive and negative terminals of the cells correctly on the diagram you draw.

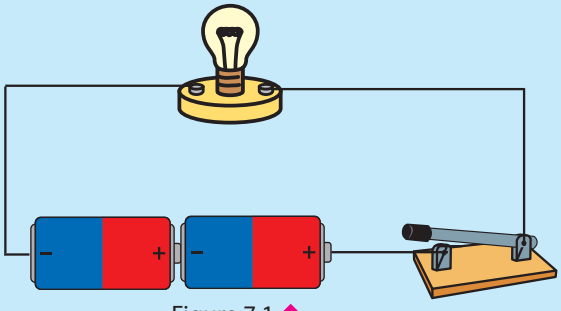


Figure 7.1

- Discuss the reason for the illumination of bulb.

The electric current produced in the cells when the switch is closed flows through the conductors of the circuit. The bulb is illuminated because current flows through it.

Flow of electrical charges through a closed circuit is known as an electric current.

7.1 Electric current

Let us do Activity 7.2 to study the flow of electric current through a conductor.

Activity 7.2

You will need:- Two dry cells, a switch, a small motor, connecting wires

Method:-

- Prepare the circuit as shown in Figure 7.2
- Connect the parts as indicated in Table 7.1 and switch on the circuit.
- Record your observations.

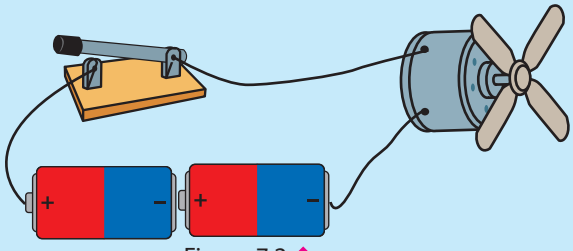


Figure 7.2

Table 7.1

Step	Observations	Observations after changing the terminals of cells
1. Connect the electric motor	It rotates to one direction	.....

- What happens when terminals of cells are changed ?
- What can be concluded according to your observations ?

The direction of the current flow, changes when the terminals of the cells are changed. The reason for the change of rotational direction of the motor is the change of the direction of current.

- There is a definite direction for the flow of electric current.
- Conventionally, it is considered that current flows from the positive terminal to the negative terminal.

A center-zero galvanometer or a center-zero ammeter/ milliammeter can be used to identify the direction of an electric current.

Figure 7.3 A galvanometer

Figure 7.4 A milliammeter

Let us do Activity 7.3 to study further about the direction of current.

Activity 7.3

You will need:- An ammeter or center-zero milliammeter, an electric motor, a dry cell, a switch

Method:-

- Prepare the circuit as in Figure 7.5.
- Operate the circuit and observe what happens.
- Interchange the terminals of the cell and observe again.
- Draw diagrams for each instance and mark the direction of the current flow.
- Discuss the reason for your observations.

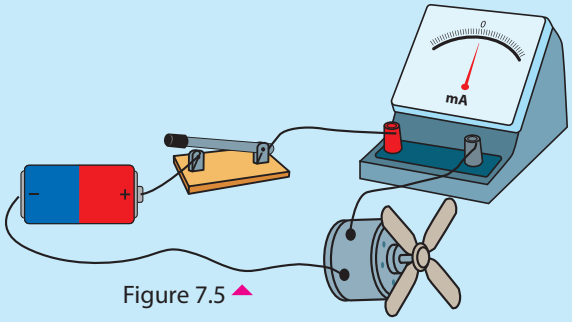


Figure 7.5

It is clear that, when changing the connecting terminals to the battery, the direction of motion of ammeter-indicator and the rotational direction of the motor are changed. The reason for this is the change of the direction of current.

Measuring the electric current

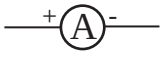
Physical quantities are measured in various instances. For this purpose various measuring equipment and various units are used. Electric current is also a physical quantity. Let us investigate how electric current is measured.

Symbol for electric current - I
International unit (SI) for electric current - Ampere
Symbol - A

Sub units are used to measure small currents. Two such sub units are given below.

- Milliampere - mA
- Microampere - μA

1000 mA - 1 A
1000 μA - 1 mA

Equipment used to measure current - Ammeter
Symbol - 

Milliammeter or microammeter can be used to measure small electric currents.

There are two terminals, positive and negative, in ammeter and milliammeter. Usually the positive terminal is red and negative terminal is black.

- When an ammeter is used in a circuit the terminals should be connected correctly.
- To measure the current, ammeter or milliammeter is connected **in series** to the circuit.

Figure 7.6 ▲ Ammeter

Figure 7.7 ▲ Milliammeter

Let us do Activity 7.4 to measure the current flowing through a circuit.

Activity 7.4

You will need:- Two dry cells, six torch bulbs, bulb holders, connecting wires, switches, an ammeter, a milliammeter

Method:-

- Prepare the circuit as in Figure 7.8.
- Connect the milliammeter to the circuit.
- Measure the current flowing through the bulb while it is illuminating.
- Draw the circuit, to which the milliammeter is connected, using symbols.
- Connect the ammeter instead of the milliammeter and take the readings again.
- Connection of which instrument makes it easier to take the readings ? Is it ammeter or milliammeter ?
- Discuss the reason for your answer in the classroom.

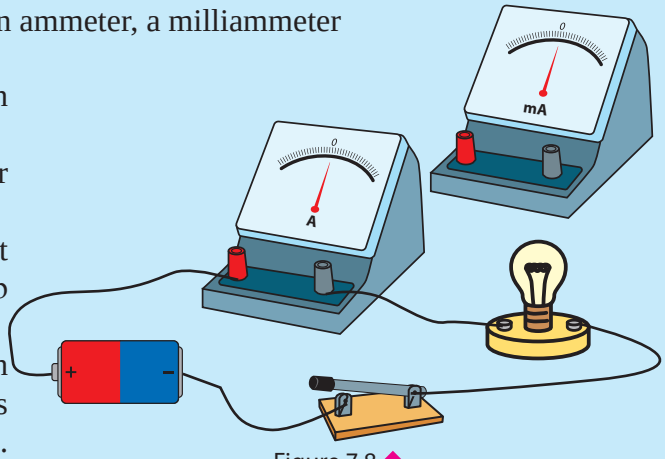


Figure 7.8 ▲

The electric current flow through the above circuit is lesser than one amphere (1A). Therefore, it is suitable to use miliammeter to measure small currents. Ammeter is suitable to measure large currents, while milliammeter is suitable to measure small currents.

Let us consider another factor, essential for flowing of electric current through a conductor.

7.2 Potential difference

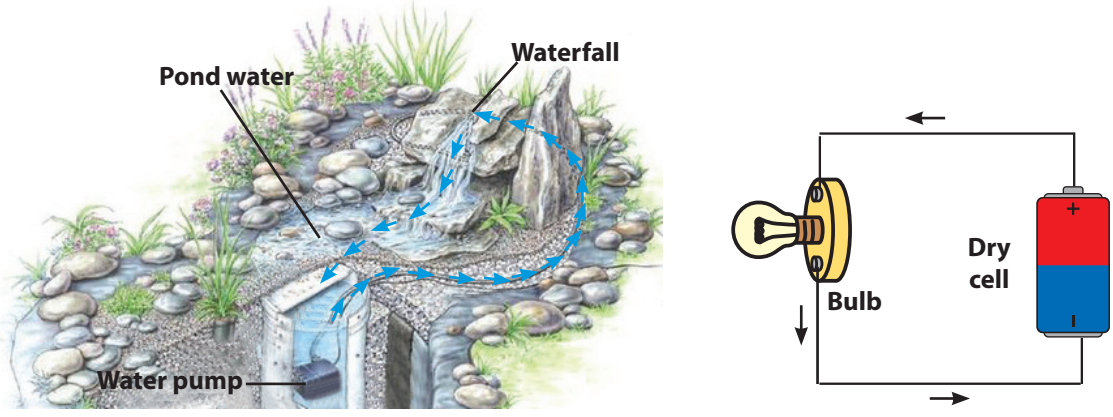


Figure 7.9

You may have seen ponds and waterfalls designed in modern houses, which function with the help of water pump. Pond water has less potential energy. But when water is pumped up to the waterfall more potential energy is stored.

