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(मान्यता, समकक्षता तथा प्रविधि मूल्याङ्कन शाखा)

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विषय : पाठ्यसामग्री स्वीकृति सम्बन्धमा ।

श्री ग्रीन बुक्स,
ललितपुर ।

प्रस्तुत विषयमा त्यस प्रकाशनबाट मूल्याङ्कन र स्वीकृतिका लागि तोकिएको अवधिभित्र पेस हुन आएका तपसिलबमोजिमका पाठ्यसामग्री आवश्यक निर्णयार्थ पाठ्यसामग्री व्यवस्थापन तथा मूल्याङ्कन समितिमा पेस हुँदा विद्यालय शिक्षाको राष्ट्रिय पाठ्यक्रम प्रारूप २०७६, आधारभूत शिक्षा (कक्षा ६-८) पाठ्यक्रम २०७७, पाठ्यसामग्री विकाससम्बन्धी विद्यमान प्रावधान, ऐन, कानुन, निर्देशिका, कार्यविधि, प्रकाशन शैलीका प्रावधान, पाठ्यक्रम विकास केन्द्रले विभिन्न समयमा जारी गरेका र पाठ्यसामग्री सुधार/परिमार्जन/पुनर्लेखनका लागि दिइएका सुझाव र निर्देशनको परिपालना गरी स्वीकृति दिन सिफारिस भएअनुसार यस कार्यालयको मिति २०७८।१२।१४ गतेको निर्णयानुसार तपसिलमा उल्लिखित निर्देशनको पूर्ण परिपालना गरी शैक्षिक वर्ष २०७९, २०८० र २०८१ गरी तीन शैक्षिक वर्षका लागि गुणस्तरीय एवम् त्रुटिरहित पाठ्यसामग्री विकास गरी प्रकाशन गर्न स्वीकृति प्रदान गरिएको छ । विद्यमान संवैधानिक व्यवस्था, ऐन, कानुन, निर्देशिका, कार्यविधि, पाठ्यक्रम विकास केन्द्रले विभिन्न समयमा जारी गरेका निर्देशनलगायतका प्रावधानहरूको पूर्ण परिपालना नगरी गुणस्तरहीन पाठ्यसामग्रीको विकास, प्रकाशन र बिक्री वितरण गरेको पाइएमा, पाठ्यक्रम परिवर्तन भएमा वा यस केन्द्रबाट अन्य निर्णय भएमा यो स्वीकृति जुनसुकै बेला रद्द हुने छ ।

तपसिल

(क)पाठ्यसामग्रीको नाम

१	Science and Technology	आधारभूत तह/ कक्षा ७

तारा पाण्डे तिवारी
पाठ्यक्रम अधिकृत

(ख) निर्देशन

१.पाठ्यसामग्री विकाससम्बन्धी विद्यमान प्रावधान तथा पाठ्यसामग्री सुधार र परिमार्जनका लागि यस अघि दिइएका निर्देशनको पूर्ण परिपालना गर्ने ।

२.पाठ्यक्रमको मूल मर्म र भावनाअनुरूप पाठ्यक्रमका सम्पूर्ण पक्ष एवम् विषयवस्तु समावेश गरी पाठ्यसामग्रीलाई गुणस्तरीय बनाउने ।

३.आवरण पृष्ठको अघिल्लो (Front) भागको बायाँ (Verso) पृष्ठमा नेपालको आधिकारिक नक्सा र आवरण पृष्ठको पछिल्लो (Back) भागको दायाँ (Recto) पृष्ठमा कोभिड १९ सङ्क्रमण रोकथामसम्बन्धी सूचना यस केन्द्रको वेबसाइटबाट डाउनलोड गरी समावेश गर्ने । विषयवस्तुको प्रकृति र आवश्यकताका आधारमा पाठ्यसामग्री भित्रका विषयवस्तु र पाठमा समावेश गरिने तथ्याङ्क तथा नक्सा आधिकारिक र प्रामाणिक हुनुपर्ने ।

४.स्वीकृति पत्र स्क्यान गरी पाठ्यसामग्रीको शीर्षक पृष्ठभन्दा पछि दायाँ (Recto) पृष्ठमा समावेश गर्ने । पाठ्यसामग्रीको प्रत्येक पृष्ठको पुच्छर (Footer) मा पाठ्यक्रम विकास केन्द्रबाट स्वीकृत भन्ने व्यहोरा उल्लेख गरी प्रकाशन गरेका पाठ्यसामग्रीका तीन प्रति यस केन्द्रमा पैंस गरेपछि मात्र बिक्री वितरण गर्ने । शिक्षा, विज्ञान तथा प्रविधि मन्त्रालयको निर्णयअनुसारको मूल्य कायम गर्ने तथा मूल्य र मुद्रण प्रतिको सङ्ख्या सर्वाधिकार पृष्ठमा अनिवार्यरूपमा राख्नुपर्ने । प्रतिलिपि अधिकार (Copy right) को सम्बन्धमा लेखक र प्रकाशक स्वयम् जिम्मेवार हुने ।

५.राष्ट्र, राष्ट्रिय एकता, सार्वभौमिकता, भौगोलिक अखण्डता, स्वाधीनता, राष्ट्रिय हित, पहिचान, सम्मान र समृद्धिमा आँच आउने तथा विभिन्न जातजाति, भाषा, धर्म, संस्कृति, सामाजिक सहिष्णुता, सद्भाव, सांस्कृतिक मूल्यमान्यता, रहनसहन आदिमा प्रतिकूल प्रभाव पार्ने कुनै पनि विषयवस्तु, उदाहरण, चित्र, अभ्यास, सिकाइ क्रियाकलाप समावेश नगर्ने ।

६.जातजाति, भाषा, धर्म, संस्कृति, वर्ण, क्षेत्र, लैङ्गिकता, अपाङ्गता, पेसा, व्यवसाय, सामाजिक सांस्कृतिक अवस्थाका आधारमा भावनात्मक रूपमा चोट पुऱ्याउने, आक्षेप लाग्ने, होच्याउने र विभेदीकरण गर्ने किसिमका विषयवस्तु, उदाहरण, चित्र, अभ्यास, सिकाइ क्रियाकलाप समावेश नगर्ने ।

७.पाठ्यसामग्रीमा समावेश गरिएका चित्र, नक्सा, चिह्न, सङ्केत आदि शुद्ध, स्पष्ट र बोधगम्य हुनुपर्ने ।

८.विद्यार्थीलाई थप भार पर्ने गरी पाठ्यक्रममा समावेश नगरिएका विषयवस्तु, अभ्यास तथा सिकाइ क्रियाकलाप पाठ्यसामग्रीमा समावेश नगर्ने ।

९.पाठ्यक्रम एवम् दिइएका सुझाव र निर्देशनबमोजिम पूर्णरूप दिइएको त्रुटिरहित गुणस्तरीय पाठ्यसामग्री मात्र प्रकाशन र बिक्री वितरण गर्ने ।

पुनश्च : यो स्वीकृति शैक्षिक वर्ष २०७९, २०८० र २०८१ का लागि प्रदान गरिएकाले सोहीबमोजिम प्रकाशन, बिक्री वितरण र प्रयोग गर्नु गराउनहुन सम्बन्धित सरोकारवाला सबैमा अनुरोध छ ।


नेपालको नक्सा
(राजनीतिक तथा प्रशासनिक)


कोरोना भाइरस रोग
(कोभिड-१९)
कोरोना भाइरस रोगको मुख्य लक्षणहरू
ज्वरो आउने
खोकि लाग्ने
श्वास फेर्न गाह्रो हुने
यस्ता लक्षणहरू देखा परेमा नजिकको तोकिएको स्वास्थ्य केन्द्रमा सम्पर्क गर्ने ।
यस रोगको संक्रमणको जोखिमबाट बच्नको लागि निम्न उपायहरू अपनाउनुपर्छ ।


कोरोना भाइरस रोगबाट
बच्ने उपायहरू
बेलाबेलामा साबुनपानीले कम्तिमा २० सेकेन्ड सिधिनिधि हात धुने वा अल्कोहल भएको स्यानिटाइजर प्रयोग गर्ने
खोक्दा हाछ्युं गर्दा नाक मुख टिस्यू पेपर वा रुमालले छोप्ने
हात मिलाउनु वा अंकमाल गर्नुको सट्टा नमस्कार गर्ने
भिडभाडमा नजाने
ज्वरो आएमा, खोकि लागेमा वा श्वास फेर्न गाह्रो भएमा नजिकको तोकिएको स्वास्थ्य केन्द्रमा सम्पर्क गर्ने

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Science and Technology

7

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Preface

It gives us an immense pleasure in presenting this book- **Green Science and Technology** for class 7. This book is written specially to meet the requirements of the new syllabus introduced by the Government of Nepal, ministry of Education, Science and Technology, Curriculum Development Centre, Sano Thimi, Bhaktapur, Nepal.

Our aim and effort while writing this book has been to help students understand, enjoy and appreciate the fascinating subject of Science and Technology by making the process of learning enjoyable and stimulating. We have attempted to present the subject matter covering the entire prescribed syllabus in a simple language and interesting style with a large number of illustrative examples for easy understanding and application of the fundamental principles of Science and Technology. Each unit of the book has been carefully planned to make it student-friendly and present the subject matter in an interesting, understandable and enjoyable manner. A **Structural Programme Learning Approach** (SPLA) has been followed and exhaustive exercises are given at the end of each unit to test knowledge, understanding and applications of concepts taught/learnt.

The text is supplemented with weighting distribution, Learning Outcomes, word power, teaching instructions, sample test papers and a large number of well-labelled accurate pictures. We sincerely hope that this book will serve its intended purpose and be received enthusiastically by both the students and teachers concerned.

We wish to express our sincere gratitude to Green Books Team for publishing this book. Our hearty thank goes to Focus Computer for excellent type setting and layout.

We also wish to acknowledge my great indebtedness to many teachers for their valuable suggestions and advice concerning the textbook. We are confident that as result of their suggestions this book will be more useful than any other textbooks. However, sympathetic criticisms and constructive suggestions for further improvement of the book, if any, will be welcomed and with warm regards incorporated in the subsequent editions.

Author and Editor
Kathmandu, Nepal
March, 2022

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UNIT
01

Scientific Learning

Estimated teaching hours : 10

Before You Begin

Science is a systematic enterprise that builds and organizes knowledge in the form of testable explanation and predictions. The word science has been derived from the Latin word "Scientia" which means knowledge . Science is based on research, which is commonly conducted in academic and research institution as well as in government agencies and companies. The learning based on scientific facts and evidences that can be verified experimentally is called scientific learning. It focuses on systematic knowledge of matter. The scientific learning process includes observation, classification, measurement, comparison, evaluation, analysis and conclusion.

Science is the knowledge which is gained through observation and experiments, when organized systematically. Science focuses the systematic and organized study of an event, matter or subject.

Scientific learning is the learning which is gained through observation and experimentation. We require special procedural skills for scientific learning.

Learning Outcomes

After completing the study of this unit, students will be able to:

- prepare reports of practical works in science.
- prepare and demonstrate models of the things related to science with explanation.

Syllabus

- Introduction to scientific learning
- Practical works in science
- Scientific report writing
- Project work in science
- Experimentation
- model making in science

Glossary

application	:	an act of applying or an act of putting to use
demonstration	:	an act of showing that something exists or is true by giving proof or evidence
derived	:	something obtained from something else
evaluate	:	to determine or fix the value of something
fundamental	:	basic, forming the source or base from which everything else is made
horizontal	:	going across and parallel to the ground
immerse	:	to put something into a liquid so that it is completely covered
mass	:	the total quantity of matter present in a body
measurement	:	the comparison of an unknown physical quantity with a known standard quantity of the same kind
model	:	a three-dimensional representation of a person or thing or of a proposed structure
observation	:	the act of careful watching and listening
parallax	:	the effect by which the position or direction of an object appears to change when the object is seen from different positions
prediction	:	the act of saying what will happen in the future
regular	:	having a fixed geometrical shape
report	:	give a spoken or written account of something that one has observed, heard, done or investigated
scientific	:	of or relating to science
time	:	the duration between any two events
weight	:	the force with which a body is pulled towards the surface of the earth

1.1. Introduction to Scientific Learning

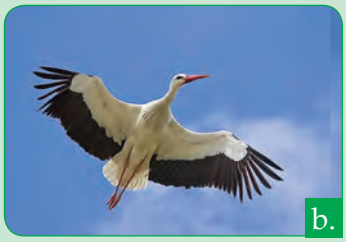
Activity 1

Observe the given figures carefully. What do you feel after observing these figures? Discuss in the classroom.

Fig. 1.1



a. *A fish is swimming in water*



b. *A bird is flying in air*



c. *An aeroplane is flying in air*

When we observe a thing or an event, we become quizzical. Many questions rise in our mind. We try to find that how do fish swim in water? How do birds fly in air? Scientists studied the mechanism of flying of birds and they invented aeroplane. So, observation and questioning are key points of scientific learning.

Science is the knowledge which is gained through observation and experiments, when organized systematically. Science focuses the systematic and organized study of an event, matter or subject.

Scientific learning is the learning which is gained through observation and experimentation. We require special procedural skills for scientific learning. The major procedural skills that are essential for scientific learning are as follows:

i. Observation ii. Classification iii. Measurement iv. Comparison
v. Evaluation vi. Analysis vii. Conclusion

Fig. 1.2





In scientific learning, first of all we observe things carefully. Then, we ask questions, we do predictions, we do experiments and finally draw conclusion. The conclusion is drawn by analyzing the things. The conclusion drawn in this way is called scientific principle.

Sir Issac Newton saw an apple falling down from a tree and propounded law of gravitation. This is called scientific principle. Similarly, James Watt observed the lid of a kettle moving due to steam and he invented steam engine. This is also called scientific principle.





Fig. 1.3

The learning process which includes observation, prediction, experimentation, discussion and conclusion is called scientific learning process.

Scientific learning process includes various steps like observation, comparison, classification, prediction, experimentation, evaluation and application. We should adopt following steps one after another during scientific learning process.

1. Careful study of things or events in the surrounding
2. To put various questions about the things or events
3. Prediction of possible answers of these questions
4. Experimentation by adopting suitable methods
5. Keeping record of the data obtained during experimentation
6. Drawing conclusion after analyzing the data
7. Preparing report of the work done after drawing conclusion

1.2. Practical Works in Science

Practical works in science play a significant role in scientific learning process.

