BASIC SCIENCE

Standard

VIII

Part I

Government of Kerala
Department of Education
2009

THE NATIONAL ANTHEM

Jana Gana Mana Adhinayaka Jaya He

Bharatha Bhagya Vidhata

Punjab Sindhu Gujarata Maratha

Dravida Utkala Banga

Vindhya Himachala Yamuna Ganga

Uchala Jaladhi Taranga

Tava Subha Name Jage

Tava Subha Ashisa Mage,

Gahe Tava Jaya Gatha

Jana Gana Mangala Dayaka Jaya He

Bharatha Bhagya Vidhata

Jaya He Jaya He Jaya He

Jaya Jaya Jaya Jaya He.

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Dear students

We have already identified how to make learning an enjoyable experience by observing and analysing the changes happening around us. Learning is a continuous process and the textbook is one of its many instruments. You should utilise all items in the textbook for the construction of knowledge.

The knowledge you construct through thinking, collecting data and sharing your experiences with friends lead the learning process forward. A number of questions will arise in your mind during the process of knowledge construction. You may not get answers for all of them. It is you yourself who should formulate ways for finding the answers to such questions. Your textbook and your teacher will help you in this attempt.

Learning becomes enjoyable when learning activities become effortless. Many such possibilities are explored in this book. May you be able to go through them along with your friends and make learning a real celebration.

With love and regards,

A.P.M. Mohammed Haneesh IAS
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Contents

1 AGRICULTURE: A WAY OF LIFE

A journey to Haritham

We can never forget our visit to Scaria Pillai Chettan's farm. The name of his house 'Haritham' itself shows his love for agriculture. The fifty cents of land owned by him is fenced with *seemakonna* (Glyricidia) and *muringa* (Moringa). The pepper vine that creeps over *seemakonna* (Glyricidia) and the *koval* (Cephalandra) that spreads over the fence is a refreshing sight. Coconut trees, plantain, *chembu* (coloccasia), elephant foot yam, koorka (coleus) etc. are also there in the farm. There were also bitter gourd, snake gourd, beans, chilly, ladies finger , tomato, pumpkin and spinach in his farm. There is a small pond for rearing fish. There are five cows in the shed. Cow dung and vegetable wastes are used for preparing vermi compost. Fodder grass is growing beside the fence. It is a real garden full of beautiful greenery where not even an inch of land lies wasted. His skill in agricultural planning is a model for any farmer to follow. He has minimised the cost of agricultural production by making use of the 'waste' of one item for another. The paddy cultivation done in twenty cents of land is also utilised for this. The roof of his house too is not left out. Hen, quail and pet birds are reared there. Mariamma Chettathi takes care of these birds.

When asked what reply he would give to the people who believe that agriculture is not profitable he humbly answered this question with his usual smile.

'For a farmer, agriculture is a way of life. Who can say that life is not profitable?' We looked at him as if we didn't understand anything. He continued. 'Lack of proper marketing facilities and fluctuation in prices are the major problems a farmer faces. The farmers' collectives should take the initiative to expand marketing facilities and to procure crops locally. Fortunately, there are such enterprises in our locality. Agriculture is profitable for those who are interested in it. The income I get from it is sufficient for me and my family.'

Scaria Pillai Chettan is not merely boasting. His homestead is teeming with agricultural crops which are life itself for him.

The passage given above is a description of a field trip conducted by Sabu and his friends. Can we make agriculture profitable as claimed by Scaria Pillai Chettan? Write your assumptions.

Observe the illustration of Scaria Pillai Chettan's farm.
Compare the description of the field trip given and conduct a group discussion on the basis of the indicators given below. Find out whether your assumption was right or wrong.

Fig.1.1
Farm land

- ★ How could he make the maximum utilisation of the land?
- ★ How could he lower the cost of production?
- ★ Does agriculture mean growing of plants alone? Formulate a working definition for agriculture.

Can agriculture be made profitable by utilising the farm land to the maximum and by adopting ways of lowering the cost of production?

List down issues that prevent agriculture from becoming profitable.

- Lack of availability of quality planting materials.
- Lack of awareness on high yielding varieties of animals and their management.
- Lack of awareness on scientific ways of manuring.
-
-

We have identified that there are a lot of issues which prevent agriculture from becoming profitable. These issues have to be analysed scientifically and remedial measures have to be adopted.

Look at the following conversation between two farmers.

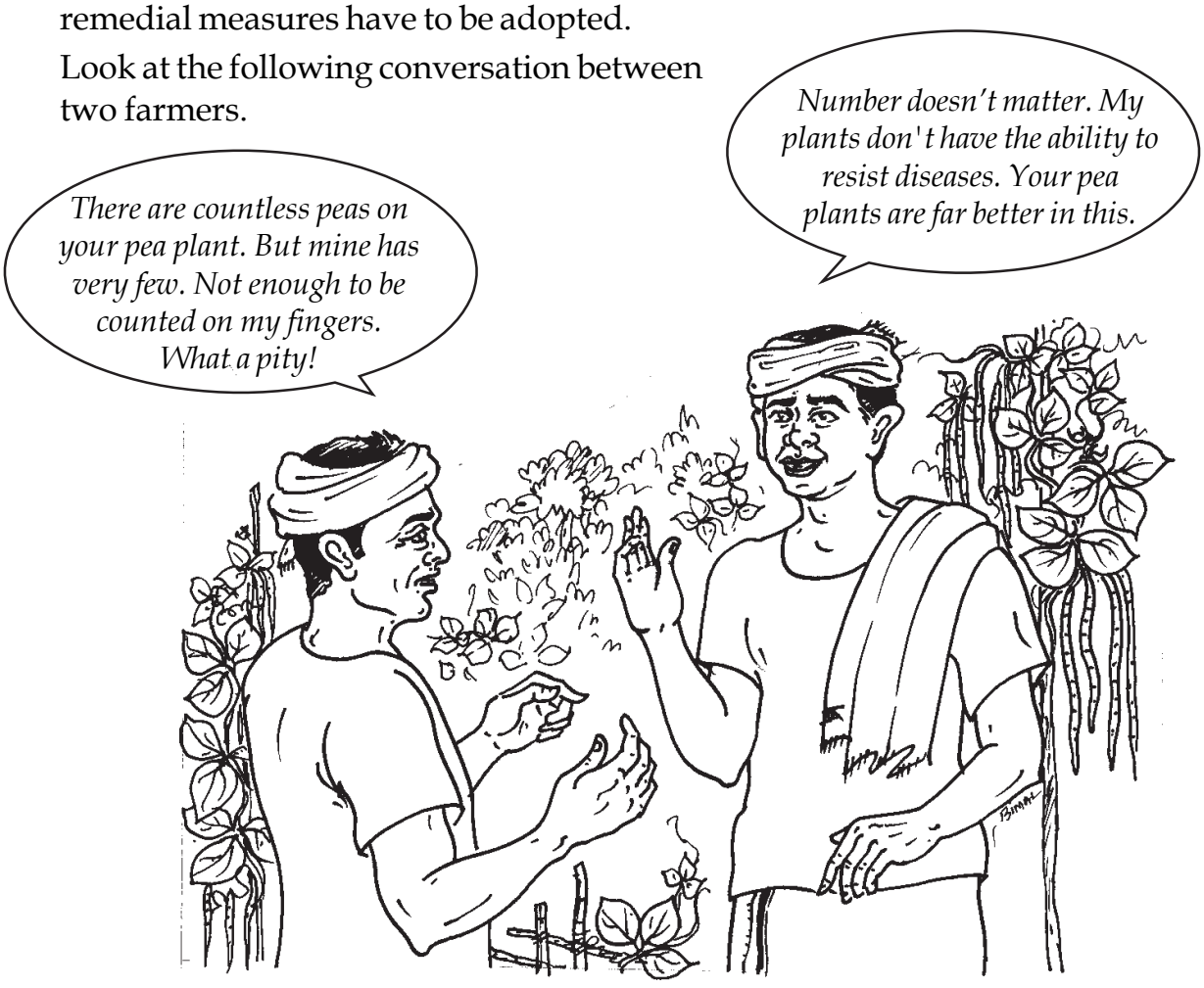


Fig. 1.2

What are the advantages and disadvantages of the pea plants of both the farmers? Can't we develop pea plants of better quality from them if we combine the qualities of both varieties together? You have already learned that the method used for this is called hybridisation.

Analyse the illustration given below using the hints. Formulate a working definition for hybridisation and record it in your science diary.

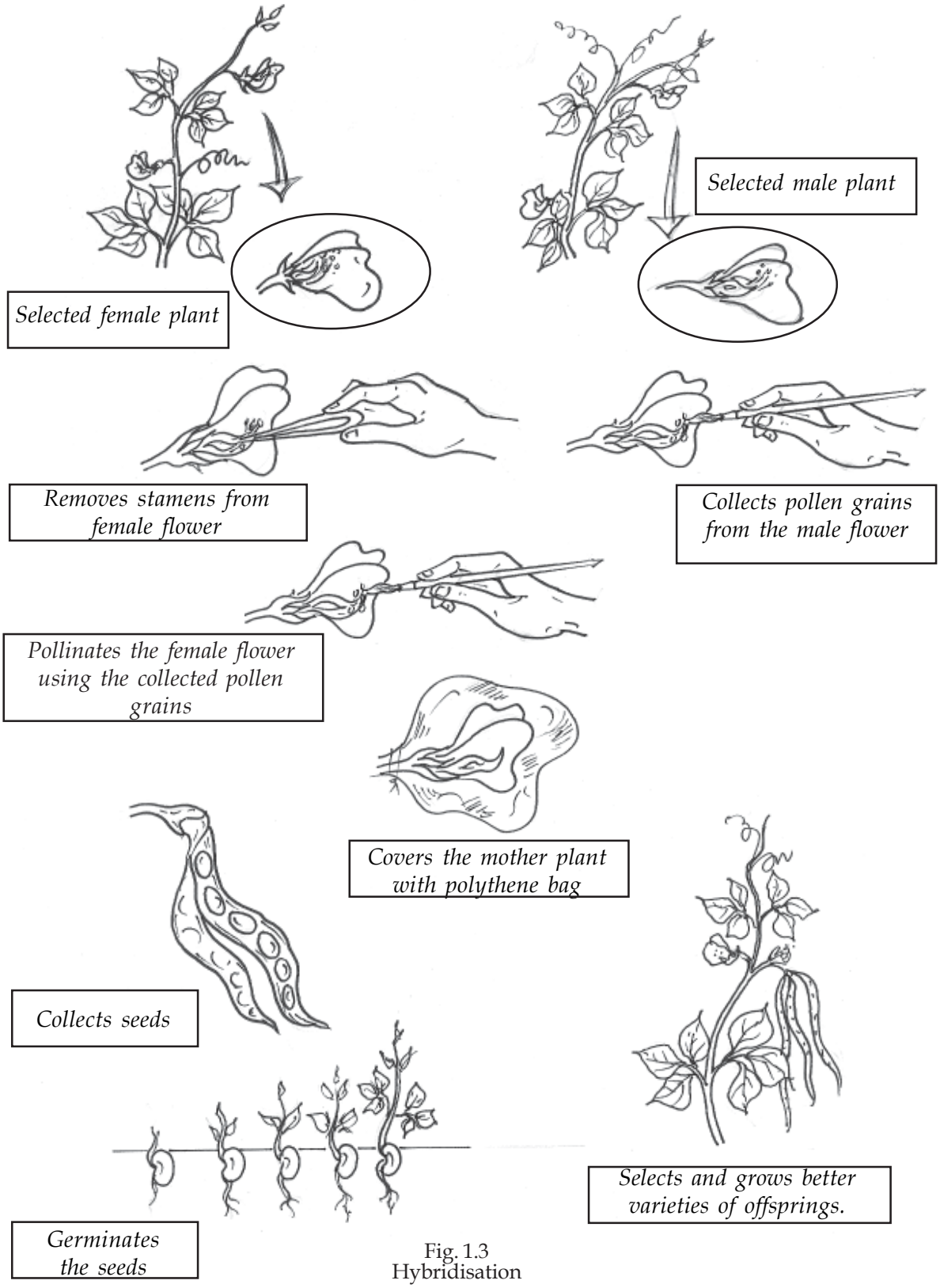


Fig. 1.3
Hybridisation

- ⋆ What are the factors to be considered while selecting the female/ male parent plant for hybridisation?
- ⋆ Why do we remove the stamens from the female plant?
- ⋆ How do we pollinate them?
- ⋆ Why do we cover the female flower after pollination?

Complete the illustration given below recording the various steps of hybridisation.

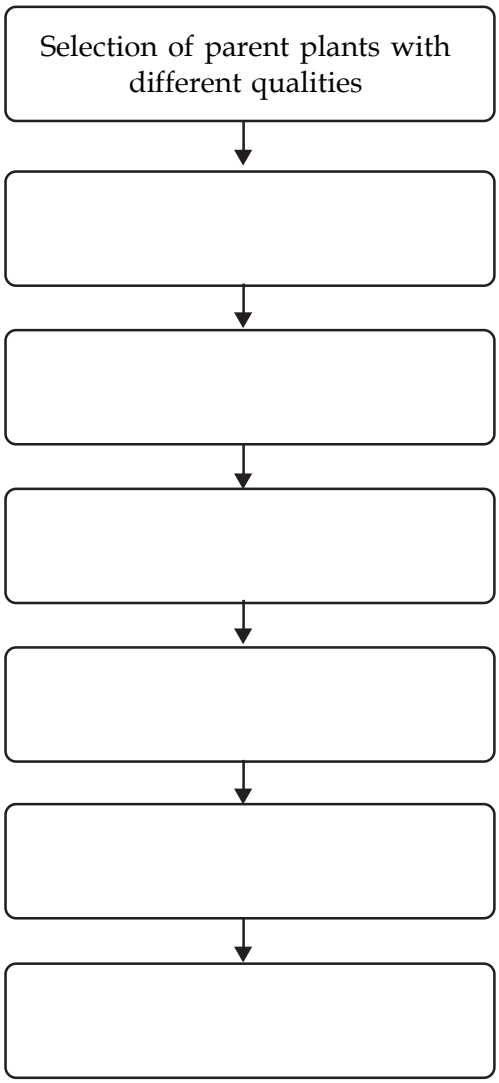


Illustration I

All the plants thus formed may not be of the expected quality. Better quality plants are produced by repeating this process in several generations. Such choices for ensuring better quality are known as selection. The hybrid varieties developed through hybridisation contribute a lot to the progress of agricultural sector. Nowadays a number of hybrid varieties having features like high yield, disease resistance, ability to give high yield within a short period, are widely used.

You are familiar with the following hybrid varieties used widely in the agricultural sector, aren't you?

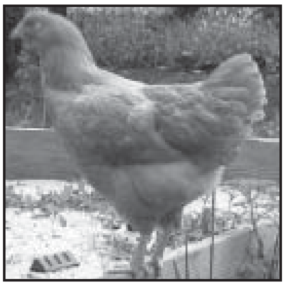
- Aswathy, Jaya, IR-8……. - rice
- TxD, DxT,………………… - coconut

Collect the names of other hybrid varieties widely used nowadays and display them on the wall magazine.

Hybridisation is utilised for developing improved varieties of plants and animals as well.

There are a number of institutions in our state which have gained global attention in developing high yielding varieties of plants and animals. 'Sunandini' is a product of Indo-Swiss project, Mattupetty.

(a) Sunandini



(b) Athulya

Fig. 1.4

'Athulya' was developed at the poultry farm of Kerala Agricultural University. A few institutions which have become famous in this field are listed below.

Enquire and learn more about agricultural research institutions.

- Rice Research Institute – Pattambi, Mankombu
- Rubber Research Institute – Kottayam
- Pepper Research Institute – Panniyoor (Kannur)
- Central Plantation Crops Research Institute – Kasargode, Kayamkulam
- Central Tuber Crops Research Institute – Sreekaryam (Thiruvananthapuram)
-
-

★ Is it necessary to maintain indigenous varieties since we have high quality hybrid varieties? What is your opinion?

- -
- -
- -

Read the description given below and examine how far the opinion you recorded is correct. Record your inference in your science diary.

The greatness of native varieties

The greenery of Kerala has been the result of the inseparable relationship between our climate, soil and vegetation. We had a lot of native varieties of plants suitable to our climate and were disease resistant. Varieties of rice like '*Thavalakkannan*', '*Kulappala*' and *Chitteni*', '*Kilichundan* mango tree which yields sweet mangoes in plenty, '*Palayamkodan*' plantain etc. are some among them. Our yam and colocasia had butter-like softness when cooked. 'Vechoor' cow which yielded milk sufficient for one family had been our own. It was less expensive to manage them as they had a short stature and high disease resistance. With the advent of the high yielding hybrid varieties, most of the native varieties have become endangered or extinct. As a result, our native biological wealth depletes and it creates a severe crisis. We seem to forget even the basic fact that we can develop high quality varieties only from the native varieties that have withstood the test of time.

Fig. 1.5
'Vechoor' cattle and native mango tree

You have learned that tissue culture is the technique used to develop plants with the similar qualities of the parent plant. The greatest advantage of this method is that a large number of plants can be produced from a single plant tissue. Through tissue culture it is possible to produce, within a short period of time, a large number of replicas of better quality plants developed through hybridisation.

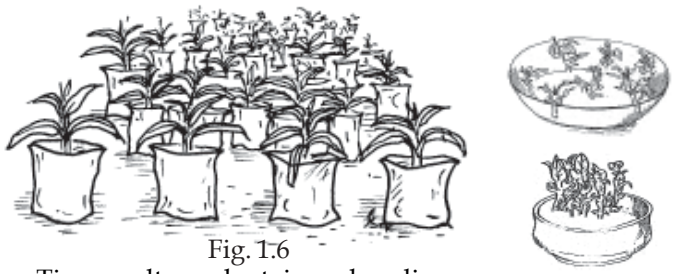


Fig. 1.6
Tissue culture plantain and saplings

Are you convinced of the importance of good quality organisms and certain methods of developing such varieties?

The growing of good quality plants alone doesn't necessarily produce good yield. You have already learned that plants require a number of elements for growth and they get these elements from soil. The soil should be fertile enough if these elements are to be available. We manure the soil to maintain its fertility.

Examine the illustration and find out how bio fertilizers and chemical fertilizers act upon the soil.

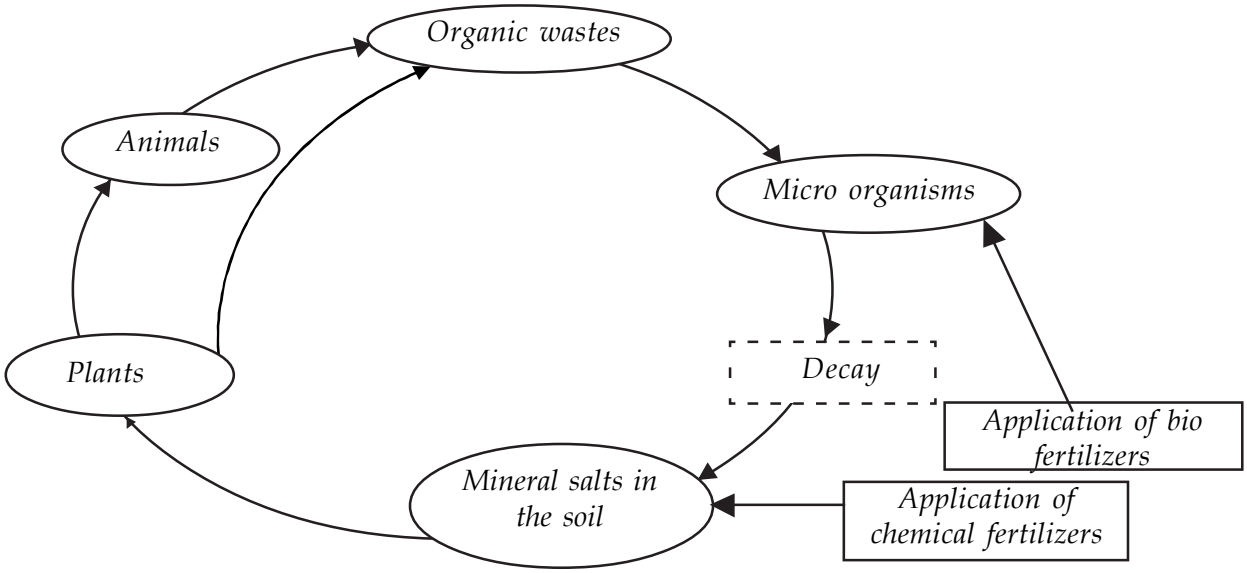


Illustration II

Manure yielding microbes

If we add the micro organisms that help in the decomposition of organic materials to soil, the process of decomposition will be quick and complete.There are micro organisms which can convert nitrogen into nitrates and phosphorus which is insoluble in water into soluble form.Azotobacter converts the atmospheric nitrogen into ammonia. Ammonia is useful to plants as nitrogenous fertilizer. Culture of Azotobacter is available in the market. It is highly effective for crops like coconut, tapioca, sugar cane etc. The aquatic plant Azola too acts as a good bio-fertilizer. The special type of cells found in the cyanobacteria living in this plant can convert atmospheric nitrogen into nitrogenous fertilizer. Besides, when Azola decays, plants get elements like phosphorus, potassium, zinc and iron as manure. Fungi which belong to the family of Mycorrhiza help plants to get phosphorus fertilizer.

Before the application of microbial manure, the availability of organic material in the soil should be ensured. There should be sufficient irrigation. Chemical fertilizers or pesticides should not be used along with microbial manure. The micro organisms can exist in soil only if these precautions are taken.

Discuss with your friends the application of fertilizers on the basis of the indicators given below. Formulate inferences and note them in the science diary.

- ⋆ How are organic wastes and bio fertilizers converted into mineral salts of the soil?
- ⋆ Which is rapidly absorbed – bio fertilizer or chemical fertilizer? Why?
- ⋆ How do bio fertilizer and microbial fertilizer differ?
- ⋆ If chemical fertilizers are used excessively, micro organisms in the soil will be destroyed. How does it affect the natural composition of the soil?
- ⋆ Which is more beneficial to plants – chemical fertilizer or bio fertilizer?

What can be done to ensure the availability of bio fertilizer?

Examine what Scaria Pillai Chettan did to ensure the availability of bio fertilizer in his method of cultivation.

Are you convinced of the importance of integrating agriculture and live stock management?

Which animals can be reared as part of agriculture? List them.

- •
- •
- •
- •
- •
- •

The agrarian culture began when man could choose what he needed from nature and grow them in his surroundings. In the course of time, many wild plants and wild animals became part of our family. Man's scientific understanding helped him to identify and develop qualitatively good ones among them. Many exotic varieties were brought into our land. Hybrid offspring of better quality were created through hybridisation.

Rearing of cattle and birds has improved from time to time. Rivers and seas were the only source of fish once. But today with the advent of the agricultural technique called pisciculture, the method of rearing fish in man made water bodies have become wide spread. Honey bees which were found only in crevices on trees could be raised in apiaries by the technique called apiculture.

Examine the pictures and notes given as 1.7 (a), (b), (c), (d).

Collect information and complete the table given.

Fig. 1.7 (a)

Sunandini, Jersey, Swiss Brown etc. are high yielding cattle suitable for the climate of Kerala. *Murrah*, *Badavari*, *Niliravi* etc. are better quality buffaloes and *Malabari* and *Jamnapari* are better varieties of goats.

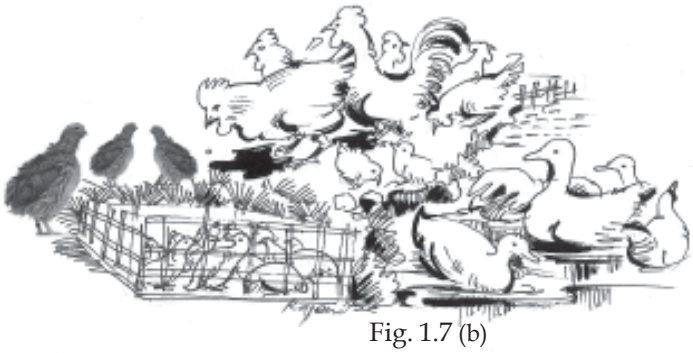


Fig. 1.7 (b)

We have developed and have been rearing many varieties of good quality birds. Hen varieties like *Minorka*, *Gramalakshmi*, *Ankona* and *Giriraja*; ducks like *Muscovi*, *Pekkins*, *Royans* and quails like Bobwhite and Japanese quails belong to this group.

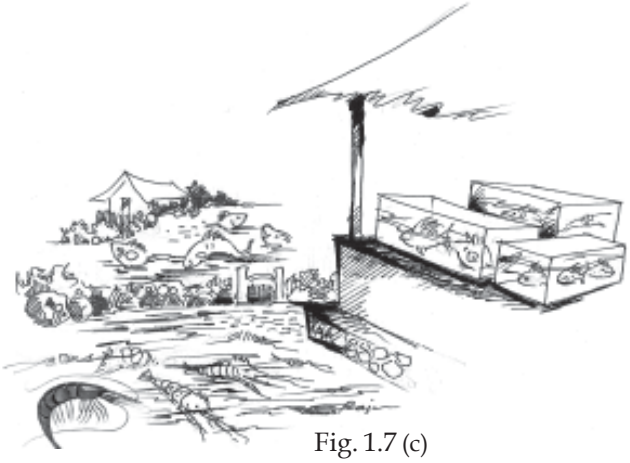


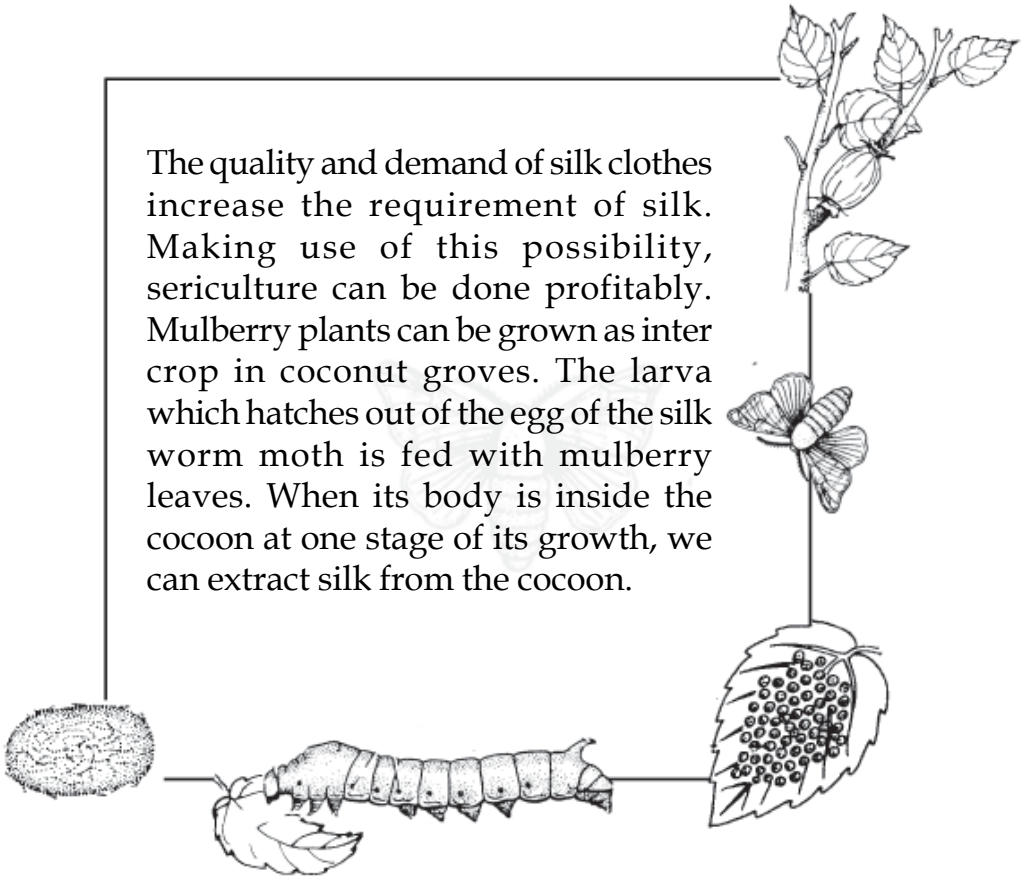
Fig. 1.7 (c)

Edible fish, ornamental fish and prawns can be reared economically. Edible fish like *Gourami, Karpe, Rohu* and *Katla* are suitable for rearing. Gold fish, Angel and Molly are ornamental fish. '*Naaran, Karrah* etc. are widely cultured prawn varieties.

Fig.1.7 (d)

Honey is a nutrient rich and medicinally valuable ideal food. Bee-keeping is a profitable job, especially in our state which has plenty of rubber plantations. Varieties like Melliferra and Apis (*Njodiyan)* are widely used in apiculture.