The process of electric circuit takes place in the same manner. Dry cell provides electric potential energy to electric chargers. Positive (+) terminal has higher potential than the negative (-) terminal.

This difference of electric potential energy between the two terminals of the cell is called voltage or potential difference.

Electic current flows from a higher electric potential to a lower electric potential.

The voltage between positive terminal and negative terminal of electric cells and batteries is marked on them.

Assignment 7.1

- Collect as many as possible electric cells and batteries used commonly.
- Observe how the positive and negative terminals and the voltage values are marked on them.
- Prepare a table of the cells you collected and their voltages.

Figure 7.10 ▲ How voltage is marked on some cells

Measuring the potential difference

Symbol for potential difference	-	V
International unit (SI) for potential difference	-	Volt
Symbol	-	V
Equipment used to measure potential difference	-	Voltmeter
Symbol of voltmeter	-	+V-

There are positive and negative terminals in voltmeter as well as in ammeter. Usually, positive terminal is red and negative terminal is black.

Voltmeter is connected parallelly to the circuit to measure the potential difference between two points.

Figure 7.11 ▲ Voltmeter

Let us do Activity 7.5 to identify the voltages of some cells and batteries which are commonly used.

Activity 7.5

You will need:- Several dry cells, a button cell, a voltmeter, connecting wires

Method:-

- Observe how the voltages are marked on the cells and batteries you collected.
- Connect the cells or batteries to the circuit you made as shown in Figure 7.12
- Measure the voltage between the terminals of the cells or batteries using the voltmeter.
- Compare the values obtained by measuring and the values mentioned.
- Tabulate your observations.

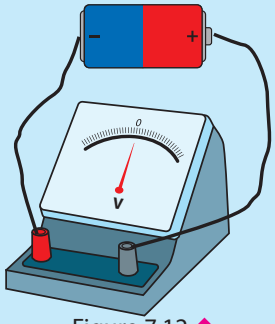


Figure 7.12

Table 7.2

Cell/ Battery	Voltage (V)
Dry cell	
Lead acid accumulator	
Button cell	

The voltage of a normal dry cell is 1.5 V. The voltage between the terminals of a car battery containing six cells is 12 V.

Let us do Activity 7.6 to measure the potential difference between two points of a circuit, using a voltmeter.

Activity 7.6

You will need:- Two dry cells, a torch bulb, a bulb holder, a small electrical motor, a voltmeter, connecting wires, a switch

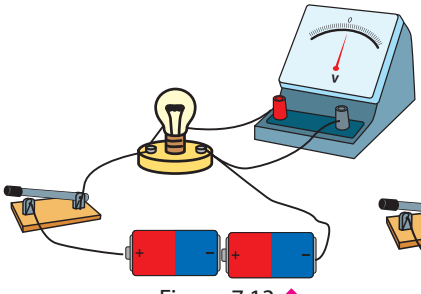


Figure 7.13

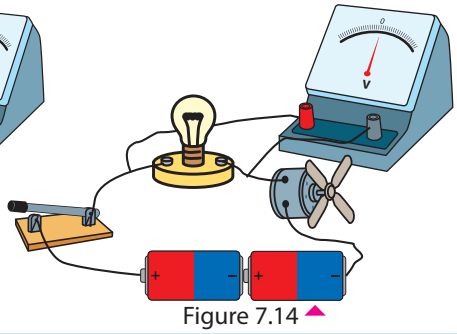


Figure 7.14

Method:-

(A)

- Build a circuit to light the bulb, using the bulb, two dry cells, and a switch.
- Connect the voltmeter correctly to measure the potential difference between the two ends of the bulb.
- Measure and record the potential difference between two ends of the bulb
- Draw the diagram of the circuit you built using symbols.

(B)

- Remove the bulb and connect the electrical motor to the circuit.
- Switch on the circuit and measure the potential difference between the terminals of the motor.

(C)

- Connect both, the bulb and the motor to the circuit as shown in Figure 7.14
- Measure separately the potential difference between the terminals of the bulb and the motor, using the voltmeter.

Now you have the ability of measuring the potential difference between two points of a given electrical circuit.

There are instances, in day-to-day life where accurate measurements of current and voltage have to be taken. Some such instances are given below.

1. To make sure, voltages, supplied to houses and factories are of the accurate voltage.
2. To detect defects of electrical appliances by measuring the current they consume.
3. To take measurements associated with electricity in power houses and electrical generators.
4. To identify whether the parts of electrical appliances are functioning properly when repairing.

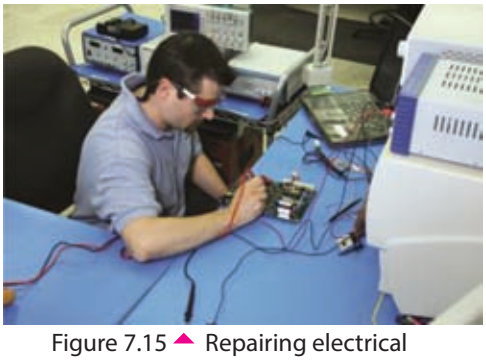


Figure 7.15 ▲ Repairing electrical appliances

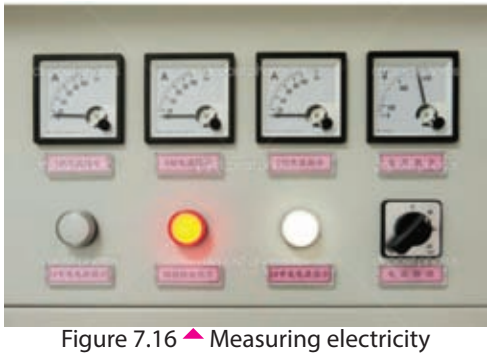


Figure 7.16 ▲ Measuring electricity in power houses and electrical generators

For extra knowledge

Very sensitive voltmeters and ammeters, assembled using digital technology, are in use currently. They are very high in sensitivity. Reading has been given on the board digitally. Therefore it is easy to use.

Modern voltmeters and ammeters assembled using digital technology

7.3 Resistance of a conductor

We have already observed that a current flows when a potential difference is applied to the ends of a conductor. Let us find out further, whether there are any other factors affecting the flow of current through a conductor.

Activity 7.7

You will need:- Two dry cells, an ammeter, a torch bulb, a bulb holder, a switch, three wires of iron, nichrome and copper of the same length (about 50 cm) and same diameter

Method:-

- Prepare a circuit as shown in the figure.
- Connect each piece of wire, separately to A and B terminals and switch on the circuit.
- Record the observations in Table 7.3
- Discuss the reasons for your observations in the classroom.