Practical works in science include the work carried out in the science laboratory or outside the laboratory, based on the facts or a certain subject matter. Practical works in science help in prediction and experimentation of scientific facts and principles.

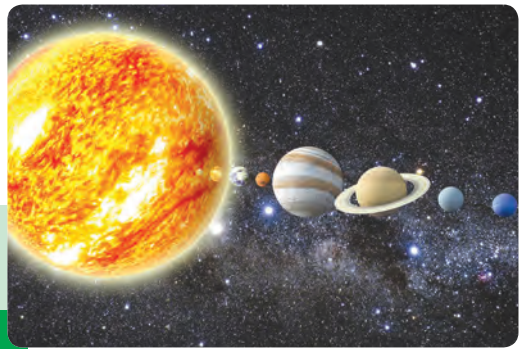
Fig. 1.4





The practical works done by field-visit are more research-based and innovative. We can demonstrate scientific models of various events or processes to make learning process easier. For example, we can make model of solar system and eclipse for meaningful learning of these things and events. Similarly, we can make model of lungs to demonstrate the process of breathing in human body.

Fig. 1.5

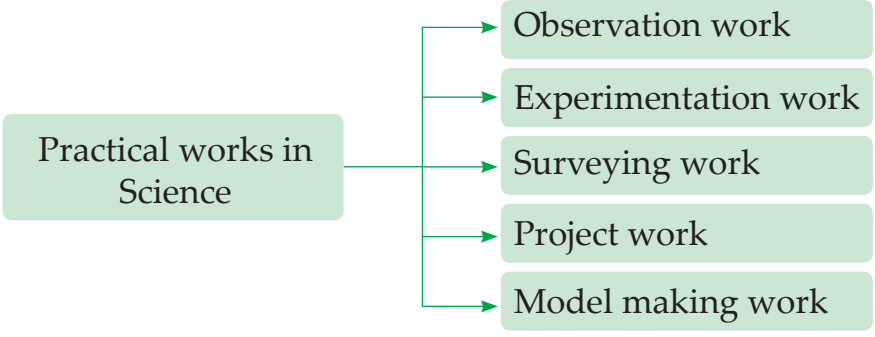


A model of solar system



A model of human lungs

We can study practical works in science by dividing them into observation work, experimentation work, surveying work, project work and model making works.



While conducting practical works in science, we should perform various steps of scientific learning in a sequence. Among various steps of scientific learning, we should do practical work to adopt suitable method of experimentation, note down the data obtained during experimentation and analyze the data to draw conclusion.

Many practical works of science can be done in the science laboratory. Similarly, many practical works of science can be done outdoors (fields, forests, aquatic body, desert, cropfields, parks and so on). Practical works can be done by observing things in our surroundings and analyzing the data collected.

1.2.1 Importance of Practical Works in Science

1. Practical work in science helps to develop important skills essential for research works.
2. It helps to solve many problems using the knowledge and skill gained while doing practical works.
3. It helps to invent new things, ideas and principles using constructive thinking and skills.

We should perform the activities, scientific facts and experiments given in the textbook while studying science. It helps to develop scientific ideas. It also helps to test the scientific facts and principles practically. The practical works in science of school level can be done in the laboratory and outside the laboratory such as cropfields, forests, ponds, etc. We should be careful while performing practical works in science.

Some examples of practical works in science that can be done in the science laboratory are as follows :

1. To verify laws of reflection of light
2. To measure the area, mass and volume of different objects
3. To study different types of mixture
4. To study properties of magnet



Fig. 1.6

5. To separate components of different types of mixture
6. To observe onion cells under the compound microscope
7. To demonstrate evaporation and condensation
8. To prepare crystals of copper sulphate
9. To study museum specimen of invertebrates and vertebrates
10. To prepare electromagnet

Some examples of practical works that can be done outside the science laboratory are as follows :

1. To study the different types of plants present around us
2. To study modified roots, stem and leaves of plants
3. To study the structure of invertebrates present in our surroundings
4. To study habitat of animals and plants



Fig. 17

5. To prepare a model of an atom using local materials
6. To prepare model of solar system
7. To study different parts of a flower
8. To study different types of rocks
9. To study the structure of fruits
10. To study the salient features of the vertebrates
11. To demonstrate melting and freezing
12. To demonstrate evaporation and condensation
13. To generate static electricity by rubbing plastic comb against hair

We should adopt precautions while performing practical works in science. We have to use equipment of glass, ceramics and other brittle materials. So we should handle them carefully to prevent breakage. We have to work with strong acids which may burn our skin when not handled properly. Similarly, we have to work with poisonous and harmful chemicals in the laboratory. The precautions adopted while doing practical works in science help to avoid possible accidents and harms. Therefore, we should be alert and careful while doing practical works in science.

Some precautions that should be adopted while doing practical works in science are given below :

1. We should wear apron while doing practical work in science.
2. We should use protective glasses and gloves while working with chemicals or any sharp objects.
3. We should not carry food and drinks in the science laboratory.
4. We should not smell, touch and taste any object in the science laboratory.
5. We should handle equipments carefully.
6. We should not conduct any experiment without instructions and supervision of laboratory in-charge and science teacher.
7. We should handle acids and fire carefully.
8. We should put off the burner after use.
9. We should handle hot objects carefully.
10. We should not play and make noise in the science laboratory.
11. We should know the location of water tap, fire extinguisher and emergency door in the laboratory.

1.3. Report Writing of Practical Work or Experimentation

A complete description which documents all aspects of experimental investigation is known as a scientific report. Topic, objective, required materials, procedure, observation, analysis, calculation, result, conclusion and precautions are various components or steps of a scientific report. It helps to check the methodology of the experiments to ensure the validity of the results obtained. It also allows to understand the activity or experiment before doing it.

Why should we write report?

We should write a scientific report to :

i. Submit the detailed description of the practical work done to the concerned person.
ii. Document the result.
iii. Know the objectives, facts or principle of a certain experiment.
iv. Clarify the scientific knowledge gained during practical work.

v. Compare the result obtained to the objective, fact or principle of a certain activity after conducting experiment.

There are various methods of writing scientific reports. It depends on the nature of the experiment or activity. We can present some reports orally as well without writing it. We should mention the date of the practical work done. We should prepare a report in a certain pattern depending on the nature of the practical work. However, we should include the major components of the scientific report while writing it. The main parts of a scientific report are described below :

a. Topic

First of all, we should write the topic of the scientific report. Topic helps us to know about the practical work done. The topic of the experiment or practical work is the topic of the scientific report.

b. Objective

Practical work is done to meet a certain objective. So, we should write the objective of the practical work while writing a scientific report.

c. Materials required

In this section, we should write the names of all materials which are required to do a certain activity or experiment. It helps to collect all the essential things before conducting a certain experiment. We should also draw a neat and labelled figure of the apparatus. Similarly, we should present the data, graph or pie-chart in a meaningful way.

d. Procedure

It is the main part of a scientific report. We should write the procedure clearly in a sequential order. It helps the learners to conduct experiment or practical work easily.

e. Observation

It is also an important part of the practical work in science. We observe things properly whether we can achieve the goal or not. Careful observation during practical work is very essential in scientific learning. Observation helps to draw conclusion of the experiment done.

f. Analysis

The data or facts obtained during observation should be analyzed. Proper analysis helps us to get the result.

g. Calculation

We need to calculate the data obtained during experimentation to find the result. But calculation is not required in all practical works.

h. Result

Result of the practical work is written nearly at the end of the scientific report. It is written to know whether the objective of the practical work has achieved or not.

i. Conclusion

After getting result, we should write the conclusion. It should be short and clear.

j. Caution

We should also mention the cautions that need to be adopted during practical work. Adopting cautions helps us to avoid possible danger and risk during experimentation. It also helps us to get the positive result of the practical work.

Report Writing model 1

Topic : Oxygen gas is released during photosynthesis

Objectives: To prove that oxygen is released during photosynthesis

Requirements

Beaker, test tube, glass funnel, stand, water, fresh twigs of hydrilla, matchbox, sodium bicarbonate

Procedure

- Take a beaker and fill it with water.
- Take a few twigs of fresh hydrilla and cover the twigs with a glass funnel and arrange the materials as shown in the given figure. Keep some sodium bicarbonate in the beaker as the source of carbon dioxide.
- Leave the apparatus in a sunny place for 3-4 hours.

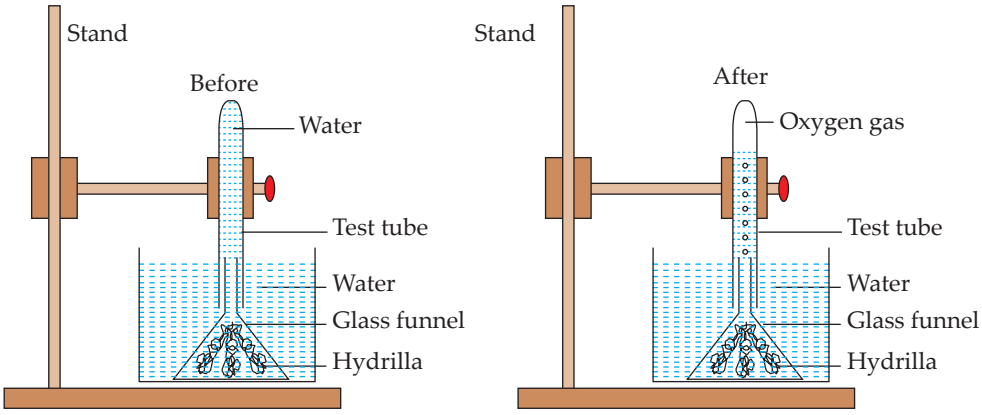


Fig. 1.8

Observation

After a few minutes, a stream of gas bubbles can be seen. This gas gets collected in the test tube by displacing water downwards.

When a burning matchstick is inserted inside the test tube, it burns with a brighter flame. It shows that the gas produced is oxygen.

Conclusion

This experiment shows that oxygen is released during photosynthesis.

Cautions

1. The apparatus should be kept in a bright sunny place.
2. The hydrilla plant should be fresh.

Report Writing model 2

Topic : Sunlight is required for photosynthesis

Objective: To demonstrate that sunlight is necessary for photosynthesis

Requirements

A potted plant with large leaves, materials for iodine-starch test, black paper, cello tape

Procedure

- Take a potted plant with large leaves and keep it in a dark room for 3-4 days to make the leaf starch free due to absence of photosynthesis.
- Now, select a leaf and cover its both sides with a black paper and cello tape.
- Keep the plant in the sunlight for 4-5 hours.

- After 4-5 hours, pluck the covered leaf and remove the tape.
- Perform iodine-starch test of the experimental leaf and observe the change in colour.

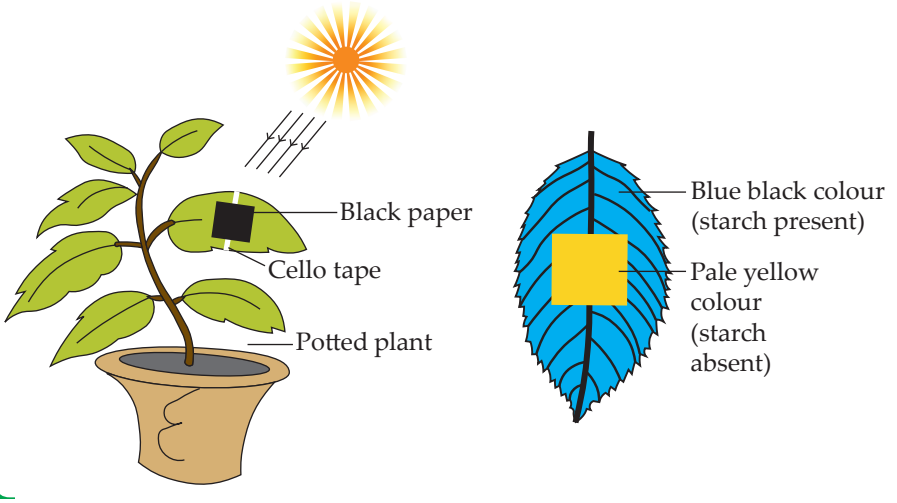


Fig. 1.9

Observation

The uncovered portion of the leaf turns blue-black in iodine solution which shows the presence of the starch whereas the covered portion of the leaf remains pale yellow which shows the absence of starch as it does not get the sunlight.

Conclusion

This experiment shows that sunlight is essential for photosynthesis.

Report Writing model 3

Topic : metals are good conductors and non-metals are bad conductors of heat.

Objective : To prove that metals are good conductor and non-metals are bad conductor of heat.

Requirements : Bunsen burner, spirit lamp or a candle, matchbox, an iron rod, a wooden stick

Procedure

- Take an iron rod and a wooden stick of the same shape and size.
- Heat the one end of iron rod with a burner/ spirit lamp/ candle for a few minutes and catch the other end of the rod. Repeat the same process for wooden stick.

Observation : The outer end of the iron rod is felt hot when heated for a few minutes but the outer end of wooden stick is not felt hot. Iron is good conductor of heat. So when one end of iron rod is heated for a while its another end is felt hot due to conduction of heat. But wood is bad conductor of heat, it does not conduct heat from one end to another. So another end of wooden stick is not felt hot.

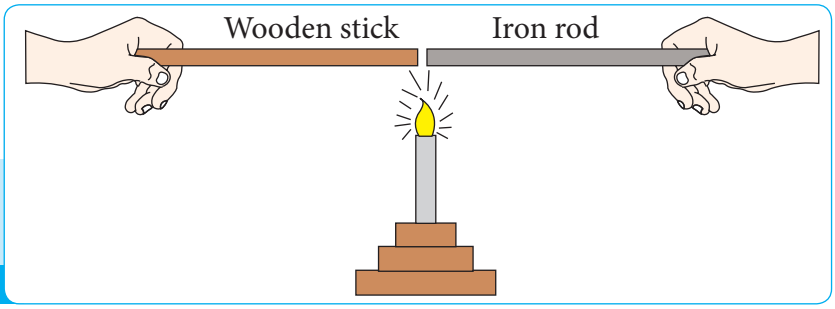


Fig. 1.10

Result : metals conducted heat from one end to another when one end of metal was heated.