The quality and demand of silk clothes increase the requirement of silk. Making use of this possibility, sericulture can be done profitably. Mulberry plants can be grown as inter crop in coconut groves. The larva which hatches out of the egg of the silk worm moth is fed with mulberry leaves. When its body is inside the cocoon at one stage of its growth, we can extract silk from the cocoon.



Fields	Varieties	Main products
Cattle rearing		
Bee keeping(apiculture)		
Pisciculture		
Sericulture		

Table 1.1

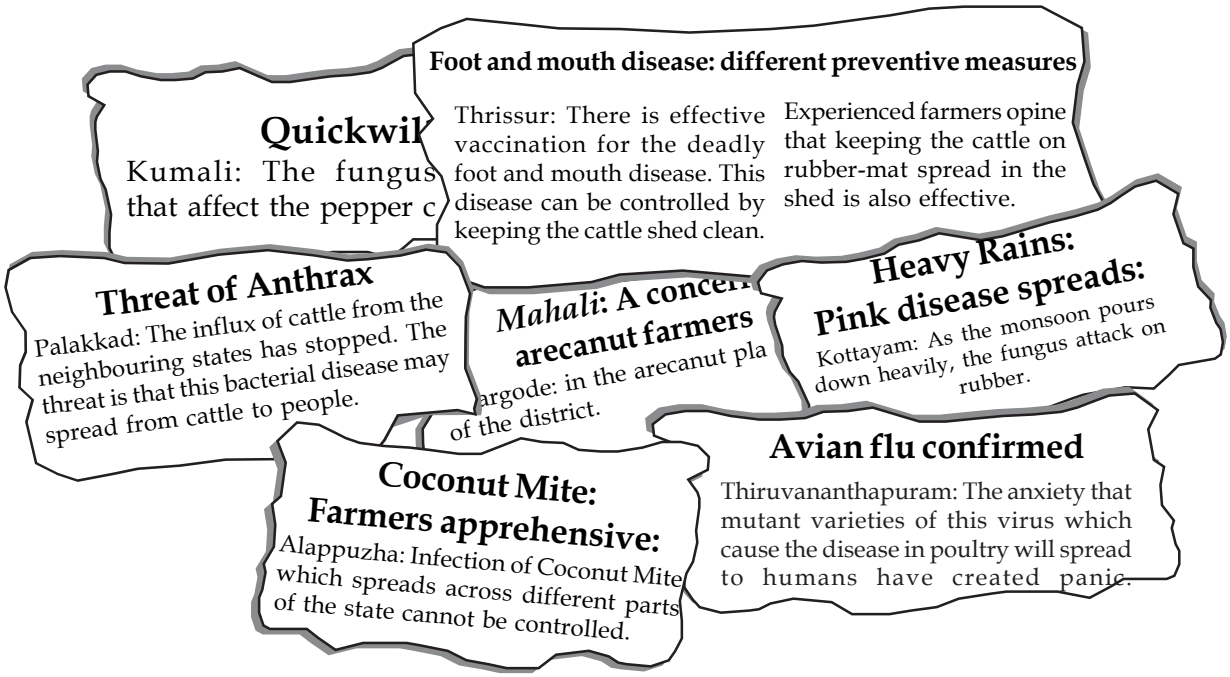
- How can we make use of animals profitably in farm lands? Suggest models. The combined use of plants and animals in this manner in farm lands is integrated farming.

Are the possibilities of integrated farming made use of in your locality? Enquire about it and prepare a short description.

We have understood that while cultivating agricultural crops we should select varieties of better quality for ensuring better income.

Agriculture may become uneconomical because of the different types of diseases affecting plants and animals.

Analyse the newspaper collage given below. Formulate inferences using the hints given and record them in the science diary.



- ⋆ Name the micro organisms that cause diseases.
- ⋆ Which are the diseases likely to be spread from domestic animals to man?

Most of these diseases spread in a short span of time. Now, We have effective vaccinations against them.

Like that of diseases, pests also cause reduction of agricultural yield.
List the pests which affect various crops harmfully.

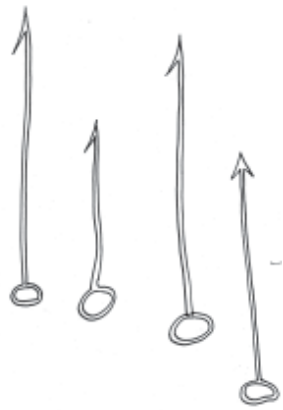
Name of the pest	Crops infected
Brown Plant Hopper	Paddy
Fruit fly (*kaayeecha*)	Vegetables

Table 1.2

Agriculture will become economical only if the pests are controlled effectively.

Read the descriptions on the methods of pest control given and find answers to the questions given below through a discussion.

Different methods of pest control

Then	Now
Mechanical control using devices like traps was mainly used. Bugs were destroyed by placing burning torches in the field.  In order to destroy leaf roller, water containing decayed fish was sprayed. This was done to attract the predators of this worm. In order to pick beetles which destroy coconut, beetle sticks were used.  Beetles were also controlled by placing some sand into the sheath of coconut leaves. Pesticides were not widely used.	Chemical pesticides are widely used. The environmental problems caused by them are numerous. Organic pesticides like tobacco decoction and neem kernel suspension are not widely used. Biological control of pests using natural enemies of pests has to be promoted. Biological control of pests using trichocards and micro organisms like pseudomonas are good indicators.

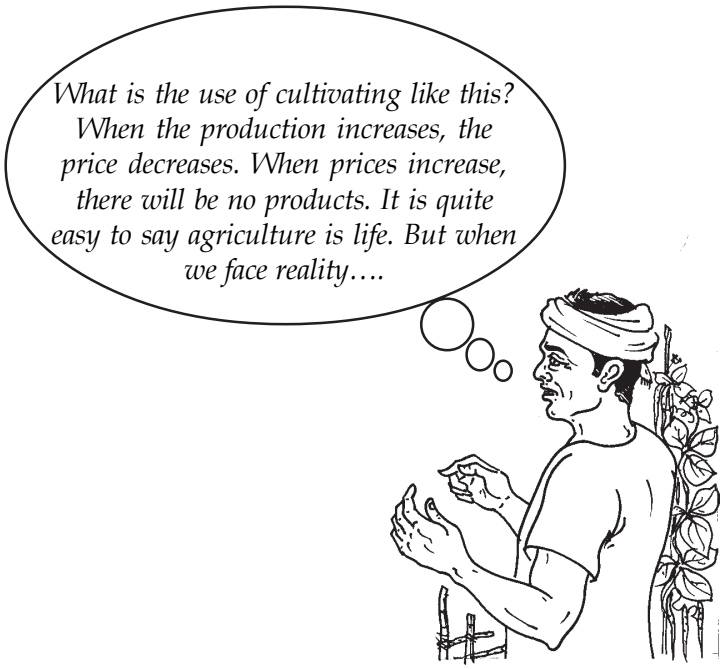
Trichocards

These are cards containing eggs of an insect called trichogremma belonging to the family of a kind of wasp. These cards are torn into small pieces and are affixed to leaves. The insects which hatch out of eggs selectively feed on the eggs of insects like stem borer and leaf roller.

- ★ How can we classify pest control methods?
- ★ Evaluate the pest control methods of olden and modern days. What is your opinion?
- ★ What is your perspective on effective pest control?

Will agriculture become profitable if we can reduce the cost of production?

Analyse the cartoon and the news item given below and formulate inferences.



- ⋆ What is the issue mentioned in the cartoon?
- ⋆ What solution can you suggest for this issue?
- ⋆ Do you agree to the farmer's opinion given in the cartoon? Why?

Procurement and Marketing Centres All Over the State

..... In order to overcome the fluctuations in prices and the exploitation of middlemen, farmers' collectives have become active throughout the state. Such collectives provide facilities for farmers to sell their products directly by avoiding middlemen. Anyone can become a member of this collective by paying a nominal fees. Farmers are paid after reducing five percent from the selling prices. The amount thus set apart will be returned to the farmer as bonus. Along with this market facilities for the procurement of crops like pepper, coconut, arecanut, rice etc. are also provided. The items thus collected are sold off when prices become higher. Loans at very low rate of interest will be provided to farmers for cultivation.

Haven't you understood how the agricultural sector can be maintained economically and sustainably?

However, a mere understanding of this is not sufficient. Agriculture becomes economical and enjoyable only when farming is actually done.

Shall we develop a small vegetable garden?
What shall we include in it?
When you hear 'vegetable garden', don't doubt whether you can do it. It is a great thing to produce even a fraction of the food items you need. So your vegetable garden can be of any size. In order to overcome the limitation of land you can plant vegetables in a sack or flower pot. Note the hints helpful for making a vegetable garden given in the table.
Collect information with the help of your teacher, and engage in the making of a vegetable garden.

Varieties	Time and method of planting	Care to be provided
Ladies finger	Can be planted in beds mixed with cow dung. There should be a gap of forty five centimeters between two saplings.Time: February – March, June – July, October - November	At the time of planting, cow dung and then vegetable mixture can be given as manure. Tobacco decoction and yellow trap can be used to prevent white fly (*velleecha*) and leaf roller
Brinjal	Can be planted at a gap of 60cm each in beds mixed with cow dung. Suitable for plantation throughout the year.	Add cow dung and ash and stir the soil. Apply neem kernel suspension and tobacco decoction intermittedly. Provide suitable irrigation.
Pea	Can be planted at a gap of 20cm each in raised beds one metre broad. Provide support for some types of them to climb up.	Cow dung and ash can be added as basic manures. When the plant grows up add 50g each of powdered oil cake. Pests can be repelled using neem oil emulsion and neem oil cake. Provide suitable irrigation.

Better seeds and nurturing methods can be got from experienced farmers or agricultural officers.

Planning the activity
• Selection of the variety • Deciding on the plot • Understanding the method of cultivation • Planting, nurturing and harvesting

What were your experiences while going through this activity?
Prepare a note of your experience.

Preparation of the note of your experience

Some hints

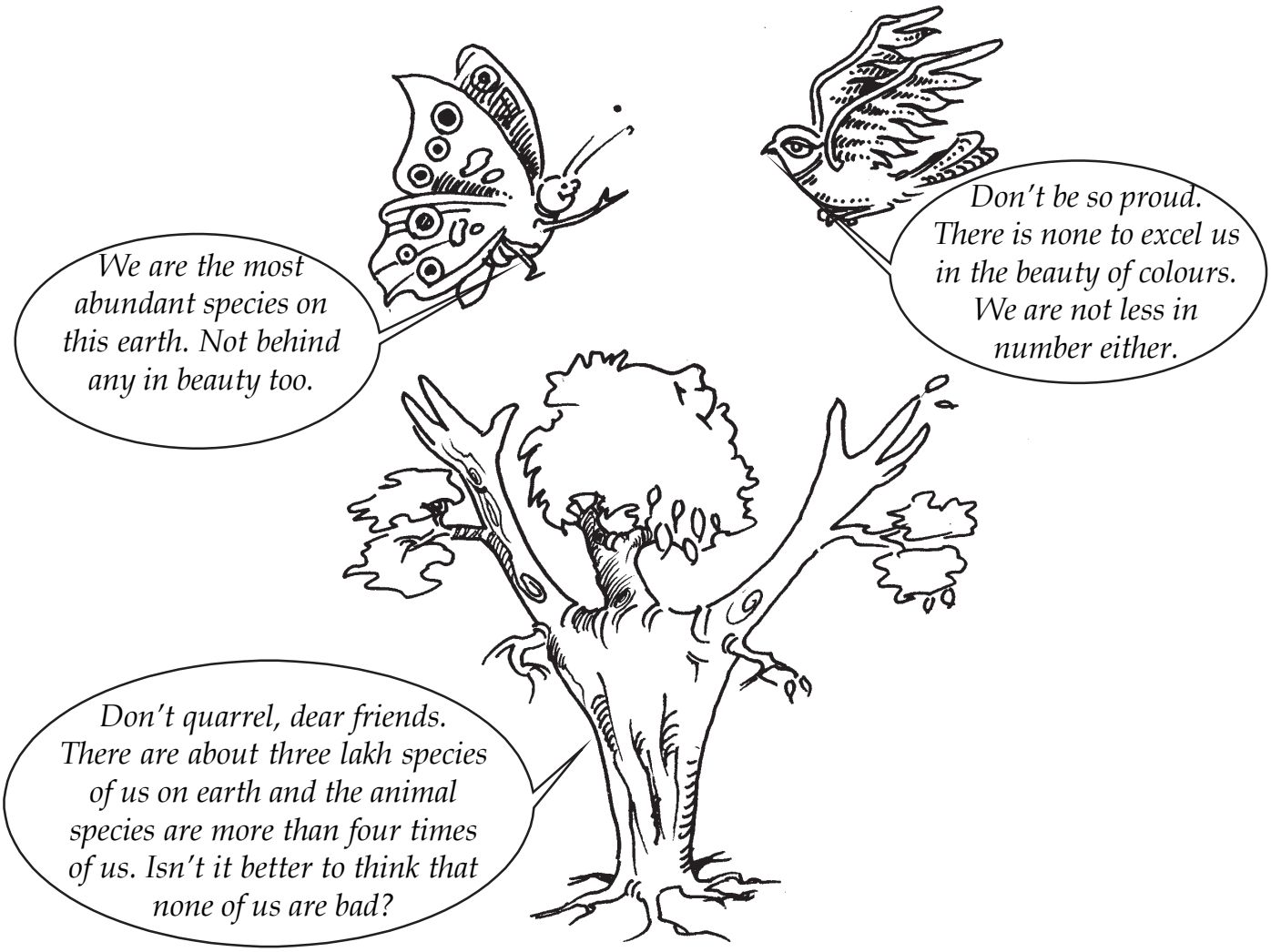
1. Item/items to be cultivated
2. The day on which bed was prepared
3. The day on which planting / sowing was done
4. The day of germination
5. The day on which the first leaf sprouted out
6. a) Manures used b) Days on which manures were applied
7. a) Days on which pests were destroyed
   b) The method of pest control adopted
8. The day on which first flower appeared
9. The day of first harvest
10. The total yield
11. The experience of going through these activities (difficulties/ happiness)

Exchange the notes you have prepared in the class and read them.

It will provide you an opportunity to acquaint with different methods of cultivation and a variety of experiences. Agriculture is one of the chief means of making man a part of nature.

Agriculture becomes profitable
when it becomes one's means of life.

2 AN ADDRESS FOR LIVING BEINGS



Are there this much plant and animal species on this earth?
How many of them are familiar to you? List them.

-
-
-

Do you think unfamiliar species are more in number? How can we learn about these living things? Is it possible to learn about each living thing separately?

How can we make the learning easy?

Can we classify them into different groups based on any criteria?

How do we classify?

You may know that living things are seen in various colours and size. There is difference in their habitat too. In what other features do living things differ?

- Shape
-
-

Shall we group them on the basis of similarity of colour?

Haven't plants, grasshopper and tree snake got green colour? If we group them together as one category on the basis of colour, won't there be a lot of anomalies?

Can we include earthworm and snake, both of which are cylindrical in shape, in one category?

What are the features that distinguish earthworm from snake?

-
-

From ancient times onwards, man had tried to group organisms on the basis of various criteria. Let's learn about some scientists who tried to make this classification more scientific.

Fig. 2.1. (a)
Aristotle
(BC 384-322) Greece

Father of biology. He classified both plants and animals. He classified animals into two groups: red blooded and non-red blooded.

Father of Ayurveda. Classified about two hundred animals and plants and recorded them in the book 'Charaka Samhitha'.

Fig. 2.1 (b)
Charaka
AD 1st century. India

Fig. 2.1 (c)
John Ray
1627-1705 England

Laid the foundation of scientific method of classification. He recorded more than 18,000 plants in the book, 'Historia Generalis Plantarum'. He used the term species for the first time.

Haven't you understood the historical background of classification?
Now look at the animals below.

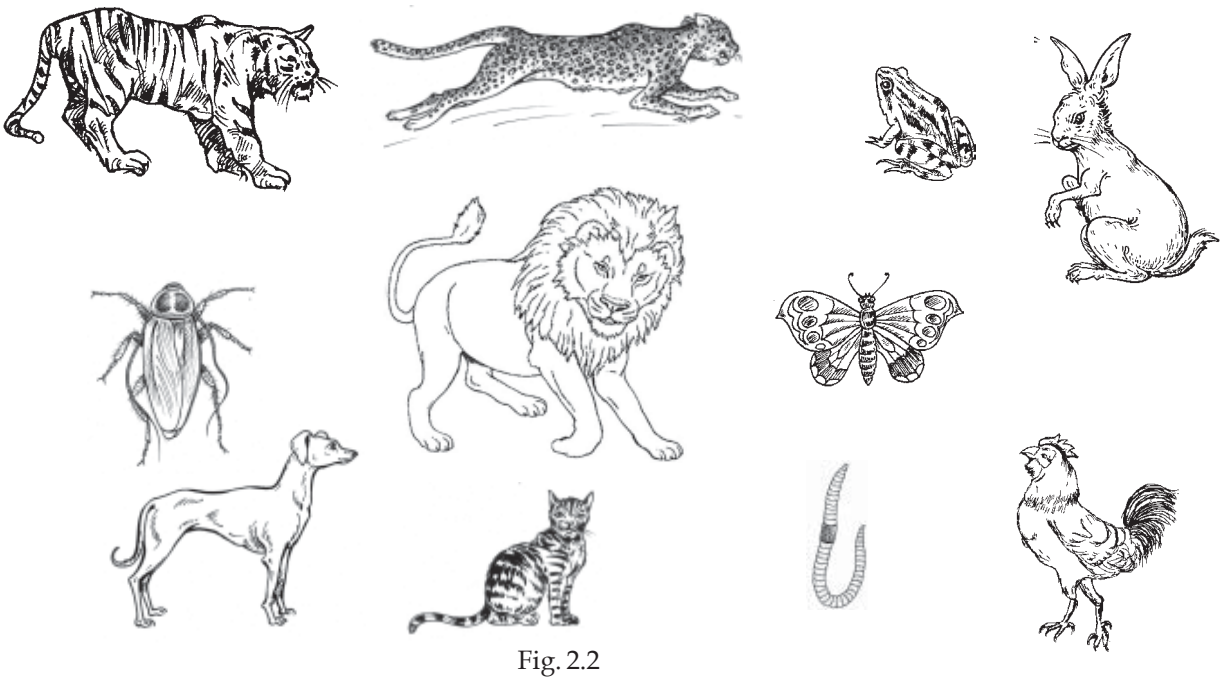


Fig. 2.2

Which is the common group to which all these animals belong?
Write the names of these animals in appropriate boxes on the basis of the indicators given below.

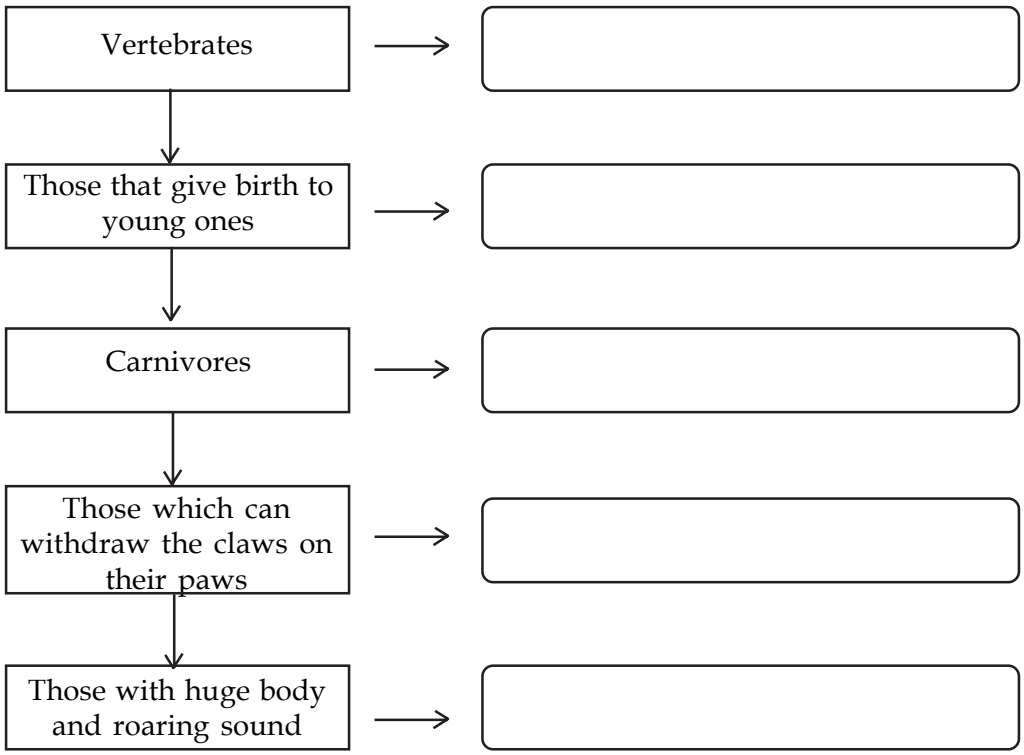


Illustration I

How can we classify them further into small groups?

We include lion, tiger and cheetah in one group, because there are a lot of similarities among them. But they have many differences too, haven't they? In classification we categorize organisms into large groups on the basis of their similarities and small groups on the basis of differences among them. If we want to categorize the above organisms further into small groups, we should find out how they differ from one another.

Only a lion can give birth to cubs. Cases of tiger and cheetah are the same. Each of them belongs to different species. Only organisms belonging to the same species can produce fertile offspring through natural sexual reproduction. A species is a group of organisms which have close resemblance. The basic constituent of classification is species. There are different levels of classifications from species up to the living world.

Look at the description below and record the different levels of classification in the science diary.

Living world	➤composed of various kingdoms	**plantae and animalia** (plantae-multicellular producers which do not have the power of locomotion. animalia- multicellular consumers which have the power of locomotion).
↑ Kingdom	➤ composed of various phyla	eg: - **animalia**
↑ Phylum	➤ composed of various classes	eg: - **Chordata** (Animals having vertebral column)
↑ Class	➤composed of various orders	eg: - **mammalia.** (Those who give birth to young ones and feed them with milk)
↑ Order	➤ composed of various families	eg: -**carnivora** (Flesh eating animals in mammalia)
↑ Family	➤ composed of various genus	eg: - **felidae** (cheetah, tiger, lion, cat)
↑ Genus	➤ composed of various species	eg: - **panthera** (cheetah, tiger, lion)
↑ Species	➤ composed of same kind of organisms	eg: **tiger -** a species named tigris, Cheetah-a species named pardes, Lion-a species named leo

Illustration II

Identify the various levels of classification of tiger and complete the worksheet below.

Kingdom-	- -
Phylum -	- -
Class -	- -
Order -	- -
Family -	- -
Genus -	- -
Species -	- -

Worksheet 2.1

Haven't we identified the various levels of classification of tiger? Similarly complete the worksheet for identifying the levels of classification of cat and dog and record it in your science diary.

Levels of classification	Cat	Dog
Kingdom	- - - - - - - - - - - - - - - -	- - - - - - - - - - - - - - - -
Phylum	- - - - - - - - - - - - - - - -	- - - - - - - - - - - - - - - -
Class	- - - - - - - - - - - - - - - -	- - - - - - - - - - - - - - - -
Order	- - - - - - - - - - - - - - - -	- - - - - - - - - - - - - - - -
Family	- - - - - - - - - - - - - - - -	canidae
Genus	felis	canis
Species	domesticus	familiaris

Worksheet 2.2

Isn't it clear that in scientific classification each organism has its own levels of classification?

Just as we classified the animal kingdom, we can classify the plant kingdom too. For this, select criteria suitable to the special features of plants.

Let's look at the levels of classification of coconut tree.

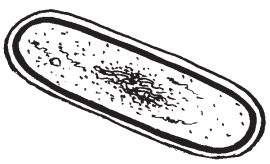
Kingdom	-	plantae
Phylum	-	angiospermophyta (seeds with covering)
Class	-	monocotyledenae (having only one cotyledon)
Series	-	calicinae (growing as single stem)
Family	-	arecaceae
Genus	-	cocos
Species	-	nucifera.

Carl Linnaeus is the scientist who classified the living world into two kingdoms.

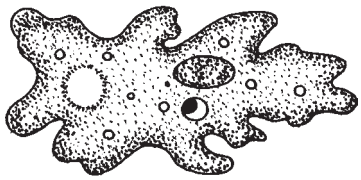
Fig. 2.3
Carl Linnaeus
(1707-78). Sweden

Carl Linnaeus suggested different levels of classification on the basis of similarities and differences and devised the system of naming each organism scientifically. Hence he is considered the father of scientific classification.

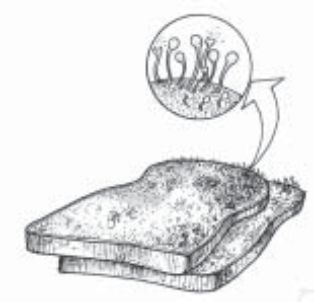
In the system of classification that we have studied there are only two kingdoms. Can we include the organisms given below in these kingdoms? Why? Discuss and record your opinions in the science diary.



Bacteria
Unicellular organisms without definite nucleus
(Prokaryotes)



Amoeba
Unicellular organisms with definite nucleus
(Eukaryotes)



Fungus
Multicellular decomposers
(Eukaryotes)

Fig. 2.4

Don't we need more kingdoms to include these organisms?

A scientist named Robert Whittaker classified the living world into five kingdoms. This system of classification became more acceptable to the world of science.

Fig. 2.5
Robert Whittaker
(1920 - 1980)
America

Living world

Monera	Protista	Fungi	Plantae	Animalia
unicellular organisms without definite nucleus	unicellular organisms with definite nucleus and simple multicellular organisms similar to them	heterotrophic unicellular/ multicellular organisms which do not have the power of locomotion	autotrophic multicellular organisms which do not have the power of locomotion	heterotrophic multicellular organisms which have the power of locomotion

Illustration III

The same organism might have different names in different localities.For example tapioca has different names like '*Kappa*', '*Cheeni*', '*Kolli*' and '*Marakkizhangu*'. Papaya is known as '*Karamoosa*', '*Oma*'and '*Kapplanga*'. If there are so many different names in Malayalam, it is quite natural that each organism has different names in various languages. Won't this be a hindrance in identifying various organisms and studying about them? This problem is solved by giving names which can be recognized internationally beyond the limits of languages.

Fig. 2.6 (a)

Fig. 2.6 (b)

It was Carl Linnaeus who designed the system of giving scientific names to organisms. In this system of naming, each organism is given a dual name which includes the name of genus first followed by the name of species. This system of giving names to organisms in this manner is known as binomial nomenclature.

Find out and record the scientific names of tiger, cat, dog and coconut tree with the help of illustrations I and II and worksheets 2.1 and 2.2.

Investigate and collect the scientific names of the organisms given below and record them in the science diary.

Papaya, paddy, tapioca, crow, man, lion.

Look at the scientific names given below.

Mangifera indica	–	Mango tree.
Apis indica	–	Honey bee.
Perna indica	–	Mytilus.

Aren't the species names of all these organisms the same? Here we can't identify the organism with the species name alone.

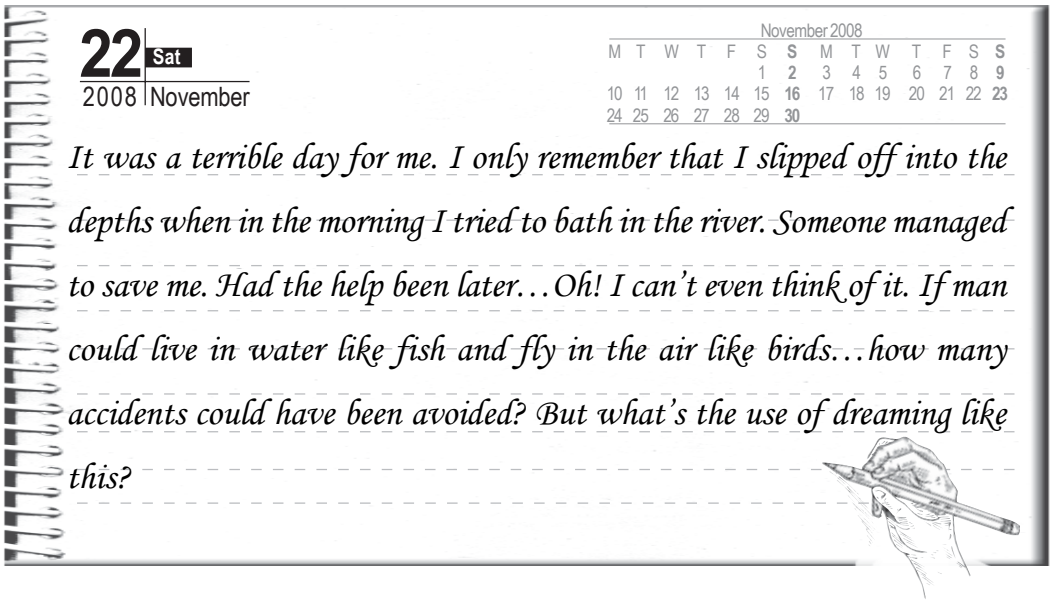
Haven't you understood the relevance of adding genus name too along with the species name of an organism?