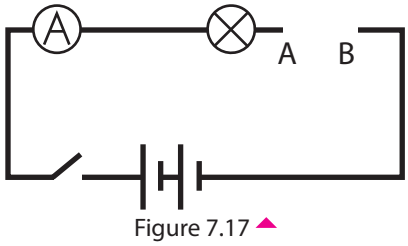


Figure 7.17

Table 7.3

Type of wire	Nature of illumination of the bulb	Ammeter reading (Ampere)
1. Copper	Illuminate brightly	.....
2. Iron	.....	.....
3. Nichrome	.....	.....

The reason for the difference in illumination of the bulb is because of the current flowing through the circuit changes depending on the type of conductor used.

- Electric current flowing through a conductor depends on the material that it is made of.
- The reason is that the obstacle for flowing of electric current is different from conductor to conductor.

The obstacle caused by a conductor to the flowing of current through it is called the resistance of that conductor.

Symbol used to denote resistance - R

Unit of measuring resistance - Ohm (Ω)

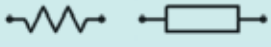
When the resistance of a conductor increases the current flowing through it decreases.

For your attention

- Resistance is a very useful factor to control the current flowing through a conductor.
- Current flowing through a conductor can be controlled by changing its resistance.
- Components called resistors, produced to various values of resistance are connected to circuits to control the current flow.
- Mostly the value of a conductor is mentioned on it according to a colour code system.

Electrical parts that possess the property called resistance are known as resistors. Some of those components are given in Figure 7.18.

Figure 7.18 ▲ Various types of resistors

Symbols for resistors 

Now you may understand that the current flowing through a circuit can be reduced by connecting resistors to increase resistance of the circuit.

Summary

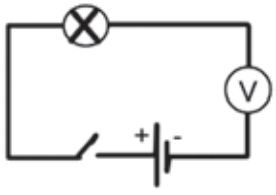
- The flow of electrical charges through a conductor is known as an electric current.
- Unit of measuring current is Ampere. The equipment used for that is ammeter.
- Ammeter should be connected in series to the circuit. The terminals also should be connected correctly.
- There should be a potential difference between two points of a circuits, for the flow of current.
- Potential difference between the two terminals of an electric source is known as its voltage.
- Unit of measuring potential difference is Volt and the equipment used is voltmeter.
- To measure the potential difference across a part of a circuit the voltmeter should be connected in parallel to it.
- Obstruction of electric current flow through a conductor is known as its resistance.
- Unit of measuring resistance is Ohm.
- Resistors of various values can be used to change the current flowing through a circuit.

Exercise

1) Complete the following paragraph using suitable terms for the blanks.

Electric current is a flow of ..... through a closed circuit. Always electric current flows from a high ..... to a ..... electric potential. ..... terminal is the place of a cell, where electric potential is high and ..... terminal is the place where it is low.

2) Figure below shows a set-up prepared by a student to measure the potential difference between two ends of a bulb.



1. Is the circuit suitable for the purpose?
2. Give reasons for your answer.
3. If there is any defect, correct it and draw the circuit again.
4. Mention two facts, that should be considered when connecting a voltmeter to a circuit.

3) Given below is a circuit prepared by a student to rotate a cardboard disc using an electric motor.
To decrease the rotational speed of this motor;

1. What property of the circuit should be increased?
2. Suggest a method to do it.

4) List out three instances in day-to-day life where measuring voltage and current is important.

Technical Terms

Electric current	-	විද්‍යුත් ධාරාව	-	மின்னோட்டம்
Electricity	-	විද්‍යුතය	-	மின்சாரம்
Electric potential	-	විද්‍යුත් විභවය	-	மின் அழுத்தம்
Voltage	-	වෝල්ටීයතාවය	-	வோல்ற்றளவு
Resistance	-	ප්‍රතිරෝධය	-	தடை
Resistor	-	ප්‍රතිරෝධක	-	தடையி
Circuit	-	පරිපථය	-	சுற்று
Conductor	-	සන්නායකය	-	கடத்தி
Voltmeter	-	වෝල්ට්මීටරය	-	வோல்ற்றுமானி
Switch	-	ස්විචය	-	ஆளி

8 Changes in Matter

8.1 Physical changes and chemical changes

Tear a paper into small pieces. Burn another piece of paper.

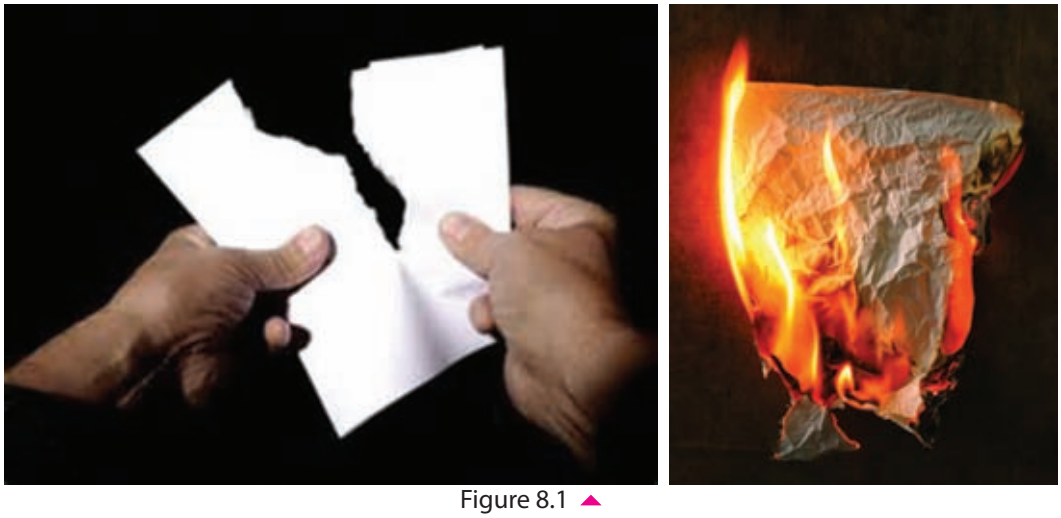


Figure 8.1

Can you explain the difference between these two changes?

Though the paper is torn into pieces, it is still a paper. So, when tearing a paper its composition is not subjected to any change. Something which is not a paper cannot be formed by tearing the **paper**. Therefore, such changes are known as **physical changes**.

Changes in which the composition of matter does not change, even though its nature of existence changes, are called physical changes.

However, when the paper is burnt, ash and smoke are formed. There the composition of the paper changed and new substances are formed. Such changes are known as **chemical changes**.

Changes in which the composition of matter forming new substances are known as chemical changes.

Let us engage in Activity 8.1 to study the nature of physical changes.

Activity 8.1

You will need:- A beaker, water, salt, tripod, spirit lamp/ bunsen burner

Method:-

- Take 250 ml beaker and add about 50 ml of water into it.
- Add about one teaspoon of powdered salt into it and dissolve thoroughly.
- Keep a wire gauge on a tripod and place the beaker on it.
- Heat the beaker using the spirit lamp/bunsun burner until water is completely vapourised.
- Record your observations.

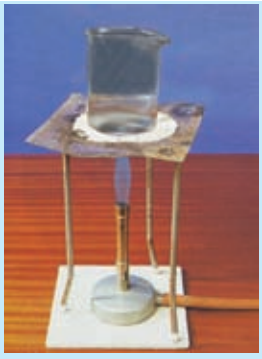


Figure 8.2

A residue can be seen at the bottom of the beaker. That residue is the salt that was previously dissolved in water. From this it is clear that the change happening during the dissolving of salt in water is a physical change.

Let us do Activity 8.2 to investigate the nature of chemical changes.