Conclusion : From this experiment, it can be concluded that metals are good conductor and non-metals are bad conductor of heat.

Precaution : The hot objects and bunsen burner should be handled carefully.

1.4 Project Work

Project work is the scientific activity performed by students by experimentation, model making and doing research in any area of science. Students can do project works in physics, chemistry, biology, geology and astronomy. Students can demonstrate their project in the classroom, science exhibition or science fair.

1.4.1 Types of Project Work

Project works can be done by a number of ways. Some of the main project works in science are as follows :

1. Experimental project work
2. Demonstration or model making project work
3. Collection project work
4. Research project work

1. Experimental Project Work

Experimental project work is the most common project work in science.

We apply scientific methods to purpose and test the hypothesis in experimental project work. It is also called investigation project work. We observe the activities and find out whether the hypothesis is accepted or rejected. For example, laboratory preparation of hydrogen gas, iodine-starch test, etc.

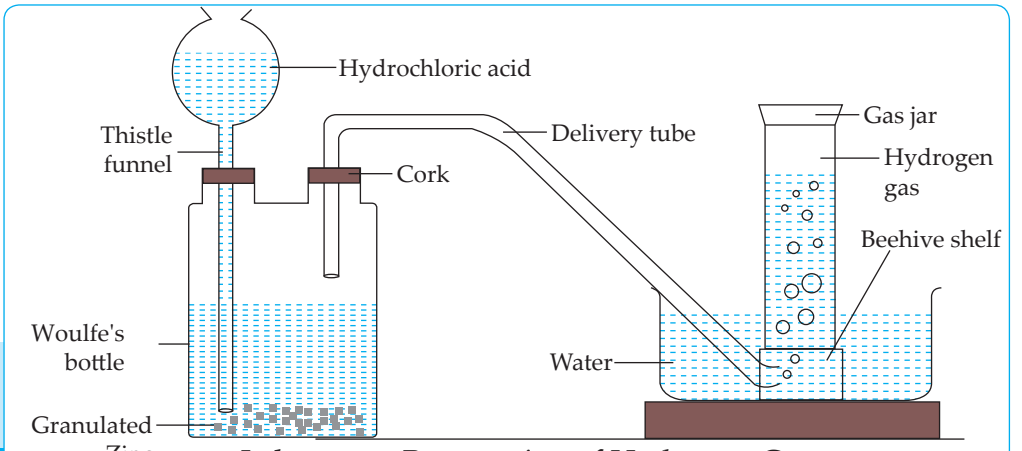


Fig. 1.11 *Laboratory Preparation of Hydrogen Gas*

2. Demonstration or model-making project work

The project work which involves re-testing an experiment that has already been done is called demonstration or model making project work. To do such type of project, we can get idea from the practical manual or internet. In this project, we can make models to demonstrate different facts or things.



Fig. 1.12 *model of a house*

3. Collection project work

This is the project work done to clarify the concept of a certain fact or principle by collecting various objects. This project work looks like demonstration project work at a glance. This project work requires a collection of so many things for a long period of time to draw the conclusion of a certain fact or principle. Collection of different types of butterflies



Fig. 1.13 *Collection of butterflies*

found in different climatic conditions is an example of collection project work.

4. Research project work

Research project work is done to investigate new things on the basis of previous findings. Information is collected about a certain topic and this information is used to investigate new findings. This type of project work is generally done by scientists. This project work takes a long time as it is carried out to find new things. For example, the research work being carried out on the moon to study possibilities of human settlement.



Fig. 1.14 *Scientists on the moon*

1.5 Experimentation

The practical work which is performed in the science laboratory is called experimentation. Experiment is a test done in controlled conditions. We should do necessary preparation before conducting an experiment. Before experimentation, we should have knowledge of objectives of the practical work, materials required, procedure and precautions. We should adopt the procedural steps in a sequential order. We should adopt following steps to perform a certain experiment.

1. What is the objective of the experiment?
2. What are the materials required?
3. What are the methods for experimentation?
4. What are the precautions that should be adopted during experimentation?
5. What are the things to be observed?
6. What are the methods of data collection?
7. What is the method of getting result?

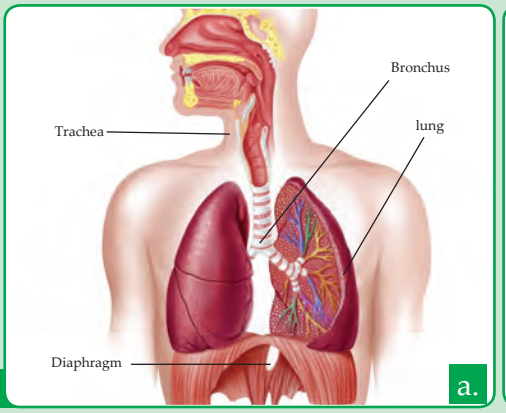


Fig. 1.15 *Scientists in the lab*

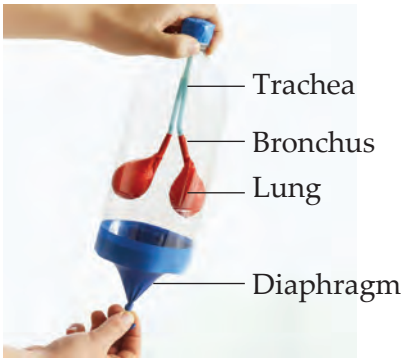
1.6 model making Process

Activity 2

Study the given figures and discuss in the classroom.



a.



b.

Fig. 1.16

Questions :

1. What is shown in fig. (a) and fig. (b)?
2. What is the importance of fig. (b) in scientific learning?
3. Give a suitable name/caption for fig. (a) and (b).

In the fig. (b), you can see the model of human respiratory system. It becomes difficult to observe real respiratory system of human being. So we can make a model of human respiratory system using local materials like plastic bottle, balloons, thread, etc. It helps to understand the mechanism of breathing in human body easily.

We cannot observe the entire earth. We can make model of the earth using clay and colours. Modeling in science is an important task. We can demonstrate models of solar system, eclipse, photosynthesis, etc. to facilitate teaching science. Some of the models that are designed for teaching science are given below :



Fig. 1.17

You might have seen the globe. It is a model of the earth. Globe is a three dimensional model. We can also make three dimensional model of the earth using clay and different colours.



Fig. 1.18

In science, model is a representation of an idea, an object or a system. It is used to describe the phenomena that cannot be observed directly. For example, we cannot observe the real position of all the members of the solar family. But, the position of all the members of the solar system can be demonstrated in a model of solar system. Therefore, model making in science is very important tools for scientific learning.

Some models can be made by collecting various things and pasting onto a surface. It is called collage. We can make collage of atomic structure, electric circuit, food chain, clouds in the sky, water cycle and so on.

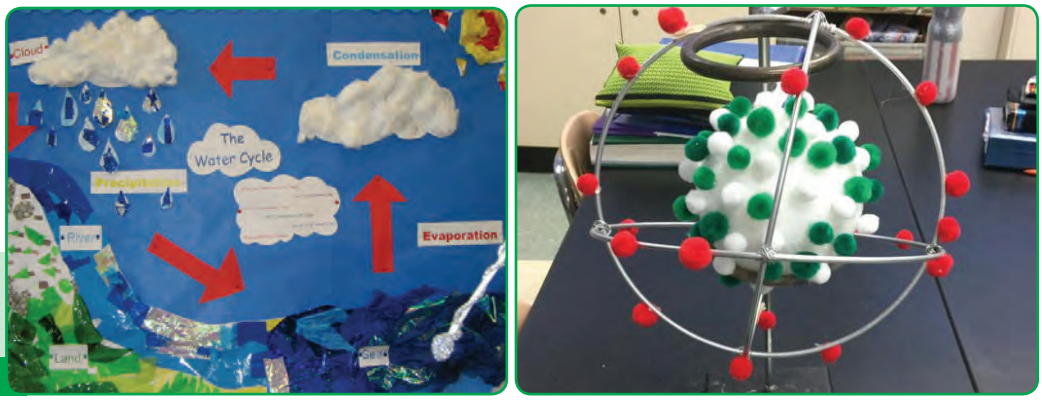


Fig. 1.19

Project Work

Prepare a model of solar system using following materials.

- Thick card board paper
- Glue
- Colours
- Paper
- Clay
- Thread
- Scissors

Demonstrate the model in the classroom.

Key concepts

1. The learning based on scientific facts and evidences that can be verified experimentally is called scientific learning.
2. Science is the knowledge which is gained through observation and experiments, when organized systematically.
3. Scientific learning is the learning which is gained through observation and experimentation.
4. The major procedural skills that are essential for scientific learning are as follows:
   i. Observation ii. Classification iii. Measurement
   iv. Comparison v. Evaluation vi. Analysis vii. Conclusion
5. The learning process which includes observation, prediction, experimentation, discussion and conclusion is called scientific learning process.
6. Practical works in science play a significant role in scientific learning process.
7. We can demonstrate scientific models of various events or processes to make learning process easier.
8. Practical work in science helps to develop important skills essential for research works.
9. We should adopt precautions while performing practical works in science.
10. A complete description which documents all aspects of experimental investigation is known as a scientific report.
11. Project work is the scientific activity performed by students by experimentation, model making and doing research in any area of science.
12. The practical work which is performed in the science laboratory is called experimentation.
13. Model making in science is very important tools for scientific learning.
14. Some models can be made by collecting various things and pasting onto a surface. It is called collage.

Exercise

1. Put a tick (√) for the correct statements and a cross (×) for the incorrect ones.

a. Observation is not essential for scientific learning. ☐

b. Practical work refers only the work done in the science laboratory. ☐

c. There are only five steps in report writing.

d. Research project work is generally done by scientists.

e. Scientific models may be two dimensional or three dimensional.

2. Fill in the blanks using appropriate words.

a. Scientific learning focuses on ..... learning of matter.

b. In scientific learning, first of all we ..... things carefully.

c. We should adopt ..... to prevent possible accidents in the laboratory.

d. Experimental project work is generally done in the ..... laboratory.

e. There are ..... types of project work.

3. Answer the following questions.

a. What is scientific learning?

b. What are the procedural skills for scientific learning?

c. What is observation? Why is it important in science?

d. What is report writing in science?

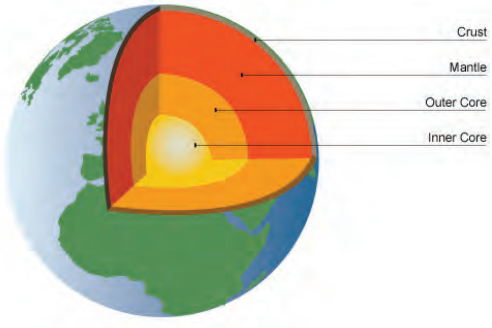
e. Write down the main components of report writing.

f. What is a project work?

g. Name four types of project works.

h. What is model making in science? Give one example.

4. A model of the earth is shown in the given figure. Explain the importance of model making in science.



5. Practical work in science is very essential for scientific learning. Describe.

6. Differentiate between collage model and 3D model.

UNIT
02

Information and Communication Technology

Estimated teaching hours : 12

Before You Begin

The word 'ICT' refers to the technologies that are used to store, manage, process data, and transfer or exchange information from one place to another. A computer is the main ICT tool that stores, manages, and creates information, displays and communicates information around the world. ICT tool, i.e. internet, provides a variety of services to users. The internet helps to exchange messages or information instantly. To stay connected with friends and relatives, most people use social media like email, facebook, messenger, twitter, whatsapp, etc. If we do not use or do not know how to use these social media or online transaction services properly, we may get into trouble. Computer hackers steal information on computer by spreading computer viruses. So we need to be alert to secure our data stored in a computer or any other electronic device.

Learning Outcomes

After completing the study of this unit, students will be able to:

- Tell about the uses of ICT tools.
- use email service of the internet in our daily life.
- use spreadsheet in daily life to perform calculation and prepare charts.
- Implement knowledge of photo editing.
- detect whether computers are infected with viruses or not and remove them.
- implement knowledge of online security.

Syllabus

- ICT tools and their uses
- Internet and email
- Spreadsheet software
- Photo editing
- Computer virus and its remedy
- Computer software and its types
- Code of conduct for using computer and internet

Glossary

Card Reader	:	It is a device that enables a computer to access data directly from a memory card.
SD memory Card	:	An SD (Secure Digital) memory card is a storage medium for digital photos.
USB	:	Universal Serial Bus is used for connecting printer, camera, mouse and other devices to a computer.
USB Port	:	It is a slot on the computer where we can plug in a USB cable.

Lesson 01

ICT Tools

2.1 ICT Tools

With the development of technology, the use of computers, internet, digital cameras, radios, televisions, mobile phones, etc. for communication has made our daily life easier. Due to the simple accessibility of the internet, even people in the village now do video chat with their relatives in the cities or abroad through smart phones.

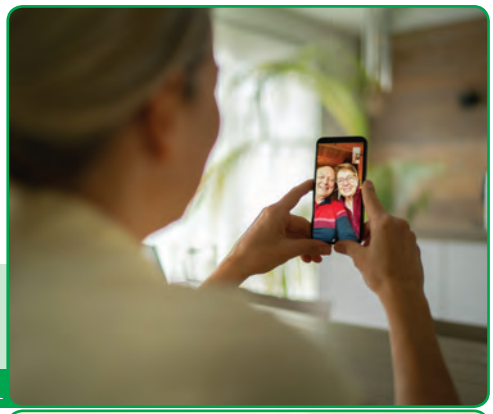


Fig. 2.1.1

Nowadays, even in teaching and learning, modern technology is being used to teach students in a new and effective way. At present, students can learn by listening to the educational programs broadcast on the radio. Similarly, students can also learn by watching educational programs broadcast on television.



Fig. 2.1.2

Radio, television, telephone, mobile phone, computer, and the internet are the means of communication. These means of communication are used to transmit information to different parts of the world quickly. Especially, computers are used to store collected data and information from different sources and produce accurate and useful information. The accurate and useful information available at the right time helps people, governments or countries to take correct decisions, set plans and make future policies.