> Taxonomy is the branch of science which identifies organisms by observing their features, classify them on the basis of similarities and differences and giving name to them scientifically.

Discuss the various uses of Taxonomy, prepare a brief note and record it in your science diary.

- to identify the position of each organism in the living world.
- to make learning easy.
-
-

Haven't we understood that though there are lakhs of organisms in the biosphere, each of them has a definite address? Now we can examine how each organism makes use of the surroundings they live in?



Why doesn't Shyam's desire fulfill?

You have learned that each organism requires a particular natural environment (habitat) for its existence. You have also understood that there are biotic and abiotic components in this environment.

Only those organisms which can effectively utilize these components have existence. Observe the surroundings of your school or your home, and classify and list down the biotic and abiotic components there. Then complete the table given below.

Abiotic components	How they are useful to organisms
Soil	Makes nutrients available to plants. Functions as the habitat of organisms.
Air	
Water	
Light	
Temperature	

Table 2.1

We have seen how abiotic components became useful to organisms.

Like the abiotic components, other organisms also influence the existence of an organism. We have also learned that ecosystem means a system which

includes the abiotic components and organisms that can live self sufficiently with the aid of mutual relationships. Write examples of ecosystem.

• • •

Picture of a sacred grove is given below.

Fig. 2.7

We know that there are food relations between organisms in this ecosystem.

Prepare maximum possible number of food chains and record them in the science diary.

On the basis of indicators, examine these food chains which you have recorded. Establish mutual links between food chains on the basis of your findings and expand the illustration given below.

- ⋆ Does an organism feed on more than one organism?
- ⋆ Does an organism become food for more than one organism?

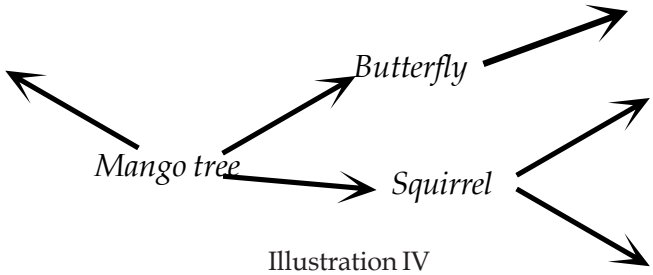


Illustration IV

Have you understood that food chains don't exist independently? Have you noticed that they have become as complex as a web through mutual relationships? This is called food web.

Classify the organisms living in the sacred grove ecosystem on the basis of the indicators given below and record in the science diary.

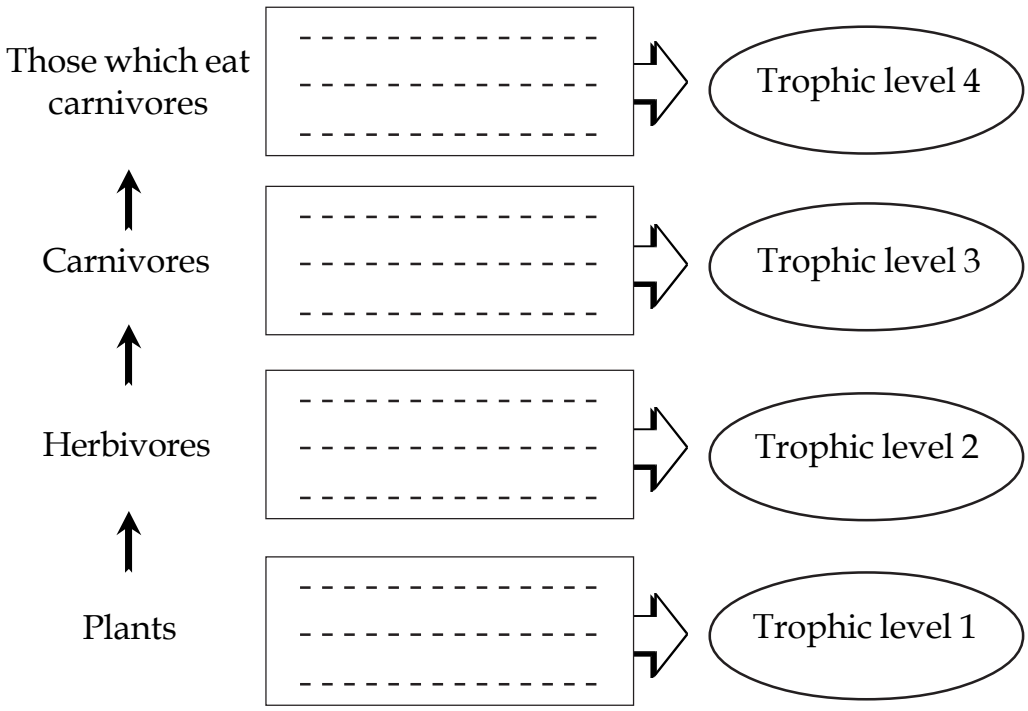


Illustration V

Haven't you arranged organisms of an ecosystem into different levels? Each of these levels is known as trophic level.

Examine whether an organism comes in more than one trophic level. Record the inferences in your science diary.

Find out other examples.

The micro organisms which decompose organic wastes are known as decomposers. Do you know that organisms like bacteria, fungi etc belong to this category?

Which trophic level do these micro organisms belong to?

Discuss with your friends and write the inferences.

There might be different types of ecosystems in the surroundings of your school and home. Visit these ecosystems in small groups with the help of your teacher and make sketches and draw diagrams of the food chains of the organisms there. Prepare diagrammatic representations of the distribution of organisms in various trophic levels and display them in the class room.

Different types of relations among organisms

Different types of relations are found among organisms of various types. These relationships are useful for ensuring food and space for living. On the basis of the benefits and harmful effects of organisms, these relations can be categorized into two, namely, positive interaction and negative interaction.

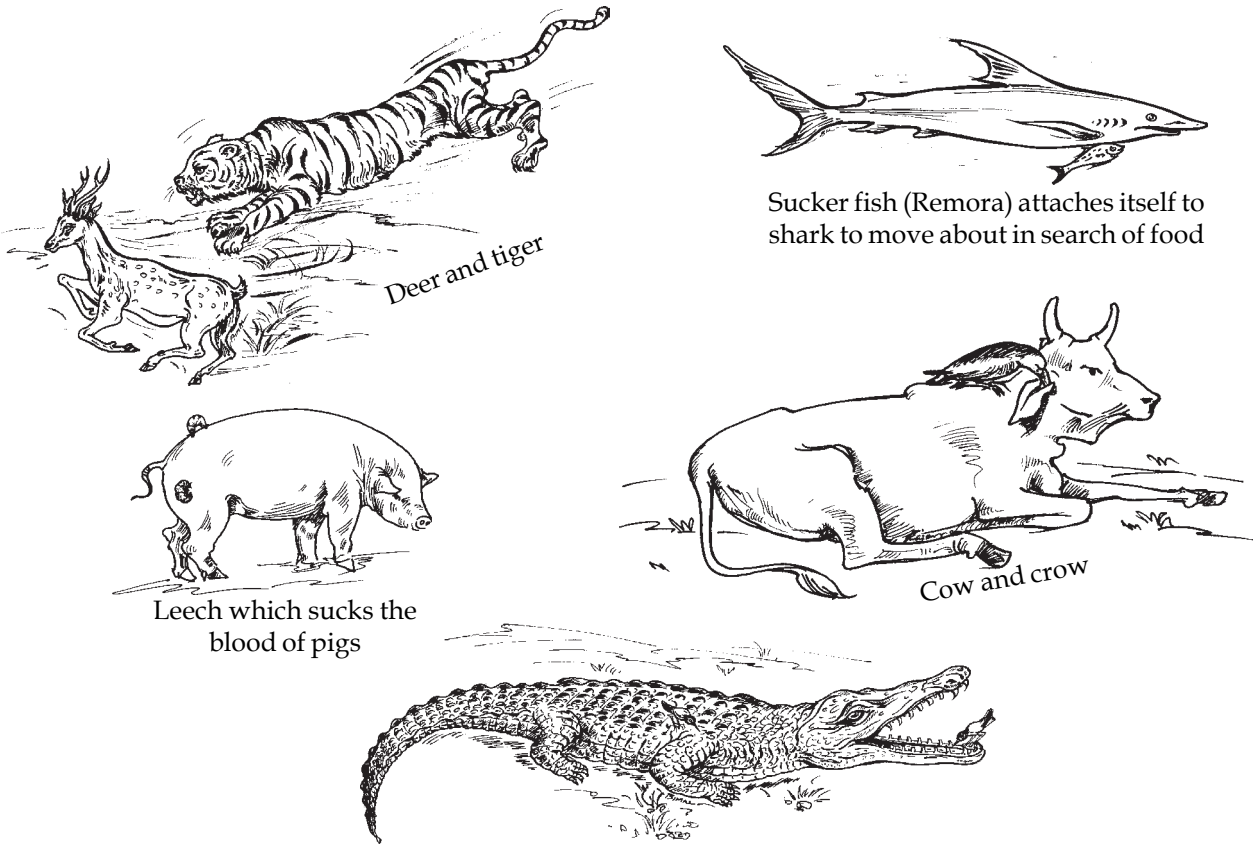


Fig. 2.8

Observe the pictures given. Prepare a write-up on the relations between organisms by analyzing the table and the indicators. Find out more examples.

Type	Name	Peculiarity	Example
Positive interaction	mutualism	two organisms are benefited	butterfly and flowering plants
	commensalism	one is benefited and the other is neither benefited nor harmed	vanda and mango tree
Negative interaction	predation	one is benefited and the other is harmed	eagle and chicken
	parasitism	one is benefited and the other is harmed	mango tree and loranthus
	competition	both organisms suffer at first. But the organism which wins is benefited.	crops and weeds

Table 2.2

- ★ What types of relationships between living things are seen in the figure?
- ★ Which organisms benefit due to the mutual relationships?
- ★ Which organisms are harmed?
- ★ What is the difference between predation and parasitism?

3 THE BEAUTY OF NATURE

Biosphere and me

Life is one of the greatest wonders of nature. Biosphere is that part of earth where living organisms are seen. The biosphere extends to a height of 10 kilometers in the atmosphere and 10 kilometers deep into the oceans. Does life exist only on earth? There is a branch of science, ***exobiology*** *which investigates whether there is life beyond the biosphere.*

The basic component of biosphere is the ecosystem where a variety of living things live together. Those organisms which belong to a particular species in an ecosystem are collectively called a population. In each ecosystem, living things are seen as a community composed of various populations. I am a member of the human population in the biosphere which involves numerous communities of organisms.

Humans have a better intellect than all other organisms and they can exploit others for their own needs. Shall I too behave the same? How long can biosphere exist like this if I do so? Hence I should use my intellect to preserve rather than exploit all resources of nature including the living things. What all can I do for that?

This is a part of the paper presented by Achu in the class seminar. Examine this and write brief notes on the mutual relationships among population, community, ecosystem and biosphere.

Have ecosystems a role in the stable existence of the biosphere?
How does food web help in strengthening each ecosystem?

Observe the illustration of a food web given below. Draw inferences through a group discussion and record them in the science diary.
You may make use of the hints given for your discussion.

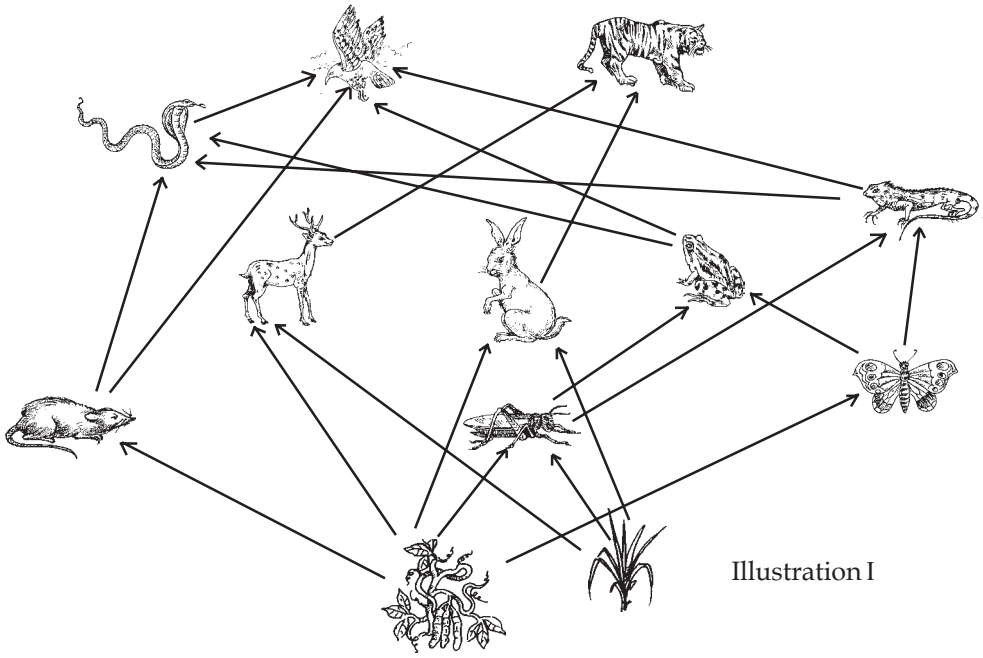


Illustration I

- ⋆ If any one of the organisms is removed from the food web, how will it affect the other living beings?
- ⋆ How will it affect the complexity of the food web?
- ⋆ As a result, what will happen to the ecosystem?

As the complexity of the food web decreases, the equilibrium of the ecosystem will be disturbed. Hence each organism of an ecosystem has its own identity and importance.
There are more than 125 lakh species of organisms on earth. Observe the pie diagram given below and compare the numbers of species identified so far.

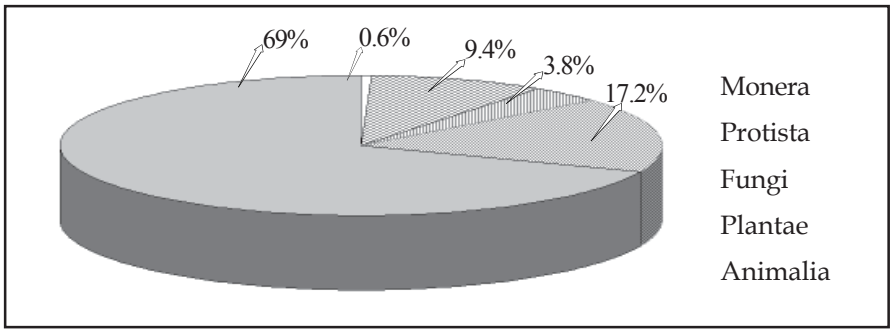


Illustration II

Which species are more in number? Which species is less in number?

The bio-richness of the earth which includes different kinds of plants, animals and micro organisms is known as biodiversity.

What is the present state of biodiversity in your locality? Enquire. What all things have to be considered if we want to know about it? Form the required hypothesis using the hints given below.

- ⋆ Do all species in your locality of the past exist even today?
- ⋆ Has the number of species and number of organisms increased?
- ⋆ Have the change in the agricultural sector influenced biodiversity?
- ⋆ Does the change in life style cause depletion of biodiversity in any way?
- ⋆
- ⋆
- ⋆

What are the ways adopted for verifying the validity of the hypothesis formed by you?

- Observation.
- Interview with elders.
-
-

Discuss with your teacher and friends about the suitable methods of collecting information and plan a comprehensive schedule of action.

Analyze the collected information scientifically and draw inferences. Record them in your science diary.

Aren't you convinced of the real condition of the biodiversity in your locality? What can be the causes of the problems affecting biodiversity? What can you suggest to solve them? Record your findings in your science diary. Plan an activity with the help of your teacher and friends to lessen the depletion of biodiversity. Try to execute your plans with public participation.

Record your experiences of participating in such activities in your science diary.

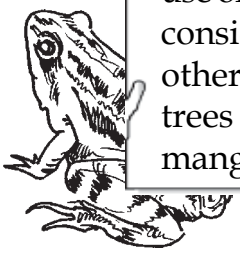
Is depletion of biodiversity confined to your area alone? What is the condition of biodiversity at the global level? Examine the notes and illustrations given below, draw inferences and record them in your science diary.

Today's Rain Forests Tomorrow's Deserts...

Tropical forests are the reservoirs of biodiversity. As per the statistics of 1980, about 44% of the tropical forests/rainforests has been lost within the last 40 years. Every year about 75,000 square kilometers of rainforests are getting lost due to deforestation. If we go on like this it won't be a surprise that after 80 years all our rainforests will become deserts. The condition of not only the forests but also habitats like water bodies, grasslands etc. are in great concern.

Frogs and the Native Mango Tree

What is the relationship between them? One might wonder. The most striking similarity is that both are facing the threat of extinction. The increasing demand for frog's leg and the use of pesticides reduced the number of frogs, considerably. The indiscriminate planting of other trees and hybrid varieties of mango trees led to the disappearance of the native mango trees.



This condition shouldn't prevail....

Between 1600 and 1900 about 75 species of plants and animals disappeared from the face of the earth. A same number of living things were destroyed between 1900 and 1970 too. The rate of destruction increased further during the last twenty five years. If it continues, how long can the biological wealth of the green earth remain hereafter?

These exist only in pictures now.

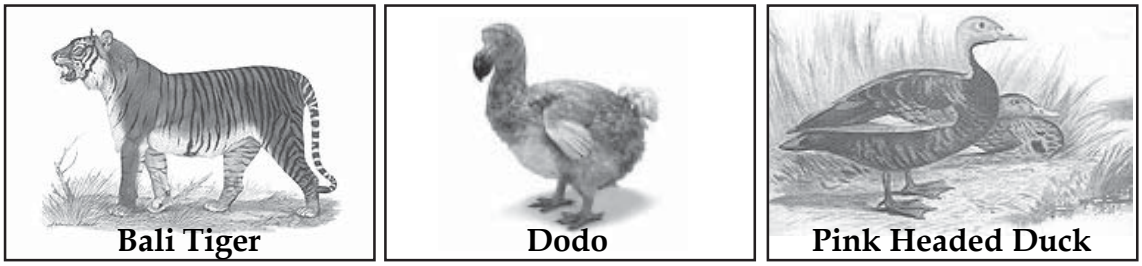


Fig. 3.1

A true story from Malaysia

In the 1970s the fruit production of Durian tree in Malaysia became nominal. As a result, the fruit processing industry that depended on it collapsed. Do you know the reason? As the mangroves were cleared up for prawn farming, the bats living there disappeared. Bats being the pollinators of the Durian tree, their disappearance ended the fruit production of these trees. Look at the chain of destruction here.

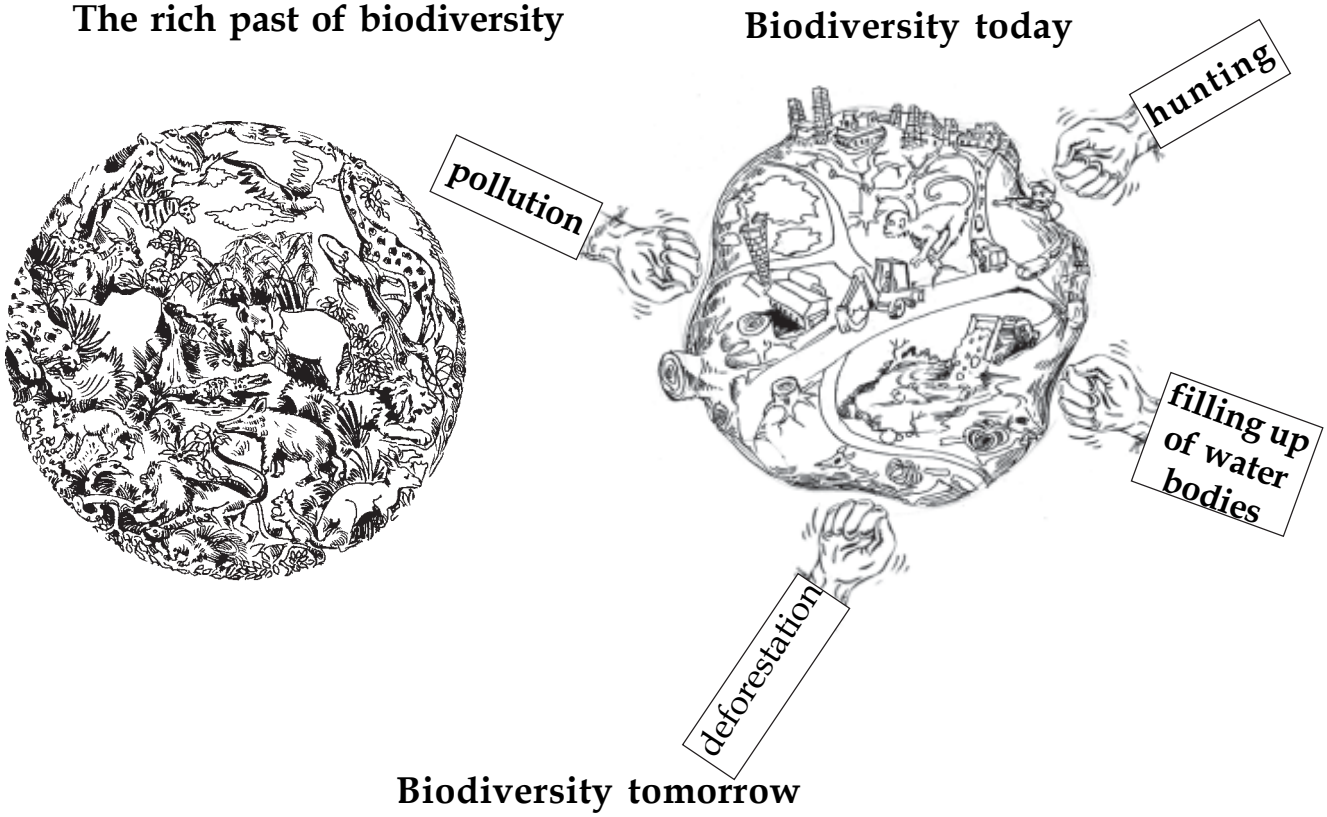
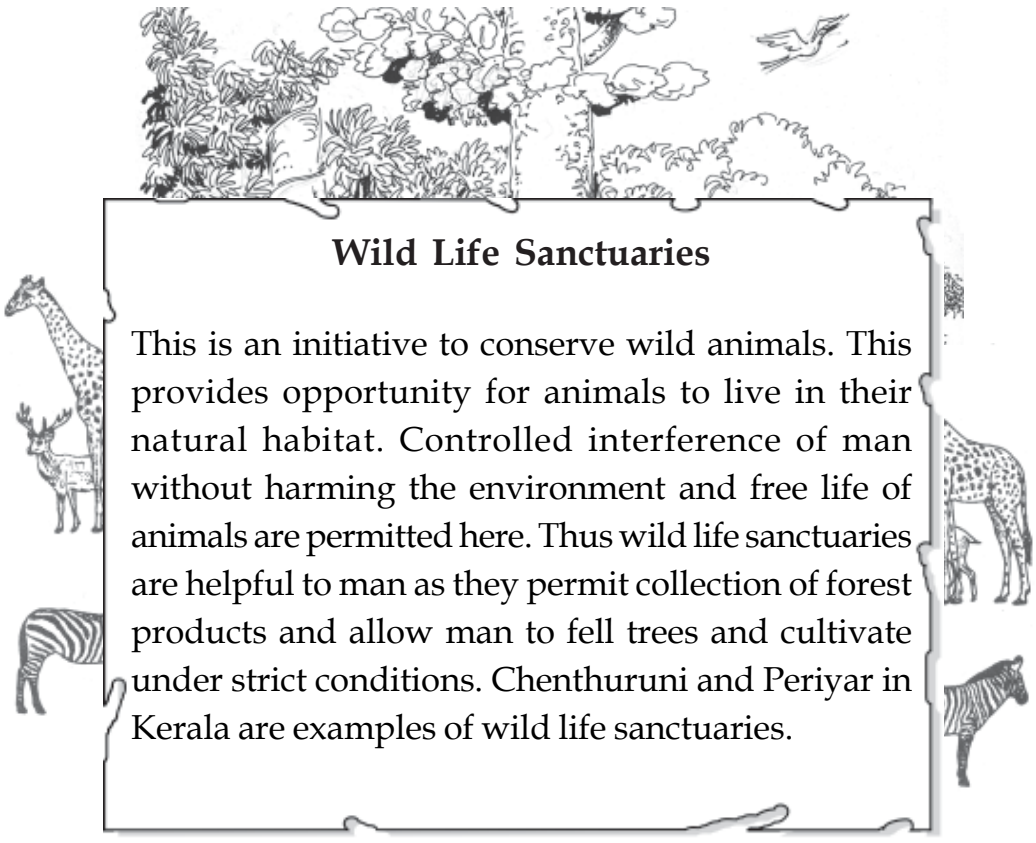


Illustration III

Conservation of biodiversity doesn't mean keeping the natural resources unused. Besides preventing over exploitation, we should take measures to preserve organisms which are facing extinction. We have adopted many measures at the global level to replenish the loss of biodiversity.

The methods of conserving living things within their natural ecosystem (in-situ conservation) and conserving them in suitable places outside their natural ecosystem (ex-situ conservation) are practised. Wild life sanctuaries, national parks, biosphere reserves, sacred groves etc. belong to the first category and botanical gardens, zoological gardens, gene banks etc belong to the second category. Along with this, there are particular projects for the conservation of some species of living things. e.g. Project Tiger. Collecting information about the biological wealth of each locality and preparing the biodiversity registers are also part of conserving the biodiversity.

Look at the descriptions given below.

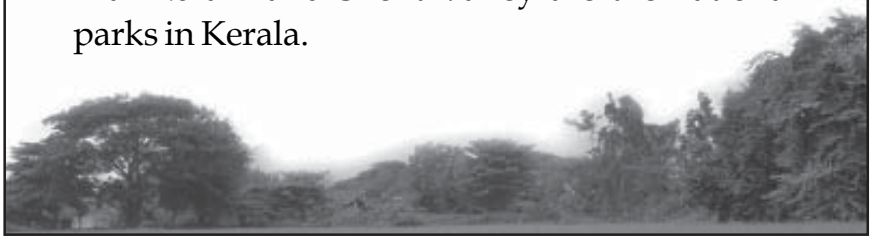


Wild Life Sanctuaries

This is an initiative to conserve wild animals. This provides opportunity for animals to live in their natural habitat. Controlled interference of man without harming the environment and free life of animals are permitted here. Thus wild life sanctuaries are helpful to man as they permit collection of forest products and allow man to fell trees and cultivate under strict conditions. Chenthuruni and Periyar in Kerala are examples of wild life sanctuaries.

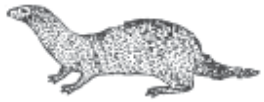
National Parks

Many farsighted activities have been planned to repair the damages caused to the environment by human invasions. National parks are one among them. These parks are extensive forests which maintain the original beauty and complexity of nature. Here human interventions like farming, plantation etc are strictly prohibited. Private holdings are also not permitted in the national parks. National parks, which give opportunities for all organisms to live as part of nature, are the enriched store houses of biological wealth. Eravikulam and Silent Valley are the national parks in Kerala.



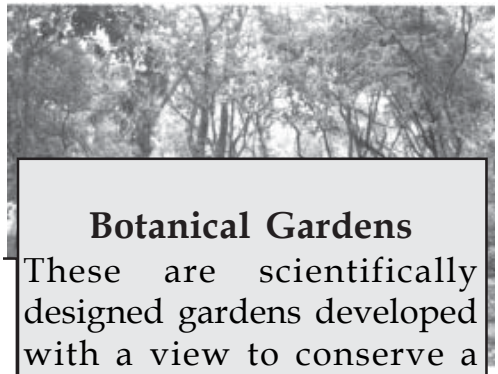
Biosphere Reserves

Biosphere reserves are replicas of the biosphere. When compared to other sanctuaries they have an extensive area. Many national parks and wild life sanctuaries are seen in a biosphere reserve. Silent Valley, Chenthuruni and Periyar belong to Nilgiri biosphere reserve. No human activity is permitted in the core zone of a biosphere reserve. It is the private land of the wild animals living there. The buffer zone around this is the storehouse of many resources. These resources can be utilized for studies and researches. Controlled human interventions are permissible. The outer most region or transition zone is the habitat of humans too. Human interventions are permissible in these regions. But the entry of human beings beyond this is subject to strict conditions and laws.



Zoological Gardens

From olden days man developed interest in rearing wild animals in artificial conditions. This interest has led to the setting up of zoos. Though the freedom and natural conditions of wild animals cannot be provided to the fullest extend, zoos have great importance as centers for conserving many endangered animals. The zoo at Thiruvananthapuram is a zoological garden which is very old and has a variety of animals.