Activity 8.2

You will need:- A magnesium ribbon, a candle or a spirit lamp

Method:-

- Take a magnesium ribbon and clean it well.
- Burn it by holding to the flame.
- Record your observations.

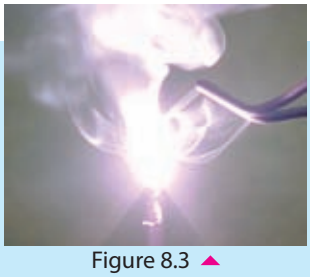


Figure 8.3

Before burning, the magnesium ribbon had a metallic lustre.
When held to the flame, it burnt with a bright flame leaving a white powder. Here, the composition of magnesium has changed and a new substance has formed. Therefore, burning of the magnesium ribbon is a chemical change.

Like this, the changes we experience in our day-to-day life can be divided into two types, physical changes and chemical changes. Engage in Assignment 8.1 to reinforce your knowledge in this regard.

Assignment 8.1

Classify the following changes as physical changes and chemical changes.

- Melting of solid wax
- Vapourisation of water
- Rusting of iron
- Melting of ice
- Breaking granite into pieces
- Burning camphor
- Burning firewood
- Lighting a cracker

8.2 Changes of state as physical changes

Let us do Activity 8.3 to gain an understanding about the changes of state.

Activity 8.3

You will need:- A beaker, a tin lid, a bunsen burner, a glass plate, a tripod, a wire gauge, a crucible, a glass funnel, boiling tubes, surgical spirit, water, a piece of wax, naphthalene, iodine

Method:-

Do the activities as indicated in Table 8.1 and record relevant observations.

Table 8.1

Activity	Observation
1. Place the piece of wax in a boiling tube and heat. Observe. Allow to cool and observe again.	
2. Put some pieces of ice into a beaker and heat. Observe. Continue heating even after the piece of ice completely turns into water. Make your observations. Hold the plate of glass over the beaker when water boils. (Do as a teacher demonstration)	
3. Put a few pieces of iodine into a crucible and heat. Hold an inverted funnel a little above the crucible.	

You would have observed that the wax melted when it was heated in a boiling tube. You would have also observed that liquid wax turns into solid when it is allowed to cool. When a solid substance is heated, it turns into the liquid state at a certain temperature. The transition of a substance from the solid state to the liquid is called **melting** or **fusion**. Transition of a substance from the liquid state to solid state is called **freezing**.

You would have observed that ice turns into water. Ice is a substance that exists in the solid state. Water is a liquid. The conversion of a substance from the solid state to liquid state is also a change of state and it is known as fusion. When that water is heated further water vapourises. The change of a liquid into a gas is known as **vapourisation**. When water boils, formation of droplets of water on the glass plate can be observed. These droplets were formed by the cooling of steam. The conversion of a substance that exists in the gaseous state into liquid state is called **condensation**.

When crystals of iodine were heated in a crucible, you would have seen that iodine turned directly into a gas. When that iodine gas was brought into contact with a glass surface, crystals of iodine can be seen on the surface from this, it is clear that

when iodine vapour cools it directly turns into solid iodine without becoming a liquid. The turning of a solid into vapour without passing through the liquid state is also a change of state. It is known as **sublimation**.

During a change of state no new substances are formed by changing the composition. Therefore, the changes of state are physical changes.

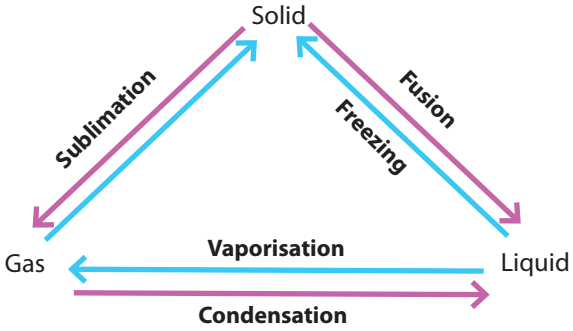


Figure 8.4

8.3 Chemical changes

So far we have discussed about the nature of physical changes. When a physical change occurs, a change in the composition of the substances does not occur.

But when chemical changes occur, new substances are formed.

Let us do Activity 8.4, 8.5, 8.6 and 8.7 to study the nature of chemical changes further.

Activity 8.4

You will need:- Lead nitrate, a boiling tube, a bunsen burner

Method:-

- Take about 1g of lead nitrate to a boiling tube.
- Heat the boiling tube using the bunsen burner.
- Record your observations.

When white lead nitrate is heated a brown coloured gas is evolved leaving a red coloured powder in the boiling tube. Since, the composition of lead nitrate has changed this is a chemical change.

Activity 8.5

You will need:- Copper sulphate, an iron nail, a boiling tube, a thermometer

Method:-

- Add water and copper sulphate crystals to the boiling tube and prepare a light blue solution.
- Put the cleaned iron nail into it.
- Record your observations.

When a cleaned iron nail is placed in a copper sulphate solution you would observe that the blue colour of the solution decreases, a reddish brown subtance deposits on the nail and at the bottom while the temperature rises.

Activity 8.6

You will need:- A solution of copper sulphate, a solution of sodium hydroxide, two test tubes

Method:-

- Mix the copper sulphate solution with the sodium hydroxide solution.
- Record your observations

When the copper sulphate solution is added to the sodium hydroxide solution, a formation of a light blue solid can be observed. Such solids are called precipitates.

Activity 8.7

You will need:- Dilute hydrochloric acid, a zinc granule, a boiling tube

Method:-

- Add a little dilute hydrochloric acid to the boiling tube.
- Add the piece of zinc into it.
- Record your observations.

When a granule of zinc is added into hydrochloric acid, we see that zinc dissolves and a gas is liberated.

Pay your attention to the above activities. In all of them new substances are formed. You already know that in chemical changes new substances are formed. In the above activities, identify the observations which testify the formation of new substances and complete Table 8.2.

Table 8.2

Reaction	Observations in support of the formation of new substances
1. Heating lead nitrate	Formation of a red powder Evolution of a brown coloured gas
2. Putting an iron nail into a copper sulphate solution	
3. Adding copper sulphate solution to sodium hydroxide solution	
4. Adding a zinc granule to hydrochloric acid	

Based on the observations made with regard to the chemical reactions stated in this chapter before, some of the following can be given as evidences in support of the fact that a chemical reaction has taken place in the above activities.

- Evolution of gases
- Change in colour
- Change in temperature (exchange of heat)
- Formation of precipitates
- Production of sound/light
- Production of an odour

The formation of a new substance having a different composition or several new substances by one or more substances undergoing change is known as a chemical change or a chemical reaction.

Recall the burning of magnesium again. Magnesium is a metal with a silvery lustre. Upon heating, it combines with oxygen in the air and forms a white powder. That powder is known as magnesium oxide.

The substances that get subjected to change during a chemical reaction are called reactants.

Hence, the reactants of the above reaction are magnesium and oxygen.

The new substances formed by a chemical reactions are referred to as products.

The product of this reaction is magnesium oxide. This reaction can be shown in the form of a word equation as follows.

Magnesium + Oxygen ⟶ Magnesium oxide

Hence, in a chemical reaction, reactants turn into products.

Rusting of iron, tarnishing of metals, combustion of materials, decay of organic matter, ripening of fruits, blast of a cracker and digestion of food by enzymes are some chemical reactions taking place every day.

Law of conservation of mass

What kind of a change do you think will happen to the total mass of the substances that are subjected to the chemical changes or chemical reactions you have identified? To inquire into this let us do following activities.