Fig. 2.1.3

Information and Communication Technology (ICT) refers to the technologies that are used to store, manage, process data, and transfer or exchange information from one place to another. The technology that stores, manages, and processes the data to obtain information is referred to as information technology. The technology that transfers or exchanges information from one place to another is known as communication technology. So, ICT is the integrated technology that retrieves information from raw data and makes it accessible via computers, internet and different communication devices or systems.

ICT uses computers, the internet, mobile phones, and various communication devices or systems to collect and store data, produce information and communicate information in digital form all over the world.

Information and Communication Technology (ICT) is the integrated technology that is used to collect and store data, convert data into information and communicate that information around the world through computers, the internet and various communication devices or systems such as radios and televisions.

Activity 1

Complete the table after discussing the usages of the following devices:



Fig. 2.1.4

S.No.	Name of the Devices	Uses
1.	Computer	
2.	Television	
3.	Digital camera	
4.	Smartphone	
5.	multimedia projector	
6.	Radio	
7.	Google Chrome	

Devices or systems that are used to store, manage, and create information, display and communicate information around the world are ICT tools. Computer, television, radio, digital camera, smartphone, multimedia projector, and the internet are the ICT tools.



Fig. 2.1.5

Computer is the most common ICT tool for storing, managing, producing information, and transmitting data and information. ICT tools like digital camera, scanner, graphics software, etc. are used for capturing and editing images. ICT tools like WWW (World Wide Web), E-mail (electronic mail), chat, radio, television, telephone and mobile phone are used for communicating information. Similarly, ICT tools like multimedia projector, e-book, tutorial video, etc. are used for presenting information.

ICT tools may be simplex or duplex. A simplex ICT tool can only transmit information. It is one way means of communication. Newspaper, radio, television are the simplex ICT tools. A duplex ICT tool can exchange (i.e. send or receive) messages or information. It is two-way means of communication. Telephone, mobile phone, computer and the internet are duplex ICT tools.






Fig. 2.1.6 Simplex ICT tools





Fig. 2.1.7 Duplex ICT tools

A brief description of some common ICT tools is given below:

a. Scanner

A scanner is an ICT tool that converts a picture, printed text or handwritten text into digital form and sends to the computer. The digital images stored in a computer can be modified by using suitable application software like Microsoft Paint, Adobe Photoshop, CorelDraw, Photo Editor, etc. The digital images are used in e-books, newspapers, etc.



Fig. 2.1.8

A scanner works like a photocopy machine. There are several types of scanners. Most of them look like a flat tray with a glass pane and a lid to cover it.

b. Digital camera

A digital camera (also known as Digicam) is an ICT tool which can capture photos and videos in digital format. It looks like a manual camera. It has

electronic photosensitive sensor. It stores the captured photos or videos in its memory card in the digital form. The digital photos or videos can be transferred into a computer. The digital photos and videos can be used in the e-books, electronic magazine, newspaper, websites, and tutorial videos.



Fig. 2.1.9

c. Multimedia projector

A multimedia projector is an ICT tool that shows text or videos on a big screen. It is used for presenting presentations, lessons, tutorial videos, etc. in front of a large number of people.


Fig. 2.1.10

d. World wide web

World Wide Web (WWW) is one of the popular services of the internet. It is also called Web. It enables people to share data or information on various topics or subjects easily all over the world through the internet. The different information on the web are provided to users through different web pages of websites. A website contains many web pages. A web page is just like a page of a website. In a web page, information is presented by using text, audio, video, images and animations. A web page is also known as HTML document.

People, offices, companies, governments, organizations, etc. have their own websites where they keep different information that they want to share with other. Each website is identified by the unique internet address or Uniform Resource Locator (URL). Some popular websites are www.google.com, www.bing.com,www.yahoo.com,www.onlinekhabar.com, www.moecdc.gov.np, www.see.gov.np, www.nepalisongs.com, www.daraz.com.np,www.fursad.com, www.ekantipur.com, www.dcnepal.com,etc.

e. Web browser

A web browser is a program that displays the content of a web page of a website on the computer. A web browser is also called Internet browser. Microsoft Edge, Google Chrome, Mozilla Firefox, Opera, Safari, etc. are some popular web browsers.



Fig. 2.1.11

f. Search engine

If you do not know a website where you get the information then you can use a search engine. It search engine is a special website that searches and displays the list of websites where you can get the information that you are looking for. It searches the websites where you get information on the basis of keyword. Some popular search engines are www.yahoo.com, www.google.com, www.bing.com, and www.msn.com.



Fig. 2.1.12

g. Electronic book

An electronic book (eBook) is an ICT tool that presents a book in digital form. It is the non-editable electronic version of a printed book. You can read/access e-books through any digital device like computer or handheld device (e.g. mobile, tablet, eBook reader). It is available on the web with different file formats. You can download eBooks on a computer, smartphone or tablet from the related websites. You can store many eBooks on a computer or mobile since it occupies less space.Some websites where you get free eBooks are www.learning.cehrd.edu.np, www.neemaacademy.com, www.gutenberg.org, www.books.google.com, www.freetechbooks.com, www.oreilly.com, www.bookboon.com, www.wikibooks.org, www.niti.siyavula.com, free-ebooks.net, www.manybooks.net and www.obooko.com.

h. Tutorial video

You can learn lessons through tutorial videos. A tutorial video presents the lesson or information with the help of videos. It displays the step by step procedures to perform a task. It guides and allows you to practice the procedure. You may get many tutorial videos on web. Some online tutorial educational sites are www.neemaacademy.com, www.nepalonlineschool.org, www.kullabs.com, www.mero.school, and www.dlc.dwit.edu.np.

Activity 2

A. Getting latest news

To get the latest online news, follow these steps:

i. Open Google Chrome by double clicking on its icon on the desktop or laptop.



Fig. 2.1.13

ii. Type www.ekantipur.com on the Address bar.

iii. Press the Enter key. It opens home page of the website on the screen.

B. To search the information on the web, follow these steps:

i. Open Google Chrome.

ii. In the search box, type the text/keyword what you want to search. For example, type eBooks. It displays list of matching phrases.

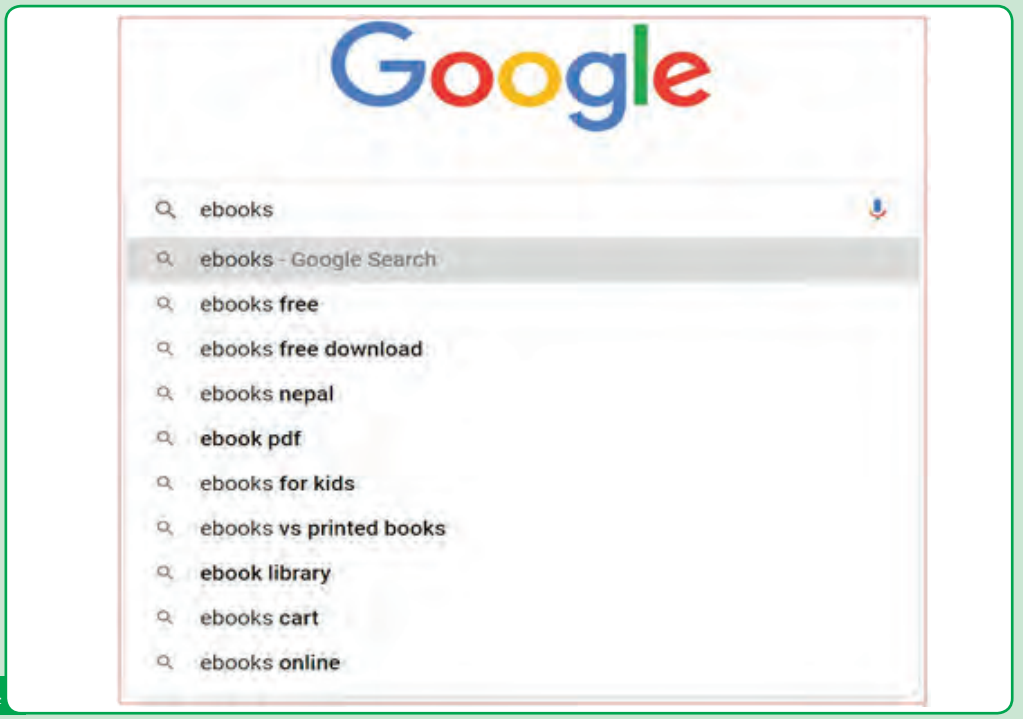


Fig. 21.14

iii. Press the Enter key. It displays list of matching websites.

iv. Choose the appropriate website and open it.

C. To search online tutorial on the website of Center for Education and Human Resource Development.

i. Open Google Chrome.

ii. Type www.cehrd.edu.np on the address bar of the browser and press Enter key. It displays home page of Center for Education and Human Resource Development.



Fig. 21.15

iii. Click on the down arrow (▽) next to Info Center. It displays options.

iv. Choose Online Study.

v. Choose Virtual Class of All Compulsory Subjects (Class 1-10), E-Path-Digital Learning Activities or CEHRD's Learning Portal.

Key concepts

1. The technology that stores, manages, and processes the data to obtain information is referred to as information technology.
2. The technology that transfers or exchanges information from one place to another is known as communication technology.
3. Information and Communication Technology (ICT) is the integrated technology that is used to collect and store data, convert data into information and communicate information around the world through computers, the internet and various communication devices or systems such as radios and televisions.
4. A simplex ICT tool can only transmit information.
5. A duplex ICT tool can exchange (i.e. send or receive) messages or information.
6. www enables people to share data or information on various topics or subjects easily all over the world through the internet.
7. Each website is identified by the unique internet address or Uniform Resource Locator (URL).
8. A web browser is a program that displays the content of a web page of a website on the computer.
9. A search engine is a special website that searches and displays the list of websites where you can get the information what you are looking for.
10. Computer, digital camera, scanner, multimedia projector, www, search engine, e-mail, eBook, radio and television, etc. are some common ICT tools.

Exercise

1. Choose the correct option from the given alternatives.

a. A means of communication is .....

i. keyboard ii. mouse iii. pen drive iv. radio

b. Which of the following ..... is an ICT tool.

i. book ii. mobile phone iii. watch iv. calculator

c. A simplex ICT tool is .....

i. telephone ii. chat iii. television iv. computer

d. Which of the following following provides information on various topics all over the world via the internet?

i. Search engine ii. Web Browser iii. www iv. eBook

e. Microsoft Edge and Google Chrome are .....

i. Search engines ii. Web Browsers iii. Webs iv. Websites

f. e-Books can be accessed by using .....

i. mobile ii. tablet iii. e-Book reader iv. All of them

2. Fill in the blanks with appropriate words.

a. Information technology is a technology that is concerned with the storage, retrieval, manipulation, transmission or receipt of information in a ..... form.

b. Telephone, mobile phone and ..... are the duplex ICT tools.

c. A ..... is an ICT tool that converts a picture into digital form.

d. Digital camera is also called .....

e. A ..... is an ICT tool that enables a user to present information on the big screen.

f. A ..... contains many web pages.

g. A .....is a program that displays the content of a web page of a website on the computer.

3. State whether the following statements are True or False.

a. Radio, television, telephone, mobile phone, computer, and the internet are the means of communication.

b. ICT stands for Information and Computing Technology.

c. A technology that transfers or exchanges information from one place to another is information technology.

d. Newspaper, radio, television and telephone are the simplex ICT tools.

e. A scanner can capture video of an event.

f. Each website is identified by Universal Resource Locator.

g. Google Chrome and Mozilla Firefox are search engines.

4. Answer the following questions.

a. What is ICT?

b. What is ICT tool? List any four ICT tools.

c. What is web? List any four popular websites.

d. What is a web browser? Write name of any two web browsers.

e. What is a search engine? List any two search engines.

f. What is eBook? List any two sites where you get eBooks.

5. Write the full form of the following:

a. ICT b. www c. URL d. email

6. Write the technical terms for the following statements:

a. A technology that is used to collect, store and process data into information and communicate the information all over the world.

b. An ICT tool that converts a picture or printed text into digital form.

c. An ICT tool that displays information on the big screen.

d. A website that searches the information on the basis of keyword.

e. A program on a computer that displays the content of a web page.

f. An electronic version of a book.

Lesson 02

Internet and Email

2.1 Internet



Fig. 2.2.1

Computers in the whole world can be interconnected with the help of cables, telephone lines or some wireless communication media and network devices. A group of interconnected computers is known as computer network. The largest network of computers in the world is known as the internet. It is also known as Net. In the internet, there are many groups of computer networks. So, the internet is network of networks. Computers on the network can share data, information, programs, hardware and communicate with each other. To get the resources of the internet, personal computers or communicating devices like mobile phone, tablets, etc. are needed to connect with the internet. An ISP (Internet Service Provider) provides internet connection facilities to users. Nepal Telecom (NTC), World Link (Wlink), Vianet, NCell, Mercantile Office System (MOS), Subisu, etc. are the ISPs of Nepal.

The computers connected with the internet can do following things or tasks.

a. They can easily get the information on different topics or subjects.
b. They can send and receive messages using e-mail facility.
c. They can send instant messages.
d. They can access online classes.
e. They can get the latest information and news.
f. They can play computer games online with different persons/ players sitting in different parts of the world.
g. They can watch movies and listen to songs.

2.2 Electronic mail (Email)

Electronic mail (e-mail) is the popular services of the internet. It enables us to send or receive electronic messages from one computer to another connected to the internet. It is a fast, cheap, convenient and reliable means of communication. To use the email, you need to have email account or email address. You can create email account on Google, Yahoo and Hotmail. When you create an email account, you will get an email address. An email address is the unique identification of email of a user which looks like below:

greenbooksnepal@gmail.com



Fig. 222

When you send emails, the emails will store on the recipient's email box.

Email has many advantages than the postal mail service.

Some advantages of emails are as follows:

a. It is a fast, economic and reliable messaging service.
b. It can be sent or received at any time from any place using a computer or smart phone.
c. It can be sent to many people at a time.
d. It enables us to send pictures, audios or videos as the attachment files.

Some disadvantages of email are as follows:

a. It can be used only in places where there is the internet facility.
b. Computer viruses can be spread through emails.
c. An email user may get a lot of spam mails or junk mails. A spam mail is an unwanted email that makes us uncomfortable.
d. It can be hacked by a hacker.