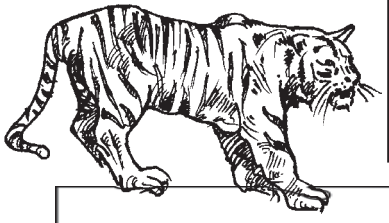


Botanical Gardens

These are scientifically designed gardens developed with a view to conserve a variety of plants. They are different from ordinary gardens. The plants will have labels containing information about them. The Tropical Botanical Garden and Research Institute (T B G R I) at Palode, Thiruvananthapuram is an example.

Gene Banks

Gene banks are modern technological system which collect and conserve the factors which control the characters of organisms (genes). There are many variant forms of gene banks like seed bank, sperm bank etc. Genes can be collected at when available and the organisms can be recreated when required. Thus their extinction can be prevented.



Project Tiger

Project Tiger was initiated when India's national animal – tiger faced threat of extinction. As per the project initiated in 1973, efforts were taken to conserve tigers in their natural habitats. There are twenty three such centers in India. E.g: Periyar Tiger Reserve in Thekkedy. Statistics indicates that as a result of Project Tiger, there is a significant increase in tiger population.

Red Data Book

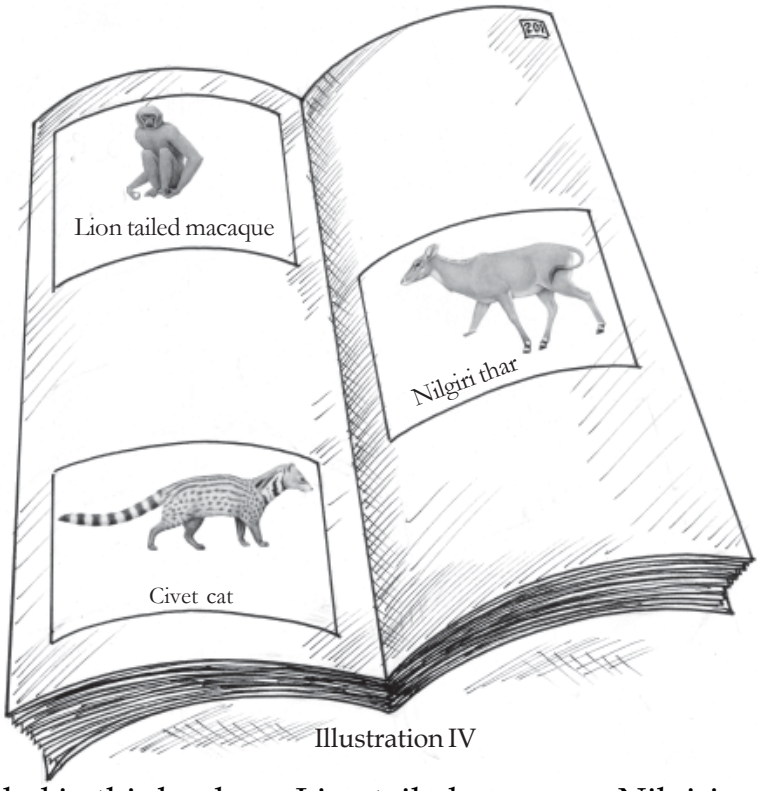


Illustration IV

Organisms which face the threat of extinction are listed in the Red Data Book. In addition to the Red Data Book prepared at the global level by IUCN, there are Red Data Books prepared by many countries on their own. On the basis of the intensity of threat faced by the organisms, they are included as various categories in this book. Some mammals of Kerala which are included in this book are Lion tailed macaque, Nilgiri thar and Civet cat.

Analyze the description you have read on the basis of the hints given below. Write your inferences in the science diary.

- How are wild life sanctuaries different from zoological gardens?
- Biosphere reserves are a cross section of the biosphere. Why?
- How does Project Tiger stand apart from other wildlife conservation projects?
- How does Gene Banks help in conserving biodiversity?
- What is the importance of the Red Data Book?

There are organizations and institutions at the national and international level for developing and coordinating biodiversity conservation activities. WWF (World Wide Fund for the conservation of plant and animal resources), IUCN (International Union for the Conservation of Nature and Natural Rescourses), Forest Survey of India, Wild Life Institute of India etc. are examples. There are many laws and rules related to the conservation of biodiversity existing in our country. Torturing and killing endangered animals and keeping them without special permission are punishable.

Legal protection

As per the biodiversity act of 2002, Biodiversity Boards were formed in all states. On the basis of it, bio diversity management committees should be constituted in each local self government institution. A biodiversity register of that locality has to be maintained by them. For this, the service of teachers, students, volunteers etc can be made use of. Along with making a biodiversity register, the local self government institutions have the responsibility to give directions to judiciously utilize the biological wealth of that locality for the benefit of the people there.

Why so much cruelty to animals!

The concept that man is the only heir of the biosphere is not right. Nature has accorded equal rights and importance to all organisms. But man tries to exploit all living things using his intellect. Though judicious exploitation is permissible, the reality is that many times it crosses the limits. Nowadays animals are commonly used for scientific experiments and they are tortured mercilessly before slaughter and hardships are also inflicted on them. Man himself has thought against these tendencies and has constituted many organizations a view to ending cruelty to animals. One such important organization is SPCA (Society for the Prevention of Cruelty to Animals).

When we consider the wealth of biodiversity in a locality, the number of endemic species has great importance. The regions where the numbers of endemic species are large and where the threats of ecological destruction exist are known as ecological hot spots. There are about 34 hot spots in the world. The most important among them are Western Ghats and the Eastern Himalayan regions of India. India is one of the twelve mega diversity nations of the world. This means that nature itself has selected India as a suitable

for most of the organisms to live in. This resource wealth is the fortune of our country. Each Indian has the responsibility to protect it.

- ★ Won't over importance to the conservation of biodiversity block development?
- ★ If we don't increase the pace of developmental process making use of science and technology, will the progress of mankind be possible?

Record your personal opinion. Exchange your ideas through a debate in the class room under the supervision of your teacher. Consolidate the debate on the basis of the hints given below.

- ★ How can we link conservation of biodiversity and development together?
- ★ What is meant by sustainable development?

4 CHANGES

30 years ago

Fig. 4.1 (a)

Now

Fig. 4.1 (b)

Haven't you seen the picture of a scene from a city? What changes have happened here during the past thirty years? In what all ways could these changes have affected the nature and the human beings here?

What all activities take place around us everyday? In your science diary write the changes happening in your kitchen and surroundings.

Are there helpful and harmful ones among them? Are there natural changes and artificial changes?

Which are they? ………………………………………………………..

In what other ways can you categorise changes? Write the classification and the criteria for it in the science dairy.

Your friend is trying to convert water into steam and back into water.

What could be the arrangements for this?

- -

- -

Can you too do it by making some arrangements like this? Try. Write the features of this change.

- -

- -

The diagram given is that of water and water vapour at the molecular level. Can't we understand what has happened to the molecules of water when heated and cooled?

The changes that have happened in the arrangement of water molecules when water became water vapour -

When water vapour became water -

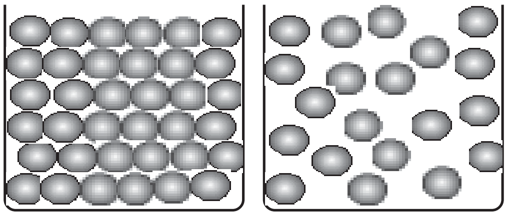


Fig. 4.2

Are all other changes like this? Look at the objects collected for conducting another experiment.

Ammonium dichromate crystals, pieces of tiles or bricks, match box.

Activity

Make a heap of ammonium dichromate crystals on the tile or brick. Cut and bury the heads of one or two match sticks on top of this heap so that it can catch fire easily. Burn a match stick and set fire to the heap.

Observe the changes that have happened.

- In colour ....
- In measure ....
- ....
- ....

Has a new substance been formed?

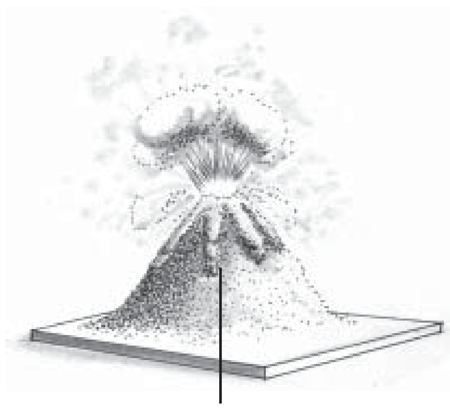


Fig. 4.3

Shall we do another experiment?

Make arrangements as seen in the picture and conduct this activity.

What are the materials required? Make a list.

The solution taken: Common salt solution to which two or three drops of phenolphthalein are added. The colour of the solution before the experiment

....

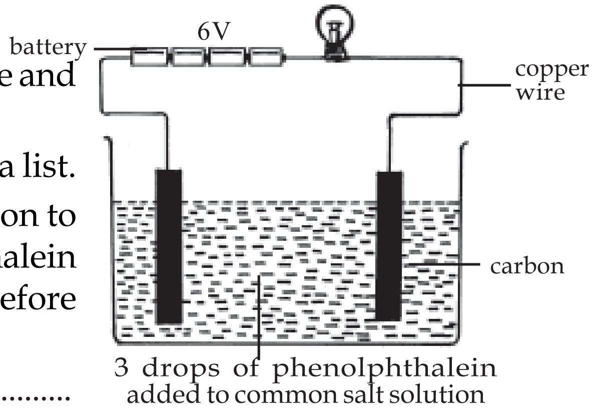


Fig. 4.4

What I observed from the experiment?

- -

What have you understood about the change that happened to the nature of the solution from its change in colour? Put a tick against the suitable statements. (✓)

The solution became acidic in nature. ☐

The solution became alkaline in nature. ☐

The solution hasn't changed. ☐

Haven't you learned that the solution in the end is not the one taken in the beginning of the experiment?

Phenolphthalein as an indicator

An indicator can be used to understand whether a substance has acidic nature or alkaline nature. Litmus or the juice of shoe flower or the juice of beetroot can be used as indicators. Phenolphthalein is an indicator used in the laboratory. It doesn't show any colour in acids and neutral solutions. But it shows pink colour in solutions of alkaline nature.

Thus when substances with different properties are formed, new molecules could have formed.

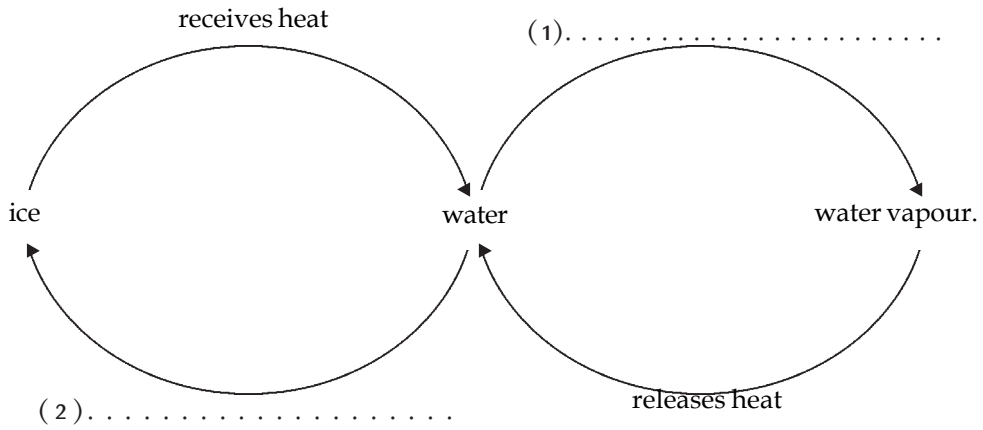
In the activity where the water was heated and cooled, only the arrangements of the molecules have changed when heated. Hence it could be reversed when it was cooled. These types of changes which are temporary are **physical changes.**

But in the other two activities, haven't new molecules been formed?

The substances formed here cannot be changed back to its former state of ammonium dichromate or common salt solution. That means these are permanent changes.

Since new molecules (substances) are formed, permanent changes are known as **chemical changes** or **chemical reactions**. Look at the diagram about the changes of state of water.

★ Which is the form of energy that influences the change of state of water?



Fill in the blanks (1) and (2) in the figure.

Find out more examples for physical changes and write what are the energy changes related to it, in the science dairy.

Now let's do some more activities.

Activity-1

After rubbing a piece of magnesium ribbon clean insert it into a flame.

Record the observation.

- -

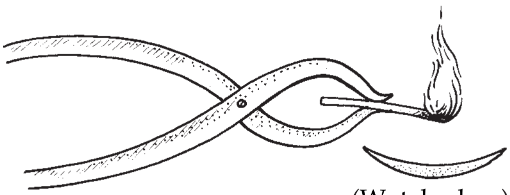


Fig. 4.5

Has a new substance been formed?

Collect the ash, dissolve it in some water and examine the nature of the solution with the help of litmus. What have you understood? Why do you say that it is a chemical change?

- -

Activity 2

Soak two pieces of white cloths of equal size in silver nitrate solution. Enclose one in a cardboard box without allowing any light to enter it. Place the second one at a spot where it gets direct sun light. Observe both after some time.

★ What change happened in the cloth placed in sunlight?

- -

- -

★ What change happened in the cloth placed in darkness?

- -

- -

★ What is the role of sunlight in the change of colour?

- -

- -

Activity 3

Take some potassium permanganate crystals in a dry test tube and show a burning splinter at the mouth of the test tube. What do you observe?

Then heat the test tube and repeat the experiment.

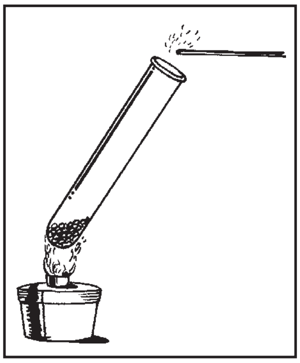


Fig. 4.6

Observation:

- -

- -

- ⋆ Which gas helped in this?
- ⋆ How was it formed?

  potassium permanganate → potassium manganate + manganese dioxide + oxygen

- ⋆ Which is the form of energy that influenced the decomposition of potassium permanganate?

Activity 4

Have you observed the arrangements in the figure?

Substances taken for experiment - copper wire, magnesium ribbon, dilute sulphuric acid.

Try to write the procedure of this experiment.

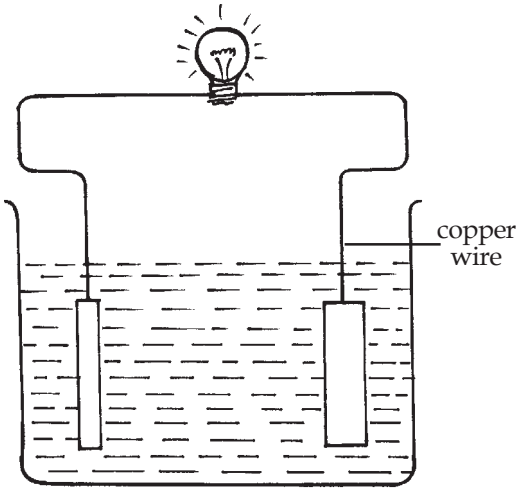


Fig. 4.7

Observation:

- -

- -

- -

Copper and magnesium are metals.

We know that metals react with acids.

What is the energy required for the bulb to glow? How might have it been formed? From the reactions done, so far we have discovered that new substances (molecules) are formed in permanent changes. What are the other features noted in such changes?

List in your science diary, the energy changes associated with each chemical change.

Activity	Forms of energy exchanged
1 Burning of magnesium	•
2	•
3	•
4	•

Table 4.1

Let's classify these chemical changes on the basis of the main form of energy associated with the above changes.

Activity	Form of energy mainly exchanged	Name of the reaction
1 Burning of magnesium	• Temperature	•Thermo-chemical reaction
2	•	•Photo chemical reaction
3	•	•
4	•	•Electro-chemical reaction

Table 4.2

★ Do all thermo-chemical reactions invariably release heat?

Haven't you seen lime being made from shells? Does lime have the same property as the shell? Shell is calcium carbonate. Look at some of the features of the gas obtained when the shell is heated.


Fig. 4.8

- If we pass it through clear lime water, it will turn milky.
- It is heavier than air.
- It can extinguish fire.

  Which might be this gas? Fill the equation given below.

  Calcium carbonate + heat → calcium oxide + …………

★ Is the process of continuous heating an indication of absorbing or releasing heat?

Grind a few pieces of calcium oxide, put them in a test tube and pour some water. What do you feel when you touch the bottom of the test tube?

- -

Calcium oxide + water → calcium hydroxide + heat.

★ What is the common name of the new substance found?

★ When shells are converted to lime heat is absorbed. But what happens when lime is converted into slaked lime?

- -

Thermo chemical reactions include **exothermic reactions** and **endothermic reactions.**

What about other activities?

- -

> The substances that take part in a chemical reaction are the ***reactants*** and the substances formed as a result of the reactions are the ***products***.

List the reactants and products in the activities done by you, in your science diary.

Shall we pass electricity through water?

Remove the insulation from both the ends of two insulated copper wires of medium lengths. Connect one end of each to the graphite rods taken from a discarded battery. Fix the two rods in a glass beaker with candle wax, as shown in the figure 4.9. Pour water into the beaker and add a few drops of an acid. Place inverted test tubes filled with water over each graphite rod.

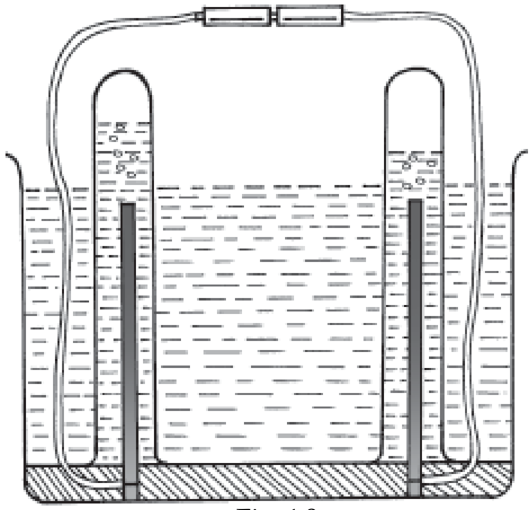


Fig. 4.9

Do it carefully with the help of your teacher.

Connect the free ends of the wire to a battery.

Our observations.

- -

- -

Shall we examine the gases formed? Take out the two test tubes carefully and show a burning splinter at their mouths. What can you see?

★ What are the gases in each?

- -

- -

★ Which was the energy absorbed for the decomposition of water?

Like this there are also other activities in which energy is absorbed or released. Complete table 4.3 with examples.

Those absorbing heat : Those releasing heat :	
Those absorbing electric energy : Those releasing electric energy :	
Those absorbing light energy : Those releasing light energy :	

Table 4.3

Are there occasions in our daily life where we use the energy changes that take place during chemical changes?

Look at some situations.

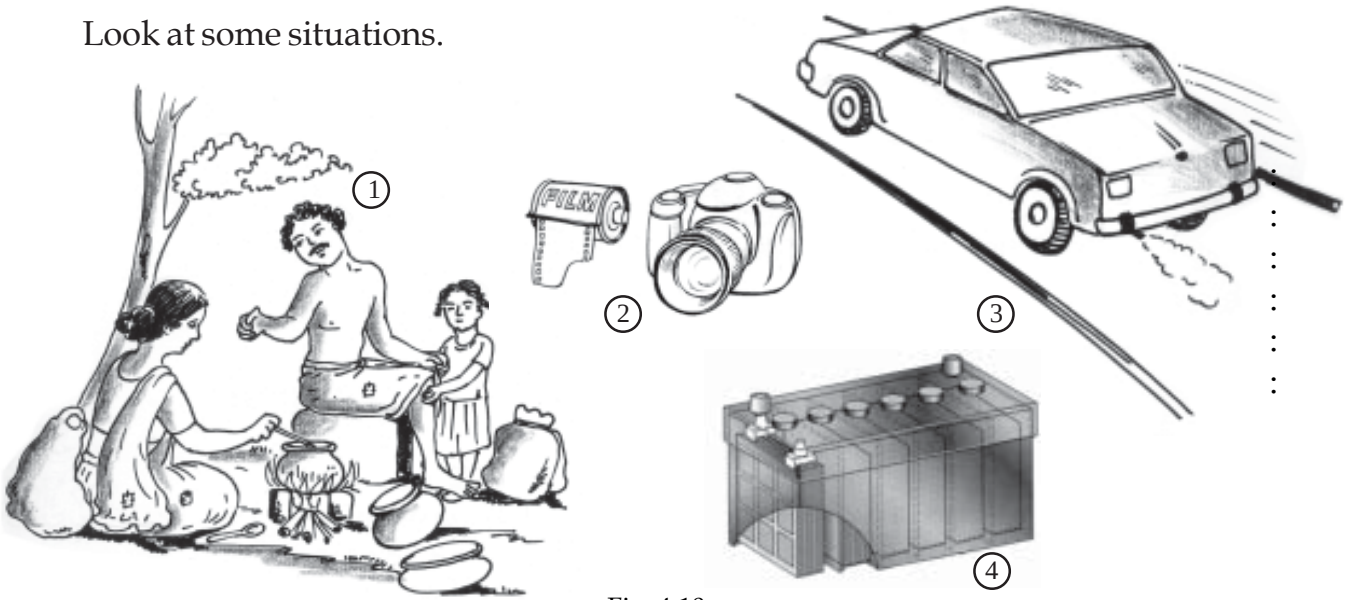


Fig. 4.10

Analyse the picture and record in your science diary the main energy changes happening in each situation.

Can't you find out more examples?

The Chemistry of Fire Works

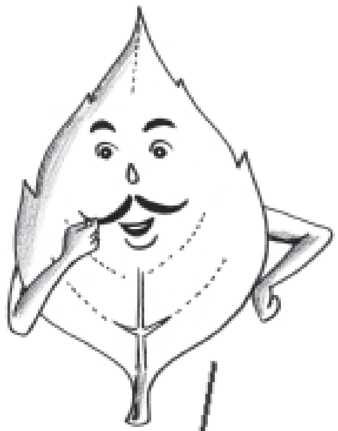
The burning of gun powder is a chemical reaction. The gunpowder mixture is made by mixing potassium chloride, powdered sulphur and carbon powder. Potassium nitrate (Nitre) is also used for it. As the burning of this is a very fast process, a lot of gas is formed suddenly. As a result explosion and brilliant flames are produced. In order to increase the brilliance, aluminium powder is used. The chemicals added with the gun powder give beautiful colours to the flame.

Fig. 4.11

Salts of different metals are added for this. Copper salt gives bluish green colour to the flame, barium salts give light green colour, potassium salts give lilac colour and sodium salts give yellow colour. Calcium salts are used to give brick-red colour to the flame.

Collect available salts among these from the school laboratory. Grind each of them thoroughly, take them in a watch glass and make a paste by adding a little amount of concentrated hydrochloric acid. Take a little bit of this at the charred end of a splinter and insert it at the colourless part of a flame. Observe the colours given by each salt to the flame.

- -



The Boasting of Green Leaf

Only I and my friends can make food using sunlight, water and carbon dioxide in air. What would be your condition if I were not in this world?

You feel proud that you are doing great things. You boast that world is at your fingertips. But could you ever make starch using carbon dioxide, sunlight and water in a laboratory…?

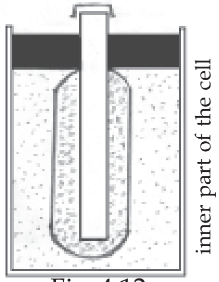
Look at the boasting of green leaf…?

Had there been no sunlight…?

Encased Electricity

You have seen dry cells used in torches and other electronic equipments. Break open a dry cell.

What can you see?

Mercury cell	Dry cell
This cell is made by filling chemicals like mercury, mercuric oxide, carbon powder, zinc oxide etc in a steel container having the size of a button. Mercury cell is used in watches, calculators, small torches and toys. Because of the presence of the highly poisonous mercury, throwing them away after use is becoming an environmental hazard. 	The dry cell is a zinc container having a mixture of manganese dioxide and carbon powder into which a graphite rod is inserted. In between the mixture and the rod, there is a paste of ammonium chloride and zinc chloride. When the zinc container and the brass cap of the graphite rod are connected to a device, using wires, electricity produced by the chemical reaction in the cell will flow through the device.  Fig. 4.12

Cells are systems which generate electricity through chemical change.

★ Do you know about other cells used in electronic equipments? Write their names.

★ There are cells which can be recharged and reused. Write their names.

•

•

You can also make a battery

Materials needed: two or three potatoes, copper plate, zinc plate, copper wire and LED.

Arrange the equipments as in the picture. You may repeat the experiment using other available fruits and vegetables instead of potato. From which do you get more electricity? Try to find out using milli voltmeter.

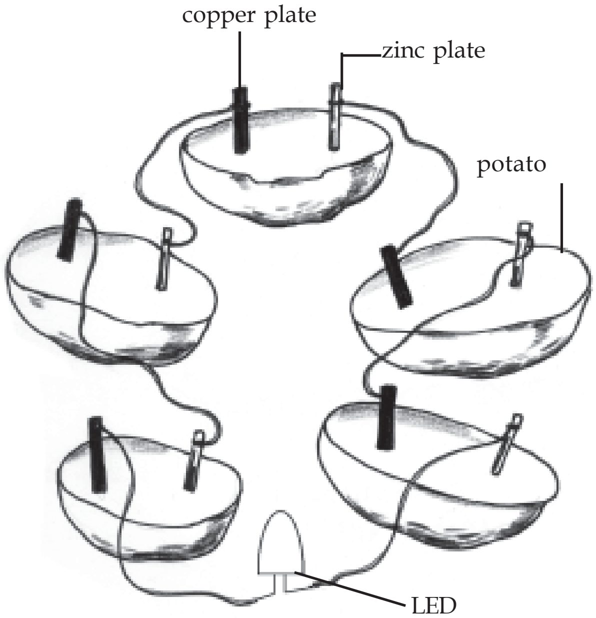


Fig. 4.13

Look at another instance where electro chemical reactions are made use of.

One gram gold covered ornaments are available here.

You have noticed such advertisements. Electricity is made use of to make a thin but beautiful coating of a small amount of gold on metals. This process is called **electroplating**.

Look at the simple arrangement for plating gold.

Haven't you noticed the way in which the object to be coated with gold and the gold sheet are connected with the battery.

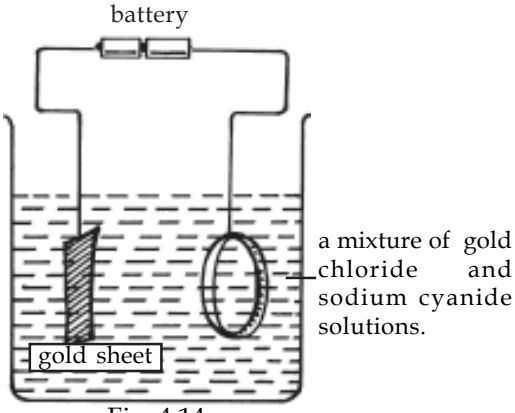


Fig. 4.14

Shall we electroplate copper on an iron nail?

We can use copper sulphate dissolved in water, as the solution. Seek the help of your teacher to make the arrangements.

Find out other situations in which electroplating is made use of and record it in your science diary.

Seminar

Shall we conduct a seminar in the class based on the topic 'Chemical reactions and the energy changes in them'? You have analysed certain chemical changes and situations related to daily life. What should be done to develop them further? Write them in the science diary?

Many of the changes about which we discussed here are beneficial to the progress of mankind. At the same time aren't some of them against nature?

Equilibrium of Nature

The very basis of the existence of the life is the states of equilibrium formed automatically in nature. A lot of changes are happening in the nature every moment. There are natural (innate) changes among them as well as those artificially made by man. Nature will easily adjust itself to natural changes and a certain extent to the artificial changes and substances made by us. But if the limits are exceeded, the balance and rhythm will be lost. Even though organic wastes can decompose, they will create problems on accumulation. Then what will happen if non degradable substances get accumulated?

Concrete covering the soil

Most of the buildings being erected around us are concrete buildings. These have only a life span of fifty to hundred years. After some years they will develop leakage, the iron bars get rusted and eventually they will collapse. Then shouldn't we dismantle them and build new ones? Do mites eat the dismantled building parts or do these building parts dissolve in soil? If such buildings are dismantled on a large scale, what will be the condition of our soil? Have you started facing such problems around you?

Light emitters that may become harmful

We have listed cells that produce electricity through chemical reactions.

How long are these cells used?

Type of cell	Devices that use this cell	Approximate life span of the cell
Dry cell	• Radio • Torch • Clocks • Remote control	• 3 – 6 months • • •
Mercury cell	• Small torches • Watches • Calculators	• • •
Nickel–Cadmium cell	• Rechargeable torch	•
Lithium ion cell	• Mobile phones	• 6 – 12 months

Table 4.4

When the same type of cell is used for different purposes, the duration for which the cell lasts may change. E.g.: Small dry cells when used in a camera lose their charge within a few hours.

