SCIENCE
FOR CLASS V

5

SINDH TEXTBOOK BOARD

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Preface

It is a matter of great pleasure and satisfaction for me to iterate that the Sindh Textbook Board has been providing the students of the entire Sindh province, with textbooks of worthy standard from the point of its inception, till now. On one hand, these books are quite affordable; on the other hand, their publication and availability is being managed in a timely and efficient manner.

The main ideology behind these textbooks is that they must contain knowledgeable, qualitative material in order to impart in ours students, the skills that can help them compete in today's ever changing and challenging world. The present global scenario demands that first and foremost, our new generation must be well conversant with the Islamic ideology; then it must possess an exemplary character, a high degree of patriotism, and a sense of responsibility, brotherhood, fraternity and equality. The possession of all these qualities will assist them in their studies in general. However, acquisition of these skills is all the more important particularity in science teaching and learning, if the students are to actively participate in new scientific research and inventions, and develop awareness, soundness of mind and a progressive mind set.

Our students will be able to achieve success and economical stability and lead a prosperous and successful life, only when they are able to master these skills. Along with these skills our students will have to develop inquiry, communication, critical thinking and problem solving skills for a bright future. Having a bright future, they will be able to ultimately hold the reins of their country and provide it the much needed prosperity and economic soundness. They will become model citizens of their country and nation in shape of learners, implementers and innovators.

With objectives and intentions of such noble national spirit, the Sindh Textbook Board is introducing this book of "Science Grade-5" for new entrants in the field of education. This book has been written by well-experienced authors and reviewed by senior educationists in accordance with the "New Curriculum 2006" for inclusion in the syllabus. Thus, the Sindh Textbook Board is quite hopeful that the teachers, students and other respective stakeholders will benefit from this book.

Lastly, it is requested that in case there are any concrete recommendations(s)/suggestions from your side with reference to the material contained in this book, feel free to convey them to us, so that they can be incorporated in the subsequent edition.

The Chairman,
The Sindh Textbook Board, Jamshoro.

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Chapter 1

Classification of living things

Have you ever tried to observe and classify the living things in your surroundings? What are the main differences among these living things? Have you ever thought how many living things exist on earth? And how are they classified into plants and animals?

Figure 1.1: Coral reef

Does this creature look like a plant or an animal? Is it a plant or an animal? Can you explain your answer?

Figure 1.2: Mushrooms

"I am neither classified under plants nor animals." WHY?

In this chapter, you will learn about:

- Introduction to the main kingdoms (Bacteria, Algae, Fungi, Plants and Animals)
- Classification of the kingdoms
- Classification and characteristics of animals (vertebrates and invertebrates)
- Classification and characteristics of plants (flowering and non flowering plants)
- Classification of flowering plants (monocotyledonous and dicotyledonous plants)
- Characteristics of monocot and dicot plants (leaf shape, venation, seed and number of floral leaves)

All the students will be able to:

- ✓ Define classification.
- ✓ Explain the need and importance of classification.
- ✓ Differentiate between vertebrates and invertebrates according to key characteristics.
- ✓ Identify vertebrates and invertebrates from their surroundings.
- ✓ Classify vertebrates into mammals, reptiles, fish, birds and amphibians on the basis of their characteristics.
- ✓ Identify key characteristics of worms and insects.
- ✓ Compare flowering and non-flowering plants.
- ✓ Classify the flowering plants into two major groups and give examples of each group.
- ✓ Compare the structure of monocot and a dicot seed.
- ✓ Compare the structure of monocot and a dicot leaf in terms of its shape and venation.
- ✓ Differentiate between the structure of monocot and dicot flower in terms of number of floral leaves.

Introduction to the main kingdoms

- Define classification.
- Explain the need and importance of classification.

Think about it!

Which features can help you in classifying living things?

Figure 1.3: Animal kingdom

In the previous class, you have studied the needs, characteristcs and life cycle of living things. You have also studied that living things can be classified on the basis of the food they eat. now we will study another way to put living things in groups. Observe all the living things in your Surroundings; a scientist calls these living things, **organisms.** Many living things are alike in some way. They can be put into groups according to the ways they are alike. Putting living things into groups is called **classifying.** In order to study living things easily and systematically, we need to classify them.

Unscramble the given word:
REVETARBTE

_ _ _ _ _ _ _ _

Hint: The animals that have backbone.

For a long time, living things have been classified into the plant kingdom and the animal kingdom, according to their common characteristics. With the advancement of technology, scientists have observed more details in living things. As a result, living things are now classified into five different kingdoms.

Do you know that living organisms are made up of cells? Cell is the basic unit of living things. Cells are also microscopic. Most cells have nucleus and cell wall.

Living things

Bacteria

Figure 1.4: Bacteria

Unicellular organisms (single-celled), have cell wall but do not have proper nucleus.

They occur in air, water, soil or inside other organisms. Many of them cause diseases. But some are used to make medicines, yogurt, and cheese.

Algae

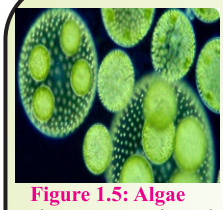


Figure 1.5: Algae

Mostly unicellular with proper cell wall and nucleus.

They contain chlorophyll and make their own food just like plants by photosynthesis. They live mainly in water. Many of them are used as food. Some cause diseases; for example, Cutleria, Ulva, and Volvox.

Fungi

Figure 1.6: Fungi

They are mostly multicellular, with modified cell wall and nucleus.
They do not have chlorophyll and do not photosynthesize.
Instead, they feed on material like human foods and dead plants or animals. Many of them cause diseases. Some are used to make medicines and bread.

Plants

Figure 1.7: Plants

Multicellular organisms (many-celled) with modified cell wall and nucleus. Also contain the green substance chlorophyll and make their own food by photosynthesis. They have proper roots, stems, leaves, flowers and also produce fruits.

Animals

Figure 1.8: Animals

They are multicellular organisms with modified nucleus but do not have cell wall. They cannot make their own food; feed on other organisms and usually move around. They are classified into vertebrates and invertebrates.

Activity1: Your garden, farm or nearby park can be a living place for many living things. Make a list of all the living things that visit or live in , any one of these places.

What I need:

- Observe in your garden.
- Observe how many different types of animals and plants visit or live in your garden.
- Talk to your family members, elders, teachers and senior fellows.
- Use hand lens if required.

What to do:

1. Your teacher will form groups of three students in a team.
2. Ask each member to observe and record physical characteristics of any one living thing from the garden (like bird, earthworm, butterfly, cat, grass, flower, etc.)
3. Draw or bring a picture of the living thing.
4. Along with the teacher, observe the living thing and its physical characteristics.
5. Now share the name/picture of the living thing, along with the characteristics, with group members.

What I observed:

Living things from the garden	Physical characteristics of any one common living thing

Activity questions:

1. What characteristics were most common in all living things?
2. Can you classify them according to their physical characteristics?

Teacher Note: Arrange and provide the materials for classification and facilitate students by observing the living things. Also ask the students questions during observation. Also help students in writing at least three characteristics of living things.

Classification and characteristics of animals

- Differentiate between Vertebrates and Invertebrates according to key characteristics.

Vertebrates and invertebrates:

All the animals on the Earth form a kingdom called the **animal kingdom**. Some are microscopic; so small that they can only be seen under a microscope. Others are gigantic, such as the enormous blue whale.

Which part of your body helps you stand tall or sit up straight? It is your backbone. You are a member of a large group of animals that all have backbones. Animals with backbones are called **vertebrates.** Fish, amphibians, reptiles, birds and mammals are all vertebrates. Some animals do not have backbones. These animals are called **invertebrates.** Worms, spider and insects are all invertebrates.

Activity 2: Find out the names of different animals.

Find the names of four vertebrates and four invertebrates hidden in the word search. Then write them in the correct group.

B	R	A	B	B	I	T	B	U	D
E	A	G	I	R	A	F	F	E	L
E	W	O	F	H	E	P	R	U	W
T	O	G	K	L	C	M	O	T	H
L	R	N	F	R	Y	S	G	I	A
E	M	L	I	O	N	O	J	E	L
R	S	P	I	D	E	R	M	R	E

Vertebrates

1. _____.
2. _____.
3. _____.
4. _____.

Invertebrates

1. _____.
2. _____.
3. _____.
4. _____.

Teacher Note: Engage students in the activity and help them write the names of four vertebrates and four invertebrates.

Animals know-how!

The word "animal" comes from a Latin word meaning **soul** or **breathe.**

There are more than 30,000 kinds of fishes.

There are over 9,000 kinds of birds.

There are over 8,00,000 kinds of insects.

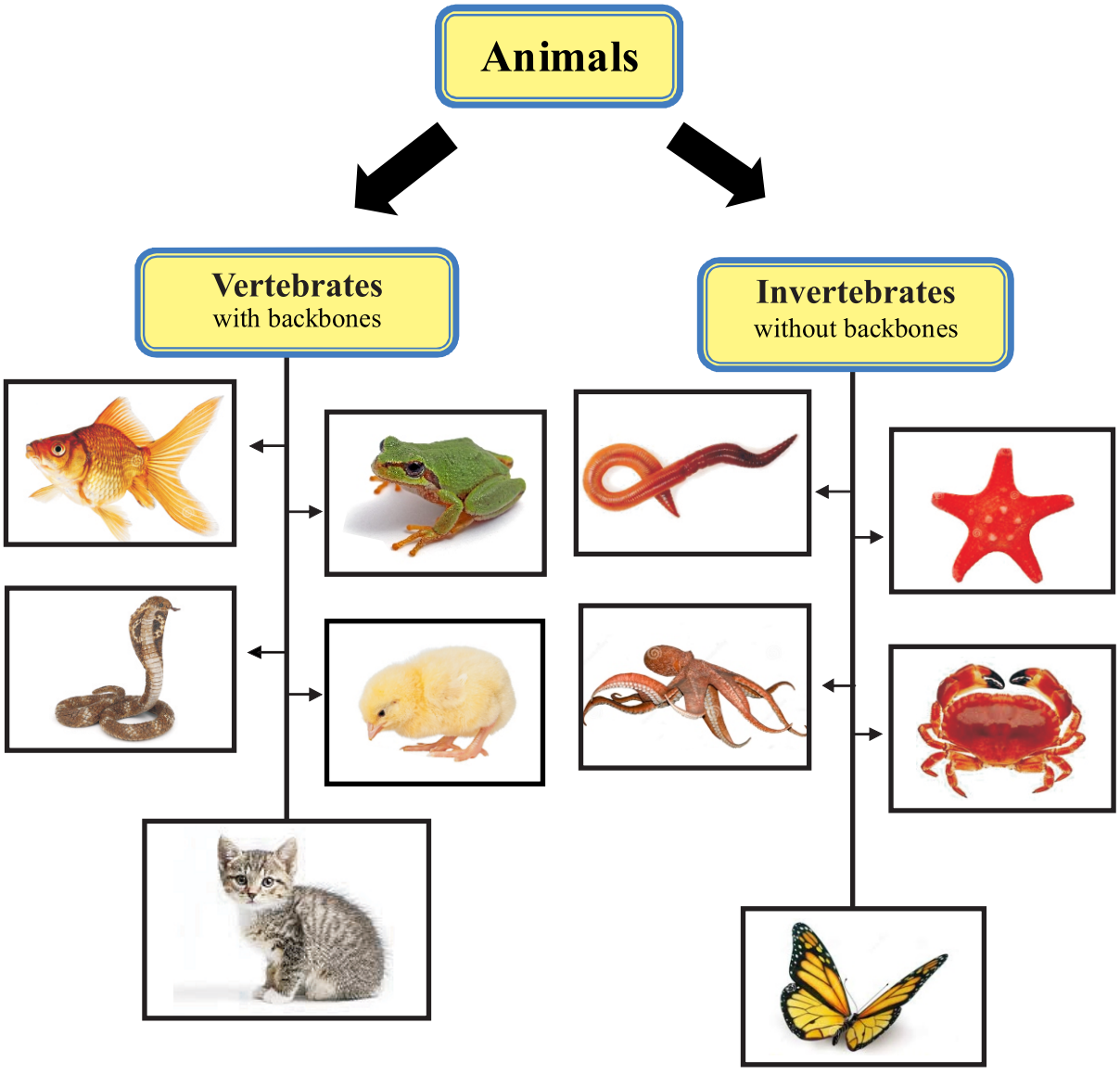


Figure 1.9: Classification of Animal (Vertebrates and Invertebrates)

Did you notice that the organisms are classified through divisions into two smaller groups each time? This is called a **Dichotomous key.**

Unscramble the given word:

LOYZOGO

_ _ _ _ _ _ _

Hint: The scientific study of animals·

Activity 3: With your parents/teacher, plan a visit to a zoo, or observe animals on a farm. Observe how many classes of animals are found there. What environment is provided to each class of animal at the zoo? Do not forget to take a notebook with you to record all these things.

Identify vertebrates and invertebrates from their surroundings.

What I need:

- Observe the animals.
- How many types of animals are found there?
- Observe differences among them according to their physical characteristics and way of living
- Talk to your family members, elders, teachers, class fellows and senior fellows.
- Also visit a library, visit WWF website or WWF center in Karachi.
- Watch a National Geographic program.
- Use hand lens if required.

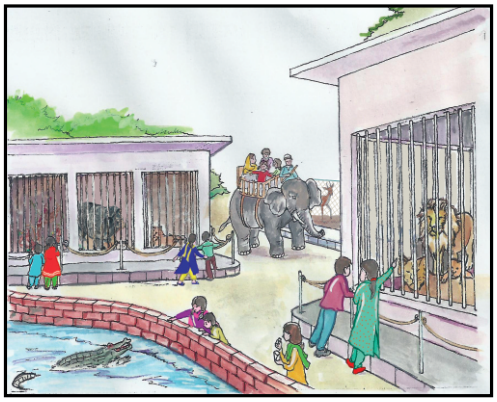


Figure1.10: Children are observing the animals

What to do:

1. Your teacher will form groups of four or five students in a team.
2. Ask each member to observe and record physical characteristics of one vertebrate and one invertebrate from the zoo. Also observe the living place of each animal.
3. Draw or bring a picture of the vertebrate or invertebrate.
4. Observe the vertebrates and invertebrates animals with your teacher and record their physical characteristics.
5. Now share the name/picture of the vertebrates and invertebrates, along with their characteristics, with group members.

Teacher Note: Discuss with students and assist them in identifying and recording the characteristics of vertebrates and invertebrates. The teacher should also bring pictures of vertebrates and invertebrates for observation.

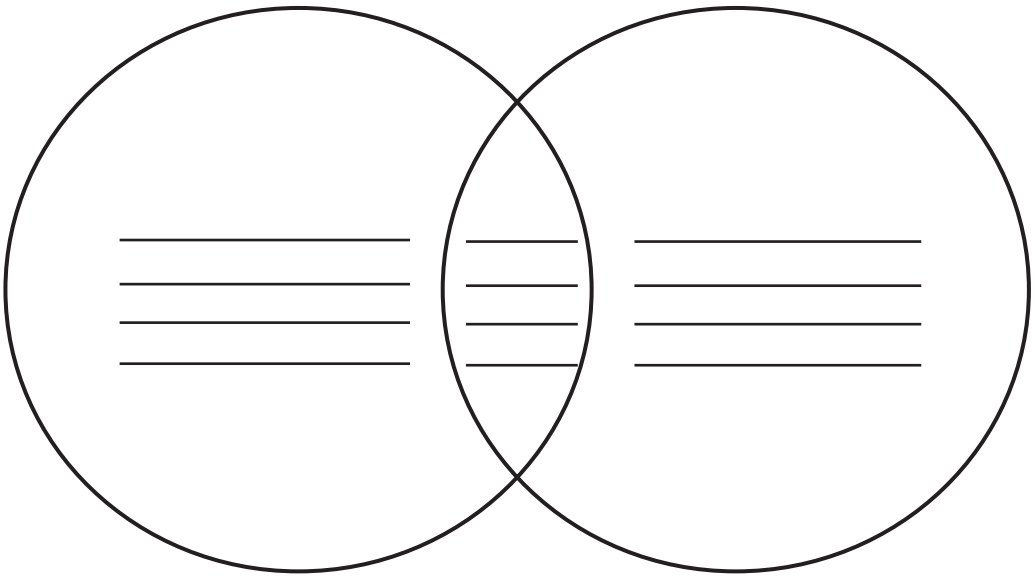
What I observed: **(Remember to write your team member's names.)**

Team members	Name/Picture of vertebrates and invertebrates	Characteristic of vertebrates and invertebrates	Way of living

Activity questions:

1. Which team member shared the most interesting characteristics? What were the most interesting and unique characteristics?
2. What characteristics were most common in vertebrates and invertebrates?
3. Compare vertebrates and invertebrates? How are the characteristics of the vertebrates and invertebrates similar and different? Write their similarities and differences.

Vertebrates **Similarities** **Invertebrates**



Teacher Note: Engage students in the activity and help them identify similarities and differences, in vertebrates and invertebrates .

Vertebrates

- Classify vertebrates into mammals, reptiles, fish, birds and amphibians on the basis of their characteristics.

Do you know some vertebrates are cold-blooded animals and some are warm-blooded animals? **What are cold-blooded and warm-blooded animals?** Are their body structures same or different?
Fishes, amphibians and reptiles are cold-blooded animals because they take on the temperature of their surroundings.
Birds and mammals are warm-blooded animals because they maintain a constant body temperature. This means that their body temperature does not depend upon the temperature of their environment.

Classification of vertebrates

Fish

Fish live in water.
Fish are cold-blooded.
They have fins not legs.
They lay their eggs in water.
Their body is covered with scales.
They have gills to help them breathe in the water.

Amphibians

Amphibians live on land and in water.
Amphibians are cold blooded.
They have moist skin.
They lay their eggs in water.
(Frogs, toads, newts and salamanders are amphibians.)

Reptiles

Reptiles have dry scaly skin.
They are cold-blooded.
They lay their eggs on land.
Reptiles live in water and on land.

Figure1.11: Classification of vertebrates

Activity 4: Identify the structural differences among vertebrates. Select any one vertebrate and become an expert on it. Research your vertebrate and complete the profile given below. Also, write all your information on a chart.

Common Name: _____.

Scientific Name: _____.

Found in/or: _____.

Feeding habits: _____.

Unusual characteristics: _____

_____.

1. Display the chart in your class.
2. Share the picture, along with the characteristics, with other students.
3. Record all the structural differences among vertebrates on your notebook.

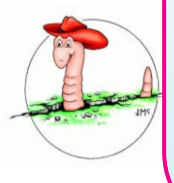
Teacher Note: Explain this activity and instruct the students in doing the research work.

Invertebrates

Identify key characteristics of worms and insects.

Do you think that earthworms are insects? Earthworms and insects are alike in many ways, but earthworms are not insects. **What are earthworms?**
Earthworms are worm- like invertebrates. Other examples of invertebrates are leech, flatworm, tapeworm and roundworm. Some worms have segmented bodies; others do not have segmented body. They do not have legs. Some of them suck blood like leech and roundworm. Some worms are even environment friendly like, the earthworm.

Worms:



Activity 5: To find out the characteristics of different worms.
'Secret code for worm lovers'

What to do:

A	B	C	D	E	F	G	H	I	J	K	L	M
1	2	3	4	5	6	7	8	9	10	11	12	13

N	O	P	Q	R	S	T	U	V	W	X	Y	Z
14	15	16	17	18	19	20	21	22	23	24	25	26

To decode the secret words, use the code below.

Earthworms can also be called **14 9 7 8 20 3 18 1 23 12 5 18 19**.

A tapeworm lives inside the **8 21 13 1 14** body.

As earthworm **2 21 18 18 15 23** through the soil, they give plants the **1 9 18** that they need.

A leech sucks **2 12 15 15 4** through its suckers.

Teacher Note: Engage students in performing the activity in groups or demonstrate it. Arrive at a conclusion along with the students.

Insects:

Do you know the name of the world's heaviest insect? Its name is goliath beetle. It can weigh over 100 gm. It lives in Africa.

All insects have three pairs of jointed legs, and in addition to this, many of them have one or two pairs of wings. Some of them have an antennae on their heads. Their body is divided into three main segments. They suck our blood or nectar of flowers. And they lay eggs.

Activity 6: Find out the characteristics of different insects.

Word Bank

Lady bug	**Mosquito**
Cockroach	**Dragonfly**

What to do:

Use the following hints and the Word Bank to decide which insect each riddle describes.

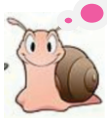
1. I have two pair of long, thin wings.
   I eat mosquitoes and other small insects.
   I live near lakes, ponds, streams and rivers.
   My abdomen is very long, as long as a darning needle.

   What am I? _____.

2. I like warm, damp and dark places and come out at night.
   Humans hate me.
   I am a destructive household pest.
   I am closely related to grasshopper and crickets.

   What am I? _____.

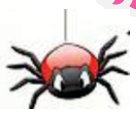
Insect's world!



Have you ever wondered why there are so many insects?

There are many reasons why insects outnumber any other group of animals in a count of heads!

Because they are small, they need less food.



Their small size helps them to hide from enemies.

Classification and characteristics of plants

- Compare flowering and non-flowering plants.
- Classify the flowering plants into two major groups and give examples of each group.

Do you know? Scientists have discovered over 380,000 different species of plants.

Plants are different from animals in such a way that they are rooted to one place and they use spores or seeds for reproduction. They also make their own food using carbon-dioxide and water in the presence of sunlight, with the help of chlorophyll, which is in their leaves, in a process called photosynthesis.

Do you know what plants do to give us food?

What food did you eat today? Did anything in it come from plants?

Do you have any plants at your home? Can you identify which type of plant is it?

How many types of plants do you have at your home? Which type of plant is more?

All the plants on the earth make up a kingdom, called the **plant kingdom.** Plants are divided into two main groups, those which have flowers are called flowering plants and others without flowers are called non-flowering plants.

Unscramble the given word:

TNAOBY

_ _ _ _ _ _

Hint: The scientific study of plants.

Classification of plants

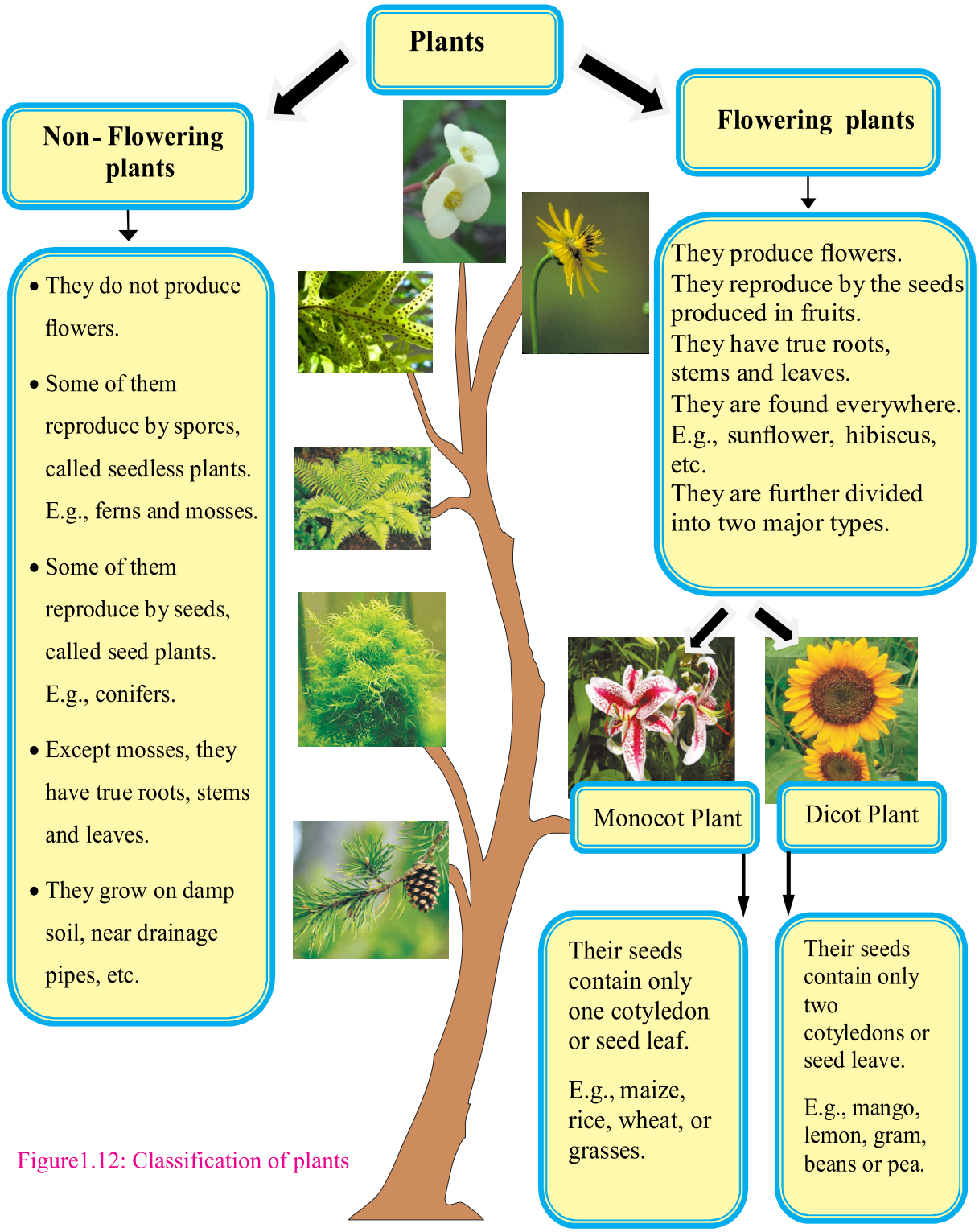


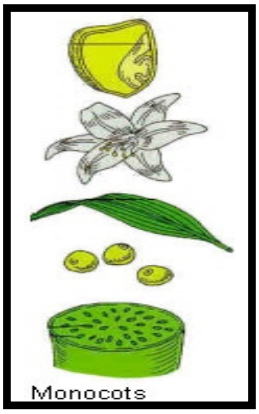
Figure1.12: Classification of plants

Characteristics of monocot and dicot plants

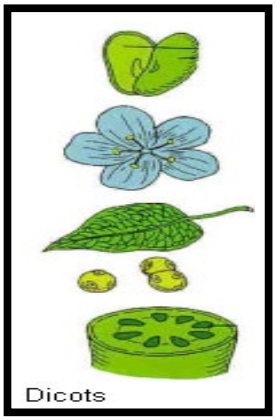
- Compare the structure of a monocot and a dicot seed.
- Compare the structure of a monocot and a dicot leaf in terms of its shape and venation.
- Differentiate between the structure of monocot and dicot flowers in terms of number of floral leaves.

Am I a monocot or a dicot plant?

Do you know the main differences between monocot and dicot plants?



Monocotyledonous plants	Dicotyledonous plants
One cotyledon or seed leaf.	Two cotyledons or seed leaves.
Generally marked parallel leaf venation.	Generally marked netted venation of leaves.
Flower parts typically in groups of three or multiples.	Flower parts typically in groups of four or five.



Activity 7: Identify the structural differences between monocot and dicot plants.

Name the following plants. In the circle provided, write 'M' if it is a monocot and mark a 'D' if it is a dicot.

Teacher Note: Engage the students in performing the activity in groups. Also assist the students in identifying the characteristics of monocot and dicot plants

Activity 8:

What I need:

- Visit a nearby nursery or farm with your class, where you can see a variety of plants. Take your notebook, pencil, and the pictures of seeds, leaves and flowers of both monocot and dicot plants with you.

Figure 1.13: A nursery

- Ask the nursery keeper/farmer to give you the six different types of seeds of both monocot and dicot plants.
- Soak these seeds in a container. Draw all the types of seeds and also write their names. Now slowly peel the outer covering of the seed. Observe how many cotyledons it has. You may need to use the hand lens for cotyledons.
- Observe different plants and note down the differences in their leaves and flowers.
- Collect six different types of leaves and flowers of both monocot and dicot plants.
- Examine each leaf carefully for its characteristics like shape and venation. Sketch a drawing of each leaf on your notebook. Discuss your findings with your pair and teachers. Also compare your sketches with the sample picture.
- Examine each flower carefully for its characteristics, like the number of floral leaves. Sketch a drawing of each flower on your notebook. Discuss you findings with your pair and teachers. Also compare your sketches with the sample picture.

What to do:

1. Your teacher will form groups of six students in a team.
2. Ask each member to observe and record characteristics of one leaf, one flower and one seed from the nursery.
3. Draw or bring a picture of the monocot and dicot plants.
4. Along with the teacher, observe the monocot and dicot plants, and their characteristics.
5. Now share the name/picture of the monocot and dicot plants, along with the characteristics, with group members.

Teacher Note: Discuss with students and assist them in identifying and recording the characteristics of monocot and dicot plants. Also, bring pictures of monocot and dicot plants for observation.

What I observed: (Remember to write your team member's names.)

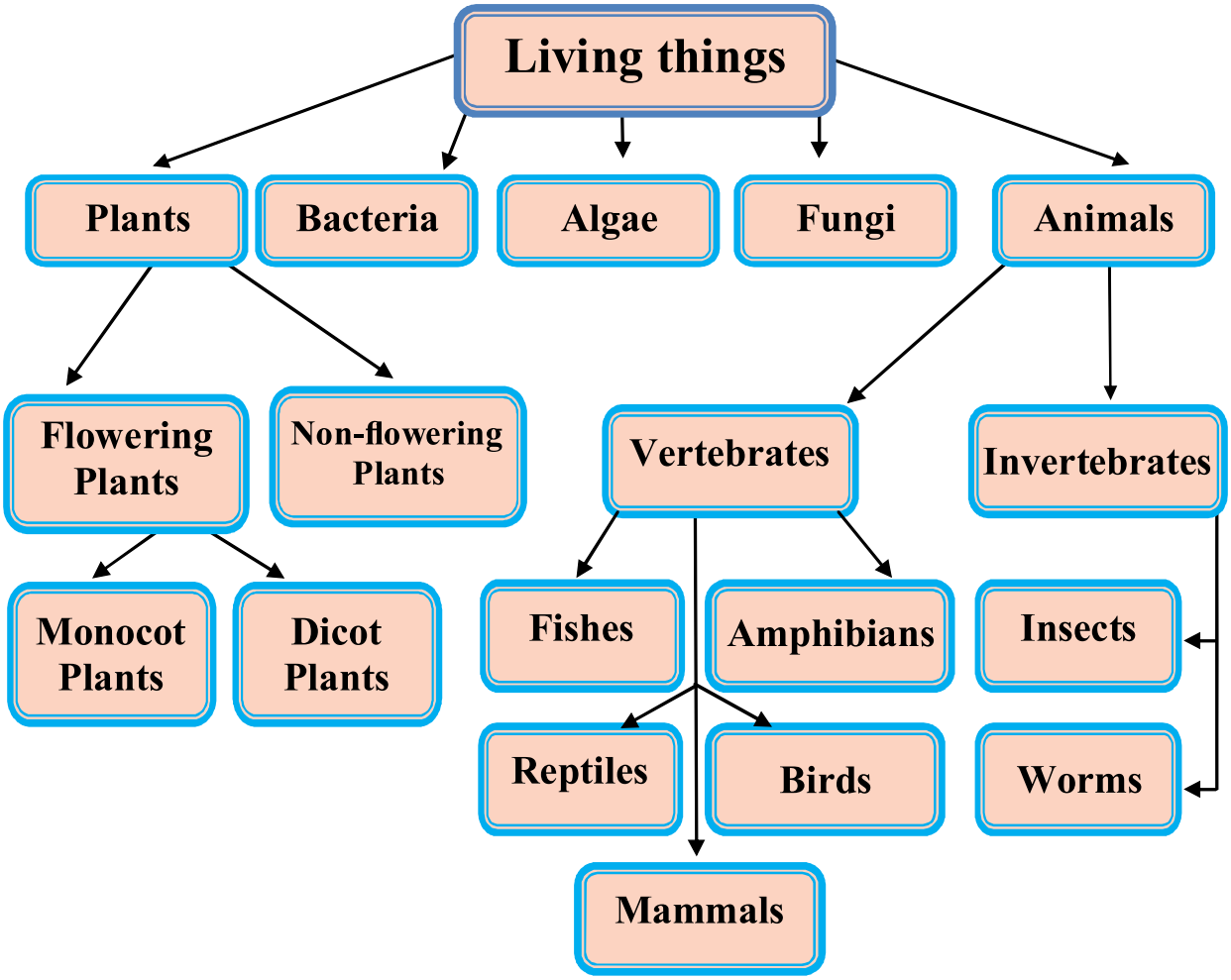
Team members	Name/Picture of monocot and dicot plants	Characteristics of Monocot and Dicot plants **(use tick)**					
		Seeds		Leaves		Flowers	
		One cotyledon	Two cotyledons	Parallel venation	Netted venation	Floral leaves three or multiple of three	Floral leaves four or multiple of four

Activity questions:

1. What characteristics were most common in monocot and dicot plants?
2. What characteristics were different in monocot and dicot plants?

Teacher Note: Engage the students in the activity and help them to identify similarities and differences in monocot and dicot plants

Summary



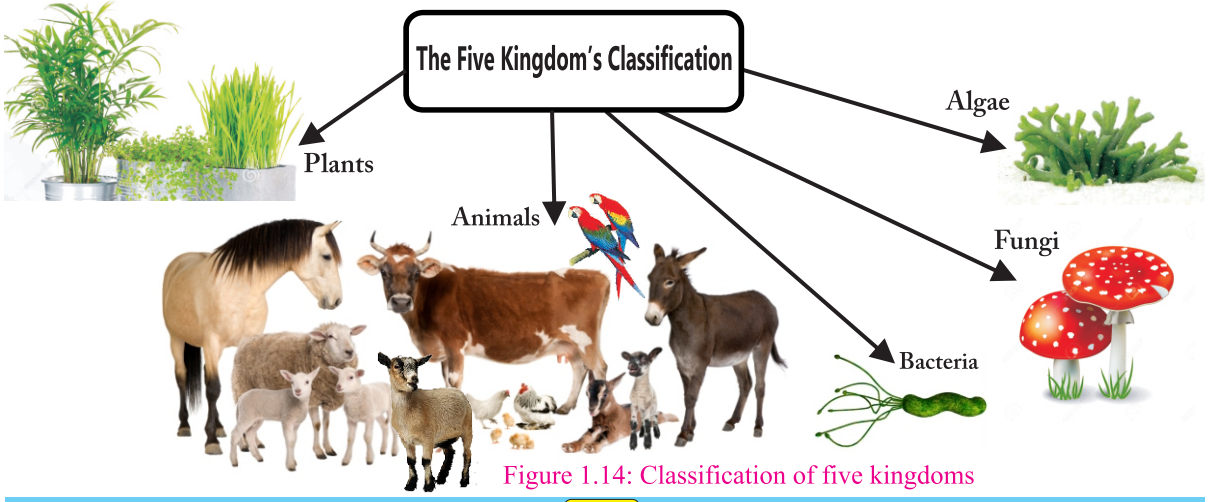


Figure 1.14: Classification of five kingdoms

Review questions :

1. Circle T for True and F for False Statements:

a) spider is an insect. T F

b) mushrooms belong to plant kingdom. T F

c) leech is an example of an invertebrate. T F

d) dicot leaves have parallel venation. T F

e) all insects have two pairs of wings. T F

2. Circle the best answer.

i. Which one of the following is an example of amphibian?

a) lizard

b) salamander

c) turtle

d) bat

ii. Which one of the following is not an example of mammals?

a) cat

b) bear

c) newt

d) dolphin

iii. The body of birds is covered with:

a) scales.

b) hair.

c) feathers.

d) fur.

iv. Which of the following is not a characteristic of a monocot plants?

a) Its leaves have parallel venation.

b) Its seeds consist of one cotyledon.

c) Its flowers have three or multiple of three floral leaves.

d) Its flowers have four or multiple of four floral leaves.

v. Which one of the following incorrectly shows the types of vertebrates through its examples?