2.3 Creating a Web Based E-mail Account

You can create an email account either in Gmail, Hotmail or Yahoomail. Gmail is the email service provided by Google. Gmail is very popular email service and is required for using many apps in a smartphone.

To create a web based e-mail account, follow these steps:

a. Open a web browser.

b. Type the address of any web based e-mail site in the address bar. For example, type www.google.com in the address bar of the web browser and press the Enter key.

c. Click on Create an account. It displays a web page having 'The Registration form'.

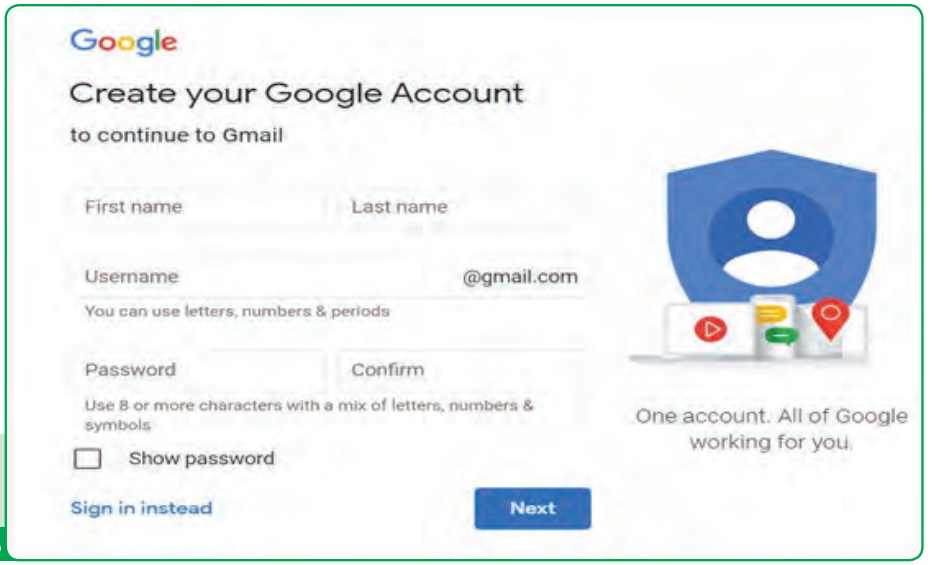


Fig. 2.2.3

d. Fill up all the necessary details in the given text boxes.

e. Click on the Next. It displays the Welcome Screen.

f. Now, fill the correct mobile number, recovery email address, date of birth. When we forget password, these information help us to recover the password.

g. Click on Next. It displays Term of Service.

h. Click on I agree to create an email account.

i. Click on Gmail and compose a mail and exchange with friends.

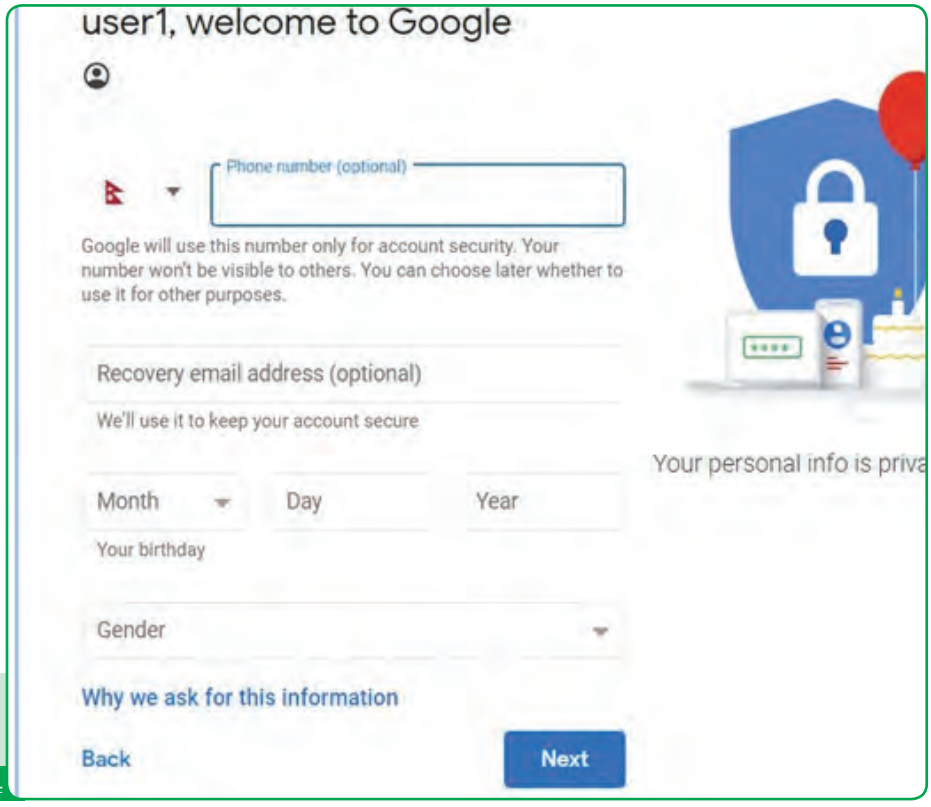


Fig. 2.24

Activity 3

Create your own email id and exchange emails among friends.

Reading or Sending e-mails

To read or send web based e-mails, follow these steps:

a. Open a web browser.

b. Type the website address of the email based website in the address bar. For example, type www.google.com in the address bar of the web browser and press Enter key.

c. Select mail tab. It displays a web page which allows the new users to create their mail accounts and the existing users to login into their accounts.



Fig. 2.2.5

d. Type e-mail ID and press Enter key and enter password and click the Sign In button. It displays a web page with all the facilities of e-mail.

e. Perform any one of the following:

- Click on the Inbox tab and click on the email that you want to open.
- Click on the Compose tab, type the message, enter e-mail ID of the recipient into Textbox, enter subject and click the Send button. To send email to many people, type email address of each person respectively or choose CC (Carbon Copy) and BCC (Blind Carbon Copy) and type email address of each recipient.
- To send file or files as attachment, click on Attach files and select file or files from the specified folder or drive and click on Open button.

f. Once you finished tasks, click on the Sign out button.

2.4 Code of Conduct for using Computer and Internet

Computers have made our tasks easier and simpler. We can use the

internet to exchange messages or information instantly. So, the usage of computers and the internet is increasing day by day. To stay connected with friends and relatives, most people use social media like email, Facebook, messenger, Viber, Twitter, Whatsapp, Microsoft meet, Zoom, etc. They share or post photos, videos, links, comments, and their personal information on social media. Sometime, the personal or private information shared with close friends may get leaked and you may get into trouble.



Fig. 2.2.6

Computers and the internet can be used to access digital services such as online banking and digital wallets. You may get into trouble if you do not use or do not know how to use these social media or online transaction services properly. So, you must follow codes of conduct when utilizing computers and the internet for social media or digital transactions. Some codes of conduct for using computers and the internet are listed below:

a. Do not share your password with anyone.
b. Use a different password for each of your social media accounts.
c. Do not provide personal information to an unknown person, such as your name, age, birth place, mobile number, etc.
d. Do not accept the friend request of an unknown person.
e. Do not share or post any photos, videos or messages that are offensive.
f. Only share or post material that is not harmful.
g. Log out from your account after you have finished work.
h. Do not make or use a fake ID.
i. Do not use other people's computers or internet passwords without taking permission.
j. Do not copy someone else's files without permission.
k. If someone tries to bother or harass you, report it to the cyber police.
l. Do not open emails from strangers that appear to be suspicious.

m. Do not post or share information that helps criminals.

n. Inform your parents or teachers if someone tries to be very close to you or sends you unwanted messages.

Key concepts

- A group of computers connected with the help of cables, telephone lines or some wireless communication media and network devices is known as computer network.
- Internet is the largest network of computers in the world. It is the network of networks.
- An ISP (Internet Service Provider) provides internet connection facilities to users. For example, NTC, Wlink, Vianet, NCell, Subisu, etc.
- Email is fast, cheap, and reliable electronic messaging service that enables us to send or receive messages from a computer or communicating device to another on the internet.
- You may get into trouble if you do not use or do not know how to use social media or online transaction services properly.
- You must follow code of conduct when utilizing computers and the internet for social media or digital transactions.

Exercise

1. State whether the following statements are true or false.

a. Computer network only allows us to share computer hardware. ☐

b. Wlink, Vianet and NCell are internet service providers in Nepal. ☐

c. You can get the latest news on the internet. ☐

d. E-mail is the service of the internet that provides information on any topic or subject. ☐

e. A person can send emails only during office time. ☐

f. Computer viruses may be spread through emails. ☐

g. You can upload photos and videos on social media. ☐

h. It is good to post or share materials that are harmful to other people.

2. Fill in the blanks with appropriate words.

a. A group of interconnected computers with transmission media is known as ……..

b. The internet is network of ……..

d. The unique identification of an email is ……..

d. Gmail is the email service provided by ……..

e. The full form of ISP is .....

3. Answer the following questions.

a. What is computer network?

b. Define internet. List any two services of the internet.

c. What is ISP? List any two ISPs of Nepal.

d. What is e-mail? List any two advantages of e-mail.

4. Write the full forms of the following:

a. ISP b. email c. CC d. BCC

5. Write the technical terms for the following statements.

a. A group of interconnected computers

b. A network of networks

c. A company that provides internet connection

d. An internet service that enables you to send or receive electronic message

6. Write down the code of conduct that we should follow while using computer and internet.

Lab Activity

a. Take permission from your teacher and search study materials on the internet.

b. Create your and friends e-mail accounts in web based e-mail site.

c. Send an e-mail to your friend.

Lesson 03

Computer Software

3.1 Introduction

The computer system consists of computer hardware and software. Computer hardware refers to the visible and touchable components of a computer. Keyboard, mouse, monitor, printer, pen drive, solid state disk, web camera, etc. are some of the common computer hardware. The computer system needs both hardware and software. Computer hardware and software work together to perform tasks of users. To perform any task, a computer needs instructions or programs. A program is a set of instructions given to a computer to perform some tasks.

Software is a collection of programs that runs computer hardware to perform tasks. It is invisible and non-touchable part of the computer system. Microsoft Windows XP, Microsoft Windows 7, Windows 10, Windows 11, Linux, UNIX, Microsoft Paint, Microsoft Word, Microsoft PowerPoint, Adobe Photoshop, VLC Player, etc. are computer software. You have to purchase software to use in a computer. You can also get free software on the internet. System Software and Application Software are two types of software.



Fig. 2.3.1

3.2 System Software

System software is the collection of programs that controls and manages the operation of computer. Operating system is the system software that controls and manages the overall operation of a computer. Every computer need to have operating system. It controls and makes the computer hardware workable. It acts as an interface between a user

and a computer or between software and hardware. It provides the environment to run application software on the computer. MS-DOS, Windows XP, Windows 7, Windows 10, Windows 11, mac OS, UNIX and Linux are some examples of operating systems.

Fig. 2.3.2



Utility software is also system software that performs specific tasks related to the maintenance of computer hardware, data and software. It helps to keep a computer in good working condition. Antiviruses, WinZip, Ccleaner, Revo Uninstaller, Registry Cleaner, etc. are utilities software.

Fig. 2.3.3



3.3 Application Software

Application software is the software that can perform specific tasks of users. It helps users to perform specific tasks like preparing documents, spreadsheets, presentations, editing images and videos, preparing exam results, etc. Microsoft Word, Microsoft Excel, Microsoft PowerPoint, Oracle, Adobe Photoshop, Adobe Reader, VLC media Player, Pumori Banking Software, etc. are some examples of application software.

Fig. 2.3.4



Activity 4

Discuss about the different software and usage and complete the following table:

S.No.	Software	Uses
1.	Windows 7	
2.	MS-Paint	
3.	MS-Word	
4.	MS-Presentation	
5.	Adobe Reader	
6.	Windows media Player	
7.	Google Chrome	

Key concepts

1. Computer system consists of computer hardware and software.
2. Computer hardware includes the visible and touchable components of computer which can be seen and touched.
3. A program is a set of instructions given to a computer to perform some tasks.
4. Software is the collection of programs that runs computer hardware to perform tasks. It is non-touchable part of the computer system.
5. Operating system is the system software that manages and controls the overall activities of a computer. Windows XP, Windows 7, UNIX and Linux are operating system software.
6. Utility software is the system software that performs specific tasks related to the maintenance of computer hardware, data and software. It helps to keep a computer in the smooth functioning condition.
7. Application software is the special software that can perform some specific tasks of users. MS-Word, PDF Reader, Pumori Banking Software, etc. are application software.

Exercise

1. Choose the correct option from the given alternatives:

a. A computer hardware is ..... and ..... part of a computer.

i. visible ii. non-touchable iii. invisible iv. touchable

b. Which of the following is an example of computer hardware?

i. MS-DOS ii. Torch light iii. Pen iv. Pen drive

c. Computer software is .....

i. collection of programs ii. non-touchable

iii. invisible iv. All of them

d. Which of the given software acts as an interface between a user and a computer?

i. Application software ii. Utility software

iii. Operating system iv. Language processor

e. Windows 11 is an example of .....

i. Application software ii. Operating software

iii. Utility software iv. None of them

f. Utility Software .....

i. provides environment to run application software.

ii. controls and makes the computer hardware workable.

iii. performs tasks like preparing documents, presentations, etc.

iv. performs tasks related to the maintenance of computer hardware.

g. Anti-virus is ..... software.

i. application ii. operating system

iii. utility iv. None of them

2. Write the technical terms for the following statements:

a. A set of instructions given to a computer to perform a task

b. A collection of programs

c. The software that acts as an interface between a user and a computer

d. Software that takes care and maintain a computer hardware and data.

e. Special software that can perform some specific tasks

3. State whether the following statements are true or false.

a. Software is the visible and touchable part of the computer. ☐

b. Software can perform tasks without hardware. ☐

c. A computer can do tasks without a program. ☐

d. A collection of programs is known as software. ☐

e. Software guides hardware what to do and how to do. ☐

f. MS-Word and MS-Excel are operating systems. ☐

g. Application software keeps a computer in the smooth functioning condition. ☐

4. Answer the following questions.

a. What is a program? Can a computer run without programs?

b. What is computer software? List any two computer software.

c. What is operating system? List any two of it.

d. What is utility software? Name any two of them.

e. What is application software? Give any two examples.