Activity 8.8

You will need:- Iron wool, two identical iron wires, a horizontal rod

Method:-

- Take two equal masses of iron wool and lump them loosely
- Using the two iron wires tie them to the horizontal rod as shown in Figure 8.5.
- Suspend the rod on a support to balance it horizontally. Light one lump of iron wool.
- Record your observations.

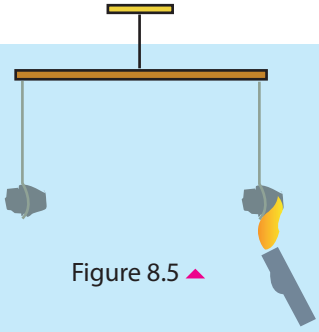


Figure 8.5

Iron wool burns giving reddish sparks. At the same time the side with burnt wool moves down. From this we can infer that when iron wool turns into the products of combustion, the mass increases.

Activity 8.9

You will need:- A few heads of matches, a boiling tube

Method:-

- Put a few heads of matches to a boiling tube. Weigh the boiling tube with them.
- Heat the boiling tube strongly with an open flame until the match heads catch fire.
- After cooling, weigh the boiling tube with its contents.
- Record your observations.

Here, you will be able to observe that the mass after the reaction is lower than the mass before the reaction.

Here, you may have the problem why there was an increase in the mass when iron wool was burnt in Activity 8.8 while a decrease in mass was shown when the match heads were burnt in Activity 8.9. In the above experiments, the substances were burnt in open environments. Therefore, when those substances react there is a chance to combine with some substances in the environment and also to release the products of combustion to the environment. An increase in mass occured due to addition of some substances. A decrease in mass was noticed due to the loss of some substances to the environment.

- **Open systems** - The systems in which the substances can exchange between the system and the surroundings are referred to as open systems.
- **Closed systems**- The systems in which the substances cannot exchange between the system and the environment are called closed systems.

Therefore, to find out whether a change occurs in the total mass of substances taking part in a chemical reaction, the experiment should be conducted in a closed system in which substances are neither gained from nor lost to the surrounding. Let us engage in Activity 8.10 and Activity 8.11 which have been designed after taking these facts into consideration.

Activity 8.10

You will need:- A few matches, a boiling tube, a rubber balloon

Method:-

- Let us now conduct Acitvity 8.9 in a closed system.
- As shown in Figure 8.6, close the mouth of the boiling tube containing matches with a balloon. Measure its mass.
- Apply heat close to the bottom of the tube until the matches light up.
- Allow the boiling tube to cool and weigh again.

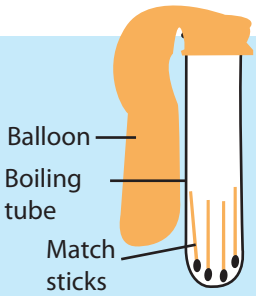


Figure 8.6

When the matches burn, the balloon get inflated gradually.

During the reaction the products are not lost. Also it is seen that there is no change in the total mass before and after the reaction.

Activity 8.11

You will need:- A conical flask, lead nitrate 1 g, water 20 ml, sodium chloride 1 g, a boiling tube

Method:-

- Take about 1g of lead nitrate to a conical flask and dissolve in about 20 ml of water.
- Take about 1g of sodium chloride to a test tube, dissolve it in about 5ml of water and transfer this solution to an ignition tube.
- Tie the ignition tube with sodium chloride solution with a string and suspend it inside the conical flask containing the lead nitrate solution with the help of a stopper as shown in Figure 8.7.

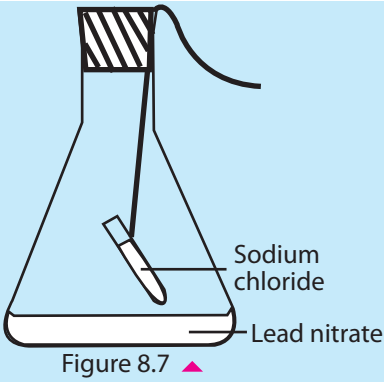


Figure 8.7

- Seal the conical flask by applying vaseline around the stopper. Weigh the flask with its contents.
- Slant the apparatus slowly and let the two solutions mix. Record your observations.
- Weigh the apparatus again and note the mass.

Formation of a white precipitate on mixing the two solutions indicates the occurrence of a chemical reaction in the apparatus. The result of the experiments also shows that there is no change in the total mass before and after the reaction.

The french scientist Antoine Lavoisier (1743 - 1794) who conducted many experiments such as the above in relation to various chemical reactions showed for the first time that the total mass of the substances taking part in a chemical reaction (reactants) is equal to the total mass of the products obtained after the reaction. Later this finding came to be known as the **Law of conservation of mass**.

Law of conservation of mass

During chemical reactions the total mass does not change. That means the mass is conserved.

8.4 Combustion

When magnesium burns in air, magnesium reacts with oxygen in the air forming magnesium oxide.

Oxygen gas in air is essential for combustion. Oxygen is the gas in air that supports combustion. There are substances which can be burnt and which cannot be burnt. The substances that can be burnt are known as combustible substances. The substances that cannot be burnt are non-combustible substances.

- **combustible** substances: e.g. :- camphor, wax, sulphur, sugur, lacquer, paper, tar, flour, petrol, kerosene
- **non-combustible** substances: e.g. :- asbestos, glass, sand, rock

Combustion is the reaction of a combustible substance with a gas which acts as a supporter of combustion. **The special feature of the reaction of combustion is that it is a chemical change which takes place releasing thermal energy and light energy.**

A combustible substance has to be heated to a certain temperature for combustion (to start to reacting with oxygen gas). This temperature changes from substance to substance. **The temperature at which a combustible substance begins combustion in the air is called its ignition temperature (ignition point).**

Let us do Activity 8.12 to compare the ignition temperatures of several combustible substances.

Activity 8.12

You will need:- A tin lid, a stand, a match, a piece of paper, cotton wool, magnesium ribbon, sugar, a piece of sulphur

Method:-

- Fix the tin lid to the stand.
- Place the above substances on the tin lid.
- Keep the Bunsen burner underneath the tin lid and heat.
- Observe the sequence in which the combustible substances placed on the tin lid ignite and note it down.

The substances which ignite early have low ignition temperature.

A combustible substance starts to burn after it gets heated to its ignition point.

Thus, three main factor essential for combustion can be identified. They are;

- Presence of a combustible substance
- Having access to a supporter of combustion (Oxygen).
- Heating the combustible substance to its ignition temperature.

Fire triangle

Pay your attention to a fire broken out by accident. The fire should be extinguished to prevent damage. If a fire is to be extinguished the factors causing fire should be removed from the fire. The following figure which shows the relationship among the factors required to create a fire is known as the fire triangle. Examine it well.

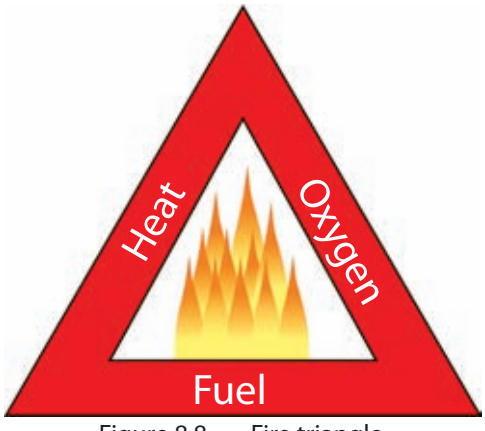


Figure 8.8 ▲ Fire triangle

To extinguish a fire it is required to prevent the access of the supporter of combustion to the fire, prevent reaching the ignition temperature (i.e.prevent receiving heat) and remove the combustible substance.