	Types of vertebrates	Examples
a)	Reptile	Snake
b)	Mammal	Shark
c)	Bird	Ostrich
d)	Amphibian	Toad

3. Give brief answer to the following questions.

i. What is meant by classification? Why do scientists classify things?

ii. Define the following terms with examples of each:

a) insects b) worms

iii. Think of two different kinds of vertebrates. List at least two similarities and two differences between them.

iv. How would a scientist describe the following:

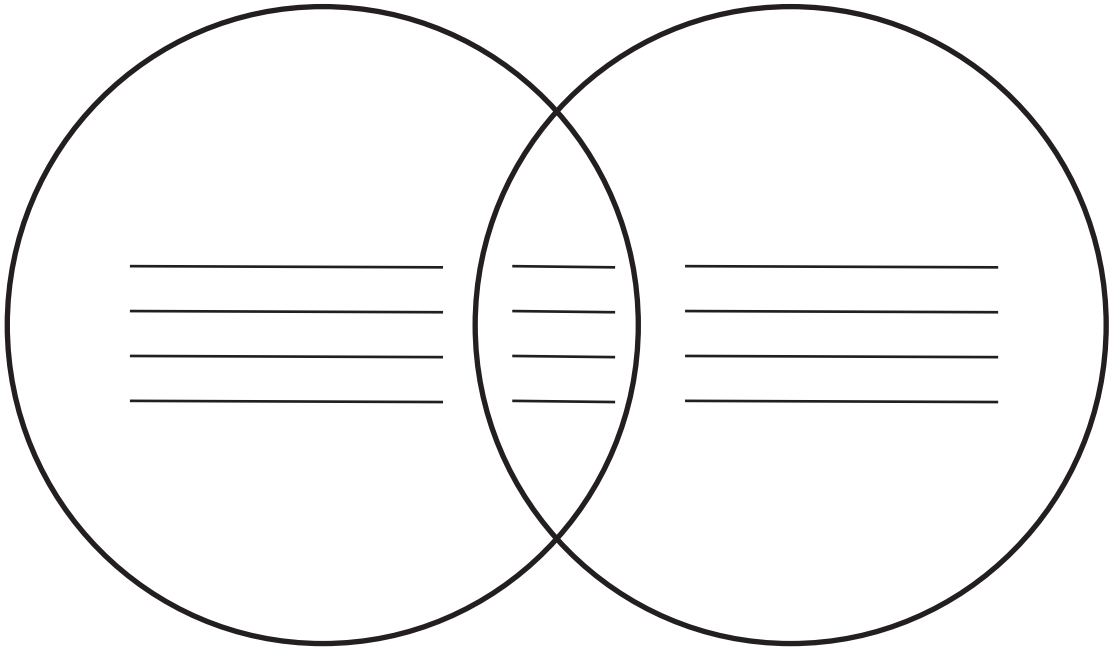
a) a fish b) a mammal c) a non-flowering plant

v. A crocodile can also spend some time in water. List at least three ways in which it is different from a frog.

4. Flowering plants comparisons

Use the Venn diagram below to compare the following plants. Fill in the circle below the monocot plant with characteristics common only to the monocot plant. Fill in the circle below the dicot plant with characteristics common only to the dicot plant. Where the circles overlap, fill in characteristics both flowering plants share. Write a story about your findings on another piece of paper.

Monocot plant **Similarities** **Dicot plant**



Chapter 2

Microorganisms

Have you ever thought how milk gets sour if it is left out in the open during hot weather? Why do vegetables and fruits rot? Why does garbage stink? Why do we catch the flu? It is because of the germs. Do you know that a lot of really tiny organisms, like germs are present in our environment? They are everywhere and they affect us in various ways. As you have studied that we need to wash our hands with soap and water, before and after eating, to protect ourselves from these germs. The germs might enter our body via dirty hands, if they are not washed properly. Do you know that there are many groups of these tiny organisms?

Figure 2.1: A picture of dirty finger-nails

What gets under your nails? Is it only dirt? No, there are thousands of tiny germs that can make you seriously ill. What should we do to stay safe from germs? Why should you trim your nails?

Unscramble the given word:
oomcirragnsim

_ _ _ _ _ _ _ _ _ _

HINT: very tiny organisms which can only be seen with a microscope.

In this chapter, you will learn about:

- Virus, bacteria and fungi.
- Usefulness of microorganism in food preparation and harmfulness in causing infection.
- The transmission of microorganisms and protection from these microorganisms.

All the students will be able to:

- ✓ Define microorganisms.
- ✓ Identify main groups of microorganisms and give examples of each.
- ✓ Describe the advantages and disadvantages of microorganisms in daily life.
- ✓ Define infection.
- ✓ Identify ways in which microorganisms can enter the human body.
- ✓ Suggest ways to avoid infection.

Virus, Bacteria and Fungi

Microorganisms

Define microorganisms

Are you aware that there are millions of organisms on the planet earth? Some of them are extremely small in size and cannot be seen with the naked eye. These are called **microorganisms**.(micro - extremely small, organism - living being).

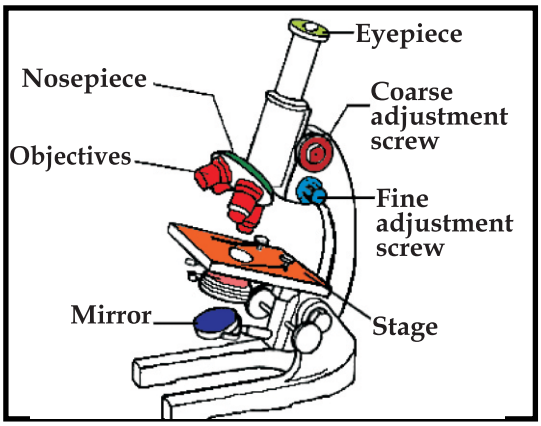


Figure 2.2: A microscope

A microscope makes things look bigger in size. Therefore we can say that a microscope magnifies objects.

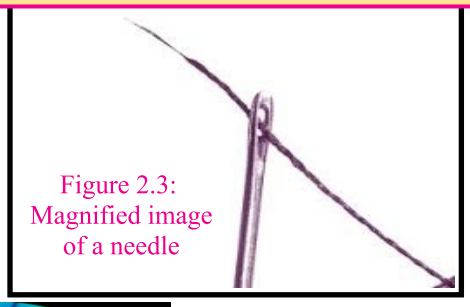
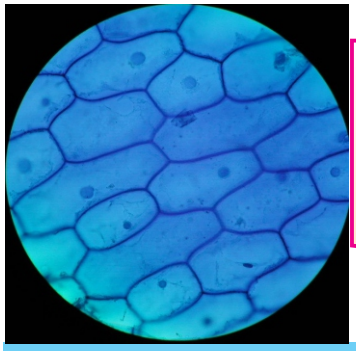


Figure 2.3: Magnified image of a needle

Microorganisms are present in the soil, air, water, on the surface of plants, animals and humans, and even inside their bodies. Another name for microorganisms is microbes. They can only be seen with the help of an instrument called the microscope. Microorganisms are so small that millions of them can accommodate themselves in the eye of a needle.



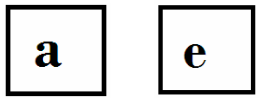
Do you know that living organisms are made up of bricks called cells. Cell is the basic unit of living things. Cells are also microscopic. This picture shows cells in onion skin as seen under a microscope.

Figure 2.4: Magnified onion skin cell

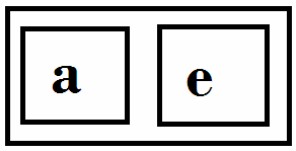
Activity 1: How does a microscope work?

Collect the following materials: clips of newspaper, scissors, glue, plain paper, glass, tape, water, and ruler.

1.Cut the letters **a** and **e** from a newspaper.



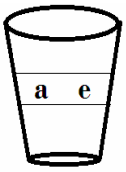
2 . Stick them on a piece of plain paper



3.Measure the size of the letters record in your note book .

4. Now take a glass. Stick the paper with plain side out(you can see the letters from the other side)

5 Fill the glass with water.



6. NOW SEE THE LETTERS. They are big! Magnified! Measure their size now. Record in the table below.

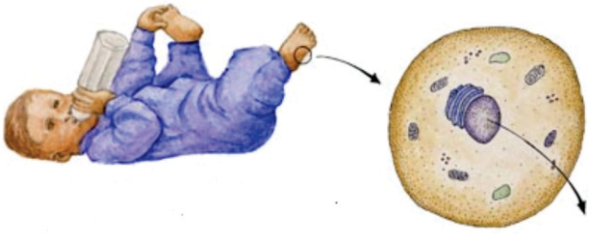
Letters	**A** Initial size (mm)	**B** Size with water and glass (mm)	**B – A (B minus A)**	**C** Size increase (mm)
a				
e				

Teacher Note: Engage the students in performing the activity. Encourage group work. Help taking measurements.

Major groups of microorganism: Virus, Bacteria and Fungi

- Identify the main groups of microorganisms

Microorganisms are **classified** into many groups. These groups are made based on the **similarities** and **differences** among them. Microorganisms are grouped as **viruses, bacteria and fungi.**



Do you know that large organisms have trillions of cells but most microorganisms have only one cell in their bodies?

Bacteria are **single** celled micro-organisms. Bacteria feed, grow, breathe, move, and divide to produce more bacteria. This is how you may see bacteria under a microscope. Some bacteria are shaped like rods; others are round or spiral in shape. E.g a bacterium which lives in the intestines of human beings and animals is ***Escherichia coli***

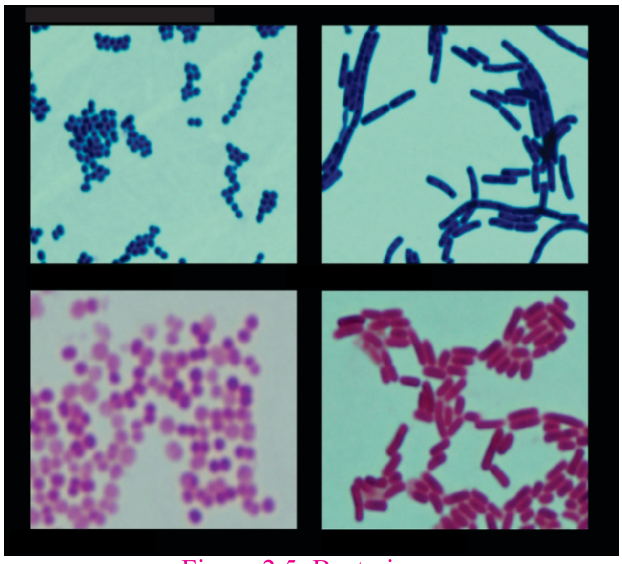


Figure 2.5: Bacteria

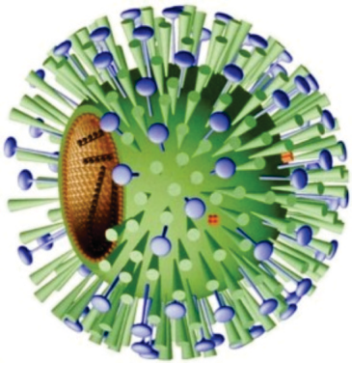


Figure 2.6: Virus

Viruses: are the simplest of all microorganisms. Scientists use high-powered microscopes to observe them. The structure of the virus is so simple; it is not even called a cell. Viruses do not feed, grow or divide on their own. They do so when they are inside other living organisms such as bacteria, animals, plants or human beings.

Do you know that a virus gives you a runny nose when you get a common cold? The common cold is caused by the **flu virus** or **influenza virus.**

Fungi: Some microorganisms belong to the group of living organisms called fungi. You should however remember that, **all fungi are not microscopic.** There are some fungi which can be easily seen with the naked eye.

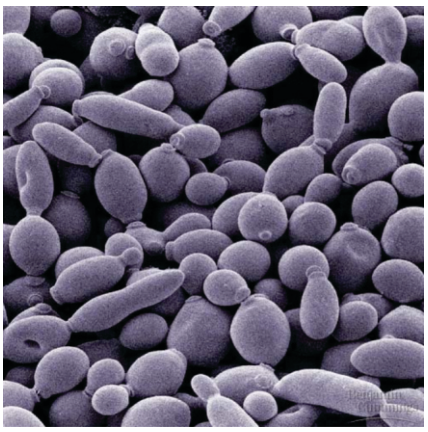


Figure 2.7: Fungi

You have studied about a fungus that is not a microorganism in the previous chapter. Do you remember the fungus?

Only single celled fungi are microscopic. The cell of microscopic fungi is somewhat larger than a bacterial cell. Therefore among bacteria, virus and fungi, fungi are the largest microbes. An example of unicellular microscopic fungus is **yeast.**

Do you know that the yummy fruit bun you eat has yeast added in it?

Unscramble the given word:
suriv

_ _ _ _ _ _ _ _

Hint: A non cellular microbe

Main characteristics of bacteria, virus and fungi

Bacteria	Virus	Fungi
Unicellular organisms; cells are simpler.	Non cellular organism	Unicellular organisms; cells are more complex than those of bacteria.
Feed, grow , breathe, move and divide in order to produce more bacteria.	Grow and divide, only when they are inside other living organisms.	Feed, grow, breathe, move and divide into new fungi on their own.
	Smallest microbes	Largest microbes

Usefulness and harmfulness of microorganisms

Describe the advantages and disadvantages of microorganisms in daily life.

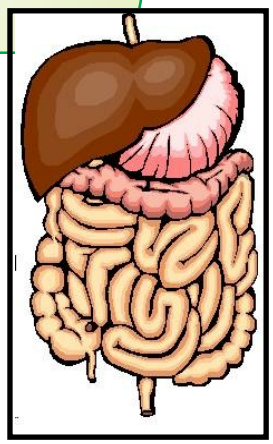
Microorganisms are very important for maintaining the life on earth. These tiny organisms created by nature can be both useful and harmful. They carry out many processes in nature.

You know all of us are not bad. Some of us are very useful for you.

Decomposition: The bacteria in soil break down garbage and remains of living organisms into simple nutrients. Without them we would be living in huge heaps of garbage. The nutrients released into the soil, make it fertile and helpful for plant growth.

Figure 2.8: Organic waste

In Food Making: Yeast is used for the raising of bread. Some bacteria are used in the making of yogurt, cheese and sour cream, etc.



Food Digestion: Some bacteria and fungi are normally present on the surface and inside the bodies of plants, animals and humans. They help in their body processes. Cattle, goat, sheep, and rabbits have special bacteria living in their digestive tube, which help in the digestion of food.

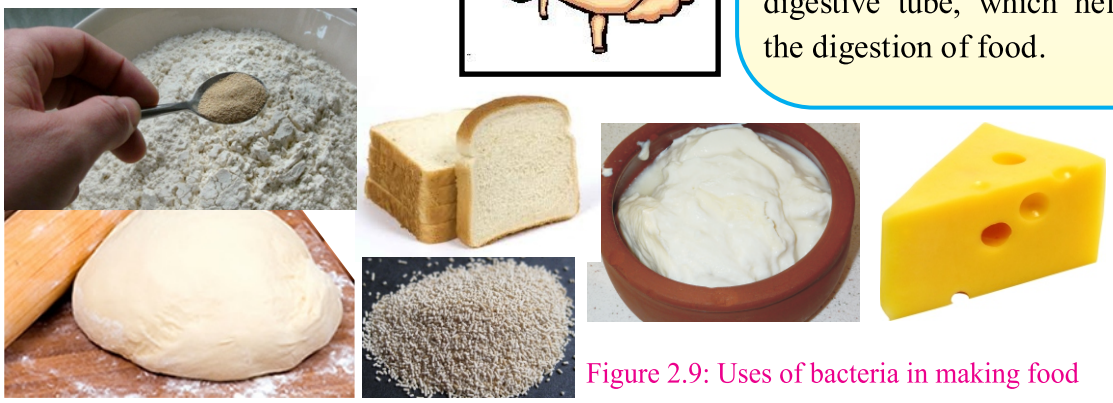


Figure 2.9: Uses of bacteria in making food

Activity 2: Using yeast to raise bread dough and converting milk into yogurt.

What do you need

- All purpose flour
- Yeast available at a local grocery or sweet shop
- Water
- Two tablespoons of sugar
- Milk
- Yogurt starter

Figure 2.10: Dough before and after raising.

What to do?

For bread dough

1. Your teacher will mix yeast with a little luke warm water.
2. Pour this mixture into flour containing two tablespoons of sugar. Knead the mixture to make dough. Take a container, put the dough in it and level the surface. Measure the height of the dough, this height is A
3. Leave the dough at a warm place for 3-4 hours.
4. After 4 hours, measure the height of the dough again. This height is B, find B-A. Has the dough risen? How much?

Initial height of dough (cms)	Final height of dough (cms)

For yogurt

1. Heat pre-boiled milk until its Luke warm.
2. Add a table spoon of yogurt. Mix well.
3. Cover the container with a lid. Leave it undisturbed for four to five hours
4. Check the contents after five hours. What do they look like?

What did you observe?

What happens to the milk?

Bacteria present in the yogurt start changing the milk into yogurt. In a few hours, all the milk is completely converted to yogurt.

What happens to the dough?

Yeast feeds on sugar in the dough and produces carbondioxide gas.

As carbondioxide is released in the dough, it rises up.

Activity questions:

Do you think that the dough will rise if the yeast is put in ice cold water?

Do you think that the dough will rise if the yeast is put in boiling water?

In antibiotics and vaccines: When did your doctor prescribe you an antibiotic? Some microbes produce chemicals called **antibiotics.** These chemicals destroy living cells, particularly micro organisms. They are used for the treatment of some diseases. **Penicilium** is a fungus that produces antibiotic called **penicillin.**
Microbes also produce **vaccines.** Vaccines prevent us from contracting certain diseases. Polio drops are a form of vaccine, made from the polio virus.

Figure 2.11: Doctor giving Polio drops to a child

Unscramble the given word:
ntiaoibitc

_ _ _ _ _ _ _

Hint: A chemical that destroys living cells

Teacher Note: Perform activity in class. Encourage students to observe the changes in dough and take measurements. Let them taste the yogurt and notice that the milk has changed.

Figure 2.12:Detergent powder

They are also used in the making of **leather** and **detergent powders.**

Figure 2.13: A pair of leather shoes

Harmful effects of microorganism

Figure 2.14: A rotten orange

Spoiling of food:

Some harmful bacteria get into our food and produce harmful chemicals. The food goes bad and produces a foul smell. Vegetables and fruits also rot when certain microbes attack them.

Contamination of drinking water:

Do you know many harmful microorganisms live in water? They make the water unfit for drinking. This water can only be purified from these microbes, by boiling it for at least five minutes. Boiling kills microbes.

Figure 2.15: A rotten cucumber

Activity 3: Observe the spoilage of food; growth of a fungal colony on a piece of bread.

A colony is a group of same kind of individuals living together.

What do you need?

A piece of moist bread.

What to do?

Take a piece of bread or roti. Moisten it and keep it at a warm open place. You may keep it in an open jar with a little water at the base.

Observe the bread piece every day. What changes do you observe? Do you see anything forming on the piece of bread? Use a hand lens to observe.

Moisten the piece of bread or roti if it gets dry.

What did I observe?

Days	What's new in my jar today?

Activity questions:

What is the colour of the colony?

Does the size of bread piece or roti change with the growth of colony?

Infections and diseases

Define infection

How often does your doctor tell you that you have an infection? What is an infection? **Any disease caused by the presence, and increasing multiplication of microbial organisms in the body, is called an infection or infectious disease.** Common cold or flu in which a person has a runny nose, sneezing, fever and headache is a viral infection.

Teacher Note: Engage the students in performing the activity. Observe the changes every day. Help them look at the structure of the fungal colony with a hand lens.

Some kinds of diarrhoea are caused by a bacterial infection. Various skin problems such as rashes, etc, are fungal infections. Plants and animals are also infected by various microbes.

Figure 2.16: A boy down with flu and fever; a viral infection

Figure 2.17: Athlete's foot: fungal infection of the foot

Routes to infection

Identify ways in which microorganisms can enter the human body

You know that microbes are present everywhere, in air, in soil, in water bodies, public bathrooms and on various surfaces. They may enter the human body through one of the following routes:

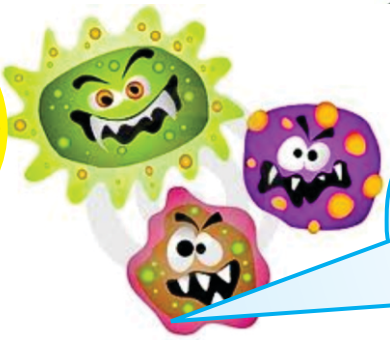
through the mouth, while eating

through the nose, while breathing

through the cuts in skin

Do you know? infection causing microbes are very good friends of our hands. Our hands touch many surfaces, so they carry germs of all kinds.

Microbe talk!



We are the bad microbes called germs. We cause typhoid, jaundice and athletes foot. Have you ever been infected by us?

Preventing infection

Suggest ways to avoid infections

Do you know how you can protect yourself from catching infections? The only way to stop the spread of infections is to maintain hygiene. Hygiene means cleanliness. Hygiene includes personal and environmental hygiene.

Figure 2.18: Ways to maintain hygiene

Personal hygiene includes washing hands frequently, trimming nails, bathing regularly and brushing teeth twice a day. Washing hands with soap and water after using toilet is also necessary. A clean body is free from harmful microbes that may cause diseases.

Environmental hygiene means that streets, roads, water bodies and bare grounds should be kept clean.

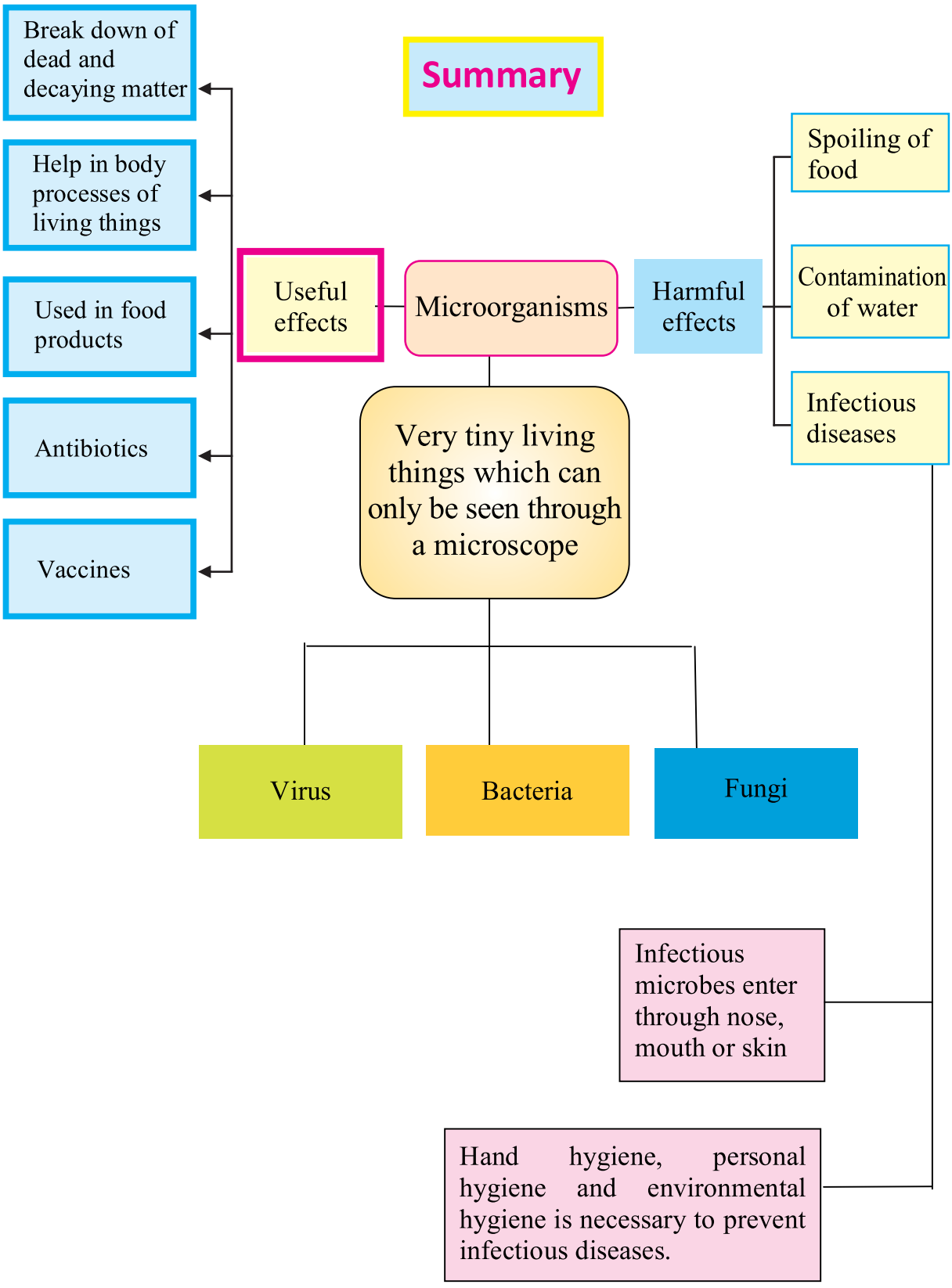
Harmful microorganisms do not grow at clean places.

Unscramble the given word:
ctionfein

_ _ _ _ _ _ _ _

Hint: A disease caused by microorganisms

Summary


Break down of dead and decaying matter
Help in body processes of living things
Used in food products
Antibiotics
Vaccines
Useful effects
Microorganisms
Harmful effects
Spoiling of food
Contamination of water
Infectious diseases
Very tiny living things which can only be seen through a microscope
Virus
Bacteria
Fungi
Infectious microbes enter through nose, mouth or skin
Hand hygiene, personal hygiene and environmental hygiene is necessary to prevent infectious diseases.

Project

Stop the spread

What do you need:

- List of infectous diseases and questions to explore, how are they caused and how do they travel from person to person.
- List of people such a doctor, nurse, dispenser, science teacher you could talk to.
- List of websites.
- Poster, chart paper and markers.

What to do: Choose a common infectious disease that affects human beings, plants or animals. Explore the following questions about it.

- Which microorganism is the cause of the disease?
- What happens to the diseased person? (what happens to the crop plant or animal)
- Where the microorganism is normally found?
- How does it enter the body of plant, animal or human?
- What can be done to stop the spread of disease?
- Use interesting figures or puppets to show your microbe in class.

1. Discuss with your family members, teachers, pair and senior fellows to find answers to the given questions and those that you have listed.
2. Explore books, websites, tv and radio or text your family and friends.
3. Present your findings through a poster titled " Stop the Spread" or a story called a "Germ Story" or a role play titled "Meet us".

Review questions:

1. **Fill in the blanks:**
   a. Yeast is an example of a _____
   b. E. coli is an example of _____
   c. Flu is caused by a _____
   d. An example of antibiotic is penicillin, which is produced by a fungus called _____
   e. An example of vaccine is _____. It works against the polio disease.
2. **Mark true or false:**
   1. All microbes cause diseases. T / F
   2. Microorganisms have bodies composed of just one cell. T / F
   3. Viruses are single celled and can live, grow and divide outside living cells. T / F
   4. Athlete's foot is a fungal infection T / F
   5. Flu is a bacterial infection T / F
3. **Define and give an example of each of the following:**
   microorganisms
   microscope
   antibiotics
   infection
   personal hygiene
   environmental hygiene
4. **Answer the following questions:**
   a. Briefly describe the three groups of microorganisms. Give examples for each.
   b. Make a list of good hygiene habits.
   c. Omer has been diagnosed with a bacterial throat infection. His sister, Abida, has a viral infection called measles. Write in your own words what each of these mean?

5. This is a gang of ugly and bad microbes. They call themselves BAD GERMS. Do you know how they harm human beings animals and plants? Write in your own words. Describe ways in which we can save ourselves from the GERM GANG.

These are friendly microbes. Do you know how they are important for human beings and the environment?

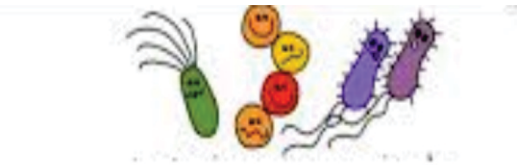


Figure 2.17: Probiotics

6. **Scientific Problem Solving**

The people of the Province of Sindh, Pakistan, are facing a serious problem these days. Many people are developing a disease called Dengue. The diseased person develops high fever, skin rash and sometimes may bleed.

Doctors explain the disease as the following: Dengue is a disease caused by the bite of one kind of mosquito. The mosquito contains a virus called dengue virus. When the mosquito bites a human, it transfers the virus into the human body. The mosquito causing dengue thrives in fresh water ponds.

The community is thinking of solutions to fight dengue. Can you help in coming up with some solutions? Discuss with doctor, nurse, dispenser, science teacher, senior fellows or call family members. Share your solutions with your class fellows.

7. **Environmental Hygiene is important in order to protect ourselves from germs. Observe the home environment and share ways that germs can enter our bodies. Suggest ways to clean the environment and protect the family from germs.**

Figure 2.18: Unhealthy home environment

Chapter 3

Seeds, their structure and germination

Have you ever observed the seeds in a fruit or a vegetable? We all come across seeds when we eat different kinds of fruits and vegetables. Some seeds are small, others are large Have you ever grown some seeds in your farm, flower pot or home garden? A seed grows into a baby plant and then a tall tree. What does a seed need to grow into an adult plant? Do the seeds eat? Where do they get the energy to grow? Are the seeds of all plants similar? Is there any difference between the seeds of different plants?

Figure 3.1 Fruits with seeds

Do you recognize these fruits and their seeds? Which of the seeds are edible? Which of these are not edible?

Explore

Are there any fruits without seeds? **Name a fruit without seed.**

In this chapter, you will learn about:

- The structure and germination of a French bean seed.
- The structure and germination of a maize seed.
- Function of Cotyledons
- Conditions necessary for germination.

All the students will be able to:

- ✓ Compare the structure and function of a French bean seed and a maize seed.
- ✓ List the functions of Cotyledons.
- ✓ Identify the conditions necessary for germination.
- ✓ Predict what would happen to a plant if conditions necessary for germination are not fulfilled.
- ✓ Conduct an investigation to assess your prediction.

Structure and germination of French bean seed

Have you ever eaten French beans? You know that seeds are parts of the plant that grow into new plants. Observe the picture; it shows a bean pod. It is a fruit, and there are several seeds or beans inside it.

Figure 3.2: French beans

Figure 3.3: French bean pod

Parts of a French bean seed:

Seed coat: Each seed is covered on the outside by a seed coat. The seed coat protects the seed. The scientists call the seed coat a **testa**. There is a small opening in the seed called **micropyle.**

Cotyledons: Soak a bean in water, remove its seed coat, press it gently between your fingers, it will split into two halves. Each half is a Cotyledon. The plants which have these kinds of seeds are called **dicotyledonous** (di; two) or **dicots.**
A French bean plant is a dicot.

Embryo: Inside the split French bean seed you will see a mini plant. This is called the **embryo.** Embryo is the part of the seed that develops into the new plant. It contains structures that develop into the root, stem and leaves of the new plant.

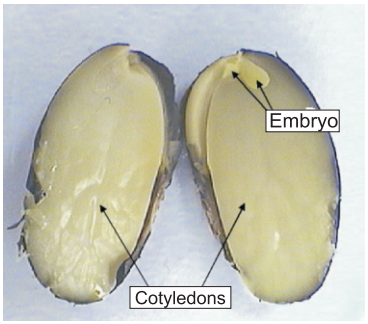


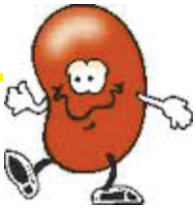
Figure 3.4: Transection of a French bean

Unscramble the given word:
ASETT

_ _ _ _ _ _ _ _

Hint: The scientific term for a seed coat.

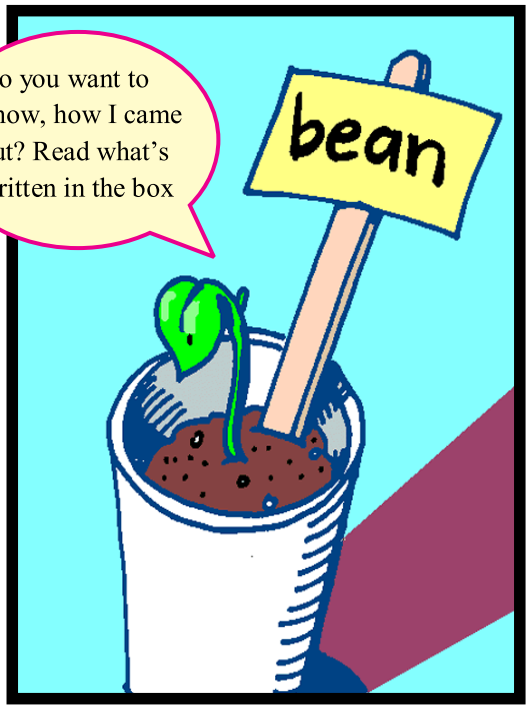
Keep in mind that French beans are dicotyledonous!



Seed talk!

Germination of a French bean seed

Do you know what does germination mean? Germination or seed germination is a process by which seeds sprout and begin to grow. When a French bean seed germinates in soil in the presence of water and oxygen, the embryo starts developing.



Germination of a French bean

The root emerges first. It grows downwards.

Then a hook like structure emerges from the soil. This hook like structure is called a **hypocotyl.** The **hypocotyl** pulls the **cotyledons** containing the **embryo** out of the soil.

The cotyledons that are now above the soil form the tip of the plant.

Then the seed coat falls to the soil.

After sometime the leaves of the plant appear. They start **photosynthesis.**

The cotyledons shrivel and fall off the plant.

Figure 3.5: Formation of hypocotylc

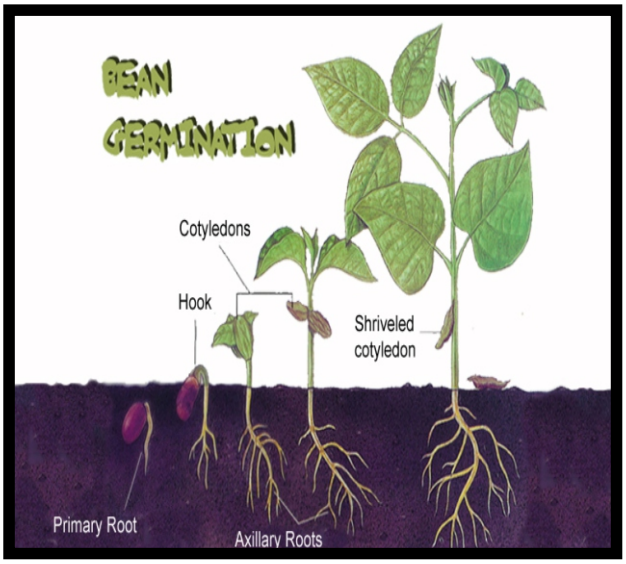


Figure 3.6 : Germination of seed

Do you know that this type of seed germination in which the cotyledons emerge above the ground is called **epigeal germination?**

Unscramble the given word:
leeaigp

_ _ _ _ _ _ _ _

Hint: The kind of germination in which cotyledons emerge above the ground.

Figure 3.7: Chickpeas

Do you know that the pea and chickpea also germinate just like French beans?

Do you know that there are thousands of different kinds of beans. They all germinate the same way.

Figure 3.8: Different kinds of beans

Structure and germination of a maize seed

This is a maize fruit with many seeds. You must have eaten it as roasted seeds or a roti of maize seeds.

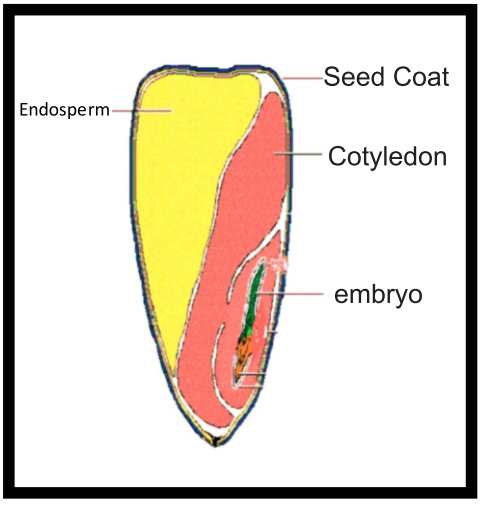


Figure 3.9: Transection of a maize seed

Parts of a maize seed:

Seed coat: The maize seed is surrounded by a seed coat. It has an opening called **micropyle.**

If the teacher cuts a maize seed longitudinally, using a razor blade, you will see the following structures:

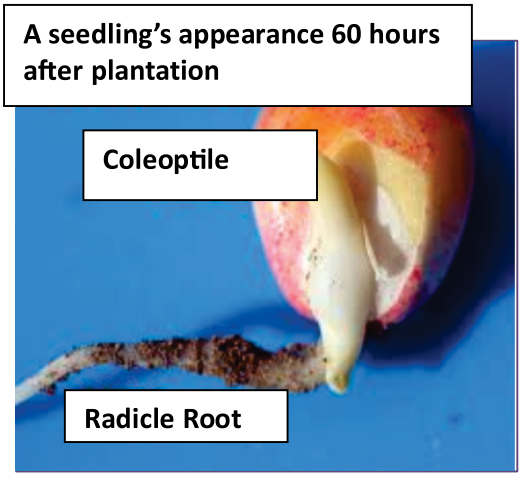
Embryo: A part of the seed that develops into a new plant. It has structures that develop into the root, stem and leaves of new plant.