- ⋆ What do you do with such cells after use? Can they be recharged? If possible, how many times?
- ⋆ In the houses in your locality, how many of these types of cells are used in a month?
- ⋆ Do the chemicals in these cells cause pollution?

The changes we bring about to produce new products and our carelessness in using them are becoming harmful to us.

What are the situations that you can cite as examples from the scene of a city given at the beginning of the lesson as well as from your locality? Prepare and present a note on it.

5 Molecule, Atom

Fig 5.1 (a)

Making smaller ... and smaller....

You are familiar with situations in which large ice blocks are broken down into small pieces. Can you list other situations in which objects are broken into different sizes and used?

-
-
-

Fig 5.1 (b)

Fig 5.1 (c)

★ Ice pieces can further be broken into smaller grains. To what extent can this be continued? If a grain of ice is placed in open, won't it change into water and then into water vapour? Are we able to see water vapour? What may be the reason?

You have realised that objects can be made invisibly small. What can you do to convince this using sugar and salt? Record it in your science diary. Sugar and salt are available in different sizes - as big blocks, small grains and powder. What are the properties retained by them in all these forms?

- Sugar .....
- Salt .....

★ Even when salt and sugar are made invisibly small, do they retain their properties? How did you understand it?

★ What may be the reason?

Is it not the presence of particles having the properties of sugar that gives a sugar solution its qualities?

★ Then, what with salt solution?

★ Why does any part of a sugar candy taste sweet? Is it due to the similarity of tiny particles? Why do salt and sugar candy show different qualities? Isn't it because of the difference in their tiny particles?

In sugar, we have only the tiny particles of sugar. Hence sugar is a pure substance.

A molecule is the smallest particle having all the basic properties of a pure substance. All the molecules of a pure substance are alike.

★ Which are the molecules present in sugar solution?

★ Can you list down substances having different kinds of molecules and substances having only one kind of molecule?

Same kind of molecule	Different kinds of molecules
• Glucose • • •	• Rice water • • •

Table 5.1

Sugar and salt are pure substances while sugar solution and rice water are mixtures. Then can you write working definitions for pure substances and mixtures?

- -

- -

Find out more examples for pure substances and mixtures.

Let's investigate more about mixtures.

How did mixture bought from bakeries get its name? Are the properties of mixture same throughout it? How can we examine?

- -

- -

★ Sugar solution is a mixture. Are its properties the same as that of the mixture in a bakery? What are the differences between them?

Homogeneous mixtures have uniform properties throughout the mixture. Heterogeneous mixtures have different properties in different parts. Find more examples for homogeneous and heterogeneous mixtures and write down.

'All solutions are homogeneous mixtures.' Do you agree with this statement? Explain with reasons.

Let's separate the components

You have understood that there are different kinds of molecules in mixtures. Can you separate the components of mixtures? Record, in your science diary, the method of separating salt from salt solution.

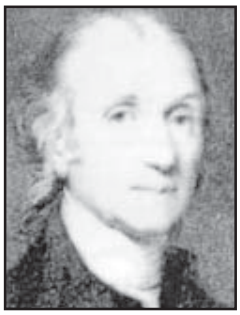
Can the salt and the water separated from the salt solution be again divided into their components?

If it can be done, will they lose their properties?

Those who let the giant free

There was a period when there existed the tendency of explaining natural phenomena on the basis of certain principles only. Prominent in those days were the theories of Aristotle who was one among the ancient philosophers. These theories were not based on experiments and observations. Aristotle argued that the basic constituents of matter are elements like air, soil, water and fire. The argument that existed in India were that matter is made up of five elements with the sky included. Can we think like that today? How was Aristotle's theory over-thrown? Experiments and observations conducted by Robert Boyle (1627 – 1691) and the bold experiments conducted by scientists like Joseph Priestly (1733 – 1804) and Henry Cavendish (1731 – 1810) gave us new information about the composition of matter.

Henry Cavendish proved that water is a substance composed of more than one constituent. The famous experiment conducted by him by burning hydrogen gas in oxygen led the world of science to understand the constituents of water. This was confirmed by the experiments done by Humphry Davy in 1806 by passing electricity through water



Henry Cavendish
1731-1810
Fig. 5.2

- ⋆ What clues does it give about the constituents of a water molecule?

  Like Humphry Davy, you also have done the experiment to dissociate water. What were your observations?

- ⋆ What are the constituents of water identified by you?
- ⋆ Conduct more experiments to learn about the constituents of a molecule.

Activity – 1

Take some sugar in a dry test tube. Place some anhydrous copper sulphate wrapped in cotton at the mouth of the test tube. Heat the test tube for some time. Record the observations in the science diary.

What is the substance remaining in the test tube? Does it have the property of sugar?

Did you identify the substance that could have caused the colour change in the copper sulphate wrapped in cotton? What are its constituents?

To identify the presence of water

Copper sulphate crystals are blue in colour. If we heat it strongly, it will change into a white powder. This is anhydrous copper sulphate. If we add water to it, the colour will be regained.

Find out the constituents of sugar by analysing the results that you got from this experiment.

Constituents of sugar.

-
-
-

Activity – 2

Take mercuric oxide in a test tube and heat it strongly. Show a glowing splinter at the mouth of the test tube. What do you observe? Which gas came out of the test tube? What are the shining drops sticking to the sides of the test tube?

Note down your inferences.

Do the tiny constituents of the molecule have the same properties as that of the original substance? Record the inferences you have arrived at, based on your experiments.

Fig. 5.3

Joseph Priestly
1733-1804

Joseph Priestly made oxygen for the first time by heating mercuric oxide.

- -
- -

The tiny constituents, with which molecules are built, are **atoms**. If there is only one kind of atoms in the molecule of the substance, it is an **element**. Substances formed by the combination of the atoms of different elements are **compounds**. Elements and compounds are pure substances.

More substances and the atoms in them

Substance	Atoms contained in a molecule
Carbon dioxide	Carbon , Oxygen
Hydrogen chloride	Hydrogen, Chlorine
Oxygen	Oxygen
Common salt	Sodium, Chlorine
Nitrogen	Nitrogen
Water	…….....
Hydrogen	Hydrogen
Carbon	Carbon
Sugar	…….....
Mercuric oxide	…….....

Table 5.2

- ⋆ Are all molecules alike? Which of them are formed from the same kind of atoms? Which molecules have different kinds of atoms in them?

Classify the substances in table 5.2 into elements and compounds.

Elements	Compounds
•	•
•	•
•	•

Table 5.3

Expand the table as you get more information and write it in your science diary. The table 5.4 given below shows details of all the elements discovered so far. Analyse the table and find out the following.

- ⋆ How many elements are there in total?
- ⋆ Which are the elements more familiar to you?
- ⋆ Which elements have you seen directly?
- ⋆ Which elements are more useful to us in our daily life?
- ⋆ Many of the elements are in solid state. Which elements are found in liquid state and gaseous state?

Periodic Table of Elements

Key
gas
liquids
artifical elements

Atomic Number
Symbol
Name
Name in English
Name in Latin/Greek

1 H Hydrogen																	2 He Helium
3 Li Lithium	4 Be Beryllium											5 B Boron	6 C Carbon	7 N Nitrogen	8 O Oxygen	9 F Fluorine	10 Ne Neon
11 Na Sodium (Natrium)	12 Mg Magnesium											13 Al Aluminium	14 Si Silicon	15 P Phosphorus	16 S Sulphur	17 Cl Chlorine	18 Ar Argon
19 K Potassium (Kalium)	20 Ca Calcium	21 Sc Scandium	22 Ti Titanium	23 V Vanadium	24 Cr Chromium	25 Mn Manganese	26 Fe Iron (Ferrum)	27 Co Cobalt	28 Ni Nickel	29 Cu Copper (Cuprum)	30 Zn Zinc	31 Ga Gallium	32 Ge Germanium	33 As Arsenic	34 Se Selenium	35 Br Bromine	36 Kr Krypton
37 Rb Rubidium	38 Sr Strontium	39 Y Yttrium	40 Zr Zirconium	41 Nb Niobium	42 Mo Molybde-num	43 Tc Technetium	44 Ru Ruthenium	45 Rh Rhodium	46 Pd Palladium	47 Ag Silver (Argentum)	48 Cd Cadmium	49 In Indium	50 Sn Tin (Stanum)	51 Sb Antimony (Stibium)	52 Te Tellurium	53 I Iodine	54 Xe Xenon
55 Cs Caesium	56 Ba Barium	57 La Lanthanum	72 Hf Hafnium	73 Ta Tantalum	74 W Tungsten (Wolfrum)	75 Re Rhenium	76 Os Osmium	77 Ir Iridium	78 Pt Platinum	79 Au Gold (Aurum)	80 Hg Mercury (Hydrargyrum)	81 Tl Thallium	82 Pb Lead (Plumbum)	83 Bi Bismuth	84 Po Polonium	85 At Astatine	86 Rn Radon
87 Fr Francium	88 Ra Radium	89 Ac Actinium	104 Rf Rutherfordium	105 Db Dubnium	106 Sg Seaborgium	107 Bh Bohrium	108 Hs Hassium	109 Mt Meitnerium	110 Ds Darmstadtium	111 Rg Roentgenium	112 Uub Ununbium	113 Uut Ununtrium	114 Uuq Ununquddium	115 Uup Ununpentium	116 Uuh Ununhesium		118 Uuo Ununoctium

58 Ce Cerium	59 Pr Praseody-mium	60 Nd Neodymium	61 Pm Promethium	62 Sm Samarium	63 Eu Europium	64 Gd Gadolinium	65 Tb Terbium	66 Dy Dysprosium	67 Ho Holmium	68 Er Erbium	69 Tm Thulium	71 Yb Ytterbium	71 Lu Lutetium
90 Th Thorium	91 Pa Protactinium	92 U Uranium	93 Np Neptunium	94 Pu Plutonium	95 Am Americium	96 Cm Curium	97 Bk Berkelium	98 Cf Californium	99 Es Einsteinium	100 Fm Fermium	101 Md Mendelevium	102 No Nobelium	103 Lr Lawrencium

Table 5.4

What information have you collected about elements so far?
Prepare a note including all these, and write it in your science diary

Illustrations of the molecules of some substances are given in the box.

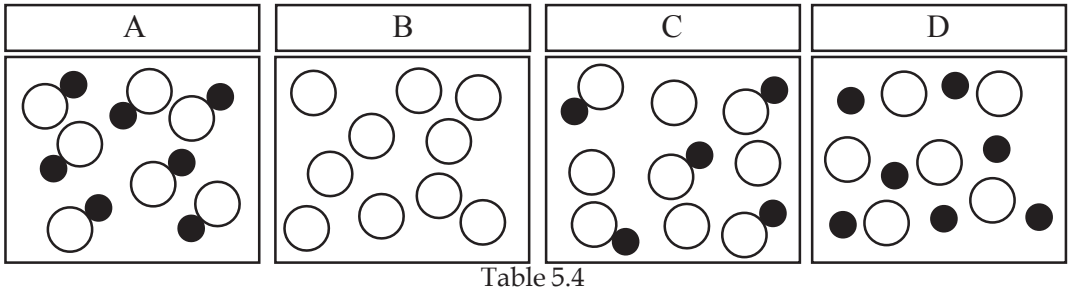
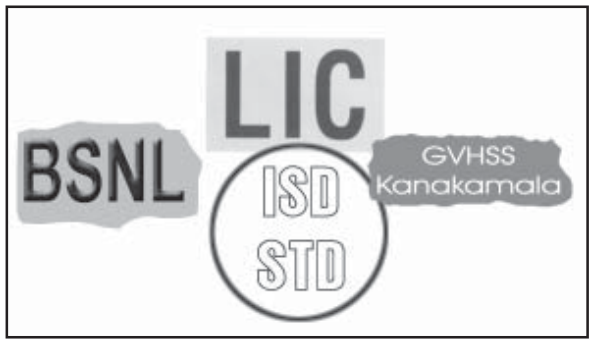


Table 5.4

★ Analyse the figure and find out which among them is an element, a compound and a mixture. Are there any differences between the mixtures found out? Which mixture contains only elements?

Abbreviations in Chemistry too

What ways do we adopt to indicate something quite easily? We use abbreviations instead of writing the full name of our school. Like this don't we use many abbreviations for day to day communications? List down the situations you are familiar with.



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Let's look at the possibilities of using abbreviations in the study of chemistry. Like this, why can't we use symbols and abbrevations to understand elements easily?

Name of elements	symbols (abbreviations)
Hydrogen	H
Helium	He
Aluminium	Al
Carbon	C
Calcium	Ca
Oxygen	O
Nitrogen	N
Neon	Ne
Chlorine	Cl
Phosphorus	P
Curium	Cm
Roentgenium	Rg

Table 5.5

Examine the table and prepare a note regarding the basis of forming a symbol.

Clues

- The relationship of names of elements with their symbols.
- The reason for using two letters in a symbol, the method adopted for writing symbols and the features of the letters used.

See how the symbols of some other elements have been formed. Can you find the basis of forming these symbols?

Name	Latin name	Symbol	The basis of accepting these symbols
Sodium	Natrium	Na	
Potassium	Kalium	K	
Gold	Aurum	Au	
Silver	Argentum	Ag	
Iron	Ferrum	Fe	
Copper	Cuprum	Cu	
Mercury	Hydrargyrum	Hg	

Table 5.6

Haven't you listed the elements known to you earlier? Find out their symbols and expand the table.

- Symbols are the abbreviations of names of elements.
- A symbol indicates an atom of an element.
  If we write 'H', it is the symbol of hydrogen and at the same time it indicates an atom of hydrogen. Based on this do the following activities.

★ 12H, 3C and 5Al. What does each of these indicate?

★ How can you write the abbreviated form for five sodium atoms, two phosphorus atoms and fifteen nitrogen atoms?
(Use the periodic table to find out the names and symbols).

The symbols we use now in the study of chemistry were developed by the scientist, Berselius.

Berselius

Fig. 5.5

Born on August 20, 1779 at Linkoping in Sweden, his father and mother died before he attained the age of ten. He earned M.D (Doctor of Medicine) degree at the age of twenty three. His 'Text Book of Chemistry - Part I' was published in 1808 and Part II was published in 1812. It was the most authentic text of those times and was translated into five European languages.
He discovered the elements selenium, thorium, cerium and silicon.
The king of Sweden honoured him with the title of 'Baron'.

★ In what ways did this method introduced by Berselius help in the study of chemistry?
Isn't it interesting to know the ways in which the elements got their name?

★ Which are the elements that are given the names of scientists? Write the names of those elements and their symbols.

- -

- -

The scientists are honoured by giving their names to elements, in recognition of their contributions to science.
Though a lot of contributions are to his credit, the name of Berselius was perhaps forgotten here.
Collect information about the lives and scientific achievements of these scientists.
Why don't we publish this in our school science magazine?
Find out the names of elements associated with countries, regions and planets and make a list of them with their symbols.

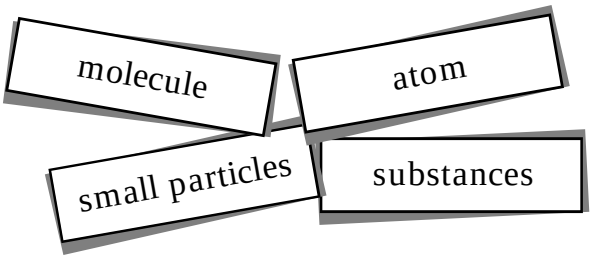
6 STRUCTURE OF AN ATOM

Smaller than the smallest

We have already gone into the variety and minuteness of substances. What all things have you understood? Have you ever thought of this world of minute particles which are beyond your sight? Don't their colour, shape, size, movement and nature arouse wonder in you? Shall we make a journey into the interiors of this micro world?

Before doing that, recollect what you have understood so far.

Can you arrange the items in the boxes in the descending order of their size?



Is atom divisible? Dalton's theory says 'no'.

John Dalton

Even before centuries, visionaries predicted that substances were made of small particles. philosophers like Kanadan (India), Democretes (Greece) and others believed in atomic theory. Investigation into the structure of matter led them to the atomic theory. The propounder of atomic theory in modern period is John Dalton (1807). The following are the postulates of Dalton on an atom.

(1776 - 1884)
Fig. 6.1

- All matter is made up of small particles called atoms.
- Atom is the smallest particle which can engage in a chemical reaction.
- All the atoms of an element have the same properties. That is, they have the same mass, size and character.
- Atoms of different elements have different characteristics.
- Atoms can neither be created nor destroyed.
- Atoms are indivisible.

The word 'atom' originated from the Latin word 'atomos' which means "that which cannot be divided". But certain accidental discoveries in the world of science changed Dalton's concept that atom is 'indivisible'.

Into an atom

Have you worn silk or polyester clothes immediately after ironing them? What have you experienced? What did you feel when you placed your hand near the TV screen immediately after switching it off?

Rub a plastic scale on dry hair and bring it near tiny bits of paper.

What do you observe?

.....

This happens because electric charge is produced when substances are rubbed against each other.

A scientist named Michael Faraday dissolved some substances like sodium chloride in water and passed electricity through it. He realised from his observation that there is electric charge in the substances dissolved. He made this finding in 1830s. Have you ever thought why substances have electric charge like this?

Nature of electric charge

When a body is charged, it attracts other chargeless bodies. Charges are of two kinds: positive (+ve) and negative (-ve). Like charges repel and unlike charges attract.

Michael Faraday's experiment was a beginning in this line. This paved the way for a detailed study of the characteristic features of these substances. A large number of scientists have given laudable contributions in this field. Neils Bohr, through his atom model, presented a simple and scientific explanation of the structure of atom, so as to describe the properties of substances. This gained wide spread recognition in those days.

Look at the Bohr model of Lithium atom.

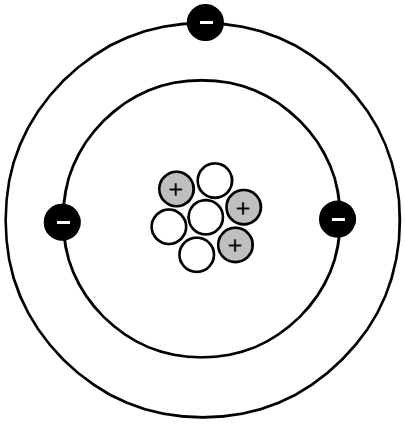


Fig. 6.2

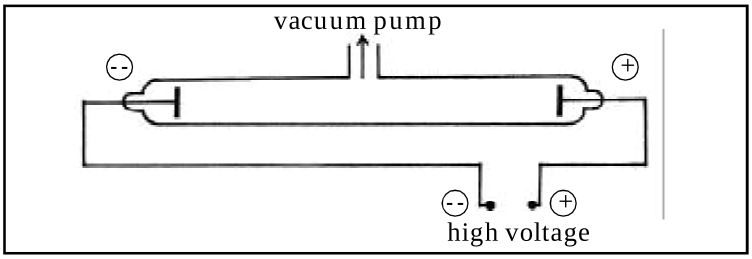
The figure is indicative of the structure of Lithium atom. Aren't there clear hints in this figure that there are minute particles within an atom? Can you guess from the figure, how many types of particles are there in an atom?

.....

Let's look into the history of science that led to the finding that in an atom there are particles smaller than it.

It is from the experiments done by passing electricity through gases at low pressure in an

instrument called discharge tube that the world of science was led to the secrets of charge. The experiments conducted by Sir J.J.Thompson after making certain changes in the discharge tube, revealed some clear pictures of it.



Discharge Tube

Fig. 6.3

J.J.Thompson
(1856 - 1940)
Fig. 6.4

Thompson noticed that when electricity was passed through the gas in the discharge tube at a low pressure, the glass walls of the tube at the side of the positive plate were glowing. He found out that some particles formed inside the tube caused this glow.

When an opaque object was placed as a hindrance, its shadow was formed at the positive plate.

★ From this observation, what inference can you draw on the path and direction of travel of these particles?

- -

- -

- Plates with positive and negative charge were arranged in the path of particles coming from the tube, as shown in the figure.

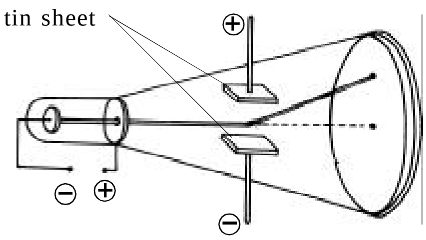


Fig. 6.5

Observation: The path of particles causing the glow was found to have deviated towards the plate with positive charge.

★ The glow was attracted towards the positive plate. What inference can you draw on the charge of the particles from this?

- -

- -

- Though metal plates, gases and discharge tubes used were changed repeatedly, no changes in the nature of particles were observed.

★ What might be the reason for getting the same result when the experiment was repeated by changing the objects used?

The inferences arrived by Sir J.J.Thompson

- The cause of the glow is the invisible rays emitted from the negative metal plate of the discharge tube.
- It is a flow of particles with negative charge.
- There are particles carrying negative charge in all substances.

These particles which had negligible mass were given the name "electron". The mass of an electron is 1/1837 of the mass of the smallest atom - hydrogen.

Thus the world of science in 1897 recognised that atoms are made up of minute particles and that atoms are divisible.

Protons as part of atoms

If there are only electrons in atoms, won't all substances become negatively charged and repel mutually?
Do substances around us repel in this manner? The investigations which took place subsequently were related to this.
The scientist Goldstein conducted another experiment using discharge tube and identified the presence of positively charged particles in the atom.
Later Ernest Rutherford, through his experiments, confirmed the presence of protons - the positive particles in an atom. A proton has almost as much mass as a hydrogen atom. He discovered that its charge is equal and opposite to that of an electron.


Ernest Rutherford
(1871 - 1937)

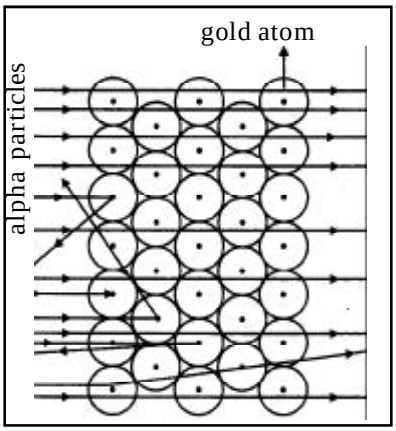
Fig. 6.6

Why is it that the atoms and the substances formed by combining them don't have charge?

Gold foil experiment

Gold has some specialities that make it different from other metals. Gold is a metal which can be made into very thin foil. We can make gold foils which have only the thickness of a few atoms.

Rutherford conducted the experiment by allowing high speed alpha particles to hit a very thin gold foil. Most of the alpha particles passed through it. The paths of some particles were seen to have slightly deviated. Some rare ones (about one in 20,000) came back in the opposite direction as if they hit at something. Rutherford found out these things by analysing the impressions made by alpha particles on a screen placed behind the gold foil. He arrived at some inferences from these observations.



Deviation of alpha particles through gold foil
Fig. 6.7

- Atom has a central part. He called it nucleus.
- Nucleus has positive charge.
- Compared with the total volume of an atom, the volume of the nucleus is very meager.
- The mass of an atom is concentrated in the nucleus.
- Electrons are distributed in the space around the nucleus.

Alpha particles

Alpha particles (α particles) are particles having positive charge and mass. They are repelled by positive charge and are attracted by negative charge.

Examine the results of the experiment and inferences of Rutherford.

★ Why did majority of the alpha particles pass through the gold foil?

★ Why did the path of only some alpha particles deviate?

★ What may be the reasons for the return of an extremely smaller number of alpha particles?

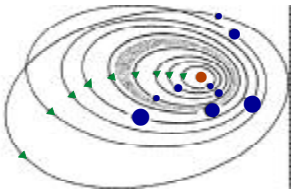
What inferences of Rutherford will help you to answer these questions?

★ Do you agree with the idea that 'All protons are concentrated in a particular part in an atom?' Note down your opinion in the science diary.

The Model of an Atom

Rutherford presented an atom model based on his inferences.
The central part of an atom is its nucleus. The nucleus is very small in size and it has positive charge. Negatively charged electrons revolve around nucleus at high speed. Almost whole of the mass of an atom is concentrated in the nucleus.

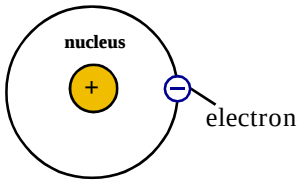
The structure of the atom presented by Rutherford is similar to that of the solar system.



Universe

Fig. 6.8

Analyse and fill up the table



The atom model of Rutherford

Fig. 6.9

Universe	Atom
Centre : Sun	Centre : .....
Planets : Revolve around the sun	Electron : .....
Orbit : Path through which planets move	Orbit : .....

Table 6.1

Though Rutherford suggested the model of the atom, he faced difficulty in explaining the difference in the total mass of the protons and the total mass of the atom. He couldn't state precisely the reason for this. But in the 1920s itself Rutherford had predicted the presence of a neutral particle having mass inside the nucleus.
As a result of the many studies that followed, James Chadwick in 1932 found out that apart from electron and proton, there is also a chargeless particle named neutron in an atom. Its mass is almost equal to the mass of a proton.

Consolidate and complete the table.

Particles in an atom	Electric charge	Mass	Location in the atom
Electron Proton Neutron			

Table 6.2

Bohr model

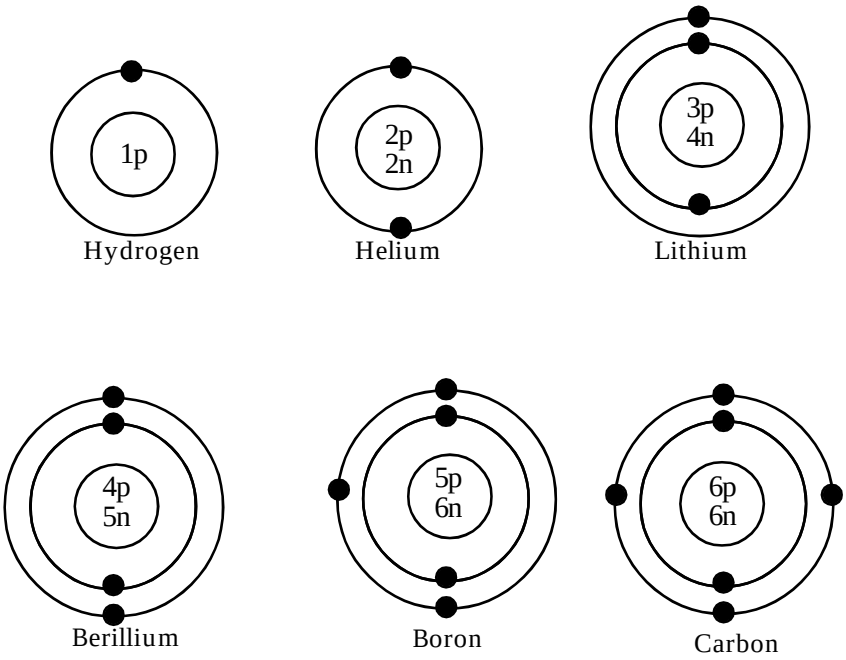
Unlike in the solar system, electrons in the Rutherford model revolve around a charged nucleus. James Clark Maxwell postulates that when one charge revolves around another charge, it will lose energy and ultimately will come closer to the nucleus. When this posed a challenge for the stability of the atom, there arose the need for a better model of an atom.

Neils Bohr established that when electron revolves through certain definite paths around the nucleus, it doesn't suffer energy change. He called these paths orbits. He understood that a definite number of electrons are included in each orbit.

Each of the orbits is a specific energy level. The energy of electrons in a particular orbit doesn't change. The energy of orbits increases with increase in its distance from the nucleus.

In the Bohr model of the atom, energy levels 1,2,3,4 and 5 are represented by the letters K,L,M,N and O respectively. Later, these energy levels were known as 'shells'.

Look at the Bohr model of some atoms.



Hints

- ● - electron
- p - proton
- n - neutron

Fig. 6.10

Examine the number of protons in each atom.

★ Do any two elements have the same number of protons?
Do the elements differ when the number of protons changes?

★ Are there elements which have equal number of neutrons?
Which are the particles that decide an element- protons or neutrons ?

The number of protons in an atom is the atomic number (z) of the element.

★ What is the relationship between the number of protons and the number of electrons in an atom? Analyse the Bohr model and find it out.

★ What is the relationship between atomic number, the number of protons and the number of electrons? Write down.

★ Which are the particles that mainly decide the mass of an element?

★ Where are they located in the atom?

The total number of particles in the nucleus is known as mass number (M). Mass number is the total number of protons and neutrons.

Look at the abbreviations of the elements referred to above.

$^{1}_{1}H$, $^{4}_{2}He$, $^{7}_{3}Li$, $^{9}_{4}Be$, $^{11}_{5}B$, $^{12}_{6}C$

What do each numbers written above and below the symbols stand for?
Write the hints in the symbol of berillium given below.

(.....)$^{9}_{4}$Be

Look at the symbol of fluorine.

$^{19}_{9}F$

$^{19}_{9}F$ Z = ...
M = ...