5. Study the given figures and identify the type of software.

a. 

b. 

c. 

d. 

6. Differentiate between utility software and application software.

Lesson 04

Computer Virus and Its Remedy

4.1 Introduction



Fig. 2.4.1

A computer virus is a harmful program that is made intentionally to disturb the normal functioning of a computer. It can destroy data, information and other useful programs on the computer. It makes a file or program unusable. It can run unnecessary programs itself. It can create undeletable folders on a disk. It can delete data, information and programs on a computer. Nowadays, computer hackers use computer viruses to steal important information on computers.

Since it is hidden in other host files, you cannot see it. It can replicate and execute itself. Computer viruses can transfer themselves from one computer to another without the notice of the users. They usually transfer through the infected pen drives, portable hard disks, CD/DVD, pirated software, emails and the internet. When a virus infected file is used, the virus becomes active and infects other files.

4.2 Symptoms of Computer Viruses

There are a variety of computer viruses. New viruses with different characteristics are created everyday. So, the number of computer viruses is increasing day by day. It is very difficult to detect whether a computer is infected with viruses or not. When a computer system is infected with viruses, you may notice the following symptoms:

- A computer runs slower than usual.
- A computer takes more time to boot than usual. That means booting of the computer becomes slow.

- A program takes more time to load, hangs frequently or does not work.
- A computer crashes frequently and restarts automatically.
- The computer displays unusual error messages or encounters errors frequently.
- New programs are installed incorrectly.
- Missing of files or appearance of unexpected files or folders occurs.
- Low memory message appears frequently.
- The size of the files changes frequently.

4.3 Protection of Computer from Viruses

We should keep a computer free from computer viruses. It is better to prevent a computer from being infected with computer viruses. The following are the ways of protecting a computer from being infected with computer viruses:

a. Install reliable anti-virus software and update it frequently.
b. Scan the computer for viruses regularly.
c. Install the latest security patch.
d. Install firewall and enable it.
e. Always scan pen drives or any portable storage device for viruses before using them.
f. Do not use pirated software.
g. Do not surf unsecured websites and do not download files from those sites.
h. Do not open suspicious e-mails and attachments.



Fig. 2.4.2

4.4 Detecting and Removing Computer Viruses from Computer

To detect and remove computer viruses from a computer, anti-virus software is used. Anti-virus software detects and removes viruses from a computer. The anti-virus software continuously monitors the computer and prevents the computer from being infected with viruses.

Some antivirus software are:

a. Kaspersky Anti-virus software
b. McAfee's Anti-virus
c. 360 Total Security
d. Norton Anti-virus
e. AVG Anti-virus
f. Avira Anti-virus software
g. Avast Anti-virus software



Fig. 2.4.3

Activity 5

The following steps help to detect and remove viruses from a computer:

a. Open the anti-virus program installed in the computer. For example, Double click on 360 Total Security Anti-virus icon on the Desktop to open it.

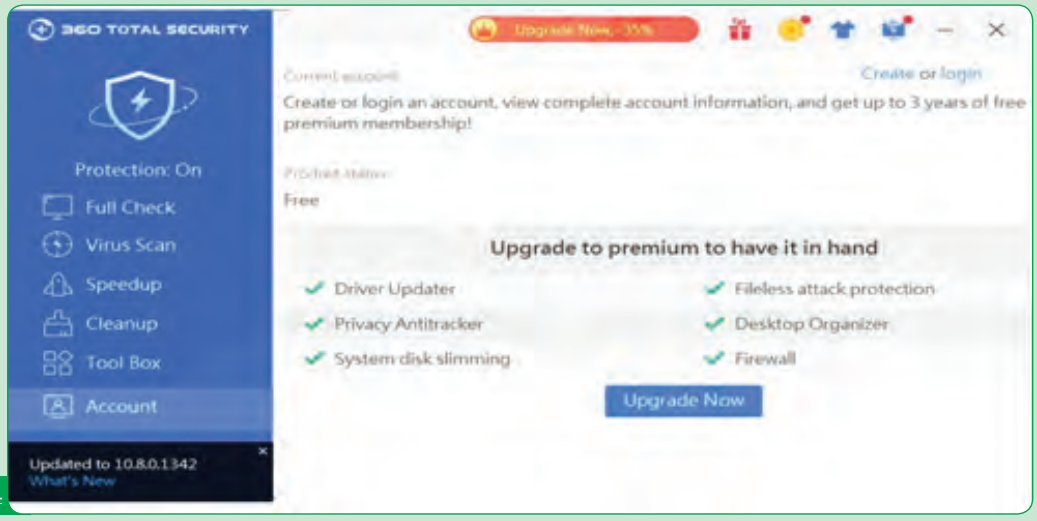


Fig. 2.4.4

b. Do any one of the following options:

- Click on Full Check if you want to scan the entire hard disk for viruses and click on Check Now.

- Click on Virus Scan. It displays three options: Quick Scan, Full Scan and Custom Scan.

– Click on Quick Scan if you want to scan only system files, common Apps and critical files.

– Click on Custom Scan. Choose drive or folder that you want to scan and click on Scan.

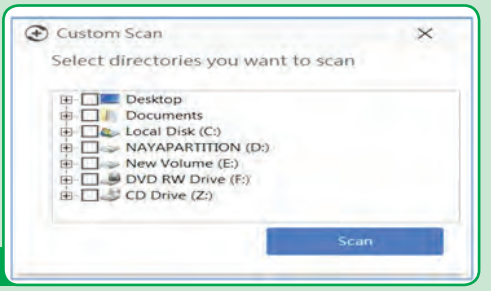


Fig. 2.4.5

c. Click on Resolve button.

d. Click on Completed and Finish.

Key concepts

1. A computer virus is a harmful program that is made intentionally to disturb the normal functioning of a computer.
2. Computer viruses can destroy or delete files or programs on a computer.
3. Computer viruses can run unnecessary programs and steal information on a computer.
4. Computer viruses transfer through the infected portable hard disk, optical disks, pen drives, emails and the internet.
5. A 'virus infected computer' takes more time to boot, load programs, crashes frequently and restarts automatically.
6. Computer can be protected from being infected using anti-viruses and security patches.
7. Antivirus is a program that detects and removes computer viruses from a computer. It also prevents computer from viruses.

Exercise

1. State whether the following statements are true or false.

a. A computer virus is a useful program that prevents software piracy.

b. A computer virus can hide in other host files but can replicate itself.

c. Computer viruses can transfer from a computer mouse.

d. A virus infected computer becomes faster than usual.

e. Anti-virus software detects and removes viruses from computers.

2. Fill in the blanks with appropriate words.

a. Computer virus can run unnecessary ..... itself.

b. Computer virus can destroy files and useful programs on .....

c. Computer viruses transfer through the infected pen drives, and .....

d. A virus infected computer runs ..... than usual.

e. Anti-virus software detects and ..... viruses from a computer.

3. Answer the following questions.

a. What is computer virus? What does it do?

b. How do viruses transfer?

c. List any four symptoms of computer viruses.

d. List the four ways for protecting computers from being infected with computer viruses.

e. What is anti-virus? List any four anti-virus software.

4. Write the technical terms for the following statements.

a. A destructive program that harms data and other programs on a computer.

b. A computer program that can damage or delete files on a computer.

c. A program that detects and removes computer viruses.

5. How can you protect your computer from viruses? Write any five ways.

6. Write down the steps for detecting and removing viruses from a computer.

Lesson 05

Spreadsheet

5.1 Introduction

Spreadsheet software is the application software that is designed to help users in calculations and preparing graphs or charts on computers. It enables a user to perform day-to-day mathematical and financial calculations easily and accurately. Microsoft Excel, Google Sheet, Open Office Calc, Quattro Pro, Apple Works, etc. are some popular spreadsheet programs.



Fig. 2.5.1

Among the available spreadsheet software, Microsoft Excel is the most widely used spread sheet software. In class six, you have already learned to enter data and arrange them in a spreadsheet. Now in class 7, you will learn to perform arithmetic calculations (addition, subtraction, multiplication and division) and prepare charts.

Activity 6

Study the given spreadsheet and answer the following questions:

Class7.xlsx

	A	B	C	D	E	F	G	H
1	Roll no	Student name	Math	Computer Science	Science and Technology	Nepali	English	Total
2	1	Ekta Sharma	75	65	70	72	76	?
3	3	Monika Gurung	65	95	65	65	75	?
4	4	Kamal Thapa	85	90	45	45	49	?
5	5	Sakti Kumar Rai	45	87	68	42	56	?
6	6	Mohan Rumba	47	97	78	57	78	?
7								

Sheet1 Sheet2 Sheet3

Fig. 2.5.2

a. In which column, Student Name is kept?
b. In which row, information of 'Monika Gurung' is kept?
c. What is the cell address of marks in Computer of Kamal Thapa?
d. What is the cell address of Mohan Rumba?

Perform these tasks:

i) Save the workbook as ExcelPrac2.xlsx.

ii) Select H2 cell and type =C2+D2+E2+F2+G2. It adds all the marks secured by Ekta Sharma and stores it in cell H2.

Or

Select H2 cell and type =Sum(C2:G2)

Or

Select H2 cell and click on AutoSum (∑)tool, it automatically adds the selected cells.

iii) Now, select H2 cell again. Drag the fill handle down up to H6 cell. It calculates Total marks of other students.

Activity 7

Show the use of subtraction and multiplication operators on numeric data.

i) Open a workbook and enter the following data in a worksheet.

Class7.xlsx

	A	B	C	D	E	F	G	H
1	Sno	Particular	Unit Price In Rs.	Quantity	Unit	Amount	Discount	Net Amount
2	1	Basmati Rice	140	25	Kg	=C2*D2	=F2*5%	=F2-G2
3	2	Jira Masino Rice	150	30	Kg			
4	3	Sugar Free Biscuit	85	3	Pck			
5	4	Cooking Oil	240	5	lt			
6	5							
7							Grand Total	=SUM(H2:H6)
8								

Sheet1 Sheet2 Sheet3

Fig. 2.5.3

ii) To calculate Amount (i.e. product of Unit Price in Rs. and Quantity)

a. Select cell F2.
b. Enter the formula = C2*D2 in the cell F2.
c. Click on the cell F2 and drag the fill handle of the cell down till E4.

iii) To calculate Discount (5% of Amount)

a. Select cell G2 and enter the formula =F2*5%

b. Click on the cell G2 and drag the fill handle of the cell down till G4.

iv) To calculate Net Amount (i.e. difference of Amount and Discount)

a. Select the cell H2 and enter the formula =F2-G2.

b. Drag the fill handle of H2 cell down till H4.

v) To calculate Grand Total, enter formula =Sum (H2:H6) in H7 cell.

5.2 Charts in ms-Excel

A chart shows numeric data in visual form. You can create Column chart, Pie chart, Line chart, Bar chart, etc. in Excel. It shows the changes of numeric data in different time periods through graphs so that it can be easily understood. It enables a user to analyze numeric data easily. When you change the data on the worksheet, MS-Excel automatically updates the charts.

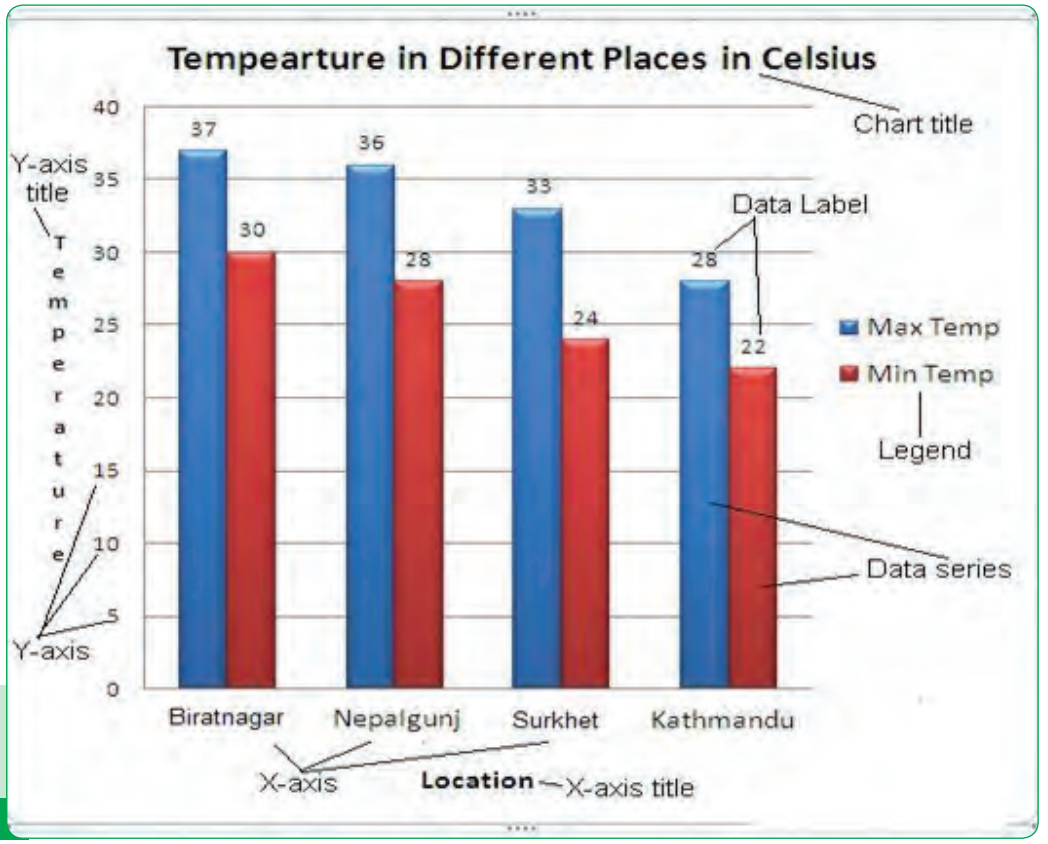


Fig. 2.5.4

Creating a Column Chart

A column chart displays data with the help of vertical rectangular bars. In a column chart, different categories are organized in the horizontal axis and values are organized in the vertical axis.