Endosperm: A part of the seed that contains stored food. The stored food is used by embryo when it germinates.

Cotyledon: Since maize is a **monocot,** there is a single cotyledon in a maize seed. **Cotyledons** supply food from the endosperm to the developing embryo.

Germination of maize seed

You know that germination is a process by which seeds sprout and grow into seedlings. When a maize seed is sown in soil, the embryo starts developing.



Germination of a maize seed

The seed develops a root first. The root starts growing downwards.

A straight stalk grows out of the soil. This stalk like structure is called a **coleoptiles.** Then it splits and the new stem and leaves of the plant come out and grow upwards.

The **cotyledons** and **seed coat** remain below the soil.

During germination, the seed gets its food from the stored food in the **endosperm. Photosynthesis** does not take place until the first leaves develop.

This kind of germination in which cotyledons remain inside the soil is called **hypogeal germination.**

Unscramble the given word:
oopcleilte

_ _ _ _ _ _ _ _

Hint: The stalk like structure that comes out of soil during germination of maize

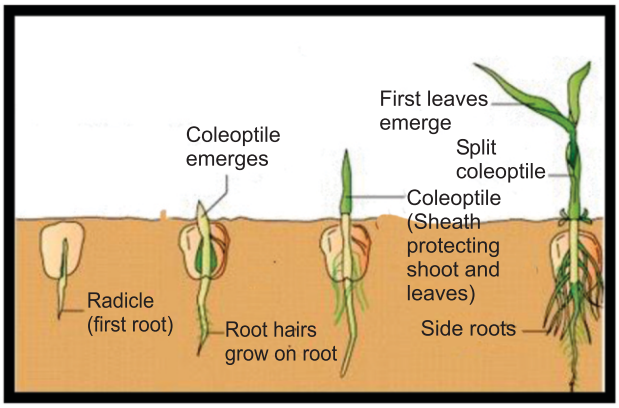


Figure 3.10: Germination of a maize seed

Activity 1: Studying the structure of french bean seed and maize seed and watching them germinate.

What do I need?

Dry and pre-soaked bean seeds and maize seeds, hand lens, blade, transparent glasses, tissue paper and water

Figure 3.11: Bean seeds planted in glass jars

What to do:

1. Observe a dry b ean seed. Locate the seed coat and micropyle.
2. Take a pre-soaked bean seed. Split open a pre-soaked bean. Locate embryo and cotyledons. Draw what you see.
3. Similarly observe a dry maize seed. Locate seed coat and micropyle. Take a pre-soaked maize seed. Cut a pre-soaked maize seed longitudinally into two halves. Locate embryo, endosperm and cotyledons. Draw what you see.
4. With the help of your teacher set up two separate glass jars for germination of the seeds. Spread a cloth piece or tissue paper along the walls of the jars and put a little water at its base.
5. Slip seeds into the space between the glass wall and the cloth/tissue paper. Make sure they are kept in various directions as shown in the picture.
6. Watch your seedling glass jars every day. Make sure that the water is one inch deep. But it should not reach the seeds.
7. Record your observations in the table every day.

What I observed:

Copy this table in your science notebook. Extend it up to 20 days. Observe your set up everyday till 20 days. Write or draw in the table. Take photographs if possible.

Days	What's new in the bean jar today?	What's new in the maize jar today?

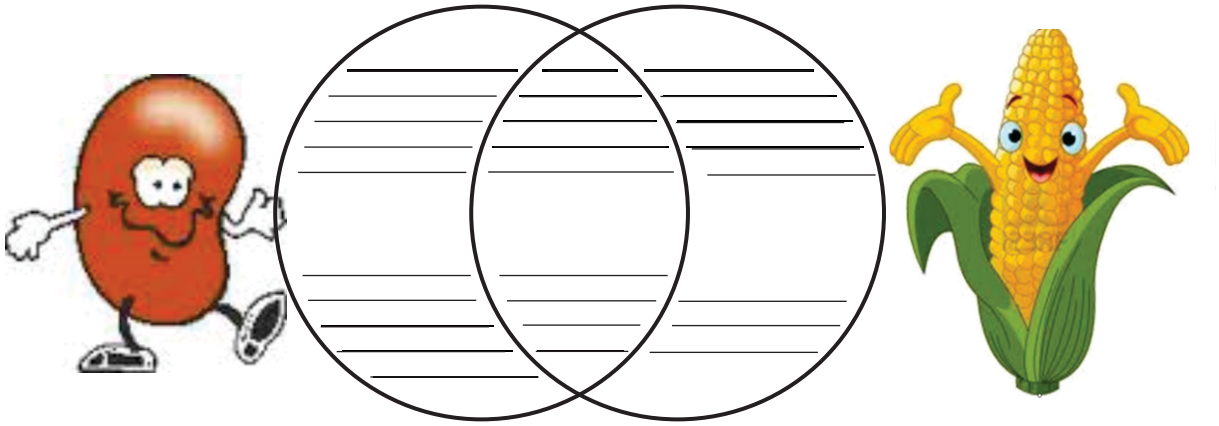
Teacher Note: Arrange dry and pre-soaked seeds and show each structure to the students while referring to the diagram and explanation given in the textbook. Draw their attention to the changes taking place during germination.

Do you see how tiny seeds develop into beautiful plants which benefit us? Do you know how tiny seeds are protected during their germination and growth. Talk to your teacher and classfellows about the process.

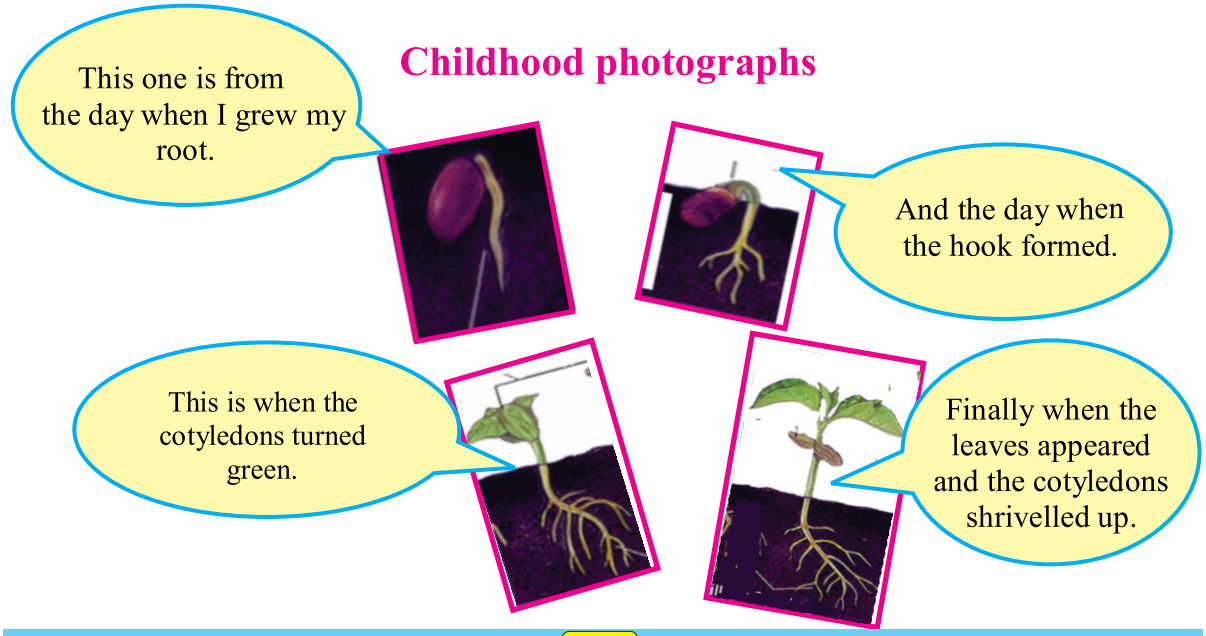
Compare the structure and germination of a French bean and a maize seed

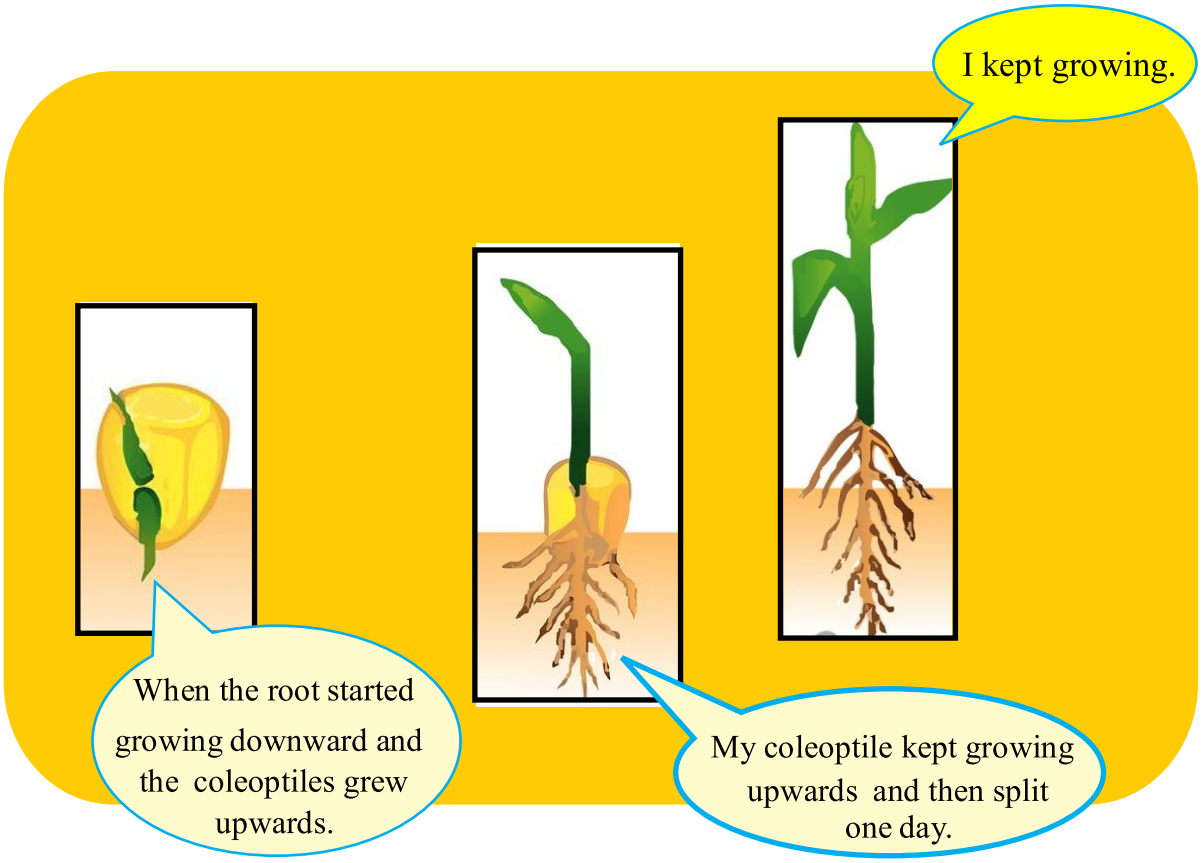
Comparison of structure and germination of a French bean seed and a maize seed

Do you see that there are some important differences in the structure as well as in the germination of French bean and maize seeds? We have found that a maize seed has one cotyledon while a French bean has two. Did you notice some other similarities and differences in the structure and germination of the two seeds? Fill up this Venn diagram.



French bean and maize plants are showing each other their childhood photographs.





Function of cotyledons

List the function of cotyledons.

You know that cotyledons are a part of the seed. Do you know what cotyledons do? They play an important part in seed germination.

In a mature seed, cotyledons contain food themselves or can get food from the endosperm, for the developing seedling. Thus they provide the energy necessary for germination.

Unscramble the given word:
yledontoc

_ _ _ _ _ _ _ _

Hint: The part of the seed that has access to stored food or stores food itself.

In one kind of germination like that of the French bean seed, the **cotyledons** grow out of the soil. They become **photosynthetic.** This means that they take in water and absorb sunlight to make food for the plant. Thus, they act as the first leaves of the seedling. In many cases, they stay on the plant for quite some time after the first leaves appear.

Unscramble the given word:
naiontrmeg

_ _ _ _ _ _ _ _

HINT: The sprouting of a seed into a seedling.

Do you know humans also consume the food stored in the cotyledons of seeds such as peanuts and chickpea. example of a seed that we use for food.

The conditions necessary for germination

Identify the conditions necessary for germination.

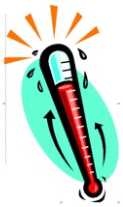
Millions of seeds are produced every day by various plants. Do all these seeds germinate? Which of these seeds are able to germinate and grow into new plants? Which of the seeds fail to germinate?

Only the seeds that receive the right conditions for germination are able to germinate. What are these conditions? Scientific experiments have shown that following conditions must be fulfilled for a seed to germinate.

Oxygen: It is necessary for life. For the seed to be able to germinate it must receive oxygen. When the seeds receive oxygen they start respiration. Respiration breaks down the stored food in seed to give it energy for growth.

Water: Seeds need water to swell them up in order to break the seed coat. Without water, the seed coat of a dry seed cannot break itself open.

Proper temperature: Every kind of seed germinates at a particular range of temperature. Most seeds will germinate between 16-24°C; however, there are some seed kinds which need colder temperatures i.e., 2-4°C, such as radish and spinach.



Some seeds also need exposure to light for their germination. While some other seeds require complete darkness.

And what about sunlight?

You know they must get water, oxygen and warmth.

Figure 3.12: Children planting sprouts

Predict what would happen to the plant if the conditions necessary for germination are not fulfilled. Conduct an investigation to assess your prediction.

Do you think your seeds might be able germinate if we don't give them oxygen, water and warm temperature? Most probably no! Let us test our idea using an experiment.

Activity 2: Investigating whether a seed will germinate in the absence of oxygen, water or in refrigerator temperature.

What do you know? Seeds are the parts of plants that grow into new plants. All seeds do not germinate in order to produce new plants.

What do you want to know from your experiment?

I want to know whether a French bean seed will germinate in the absence of water, air and proper temperature.

What do you need?

French bean seeds, four glass jars or test tubes, cotton wool, boiled and cooled water, and a refrigerator.

What to do:

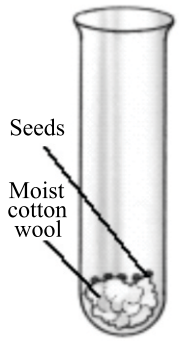
I will take four sets of seeds.

a. I will germinate the first group of seeds (A) in moist cotton wool (in the presence of water and air at room temperature).

b. I will germinate the second set of seeds (B) in dry cotton wool (in the absence of water at room temperature).

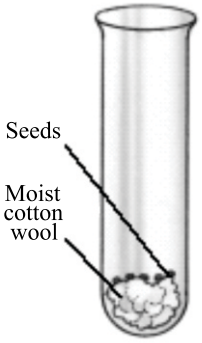
c. I will germinate the third set of seeds (C) in moist cotton wool in refrigerator (in the presence of water and air at low temperature).

d. I will germinate the fourth set of seeds (D) in boiled cooled water with a layer of oil above it (in the presence of water and absence of air).



A

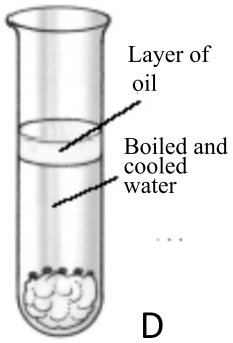
B



C

What do you think will happen? (Use the words **will** or **will not**, to complete the sentences.)

- Seeds _____ germinate in the first jar in the presence of water, air and proper temperature.
- Seeds _____ germinate in the second jar in the absence of water.
- Seeds _____ germinate in the third jar in the absence of proper temperature
- Seeds _____ germinate in the fourth jar in absence of air.



D

Jar / Test tube	What happened to the seeds? Did the seeds begin germination?
Jar 1 (with water, air and proper temperature)	
Jar 2 (without water)	
Jar 3 (without proper temperature)	
Jar 4 (without oxygen)	

What happened in your experiment?

The experiment shows that

_____

_____

_____

I conclude that:

_____

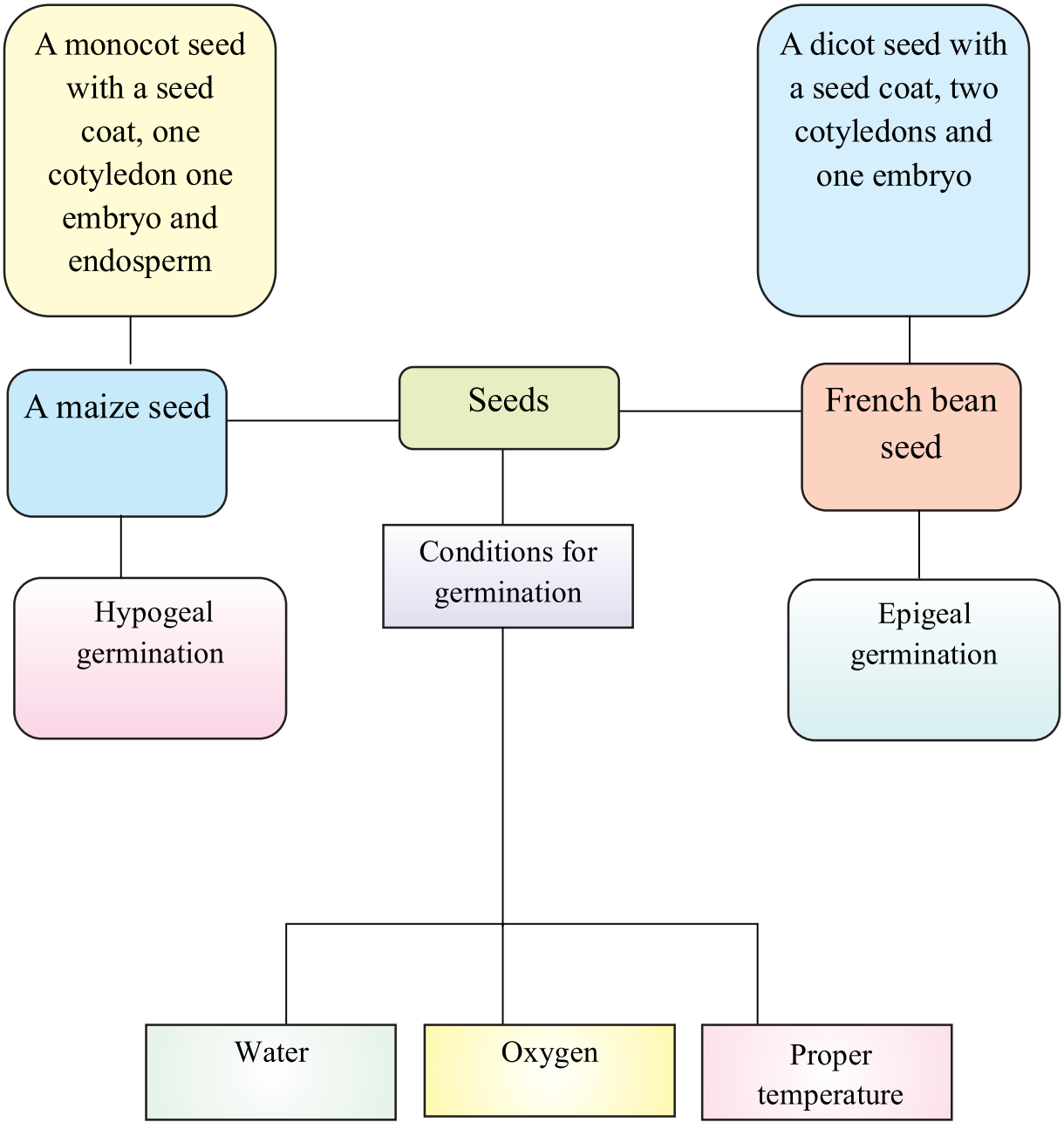
_____

_____

_____

Teacher Note: Engage the students in performing the experiment in groups or demonstrate it. Arrive at a conclusion along with the student.

Summary


A monocot seed with a seed coat, one cotyledon one embryo and endosperm
A dicot seed with a seed coat, two cotyledons and one embryo
A maize seed
Seeds
French bean seed
Hypogeal germination
Conditions for germination
Epigeal germination
Water
Oxygen
Proper temperature

Project

"Better seeds, better crops, better food"

What I need:

- List of questions to explore how seed germination is important in order to deal with the world's food problems.
- List of people/organizations that you could talk to, consult and visit.
- List of books and websites.
- Poster/ Chart paper and markers.

What to do:

1. Explore these questions. Add some more to this list.
    - Have the scientists developed any techniques to test the quality of a seed before it germinates?
    - What techniques are being used today to achieve better germination of seeds of crop plants? Are there any chemicals or machines that help achieve better germination?
    - Do pesticides affect seed germination?
2. Discuss with your family members, teachers, pair and senior fellows to find answers to the given questions and those that you have listed.
3. Explore from books, websites, tv and radio or text your family and friends.
4. Present your findings through a poster/Power Point presentation, story or role play entitled "Better seeds; Better crops; Better food".

Review questions

1. Circle T for True and F for False statements :

a) A French bean seed has one cotyledon. T F

b) A maize seed has two cotyledons. T F

c) In the germination of a French bean seed, the cotyledons come above the ground and perform photosynthesis. T F

d) Water, air and proper temperature are the conditions required for germination. T F

e) In the germination of a maize seed, the cotyledons stay below the soil. T F

2. Choose the correct answer

(i) The germination in which the cotyledons come above the ground.

a. Hypogeal germination
b. Epigeal germination
c. Germination

(ii) These conditions required for germination of a seed:

a. Carbon-dioxide, water, proper temperature
b. Oxygen, dry soil, proper temperature
c. Oxygen, proper temperature, water

(iii) About the requirement of light for germination.

a. Some seeds germinate in dark whereas some require light.
b. All seeds germinate in dark.
c. All seeds germinate in light.

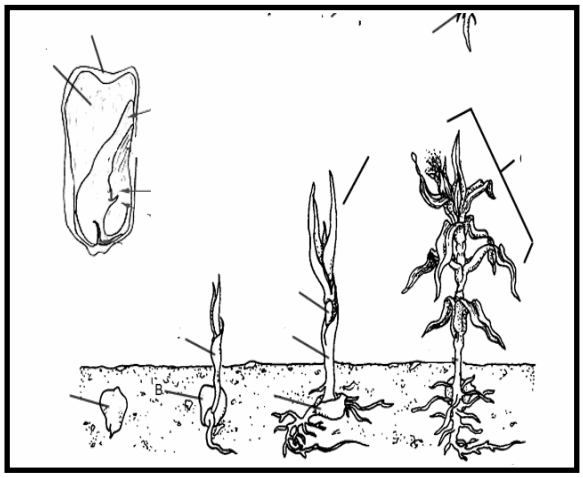
(iv) Hypocotyls hook is formed during the germination of:

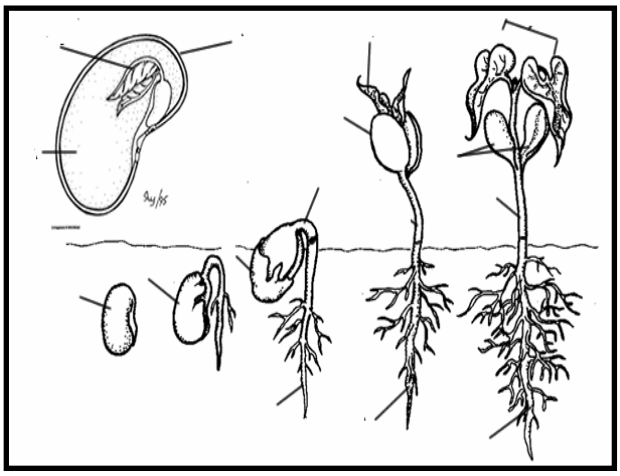
a. Maize seed
b. Bean seed
c. All seeds

(v) Coleoptile is a structure found in:

a. Maize seed
b. Bean seed
c. All seeds

3. Colour and label the diagrams given below:





4. Collect the following fruits. How many seeds do you find per fruit? Look at their structure. You may pre-soak them to have a better look. Then fill in the following table.

Fruits	How many seeds do you find per fruit?	No: of cotyledons	Do you see an embryo inside the seed?
Melon or Watermelon			
Lemon			
Green chillies			
Peach			
Pea Pod			

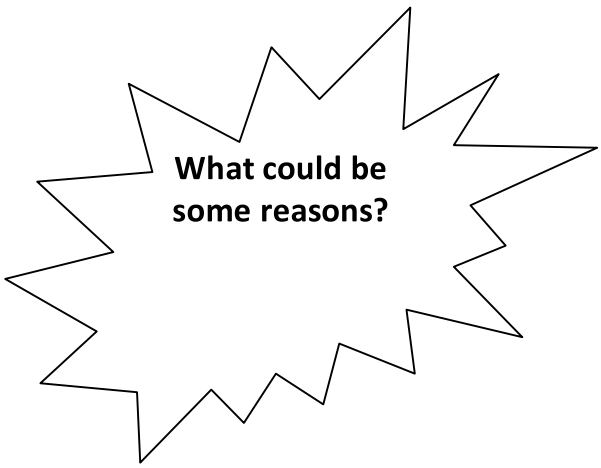
Paste the seeds in your notebook and write the important information about them

5. Answer the following questions

a. Differentiate between epigeal and hypogeal germination.
b. Describe the conditions required for germination of seeds.
c. What are the functions of cotyledons?

6. Scientific Problem Solving

Robina is trying to germinate sunflower seeds. It is summer. She put the seeds in a glass jar with moist cotton wool and places the set up in hot sunny place. A week has passed and the seeds have not germinated. Now Robina is thinking what might have stopped the seeds from germinating. Can you help her sort out the problem? What could be some reasons?



Chapter 4

Environmental pollution

What kinds of **pollution** are there in your surroundings? What are the main sources of pollution? How are you affected by pollution? Have you taken any step to reduce pollution and its harmful effects? What are the differences in **biodegradable** and **non-biodegradable** materials?

In this chapter, you will learn about:

- Pollution.
- Kinds of pollution. (Water, Air and Land).
- Main sources of pollution (smoke, sewage water, solid wastes, industrial wastes, etc.)
- Measures to reduce pollution.
- Biodegradable and non-biodegradable material.

All the students will be able to:

- ✓ Define pollution.
- ✓ Describe different kinds of pollution.
- ✓ Explain main causes of water, air and land pollution.
- ✓ Explain the effects of water, air and land pollution on the environment, and suggest ways to reduce them.
- ✓ Plan and conduct a campaign to bring awareness to the problem of environmental pollution in their surroundings.
- ✓ Differentiate between biodegradable and non-biodegradable material.
- ✓ Explain the impact of non-biodegradable material on the environment.
- Suggest ways to reduce the impact of non-biodegradable materials.

Figure 4.1: Environmental pollution

Kinds of pollution (Air, Land, Water)

Activity 1: Defining and describing kinds of pollution.

- Define pollution.
- Describe different kinds of pollution.

Do you know what pollution is? Look at the pictures below and name the kinds of pollution. Do you know what pollutants are? The pollutants are the harmful things that pollute the air, water and land environment, and make adverse changes to the air, water and land environment . Observe your surroundings. Talk to your elder siblings and peer. Draw or take and share photographs. Make a list of the pollutants in the air, water and land environment.

Teacher Note: Write the word "pollution" on the board or ask the students to observe the pictures above. Ask the students, "What is pollution?" What environments are polluted? Which pollutants can they observe in the pictures and in their living environments? Write student's responses on the board.

Figure 4.2: Different kinds of pollution.

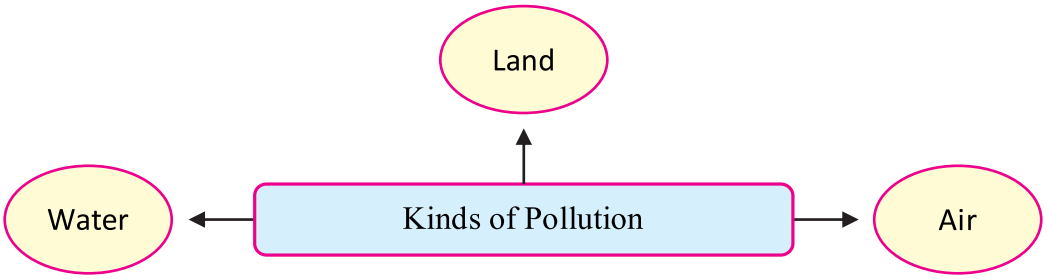
Many harmful substances called pollutants have been added to the environments causing **(Land, Water and Air) Pollution** in the above pictures. All living things in these environments have to experience the adverse effects of these changes to the environment. The air pollution is due to the release of smoke from the industries and vehicles into the clean air and the land pollution from dumping of solid waste and water pollution due to discharge of sewage from our homes and industries into the water bodies. **Smoke, solid waste and sewage** are **pollutants** that cause air, land and water pollution. These pollutants

are harmful for plants, animals and human beings living in these polluted environments.

What are the different polluted environments? What is pollution? What are pollutants?

Pollution is an undesirable change in the characteristics of air, water and land environment that is harmful to humans and other **living things** in the environment. Commonly, pollution is a form of addition of an undesirable and harmful substance like **smoke** or **non-biodegradable** material, like **plastic bags**, in the environment. Such **added substances** produced from human activities, bring about an undesirable change in the characteristics of air, water and land environment and are called **pollutants.**

Following are threes types of pollutions:



Do you know?

Karachi is ranked at **fifth place** among the **top six polluted cities in the world.** The major cause of air pollution in Karachi is emissions from vehicle. In fact the residents suffer many health ailments due to the increasing rate of suspended particulates in the air. Failure to take appropriate steps to control the hazard could be very dangerous to the Lives of the people.

Main sources of pollution (smoke, sewage water and solid wastes)

Explain the main causes of water, air and land pollution.

We are affected by various kinds of environmental pollution in Pakistan. Look at the pictures. What are the main causes of these water, air and land pollution? Discuss with your class fellows and elder siblings and parents.

Figure 4.3: Air pollution

Air pollution is caused by the **solid, liquid** and **gaseous pollutants** released from the burning of fuel, such as coal, oil, natural gas, waste papers and trash in industries, vehicles and at homes. The **pollutant** is commonly known as smoke.

Water pollution is caused by the addition of **untreated sewage water** from our domestic use i.e., from washing and toilets, into the water bodies.

Water pollution is also caused by untreated water that contains various **harmful chemicals** from our industries.

Water pollution is also caused by the water run-off from agriculture that contains various **harmful pesticides** and **fertilizers.**

Figure 4.4: Water pollution

Figure 4.5: Land pollution

The **land pollution** is caused due to the dumping of solid wastes such as plastic bags, bottles, papers, glass bottles, tin cans, vegetable and fruit cuttings and other animal wastes and faeces on the land. These solid wastes that are dumped on to the ground are of two types. Do you know that some of these **solid wastes** are **biodegradable;** while others are **non-biodegradable?** Talk to your classfellows and elder siblings about biodegradable and non-biodegradable waste. Can you identify the biodegradable and non-biodegradable waste? Make a list of biodegradable and non-biodegradable waste that you throw away at home for one week. Share the list with your class fellows and siblings.

Cause of pollution

Talk to your class fellows and complete the table below:

Kinds of pollution	Causes

Effects of environmental pollution

Explain the effects of water, air and land pollution on the environment.

The prolonged exposure of human beings and living things to water, air and land pollution has harmful effects on their health. Read, share and explain the effects to your elder siblings and family member.

Kinds of pollution	Effects
Air pollution	Headache , eyes and nose irritation, sore throat, nausea, ill feeling, asthma, drowsiness, weakened judgement and lung diseases, such as pneumonia and cancer.
Water pollution	Cholera, typhoid , diarrhoea and other water borne diseases m ostly related to digestive tract problems in human beings. Death of fishes, aquatic animals and plants living in the water or sea shores. Immune depression, reproductive failure or acute poisoning.
Land pollution	Toxic substances from the decay of land pollutants effect the underground water and the surrounding air.

Measures to reduce pollution

Suggest ways to reduce environmental pollution.

Environmental pollution is mainly caused by human activities and it could be reduced by taking the following measures at individual and collective levels.

- **Reduce** waste by refusing the use of unnecessary materials and non-biodegradable waste.
- **Reuse** and **recycle** non-toxic cans, bottles, pots and other pottery, plastic, metal, glassware and paper.
- Use **public transport** or carpools.
- Do not burn **trash** and **waste.**
- Do not **dispose** solid waste in coastal areas or water bodies.
- Use **eco-friendly fuels,** washing liquids and bathroom cleaners.
- **Recycle** water used at home for cleaning purposes.

Activity 2: Awareness campaign on problems of environmental pollution in our surroundings.

Plan and conduct a campaign to bring awareness to the problem of environmental pollution in one's surroundings.

What I need:

Observe in your surroundings.

- Talk to your pair, family members, elders, teachers, peer and senior fellows.
- Visit a library, visit the **IUCN** website or other websites and watch TV.

What to do:

1. Your teacher will form groups of four or five students in a team.
2. Ask each member to observe and record problems of environmental pollution in his or her surroundings.
3. Draw or bring a picture/photograph of three major environmental problems from your own surrounding.
4. Along with the teacher select one or two major problems faced by the community and explore its causes and effects. Make a poster.
5. Discuss and share the poster on the environmental problem, its causes, effects and ways to reduce it at the school assembly and in an event with parents and community members to create an awareness.
6. Ask all to sign a petition in order to take a personal action towards reducing environmental pollution.

	Name and signature
I will take actions to reduce environmental pollution.	

Teacher Note: Engage students in the activity and help them write the causes, effects and ways to reduce pollution. Engage the students in developing a poster and presentation skills.

What I observed: (remember to write your team member names)

Team members	Kind of pollution /Picture of Environmental Pollution	Causes/Effects

Activity questions:

1. What were the effects of the environmental pollution? Whom did you consult? What did you read?
2. What were the most common causes of environmental pollution?
3. Which actions could be taken to reduce environmental pollution?

Do you know?

Microbial pollutants from sewage water are a major problem in the developing world that causes diseases such as **cholera**, **diarrhoea** and **typhoid** being the primary causeof children death in our community.

Biodegradable and non-biodegradable materials:

Differentiate between biodegradable and non-biodegradable materials

- Differentiate between biodegradable and non-biodegradable materials.
- Explain the impact of non-biodegradable material on the environment.
- Suggest ways to reduce the impact of non-biodegradable materials.

We have various types of solid wastes. Some of the solid waste can be easily reduced through the natural waste reduction processes. These solid wastes that are easily decomposed by decomposers are called biodegradable. Other solid wastes that are not easily decomposed by decomposers or microorganisms, and that remain undecomposed on the earth for many years are called non-biodegradable wastes. Observe the picture A and B. What is similar and different materials?

Picture A

Picture B

Differences A	Similarities	Differences B

Major effects of non-biodegradable waste on the environment:

- Pollute ground water by emitting toxic pollutants into the ground water.
- Pollute air by emitting toxic gases on heating and burning.
- Polystyrenes and plastics can get into the oceans and water bodies and effect aquatic animals.
- Polystyrene and plastics break down into smaller pieces in the seas and oceans, causing small fishes and birds to accidentally swallow these pieces, thus endangering their lives.
- These wastes also choke the drainage systems and lead to over-flowing of gutters and flooding.