★ How many protons are there in a fluorine atom?

★ What is the number of electrons?

★ Can you find out the number of neutrons by relating the mass number and the atomic number?

Form an equation to find out the number of neutrons.
The number of neutrons = _____

Electrons in Shells

How many electrons are there in a hydrogen atom? In which shell are they located? Can you analyse the Bohr model? What about helium atom?

★ How are electrons arranged in lithium?
1st shell (K) _____ electrons
2nd shell (L)_____electrons

Since more than two electrons cannot be accommodated in K shell, the next electron is arranged in the L shell.

The Bohr model of sodium is given in the picture.

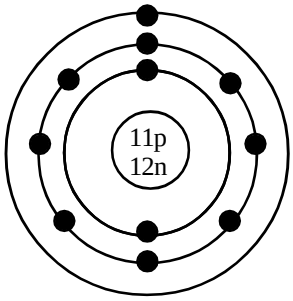
★ How many electrons are there in sodium atom?
.....

★ How many in K shell? .....

★ What is the remaining number of electrons? .....

Examine the figure.

What guess can you make about the maximum number of electrons that can be accommodated in the L shell?



Model of Sodium atom
Fig. 6.11

.....

There is a limit to the maximum number of electrons that a shell can contain. This can be found out using the formula $2n^2$. 'n' indicates the shell number.

Write in the table, the maximum number of electrons that can be included in each shell, based on the formula.

Shell	Shell number	The maximum number of electrons to be accommodated($2n^2$)
K	1	$2 \times 1^2 = 2$
L	2	
M	3	
N	4	
O	5	

Table 6.3

The arrangement of electrons in the shells around the nucleus is called electronic configuration.

★ Write the electronic configuration of the elements given below and draw their Bohr model.

$^{19}_{9}F$, $^{24}_{12}Mg$, $^{27}_{13}Al$, $^{35}_{17}Cl$

The number of protons decides an element. If the number of protons changes, the element itself will change. What if the number of neutrons changes without a change in the number of protons?

$^{1}_{1}H$		$^{2}_{1}H$		$^{3}_{1}H$	
p		p		p	
n		n		n	
Protium		Deuterium		Tritium	

★ Which particle's number differs?

Draw the Bohr Model.

★ What similarities and differences do you notice if you examine their atomic number and mass number?

Such different forms of the same element are **isotopes**.

Can you formulate a working definition for isotopes?

The Plenitude of Hydrogen

Three fourth (75%) of the entire matter of the universe is hydrogen. Deuterium isotope is only 0.015% of the total amount of hydrogen. The amount of tritium is much less than this. It is found only in traces The rest is the ordinary form of hydrogen (99.985%). Heavy water formed by the reaction of deuterium with oxygen is used in nuclear reactors.

Elements having the same mass number and different atomic numbers are **isobars**.

Eg: $^{40}_{18}Ar$, $^{40}_{20}Ca$

Identify and write the isotopes and isobars in the atoms of the elements given below. (P,Q,R,S, and T are not symbols of real elements.)

$^{14}_{6}P$, $^{35}_{17}Q$, $^{14}_{7}R$, $^{36}_{17}S$, $^{16}_{8}T$

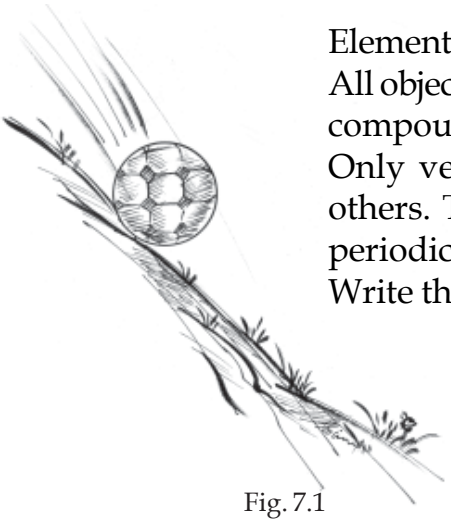
Examine the details given in the table below and fill in the blanks.

Element	p	e	n	The number of electrons in each shell			The configuration of electrons
				K	L	M	
$^{16}_{8}O$	.....	.....	.....	2	6		2, 6
$^{27}_{13}A1$	.....	.....	.....	.....	.....	.....	.....
$^{.....}_{.....}Ne$	.....	.....	10	.....	.....	.....	.....
$^{23}_{11}Na$	.....	11	.....	.....	.....	.....	.....
$^{.....}_{.....}Mg$	.....	.....	12	.....	.....	2	.....

Table 6.4

We have in this world a variety of elements because the number and arrangement of the small particles in their atoms differ. These particles are too small to be felt or seen directly. The variety in the atoms of the elements contribute to the variety of the substances in the universe. The knowledge of the basic constituents of substances will help us to analyse and understand the characteristic features of a substance.

7 FOR STABILITY



Elements combine together to form compounds. All objects around us contain these elements and compounds and the mixtures formed by them. Only very few elements don't combine with others. The elements in the last column of the periodic table are of this type. Which are they? Write them.

- -
- -
- -

Fig. 7.1

Since these elements have maximum stability, they are known as noble elements. Since all of them are gases, they are also known as noble gases. While atoms of other elements form molecules of that element or molecules of a compound to attain stability, the noble elements are stable in their atomic state itself. It is due to this stability that they refrain from entering into chemical reactions. So they are also known as inert gases.

Why did noble elements become stable? Let's examine.

Find out the atomic number of a few elements you know and write their electronic configuration in the table. Also write a few compounds you know that includes these elements.

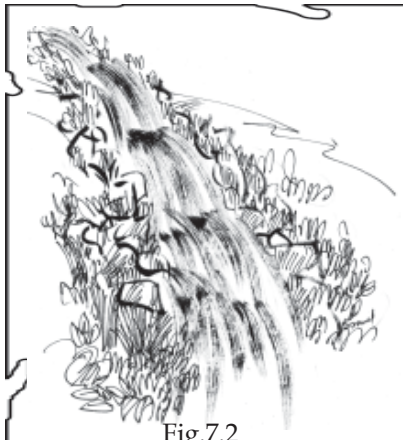


Fig.7.2

Stability and Energy

The stability of a system is related to its energy. When energy increases, stability decreases. Hence each system tries to attain stability by reducing its energy. It will adopt the most suitable means for this. An object at a great height tends to come down to lower heights to attain stability by reducing energy.

Element	Atomic number	Electronic configuration	Compounds you know

Table 7.1

The electronic configuration of noble elements is given in the table.

Element	Atomic number	Electronic configuration	
He	2	2	**Generally don't form compounds**
Ne	10	2, 8	
Ar	18	2, 8, 8	
Kr	36	2, 8, 18, 8	
Xe	54	2, 8, 18, 18, 8	
Rn	86	2, 8, 18, 32, 18, 8	

Table 7.2

★ What speciality of the electronic configuration of these elements (except helium) differs from that of other elements?

★ What inference can be drawn about the connection between stability and electronic configuration?

★ What about helium? Draw its Bohr model of atom and examine. How can you describe stability of helium?

Helium, which has the smallest atom among inert elements, has only one shell. The maximum number of electrons that can be accommodated in the first shell is two. Hence, two-electron arrangement is stable in the case of helium.

Let's look at some examples of how stable compounds are formed due to chemical reaction.

Magnesium + Oxygen → Magnesium oxide

★ Has a new substance been formed?

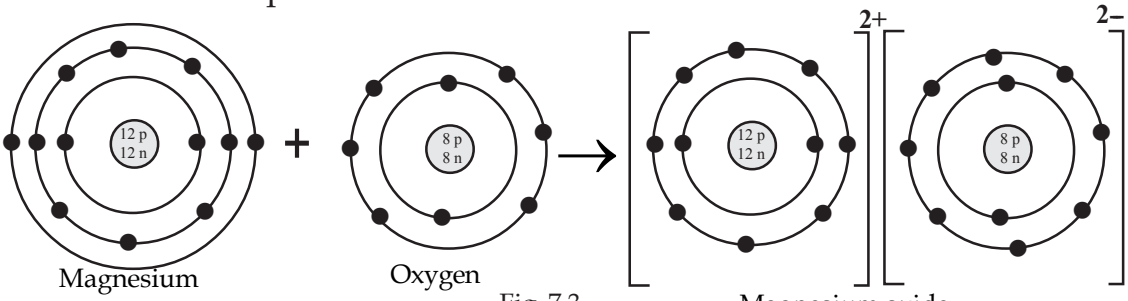
★ What may it be?

Examine certain facts related to the atomic numbers of magnesium and oxygen.

Facts	Magnesium	Oxygen
Number of protons		
Number of electrons		
Number of neutrons		
Charge		
Electronic configuration		

Table 7.3

★ Both magnesium atom and oxygen atom are chargeless. What is the reason? Compare the Bohr model of both atoms with the table.



Magnesium Oxygen Magnesium oxide

Fig. 7.3

★ In what way did magnesium and oxygen attain stability? Write it on the basis of the changes taken place in the arrangement of electrons.

Magnesium (Mg) -

Oxygen (O) -

Was there any change in the charge of magnesium when it attained stability? What about oxygen? Complete the table and verify.

	Magnesium		Oxygen	
	Before attaining stability	After attaining stability	Before attaining stability	After attaining stability
Number of electrons				
Number of protons				
Charge				

Table 7.4

An atom which has attained charge is an **ion**.

What is the charge of magnesium ion? How will you represent it? Mg^{2+}

Write how you can represnt oxide ion.

What is likely to happen when opposite charges approach? Tick the correct option (✓).

Attraction ☐
Repulsion ☐
Neither attraction nor repulsion ☐

Have you understood how magnesium oxide exists as a molecule?

Using the knowledge gained so far, prepare a note in the science diary on how magnesium combines with oxygen to form magnesium oxide.

Like this, how can you describe the formation of sodium chloride?

Element	Atomic number	Electronic configuration
Sodium (Na) Chlorine(Cl)		

Table 7.5

The ions formed : .....

The electronic configuration of ions : .....

★ Does all chemical reactions happen in this manner?

★ Are there situations in which molecules are formed without exchange of electrons?

Look at certain situations.

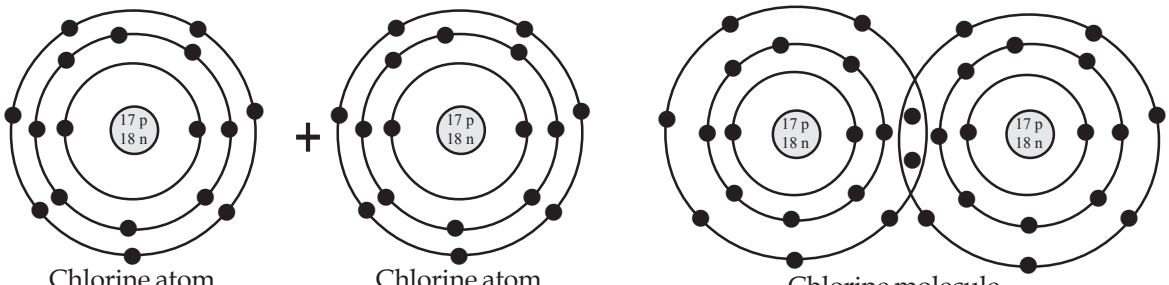
- Two chlorine atoms combine to form a chlorine molecule.
- Two oxygen atoms combine to form an oxygen molecule.

Examine the formation of chlorine molecule.

★ Electronic configuration of each chlorine atom : ……..

★ What do the two chlorine atoms require to attain stability?

★ Is there a possibility of one chlorine atom giving electron to the other? If so, can both of them attain stability?



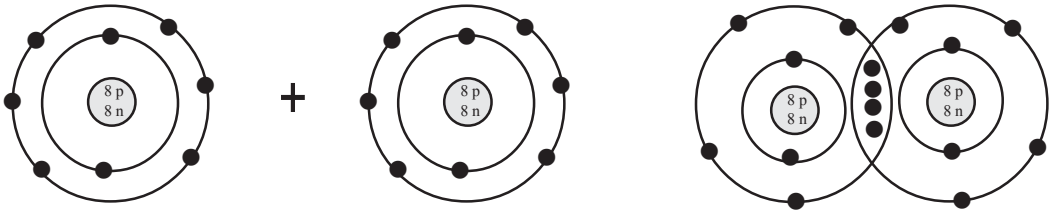
Chlorine atom Chlorine atom Chlorine molecule

Fig. 7.4

★ How did chlorine attain stability?

★ How many electrons did each chlorine atom share? Thus the eight-electron (Octet) arrangement is also formed by sharing electrons in this manner.

Look at the arrangement in the oxygen molecule.



Oxygen atom Oxygen atom Oxygen molecule

Fig. 7.5

★ How many electrons did each oxygen atom share?

★ How many electrons are either exchanged or shared by oxygen atom in the following molecules?

In magnesium oxide : exchanged/shared

In oxygen molecule : exchanged/shared

> The capacity of elements to combine together is called valency. The valency of an element is stated on the basis of the number of electrons exchanged or shared by an element during chemical reaction.

Examine some elements.

Write the electronic configuration of each and complete the table.

→

Element	Atomic Number	The number of electrons	Electronic Configuration	The number of electrons in the outer most shell	The number of electrons given /taken or shared	Valency
F						
K						
O						
Na						

Table 7.6

Frame a statement connecting outermost electron(s) and valency.

- -

★ How many electrons did magnesium lose when magnesium oxide was formed?

★ How many electrons are gained by oxygen atom?

★ What is the relationship between the number of electrons and the charge formed in each atom when magnesium oxide was formed?

- -

- ★ How many electrons must magnesium lose for it to combine with chlorine?
- ★ How many electrons can a chlorine atom gain?
- ★ If so, how many chlorine atoms should a magnesium atom combine with, in order to attain stability?
- ★ You have understood that abbreviations are used as symbols of elements. Then how can we write the abbreviations of molecules, which are formed by the combination of atoms of elements?
- ★ How can you represent magnesium chloride formed from magnesium and chlorine?

Try to write abbreviations of molecules using the symbol of elements and the number of atoms that combine.

Magnesium chloride

- ★ Which all atoms in the above table can involve in exchange of electrons?

How many atoms of each element will be involved when this happens?

Na and O, K and F

- -

- -

- ★ Can you write the chemical formula of the following?

The combined form of Na and O?

The number of electrons which Na can give ……

The number of electrons which oxygen can accept ……

- ★ The number of atoms of each that should combine to attain stability.

Na : .....

O : .....

Chemical formula : .....

- ★ Can you form more pairs like this? Look at the chemical formula of some compounds

Water - H_2O

Hydrogen Chloride - HCl

Ammonia – NH_3

Chemical Formula

Chemical formula is an abbreviation representing the molecule of an element or a compound. The number and kind of the atoms of elements can be understood from the chemical formula. The symbol and number of atoms of each element will be indicated in the chemical formula.

Let's examine how the valency of elements is made use of to write the chemical formula.

Compound	Elements contained	Valency	Chemical formula
Water	H		
	O		
Hydrogen chloride	H		
	Cl		
Ammonia	N	3	
	H		

Table 7.7

The method of forming the chemical formula.

- -

- -

Look at the chemical formula given below.
Magnesium oxide – MgO
Carbon dioxide – CO_2
Valency of Magnesium – 2
Valency of Oxygen – 2

The chemical formula formed in relation to valency ☐

Actual chemical formula ☐

If the valency number can be simplified into small units, they are indicated in the chemical formula in the simplified form.

Now think how CO_2 has become the chemical formula of carbon dioxide.
The valency of carbon – 4
The valency of oxygen – 2
Same pairs of elements are given below. Write the chemical formula of the compounds formed by them.

Al - O, Ca - O, C - H, Ca - Cl

We are now familiar with the chemical formula of certain molecules. Can you find out the total number of atoms in these molecules?

★ What is the total number of atoms in CO_2 molecule?
Number of carbon atoms : ....
Number of oxygen atoms : ....
Total number of atoms : ....

Based on the number of atoms in a molecule, they are classified as mono atomic, diatomic and poly atomic. Molecules of some elements are given below. Classify them in the manner described above.

Cl_2, Na, O_2, Mg, S_8, P_4, H_2, N_2, Fe

★ All inert gases are mono atomic. Can you say why? The chemical formula indicates one molecule of an element or a compound.

But what can be done in situations where more number of molecules are to be indicated?

Look at the way in which five water molecules are indicated: $5H_2O$

Total number of molecules: …….

How many atoms of each element: ……

H = 5 x 2 = 10

O = _ _ _ _ _ _ _ _ _

★ Which of the following has the highest number of atoms? Find out.

$5NH_3$, 6NaCl, 2MgO, $3Al_2O_3$

8 THE PATH OF LIGHT

The Light that Reflects

An afternoon. When light fell on her face, Khadeeja looked around to see where it came from. She saw her friend holding a mirror outside the class. Where could the light that fell on Khadeeja's face have come from? How did it come?

Don't you have similar experiences?

Have you reflected light onto the face of your friends or on the wall using a plane mirror?

Shall we do an activity using a source of light?

Take a cardboard box which is about 30 cm long, 12cm broad and 6cm high.

Remove the opposite sides of the box and paste transparent polythene sheet there, as shown in the figure 8.1.

Place a plane mirror inside the box as shown.

Light an incense stick and fill the box with its smoke.

Allow light from a laser torch to fall slantingly onto the mirror through the hole on top of the box.

Observe the path of light.

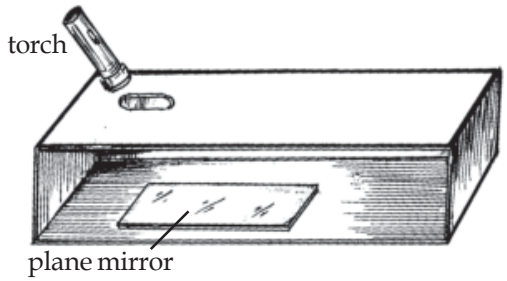


Fig. 8.1

Light from the torch comes as a beam which contains a large number of very narrow light rays. Light passes as a beam even through a small hole. Though light comes like this, the path of light is represented using a line which indicates one ray.

- ★ What can you call the ray of light which falls from the torch onto the mirror?
- ★ What can you call the ray of light which reflects from the mirror?
- ★ Repeat the experiment by changing the inclination of the ray of light. What are your observations?

The line drawn perpendicular to the surface of reflection at the point where the light falls (point of incidence) is the **normal**.

★ Is there any relation between the angles formed by the incident ray and the reflected ray with the normal?

Let's do an experiment.

Arrange a drawing sheet, protractor, plane mirror and a screen as shown in the figure.

Draw the normal and mark the angles of the protractor on the paper.

Make the laser ray fall on the mirror from different angles along the plane of the paper. Draw the path of the reflected ray on each occasion, measure the angle of incidence and the angle of reflection and tabulate.

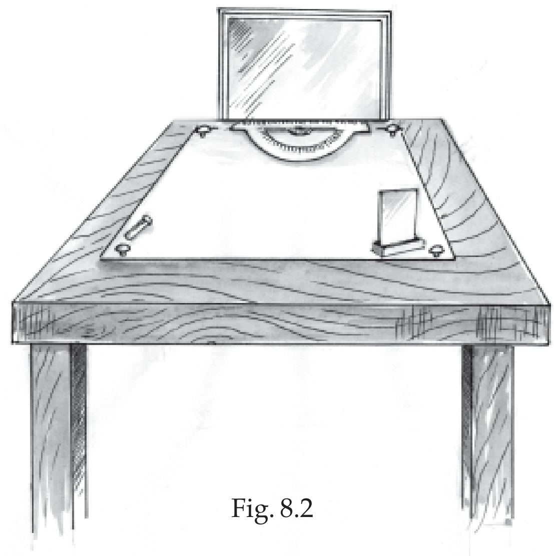


Fig. 8.2

Sl. No.	Angle of incidence (i)	Angle of reflection (r)
1 2 3 4		

Table 8.1

★ What inference can you draw from analysing the table?

- -

- -

- -

★ If you can change the plane of the ray of incidence, can we get the reflected ray in the same plane?

★ What all inferences about reflection could you draw from the activities done so far?

- -
- The incident ray, reflected ray and the normal to the plane of reflection drawn are in the same plane.

  These are the **laws of reflection**.

These laws are applicable to any type of reflecting surface.

Different types of Mirrors

Have you seen your face in the mirror of a bike? What is special about the image?
Is the mirror plane?
Look at your face in a new stainless steel spoon.

- ⋆ Are the images seen on the inner side and the outer side alike?
- ⋆ Which image is similar to the image seen in the mirror of the bike?
- ⋆ What may be the reason for seeing the image differently on both sides of the spoon?

The surface of reflection of light can also be a curved one.

If the reflecting surface of the mirror curves outward, it is a **convex mirror**. If it curves inward, it is a **concave mirror**.

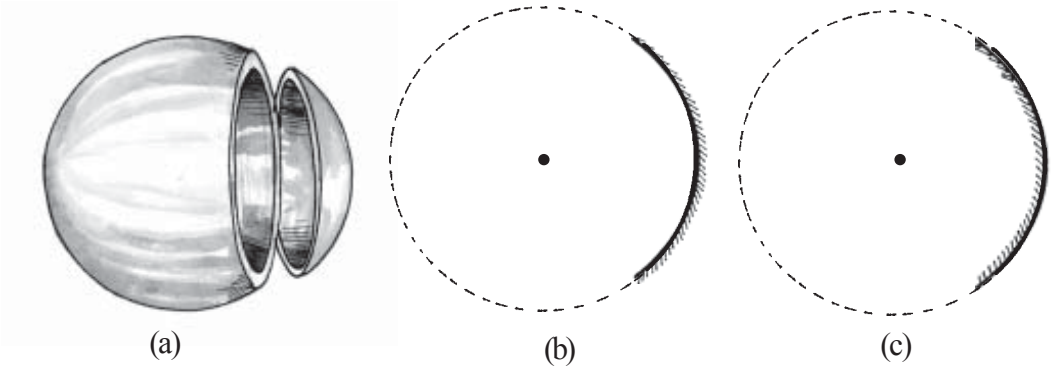
.....

Let's do an activity.
Classify the mirrors in your school lab into plane, convex and concave mirrors. Find out their features and complete the table 8.2

Sl. No.	Plane mirror	Convex mirror	Concave mirror

Table 8.2

Spherical Mirrors



(a) (b) (c)

Fig. 8.3

Cut a small portion of a plastic ball as shown in figure 8.3 (a). If we paste aluminum foil in its inner side and form a surface of reflection, what type of mirror will it be?

What if we make the outerside a reflecting surface?
Such mirrors are spherical mirrors
In figures 8.3 (b) and (c) mark the centre of curvature 'C', pole 'P', and draw the principal axis and radius of curvature.

The centre of the sphere of which the mirror is a part is the centre of curvature of the mirror and is denoted as C.
The midpoint of the surface of reflection is the pole and is denoted as P.
The line joining the centre of curvature C and the pole P is the principal axis. The radius of the sphere of which the mirror is a part is the radius of curvature.

Focus

Hold a concave mirror towards the sun (figure 8.4). Focus the sunlight at a point on the screen. Repeat the experiment several times. Measure the distance between the mirror and the screen every time. What special feature do you notice? Form images of very distant objects. Measure the distance between the image and the mirror. Compare it with the distance found earlier. Repeat the experiment using plane mirror.

In the experiment using sunlight and mirror, care must be taken to avoid reflected rays falling directly in the eyes.

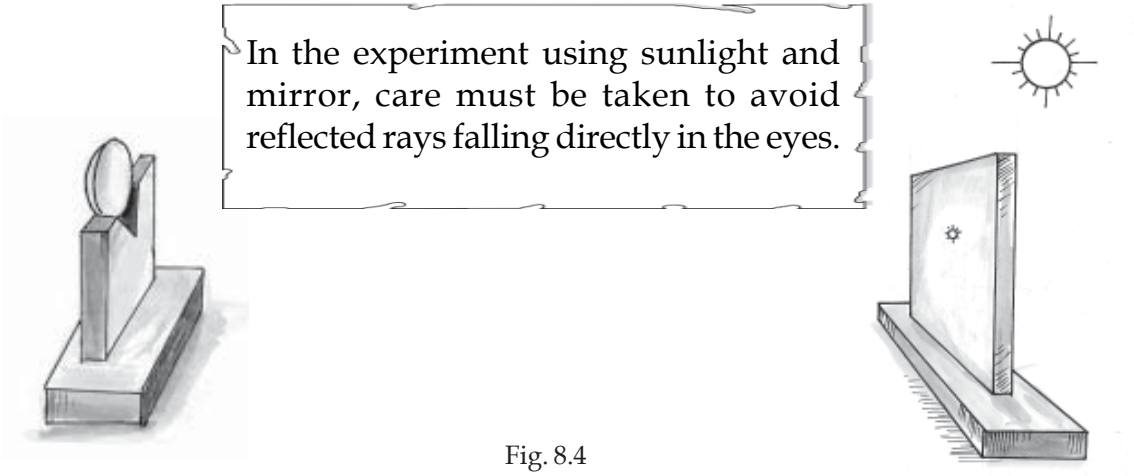
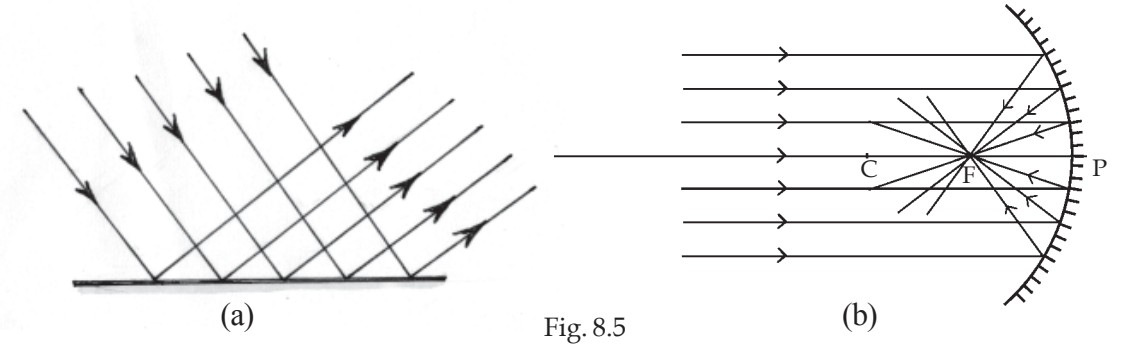


Fig. 8.4

★ How do we get the images of distant objects always at a fixed distance from the mirror? Look at the images given below.



(a) (b)

Fig. 8.5

The figure shows light rays from distant sources incident on a plane mirror and a concave mirror.

★ What special features can you notice?

- The incident rays are parallel.
-

We have seen that light rays falling parallel to the principle axis of a concave mirror converge at a point on the principal axis. This point is the principal focus of the concave mirror.

★ Then why do we get the images of distant objects at the same point?

★ Can a plane mirror have a focus?

Based on the figure 8.5, record your findings in the science diary.

★ In the above activity can we get an image on the screen, if we use a convex mirror instead of a concave mirror?

What may be the reason?

Based on the figure 8.6 and the laws of reflection, record your findings.
Don't the reflected rays in the figure appear to diverge from a point on the principal axis, behind the mirror? This point is the principal focus of the convex mirror. Since this is not real, this is a **virtual focus**.

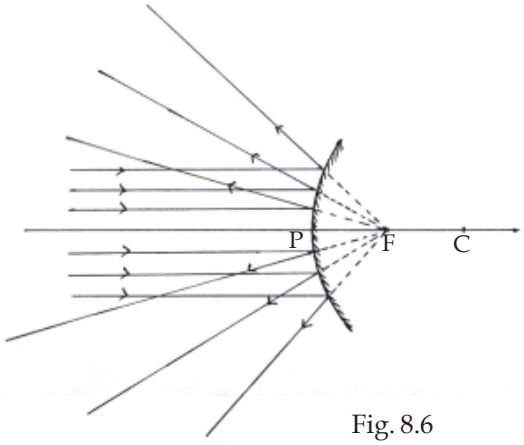


Fig. 8.6

The distance from pole to focus is the **focal length**. This will be equal to half the radius of curvature(R), or R=2f

Image Formation

Haven't you seen that the images of distant objects are always formed at the principal focus of the spherical mirror? Is the image always formed on the principal focus, if the object is placed anywhere in front of the mirror?
Let's do an activity and find out.

Fix a concave mirror of known focal length on a stand. Mark F, 2F (C) in front of the mirror. Place a lighted candle at different positions in front of the mirror and form images on the screen. Record the position of the image and its features in the table (8.3).