The method we use to extinguish a fire mostly is throwing water over the burning material. In addition to this covering the burning substance with sand and wet gunnies is also done.

- When water is sprayed over the fire it is extinguished. This is because when water vaporises absorbing heat from the burning material, temperature of under falls below the ignition temperature.
- When somebodys, clothes catch fire, the most suitable method to extinguish it is to roll on the ground. This helps break the connection between air, the supporter of combustion, and the material that has caught fire. When the clothes are on fire you should never run. During running more and more oxygen is supplied to the fire, so it spreads faster.

The same method cannot be used to extinguish all fires. The nature of the fire should be identified and then the appropriate method should be selected.

Fuels

Fuels are substances used to generate heat energy and light energy by combustion.

- Examples for solid fuels :- Firewood, coconut husks, coconut shells, wax
- Examples for liquid fuels :- Kerosine, petrol, diesel, coconut oil
- Examples for gaseous fuels :- Liquid petrolium gas (LP gas), coal gas, methane (bio gas)

Almost every fuel contains the elements carbon and hydrogen.

Let us carry out Activity 8.13 to identify the products formed during the combustion of fuels.

Activity 8.13

You will need:- A candle, a boiling tube, a bottle, a funnel, lime water, copper sulphate

Method:-

- Arrange the apparatus as shown in Figure 8.9. Connect the boiling tube/bottle with lime water to the aspirator. Light the candle and operate the aspirator. When the aspirator works an air current is drawn through the apparatus from the funnel to the boiling tube.

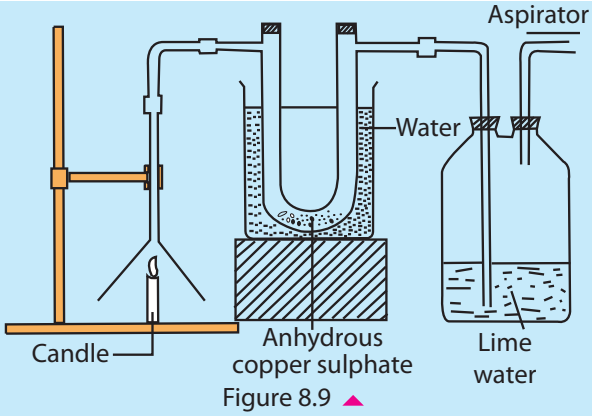


Figure 8.9

U tube contains anhydrous copper sulphate (white). The boiling tube/bottle contains colourless lime water. When the candle is lit and the aspirator is set to work you will observe that white anhydrous copper sulphate turns blue. Also, it can be seen that the lime water turns milky.

White anhydrous copper sulphate turns blue because of the water (water vapour) drawn into the U tube. Lime water turns milky due to carbon dioxide gas.

This activity indicates that when a candle burns, water and carbon dioxide gas are produced. Thus, in the combustion of fuels water and carbon dioxide gas are produced as the products.

Complete combustion and incomplete combustion of fuels

Complete combustion occurs when an adequate oxygen gas (supporter of combustion) is supplied for combustion. You know that fuels contain the elements carbon and hydrogen. On complete combustion carbon gives carbon dioxide and hydrogen gives water. More heat is produced by complete combustion.

The combustion occurring in an inadequate supply of oxygen is called incomplete combustion. In this carbon monoxide and unburnt carbon particles are also produced in addition to carbon dioxide and water. In incomplete combustion, the quantity of heat produced by the flame is relatively low.

Candle flame

When a candle is lit, solid wax turns into liquid wax. Liquid wax moves up through the wick and vapourises. This wax vapour, reacts with oxygen and produces heat and light giving rise to the flame of the candle.

Observe the candle flame well. It has three clearly visible zones.

The inner zone is the non-luminous zone. It contains wax vapour. Its temperature is low relatively to that of the other zones. Outer to the non-luminous zone is the luminous zone. The unburnt carbon particles present in that zone becomes incandescent emitting a yellow light. The temperature in this zone is greater than that of the non-luminous zone. Outer to the luminous zone is another zone which appears in blue colour at the base of the flame but is hardly visible in other areas. This is known as the outer zone (invisible zone) and has the highest temperature.

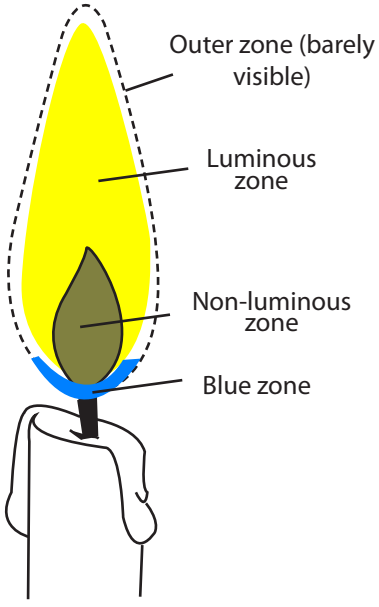


Figure 8.10 ▲ Candle flame

Bunsen flame

The colour of the bunsen flame changes with the amount of oxygen gas supplied for combustion. When the oxygen supply decreases the flame turns yellow and when the flame receives enough oxygen it turns blue. By observing the blue flame well, several zones of it can be identified.

At the centre of it is the non-luminous zone consisting of unburnt gas. Outer to the non-luminous zone lies a dark blue zone and a light blue zone respectively. The outerpart is the invisible zone. In the invisible zone complete combustion occurs.

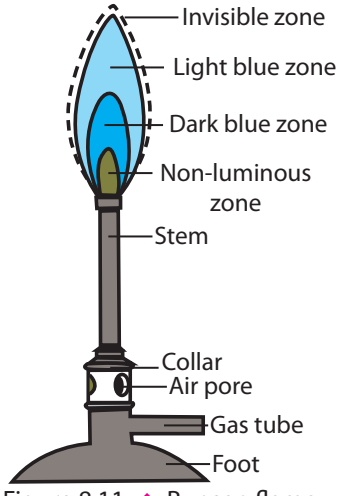


Figure 8.11 ▲ Bunsen flame

8.5 Tarnishing of metals

You have learnt that having a shiny surface is a property of metals. When metals are exposed to air for a long period, that lustre disappears. The change in surface of metals like this is called tarnishing. Almost every metal tarnishes.

A substance called rust is formed on the surface of iron due to tarnishing. This is reddish brown in colour and is called iron rust. This process is called rusting of iron. Due to tarnishing and rusting the surfaces of metals corrode. This is called corrosion of metals. Tarnishing of metals and rusting of iron are chemical changes.

Rusting of iron

Let us do Activity 8.14 and Activity 8.15 to investigate the factors essential for rusting of iron.

Activity 8.14

You will need:- Three test tubes, cleaned iron nails, coconut oil

Method:-

- Take some water into a test tube and heat to boiling. Put a cleaned iron nail into it and cover the water surface with a layer of oil (setup A). Oil layer is placed to prevent the dissolving of air when water cools.

- Take equal volumes of cold water to two other test tubes and put a cleaned iron nail into each. Put an oil layer to one of them (set-up B).
- Leave the other test tube as it is (set-up C).
- After a few days observe the setups.
- Record your observations.