Figure 4.6: Effect of non-biodegradable waste on marine life

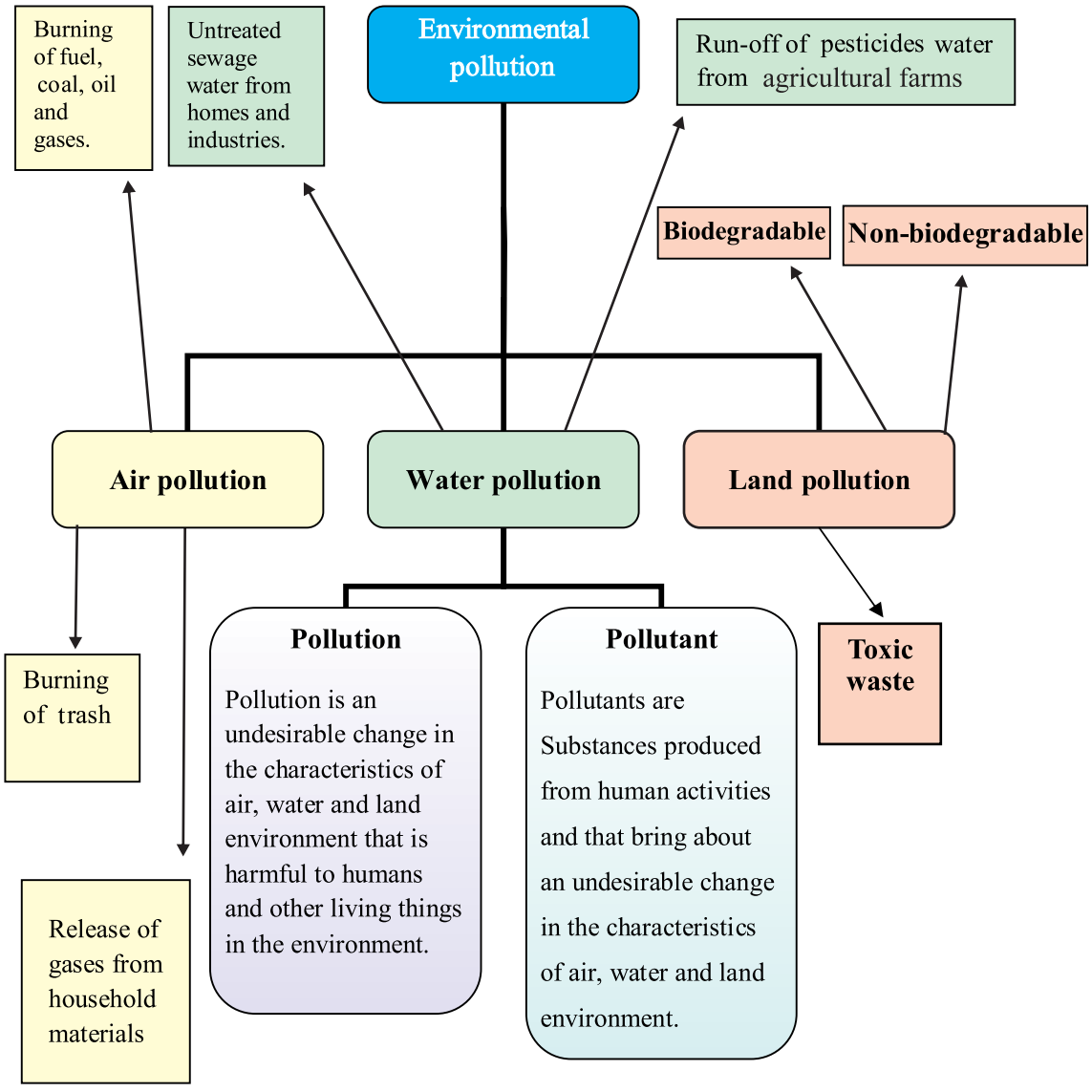
According to the United Nations Environment Program plastic is killing a million seabirds a year, year, and 100,000 marine mammals and turtles worldwide. It kills by entanglement, most commonly in discarded synthetic fishing lines and nets. It kills by choking throats and gullets and clogging up digestive tracts, leading to fatal constipation in marine life. Bottle caps, pocket combs, cigarette lighters, tampon applicators, cotton bud shafts, toothbrushes, toys, syringes and plastic shopping bags are routinely found in the stomachs of dead seabirds and turtles.

You have studied that solid wastes have several adverse effects on our environment.

So to avoid such an we should take the following steps:

1) Avoid the use of non-biodegradable material.
2) Recycle the used materials for storing non-eatables.
3) Avoid heating and burning of plastics and polystyrene.
4) Do not throw away debris into the water bodies and open places.

Summary


Environmental pollution
Burning of fuel, coal, oil and gases.
Untreated sewage water from homes and industries.
Run-off of pesticides water from agricultural farms
Biodegradable
Non-biodegradable
Air pollution
Water pollution
Land pollution
Burning of trash
Release of gases from household materials
Pollution
Pollution is an undesirable change in the characteristics of air, water and land environment that is harmful to humans and other living things in the environment.
Pollutant
Pollutants are Substances produced from human activities and that bring about an undesirable change in the characteristics of air, water and land environment.
Toxic waste

Kinds of Pollution

Land pollution | **Water pollution** | **Air pollution**

Have harmful effects on human health, living and non-living things in these environments

Solid waste

Biodegradable | Non-biodegradable

Activity questions:

1. Circle T for True and F for False statements:

a. Air pollution is caused by burning of fuels. T F

b. Water pollution is caused by burning of trash. T F

c. Land pollution is caused by disposing solid waste. T F

d. Non-biodegradable wastes do not harm marine life. T F

e. Drinking of polluted water causes water borne diseases. T F

f. Effects of breathing polluted air are headaches, eyes and nose irritation. T F

g. Agricultural run-offs pollute the water bodies. T F

2. Circle the best answer

(i) What is **not** a cause of air pollution?

a. burning of fuel b. burning of solid waste c. water from domestic use

(ii) Which is **not** a biodegradable waste?

a. vegetable peeling b. plastic bottles c. Paper

(iii) Which of these are **not** a cause of water pollution?

a. Gases from household materials

b. Sewage water from homes

c. Untreated water from industries

(iv) If a child has cholera, which environment pollution needs to be addressed?

a. Land b. Water c. Air

(v) Asthma is due to the exposure to a type of environmental pollution? Which one?

a. Air b. Water c. Land

(vi) What is an undesirable change in the characteristics of air, water and land that effects human health?

a. Harmful b. Pollutant c. Pollution

(vii) Which is the substance that causes undesirable change to the environment?

a. Pollutant b. Harmful c. Pollution

(viii) What is the major source of realease of direct pollutants in air pollution?

a. Air b. Fuel c. Gas

Use the following picture to answer the two questions that follow.

(ix) Which type of wastes are classified as biodegradable waste?

a. Waste from plastic industries.

b. Vegetable waste from farms.

c. Wasted water from homes.

(x) Which wastes are classified as non-biodegradable waste?

a. Waste from the plastic industry.

b. Vegetable waste from farms.

c. Kitchen waste from home.

3. Give reasons

Air pollution can be reduced by not burning trash.
Plant and animal life can be protected by avoiding the use of plastics.

Chapter 5

Matter and changes in its states

The World is made up of many tiny materials. As you have studied that all the **solid, liquid, gaseous** materials are **matter;** and **matter** has **mass** and occupies **space.** Have you ever thought what the solids, liquids and gases are made of? Imagine you could see inside a glass of water, an ice cube or air inside a cup. What would you see? You would see many particles arranged in different ways and moving in different ways.

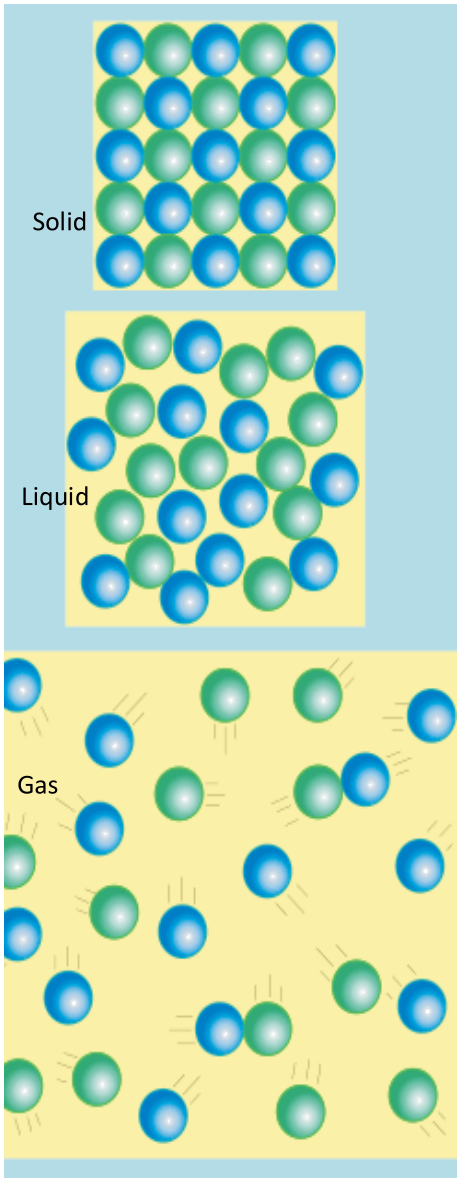


Figure 5.1: Arrangements of particles in three states of matter

In this chapter, you will learn about:

- Matter.
- Arrangements of particles in solids, liquids and gases.
- Effect of heat on arrangement of particles.
- Processes involving change of states (melting, freezing, boiling, evaporation and condensation).
- Application of condensation and evaporation in nature (water cycle).

All the students will be able to:

- ✓ Describe the properties of three states of matter on the basis of arrangement of particles.
- ✓ Demonstrate the arrangements of particles in the three states of matter through models.
- ✓ Investigate the effect of heat on particle motion during a change of states.
- ✓ Demonstrate and explain the processes that are involved in change in states.
- ✓ Describe the role of evaporation and condensation in the water cycle.
- ✓ Identify and describe forms of moisture in the environment (e.g.,dew, snow, fog, frost, rain).

Matter

Activity 1: Observing and describing the properties of three states of matter.

- Describe the properties of three states of matter on the basis of arrangement and movement of particles.

You have observed many solid materials in your previous class that are hard and you cannot change the shape. You have also observed many liquid materials that you can pour. Likewise you have observed many liquid materials that can change shape but not volume. Similarly you have observed materials that can change both shape and volume. Write the name or draw one material from each state in the below given below.

It flows and it has a fixed volume and no fixed shape.	It is hard and it has a fixed Shape and Volume.
It flows and it has no fixed shape and volume.	

These **Solid, liquid and gaseous materials** are made up of many tiny **like particles** the **atoms** and **molecules.** The particular **arrangement and movement** of these **particles** in the solid, liquid and gaseous materials provide the material its particular properties.

Activity 2: Movement of ink in a glass of water

What I need:

- A transparent glass.
- Water
- Ink
- Dropper.

What to do:

- Now take some water in a glass or cup and observe it closely.
- Is the water made up of tiny discrete particles, or is it continuous?
- Pour a drop of ink or colour with a dropper and observe closely.

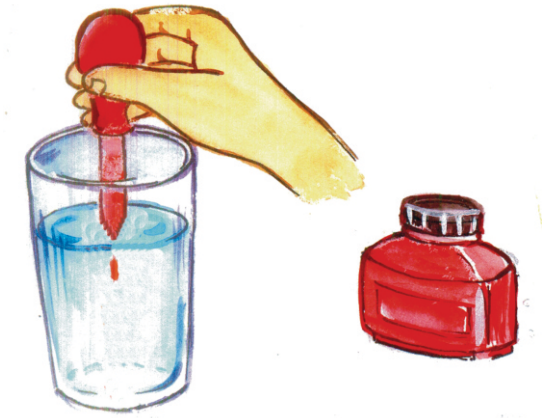


Figure 5.2: Dropping ink in a glass of water.

Activity questions:

- What did you observe?
- Why is the colour spreading/moving in the glass of water?
- How is the colour moving? What is pushing it here and there?

What I concluded: Discuss with class fellows and write here.

Teacher Note: As the students find it difficult to imagine that liquid is made up of tiny particles that can move around, rotate and slide past each other, demonstrate the activity and ask students to observe the movement. Why is ink moving about? What is hitting the ink particles and making it move in zig zag manner?

Activity 3: Demonstrating the arrangements of particles in three states of matter.

Demonstrate the arrangements of particles in the three states of matter through models.

- Observe the models a, b and c.
- Talk to your classfellows.

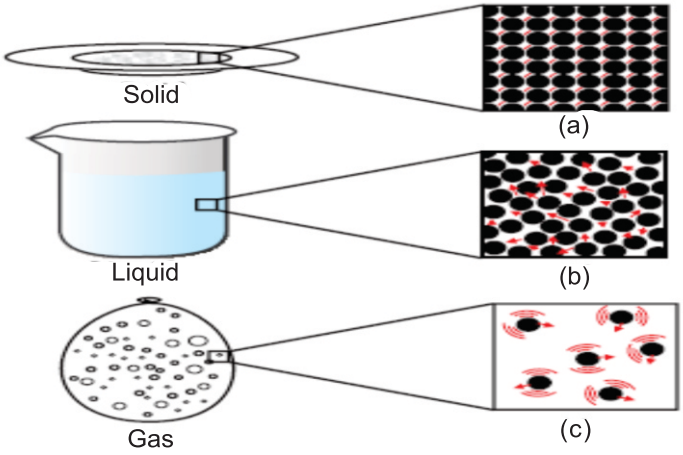


Figure 5.3: Arrangement of Particles in Solid, Liquid and Gases

Write and draw your observation below.

States of Matter Write the States below:	Arrangement of Particles Draw the arrangements below:
Model (a)	
Model (b)	
Model (c)	

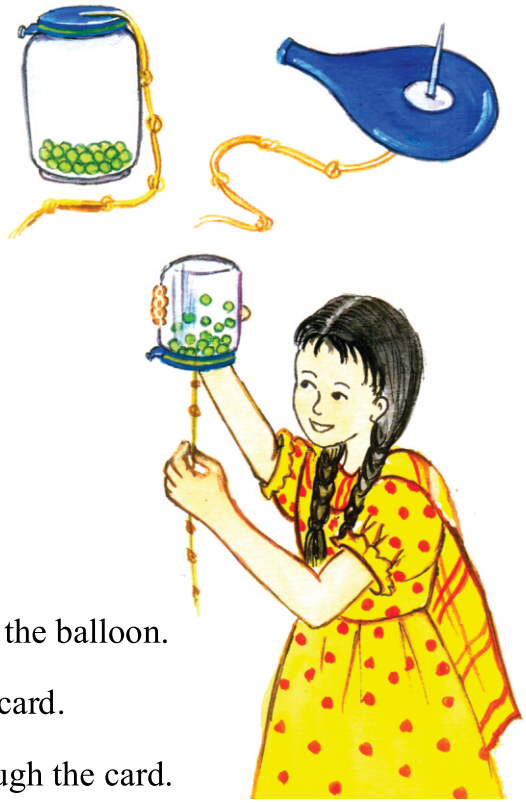
The arrangement of particles in solids, liquids and gaseous materials are different. This arrangement and movement of the particle, give the materials its particular properties and also the states. Let us study these movements through a model.

Teacher Note: Ask the students to observe the particle arrangement and movement and talk to classfellows. Then ask them to draw the arrangement of particles in the above boxes.

Activity 4: Building models of solid, liquid and gases.

What I need:

- Elastic band
- String
- Cardboard
- Balloon
- Jar
- Beads/Seeds



What to do:

1) Cut a circle of cardboard and place it on the balloon.
2) Thread a string through the balloon and card.
3) Knot the string so that it won't pull through the card.
4) Tie knots at the other end of the string, about a centimeter apart.
5) Put the Beads/seeds in the jar to form at least two layers.
6) Stretch a balloon over the neck of the jar and keep it in place with the help of the elastic band as shown in the picture.

What I observed:

Now hold the jar upside down and run your fingers gently down the string. What did you observe? Did you observe the movement of the beads/seeds on the top layer? Now pull down the string and let go; observe the beads. Repeat this and observe the movement of the beads.

Teacher Note: For model making the students need to be provided materials in groups. Help the students in making the model, observing and recording observations.

What I concluded:

Matter is made up of particles that are atoms and molecules. These atoms and molecules form different forms of matter that exists in different states as solids, liquids and gaseous states. Do you agree that the arrangement of atoms and molecules in these states are arranged differently? Study the differences and talk to your friend about the differences.

Particles in solids are closely packed together in a regular pattern with very small spaces between them, as you can observe in the picture below:

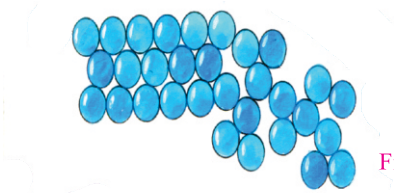
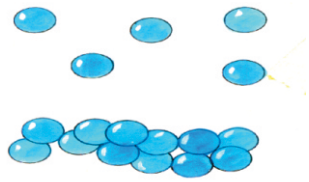


Figure 5.4: Particles changing from solid to liquid

Particles in liquids are a little less closely packed than in solids, they are in loose clusters; arrangement is not regular and have very small empty spaces between them. The picture above shows the change of solid to liquid state.



Particles in gases are widely spread out compared to particles in liquids; they have no regular pattern and have large empty spaces between them, as shown in top half of the picture on the left.

Figure 5.5: Particles changing from liquid to gas

Teacher Note: Explain to the students with example that matter is made up of atoms and molecules and it exists in three states. With the help of examples, to demonstrate the arrangement of particles . Make a list of things made up of atoms and molecules. Make models to demonstrate the difference between atom and molecules.

Effect of heat on arrangement of particles

Investigate the effect of heat on particle motion during a change of states.

We have studied that matter is made up of particles. These particles are arranged in different ways in different kinds of matter and are moving in different ways. You have also studied in the previous class that matter changes its state on heating. Let us do an activity to investigate the effect of heating on particle motion.

Activity 5: Role play on heating matter

What I need:

- An outline of the classroom or a circle on the floor or school playground.
- A circle of approximately of 90 cm, in diameter.

What to do:

1) Mark a 90 cm diameter circle on the floor, with a rope, chalk or tape.
2) Have some students stand in the circle, close to each other, and jiggle.
3) After some time, stop them; ask them to look at where they are standing and how they are moving.
4) Explain that the circle is quite dense, with so many students standing close by in the circle, and that this is how particles in solid vibrate.
5) Now ask the students to imagine that the circle is heating up. Have the students move a little more and apart in a straight line. As they move, ask them to stop.
6) Ask them how close they are? Explain that they can move freely and the circle is becoming lighter and less dense as there are less people (particles) standing there, just as a liquid is usually less dense than a solid.
7) Now ask them to move around and out of the circle also. Explain that in particles gaseous state move freely. Stop them when only one child is left in the circle.
8) Explain that the circle is really light, just like a gas.

What I observed:

What movement did you observe in solid, liquid and gaseous state?

Did you observe how it becomes lighter as it changes state on heating?

What I concluded:

Teacher Note: Help the students imagine and observe the movement of particles in the three states of matter with the help of models. Discuss with the student while using various examples and activities to help students understand this important concept of particle arrangement and movement.

Did you conclude that matter changes from one state to another due to heating? As the matter **gains energy,** it changes state from **Solid to Liquid** and from **Liquid to Gases**. As energy increases from solid to liquid, the movement changes from vibration at a fixed point to movement at short distances, and then free movement in gases. Matter becomes lighter and less dense. Now, read and underline the key sentences about arrangement and movement of the particles in solid, liquids and gases.

After reading, complete the matrix on the next page.

Gases:

In gases, the particles or molecules are far apart and have low attractive forces between particles/molecules. Thus the particles in gaseous state move around everywhere and collide with one another. In the gaseous state, molecules move quickly and are free to move in any direction. Gases expand to fill their containers and have low density.

In gases, individual molecules are widely separated and can move around easily, gases can be compressed easily and they have an undefinite shape.

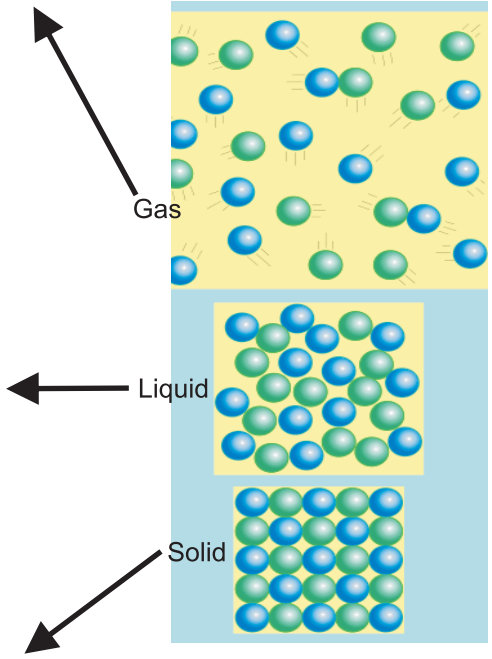
Liquids:

In Liquids, particles or molecules can move past one another, rotate and also change position; however, they remain relatively close to one another like solids.

As the temperature of a liquid is increased, the amount of movement of individual particles or molecules increases.

Thus, liquids can "flow" to take the shape of their container but they cannot be easily compressed because the molecules are already close together, constantly rotating, sliding and translating thus allowing no space to exist.

Thus, liquids have no shape, but a definite volume.



Solids:

In solids, the particles are close and have strong attractive forces between the individual particles or molecules. In solids, the individual particles or molecules are locked in a position and cannot move past one another.

The particles, atoms or molecules in solids remain in motion. However, that motion is limited to vibrational motion; individual particles/molecules stay fixed in a place and vibrate next to one another. As the temperature of a solid is increased, the amount of vibration increases, but the solid retains its shape.

In solids the particles are closely packed in place relative to one another thus solids have a high density.

Complete the matrix

States of matter	Arrangement of particles	Movement of particles	Characteristics
Gas			
Liquid			
Solid			

Processes involving change of states (melting, freezing, boiling, evaporation and condensation).

Demonstrate and explain the processes that are involved in change of states.

What will happen to an ice cube on heating? As you have studied in the previous class, on heating the particles in the ice cubes will gain energy, move faster and change to liquid water. This is called melting. What will happen if the heating of the ice cube is continued? The ice cubes will convert to water. If heating is continued, the water will gain more energy, the temperature will rise and at a point, it will boil. What will happen if the water is kept in a freezer for a day? In freezer the water particles will release energy, move less and change to frozen ice.

During the process, more water will also evaporate and convert to a gaseous state of water, called the water vapour. If the water vapours are cooled, energy will be released and the gaseous state will convert to liquid water. This process is called condensation. These conversion in states is shown in the diagram below. Talk to your friend about it.

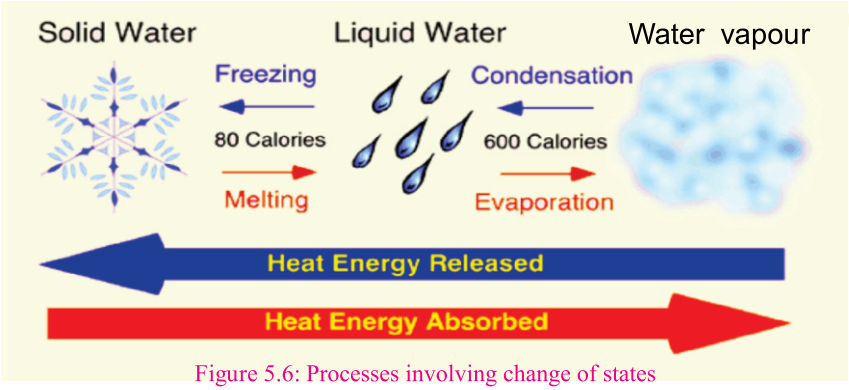


Figure 5.6: Processes involving change of states

Application of condensation and evaporation in nature (water cycle)

Activity 6: Describing the role of evaporation and condensation in water cycle and different form of moisture.

Describe the role of evaporation and condensation in the water cycle.

The story of water:

Water: "I am a water molecule, Do you know the places I travel during the water cycle and the states I live in?" Student: "No, could you tell me the places?"
Water: "I live in the oceans, rivers and lakes; When the sun shines on me, I get converted to water vapours and travel towards the sky"? Student: "What happens to you, water in the sky?"
Water: "As I rise up ward and travel higher in to cooler places, I get converted to water droplets and form clouds."
Students: " Ahaa! So that is how we get clouds after a very warm day. How do we get snow clouds"?
Water: "Yes, that is how I form clouds of water droplets, but for forming snow clouds, I have to travel from higher to colder region, so that I could cool down as clouds and form snow clouds?"
Students: "What happens after the snow and rain clouds are formed?"
Water: "Once these form into larger and heavier clouds, they fall back on hills and land as snow, hail and rain?" Student: "Yes, I have observed this rainfall from the large clouds and snowfall too. We also collect the rain water in tank on our roof. So is that all?" Water: "Next, as snow, I live on the mountain tops and as water I travel back into the oceans, lakes, and also under the ground as underground water."
Student: "Now I know, the water cycle, water you have an interesting cycle and you convert into many forms and also travel to several places. Thank you for telling me your story and how we get water." Observe the water cycle and stages below.

Teacher Note: Engage the students in a role play or a puppet show and have a dialogue on water cycle.

Heating and the states of water in water cycle

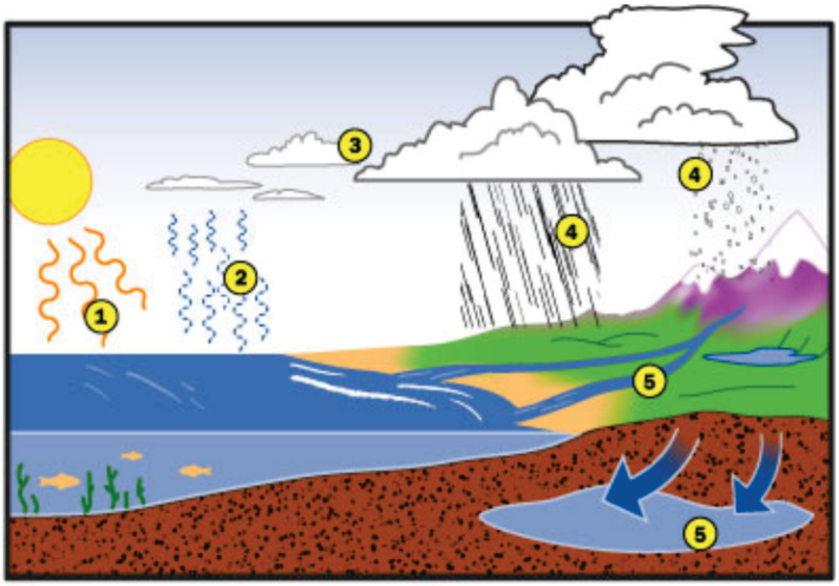


Figure 5.7:
The water cycle

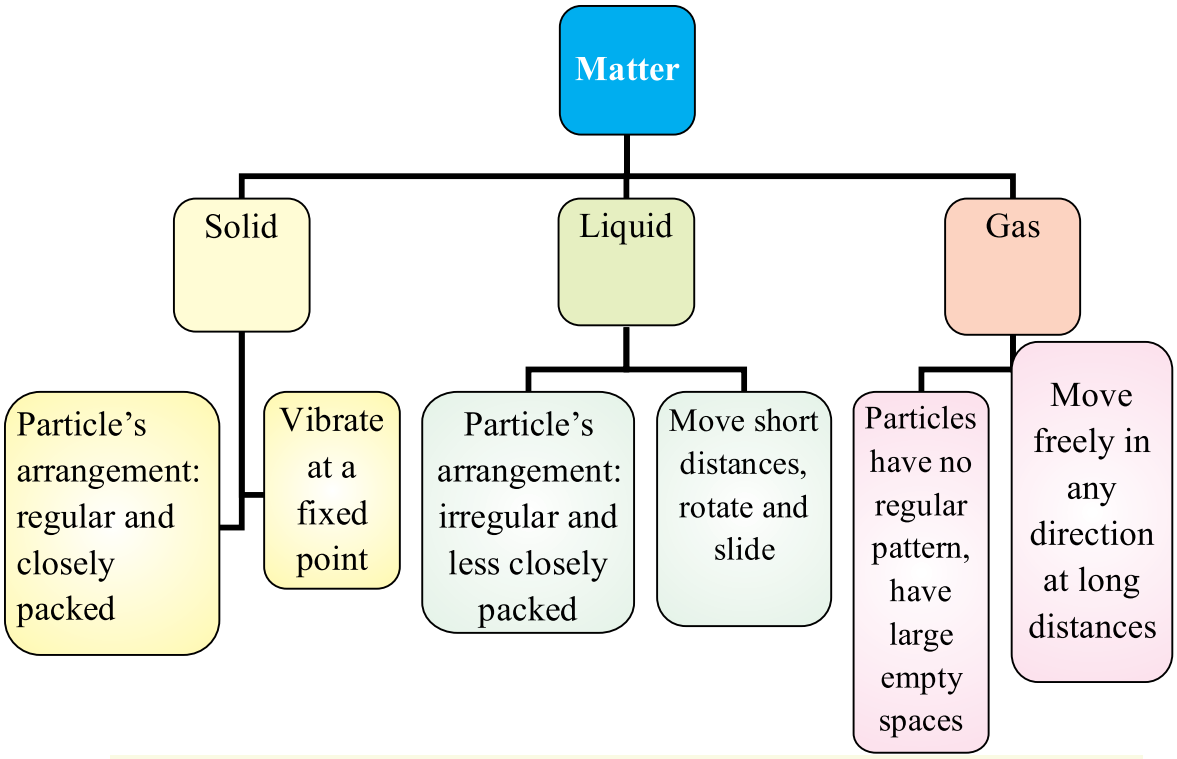
1. The sun heats the ocean.
2. Ocean water evaporates and rises in to the air.
3. The water vapor cools and condenses to become droplets, which form clouds.
4. If enough water condenses, the drops become heavy enough to fall to the ground as rain and snow.
5. Some rain collects in groundwells. The rest flows through rivers back into the ocean.

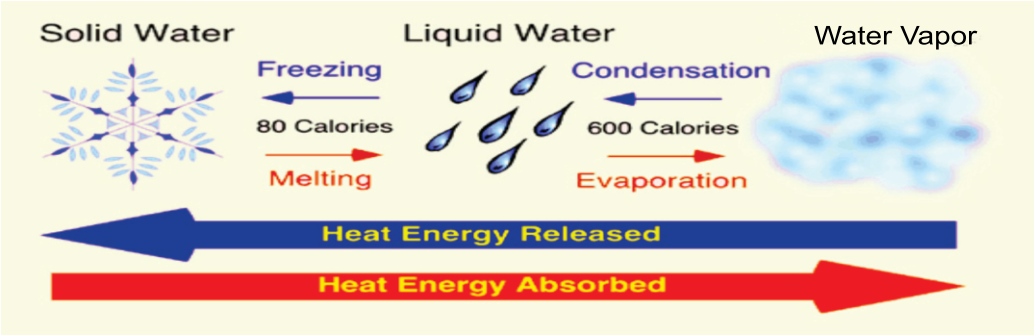
Do you know that the water cycle moves a lot of energy along with the water during the **heating** process, the conversion of **water** into **water vapour (gas)** and **cooling** process conversion of **water vapours** back into water **droplets (liquid)** and **snow (solid).** In this way the water cycle can transport huge amounts of **energy** into the **atmosphere**. The water cycle also **transports water** and naturally **purifies** water.

Identify and describe forms of moisture in the environment (e.g. dew, snow, fog, frost, and rain).

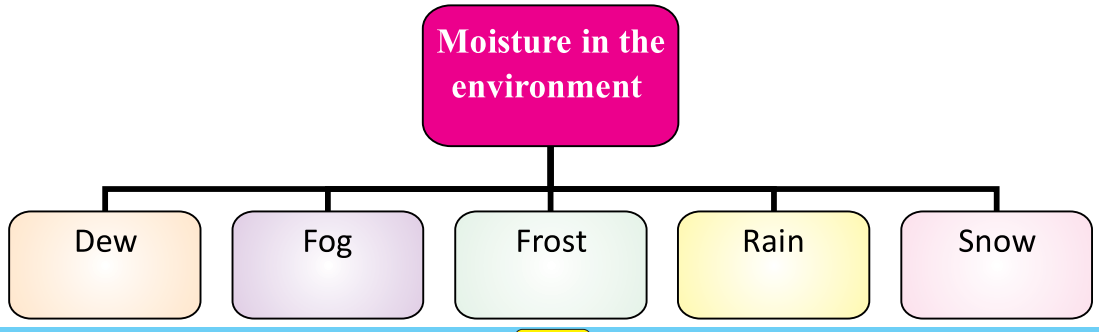
Do you know the forms of moisture in the Environment?
Dew: Drops of water that form on cool surfaces at night, due to condensation.
Snow: Water in the atmosphere frozen into crystals which falls as white flakes.
Fog: A thick cloud of water droplets on the earth's surface
Rain: Condensed water in the atmosphere of clouds that falls to the earth.

Summary





Moisture in the environment



Review questions:

1. Circle T for True and F for False statements :

a. Particles in solids freely move around. T F

b. Particles in gas move around a fixed point. T F

c. Particles in liquids move short distances, rotate and slide. T F

d. Particles in liquid are regularly arranged and are closely packed. T F

e. Particles in gaseous state are irregular and have large spaces. T F

2. Give reasons to justify your answers:

A. Ice changes into liquid water on heating.
B. Water vapour condenses to form liquid water.
C. Moisture exists in different forms.

Scientific problem solving:

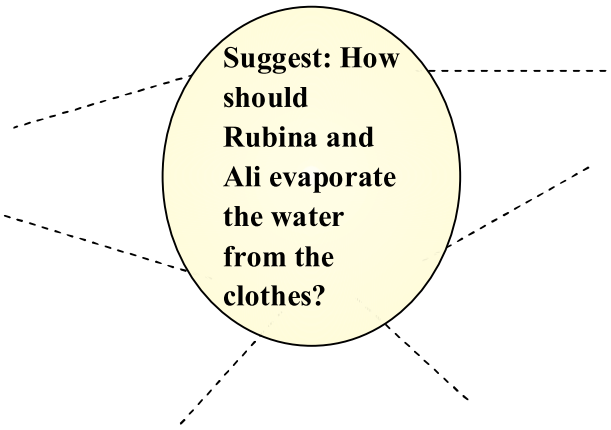
Story:

Mother was washing the school uniforms of Rubina and Ali. She wanted to dry the clothes before it gets dark. Mother was very worried how to dry the clothes quickly.

So Ali and Rubina set out to explore and dry the clothes.

How can you help Ali and Rubina in quickly drying the clothes?

Where should they hang the clothes?



Teacher Note: Guide the students to work in pairs or groups to brainstorm and record the steps and engage them in carrying out the investigation.

Activity 7: Evaporation at different places

What I need:

- three small saucers/plates
- water
- a spoon

What to do:

1. Your teacher will form groups/pairs or two students in a team.
2. Ask each member of a team to collect the materials.
3. Place a spoonful of water in each plate and mark the outline of water.
4. At the same time, place a plate A in a dark, covered and cold place; place plate B in open room ; place the third plate C in the sunny in a open air.
5. Observe the water after intervals of 30 minutes, 60 minutes and 1 hour 30 minutes and two hours.
6. Record your observation.
7. In which plate/place did the water evaporate fastest?
8. Share the results with each other.

What I observed:

What I conclude:

Teacher Note: Engage the students in the inquiry project, planning, performing, observing and recording in groups.

Chapter 6

Force and machines

Have you ever wondered why you are more likely to slip on a wet floor than a dry one? Why there are more motor bike accidents after rainfall? Why cars skid easily on an oily road than a dry one? Why is it difficult to pull or push object on rough surfaces? What helps us to walk on different surfaces?

Look at the following figure:

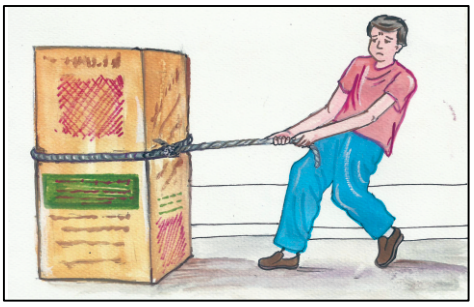


Figure 6.1: Man moving a box on rough surface

This man is having difficulty in moving the large box on the road. Why is it difficult to move the box? A runner slipped on a banana peel. Why did the runner fall down? How did the banana peel contribute to the accident?

Figure 6.2 A runner slipping on banana peeling.

All the students will be able to:

- ✓ Define friction.
- ✓ Describe causes of friction.
- ✓ Explain the advantages and disadvantages of friction.
- ✓ Suggest methods to reduce friction.
- ✓ Explain air resistance.
- ✓ Identify the ways to reduce air resistance.
- ✓ Explain gravity as a force.
- ✓ Differentiate between mass and weight.
- ✓ Differentiate between balanced and unbalanced forces.
- ✓ Describe the effects of balanced and unbalanced forces on the motion of an object.
- ✓ Explain inertia.
- ✓ Describe simple machines (wedge, inclined plane and kinds of levers)
- ✓ Describe the use of wedge, inclined plane and levers in daily life.