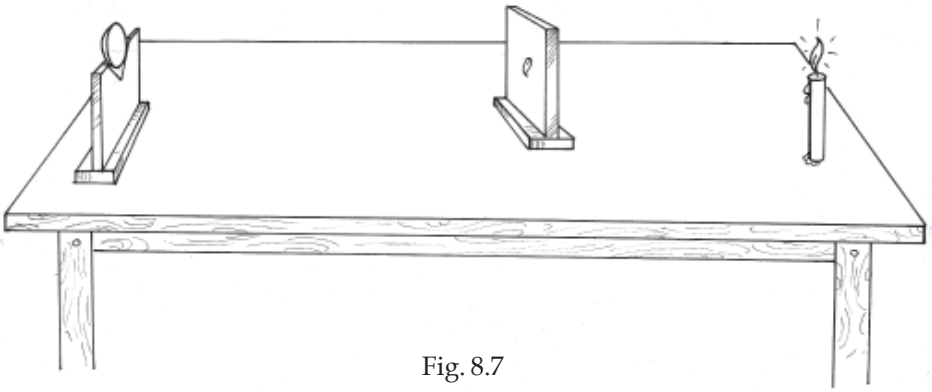


Fig. 8.7

Sl. No.	With respect to the mirror		Features of the image
	The position of the object	The position of the image	
1			
2			
3			
4			
5			

Table 8.3

Let's draw a ray diagram

Haven't you understood the formation of image of an object placed at different positions in front of a concave mirror?

We can indicate the formation of image by means of ray diagrams.

The incident ray falling on the concave mirror and its reflected ray are given in figure 8.8

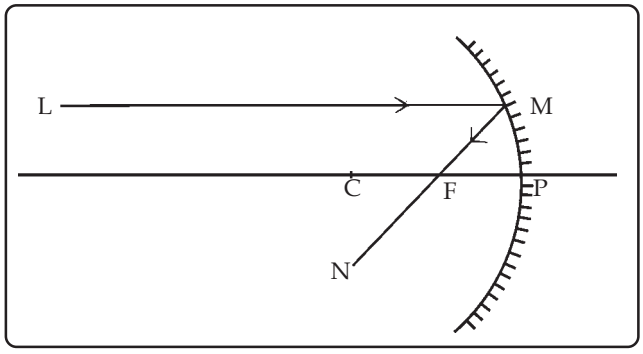


Fig. 8.8 (a)

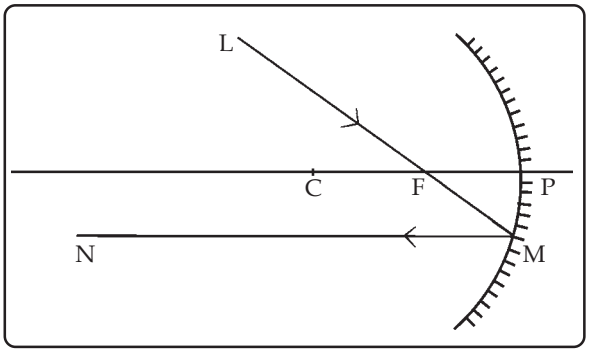


Fig. 8.8 (b)

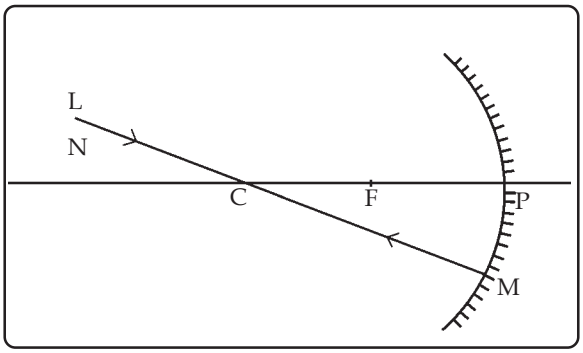


Fig. 8.8 (c)

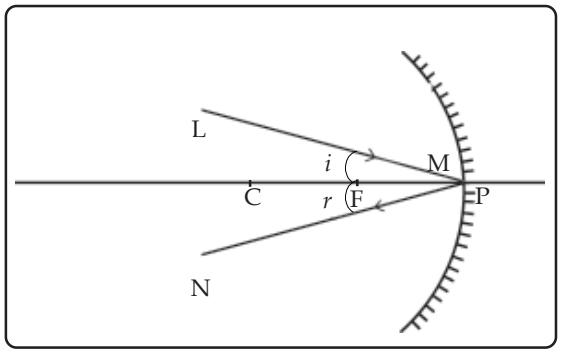


Fig. 8.8 (d)

> Any ray drawn from the centre of a sphere to its surface will be perpendicular to the surface of the sphere.

Analyse the figures on the basis of laws of reflection and record your findings.

- The ray of light falling on the mirror parallel to the principal axis, passes through principal focus after reflection.
-
-
-

Based on your findings, draw the ray diagrams of the image formation in your science diary for the positions of the object given in table 8.4. Use any two rays mentioned above. Then complete the table 8.4. Compare the tables 8.3 and 8.4

(a) The object beyond C

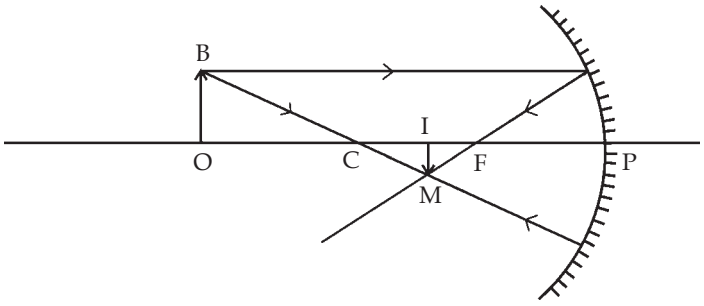


Fig. 8.9

Point M is the image of point B. Similarly, if we draw the incident ray and reflected ray from each point between O and B of the object, the image IM will be formed.

Sl. No.	With respect to the mirror		The nature of the image
	The position of the object	The position of the image	
1.	Beyond C		
2.	At C		
3.	Between C and F		
4.	At F		
5.	Between F and P		

Table 8.4

Haven't you seen the position and features of images formed by the concave mirror?

Similarly let us draw the ray diagrams of an image formed by a convex mirror.

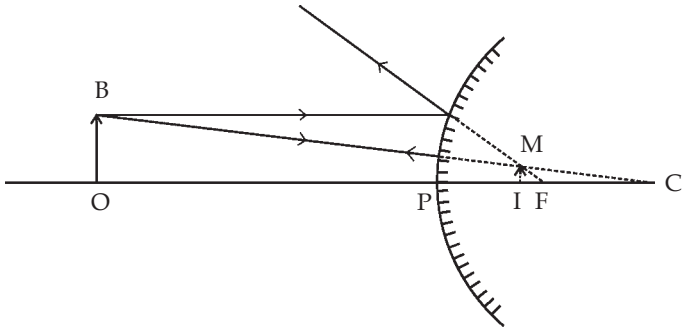


Fig. 8.10

Observe the figure and list the features of the image.

Haven't you seen the characteristics of concave and convex mirrors and the features of the images formed by them?

Find out the occasions in which we use different types of mirrors in day to day life and write them.

- In vehicles convex mirrors are used as rear view mirrors.
-
-
-

9 MOTION

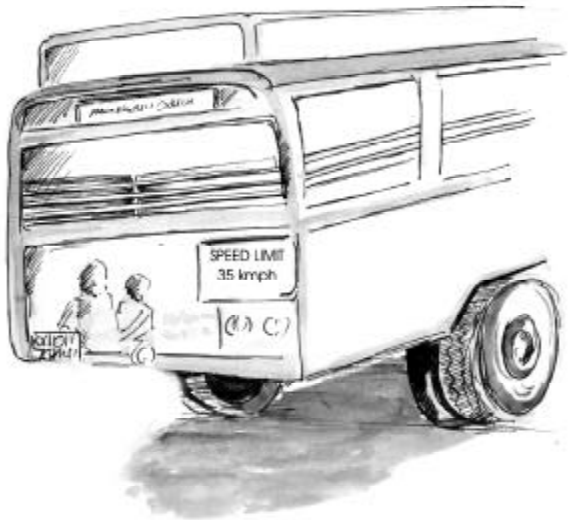


Fig. 9.1

Speed

Given above is a doubt raised by Raju while he was walking along with his father in town. He had come to town to buy new clothes for Onam.
Can you help Raju clear his doubt?
Examine the situations given below.

- ⋆ A car travels a distance of 120km in two hours and a van travels 150km in three hours. How can we find out which of them has greater speed?
- ⋆ Calculate the distance travelled by each vehicle in one hour.

Have you found out which vehicle has greater speed?
Let's examine another situation.

- ⋆ What is the speed of a cycle which travels 50m in 10s?
- ⋆ Which equation did you use to find out the speed in the situations given above?

$$\text{Speed} = \frac{\text{.....}}{\text{.....}}$$

$$\text{Unit of speed} = \frac{\text{unit of distance}}{\text{unit of time}}$$

★ If so what is the unit of speed of the car?

★ What is the unit of speed of the cycle?

Speed is the distance travelled by an object in unit time.

The basic unit of time is second(s). Usually one second is referred to as unit time.

Are you now clear about the meaning of '35kmph' written at the back of the bus?
Discuss with your friends why it is written so.
Are there any such boards erected near your school?
Do vehicles observe the speed limit there? Let's do a project and find out.
Can you find out vehicles which violate traffic rules?
What can you do against the violation of traffic rules?

Uniform Speed and Non-Uniform Speed

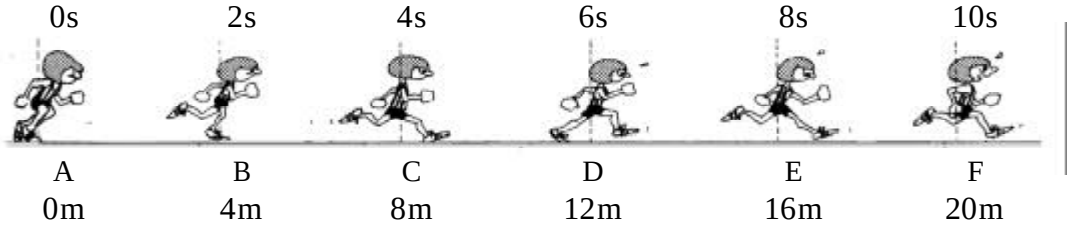


Fig. 9.2

The distance covered by Hari at different intervals of time is shown in figure 9.2.

★ What is the distance covered by Hari from A to B? What is the time taken for it?

★ What is the distance covered from B to C? What is the time taken for it?

Similarly, calculate the distance covered during other intervals and the speed.
What did you understand?
Has Hari covered equal distances in equal periods of time? In this case Hari travels at a uniform speed.
Observe the figure 9.3.

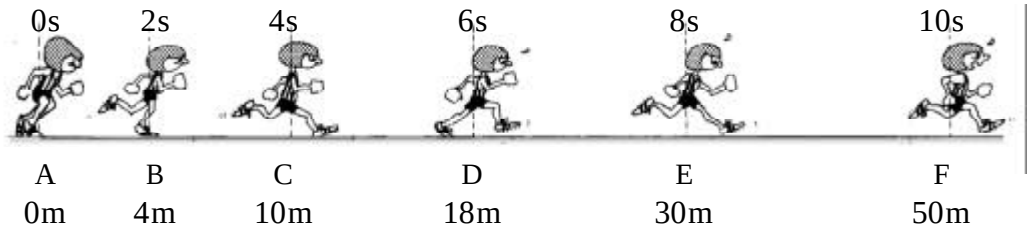


Fig. 9.3

Find out the distance covered by Hari and the time taken for it from the figure and complete the table.

Distance travelled		Time	Speed
	(in metres)	*(in second)*	*(metre/second)*
A → B	4m	2s	2m / s
B → C	6m	2s	3m / s

Table 9.1

Haven't you seen from the table that Hari has covered unequal distances during equal intervals of time? In this case Hari travels at a non-uniform speed.

Average Speed and Average of Speeds

Observe the figure.

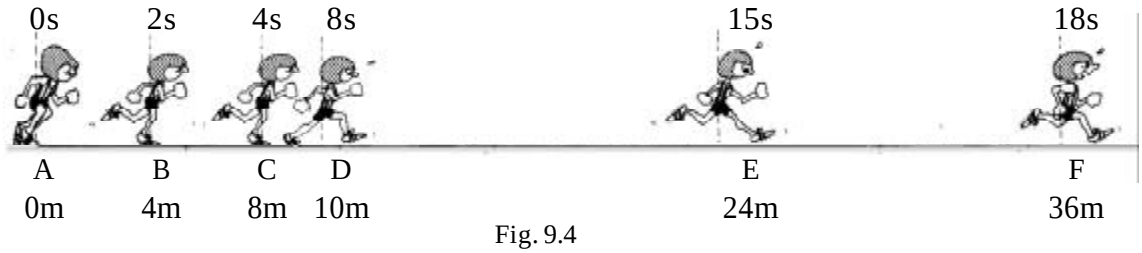


Fig. 9.4

The distance covered by Shanty at different intervals of time is given in the figure 9.4. Analyse the figure and complete the table.

Time interval (in second)	Distance covered (in metre)	Time taken (in second)	Speed = Distance / Time
0 - 2	4m	2s	$\frac{4m}{2s}$ = 2m / s
2 - 4			
4 - 8			
8 - 15			
15 - 18			

Table 9.2

Haven't you seen that the speed of Shanty in each interval of time is different? In such situations, we have to mention speed in terms of average speed. We can calculate the average speed of Shanty by considering the total distance covered and the total time taken.

$$\text{Average speed} = \frac{\text{Total distance travelled}}{\text{Total time taken}} = \frac{\text{.....}}{\text{.....}}$$

$$= \text{..... m / s}$$

But if we find the sum of the speeds of Shanty in every interval of time and divide it by the number of speeds, we get the average of speeds.

$$\text{Average of speeds} = \frac{\text{sum of the speeds}}{\text{number of speeds}}$$

$$= \frac{\ldots\ldots\ldots + \ldots\ldots\ldots + \ldots\ldots\ldots + \ldots\ldots\ldots + \ldots\ldots\ldots}{\ldots\ldots\ldots}$$

$$= \frac{\ldots\ldots\ldots}{\ldots\ldots\ldots}$$

$$= \ldots\ldots\ldots\ldots$$

Don't you notice that the average speed and the average of speeds are different?

Displacement

Notice the illustration of the paths from Rani's home to school.

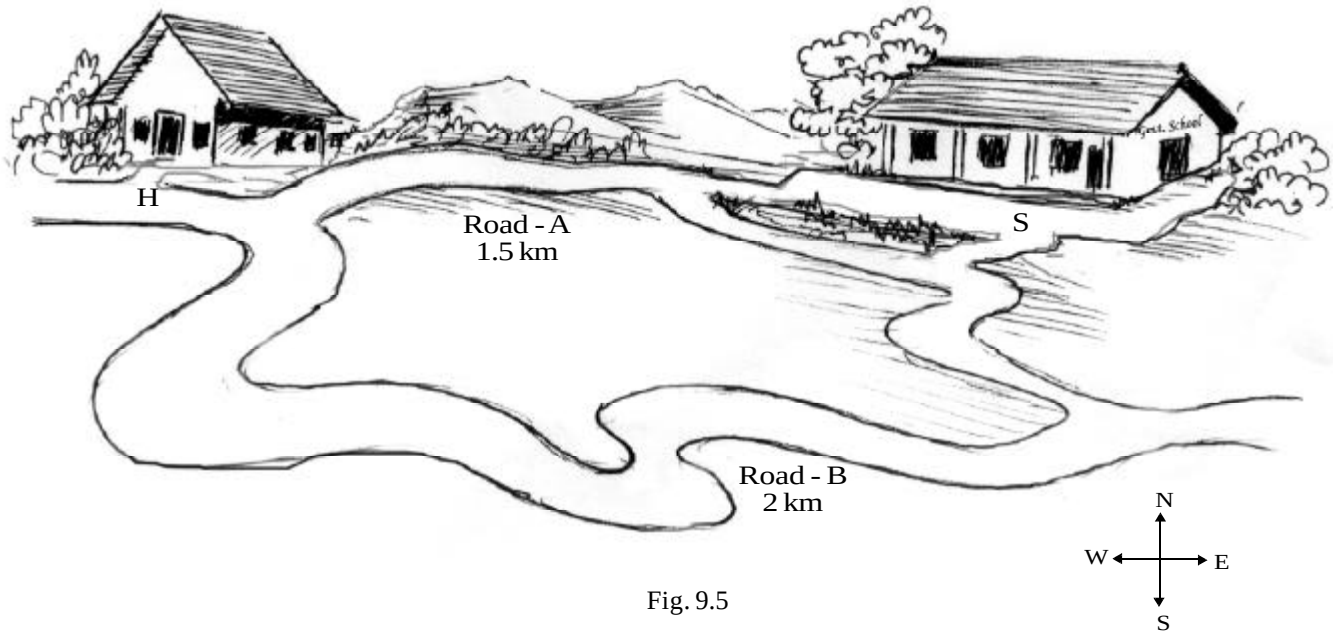


Fig. 9.5

- ★ If Rani goes to school by road A, what distance will she travel? What is the distance if she travels by road B?
- ★ Draw a line showing the shortest distance from Rani's home (H) to her school (S). Indicate the direction too.
- ★ What are the differences between the distance travelled through road A and road B, and the straight distance from school to home?
- ★ From Rani's home, in which direction is the school?

★ Can Rani reach the school if she travels the same straight distance in any other direction?

> The measure of the change of position of an object in a particular direction is known as displacement.

★ If an object travels from one place to another in a straight line, what will be the relationship between the distance and its displacement?

★ Is displacement a scalar quantity or a vector quantity?

> Vector quantities are those which need magnitude as well as direction to be stated. Scalar quantities are those which need only magnitude.

In an athletic race, Sajith completed his running on an elliptical two hundred metre track in twenty five seconds and returned to the starting point.

★ What is the distance travelled by Sajith? What is his average speed?

★ What is the displacement of Sajith?

Velocity

The following figure gives information about a car travelling through a straight path of 500m.

0m	100m	200m	300m	400m	500m
A	B	C	D	E	F
0	10s	20s	30s	40s	50s

Fig. 9.6

Analyse the motion of the car and complete the table.

The displacement (in metre)	The time required (in second)	Displacement of the car (one second)
A → B 100m	.....	.....
A → C	.....	.....
A → D	.....	.....
A → E	.....	.....
A → F	.....	.....

Table 9.3

- You would have found out the displacement of the car in one second. This is the velocity of the car.

$$\text{Velocity} = \frac{\text{Displacement}}{\text{Time}}$$

★ If so, find out the unit of velocity.

★ What are the differences between speed and velocity? Record the findings in your science diary.

★ Find out the situation in which the speed and velocity of an object become equal.

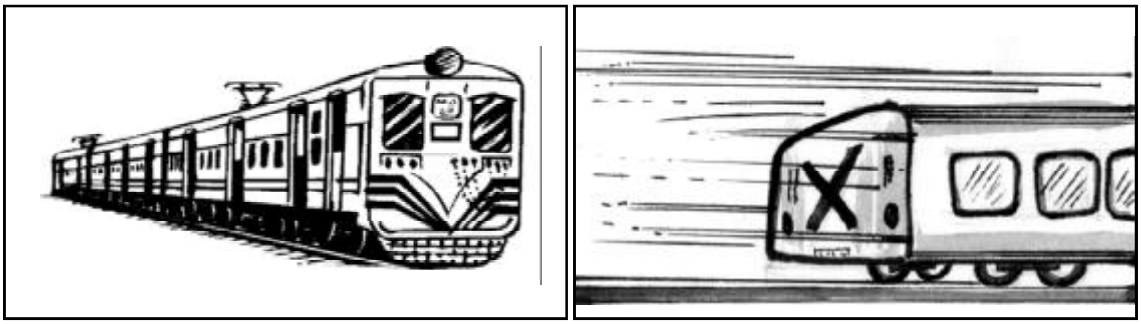
★ Why do we consider velocity as a vector quantity?
Isn't the velocity the same at each stage in table 9.3. This is uniform velocity.

★ If so, can you define non-uniform velocity?

Calculate the velocity and speed of Sajith who finished running a two hundred metre elliptical track in 25 seconds and reached the starting point.

Acceleration

Vinu was observing a train arriving at a station and departing after some time.



The train arriving at the station

The train departing from the railway station.

Fig. 9.7

★ What is the change happening in the velocity of a train approaching a station?

★ What about the velocity of the train departing from the station?

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

0 m/s	6 m/s	14 m/s	14 m/s	6 m/s	2 m/s
A	B	C	D	E	F
0 s	10 s	20 s	30 s	40 s	50 s

Fig. 9.8

	Initial velocity u	**Final velocity** v	**Change in velocity** v - u	**Time taken for change in velocity**(t)	**Change in velocity which took place in one second/ rate of change of velocity**
A - B	0	6 m/s	6 m/s	10 s	$\frac{6\,m/s}{10s} = 0.6\,m/s^2$
B - C					
C - D					
D - E	14	6 m/s	-8 m/s	10 s	$\frac{-8\,m/s}{10s} =$ ---
E - F					

Table 9.4

★ What is the change in the velocity of the train from A to B?

★ What is the change in velocity in one second (rate of change of velocity)?

The rate of change of velocity is acceleration.

★ If so, can you form an equation for finding acceleration?

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

$$= \frac{\text{Final velocity} - \ldots\ldots\ldots\ldots\ldots\ldots}{\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots}$$

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

You would have understood the unit of acceleration from table 9.4

★ Does the velocity increase or decrease when the train travels from D to E in figure 9.8.

★ Find out the rate of change of velocity at this stage.

Haven't you seen that the accelerations from D to E and E to F are negative since the final velocity is less than the initial velocity?

This negative acceleration is termed retardation. If so, is it to the approaching or departing train that retardation happens? What may be the reason for this?

★ Brakes are applied suddenly to a racing car travelling at 50m/s. If the car stops after twenty seconds, calculate the retardation of the car.

You have seen an equation for acceleration, if the initial velocity is 'u', the final velocity is 'v' and the time for change in velocity is 't'.

$$\text{Acceleration(a)} = \frac{\text{Final velocity – initial velocity}}{\text{Time}}$$

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

$$v - u = at$$

Therefore $v=u+at$. This is an equation of motion.

★ Find out the velocity attained by an object after 10 second if it starts from the state of rest and travels with an acceleration of $5 m/s^2$.

Sadath travelled on a bicycle in three different situations. The path of travel and velocity at each stage is given in the figures 9.9(i), (ii) and (iii).

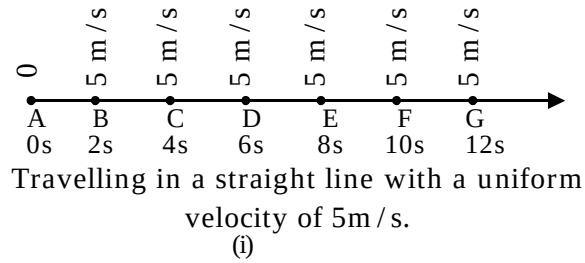
Velocity is a vector quantity. The velocity becomes non-uniform in three situations.

(i) When the magnitude changes

(ii) When the direction changes without a change in the magnitude

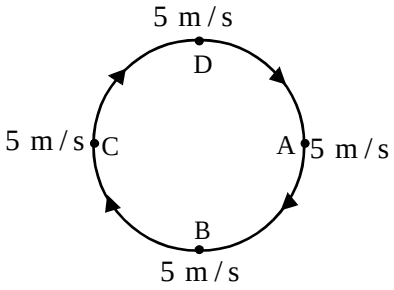
(iii) When both magnitude and direction change

Acceleration happens in all the three situations.

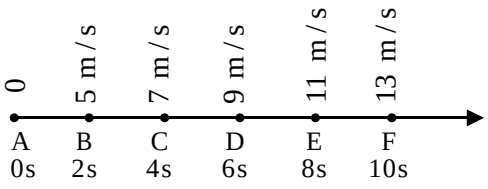


Travelling in a straight line with a uniform velocity of 5m/s.

(i)



(ii)



(iii)

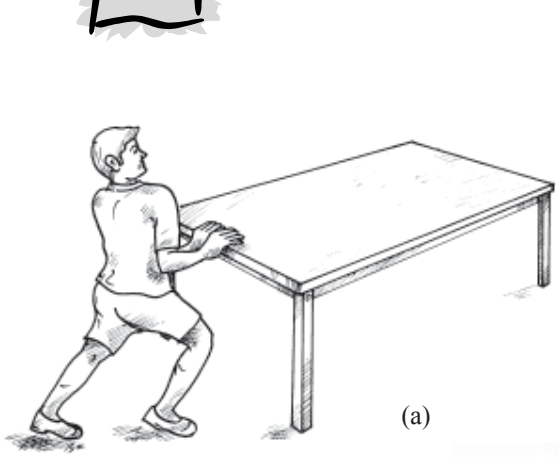
Fig. 9.9

★ Consider figure 9.9(ii). Does Sadath have acceleration? What may be the reason?

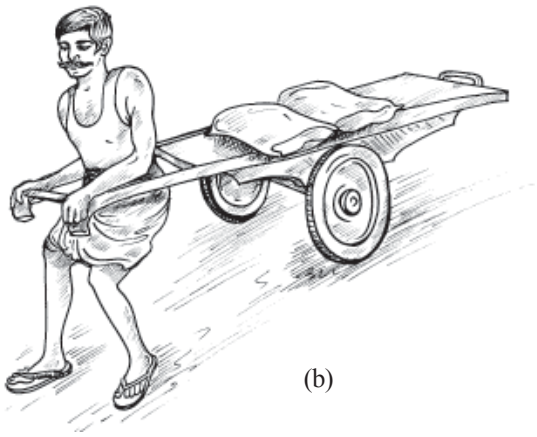
★ Consider figure 9.9(iii). Does Sadath have acceleration? What can be the reason?

★ Which are the cases where Sadath has acceleration?

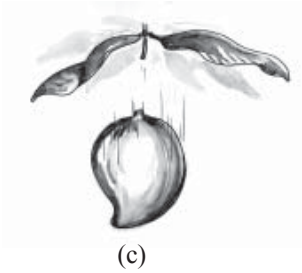
10 FORCE



(a)



(b)



(c)

(d)

(e)

Fig. 10.1

Have you noticed the figures?
What happened to the objects on each occasion?

(a) _

(b) _

(c) The mango falls down due to the gravitational force of the Earth.

(d) _

(e) _

What may be the reason for the change of position of these objects?

If so, what is meant by force? Discuss with your friends and record your findings in the science diary.

- ★ In the situations indicated in the illustration, which are the objects on which force is applied by contact?
- ★ On which objects can we see force being applied without contact?
- ★ If so, record the differences between contact force and non-contact force.

Internal Force, External Force

Do objects always move when force is applied?

Vinu was travelling to school in an autorickshaw. Suddenly the vehicle stopped. The driver asked a person standing on the road to push the vehicle and he obliged. The vehicle moved forward and it started. Then Vinu had a doubt. "Won't the autorickshaw move forward if we push it remaining seated inside the vehicle?"

Record your response to this doubt of Vinu.

Fig. 10.2

Sit on a chair without letting your legs touch the floor and try to lift the chair.

- ★ What is your experience?

Try to raise the chair by standing on the floor.

- ★ What happens?

The force applied by you in the first activity is internal force.

- ★ What about it in the second activity?
- ★ What type of force moves objects?

Now how will you respond to Vinu's doubt?

Fig. 10.3

Balanced Force, Unbalanced Force

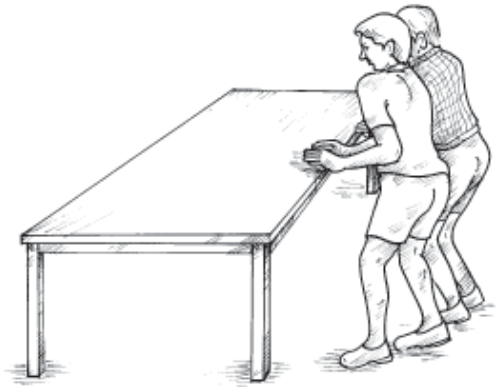


Fig. (a) Two people, standing on the same side, push a table in the same direction.

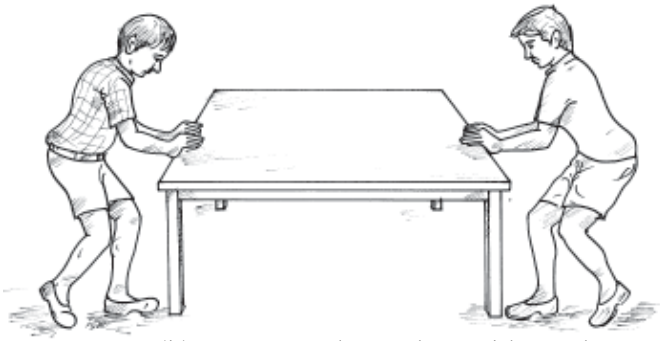


Fig. (b) Two people push a table with equal force in the opposite direction.