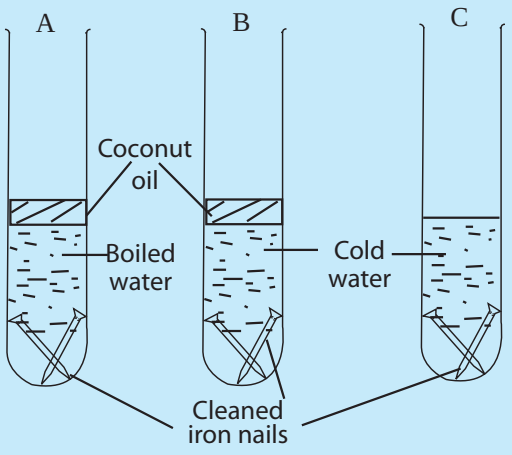


Figure 8.12

The nail in test tube A does not rust. As it contains boiled water all the air dissolved in it has been expelled. Putting a layer of coconut oil on water has prevented the dissolving of air when water cools.

Test tube B contains cold water. Therefore, its water contains air. Because there is air dissolved in water the nail in it rusts.

The nail in the test tube C is open to the outer environment. As it receives air from outside rusting occurs. Hence it can be concluded that air is essential for rusting.

Activity 8.15

You will need:- A boiling tube, two cleaned iron nails, cork stopper, calcium chloride crystals, wax, coconut oil

Method:-

- Clean the two iron nails with sand paper.
- Fix them to the cork stopper as shown in the Figure 8.13.
- Add calcium chloride crystals to the boiling tube and fix the stopper with the iron nails to it.
- Make the tube air tight with wax.
- Observe this setup for several days.
- Record your observations.

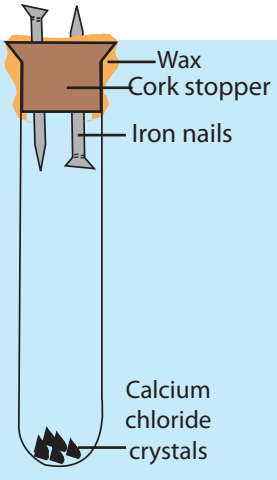


Figure 8.13

After a few days it can be seen that the parts of the nails outside the boiling tube have rusted while the parts inside the tube remain without rusting.

Calcium chloride crystals absorb moisture in the air in the boiling tube. Placing wax around the stopper makes the tube air tight and prevents the entry of moisture in air into the tube. As the air inside the tube is free from moisture, the parts of nails inside the tube do not rust.

What is expected by driving the two nails into the cork in opposite directions is to ensure that the pointed tip or the flat head of nails have no effect on rusting.

Activity 8.16

You will need:- A beaker, two test tubes, iron filings, cotton wool

Method:-

- Take two test tubes. In one of them (A) trap some moist cotton wool. In the other tube (B), trap a similar plug of moist cotton wool with some iron filings on it.
- Take some water into a beaker and dip the two inverted test tubes A and B in water as shown in Figure 8.14.
- Observe this setup a few days.
- Record the observations.

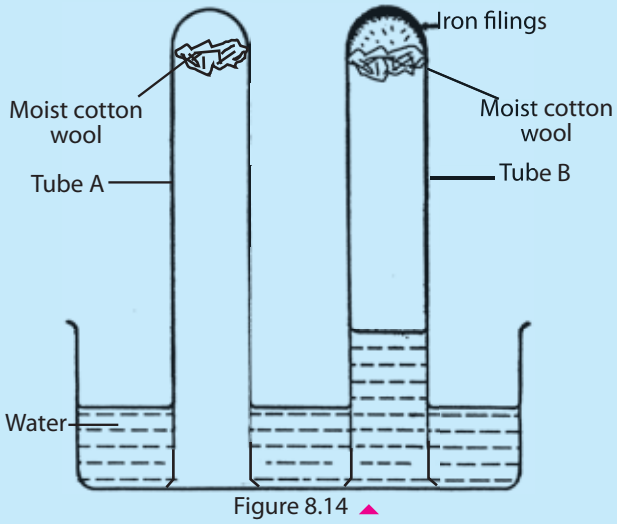


Figure 8.14

It can be seen that iron filings in tube B have undergone rusting while water has risen up to about one fifth of its height.

The percentage of oxygen in air by volume is 21%. That is, nearly 1/5 th of air in a given space is oxygen. If oxygen gas is used up for rusting, 1/5 th of the volume of air contained in space where rusting occurs should have been spent.

For the rusting of iron filings in tube B, oxygen gas in the air in that tube is used up. As 1/5 th of the volume of air is oxygen the water level rises to 1/5 th the height of the test tube. From this it is clear that oxygen gas is consumed during rusting.

These activities prove us that oxygen and water vapour/water in air are essential for the rusting of iron.

Protection of iron from rusting

Iron objects rust only when they are able to come in contact with air and water.

Figure 8.15 ▲ A galvanised bucket

Figure 8.16 ▲ A Painted gate

You would have seen that paints are applied on objects made of iron such as grills, gates and bridges. Application of paint is a frequently used method to prevent rusting of iron. It prevents iron from coming into contact with air and water. Grease is also applied in machinery made from iron to prevent rusting.

You have heard about the galvanized iron items. During galvanizing, zinc metal is applied on objects made of iron. Iron in galvanized items does not rust even if their zinc coat is scratched exposing some of their points to air. Therefore, galvanizing is a very good protective method. Items such as buckets, roofing sheets and iron nails are protected by galvanizing.

Application of tin metal is also another method used to protect iron from rusting. The containers of sealed food such as sardine and milk powder, though commonly called 'tins' are vessels made of iron. In them tin is present only as a coating. However, when scratched tin coated vessels rust very fast.

8.6 Neutralisation

Recall what you have learnt in grade 7 about acids, bases and neutral substances. Let us do Activity 8.17 to revise facts about them.

Activity 8.17

You will need:- Test tubes, red litmus, blue litmus, pH papers, hydrochloric acid, sodium hydroxide solution, sodium chloride (salt) solution, phenolphthalein

Method:-

- Take hydrochloric acid solution, sodium hydroxide solution and sodium chloride (salt) solution separately into three test tubes.
- Test these three solutions with red litmus papers.
- Test these three solutions with blue litmus papers.
- Test these three solutions with pH papers.
- Add two drops of phenolphthalein to these solutions.
- Record your observations.

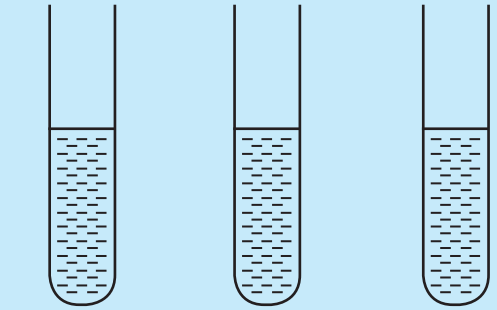


Figure 8.17

- A Solution A turns the blue litmus paper into red. Solution A does not change the colour of red litmus.When examined with a piece of pH paper, a value less than 7 is obtained. On addition of phenolphthalein it stays colourless.
- Solution B does not change the colour of blue litmus. It turns red litmus into blue. When tested by a pH paper the pH value is greater than 7. The solution gives a pink colour with phenolphthalein.
- Solution C does not change the colour of blue litmus or red litmus. The colour it gives with the pH paper corresponds to 7. It does not show a colour change with phenolphthalein.

From the above observations it can be identified that solution A is acidic, B is basic and C is neutral.

Investigating what type of a change occurs when an acid is added to a base

You might have heard that milk of magnesia liquid is given to relieve the acidity in stomach. Milk of magnesia is a basic substance. What is the reason for giving a basic substance like this to minimize the affect of an acidic substance? Let us conduct Activity 8.18 to look into this.