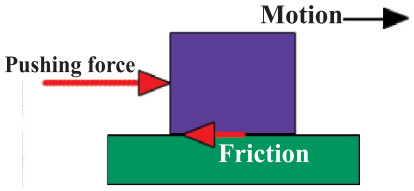
In this chapter, you will learn about

- ➢ Friction.
- ➢ Advantages and disadvantages of friction.
- ➢ Methods to reduce friction.
- ➢ Gravitational force.
- ➢ Mass and weight.
- ➢ Balanced and unbalanced forces.
- ➢ Inertia.
- ➢ Simple machine (wedge and inclined plane).
- ➢ Lever.
- ➢ Kinds of lever (scissor, hammer, plier, wheel barrow, tweezers, tongs, etc.)
- ➢ Use of lever in daily life.

Friction

- Define friction.
- Describe causes of friction.

Friction is a **force** that stops things from moving easily.



When two surfaces moves or slide over each other, they experience **frictional force**.

This force always acts in **opposite direction** and slows down moving objects.

In the illustration fig 6.2, both the runners are wearing sport shoes to help them run easily. The shoes provide a friction between the two surfaces. The banana peeling reduces this friction and the runners falls down. Without frictional forces, a moving object may continue to move or skid on surfaces for a longer period.

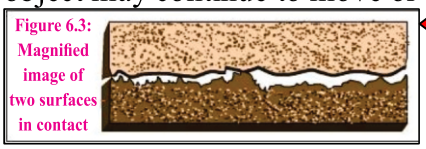


Figure 6.3: Magnified image of two surfaces in contact

The surfaces that look smooth have microscopic ridges and grooves which interlock with each and slows down the movement. That's why it is difficult to move the large box on the road. The rougher the road, the more friction will be between the box and the road.

Rough surfaces provide more friction. Smooth surfaces provide least friction.

Have you ever pondered about the friction of your running shoes?

Why are there ridges and grooves on the soles of the shoes?

Figure 6.4: A pair of shoes with ridges and grooves

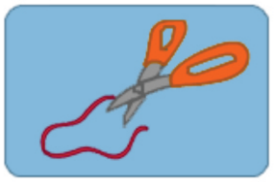
Activity 1: Investigating surfaces that cause more or less friction

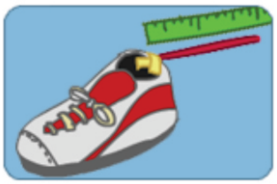
What I need:

- a shoe
- a large rubber band
- a tape
- a big ruler
- a pencil and paper
- a large piece of sandpaper
- a doormat
- two clear plastic pieces

[Note : doormat, sandpaper and plastic should be of equal sizes.]

What I do :





1. Cut the rubber band and measure its length without stretching and record it in the table given below.
2. Tie the rubber band from the shoe lace hole.
3. Stick doormat, sand paper, plastic pieces on the table.
4. Spread some oil on one of the plastic piece.
5. Keep the shoe on one end of the doormat and drag it till the other end.
6. Measure the length of the rubber band in the stretched position and record it in the table.
7. Repeat steps 5 and 6 with three other surfaces that you have prepared.

What I observed:

Initial length of the rubber band	

S. No:	Surfaces	Length of the rubber band
1.	Door mat	
2.	Sand paper	
3.	Clear plastic	
4.	Oil	

Activity questions:

1. Which surface provides the least friction? Why?
2. Which surface provides the most friction? Why?
3. What is the effect of different surfaces on the length of the rubber band?
4. On which surface the rubber band stretches the most?
5. What can you conclude about the above activity?

What I concluded:

Advantages and disadvantages of friction

- Explain the advantages and disadvantages of friction.
- Think of the ways to reduce friction.

Can you easily walk on a highly polished floor with smooth soles? Can you comfortably stand on a wet soapy floor? Definitely not. In both cases we have reduced **friction;** however sometimes friction can be useful, and at other times we need to reduce it. let us study the advantages and disadvantages of friction.

Advantages of friction

1. We need friction between our shoes and the floor to walk easily.
2. Car brakes work due to the force of friction.
3. Friction also prevents knots from coming undone.
4. Nuts, bolts and nails remain fixed due to the force of friction.

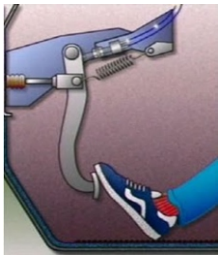


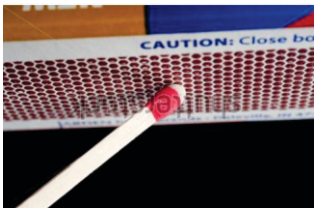
Figure 6.5: Applying brakes in car

Figure 6.6 Nut, bolts and knots

Look at the pictures. How is friction involved in these processes?

In winters, why do we rub our hands together?

Friction produces heat.



Why do we rub a match stick to burn it?

Disadvantages of friction

1. In overcoming the friction, a lot of energy is converted to non-usable form of energy and lost in the surrounding environment.
2. Friction causes wear and tear of the moving parts.
3. Due to friction, speed of automobiles cannot be increased beyond a certain limit.

Ways to reduce friction

1. By making the surfaces smooth.
2. By decreasing the area of contact of the surfaces.
3. By using oils and lubricants between the moving parts of machines.
4. By polishing the surfaces so that they can slide easily.
5. By using ball bearings because rolling objects provide less friction than the sliding ones.

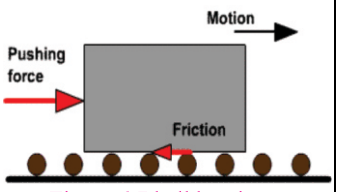


Figure 6.7 ball bearings as, used to roll the object.

Air resistance

- Explain air resistance.
- Identify the ways to reduce air resistance

When you ride a bike or run, you feel that air is pushing you back.

Moving objects like aircrafts, cars and arrows experience similar air resistance when they are in motion. Frictional forces between the air and the moving object cause this resistance. There is more resistance with faster movement and less resistance with slower movement.


Figure 6.8 Cycling

Air resistance is a force (friction) that opposes any object moving through the air.


Figure 6.9: streamlining the body to reduce air resistance

This boy is bending himself to reduce the air resistance and making his body **streamlined.**

He is wearing smooth clothing and helmet designed to overcome air resistance. This makes him glide through the air with faster speed.

Cars, aeroplanes and many fast moving objects are usually streamlined to overcome air resistance.


Figure 6.10: streamlined car and aeroplane

Swimmers make their bodies streamlined to reduce friction under water. This helps them swim easily and smoothly through water.

On the other hand parachutes increases air resistance due to the spread in surface air and allows the sky diver to easily descend towards the Earth.

Figure 6.11: Swimmers

Gravity

- Explain gravity as a force.

Do you know?
Gravity also holds Earth and the other planets in their orbits around the Sun.

Do you think these two things when dropped would hit the ground at the same time?

Gravity is a pull or force of attraction between two objects and is a property of all matter.

The more gravity of earth save for heavy mass and an object has, the bigger its attraction is to another object.

The Earth is huge object with lot of mass. Everything on earth is pulled towards its center. Our weight is caused by the pull of gravity. Our weight is a force with which the earth attracts us towards its center.

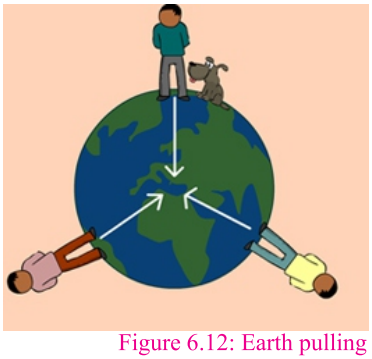


Figure 6.12: Earth pulling the objects towards its center

Mass And Weight

Which of the following has more mass? A bowling ball or a balloon?

- Differentiate between mass and weight.

Figure 6.13: Bowling ball and balloon

Every object is made up of matter. **Mass is the quantity of matter in an object.** You are often confused between mass and weight.

Weight is not the same as mass. Weight is the pull of gravity that acts on the mass of an object. Mass is measured in **kilogram (kg)** while weight is measured in newtons (N). Mass is independent of gravity .It means that mass remains the same on Earth or on any other heavenly body, but weight changes due to the difference in gravity.

Thus if you were to travel to the Moon your weight would change because the pull of gravity is weaker there than on Earth but, your mass would stay the same because you are made up of same amount of matter. This is shown in the figure on your right.

Weight= mass x gravity.

The gravity on moon is 1/6 of the Earth.

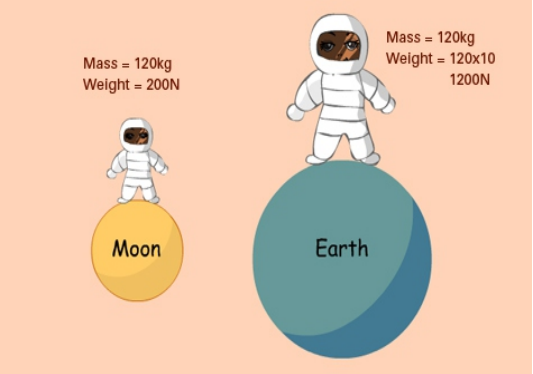


Figure 6.14: The Earth and the Moon

Activity 2: Identify the difference between mass and weight

Things I need:

- A school bag
- All your school books

What to do:

1. Take out your entire books and place it on the table. Now, try lifting the school bag with two of your fingers (middle and index fingers).
2. Next, add a few books and try to lift it.
3. Keep on adding your books to the bag, and try lifting it.
4. Repeat step 2, until all books are inside the bag, now lift the bag.

Activity questions:

1. Was it harder to lift the bag without the books or the full bag? Why?
2. Why do you think that adding books to the bag made it more difficult to lift?
3. What happened to the mass and weight of the bag, as more books were added to it?

What I conclude:

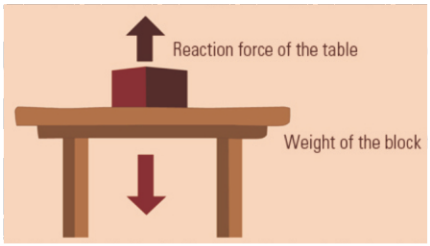
- Differentiate between balanced and unbalanced forces.
- Describe the effects of balanced and unbalanced forces on the motion of an object.

Balanced and unbalanced forces

These people are engaged in a tug of war. Both the teams are applying forces but none of them are moving. Can you think why?

Figure 6.15: Tug of war

When two equal sized forces are applied on an object in opposite directions, the object does not move. We say that the forces are balanced. Anytime when an object experiences balanced forces, it stays still, or continues to move in the same speed and in the same direction.



In the figure on your right, a block of wood is resting on the table. The block is not moving because two forces are acting on it. The forces are the weight of the block, which acts downwards and reaction force of the table which acts in upward direction.

Balanced forces can be demonstrated through the hanging, floating and sitting objects.

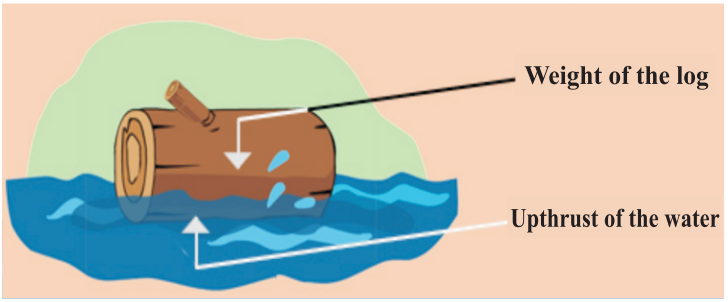
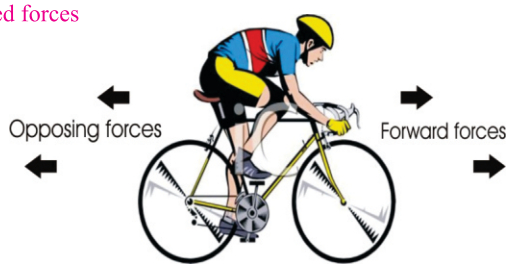


Figure 6.16: Balanced forces

When forces are unbalanced, there is motion:

Figure 6.17: Unbalanced forces

Imagine you are riding a bike on a flat road. When forward forces are bigger than opposing forces you accelerate. When the forces are balanced, your speed stays the same.



Inertia

Explain inertia.

Imagine you are sitting in a bus, when the bus starts moving, you are likely to fall backward. But when the bus stops moving, you are likely to fall forward. Do you know why this happens? This happens because when the bus moves suddenly from the state of rest, our feet are carried forward along with the moving bus but the inertia of our body tends to keep us at rest. This causes our body to fall backwards. When the bus stops suddenly, our feet are brought to rest with the bus, but the inertia of our body tends to continue its forward motion. This causes our body to fall forward.

The inertia of an object is the tendency of the object to remain at rest or, if moving, to continue its uniform motion in a straight line."

Activity 3: Demonstrating Inertia

What I need:

- a card piece
- a glass
- a coin

What I do:

1. Place the card piece on an empty glass.
2. Put a coin on the card piece.
3. Flick the card from the glass with a sharp blow of your finger. Record your observation.

What I observed:

When the card is flicked…….

Activity questions:

1. What happens when the card is flicked?
2. Why is it necessary to flick the card with a sharp blow?
3. What would you conclude about above activity?

Levers

- Describe simple machines (wedge, inclined plane, and kinds of levers)
- Describe the use of wedge, inclined plane and levers in daily life.

Look at the following figures and select the object that you would choose to open a can.

a spoon

stones

a tin can

In the figure above, spoon acts as a lever.

Teacher Note: This activity can be done individually. Ask the students to bring a glass and a coin. Engage the students in the activity and provide them an explanation.

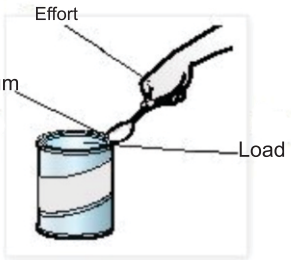
A **lever** is a long bar or stick which moves around a fixed point called **fulcrum.**

Lever is a kind of a **simple machine.** Simple machines make our work easier by reducing the amount of effort.

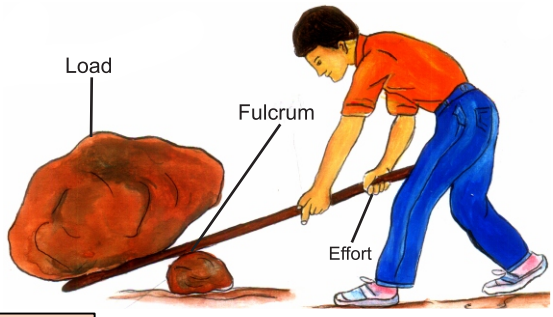
In the given figure, the spoon would acts as a lever.

The lid which you want to remove is a **load.**

The fixed point (corner of the can) on which the spoon moves is the **fulcrum.** The force which you apply to open the load is the **effort.**



Similarly this man is trying to move a large stone with the help of a long rod which acts as a lever.



Do you know? Levers have been used since the prehistoric times for cultivation, excavation, and moving large objects. The oldest archaeological findings of a lever dates back to the Archimedes, Greek mathematician and physicist during the 3rd century BC. The Egyptians used the lever to move things over 100 tons.

Figure 6.18: Using lever to move heavy load

Kinds of levers

According to the positions of effort, a fulcrum and load, lever is divided into three kinds.

First kind of lever

In the first kind of lever, the fulcrum is between the effort and the load.

First kind of lever

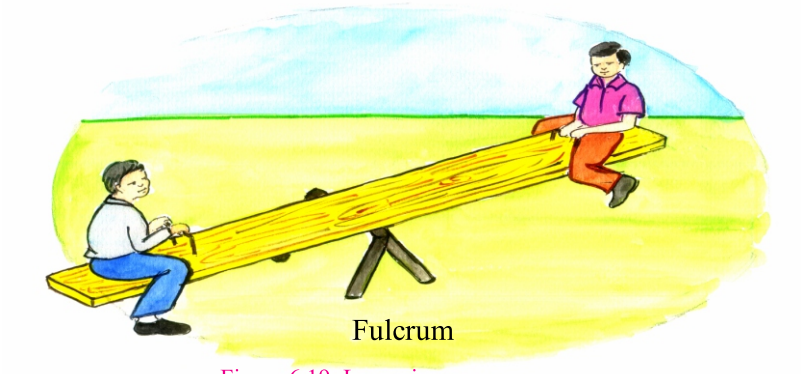


Figure 6.19: Lever in a see-saw

Second kind of lever:

In the second kind of lever, the load is between the effort and the fulcrum.

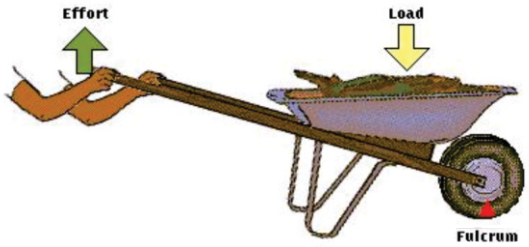


Figure 6.20: Lever in a wheel-barrow

Third kind of levers:

In the third kind of lever, the effort is between the load and fulcrum.

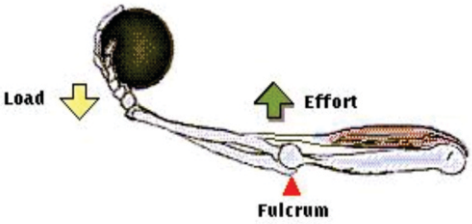


Figure 6.21: Lever in a an arm

Activity 4: Identifying the three kinds of levers

What do I need:

- a nail cutter
- a stapler
- a bottle opener
- a pair of pliers
- a pair of scissors
- a pair of tongs
- Pictures of a person brooming and wheel barrow

What I do:

1. Identify the positions of fulcrum, effort and load in each of the item mentioned above.
2. Classify each item as first, second and third kind of levers and record your observations in the table.

[Note: The students will perform this activity in groups.]

What I observed:

First kind of lever	Second kind of lever	Third kind of lever

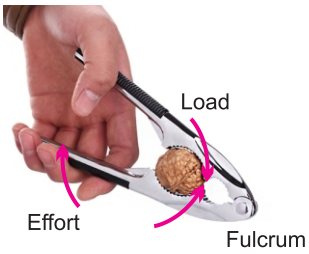
Activity questions:

1. Which items are the first kind of levers?
2. Which items are the second kind of levers?
3. Which items are the third kind of levers?
4. Which of the kinds are the easiest to identify? Why?

Levers around us

Levers make our lives easier. In your home you may find different kinds of levers.

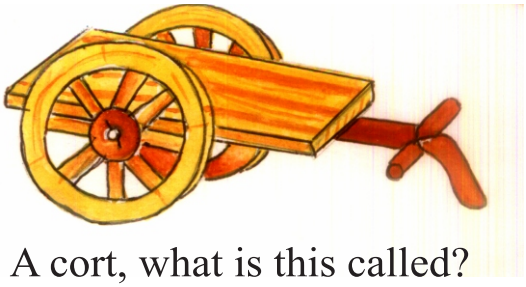
Some are shown below:



a nut cracker

a bat and ball

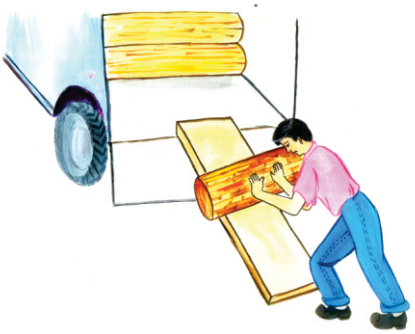
- a pair of scissors
- a pair of tongs
- a see-saw
- a pair of plier



A cort, what is this called?

Inclined plane:

This man is rolling a heavy drum on the wooden ramp. Why is he doing it? Will he be able to move the drum up without the ramp? A ramp is an example of an inclined plane. An **inclined plane** is a type of a simple machine. It is a flat and sloppy surface used to move heavy objects up or down over a vertical height.

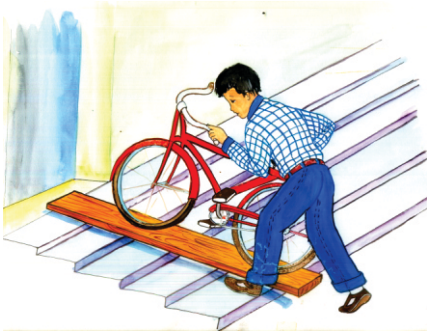


Inclined plane around us

Ramps for wheelchairs

Ramps are used for loading and unloading

In plane emergency exit



Ramps for moving objects

Figure 6.22: Different inclined planes

Activity 5: Demonstrating an inclined plane

What I need :

- 2-4 thick books
- a large stone or potato
- a string
- a small board or heavy cardboard for the inclined plane
- a spring scale

What I do :

1. Stack the books on the table top or the floor.
2. Place one end of the cardboard on the stack of the books and the other end on the table (or the floor).
3. Tie the string around the stone. Make a loop at the other end of the string and hang it on the hook of the spring balance.
4. Lift the stone from the table top (or floor) to the top of the stack of books (vertically) with the help of the spring balance and note down the force in newtons and record it in the table.

5. Now pull the stone up the inclined plane from the table top (or floor) towards the top of the books. Note down the reading on the spring scale and record it in the table.

What I observed:

Force (N) applied to lift the stone without the inclined plane	Force (N) applied to lift the stone using the inclined plane

Activity questions:

1. How much force is applied to lift the stone without using the inclined plane?
2. How much force is applied to lift the stone using the inclined plane?
3. What is the difference of force applied in both the cases?
4. Experiment with different heights by adding or removing books under the inclined plane. Is it more difficult to move the stone over a steep incline, a short horizontal distance or a gradual incline over a longer horizontal distance?

Wedge

A wedge is a type of a simple machine with two slanting sides ending in a sharp edge, which cuts the material apart. A wedge has two inclined planes which join back to back. A wedge is used to cut things. This man in the figure right, is cutting the wood with an axe which has a wedge shaped blade. He pushes the wood downward with force and the wedge shaped blade pushes the wood apart.

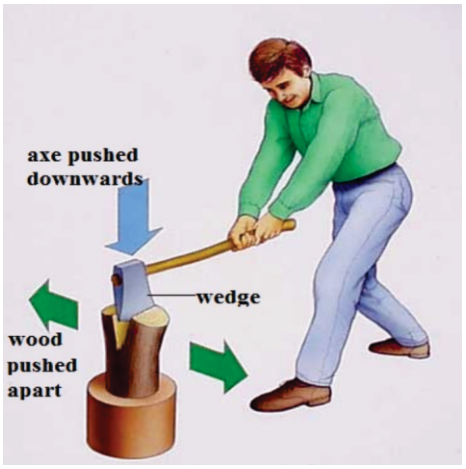
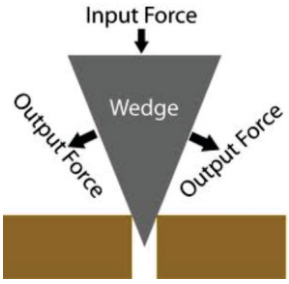


Figure 6.23: Man cutting wood with a wedge shaped axe

Do you know the types of wedges around you?



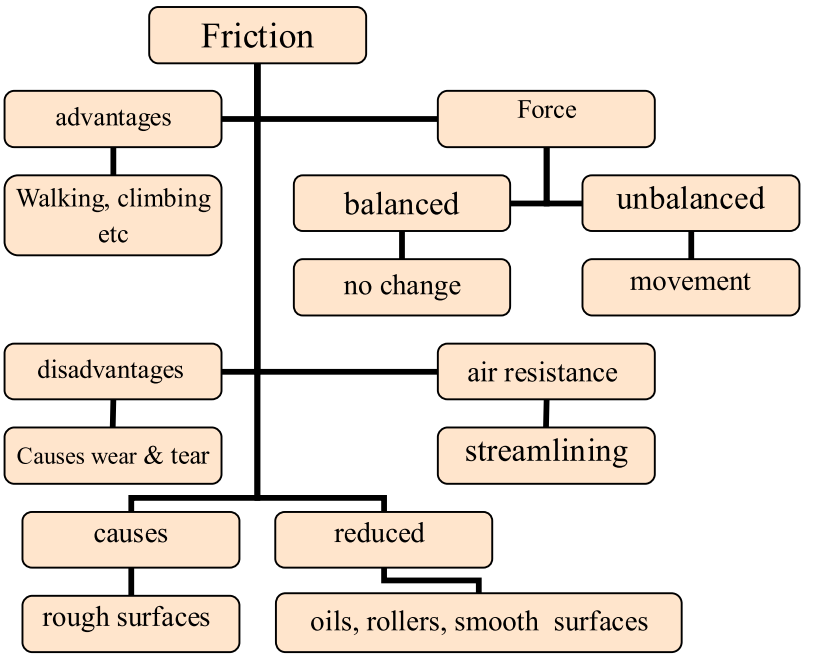
Kitchen knives

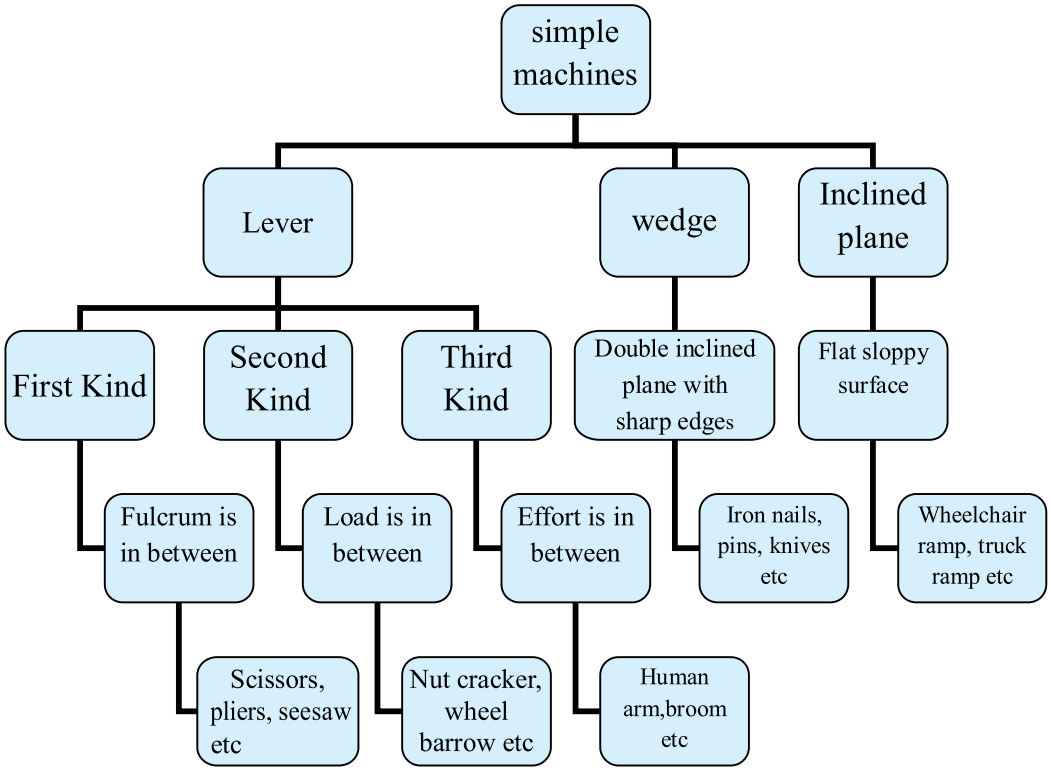
Push pin

Iron nails

Figure 6.24: Different types of wedges

Summary


Friction
advantages
Force
Walking, climbing etc
balanced
unbalanced
no change
movement
disadvantages
air resistance
Causes wear & tear
streamlining
causes
reduced
rough surfaces
oils, rollers, smooth surfaces


simple machines
Lever
wedge
Inclined plane
First Kind
Second Kind
Third Kind
Double inclined plane with sharp edges
Flat sloppy surface
Fulcrum is in between
Load is in between
Effort is in between
Iron nails, pins, knives etc
Wheelchair ramp, truck ramp etc
Scissors, pliers, seesaw etc
Nut cracker, wheel barrow etc
Human arm,broom etc

Review questions :

1. Locate fulcrum, effort and load in each of the following items by writing F,E and L respectively in the figures.








2. Fill in the blanks.

a) A stapler is _____ kind of lever.

b) _____ is a force you put into the simple machine.

c) _____ is the fixed point around which a lever moves.

d) Unbalanced forces cause _____in an object.

e) _____ is an example of a wedge.

3. Give two reasons for the following statements.

a) Car tyres have treads.

b) Air crafts have streamlined bodies.

4. Explain with the help of one example from daily life, why frictional forces depend on the

a) surfaces in contact

b) weight of the object

5. What are unbalanced forces? Explain with the help of one example.

6. Tick the correct answer.

i. Which of the following is the second kind of lever?

a) A nail cutter

b) A fishing rod

c) Pliers

d) Claw hammer

ii. Which of the following can be used to reduce friction between the moving parts of machines?

a) sand

b) grease

c) gears

d) screws

iii. Unit of mass is

a) Newton

b) kilogram

c) joules

d) centimetre

Inquiry project:

Find different types of simple machines around your school and home.

Draw or stick a picture of a simple machine.	State the function

Chapter 7

Properties and behavior of light

Every morning we see sunlight which makes our day bright. Can you imagine the world without the Sun? Have you ever thought why does the sun glow? Why do the stars shine at night? Why can't we see without the presence of light? It is because light enables us to see material objects.

Figure 7.1: The sun giving light to various places

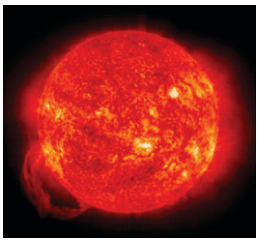
In this chapter, you will learn about:

- Luminous and non luminous objects.
- Transparent, opaque and translucent objects.
- Light travels in straight lines.
- Shadow formation.
- Eclipse formation.
- Pinhole camera.
- Phases of moon.

All the students will be able to:

- ✓ Understand that light is a form of energy.
- ✓ Know that light travels in a straight line.
- ✓ Differentiate between luminous and non-luminous objects.
- ✓ Identify and differentiate between opaque, translucent and transparent objects in the surroundings.
- ✓ Understand the formation of shadows.
- ✓ Explain how do eclipses occur.
- ✓ Explain the effect of position of an predict location, size and shape of the shadow from the light sources.
- ✓ Explain the working principle of a pinhole camera.
- ✓ Identify different phases of the Moon.

Luminous and non-luminous objects



- Differentiate between luminous and non-luminous objects

Look at the figures on your right.

Which one of these objects shine? Does the sun shine? Does the moon shine?

Your answer may be both. What is the difference between the glowing Sun and the moon light that you see at night?

The Sun shines because it is capable of producing its own light. The Sun is a luminous object. The Moon shines due to the light of the sun. It reflects sun's light. It cannot produce its own light. The Moon is a non-luminous object.

A **luminous** object is one which produces and emits its own light. In other words, it glows on its own accord. To be able to glow, an object must have its own source of energy. The Sun is a luminous object, it is made up of such substances which provide it energy to glow.

A torch is also a luminous object. It shines because of the energy stored in its batteries. Thus we can say that light is a form of energy.

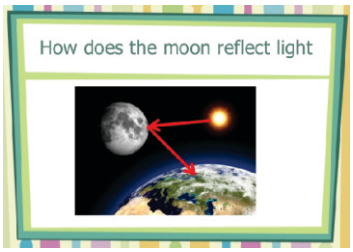
Other examples of luminous objects are lamps, candle, fire flies, stars and lantern fish.

Figure 7.2: Luminous objects

Do you know? Our Sun is the principle source of energy for all the organisms on the earth. Our Sun is an atomic furnace that turns mass into energy. Every second, it converts over 657 million tons of hydrogen into 653 million tons of helium. The missing 4 million tons of mass are discharged into space as energy. The Earth receives only about two-billionths of this as heat and light.

A **non-luminous** object is one which does not produce its own light but it reflects light that comes from the luminous object. Some examples of non-luminous objects are furniture in the room, books, clothes, trees and planets. Identify, draw and share names and pictures of luminous and non-luminous objects from your surroundings, with your classfellows.

Figure 7.3: Non-luminous objects



How are we able to see objects?

- Know that light helps us to see.
- Explain reflection of light.

Light is a form of energy. When light rays falls on any material object, the light rays bounce back or get reflected. This process is called **Reflection**. Reflection is one of the properties of light. Light from the luminous objects travels in a straight line and directly enters into our eyes.

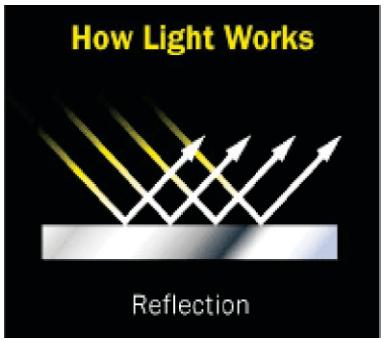
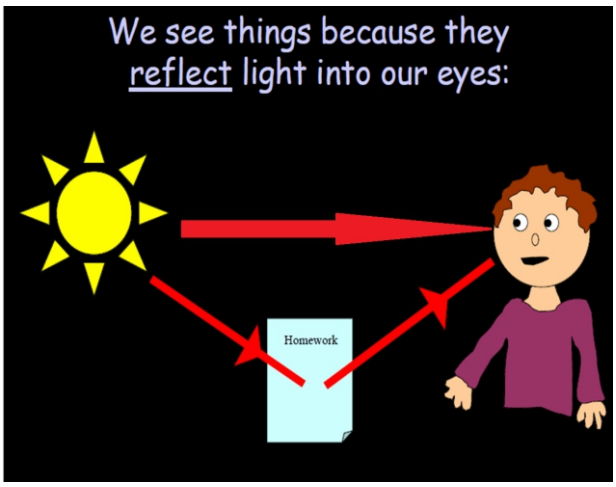


Figure 7.4: Reflection of light

When our eye receives these reflected light rays, we are able to see the objects.

We are not able to see objects in the absence of a light source.



In the dark room, no reflected light enters into our eyes; therefore we cannot see objects in the dark room. Take a torch and a small mirror. Point the torch light towards the mirror. Turn the mirror a little. you get a spot of light on the opposite wall? Observe the bouncing of light by the shining object. Share how we see objects with your classfellows. Do other objects reflect light? Let us study how light behaves with different objects.

Transparent, translucent and opaque objects

- Identify and differentiate between transparent, opaque and translucent objects in their surroundings.

In playing hide and seek, you often hide yourself under the table or behind any wall. Why don't you hide behind a transparent glass or window? It is obvious that you will be seen if you hide behind a glass because light passes through the glass, as glass is a transparent material.


Figure 7.5: Light passing through a transparent window

Light behaves differently with different materials.

Transparent objects allow light to travel through them. Materials like air, water, and clear glass are transparent. When the light strikes transparent materials, almost all of it passes directly through them.

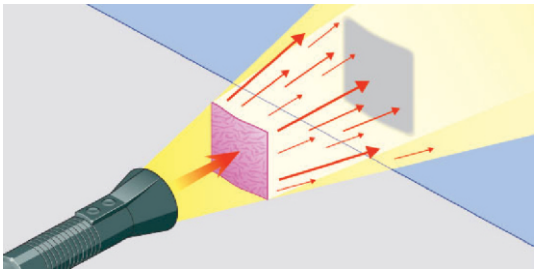


Figure 7.6: Light shining on translucent object

Translucent objects allow some light to travel through them. Materials like frosted glass and some plastics are called translucent. When light strikes translucent materials, only some of the light passes through them. The light that passes through these materials does not pass directly through the materials but it is scattered. Therefore, we cannot see clearly through them and objects on the other side of a translucent material appear fuzzy and unclear.

Opaque objects do not allow any light to pass through them and block the light. They reflect most of the light and absorb some. Brick wall, wooden objects, tree, thick clothing are opaque materials.