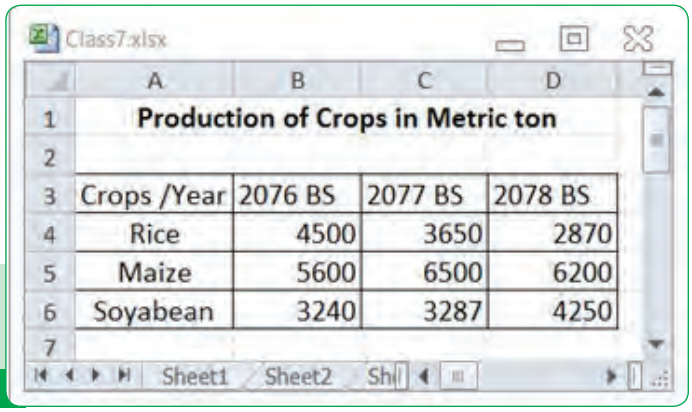


Fig. 2.5.5

Suppose you want to create a column chart on the basis of the following data, you need to follow these steps:

i. Select the data you want to include in a chart. For example, select all data from range A3..D6.

ii. Select Column from Charts group under the Insert Tab. It displays list of column charts.

iii. Click on the appropriate chart sub-type and press the Enter key. To place the chart on a chart sheet, right click on the chart and choose move Chart option and then select New Sheet and click on OK button.

iv. Select Layout tab on Chart tools and perform these tasks:

   a. Click on Chart Title under the Labels group and select Above Chart. Add appropriate chart title. For example, type 'Production of Crops in metric ton' and press the Enter key.

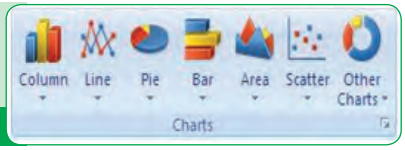


Fig. 2.5.6

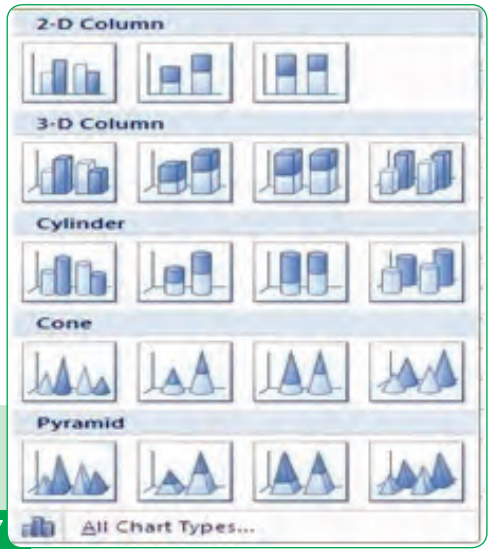


Fig. 2.5.7

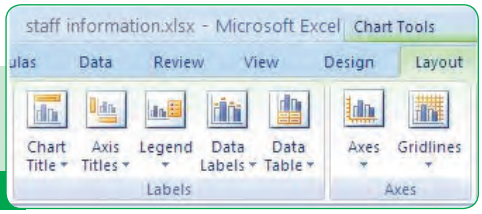


Fig. 2.5.8

b. Click on Axis Titles under the Labels group to add, remove or position the horizontal title and vertical title.

c. Click on Legend under the Labels group to add, remove or position the legend on the chart.

d. Click on Data Labels under the Labels group to add or remove Data Labels from the chart.

e. On the Layout tab, under the Axes group, click on Axes to add or remove horizontal or vertical axes.

f. On the Layout tab, under the Axes group, click on Gridlines to add or remove Horizontal or Vertical gridlines.

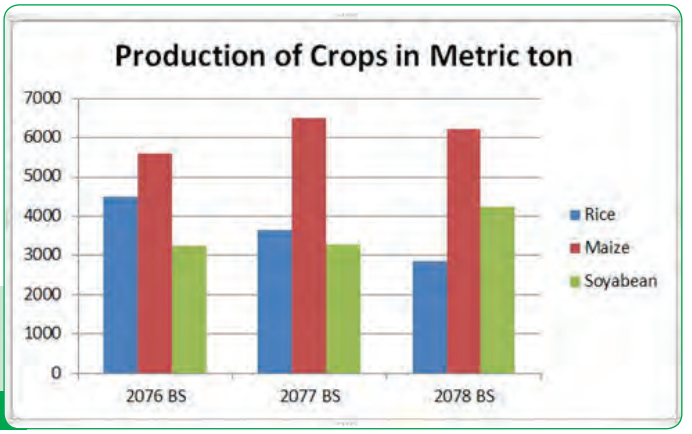


Fig. 2.5.9

Key concepts

1. Spreadsheet software is the application software that is designed to help users in calculations and preparing graphs or charts on computers.
2. Microsoft Excel, Google Sheet, OpenOffice Calc, Quattro Pro, AppleWorks, etc. are some popular spreadsheet programs.
3. To perform arithmetic calculation in numeric data in a worksheet, you have to use correct formulae.
4. A chart shows numeric data in visual form. It enables a user to analyze numeric data easily.
5. A column chart displays data with the help of vertical rectangular bars.

Exercise

1. State whether the following statements are True or False.

a) Microsoft Excel is spreadsheet software.

b) In order to enter formula in a cell, you have to type = sign.

c) A chart shows numeric data in visual form.

d) Quattro pro is the most widely used software.

2. Answer the following questions.

a) What type of software is spreadsheet?

b) List any two spreadsheet software.

c) What is a chart?

d) Does MS-Excel update a chart automatically when the related data of chart are changed?

e) Why is spreadsheet software used?

PRACTICAL EXERCISE

1. Open a workbook and enter the following data in a worksheet.

S.N.	A	B	C	D	E
1.	Computer Enterprises				
2.	S.N.	Item Name	Unit Price (Rs.)	Qty.	Amount
3	1	Maxtor 256 GB SSD	5400	12	?
4	2	1 TB Seagate HDD	5500	9	?
5	3	Keyboard	550	25	?
6	4	Gaming mouse	950	12	?
7				Net Amount	?

Perform the following tasks.

a. In column E, calculate Amount for each item.

b. In E7, calculate Net Amount (i.e. sum of E3 to E6 cells).

2. Open a workbook and enter the following data in a worksheet.

S.N.	A	B	C	D
1	Name	Basic Salary	PF	Net Salary
2	Asha Nakarmi	25000	?	?
3	Rachana Oli	22000	?	?
4	Janaki Karna	18000	?	?
5	Ganesh Thapa	15000	?	?

a. In column C, calculate Provident fund (PF) at the rate of 10% of Basic.

b. In column D, calculate Net Salary by adding Basic Salary and PF.

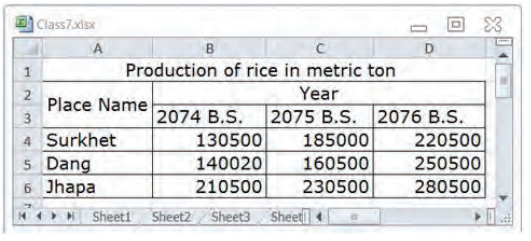
3. Open a workbook and enter the following data in a worksheet.

S.N.	A	B	C	D	E	F	G
1.	**Result Sheet of grade VII**						
2.	**S.N.**	**Name**	**math**	**Sci.**	**Eng.**	**Total**	**Amount**
3	1	Dipak Thapa	95	70	70	?	?
4	2	Prem Aryal	90	57	65	?	?
5	3	Sabita Ghale	85	65	57	?	?
6	4	Ganesh KC	65	46	52	?	?

a. Calculate Total of each record in column F.

b. Calculate Percentage in column G.

4. a. Open a worksheet and enter the following data that shows production of rice in metric ton at different places in three consecutive years 2074 B.S., 2073 B.S. and 2076 B.S.



b. Prepare a column chart to show Production of Rice in metric ton of different places in three consecutive years on the basis of above data. [Hint: select cells from A2 to D5]

c. Assign Chart title as 'Production of Rice'.

Lesson 06

Photo Editing

6.1 Introduction



Fig. 2.6.1

We take photos on different occasions and festivals using digital camera or smart phone. When we visit new places we take photos for memory. The photos captured by digital cameras or smartphones can be transferred to computers. Photos are stored on a computer as digital photos and are called computer graphics. A digital photo file may have BMP (Bitmap), JPEG (Joint Picture Export Group), PNG (Portable Network Graphics), GIF (Graphics Interchange Format) or TIF (Tagged Image Format) extension.



Fig. 2.6.2

Digital photos are very useful for presenting information quickly and easily understandable way. Digital photos are used in web pages, eBooks, electronic magazine, and online forms. Digital photos stored on the computer may not be exactly as the requirements. They may be large in size, fade in colour, etc. So, we may need to change size, brightness and colour of these photos. We may also need to remove some portions of photos or rotate the photos. The process of modifying photos is known as photo editing.

Photo editing helps us to enhance the photos. The graphic software on a computer or mobile phone enables us to change the size, brightness, colour and contrast of photos, crop, rotate and flip, compress and merge photos and so on.

MS-Paint, Microsoft Office Picture, Adobe Photoshop, Paint Shop, Corel Painter, Google Snapseed, Prisma Photo Editor, Google Photos, Adobe Photoshop Express, etc. are photo editing software.

Fig. 2.6.3


mS-Paint,



Adobe Photoshop


Google Photos


Corel Painter

6.2 Transferring Photos from a Digital camera or mobile phone to a Computer

You can transfer photos from a digital camera or mobile phone to a computer by using a USB cable.

To transfer photos from a digital camera or mobile phone to a computer, follow these steps:

i) Switch on a digital camera or mobile phone.

ii) Connect the digital camera or mobile phone to a computer through a USB cable.

Fig. 2.6.4





iii) Once the digital camera or mobile phone is connected, you get the notification about the connection of device.

iv) Select PC/Computer or file transfer option on the camera or mobile phone. Once this option is selected, the camera or mobile phone will appear as a drive on the computer.

v) Double click on 'Computer' or This PC' icon on the Desktop. We will see the camera or mobile phone as the drive.

vi) Open the camera or mobile phone drive and select Pictures or DCIM (Digital Camera Images) folder. Now photos on DCIM folder appear on the computer.

vii) Copy a photo or photos in DCIM folder using Ctrl + C keys.

viii) Open the specified drive or folder where photos are to be stored and paste the photo or photos using Ctrl + V keys.

Note :

You can also transfer photos from a digital camera to a computer by inserting SD memory card of a digital camera in a card reader and plug into a computer.

6.3 Editing Photos Using Microsoft Office Picture manager

Microsoft Office Picture manager is the graphic software. It enables you to resize, crop, rotate or flip, change brightness and contrast, etc. of digital photos.

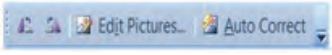
6.3.1 Cropping photo

You may need to remove some parts of a photo. The process of removing unwanted portion of a photo is known as cropping. It is also known as trimming. The cropping reduces the size of a photo too. To crop or trim a photo, Crop tool ( ) is used.

To crop a photo in Microsoft Office Picture manager, follow these steps:

a. Open a folder that contains the photo to be modified.

b. Right click on the photo that is to be cropped and select Microsoft Office 2010 to open the photo.



c. Select Edit Pictures on the Formatting toolbar.

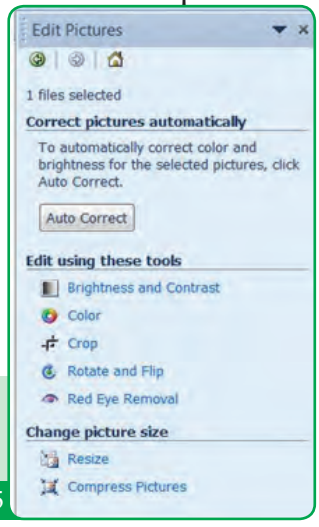


Fig. 2.6.5

d. In the Edit Pictures task pane, under Edit using these tools, click on Crop tool. Black crop handles appear on the edges and corners of the photo.

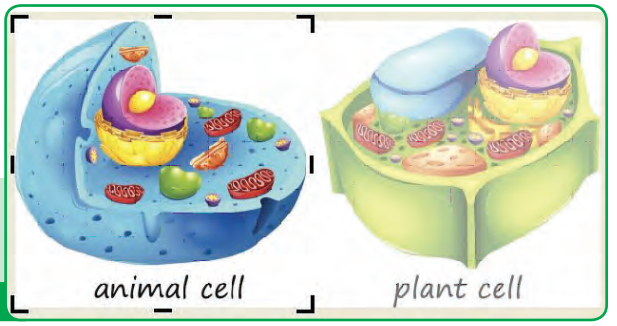


Fig. 2.6.6

e. Drag the crop handles inward, upward or downward over the part of the photo that is to be kept.

f. Click on the OK button.

g. Save the photo.

6.3.2 Resizing an image

We may need to reduce or increase size of photos. To resize a photo in Microsoft Office, follow these steps:

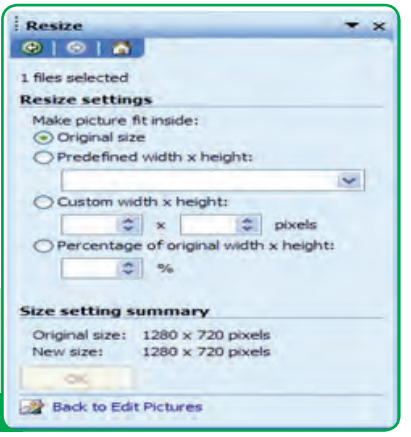


Fig. 2.6.7

a. Open a photo in Microsoft Office.

b. Select Edit Pictures on the Formatting toolbar.

c. Click on Resize under the Edit Pictures task pane.

d. Select predefined width and height or specify your own width and height.

e. Click on the OK button.

6.3.3 Adjusting brightness, contrast and colour of a photo

To change the brightness and contrast of a photo, follow these steps:

i) Open a photo whose brightness, contrast or colour is to be adjusted.

ii) Select Edit Pictures on the Formatting toolbar.

iii) Do one or all of the following:

a. Click on Brightness and Contrast tool under the Edit using these tools.

- Move the Brightness slider to left or right side to adjust the brightness of the photo.
- Move the Contrast slider to right or left side to adjust the contrast.