Activity 8.18

You will need:- A beaker, a dropping pipette, dilute sodium hydroxide solution, dilute hydrochloric acid, phenolphthalein

Method:-

- Pour dilute sodium hydroxide solution to a beaker. Add a few drops of phenolphthalein into it. Then add dilute hydrochloric acid dropwise into it using a dropping pipette and observe the colour change in the solution.
- When the acid is added the pink colour of the solution gradually decreases and at a certain moment the solution becomes colourless. This indicates that when an acid is added to a base, the basic property of the base gradually disappears.

a - Sodium hydroxide solution with a few drops of phenolphthalein

b - Nutralised to some extent due to the addition of acid

c - Totally neutralised solution

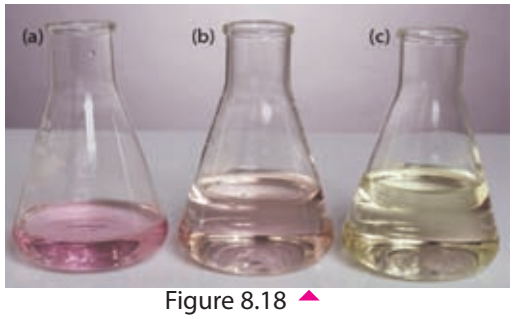


Figure 8.18

When an acid is added to a base or base is added to an acid, their acidic and basic properties decrease and at a certain point acidic and basic properties totally disappear. This process is called neutralisation. You know that sodium hydroxide is a base and hydrochloric acid is an acid. When these two react sodium chloride and water are formed which are neutral substances.

Sodium hydroxide + Hydrochloric acid ⟶ Sodium chloride + Water

This reaction between an acid and a base is a chemical reaction. It is referred to as a neutralisation reaction.

Let us now explore about some instances in which we happen to meet acid-base neutralisation in day-to-day life.

When acidity in the stomach increases milk of magnesia is administered. Milk of magnesia means the base magnesium hydroxide. This base neutralises the excess hydrochloric acid in the stomach.

The pain caused by bee stings disappear on application of lime. When bees sting, acidic substances are introduced into the skin. Lime is a base. It neutralises the acid. That is why the pain subsides.

The wasp sting is basic. Therefore, when an acidic substance such as vinegar or lemon juice is applied, the poison gets neutralised relieving the pain.

Lime is applied to acidic soils. Lime which is a base neutralises acids in the soil.

Figure 8.19

Summary

- The changes takes place in matter is of two types, physical changes and chemical changes.
- In the case of physical changes the existing nature of matter changes, though its composition remains unchanged.
- The changes in which the composition of matter changes giving rise to new substances are known as chemical changes.
- Rusting of iron, corrosion of metals, combustion nutralisation are examples for chemical changes.
- Changes of state such as fusion, vapourisation, sublimation, condensation and freezing are physical changes.
- Heat change, evolution of a gas, formation of a precipitate, colour change and change in temperature provide evidence for the occurrence of a chemical reaction.
- The substances take part in a reaction are reactants and the substances formed during a reaction are products.
- During chemical reactions, the total mass does not change. That means, the mass of the reactants that took part in the reaction is equal to the mass of the products formed after the reaction.
- The reaction of combustible substances with oxygen is called combustion.
- When many fuels are subjected to complete combustion, carbon dioxide and water are formed.
- During incomplete combustion unburnt carbon and carbon monoxide are also formed in addition to carbon dioxide and water.
- The quality of heat generated during complete combustion is relatively higher than that generated during incomplete combustion.

- Water/water vapour and oxygen are essential for the rusting of iron.
- Rusting can be prevented by methods such as applying paint, galvanizing and applying grease.
- When an acid reacts with a base, the acidic properties of the acid and the basic properties of the base disappear.
- The chemical reactions between acids and bases are called neutralisation reactions.

Exercises

01) Select the correct or best suitable answer for the following questions.

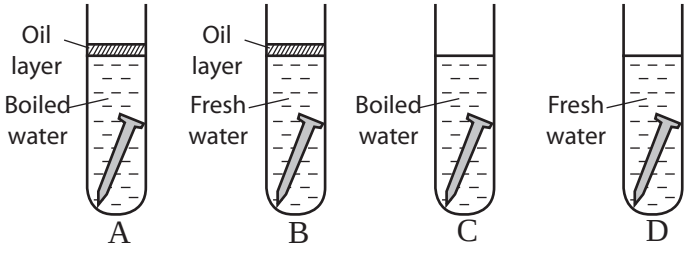
01. Which of the following is **not** a chemical change?

1. Condensation of steam
2. Burning of magnesium
3. Rusting of iron
4. Tarnishing of metals

02. Which of the following statement is **false**?

1. Combustion is a chemical reaction.
2. Oxygen is essential for the rusting of iron.
3. Complete combustion gives rise to a yellow flame.
4. It is necessary to heat something to its ignition temperature to burn.

03. The nail in which test tube does **not** rust after few days ?



04. Which of the following is **not** observed when a piece of zinc is placed in a copper sulphate solution?

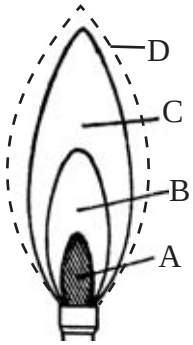
1. Gradual dissolution of the piece of zinc.
2. Deposition of a reddish brown substance around the piece of Zinc.
3. Slight heating of the solution.
4. Blue colour of the solution remain same.

05. Which of the following does **not** undergo a chemical change on heating?

A-Sulphur B-Magnesium C-Iron

1. Only A 2. Only A and B 3.Only B and C 4. A, B and C

02. The diagram shows a bunsen flame.



a. Name A, B, C and D zones.

b. In which zone complete burning occurs?

c. What is the fuel that burns in a bunsen burner?

03. Milk of magnesia is prescribed as a remedy for the discomfort caused by increasing acidity of stomach.

a. Is milk of magnesia acidic or basic?

b. How do you name the reaction between milk of magnesia and an acid?

04.Give short descriptions for the following phenomena.

1. Slaked lime is added to avoid acidic nature in soil.
2. Iron is protected from rusting by application of paint.
3. You should never run,when your clothes are on fire.

Technical Terms

Physical changes	-	භෞතික විපර්යාස	-	பௌதிக மாற்றங்கள்
Chemical changes	-	රසායනික විපර්යාස	-	இரசாயன மாற்றங்கள்
Tarnishing	-	මලින වීම	-	மங்குதல்
Melting	-	ද්‍රව වීම	-	உருகுதல்
Vapourisation	-	වාෂ්පීකරණය	-	ஆவியாதல்
Sublimation	-	ඌර්ධ්වපාතනය	-	பதங்கமாதல்
Condensation	-	ඝනීභවනය	-	ஒடுங்கல்
Freezing	-	හිමායනය	-	உறைதல்
Combustion	-	දහනය	-	தகனம்
Corossion	-	විඛාදනය	-	அரிப்பு
Rusting	-	මළකඩ කෑම	-	துருப்பிடித்தல்
Neutralisation	-	උදාසීනීකරණය	-	நடுநிலையாக்கம்
Open system	-	විවෘත පද්ධතිය	-	திறந்த தொகுதி
Closed system	-	සංවෘත පද්ධති	-	மூடிய தொகுதி
Reactants	-	ප්‍රතික්‍රියක	-	தாக்கிகள்
Products	-	ඵල	-	விளைவுகள்
Law of conservation of mass	-	ස්කන්ධ සංස්ථිති නියමය	-	திணிவு காப்புவிதி