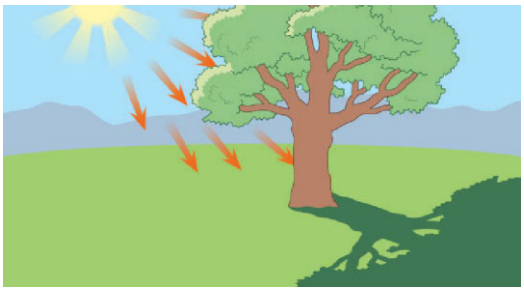


Figure 7.7: Light blocked by opaque objects

Activity 1: Investigating transparent, translucent and opaque objects

What I need:

- Different objects such as plastic wrap, cloth , paper, butter paper, bulb in which filament is visible, water, reading glasses, sun glasses, woollen clothing, aluminium foil, books, muslin piece, torch.

What I do:

1. Take a plastic wrap and shine a torch light on it. Observe whether it allows all light to pass through it, some light to pass through it, or does not allow any light to pass through it. Categorize it in the table according to the behavior of the light.
2. Repeat step 1 with each object.

What I observed:

Transparent objects	Translucent objects	Opaque objects

Activity questions:

1. Which objects are transparent?
2. Which objects are translucent?
3. Which objects are opaque?
4. What makes an object transparent, translucent, or opaque?
5. Ask students to go for an exploration in the school or home for more transparent, translucent and opaque materials. Share the name or the materials with classfellows.

Investigate that light travels in a straight line.

Light Travels in Straight Lines

You know that light is a form of energy which helps us see objects. We know that light travels in a straight line. It will continue to travel in a straight line until it strikes an object.

This is one of the properties of light.

Do you know?

Light travels very fast . Speed of light in vacuum is 300 million metres per second.

Are you able to see through the bent pipe or a straight pipe?
Obviously through the straight pipe, because light travels in a straight line.

Activity 2: Investigating that light travels in a straight line.

What I need :

- Three thick cards of 3x5 inches size
- a pencil and a ruler
- a torch
- a cutter or scissors.
- some mounting clips or objects to stand cards.

What I do:

1. Draw lines on each card from one corner to the next forming an 'X'.
2. Cut a hole in each card where the lines intersect.
3. Line up the cards with the help of the mounting clips or stand about 15 cm apart in an uneven line on the table, so that holes are not in a straight line.
4. Point light from a luminous object (candle or torch) to pass through and look from the other side. Record your observation in the table below.
5. Now line up the cards in a straight and even line so that holes are in a straight line. Repeat step 4.

Teacher Note: Arrange the materials and engage students in performing the activities in groups or demonstrate it.

What I observed:

Cards in an even line	Cards in an uneven line
Light….	Light….
Because…	Because…

Activity questions:

1. What happens when you allow light to pass through the uneven line of cards?
2. What happens when you allow light to pass through the even line of cards?
3. Is the behavior of light different in both the cases?
4. What would you conclude about the above activity?

Shadows

Explain the formation of shadows.

Light travels in a straight line until it strikes an object. When light strikes an opaque object, the light is blocked, thus a shadow is formed on the opposite side of the object.

Figure 7.8: Formation of a shadow

If an object is moved further away from the light source, the shadow gets smaller. If an object is moved closer to the light source, the shadow gets bigger.

Figure 7.9: Formation of a big shadow

Activity 3: Investigating the effect of the position of an object on the size , shape and location of its shadow.

Investigate the location, size and shape of a shadow from a light source relative to the position of the object.

What I need:

- a torch
- a dark room
- a doll or any other toy (should be opaque)

What to do:

1. Keep the table about seven feet away from the wall.
2. Make the room dark.
3. Turn on the torch and place it on the table.
4. Take the toy and bring it closer to the torch. Mark this as position 1.
5. Observe the size, shape and location of the shadow that is formed on the wall and record your observation in the table .
6. Now take the toy a little further away from the torch. Mark this position 2. Observe the shadow and record your observation.
7. Again, take the toy further away from the torch. Mark this as position 3. Observe the shadow and record your observation.

What I observed:

Positions of the toy	Shape of the shadow	Size of the shadow	Location of the shadow
1			
2			
3			

Activity questions:

1. At which position is the biggest shadow formed?
2. At which position is the smallest shadow formed?
3. What can you say about the shape and location of the shadows at different positions?
4. What would you conclude about shadow from the above activity?

Lunar and Solar Eclipses

Explain the formation of eclipses.

A Solar Eclipse occurs when the Moon comes in front of the Sun and blocks most of the Sun's light from reaching the Earth. During a total eclipse, all you can see from the Earth is a ring of light around the Moon, which is a part of the Sun that the Moon does not cover. It is dangerous to look at the solar eclipse directly with un-protected eyes.

A lunar eclipse occurs when the Earth comes in between the Moon and the Sun, thus forming a shadow of the Earth, and the Moon passes through this shadow of the Earth. A lunar eclipse can last up to an hour and a half. During a lunar eclipse the Moon may turn a reddish colour. However, it is not dangerous to look at a lunar eclipse because the Moon does not make its own light.

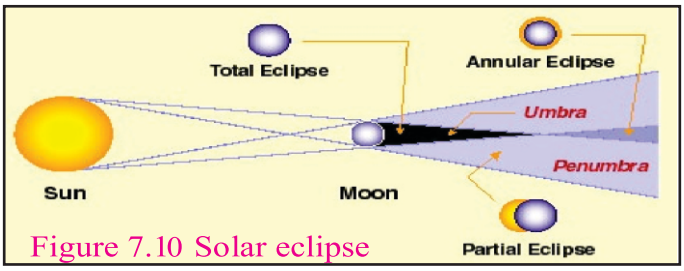


Figure 7.10 Solar eclipse

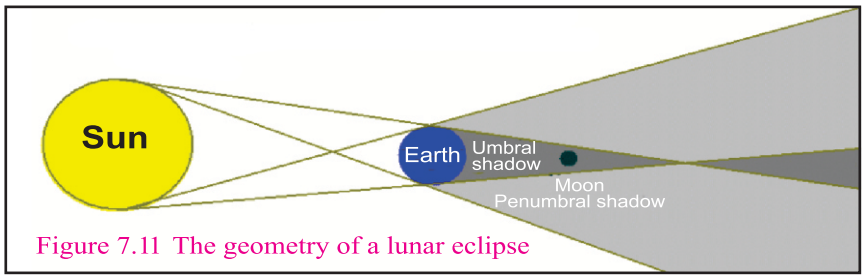


Figure 7.11 The geometry of a lunar eclipse

Activity 4: Demonstrating eclipses

What I need:

- a globe of Earth or Football (to represent the Earth)
- a small tennis ball (to represent Moon)
- a long neck glass bottle
- a projector light/Torch light source (to represent the Sun)

What I do:

1. Place a globe/football on the floor or on the table.
2. Keep the bottle at about 50 cm from the globe and place the ball (Moon) over its mouth.
3. Keep the projector/torch light (Sun) on the other side about 2.5 meters from the globe.
4. Now you should have an arrangement in which the bottle with the ball on its mouth comes between the globe and the projector.
5. Turn on the projector and record your observation.
6. For lunar eclipse, move the ball behind the globe.

What I observed:

When the ball (Moon) is between the globe/football (Earth) and the projector/torch (Sun)	When the ball (Moon) is behind the globe/football (Earth)

Activity questions:

1. How does a lunar eclipse occur?
2. How does a solar eclipse occur?
3. What can you conclude about this activity?

Phases of the Moon

- Identify different phases of the Moon.
- Explain the formation of a new Moon and a full Moon.

The changing shapes of the bright part of the Moon that we can see daily is called its phase.

The Moon is illuminated because it reflects the light from the Sun. The part of the Moon facing the Sun is lit up. The other part facing away from the Sun is in darkness. The Moon revolves around the Earth; we see different amounts of its surface lit during its 29.5 days.

What causes the different phases of the Moon?

The phases of the Moon depend on its position in relation to the Sun and the Earth. As the Moon makes its way around the Earth, we see the bright parts of the Moon's surface at different angles. These are called "phases" of the Moon.

Teacher Note: Demonstrate this activity. Engage students in observing, recording observations and solving activity questions.

What are the different phases of the Moon called?

Figure 7.12: Different phases of the Moon

The phases of the moon work in a cycle starting with the new moon.

When the Moon and the Sun are on opposite sides of the Earth,we see a full Moon. The entire side of the Moon facing the Earth is lit up by the Sun. When the Moon and the Sun are on the same side of the Earth, we see a new Moon. The side facing the Earth is in darkness.

Do you know?
Countries near the Equator see the crescent moon shaped like a smile?

There are eight phases of the moon

Figure 7.13: Eight phases of the Moon

The phases are named after how much of the moon we can see, and whether the amount visible is increasing or decreasing each day. It takes about 29.5 days to complete the cycle through all eight phases.

Pinhole Camera

Explain the working principle of pinhole camera.

Pinhole photography is lensless photography. In a pinhole camera, a tiny hole replaces the lens. When light passes through the hole; an image is formed in the camera. Pinhole cameras are used for fun, for art, and for science.

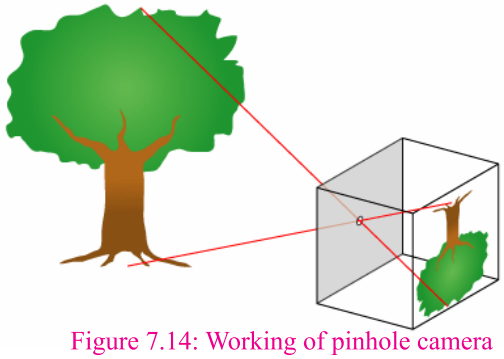


Figure 7.14: Working of pinhole camera

A pinhole camera is a small, light-tight can or box with a black interior and a tiny hole in the center of one end. It is a simple image forming device. It is a light proof box with a pinhole on one end and a piece of wax paper on the opposite inside wall. When you look through the pin hole camera, the hole lets in just few light rays from each part of the scene.

Working principle:

The pinhole camera works because light travels in straight lines.

Light from the top of the object passes through the pinhole and on to the screen. Light from the bottom of the object also passes through the pinhole and on to the screen to form an image. The rays keep going in straight lines and hit the butter paper screen, making an upside-down and smaller image of the scene.

Figure 7.15: Digital camera

Do you know? A **digital camera** is a camera that encodes digital images and videos digitally and stores them for later reproduction. Most cameras sold today are digital, and digital cameras are incorporated into many devices ranging from mobile phones to vehicles.

Activity 5 Making a pinhole camera

What I need:

- a shoebox (An empty large toilet roll can also be used)
- a black chart paper/aluminium foil
- a tape
- a pair of scissors
- a square piece of tracing/butter paper

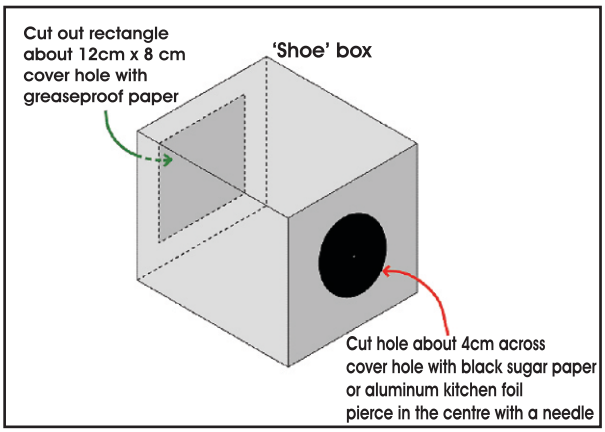


Figure 7.16: A pinhole camera

What I do:

1. Make sure that no light can get into the box once the lid is on, so tape up any rips or joints.
2. Next, you'll need to cut two holes in opposite sides of the box so you can see right through it. Draw around a cup or mug to make the first hole. The second should be a large rectangle. (12cm x 8cm should be about the right size if you're using a shoe box.)
3. Now, cut out a square of black chart paper or tinfoil. Make sure it's bigger than the circular hole and then tape it to the inside of the box so the hole is covered.
4. Next, take your drawing pin or needle and very carefully make a small hole in the centre of the foil.

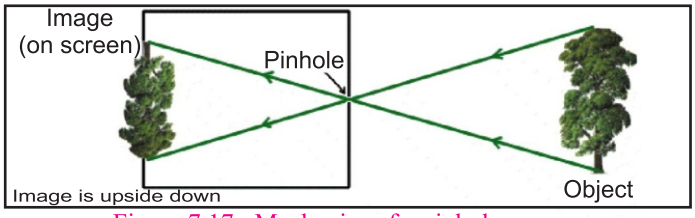


Figure 7.17: Mechanics of a pinholecamera

5. Finally, you'll need to cut out a piece of tracing paper or grease proof paper which is bigger than the rectangular hole in the other side of your box. Tape the paper to the inside of the box, making sure that it covers the hole. This will be your screen.

6. Now, tape the lid on to the box and cover it with black glaze paper, leaving the pinhole and the trace paper side.

7. Your pinhole camera is ready now.

8. Point the tinfoil/black chart paper's end of the camera towards something bright (the window is usually best) and take a look at the screen.

9. Record your observation.

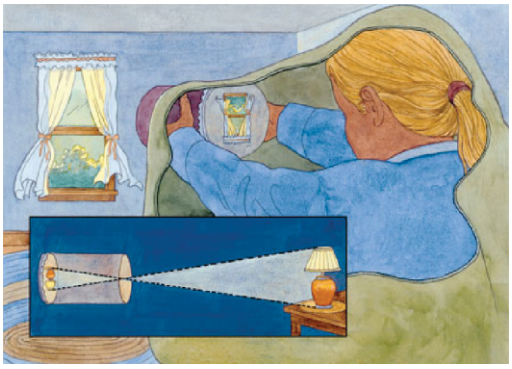


Figure 7.18: A pinhole camera made up of toilet roll.

What I observed:

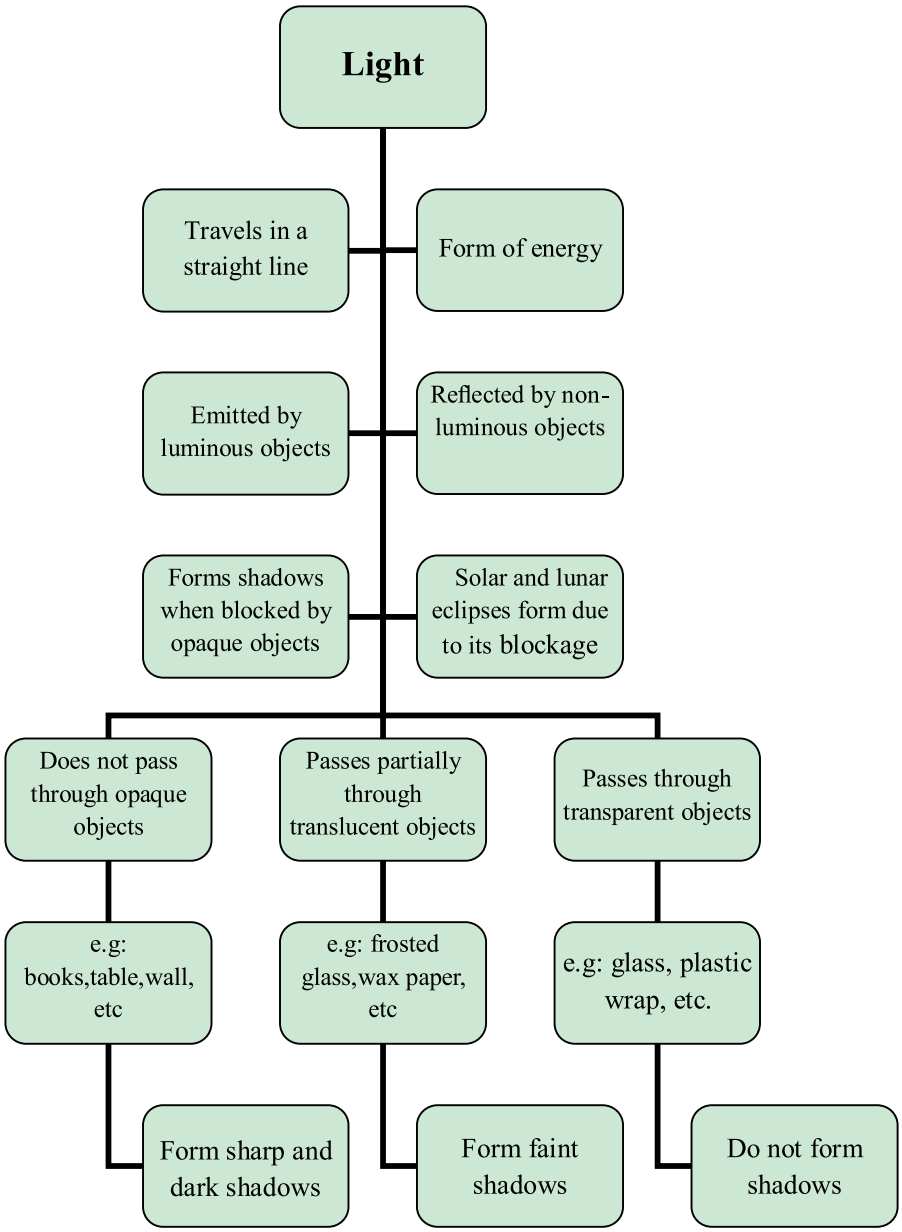
Size of an image	Type of an image

Activity questions:

1. What is the purpose of using a tracing paper?
2. What is the purpose of wrapping the camera in a black glaze paper?
3. What might be the effect on the image if the hole is made little larger?
4. What is the working principle of a pinhole camera?

Teacher Note: This activity can be done in groups. Provide the necessary materials to the students and facilitate them in performing the activity.

Summary


Light
Travels in a straight line
Form of energy
Emitted by luminous objects
Reflected by non-luminous objects
Forms shadows when blocked by opaque objects
Solar and lunar eclipses form due to its blockage
Does not pass through opaque objects
Passes partially through translucent objects
Passes through transparent objects
e.g: books,table,wall, etc
e.g: frosted glass,wax paper, etc
e.g: glass, plastic wrap, etc.
Form sharp and dark shadows
Form faint shadows
Do not form shadows

Review questions:

1. **Fill in the blanks:**
   a) _____objects do not allow light to pass through them.
   b) Butter paper is _____material because it scatters light.
   c) Shadows are formed because light travels in a _____line.
   d) We see a _____Moon when the Moon and the Sun are on the opposite sides of the Earth.
   e) We see a _____Moon when the Moon and the Sun are on the same side of the Earth.
2. **Tick the correct answer.**
   a) Which of the following allows all light to pass through it ?
      i. book
      ii. newspaper
      iii. glass
      iv. wood
   b) Which of the following is a non-luminous object?
      i. Jupiter
      ii. burning coal
      iii. glassware
      iv. fireworks
   c) When the ray of light strikes on the brick wall, it is
      i. passed through it.
      ii. scattered by it.
      iii. reflected by it.
      iv. absorbed completely.
3. **Differentiate between transparent, translucent and opaque objects.**
4. **List five luminous and five non-luminous objects.**
5. **How are we able to see the Moon even though it does not give off its own light?**
6. **State differences between solar and lunar eclipses.**
7. **Draw a simple sketch to show how does non-luminous objects reflect light.**

Project

Properties of light

Kaleidoscope

Like a microscope or telescope, the optics in a kaleido scope are used to echance our vision in some way. Vision depends on light and optics are used to reflect or bend it so that we can see in different ways. Kaleidoscopes use mirrors to reflect light into beautiful shapes and patterns.

Let's make a kaleidoscope!

Materials needed:

- Three small rectangular mirrors
- Coloured beads.
- Any adhesive tape.
- Coloured wrapping paper.
- Small empty toilet paper roll
- Pieces of transparent and transulent plastics from a used packaging.

Procedure:

1. Place the three mirrors together as shown. Use the long side of each mirror.

2. Build a prism by putting mirrors together, so that their reflective sides face inwards. Secure with the adhesive tape.

3. Insert this prism into a tube built out of the toilet paper tubes. This tube must be about (1 cm) longer than the mirrors at both ends.

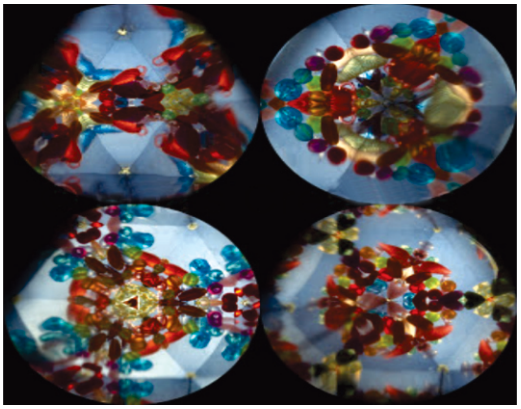
4. Cover one end of the prism with a round piece of transparent plastic and put coloured beads loosely on it.

5. Then cover this end of the tube with a piece of transparent plastic and seal it using the adhesive tape.

6. Close the other end of the kaleidoscope with a piece of cardboard that has a small hole (about 1/4 inch) in its center.

7. Finally, wrap your kaleidoscope in a wrapping paper or decorate it in any other way you like.

8. Now point the toy to a source of light (make sure the light isn't too bright) and look through it. Create new unique patterns by rotating the tube. Enjoy!



Chapter 8

Electricity and magnetism

Have you ever wondered how an electric fan works? What is a short circuit and how can it be avoided? How does lightning occur on the sky? Why do magnets attract some materials? How does a magnetic compass work?

The answers above questions, lie in our understanding of the concepts of **electricity** and **magnetism.**

In this chapter, we will learn about:

- Electric current and its flow
- Electrical circuits and its components
- Fuses and its uses
- Static electricity (Lightning as an example)
- Charges and their properties
- Magnetic lines of force and magnetic field
- Electromagnets
- The Earth's magnetism
- Magnetic compass

Figure 8.1: A magnet attracting nails

Figure 8.2: A electricity pole

All the students will be able to:

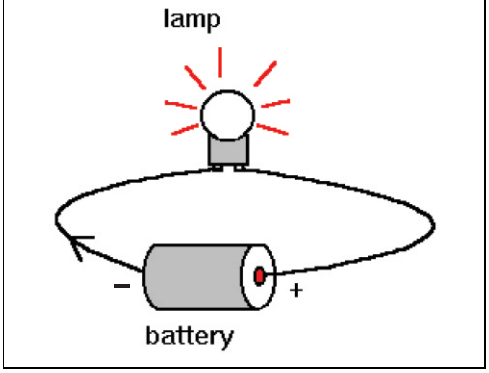
- ✓ Explain how an electric current flows through a circuit.
- ✓ Explain the working of a fuse and give details as to why it is used in an electric circuit.
- ✓ Describe how lightning occurs.
- ✓ Understand how static electric charges can be produced in some common materials.
- ✓ Investigate the magnetic field of a bar magnet.
- ✓ Construct an electromagnet and describe its working.
- ✓ Identify electromagnetic devices of everyday use.
- ✓ Explain the association between magnetism and electricity in various electromagnetic devices.
- ✓ Describe the magnetic field of Earth. and connect this concept with the use of a magnetic compass.
- ✓ Construct a magnetic compass and describe its working.

Electrical circuit, current and its flow

Activity 1: Identifying an electric circuit

Explain how an electric current flows through a circuit.

Look at the picture and explain what is happening.



Why is the light bulb glowing?

What is the source of energy for the bulb?

What does the black line represent?

What does the arrow represent?

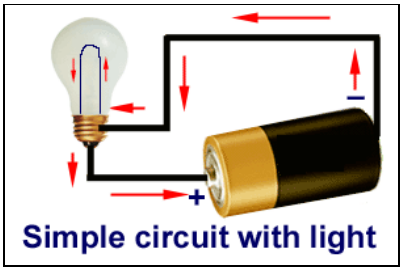


Figure 8.3 An electric circuit

As you have studied earlier, the flow of negative electric charges through an electric path (circuit) is called an electric current. An electric circuit is a loop or path along which a current flows. It mainly consists of:

- A source of electrical energy; **battery**
- A device which converts the electrical energy; **bulb**
- A pathway to aid the flow of electric current; **wires/conductors**

An electrical circuit is a path that allows electric charges to flow and perform a task, such as to light a bulb. Electricity flows from the source to the device (bulb) and then back to the original source. The device converts electrical energy into other forms of energy such as heat, light and other forms.

Activity 2: Use the symbols to draw an electric circuit

From the introduction, we believe that you have understand the primary idea of components of the electrical circuit. Following are some of the useful components which are used in circuits.

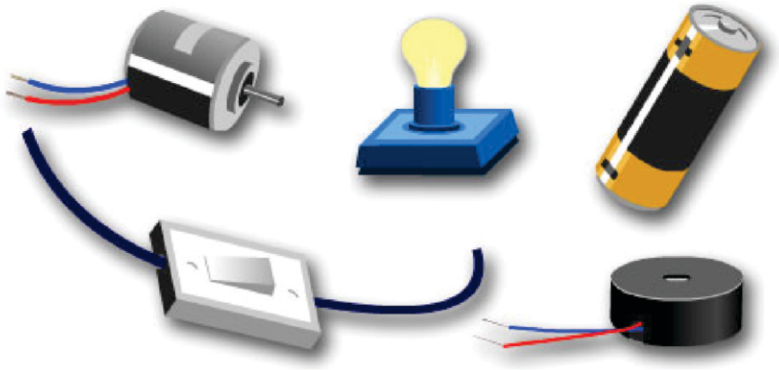
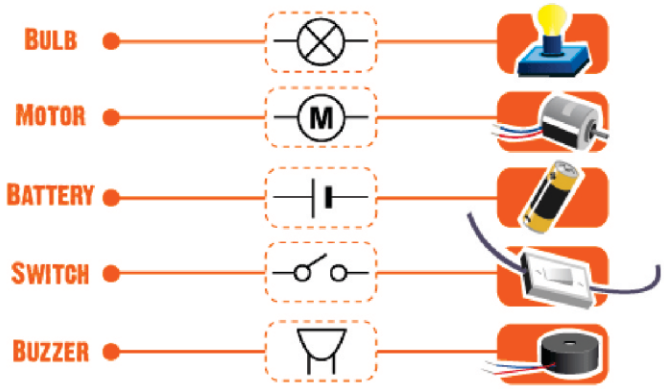


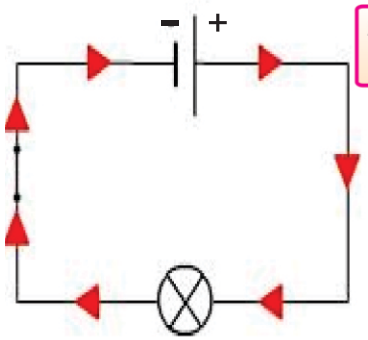
Figure 8.4: Components of an electric circuit

But we don't draw the circuits with the colorful pictures. For drawing a proper circuit diagram, we use symbols:



Now with the help of these symbols try to draw a circuit diagram.

A circuit diagram is provided here to help you do the activity.



Activity 3: With the help of the given symbols, draw three circuit diagrams,

- Draw a circuit diagram showing a cell, a switch and a bulb.
- Draw a circuit diagram showing a cell, a switch and a motor.
- Draw a circuit diagram showing a cell, a switch and a buzzer.

A fuse and it's uses:

Explain the working of a fuse and give details as to why it is used in an electric circuit.

A **fuse** is a safety device, used in a circuit to protect the appliances and equipment and its wiring from damage, which can be caused by the excessive current flow.

Inside the fuse, there is a wire; when too much current flows through it, the wire melts and stops the flow of the current. The thicker the wire, the more current is needed to melt it.

Figure 8.5: A fuse

There are different kinds of fuses but here we are introducing the most common types of fuses which we can easily find in our homes and schools. A fuse can also be called a **circuit breaker.** Have you seen these type of fuses? Explore these fuses at your school or home with an adult.

- **A Cartridge fuse**

Figure 8.6: Various cartridge fuse

- **A Rewireable fuse**

Figure 8.6: Various rewireable fuse

Static electricity and lightning

Activity 4: Understanding production of static electric charges in a balloon.

Understand how static electric charges can be produced in some common materials

You need: A balloon and a woollen jacket.

Blow air into a balloon. Tie a knot at the end of the balloon. Now start rubbing it gently against your woollen jacket. After rubbing it for at least 30 seconds, stand in front of a mirror and hold the balloon above your head.

- What happens?
- Why does it happen?

Activity 5: Understanding production of static electric charges in a comb

You need:

A plastic comb and tiny bits of torn paper.

Take a piece of used paper and tear it into tiny bits.

Take a plastic comb and run it through your dry, non-oily hair 5 to 6 times.

Now hold the comb above the bits of paper.

What happens?

You will see that the bits of paper get instantly attracted to the comb. Why does it happen?

We have learnt earlier that atoms are made up of neutral particles called neutrons and charged particles called protons, and electrons. Electrons revolve outside the nucleus.

We have now observed that rubbing objects together make them become charged.

It means that the comb and balloon has electrical charges.

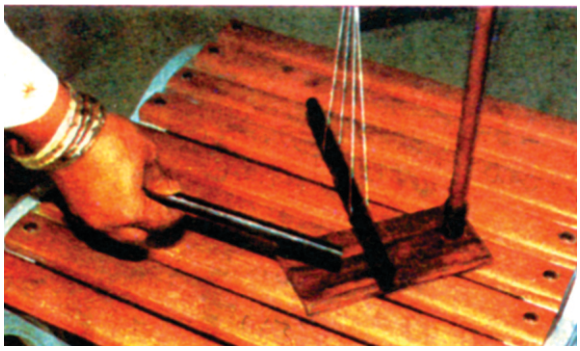


Figure 8.8: Creating static charge

These charges are build-up on the surface of an object. They Stay around the side that was rubbed because the charges remain in one area for a while rather than moving or "flowing" to another area, this is called static (non-moving) electricity. All materials that get charged by rubbing, and which keep their charge are said to have static electricity. Static charge is formed when two surfaces touch each other and the electrons move from one object to another. One object will have a positive charge and the other a negative charge. Rubbing the materials quickly, like when you rub a balloon fast over a woolen coat or your rub your feet on the carpet, will build up a large charge. Materials with different charges (positive and negative) will attract; while materials with similar charges (positive and positive) will push away from each other.

Lightning

- Describe how lightning occurs

Have you ever seen lightning?

Have you wonder how it occurs?

Lightning is caused by clouds having charges. It occurs when oppositely charged clouds interact with each other.

Huge amount of static electric charges are build-up in clouds. When it rains we can see flashes of light, it happens because of the interaction of the built up opposite charges in clouds.

Figure 8.9: Lighting

Magnets and magnetic fields:

Investigate the magnetic field of a bar magnet.

You have studied earlier that a **magnet** is a piece of material that attracts magnetic materials made of iron, cobalt and nickel.

Have you ever seen this magnet?

What does it do?

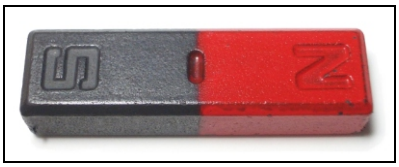


Figure 8.10: A bar magnet

The magnet shown above is called a bar magnet. What does 'N' and 'S' mean?

Activity 6: Understanding poles of a bar magnet

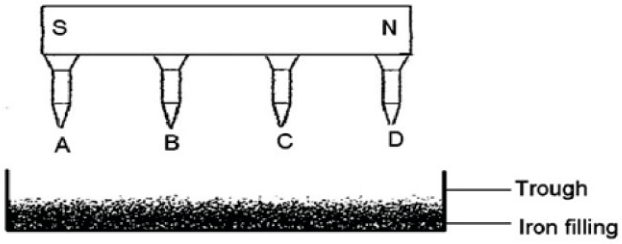
You need a bar magnet and an iron nail.

1. Place a bar magnet.
2. Bring an iron nail near it; first near the end N, then near the end S, and then near the middle of the bar magnet.
3. What do you observe? At which point does the magnet attract the nail more?

You have studied that the area around a magnet in which it attracts another object is called a magnetic field. This field is strongest at the poles. The strength of this field becomes weak as we move away from the magnet.

Activity 7: Understanding the strength of magnetic field of a bar magnet

You need a bar magnet, four small iron nails, a trough having iron fillings
Four iron nails labelled A, B, C and D, which are attached to a bar magnet as shown:



- Predict, which nail is (or nails are) able to attract the largest amount of iron filings?
- What does this prove?

Activity 8: Understanding magnetic field of a bar magnet

You need a bar magnet, a sheet of thin cardboard, iron fillings and a pencil.

- Place the bar-magnet under the cardboard.
- Sprinkle the iron fillings over the cardboard.
- Then tap the card board gently at the corner.

Observe what happens. You will observe thatthe iron fillings line up along the magnetic field lines. Now you can sketch the field lines using a pencil.

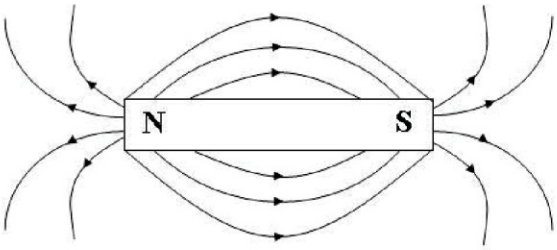


Figure 8.11: The magnetic field of a bar magnet

Activity questions:

- Where on the cardboard are iron fillings most concentrated? Why?
- What is the direction of the magnetic lines of force?

Electromagnet:

An **electromagnet** is a magnet that operates on electricity. An electromagnet is a type of magnet in which the magnetic field is induced by the flow of an electric current through a coil of wire. The magnetic field disappears when the flow of electricity is stopped.

Activity 9: Building a simple electromagnet

- Construct an electromagnet and describe its working.
- Explain the association between magnetism and electricity in various electromagnetic devices.

You need an iron rod or a two-inch iron nail, a thin insulated copper wire, a battery, few small iron nails or common pins, a sheet of thin card board, iron fillings and a pencil.

- Spin the copper wire around the rod as shown in the figure.
- Connect the ends of the copper wire to the battery.
- Bring some iron nails near one end of the rod.

What do you observe?

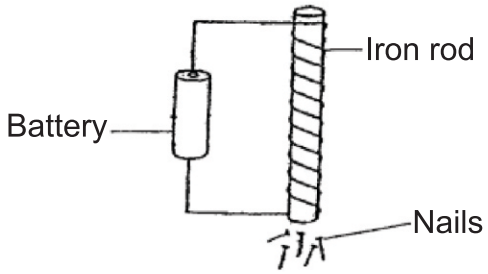


Figure 8.12: An electromagnet

- Identify electromagnetic devices of everyday use.
- Explain the association between magnetism and electricity in various electromagnetic devices.

This type of magnet is called an electromagnet. It is the type of magnet which acts as a magnet only when an electric current flows through it.

Electromagnetic devices:

There are many devices which have electromagnets.

These include electric bell, electromagnetic cranes and electric motor.

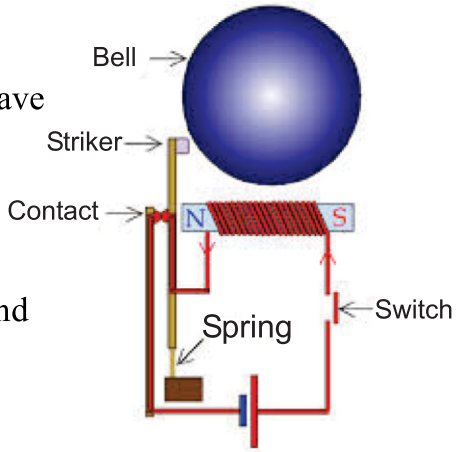


Figure 8.13: An electric bell

The electric bell:

When the current flows through the circuit, the electromagnet attracts the springy metal arm. The arm hits the gong, which makes a sound.

The electric motor:

A simple electric motor has a coil of wire. This coil can rotate between two opposite magnetic poles. When an electric current flows through the coil, the coil starts to rotate.

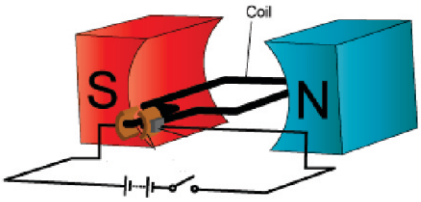


Figure 8.14: An electric motor

Do you know? A maglev (magnetically levitated) train doesn't use a regular engine like a normal train. Instead, electromagnets in the track produce a magnetic force that pushes the train from behind and pulls it from the front.

Earth's magnetic field:

Describe the Magnetic field of the Earth and connect this concept with the use of a magnetic compass.

Have you ever seen a compass needle? No matter where you turn it, the needle of a compass will always points to the North and South.