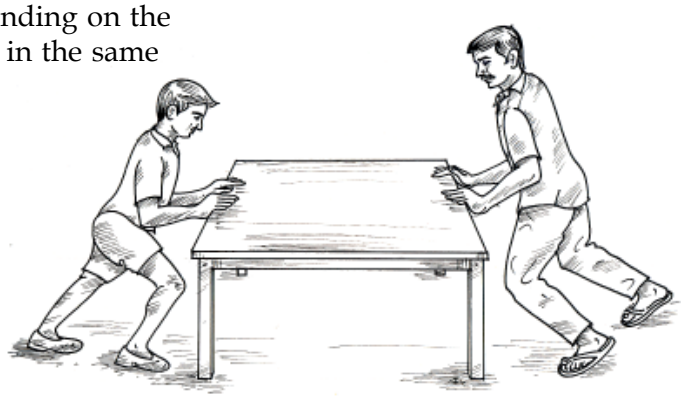


Fig. (c) Two people push a table with different forces.

Fig. 10.4

Figure 10.4 shows the different ways in which force is applied on a table.

- ⋆ On which occasions does the table move? Why?
- ⋆ On which occasion does the table remain stationary? Why?

Let's do an experiment.

Fix a pulley at both ends of a desk. Tie strings to both ends of a toy car. Pass the strings over the pulleys and hang pans at both the ends as shown in the figure. Place equal weights on the pans. Watch the toy car. Does it move?

Then increase the weight in any one of the pans. What happens to the car now?

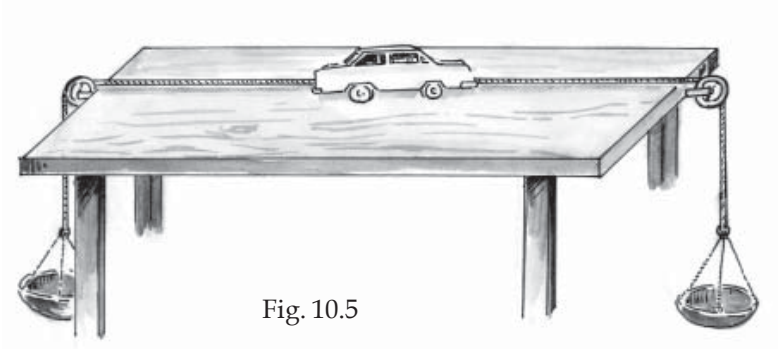


Fig. 10.5

Compare the two situations and record your observations.

- ⋆ When is a balanced force experienced?
- ⋆ When is an unbalanced force experienced?
- ⋆ What type of force moved the car?

When the car moves in a particular direction, slowly increase the weight in the pan having less weight. Observe the speed of the car in each stage. What changes happen? Why?

- ⋆ When does the car come to a rest?
- ⋆ When does the car begin to move in the opposite direction?
- ⋆ What can be the reason?

Examine whether your findings match with the statements given below.

- Force is required to move an object from a state of rest.
- Force is required to change the direction of an object moving in a particular direction.
- Force is required to increase or decrease the speed of a moving object.
- To stop an object moving in a particular direction a force is to be applied in the opposite direction.

Find out from those given below, the situations in which balanced force and unbalanced force are experienced.

- Lifts a bucket filled with water from a well.
- Holds a bucket filled with water above the water level in the well.
- The tug does not move during a tug-of-war competition despite both teams pulling very strongly.
- A cycle moves along a floor.

The unit of force is newton. When we have to support an object having 100 gram weight on our palm, the force to be applied is about 1N.

Newton's first law of motion

You know that seat belt is compulsory for those who travel in the front seat of a car. What could be its scientific aspect?

A person getting down from a moving bus stops only after running for some time in the direction of the bus.

- ⋆ Why does he run forward like this?
- ⋆ What will happen if he doesn't run like this?

Analyse the questions given below using your findings.

- ⋆ What should be done to move an object from its state of rest?

- ⋆ In games using balls, what will you do to pass a ball coming towards you to a friend standing at the sides?
- ⋆ What will you do to stop a metallic sphere rolling on a ground?
- ⋆ What will you do to increase the speed of a slowly oscillating swing?

From your findings, form an inference relating force, state of rest, speed of objects and the direction of movement.

- -
- -
- -

> "Any body continues to be in a state of rest or of uniform motion in a straight line until an unbalanced external force is applied on it". This is Newton's first law of motion.

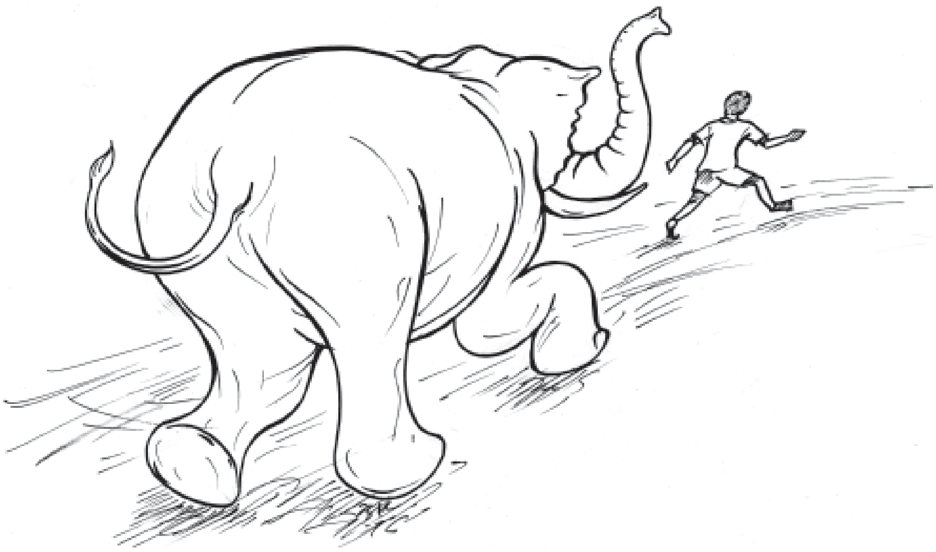


Fig. 10.6

Inertia

'If an elephant chases you, you should run zig-zag.'
What is the scientific principle in this suggestion of a guide from the forest department?
Let's do an activity.
Arrange a few carom coins one over the other on a smooth surface / on a carom board.
Strike off the carom coin at the bottom with the striker? What will happen?
Record your observation in the science diary.
Place a card above a glass and a coin above the card. Strike off the card suddenly. What happens to the coin?
What may be the reason?

Fig. 10.7

Have you travelled standing in a bus?
A passenger is standing inside a running bus. The bus stops all of a sudden. What will happen to him? Why?
What will happen when a stationary bus suddenly moves forward? From these examples, what inferences can we arrive at?

- An object in a state of motion has the tendency to continue in that state. This is inertia of motion.
-

Haven't you understood what inertia of motion and inertia of rest are?

> An object cannot by itself change its state of rest or its uniform motion in a straight line. This is inertia.

You might have seen some people jumping out of a train before it stops. Is it a good practice? Don't such activities often invite serious accidents?

Analyse these situations based on the idea of inertia of motion.

Under the auspices of the Road Safety Club of your school, conduct a seminar on such accidents and their remedies.

Tabulate other situations in which inertia of motion and inertia of rest are felt.

Inertia of motion	Inertia of rest
• A fan continues to rotate for some more time even after it is switched off. • •	• Mangoes fall when a branch of the tree is shaken. • •

Mass and Inertia

Roll the metal sphere used in shot put and a plastic ball of the same size along a slanting surface. Let your friend try to stop both the balls at the same time.

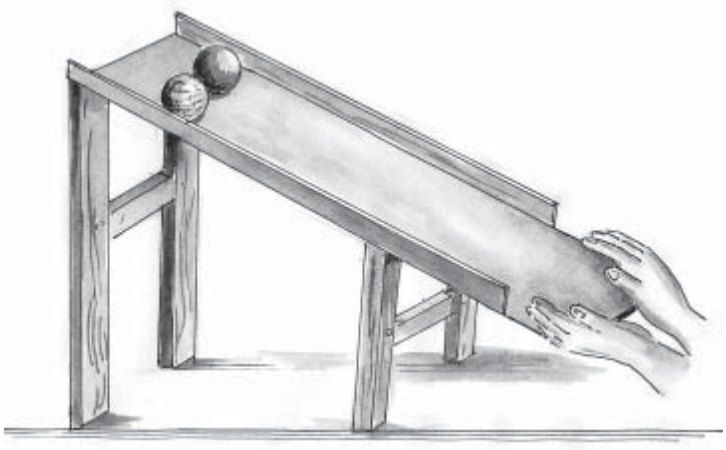


Fig. 10.8

- ⋆ Will the force to be applied to stop the balls be the same?
- ⋆ Will the force applied to move a table and a stool from a state of rest be the same?

Find out and record the relationship between the mass and inertia, comparing the situations given above.

- ⋆ Making use of your findings can you classify the scientific truth behind the suggestion given by the guide of the forest department?

Haven't you seen over crowded vehicles bringing children to school and taking them back?

- ⋆ What will happen if such vehicles have to be stopped suddenly?
- ⋆ Can you give an explanation for the above, based on mass and inertia of motion?

Organise a programme under the auspices of the Science Club to create awareness on such accidents in your locality.

11 THRUST AND PRESSURE

Thrust and Pressure

When Deepu was getting ready to play with his friends after his studies, mother called him and said.
'Deepu, cut a portion from the washing soap and bring it here'.
Deepu took a knife and started cutting the soap quickly. He was in a hurry to leave for his games. But he couldn't cut the soap properly. He observed and only then did he realise his mistake. He was trying to cut the soap with the blunt edge of the knife.

Have you ever had such experiences?

Record your experiences in the science diary.

-
-

⋆ Why is it easy to cut objects with the sharp end of the knife?

Record your guess in the science diary.

Let's do an experiment to find out whether your guess is right or not.

Spread lime powder about four inches thick in a tray of average size. Place a brick in different positions on the lime powder as shown in the illustration. Observe the depth of the pit made by the brick in the lime powder each time.

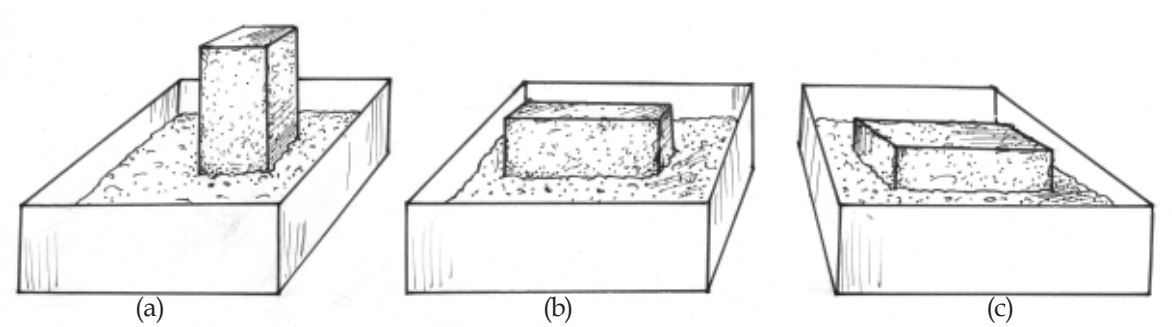


Fig. 11.1

- ⋆ What is the reason for the formation of the pit in the lime powder when a brick is placed on it?
- ⋆ In which direction does the weight of the brick (the force exerted by the brick) act?
- ⋆ When the brick was placed in different positions perpendicular to the surface of the lime powder, was the total force experienced on the lime powder the same on all occasions?
- ⋆ Are the surface areas acted upon by the force equal?
- ⋆ In which position was the brick placed when the deepest pit was formed in the lime powder?

  With smaller surface area of contact/with larger surface area of contact.
- ⋆ In which position was the brick placed when it made the shallowest pit in the lime powder?

  With smaller surface area of contact/with larger surface area of contact.
- ⋆ Though equal forces were applied on surfaces of smaller and larger areas, why did the depths of the pit differ?

Find out the weight of the brick given for the experiment using a spring balance and complete the table given.

The side kept in contact with lime powder	The total normal force exerted (weight of the brick)	Area of the surface of contact	The force exerted on unit area of contact
• **breadth wise**  • **length wise**  • **height wise** 			

Table 11.1

Which of the following inferences did you arrive at when you analysed the table?

Find out the correct one and write it in your science diary.

When the same normal force is exerted on surfaces with different areas,

- the force exerted per unit area on a surface with smaller area will be more.
- the force exerted per unit area on a surface with larger area will be more.

Haven't you seen that the total normal force acting on a surface and the normal force acting per unit area are different?

The total normal force acting on a surface is the thrust.
The force acting normally in unit area is the pressure.

$$\text{Pressure} = \frac{\text{thrust}}{\text{area}}$$

The unit of pressure is newton / square metre (N/m^2).
This is also known as Pascal.
There are many situations in real life where we make use of the relationship between pressure and area. Find out and record them in the science diary.

- The rear wheels of heavy duty freight vehicles have double tyres.
-

Liquid pressure

Haven't you noticed the figure? Why do we build dams with greater thickness at the base?
Let's try out some experiments.
Remove the bottom of a powder tin. Spread and tie a piece of balloon to cover the bottom.

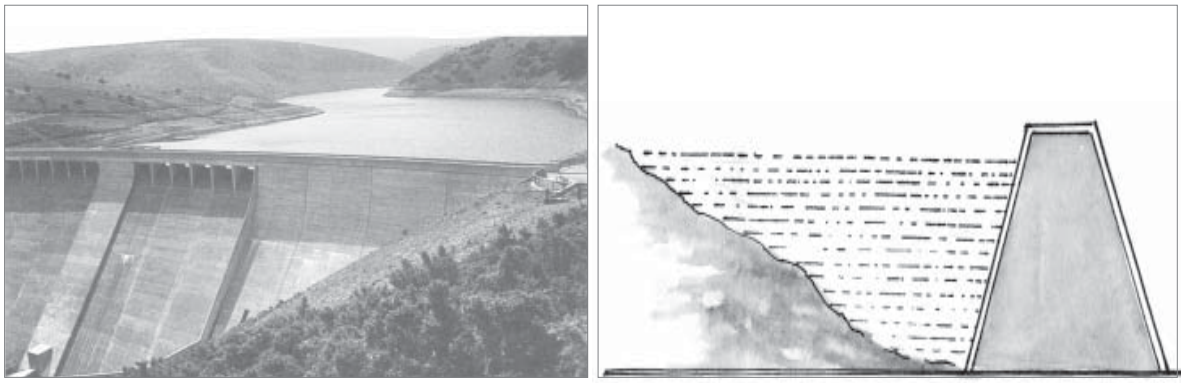


Fig. 11.2

Pour water slowly into the tin.

- ★ What happens to the balloon when water is poured?
- ★ What may be the reason?
- ★ Why does the balloon expand at different rates when there is less water and when there is more water?
- ★ What is the relationship between the depth of water and the pressure it exerts?

Fig. 11.3

Make three holes on one side of a plastic bottle at various heights. Close the holes with your finger and fill the bottle with water. Remove the fingers.

- ★ What do you see? What is the reason for water to flow out through the holes?
- ★ Through which hole does water flow with greater force?
- ★ Through which hole does water flow with lesser force?

Make four holes at equal heights around a plastic bottle / tin. Ask your friends to close the holes with their fingers and fill the bottle with water. Then ask your friends to open the holes.

⋆ What peculiarity do you observe? What could be the reason?

What inferences could you arrive at from the experiments done?

Record them in your science diary.

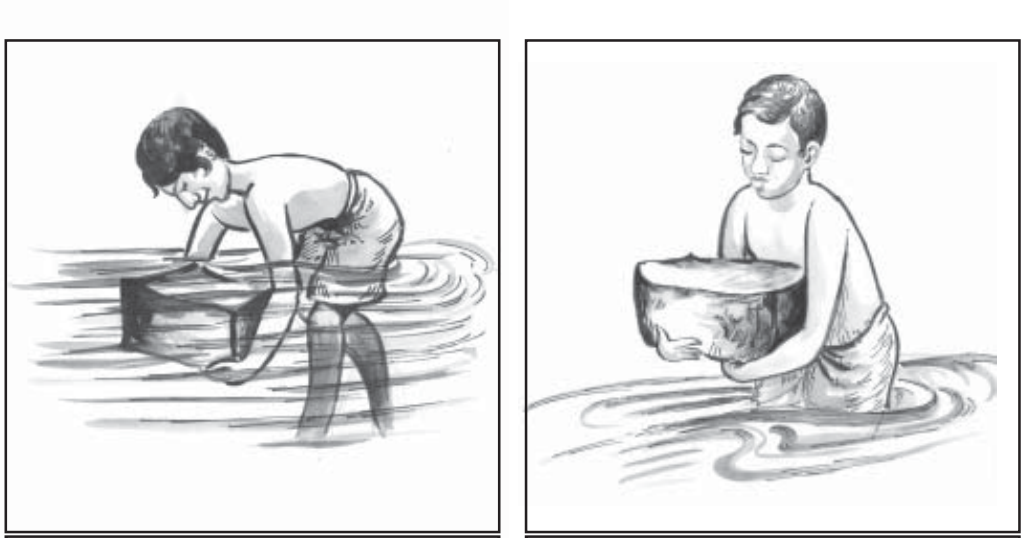
- A liquid exerts pressure on its container.
-

Find out situations where we make use of the knowledge of liquid pressure and record them in your science diary.

- Dams are constructed with greater thickness at their base.
-

Haven't you understood that the pressure experienced at any point in a liquid depends on the height of the liquid column above that point?

Buoyant Force



(a) (b)

Fig.11.4

⋆ Have you had such experiences as shown in the figure?

⋆ Why are objects felt less heavy when lifted under water?

Let's try out some experiments.

Try to immerse a tightly closed tin / plastic can slowly into the water in a bucket.

⋆ What do you feel?

Release the tin after dipping it fully.

⋆ What do you observe?

Similarly, release a cork / small rubber ball after immersing it in water.

★ What do you observe?

Discuss your findings in the group and record them in your science diary.

★ Have you felt water pushing you up while taking a dip in a pond or so?

★ Based on your experience, can you explain the reason why an object immersed in water is felt lighter?

Do all liquids apply a force like this?
Let's see.

A stone, beaker, kerosene, water, stand, spring balance etc. are provided. Plan an experiment using them and complete the table given.

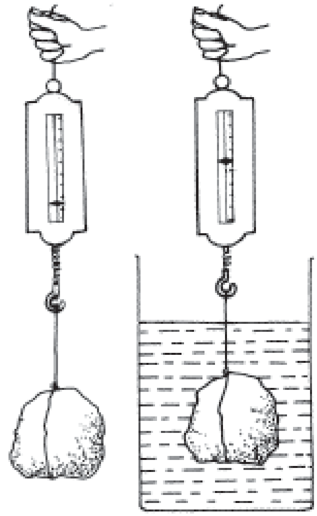


Fig. 11.5

Weight of stone in air	Weight of stone in water	Difference in the weight of the stone while in water	Weight of the stone in kerosene	Difference in the weight of the stone while in kerosene

Table 11.2

★ Does the stone show loss of weight both in water and kerosene?

Note down your inferences.

> The force exerted by a liquid on a body immersed fully or partially in it is the buoyant force.

You have seen that an object immersed in water will lose weight due to buoyant force.

★ If an object weighing 10N in air weighs 7N in water, what is the buoyant force acting on it?

Archimedes' principle

Have you heard about Archimedes?

Archimedes is a scientist who studied about buoyant force through experiments.

Archimedes is a Greek scientist who lived from BC 287 to 212. He acquired fame through his numerous discoveries.

Once, emperor Hero of Siracus entrusted some gold with a goldsmith in order to make a crown. When the goldsmith brought the crown, the king became suspicious that the goldsmith might have pilfered some gold from the crown and added copper to it. The emperor asked Archimedes to find out whether there were any impurities in the crown without damaging it in any way.

Though Archimedes thought for a long time, he couldn't find a way out. The main difficulty of Archimedes was to find out the volume of an object which doesn't have a regular shape. If he knew the volume, he could find out the density. One day when he immersed himself in a bath-tub in his bathroom, he saw that some water overflowed. Archimedes guessed that the volume of the overflowed water could be equal to the volume of his body. Thus he got a way to find out the volume of an object which doesn't have a regular shape. The story goes that he forgot the fact that he was in the bathroom and ran through the streets shouting 'Eureka, Eureka' (I have found out, I have found out). Using the crown given for examination and a cake of pure gold having equal weight, he found that the crown had impurities.'

★ How, in your opinion, did Archimedes find out whether impurities were added in the crown?

The density of an object is the ratio between its mass and volume. The density of an object will be a constant.

$$\text{Density} = \frac{\text{mass}}{\text{volume}}$$

★ Record your findings in your science diary using the given equation.

Apart from this, Archimedes conducted many other experiments.

★ A liquid will exert buoyant force on an object immersed in it. Is there any relationship between this buoyant force and the weight of the liquid displaced by the object?

Let's try out an experiment.

Determine the weight of a stone in air and in water using a spring balance. Calculate the loss of weight of the stone in water. Then take water in an overflowing jar to its fill. Tie a twine around the stone and immerse the stone in water. Collect the overflowing water in a beaker weighed earlier. Again take the weight of the beaker and the water in it together. Repeat the experiment using different objects. Enter the measurements you have obtained in the table given.

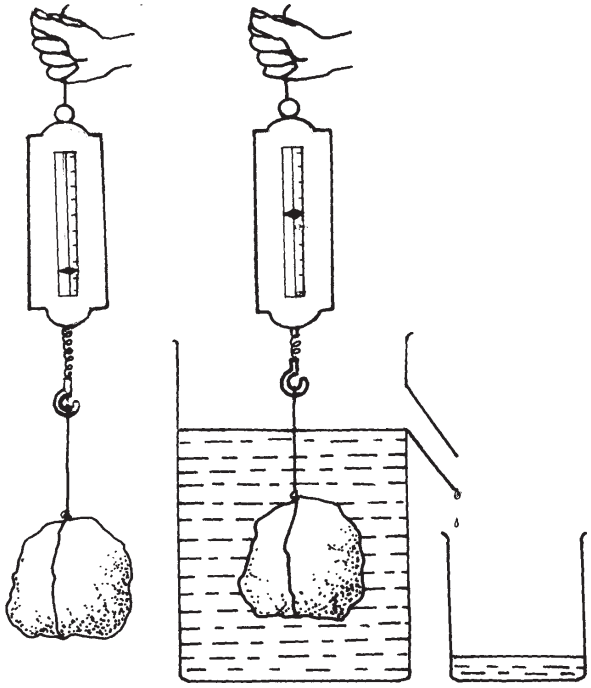


Fig. 11.6

Objects used	Weight of the object in air(a)	Weight of the object in water(b)	Weight of the beaker(c)	Weight of the beaker and the water overflowed(d)	Loss of weight of object in water (a-b)	Weight of water displaced by the object(d-c)

Table 11.3

- ★ Can you analyse the table and say, what is the relationship between the weight lost by an object in water and the weight of water displaced by it?
- ★ Can you find out the relationship between buoyant force and the weight of the displaced water?

Write your inferences in your science diary.

Compare the inferences with the statement given below.

> The buoyant force experienced by an object when it is fully or partially immersed in a liquid is equal to the weight of the liquid displaced by it.

This is Archimedes principle.

Floatation

Haven't you seen some objects floating on water and some others sinking?

List those which you know.

Those floating on water	Those sinking in water

Fig. 11.7

- ⋆ Why do some objects float on and some others sink in water?
- ⋆ Using a spring balance, find out the weight in air of a wooden block that can float on water.
- ⋆ What is its weight while floating on water?
- ⋆ Why does the wooden block weigh zero in water though the Earth attracts it downwards?

If so, what are the forces acting here? What is the relationship between them?

You know that the buoyant force acting on a body is equal to the weight of the liquid displaced by it. If so, write the conditions required for an object to float on a liquid.

- The weight of the floating object and its buoyant force will be equal.
-

This is the law of floatation.

Write a definition of floatation.

- ⋆ Though a piece of iron sinks in water, a ship made of iron floats on water. Why?

Haven't you often heard the complaint, 'Milk is adulterated by adding water'?

- ⋆ What is the instrument used to identify this adulteration?
- ⋆ How does this instrument work?

You have understood that the weight of an object floating on a liquid and the weight of the liquid displaced by it are same. If the same object floats on liquids having different densities, will the same volume of the liquid be displaced?

Let's do an experiment?

Take water in a measuring jar and mark the water level. Allow a wooden block to float on the water. Mark the water level again. Repeat the experiment using kerosene.

Based on the law of floatation record the inference you reached. Place a hydrometer in the liquids which you used for the experiment.

- ⋆ What do you observe?
- ⋆ Why is the hydrometer seen raised in water and lowered in kerosene?

Based on the law of floatation, record your findings in the science diary.

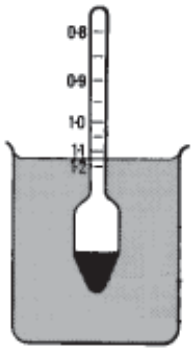


Fig. 11.8

Using hydrometer, we can find out the density of other liquids in comparison with the density of water.

> The relative density of an object is the ratio between the density of that object and that of water.

- Now, can you say how a lactometer helps to know the purity of milk?
- Try to make a lactometer / hydrometer using straw, sand and wax.

Atmospheric pressure

Haven't you understood that liquids exert pressure? Do gases exert pressure?

Let's see.

A Conical Flask that Swallows Egg

Can you insert a boiled egg, whose shell has been removed, effortlessly into a narrow-necked conical flask? Please try.

If you can't, put a piece of burning paper in the conical flask and then place the egg at the mouth. What do you observe? Can you find out the reason?

Fig. 11.9

We use pumps to pump out water from wells etc. The pumps in olden days were quite simple. It consisted of a long pipe, one end of which was immersed in the water in the well. The other end will be connected to a cylinder. The pump has a handle. Labourers will move it up and down. As the handle works, water will flow upwards. How does the water rise? When the handle works, a vacuum will be created in the cylinder. Water will rise up to fill this vacuum. What is the force that raises the water? It was believed that the water flowed through the pump because nature didn't love vacuum spots. The Italian scientist Torricelli gave a scientific answer for this. Torricelli was the disciple of Galileo Galelie who discovered that air had weight.

What information might Torricelli have made use of in order to explain the rise of water through the pump?

- There is an air column enveloping the Earth.
- The weight of this air is exerted on the surface of the Earth.
- Atmospheric pressure is the weight of air exerted on unit area.

On the basis of atmospheric pressure, find out the reason for the egg to slide into the beaker.

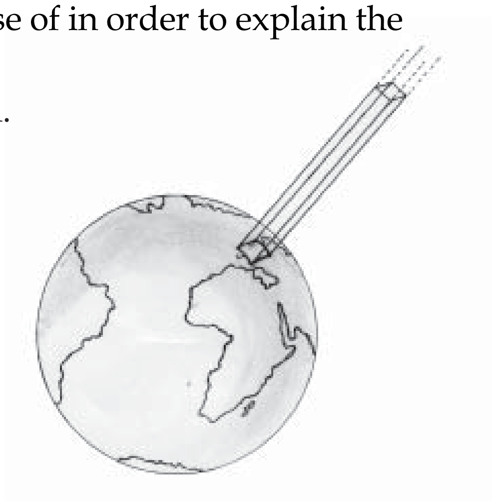


Fig. 11.10

✶ Does atmosphere exert pressure downwards only?

Let's find out.

- Fill water in a plastic bottle and close it tight. Make a small hole at the bottom of the bottle. Does water flow down through the hole?

Make another hole on the side of the bottle, above the water level. Hold it closed and then open it and repeat the process.

✶ What do you see? What is the reason?

Write the inference you arrived at.

Can you measure atmospheric pressure?

Torricelli was the first to measure atmospheric pressure. He melted and closed one end of a long glass tube and filled it with mercury. He covered the open end with his finger. Then he immersed the open end into a dish full of mercury. He removed the finger holding the tube as such. Then the level of mercury in the tube started falling. After a while the fall stopped. Torricelli measured the height of mercury in the tube. It was 76cm at sea level.

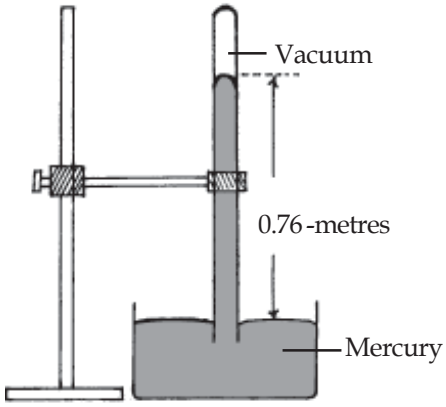


Fig. 11.11

- ⋆ Why did mercury remain at a height of 76cm instead of falling down fully?
- ⋆ Has it got any relationship with atmospheric pressure?

Record your findings in your science diary.

The instrument used to measure atmospheric pressure is barometer.

- The height of mercury level in the barometer midway up of Mount Everest is 50cm and at the top of the peak it is 30cm.

What may be the reason? Record your inference.