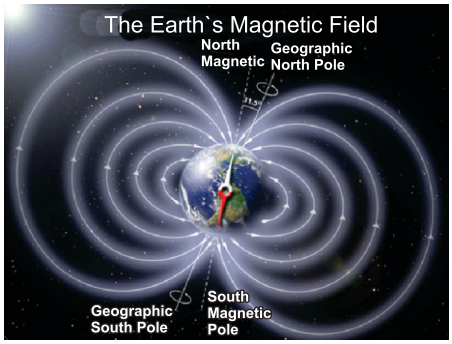


Figure 8.15: The Earth's magnetic field

It is because the Earth is like a giant magnet. It has a North pole and a South pole. This giant magnet is what makes a compass work.

Do you know? The Earth's magnetic field is caused by hot metals circulating in the core of the planet. This circulation creates electrical currents, which in turn create a magnetic field.

Making a simple magnetic compass

Construct a magnetic compass and describe its working.

900 years ago, the Chinese were the first, to discover "magnetite". They found out that if a piece of magnetite is placed in a dish full of water, the piece floats in water in such a manner that it always settles in the North-South direction. This discovery became the basis for the invention of a **magnetic compass.**


Figure 8.16: A compass

A **Magnetic** compass is used as a navigational tool on land and at sea. The compass detects the Earth's magnetic field. As we know that all magnetic fields have two poles, the earth's magnetic field also has two poles.

A magnetic compass consists of a light weight magnet, a magnetized needle on a free rotating pivot. Hence, the needle is attracted to the Earth's natural magnetic pole.

Activity 10: Making a magnetic compass and show its working.

What I need:

- a sewing needle
- a plastic bottle top or cork
- a pair of scissors
- a glue
- a bar magnet
- a shallow dish of water

What to do:

- Magnetize the needle by rubbing it from tail to tip with the N-pole of the bar magnet about 50 times.
- Stick the needle on the up-turned plastic bottle or cork.
- Place it carefully in the dish full of water.

Observe:

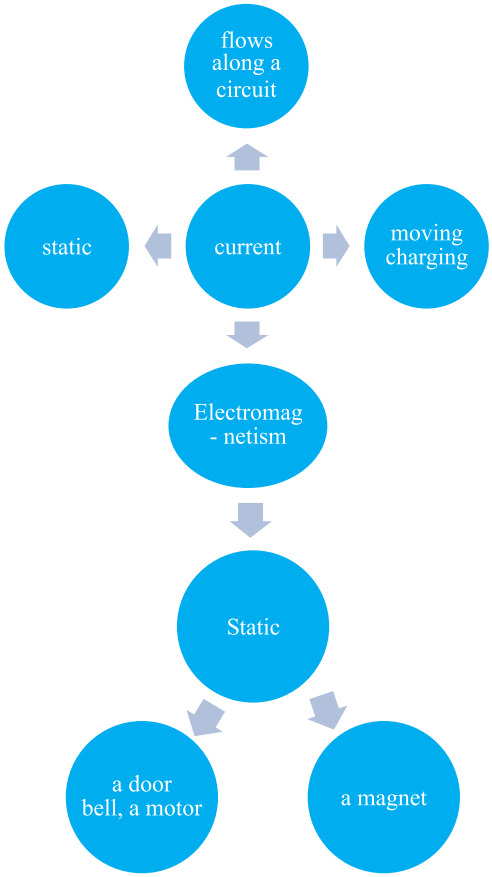
Does the needle rotate towards the N-pole?

(If the tail of the needle points towards N-pole, then you are successful in your experiment)

- Now turn the cap in various directions. What is the direction of the needle?

Teacher Note: Facilitate the students in finding out the North and South directions of the Earth.

Summary



Review questions:

Tick the correct answer.

1. **Which of the following is not a magnetic material?**
    a. steel
    b. cobalt
    c. aluminium

2. **What happens when the two same poles of magnets are brought close to each other?**
    a. They attract.
    b. They repel.
    c. They make an electric current flow.
3. **Which of the following is the main difference between electromagnets and bar magnets?**
    a. Bar magnets can be turned off but electromagnets cannot.
    b. Bar magnets have a magnetic field but electromagnets do not have them.
    c. Electromagnets need electricity but bar magnets do not need electricity.

4. **A child rubbed two balloons with a piece of wool. Which of the following happens when the balloons are brought near each other?**
    a. The balloons will repel each other
    b. The balloons will attract each other
    c. The balloons will pop
5. **Which of the following performs its function by converting electrical energy into motion?**
    a. an electric bulb.
    b. an electric motor.
    c. an electric iron.
6. **Which of the following is the main characteristic of electromagnets that makes them useful in cranes and door bells?**
    a. They are very strong.
    b. They cannot transmit electricity.
    c. They can be switched on and off.
7. **You can sprinkle iron filings around a magnet. Where will the iron filings be attracted more?**
    a. a poles
    b. a way from the magnet
    c. towards the centre of the magnet

8. WriteT for True and F for False for each of the following statements.

a) A static current flows in the wires of our home. T/F

b) The flow of current can be increased by increasing the number of turns around the iron nail. T/F

c) When a glass rod is rubbed by a silk cloth, it becomes charged. T/F

d) Steel clips are not attracted by a magnet. T/F

e) Static charges cannot flow. T/F

9. Explain why a freely suspended magnet rests in a North- South direction.

a) What is the magnetic field of a magnet?

b) How can the magnetic field lines of a bar magnet be observed?

c) How does an electric motor work?

d) What is the relationship between magnets and electricity?

Project

Materials needed:

- A small toy car
- 3 bar magnets

Procedure:

1. Tape a bar magnet to a small toy car with the North pole at the back of the car and the South pole at the front.
2. Put the car on a hard surface, like a floor or a table. Hold the bar magnet behind the car with the North pole facing the car. As you move it near the car, what happens? The North pole of your magnet repels the North pole of the magnet on the car, making the car move forward.
3. Have someone else hold another magnet in front of the car, with the Northpole facing the car. Does the car move faster with one magnet "pushing" from behind and the other magnet "pulling" from ahead?
4. You can take one more car and tape another bar magnet to it. Have a car race with your friends and enjoy.

Chapter 9

Soils

Have you ever dug through the **soil** around your house, a flower pot or in the school ground? Do you find the soil same everywhere? Is the soil in your school ground different from that around your house? Yes, it appears different because of its colour. How is soil important to plants and animals? Plants grow in soil and many animals also live in soil. Do you know which animals live in the soil?

Figure 9.1: An ant

Figure 9.2: A desert snake

Do you recognize these animals? Where do they live?

Explore

Where did all the soil on the planet Earth come from?

In this chapter, you will learn about:

- Characteristics of soil
- Types of soil
- The decomposers
- Life in the soil

All the students will be able to:

- ✓ Describe the characteristics of soil
- ✓ Identify the similarities and differences in the different types of soils.
- ✓ Investigate and describe soil components.
- ✓ Describe the effect of moisture on soil characteristics (how it holds together, texture and color).
- ✓ Compare the absorption of water by different soils.
- ✓ Observe and describe the effect of moving water on different soils.
- ✓ Investigate and describe how living things affect and are affected by soil.

Characteristics of soil

Describe the characteristics of soil.

I am the floor of the forest and the base of water bodies. I lie under your buildings.

Soil is one of the most common material present on the planet Earth. It is present all around us. As you have studied, the surface layer of land is called soil. You have also studied in social studies class that soil is composed of minerals, particles of rock and living things. Soil at different places are different in characteristics. The following characteristics of soil describe how soil looks like and feels like when touched. You will study some basic characteristics:

Colour:

Have you noticed that soil in different areas are different in colour. You may find soil that is red, green, yellow, brown or white. The soil color generally indicates the minerals present in it and the amount of moisture and organic matter in it.

Figure 9.3: Different type of soils

Soil texture:

Texture tells how something feels like, when touched. Soil may be **gritty**, **silky** and **sticky** to touch. You can perform a **feel test** by rubbing the soil between wet fingers.

Unscramble the given word:
erxettu

_ _ _ _ _ _ _ _

Hint: The way a material feels when touched.

Figure 9.4: A man performing the feel test

Sand, silt and clay are **minerals** present in soil. They are responsible for the **texture** of soil.

Feel test:

Rub a pinch of wet soil between fingers. This is the **feel test.**

Does it feel gritty? It has more amount of sand. Sand particles are large and give the soil a gritty texture.

Does it feel silky? It has a greater amount of silt in it. Silt particles are like flour or powder and give the soil a smooth and silky feel.

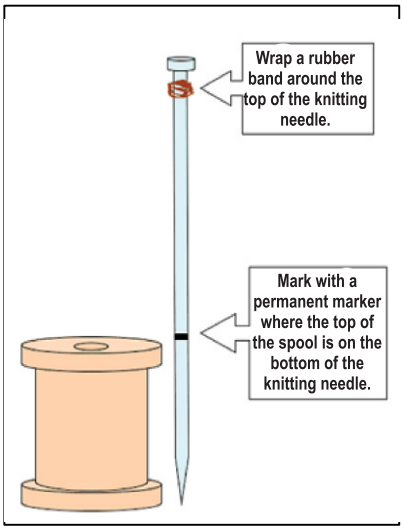
Does it feel sticky? The large portion of it is clay. Clay particles are microscopic and get sticky when mixed with water.

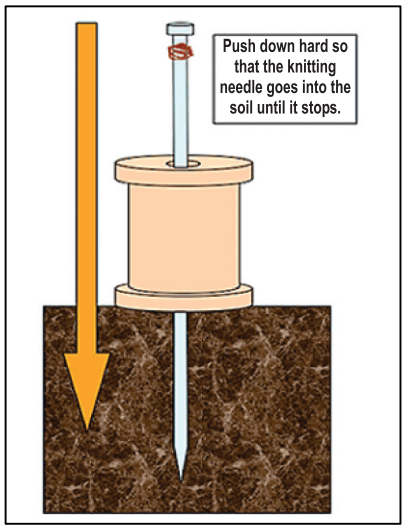
Soil organic matter: Where do dead leaves, fallen twigs and dead animal parts go? They mix up with the soil. Together, they make up soil organic matter. Organic matter is very important to soil because it provides all the nutrients necessary for plant growth. A soil rich in organic matter is thus ideal for plant growth.The organic matter in soil is also called **humus.**

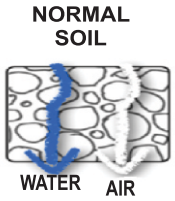
Figure 9.5: Dead twigs and leaves

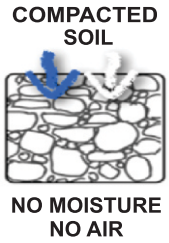
Soil compaction:

Soil compaction tells us how compact the soil is. A healthy soil must be able to breathe and take up water. A highly compact soil does not allow passage of water. A loosely compact soil is good for plant growth since it allows air and water to enter the plant and plant roots can also penetrate the soil for greater support in a better way.





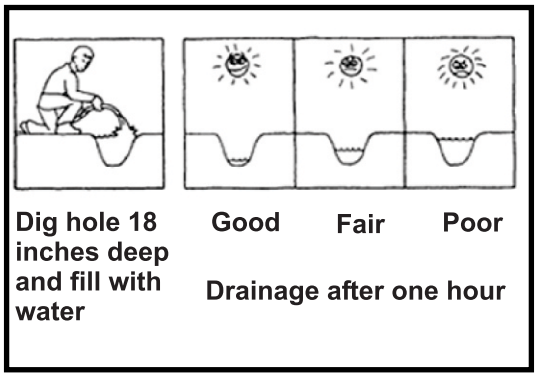




Soil moisture and drainage: You know that water falls on the soil during rainfall or the soil may also be watered artificially. This water moistens the soil and the excess of it drains out of the soil. A well drained soil contains just the right amount of water for plant growth. When water is not drained properly, it accumulates in soil and badly affects plant growth. If water is drained too quickly, the soil is left dry. Dry soil also does not support plant life.

Poorly drained soil

Well drained, moist soil



Dry desert soil

Unscramble the given word:
nicgaor

_ _ _ _ _ _ _ _

Hint: Anything that come from living organisms.

You will find that the characteristics of soil sample taken from one area are quite different from sample taken from another area. A soil characteristic test must be performed to test whether the soil is good for plant growth or not.
If a soil is compact, dry and contains little organic material, it will not be suitable for plant growth. A soil sample that is water logged and does not drain properly is also unsuitable for the growth of plants

Activity 1: How is my soil

What do you need

- a small jar, shovel or spoon
- Water
- a knitting needle (to check soil compaction)

Figure 9.6: Children digging through soil

What to do:

Dig through the soil in your neighborhood. Collect your own soil sample. Observe the soil when digging,by using your senses. Wet your fingers and rub a pinch of soil between your fingers to test its texture.

What did you observe:

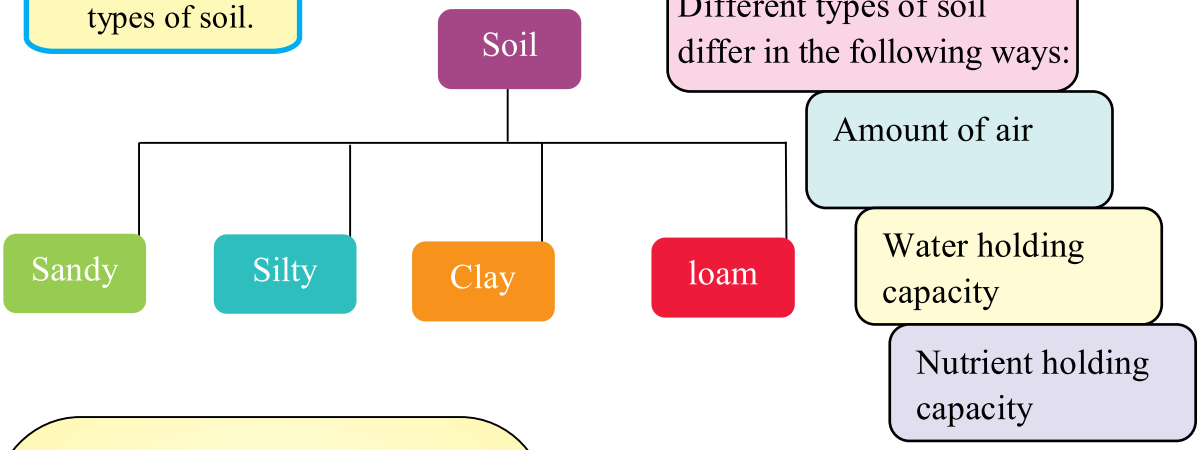
How is your soil? Color the appropriate boxes in the grid:

Contains twigs, leaves, roots	Granular	Poorly drained and wet	Dry	Well drained and moist	Contains living things	Sticky	Highly compact
Loose	Contains dead leaves	Blackish Brown	Brown	Red	Yellow	Silky	Contains animal parts

Types of soil

Identify the similarities and differences in the different types of soil.

All soils are created by weathering of rocks. However, Soil is classified into various types. This grouping is based on the type of minerals present in the soil.
Do you know the mineral present in soil?



Sandy soil: Soil that contains a lot of sand is classified as sandy soil. The sand particles are the largest of the rock particles that make up soil. These soils have a gritty texture. Sand particles do not hold onto water and are quickly drained. Sandy soil has many air pockets between the soil particles. Sand particles are also unable to hold the nutrients necessary for plant growth.

Silty soil: Silty soil contains silt as the dominant soil mineral. You know that silt particles are about the size of flour particle. Silt is powdery and silky to touch. Silty soils retain water. Sometimes, they may also become poorly drained. But they do not hold on to nutrients.

Clay soil: The chief soil mineralis among different type of soil is clay. Clay holds water thus it is poorly drained. It easily becomes water logged. It is less aerated since water takes up major space. However, clay can easily hold nutrients necessary for plant growth.

Loam: A soil which is a mixture of clay, silt, sand and **humus** is often referred to as a **loam.** It contains the nutrients necessary for plants, holds sufficient water to make it available to the plant roots, with air pockets between the particles. It allows good water drainage as well. Thus, it is the best soil for plant growth.

Desert soil is mostly sand. Since this soil does not retain water, deserts are extremely dry.

Unscramble the given word:
Tlis

_ _ _ _ _ _ _ _

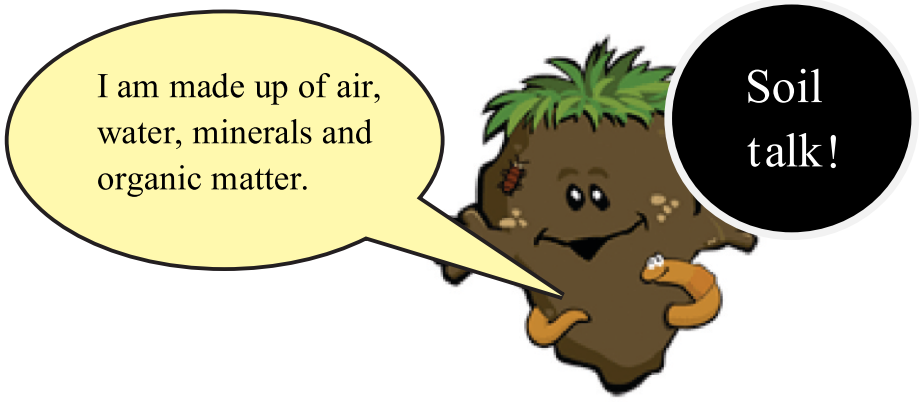
Hint: The name of a soil mineral that is silky and powdery to touch.

	Sandy soil	Silty soil	Clay soil	Loam
Aeration	good	good	poor	good
Drainage	Very fast	poor	poor	good
Nutrient holding capacity	poor	poor	good	good

Do you see now how different soil types are similar and different?

Components of soil

Investigate and describe soil components.



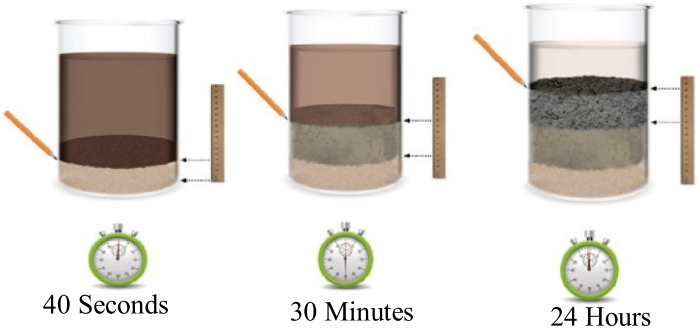
Do you know? Air, water, mineral and organic matter are called components of soil. The mineral amount in different soils varies. Let us do a simple experiment to see how much of sand, silt, clay and organic matter is present in different types of soil samples

Particle size **sand> silt> clay**

Activity 2: Separating and measuring the mineral and organic components of different soil samples.

What do you need

- Soil sample from two different places
- water
- Jars to hold soil



What to do

1. Your teacher will help you collect soil samples from different places. Secure them in plastic bags and label them with the place of collection. Your group will be given a sample.
2. Fill about half of an empty jam jar with soil. Add clean water to it until 2/3rd of the bottle is filled. Cover the jar with its lid. Shake well and leave the contents of the jar to settle for about 24 hours.
3. Observe the jar time to time. Do you see any layers? Do the layers differ in their thickness? Sand particles being the largest in size will settle at the bottom of the jar. Silt will make the medium layer. Clay layer will settle on the top. Dead leaves and remains of plants and animals will float on top.
4. Measure the height of each soil layer with the help of a ruler.

What did I observe:

Height of sand layer (cms)	Height of silt layer (cms)	Height of clay layer (cms)

Activity question:

1. **How would you classify your soil sample?**
   - sandy
   - silty
   - clay
   - loam

Activity 2: Observing effect of moisture on soil characteristics

Describe the effect of moisture on soil characteristics (how it holds together, colour, texture etc):

What do you need?

- labelled soil samples from different places
- water
- droppers

Figure 9.7: Children collecting soil samples

What to do:

1. Your teacher will help you collect different soil samples from different places in clear plastic bags. Label them with the names of the places.
2. Let them dry if they are wet. Your group will be provided with a sample.
3. Observe and touch the dry sample and fill in the table.
4. Add a little water to each sample. Use droppers for the purpose. Observe the colour and texture of the wet sample. Do you find it different from the dry sample? Record your observations in the table.

What did I observe:

Sample collected from _____

	Dry soil	Wet soil
Colour		
Texture		
How it holds together?		

Compare the absorption of water by different types of soils.

Activity 4: Comparing the water holding capacity of different soil samples

Teacher Note: Engage the students in performing the activity. Elaborate that scientists perform these kind of tests to determine the types of soil and whether or not they would be good for plant growth. Discuss question as these: What happens if a type of soil turns very hard when wet? Would such a type of soil be good for plant growth?

What do you need:

- soil samples from different places
- water
- clear plastic bottles with the base cut out

What to do:

1. Collect different soil samples in clear plastic bags. Label them.
2. Take three plastic bottles and cut their base. Cap their mouths.
3. Put weighed, say10gms, amount of each sample into each plastic bottle.
4. Add half a litre of water from a measuring cylinder into each bottle. Let it stay as such for 15 minutes.
5. After 15 minutes, open the cap. Collect the water drained from each bottle. Let it drain completely until no more drops fall. Measure the amount of drained water from each soil sample using a measuring cylinder.
6. The lesser the amount of drained water, the greater is the water holding capacity of a soil.

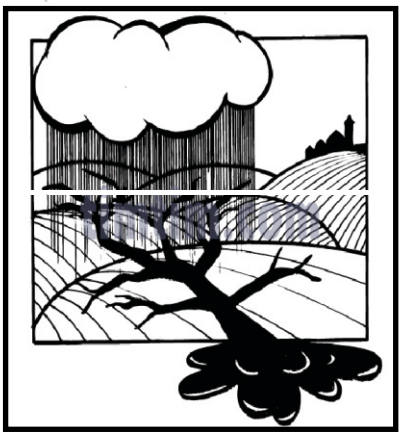
What did you observe:

Sample	Volume of drained water (ml)
Sample 1 (from a pond)	
Sample 2	
Sample 3	

Teacher Note: Engage the students in performing the activity. Elaborate that scientists perform these kinds of test to determine which type of soil holds most water and whether or not they will be suitable for plant growth. Discuss question as these: What happens if a soil holds too much water? Would such a type of soil be suitable for plant growth? What would happen if a type of soil does not hold water well? Will there be enough air in the soil that holds too much water?

Observe and describe the effect of moving water on different type of soils.

Effect of moving water on soils



A stream of water ran here. Look what it has done to the soil.

Moving water cuts through the soil, washing away the soil and taking soil particles with its flow. This process is called erosion of soil by water. Erosion is a process by which soil is displaced from the Earth surface by agents such as water or wind. Sandy soils are more erodible than silty or clay soils. Erodible soils are not good for plant growth.

Unscramble the given word:
niosreo

_ _ _ _ _ _ _ _

Hint: The displacement of soil by water or wind.

Soil talk!

Have you seen any signs of erosion like this?

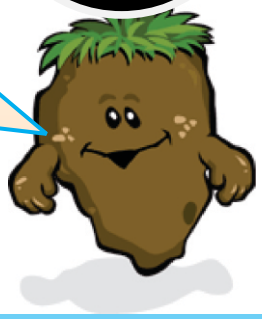


Figure 9.8: Land eroded by water

Investigate and describe now Libing things affect and are affected by different type of soils.

The Decomposers

I am a fallen leaf. Do you know what is happening to me? I will disappear after sometime. Where will I go?

Millions of leaves and twigs fall off the trees during autumn and many animals die. Together, they all make up dead organic matter.

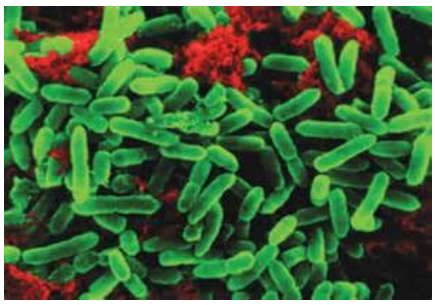


Figure 9.9: Bacteria

Figure 9.10: Fungi

Decomposers and Decomposition:

Dead leaves and parts of animals are eaten up by organisms present in soil. They undergo a process called **decomposition.** Decomposition is a process in which a dead organism or its parts are broken down into simple nutrients.

Decomposers are living organisms in the soil which break down dead organisms. The nutrients released by decomposition are mixed up with soil and are used up during the growth of plants.

Bacteria and fungi are microscopic organisms which live in soil and carry out decomposition.

Some worms also act as decomposers. Decomposers get their food from decaying living organisms. They return the nutrients back to the soil. Decomposition is a natural way of recycling nutrients in nature.

Unscramble the given word: **p e r c o m d e s o**

_ _ _ _ _ _ _ _ _

Hint: Organisms that breakdown dead organic matter.

Investigate and describe how living things affect and are affected by different type of soils.

Life in the soil

Soil is non-living itself. However, soil is home to millions of living organisms.

Do you know? That a teaspoon of soil may contain up to one billion bacteria which act as decomposers.

Do you know how soil helps organisms living in it?

Soil provides shelter and nutrients to organisms living in it.

Soil biota (soil life)

Bacteria and fungi: are one class of soil organisms. They feed on the dead and decaying organic matter in the soil. During the decay process they return back the nutrients essential for plant growth to the soil.

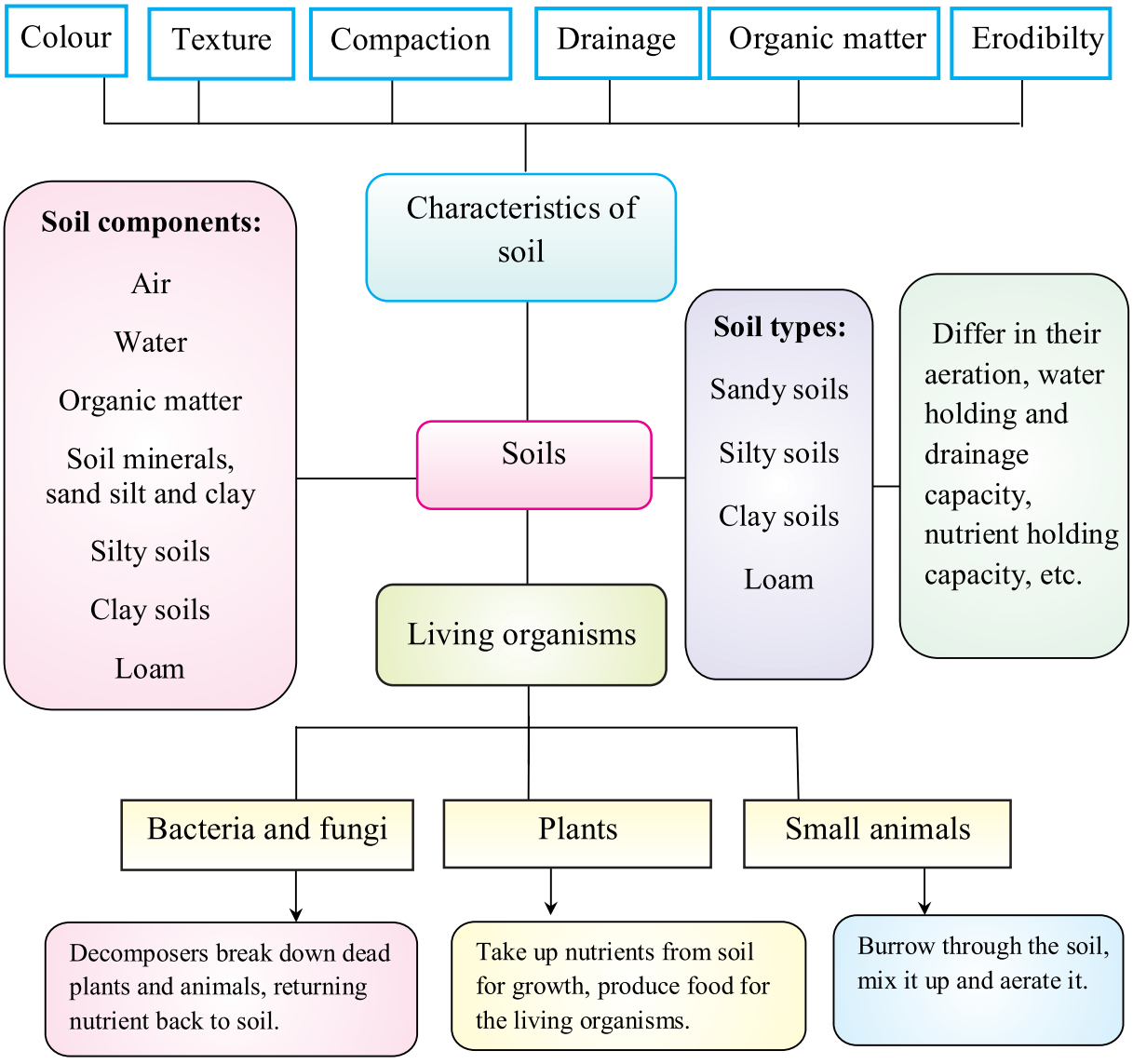
Plants: You know that all plants on the planet earth grow on soil. They absorb nutrients from the soil for their growth. They produce food for living organisms using sunlight, carbon dioxide and water by the process of photosynthesis.

Small animals: Many animals live in the soil. These include slugs, snails, earthworm, ants, spiders, rabbits and burrowing animals. These animals stir up the soil and make holes where air and water can enter. They chew up dead plants and break them into pieces. So that the fungi and bacteria can decompose them.

I am an Earthworm and Earth is my home.

I tunnel through the soil and make space for air and water to enter the soil and for the plant roots to penetrate. I also swallow soil and it passes out of my body. The soil that comes out is left in little piles on top of the ground. Humans call it worm casting and it is excellent for plant growth.

Summary



Review questions :

1. Mark the statements as true or false

a. There are three mineral components of soil, namely sand, silt and clay. T/F
b. A highly compact soil is good for plant growth. T/F
c. The soil should be wet and fully soaked with water for plant growth in the best manner. T/F
d. Sand particles are the smallest of all soil particles. T/F
e. Wet clay is sticky. T/F
f. A decomposer mix up the soil. T/F

2. Answer the following questions:

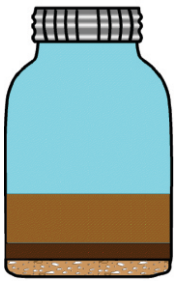
a. What are the three major soil minerals? Describe the characteristics of each.
b. What is a feel test? What do the scientist use it for?
c. How do living organisms affect a soil? How does the soil help them?
d. What is erosion?
e. How do earthworms help in aerating the soil?

3. Circle the best answer:

a. Saeed wants to grow flower plants in his garden. The nursery is offering him various kinds of soils. Which of these might be a good choice for him? Explain your answer:

- Soil 1 has a high clay content but very low sand and silt content.
- soil 2 is sandy and rich in organic matter.
- Soil 3 is mainly silty with very low sand and clay.
- soil 4 is a mixture of sand, silt, clay and organic matter .

b. Organic means belonging to living things. Saeed found the following things in the soil sample he collected. Which of these following are classified as dead organic matter:



- A dead ant
- A banana peel
- A fallen leaf
- A stone
- A piece of plastic

c. In a separation experiment, the order of the layers from top to bottom is,

- Sand; silt; clay
- Clay; silt; sand
- Clay; sand; silt

4. Scientific Problem Solving:

This farmer is worried about his field. The soil is holding too much water and is poorly drained. The situation might badly affect the plants. Can you answer the following questions? Your answers might help the farmer.

Which component of the soil gets missing when the soil holds too much water?

How can the farmer improve the soil in his field for better crop growth? Which soil mineral needs to be added so that the soil does not soak up water?

5. Dig through the soil and collect samples of dead organic matter. Secure them in small plastic bags and paste them in your notebook. Share your findings with your friends.

Chapter 10

Our solar system

In this chapter, you will learn about:

- Stars and planets
- The solar system
- Natural satellites in the solar system

All the students will be able to:

- ✓ Describe the solar system and its planetary arrangement showing position of the Earth in our solar system.
- ✓ Explain that Sun is a star.
- ✓ Differentiate between a star and a planet.
- ✓ Categorize planets and explain the relative size of the planets and their distance from the Sun using a model.
- ✓ Compare the size of the Sun, Earth and Moon.
- ✓ Investigate the moons of the different planets of the solar system.
- ✓ Compare Meteorites, Asteroids and Comets

Have you ever thought about other planets like our planet Earth? Our Sun and objects (planets, comets, asteroids) orbiting the Sun comprise of a family. Do you know the place of Earth, in this family ? Have you ever seen a meteor shower or a comet and thought about what are they made of and where did they come from? What is the origin of our Sun and the planets, and why are they so much different in size and appearance?

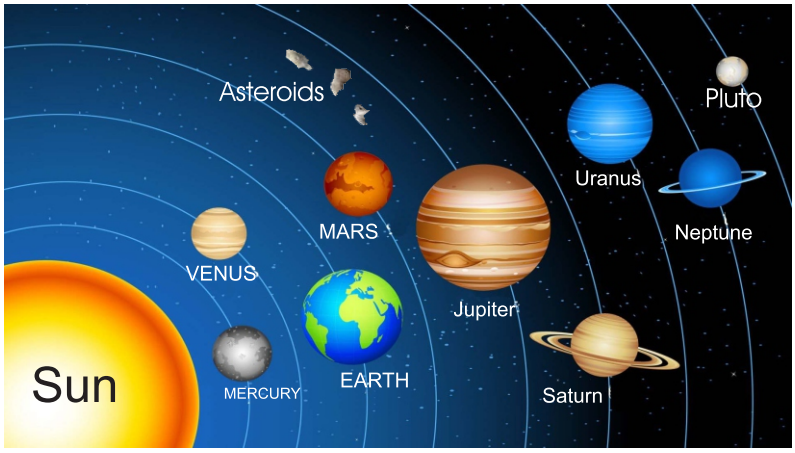


Figure 10.1: Size and distance of planets from the Sun

Do you know what is the name of the national space agency of Pakistan and its functions?

Pakistan Space and Upper Atmosphere Research Commission (SUPARCO) is the national space agency of Pakistan, established in 1961. The main objectives of SUPARCO are,

- to undertake research in the field of science and engineering.
- to utilize the benefits of space technology for the advancement of our country.

Besides these, SUPARCO's main functions are:

- to make satellites for communication, the Earth's observation and research purposes
- to conduct studies in space and atmospheric sciences, radio wave propagation, astronomy and geomagnetism.

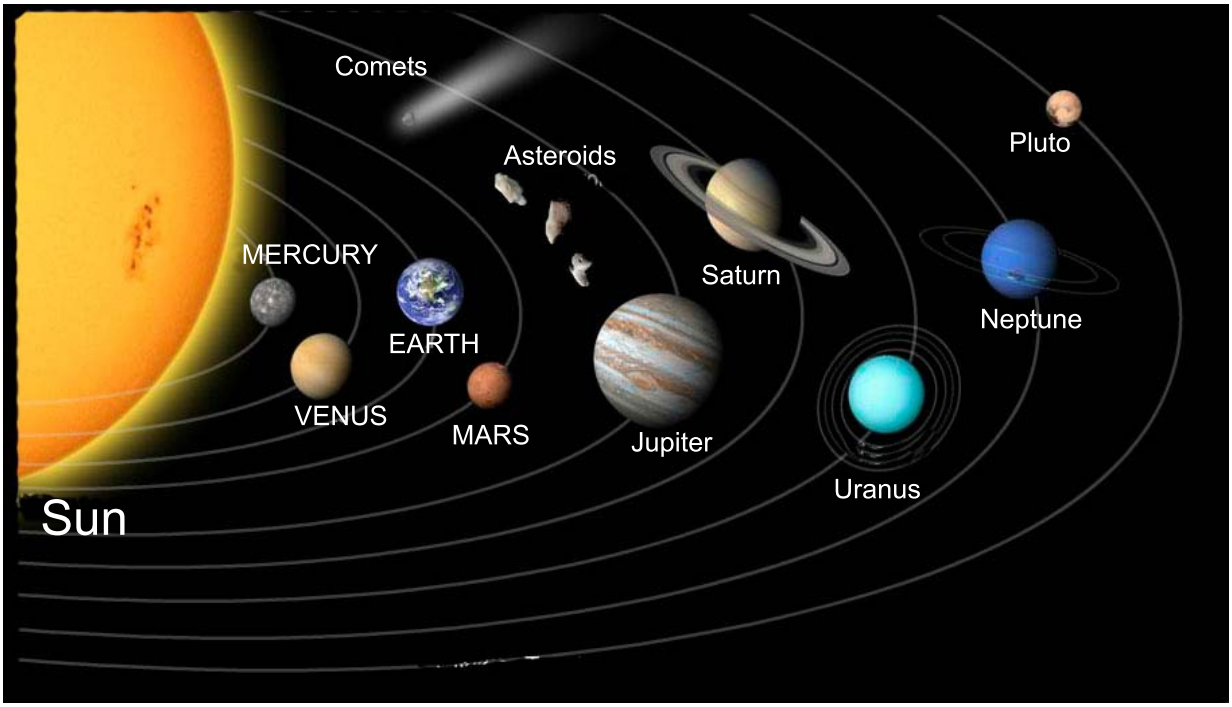
The solar system :

Describing the solar system and its planetary arrangement showing position of the Earth in our solar system.

Our **Solar System** is a collection of planets, moons, asteroids, comets and smaller debris such as meteoroids which are revolving around the Sun. The Sun is the center of our Solar System. Everything in the Solar System orbits around the Sun. The order of planets, nearest to the farthest from the Sun, in our Solar System is:

1) Mercury
2) Venus
3) Earth
4) Mars
5) Jupiter
6) Saturn
7) Uranus
8) Neptune

Out of these eight planets, five are visible to the naked eye (Mercury, Venus, Mars, Jupiter and Saturn). The remaining two (Uranus and Neptune) require telescopes for their observation. Pluto is no more considered as a planet now; instead, it belongs to a new category called 'dwarf planet'.



10.2: The Solar System

Activity 1: Remembering the order of planets in our solar system.

A mnemonic is a sentence or phrase that helps us remember a set of words in a specific order. It uses the same first letter as the words we are trying to remember.
For example, a mnemonic for remembering the order of the planets is as follows:

Mercury	M	My
Venus	V	Very
Earth	E	Excellent
Mars	M	Mother
Jupiter	J	Just
Saturn	S	Served
Uranus	U	Us
Neptune	N	Nans

Try to make your own mnemonic.

The Sun

- Explain that Sun is a star.
- Differentiate between a star and planet.

We can see thousands of stars during a night, but not the Sun. On the other hand, the Sun is the only star that we see during daytime. The Sun not only provides us light and heat, but it also gives out dangerous ultraviolet light which may cause sunburn and skin cancer. However, without the Sun, there would be no daylight, and our planet would simply be a dark, frozen world, with no oceans of liquid water, and no life.

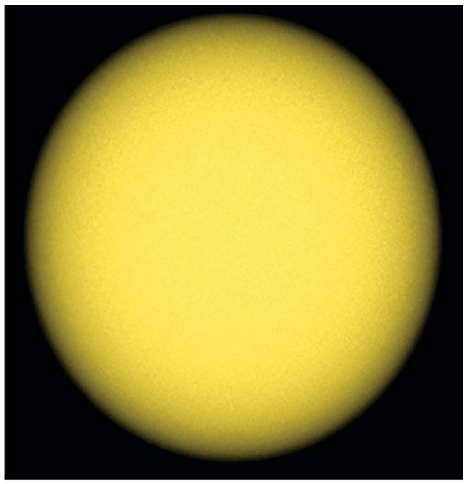


Figure. 10.3: The Sun

The Sun is a huge ball of hot gas,about 1.4 million kilometers across,which equals to 109 Earths if set side by side in terms of size. Also, it weighs as much as 330,000 Earths,and about 1,300,000 Earths would fit inside the Sun. The Sun lies about 150 million km away from us. At this distance, it takes about 8 minutes for the sunlight to reach us.

It is an extremely large star, however, in comparison with other stars; it is an average size yellowish star. Scientists estimate that the Sun was formed about 4.57 billion years ago. Our Sun is one of the billion stars orbiting the center of our galaxy.

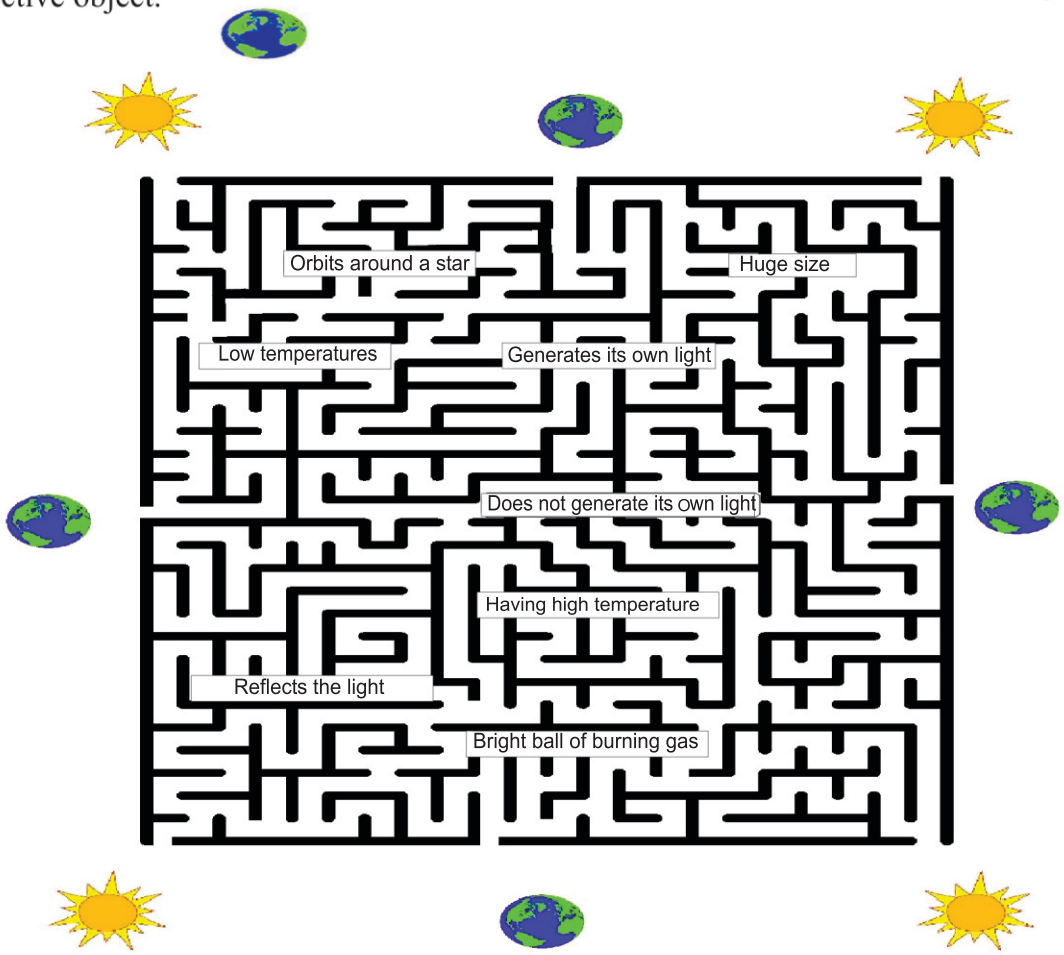
Let us understand the difference between a star and a planet.

A star, like the Sun, is a huge bright ball of burning gas that is held together by its own force of gravity. A star generates its own light. A star has very high temperature.

A planet, like Earth, is simply a large body that orbits around a star. A planet does not generate its own light, rather it reflects the light from the star it orbits. Planets have low temperatures.

Activity 2: Differentiating a star and a planet

See the following maze below; different properties belonging to a star and a planet are listed on the maze. Draw each property path back to its respective object.



The Planets:

- Categorize planets and explain the relative size of the planets and their distance from the Sun.
- Investigate the moons of the different planets of the solar system.

The planets in our Solar System are classified into two categories: **terrestrials** and **gas giants**

- **Terrestrial Planets: Mercury, Venus, the Earth** and **Mars** are all terrestrial planets. They are small and mainly made up of **rocks.**
- **Gas Giants: Jupiter, Saturn, Uranus** and **Neptune** are called **gas giants** because they are large and are made up of **gases**.

Size of the planets:

See figure 10.4(a), it shows the relative size (in the units of Earth radius) of each planet in comparison with the Earth. Each bar in the figure represents the size of the planet. Since Jupiter is the largest planet of the solar system , it has the largest bar in the figure. Similarly, Mercury has the smallest bar because it is the smallest planet in our solar system . The size of other planets can be observed likewise.

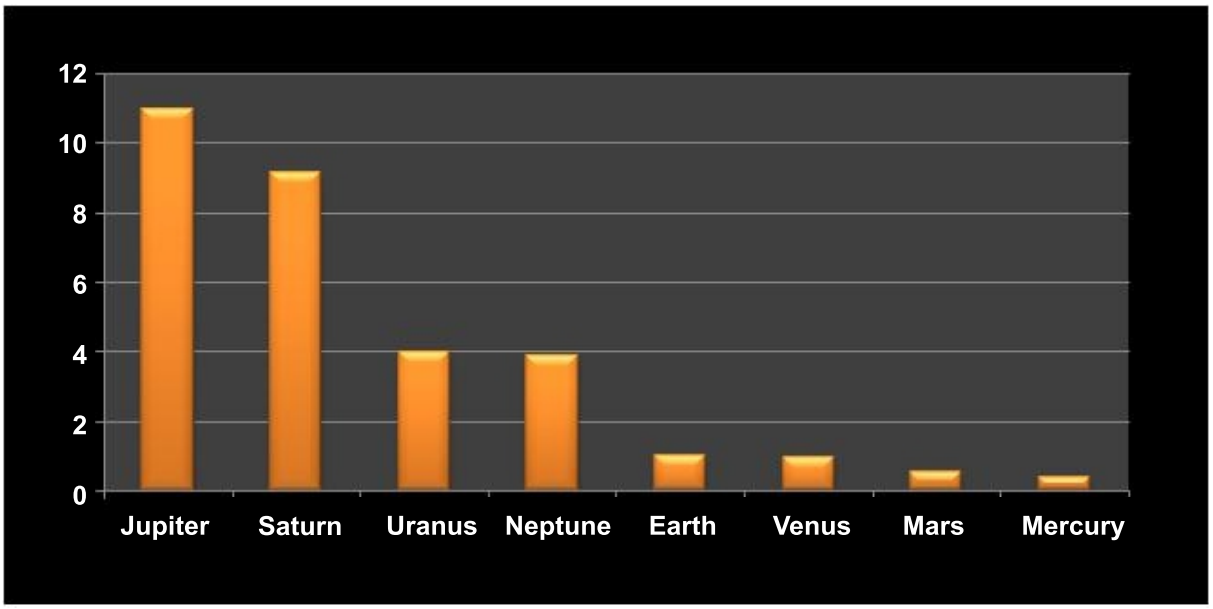


Figure 10.4: (a) Size of the planets in comparison with the Earth

Distance of the planets from the Sun:

Fig. 10.4 (b) represents the distance, in million (1000000) kilometers of the planets, as measured from the Sun. We observe that Mercury, being the first planet from the Sun,is the closest of all. As we move away from the Sun, the distance of planets increases rapidly.

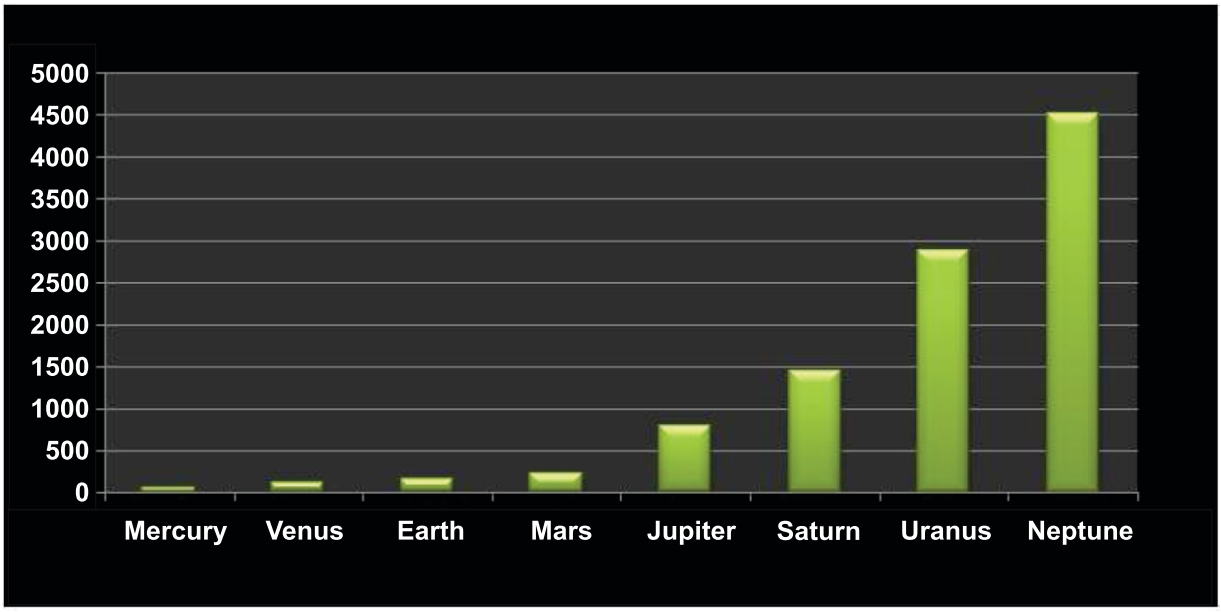


Figure 10.4: (b) Distance of the planets from the Sun

Let's have a closer look at each planet,

1. Mercury

Figure 10.5: Mercury

Mercury is mostly made up of iron. The surface of the planet Mercury is covered with craters. Mercury has no atmosphere and it has no moons.

2. Venus

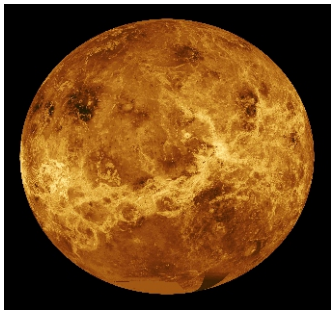


Figure 10.6: Venus

Venus is the second brightest object in the night sky after the Moon. like the Earth, Venus has an atmosphere. It is almost identical in size, chemistry and gravity, as the Earth. Venus has volcanoes, mountains and sand, just like Earth. It is sometimes called as "sister" of the planet Earth. But Venus has no moons.

3. Earth

The Earth is the biggest of all the terrestrial planets. Our planet is an oasis of life in an otherwise desolate universe. The Earth's temperature, weather, atmosphere and many other factors are just right to keep us alive. About 30% of the Earth's surface is covered with land, while about 70% is covered by oceans. The Earth has one moon and its name is Luna.

Figure 10.7: Earth

4. Mars

You may sometimes hear Mars referred to as the "Red Planet." This is because the surface of Mars is red. If you stood on the surface of Mars, you would see red dirt and rocks everywhere. Evidence suggests that Mars once had rivers, streams, lakes, and even an ocean.

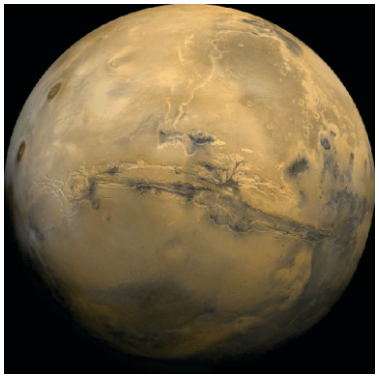


Figure 10.8: Mars

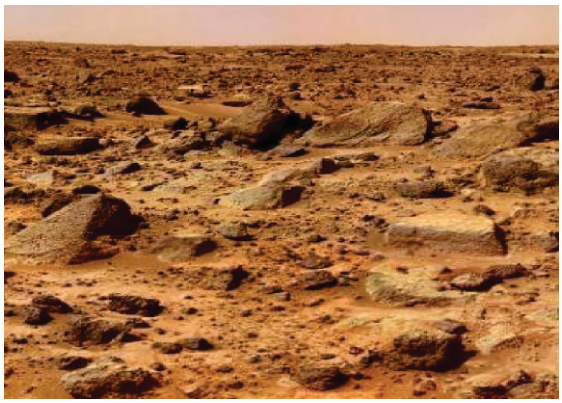


Figure 10.9: Surface of Mars

As technology advanced, scientists were able to actually land a spacecraft on the surface of Mars. It has the largest volcano in the Solar System, which is known as “Olympus Mons”. It has two moons; Deimos and Phobos.

5. Jupiter

Jupiter is a very stormy planet. The many different cloud formations and storms in the atmosphere make Jupiter a very colorful planet. Jupiter's great red spot is where a giant storm has been raging for at least 300 years. The spot at the lower right is also called "The Eye of Jupiter" because of its shape. Jupiter is considered a gas giant because it does not have a solid surface. Jupiter has 50 confirmed moons, while 12 moons are in the process of confirmation. One of its moons

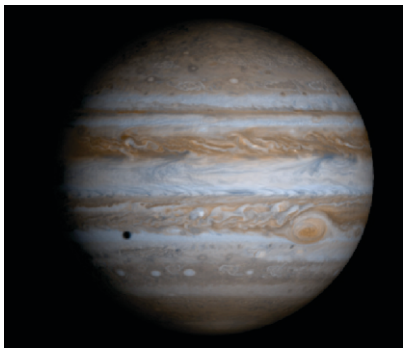


Figure 10.10: Jupiter

"Ganymede" is the largest moon of our solar system. Ganymede, along with other three largest moons of Jupiter, were discovered by Galileo in 16th century.

6. Saturn:

In many ways, Saturn is similar to Jupiter and the second largest planet in our Solar System. Saturn is the least dense planet in our solar system . Like Jupiter, Saturn is wider in the middle and narrower near its top and bottom. Saturn is most well-known for its rings. The rings are split into categories, ranging from Ring A to Ring G. The rings are not solid but are rather made up of particles of ice, dust and rocks.

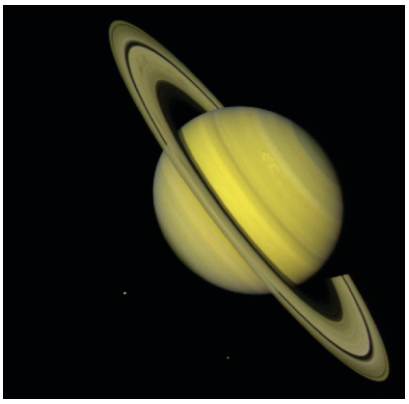


Figure 10.11: Saturn

Saturn has 53 confirmed moons and 9 still need confirmation. The most well-known of Saturn's moons is Titan. It is the second largest moon in the solar system next to Jupiter's Ganymede. Titan is larger than the planet Mercury.

7. Uranus:

Like Jupiter and Saturn, Uranus is a gas giant. But Uranus is a little different. Unlike all the other planets and most of the moons in our solar system , Uranus spins on its side. Uranus is an extremely cold planet. It has been called the "ice giant". Uranus is almost identical to the planet Neptune. Uranus has 27 moons. Five of these moons are large and the rest are smaller. The largest moon is Titania.

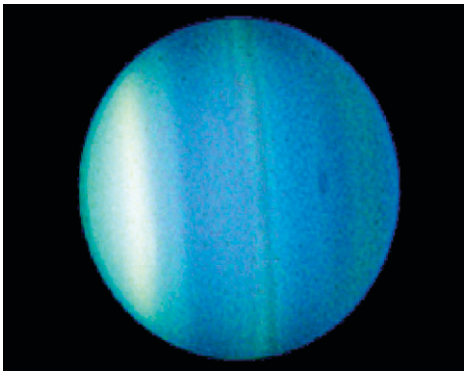


Figure 10.12: Uranus

8. Neptune:

Neptune is the smallest of the four gas giants in our Solar System. Not much was known about Neptune until it was visited by the spacecraft Voyager 2. Neptune is a very windy place. No other planet in the solar system has winds that are as strong as Neptune's. Neptune has six rings which circle the planet. Neptune has 13 moons that we know of. Because Neptune is so far away, it is difficult to see any of these.

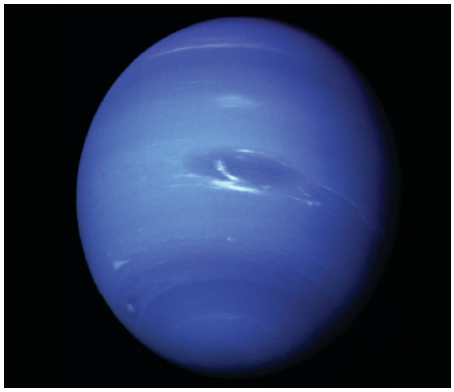
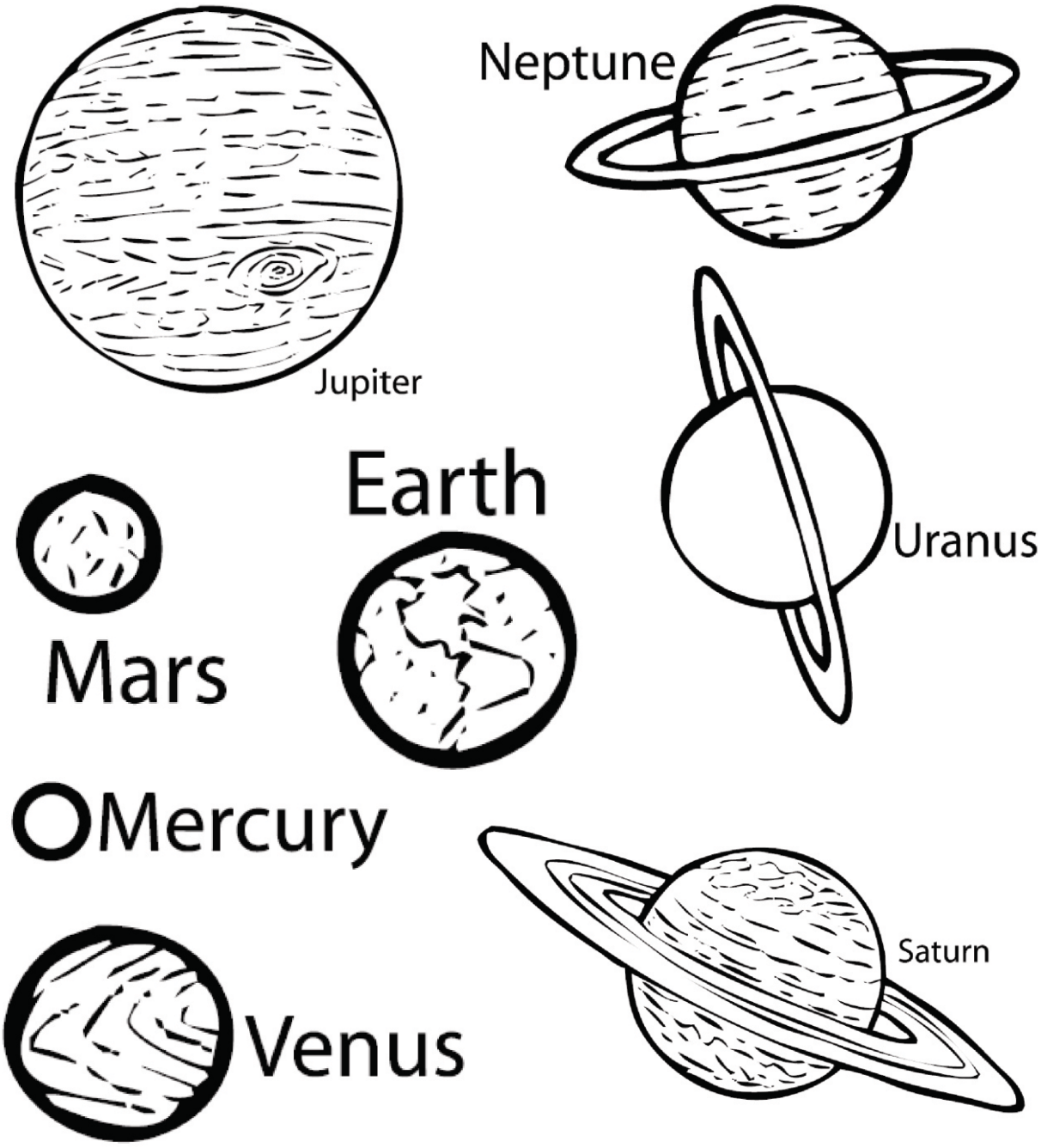


Figure 10.13: Neptune

Activity 3: Students should draw planets in their natural order in their copies. Also, coulour the planets, as observed in the previous section.



Teacher Note: Teacher should guide the students to draw these pictures on drawing paper as home work.

Meteoroids, Asteroids and Comets

Compare Meteoroids, Asteroids and Comets.

Meteoroids are rocky, stony and metallic debris in space revolving in a variety of orbits around the Sun at variety of speeds. They can be the size from a pebble up to several meters. When small meteoroids come close to the Earth, they get attracted towards it. They travel very fast and burn up because of the heat generated. They then produce a bright streak of light in the sky as they enter the Earth's atmosphere. We call them 'shooting stars' or more specifically 'meteors'. Large meteoroids can produce craters on the Earth's surface.

Figure 10.14 (a): Meteor

Asteroids are also rocky objects, mostly orbiting the Sun in a region between Mars and Jupiter which is known as 'the asteroid belt'. They can also produce craters on the Earth's surface. They come in size from a few meters up to several hundred meters. They are sometimes called 'Planetoids'. Vesta is an example of an asteroid.

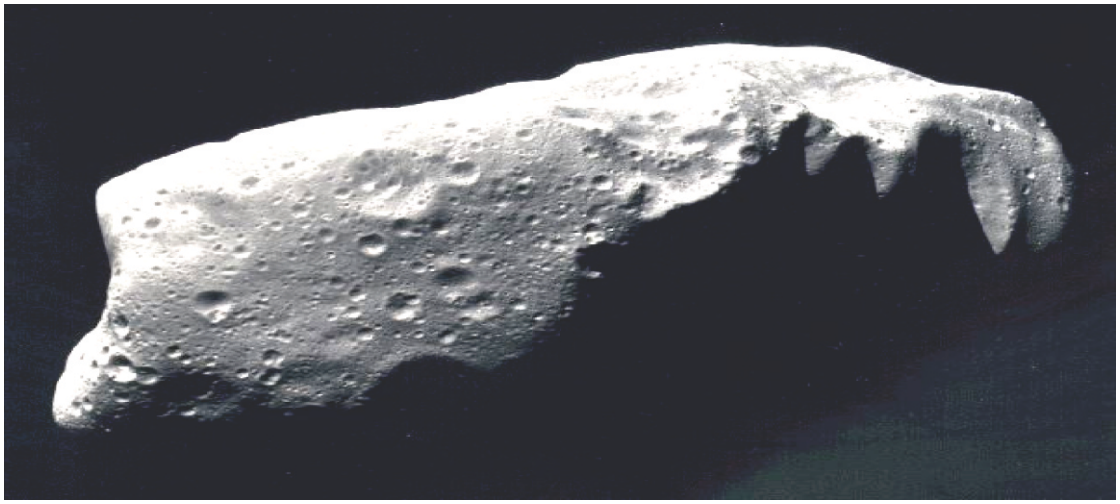


Figure 10.14 (b): Vesta, an asteroid

Comets are small bodies made up of ice, dust and rock. They have been referred to as dirty snowballs. They have a center called 'nucleus' which is surrounded by a hazy cloud called 'coma'. They move in highly elongated orbits around the Sun. When they come close to the Sun, their gas evaporates due to the heat from the Sun, thus producing a long tail.

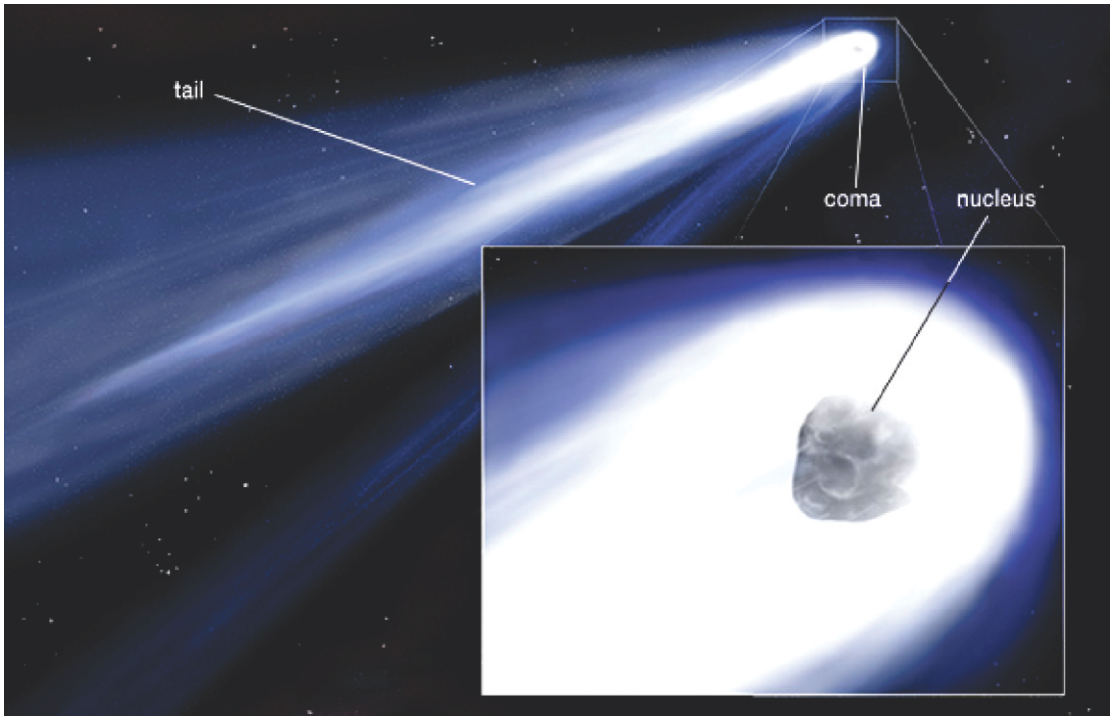


Figure 10.14 (c): Comet

Activity 4: Understanding the differences and similarities among meteoroids, asteroids and comets.

Pick the properties listed in the box below and write in front of the object they belong to. A property may belong to more than one object.

UP TO SEVERAL HUNDRED METERS LONG TAIL ICE, DUST AND ROCK
BURN UP IN ATMOSPHERE CAN PRODUCE CRATERS DIRTY SNOWBALLS
HAVE ELONGATED ORBITS COMA SHOOTING STARS PLANETOIDS
PRODUCE A BRIGHT STREAK OF LIGHT VARIETY OF ORBITS NUCLEUS
UP TO SEVERAL METERS ROCKY, STONY AND METALLIC
FOUND REGION BETWEEN MARS AND JUPITER

Comets:

Asteroids:

Meteoroids:

Review questions:

1) Read and complete the sentences with appropriate words given below:

i. ---------- is a collection of planets, moons, asteroids, comets and smaller debris such as meteoroids that are revolving around the Sun.
ii. The arrangement of first four planets is ---------, ---------, ---------- and ----------.
iii. Out of these eight planets, ----- are visible to the naked eye.
iv. ------ is now considered as dwarf planet.
v. ------- is the brightest and the largest object in our solar system .
vi. The Sun is a glowing ball of -------.
vii. ----------does not generate its own light.
viii. Planets in our solar system can be classified into two categories: -------- and ------.
ix. ------ is the largest planet of our solar system .
x. -------- is the farthest planet in our solar system .
xi. Mars is also referred to as ----------
xii. The most remarkable feature of Jupiter is its great --------.
xiii. --------- is a fragment of rock that survives the journey through the Earth's atmosphere
xiv. -------- is a rocky object smaller than a planet orbiting the Sun.
xv. -------- are referred to as dirty snowballs.

Neptune	**Mercury**	**gas giants**	**Venus**	**the Earth**	**red spot**	
Saturn	**The Sun**	**red planet**	**Solar system**	**five**	**Pluto**	
meteorite	**asteroid**	**Mars**	**Jupiter**	**comets**	**terrestrial**	**gas**	**Planet**

2) Circle the **True** and **False** statements and write down the correct statement for False statements:

i.	Mercury is the brightest planet in the sky.	**T**	**F**
ii.	Venus has two moons.	**T**	**F**
iii.	Pluto is the ninth planet of our solar system .	**T**	**F**
iv.	Everything in the solar system is orbiting the Sun.	**T**	**F**
v.	The Sun provides the light and heat necessary to sustain life on the Earth.	**T**	**F**
vi.	Mars is called the sister of the planet Earth	**T**	**F**
vii.	Jupiter is the second biggest planet of the solar system .	**T**	**F**
viii.	Asteroid belts lie between Jupiter and Saturn .	**T**	**F**
ix.	Comets have bright tails which point away from the Sun.	**T**	**F**
x.	Saturn has a system of rings, ranging from A to G.	**T**	**F**

3) Choose the correct answer from the given options:

i. ------- generate their own light.
a. planets b.stars c. dwarf planets d. asteroids

ii. Our sun is one of the ----------of stars in our galaxy.
a. millions b. billions c. hundreds d. thousands

iii. Terrestrial planets are mainly made up of ---------
a. ice b.water c. rocks d.carbon material

iv. Mars has ------- moon(s).
a. one b.three c. two d.none

v. The planet mostly made up of iron is -------
a. venus b. mars c. mercury d. earth

vi. Venus and Earth are identical in --------
a. size b. chemistry c. gravity d.all of above

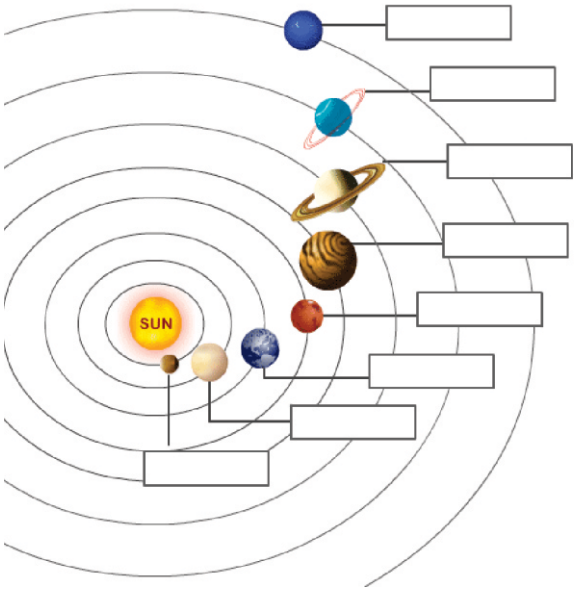
vii. The largest volcano of solar system is "Olympus Mons" lies in --------
a. mars b. jupiter c. earth d.uranus

viii. Neptune has -------
a. five rings b. six rings c. four rings d. eight rings

ix. The center of a comet is called --------
a. coma b. nucleus c. tail d. ice

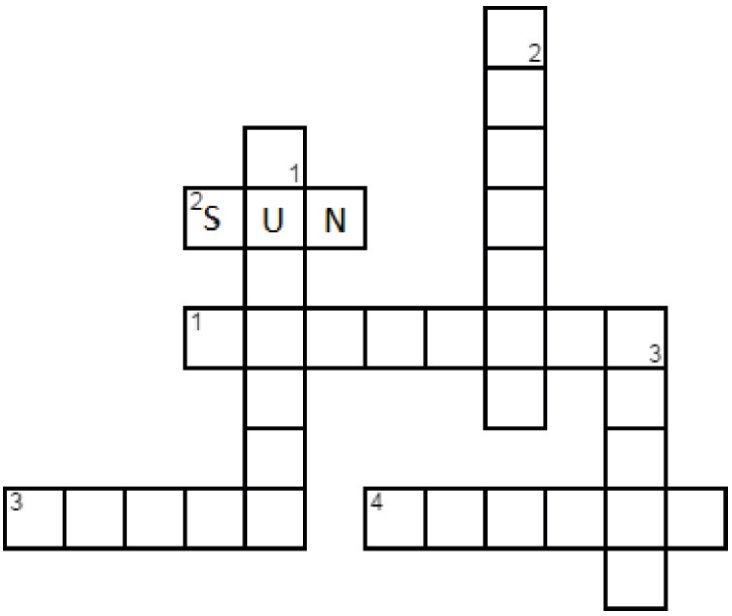
x. It takes ------- minute for light to reach the earth
a. 6 b.10 c. 8 d.12

4) Identify and fill in the names of the planets:



5) Complete the puzzle with the help of the hints given below. Use capital letters. Answers are given at the end of the chapter.

The Solar System



Across

1. The largest moon of the solar system
2. Center of our solar system
3. Now called the Dwarf Planet
4. Known as Dirty snowballs

Down

1. Name of Pakistan's national space agency
2. The largest planet
3. The only Planet with life

Key

Across

1. Ganymede
2. Sun
3. Pluto
4. Comets

Down

1. SUPARCO
2. Jupiter
3. Earth