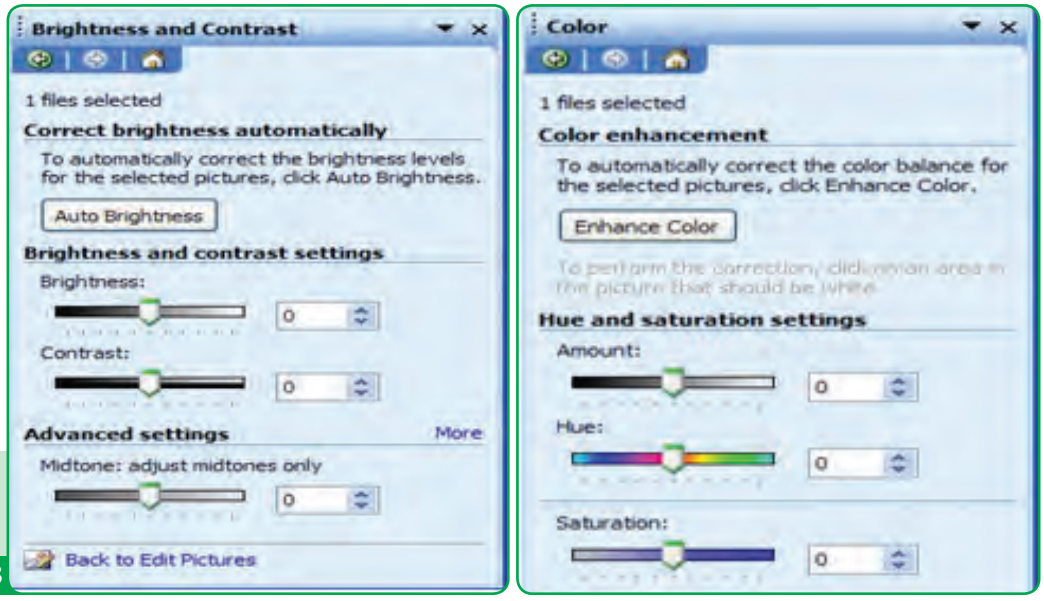


Fig. 2.6.8

b. Click on Colour tool under the Edit using these tools.

- Move Amount slider under the Hue and saturation settings to left or right side to adjust colour amount.
- Move the Hue slider to left or right side to adjust the hue of the photo.
- Move the Saturation slide to the left or right side to adjust the colour saturation of the photo.

Note :

1. We can easily crop, resize and rotate photos in MS-Paint and Adobe Photoshop.
2. We can easily change colour, brightness, etc. of pasted photos in a MS-Word document or MS-PowerPoint slide.

Key concepts

1. Photos are stored on a computer as digital photos and are called computer graphics.
2. A digital photo file may have bmp, jpeg, png, gif, or tif extension.
3. The process of modifying photos is known as photo editing.

- Digital photos are very useful for presenting information quickly and easily understandable way.
- MS-Paint, Microsoft Office Picture, Adobe Photoshop, Paint Shop, Corel Painter, Google Snapseed, Prisma Photo Editor, Adobe Photoshop Express, TouchRetouch, and Google Photos are some popular photo editing software.
- The process of removing unwanted portion of a photo is known as cropping. It is also known as trimming.

Exercise

1. State whether the following statements are true or false.

a. The photos captured by digital cameras or smartphones can be transferred to computers. ☐

b. Digital photos are used in web pages and eBooks. ☐

c. A digital photo cannot be modified. ☐

d. MS-Paint, Microsoft Office Picture manager and Adobe Photoshop are photo editing software. ☐

e. The crop tool changes brightness of photos. ☐

2. Write the full form of the following.

a. BMP b. JPEG c. GIF d. TIF e. PNG

3. Answer the following questions.

a. What is computer graphic?

b. List any two file extensions of digital photo files.

c. What is photo editing? Write any two uses of photo editing.

d. What is cropping photo? Why is it done?

e. Write name of any two photo editing software.

Practical Exercise

a. Open a photo in Microsoft Office Picture manager and crop the photo.

b. Open a photo in Microsoft Office Picture manager and adjust contrast, brightness and colour.

UNIT
03

Living Beings and Their Structure

Estimated teaching hours : 12

Before You Begin

Different types of living beings are found on the earth. These living beings are broadly classified into two kingdoms, viz (i) Animal Kingdom and (ii) Plant Kingdom. All the animals present on the earth belong to animal kingdom and all the plants present on the earth belong to plant kingdom. To make the study of animals, scientists have divided plant/animals into two categories, i.e. invertebrates and vertebrates. Invertebrates are animals having no back bones or vertebral column whereas vertebrates are the animals having backbones or vertebral columns. Similarly, plant kingdom has been divided into two main categories. They are cryptogams and phanerogams. Cryptogams are plants that do not bear flowers and seeds whereas phanerogams are plants that bear flowers and seeds.

Different types of non-flowering and flowering plants are found in our surroundings. The plants that bear flowers, fruits and seeds are called flowering plants. Sunflower, lotus, rose, marigold, pea, bean, mustard, mango, apple, etc. are some common examples of flowering plants. A flowering plant consists of various parts like root, stem, branches, leaves, buds, flowers and fruits. These parts perform specific functions. A flowering plant can be divided into two parts, viz. root system and shoot system. Root system is the part of a plant below the soil whereas shoot system is the part of the plant above the soil. Stem, branches, leaves, flowers and fruits are the parts of the shoot system.

We have seen butterfly, snail, grasshopper, earthworm, slug, ant, honeybee, mosquito, leech, etc. in our locality. These animals are called invertebrates. They do not have backbone or vertebral column. The animals which do not have a backbone or vertebral column are called invertebrates. These animals may be unicellular or multicellular. Some invertebrates like amoeba, paramecium, euglena, etc. are unicellular and microscopic. Invertebrates may be aquatic or terrestrial.

The bodies of living organisms are made of very small units. These small units are called cells. The bodies of all plants and animals are made of cells. Cells act as the building blocks of life. Some animals like amoeba, paramecium, euglena, etc. are made of only one cell. These organisms are called unicellular organisms. Many plants and animals contain so many cells in their bodies. These organisms are called multicellular organisms.

In this unit, we will study various parts of plants, features of invertebrates. Similarly, we will study cell, structure and functions of different parts of a cell in brief.

Learning Outcomes

After completing the study of this unit, students will be able to:

- explain functions of various parts of flowering plants.
- identify modified parts of plants like root, stem and leaf and explain their structure and functions.
- classify invertebrates and state characteristics of various groups of invertebrates.
- introduce cell and identify main components of plant cell and animal cell.

Syllabus

- Introduction to living beings
- Parts of a flowering plant
- Structure and functions of root, stem, leaf, flower, fruit and seed
- Introduction to invertebrates
- Classification of invertebrates
- Introduction to cell
- Structure of plant cell and animal cell

Glossary

cell	:	the basic, structural and functional unit of life
cellulose	:	non-living substance that forms cell wall
cell organelles	:	the living bodies present in a cell, e.g. mitochondria, nucleus, etc.
cephalic	:	in or related to the head
cytoplasm	:	a jelly-like substance found in cells
endosperm	:	the part of a seed which acts as a food store for the developing plant embryo
embryo	:	an unborn or unhatched offspring in the process of development
flower	:	the sexually reproductive organ of a flowering plant
hermaphrodite	:	having male and female reproductive organs in the same body
inclusions	:	the non-living structures present in a cell, e.g. vacuoles
marine	:	found in sea, connected with the sea
membrane	:	a very thin layer
microscopic	:	extremely small and difficult or impossible to see without a microscope
multicellular	:	having many cells in the body
primitive	:	very simple in structure, less developed
plumule	:	the part of a plant embryo that develops into the shoot or stem
radicle	:	the part of a plant embryo that develops into the primary root
unicellular	:	having only one cell in the body

A. Living Beings

3.1 Introduction to Living Beings

Activity 1

Study the given figures and answer the following questions.



mushroom *Fern* *Rose* *mango*

Snail *Octopus* *Fish* *Panda*

Fig. 3.1

i) What type of organisms are shown in above figures?

ii) What is the difference among them in their shape, size and structure?

iii) Where are these organisms found?

iv) How many parts are found in their bodies?

Different types of plants and animals found around us are called living beings. So the things having life are called living things. They include different types of plants and animals. Lotus, rose, spirogyra, grass, crops, fruits, vegetables, insects, birds, fishes, snakes, etc. are examples of living beings. Growth, reproduction, respiration, digestion, excretion, etc. are the basic properties of living beings.

Living beings found around us may be plants or animals, unicellular or multicellular and aquatic or terrestrial. Living beings are broadly classified into the Plant Kingdom and the Animal Kingdom. The Plant Kingdom includes different types of plants like spirogyra, mushroom, moss, fern, cycas, maize, grass, mango, orange, etc. Both flowering plants and non-flowering plants are kept in the Plant Kingdom. The Animal Kingdom includes different types of animals like amoeba, hydra, tapeworm, butterfly, roundworm, earthworm, snail, starfish, fishes, frogs, snakes, birds, mammals, etc.

Fig. 3.2


Panda


Yak


Dhupi sallo


Rhododendron

Fig: Living beings found in cold places

Fig. 3.3


Elephant


Mango tree


Rhinoceros


Paddy field

Fig: Living beings found in hot places

Animals and plants are found in different habitat and climatic conditions. They have different structures and characteristics according to their habitat. The living beings that live in water differ from the living beings that live on land. Similarly, the living beings that live in cold places are different from those that live in hot places.

Activity 2

- Observe any five plants and five animals in your locality.
- Study their characteristics and find out the differences between plants and animals.
- Prepare a short report and submit to your science teacher.

3.2 Parts of a Flowering Plant

Activity 3

- Visit a nearby garden or cropfield.
- Uproot a flowering plant such as marigold, pea, mustard, soyabean, etc.
- Observe the plant and identify its various parts.
- Draw a neat and labelled figure of the plant on a chart paper.
- Colour the picture and submit to your science teacher.

Different types of non-flowering and flowering plants are found in our surroundings. The plants that bear flowers, fruits and seeds are called flowering plants. Sunflower, lotus, rose, marigold, pea, bean, mustard, mango, apple, etc. are some common examples of flowering plants. A flowering plant consists of various parts like root, stem, branches, leaves, buds, flowers and fruits. These parts perform specific functions.

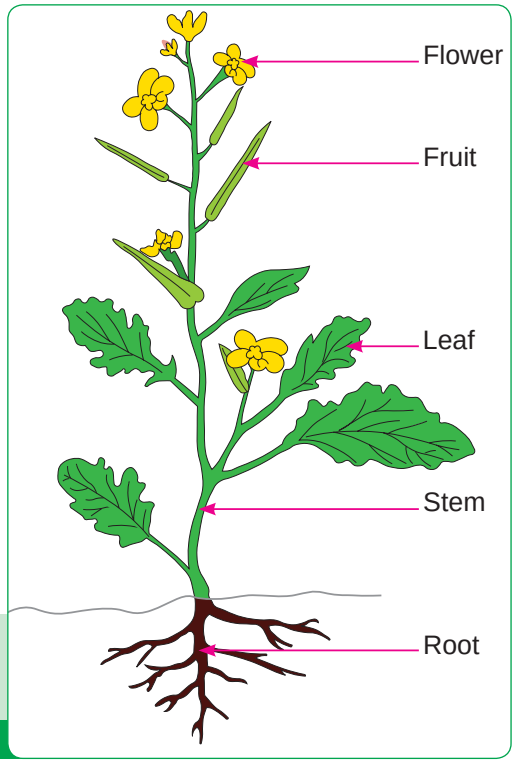


Fig. 3.4 *A flowering plant*

A flowering plant can be divided into two parts. They are root system and shoot system. Root system is the part of a plant below the soil whereas shoot system is the part of the plant above the soil. Stem, branches, leaves, flowers and fruits are the parts of the shoot system.

3.2.1 Root System

The underground part of the plant is called root system. Flowering plants have two types of root system. They are (i) tap root system and (ii) fibrous root system.

The root system having primary root, its branches and sub-branches is called tap root system. The branches of primary root are called secondary roots and the branches of secondary roots are called tertiary roots. Tap root system is found in dicot plants like bean, pea, mustard, apple, mango, rose, soyabean, orange, etc.



Fig. 3.5 *Tap root system*

The root system having cluster of roots of the same size and thickness is called fibrous root system. Fibrous roots grow from the base of the stem and spread in all directions. Fibrous root system is found in monocot plants like sugarcane, onion, maize, bamboo, paddy, wheat, garlic, etc.

Fig. 3.6



Fibrous root system

Functions of roots

1. Roots absorb water and minerals from the soil.
2. They fix the plant to the soil.

Modification of Roots

Roots absorb water and minerals from the soil and they fix the plant body to the soil. Besides these major functions, the roots of plants are modified to perform following functions:

i. For storage of food
ii. For mechanical support
iii. For vital function

i. For storage of food

The roots of some plants like radish, turnip, carrot, etc. are modified to store food. In radish, upper portion of the root is swollen and lower portion of the stem is tapered.

In turnip, the upper part of the root is round and swollen and lower part is tapered. In carrot, the upper portion of the stem is flat and lower portion is tapered.

Fig. 3.7



Root of radish



Roots of turnip



Roots of carrot

ii. For mechanical support

The roots of some plants like peepal, banyan, maize, bamboo, sugarcane, etc. are modified to provide mechanical support to the plant.

Fig. 3.8



Prop roots of banyan



Supporting roots of bamboo



Supporting roots of maize

iii. For vital functions

The roots of plants are modified on the basis of their functions. Roots of aquatic plants have air storage tissues which help them to float easily (e.g. hydrilla, water hyacinth, etc.). The roots of plants that are found in marshy places are modified for breathing. Roots of some plants contain chlorophyll for breathing. Roots of epiphytes are modified to absorb food from other plants.

Fig. 3.9



Roots of water hyacinth



Roots of epiphytes



Roots modified for breathing

Activity 4

- Visit a nearby garden and uproot a few plants like onion, pea, bean, garlic, mustard, wheat, radish, carrot, etc.
- Wash the roots of these plants and study their structure.
- Compare these roots and identify fibrous roots and tap roots.
- Draw a neat and labelled figure of each root system.

Activity 5

- Take a plate and keep some moist cotton on it.
- Keep some soaked seeds of maize and bean in moist cotton and leave it in a warm place and wait until those seeds germinate.

- Compare the roots of maize and mustard. Study their structure and identify fibrous roots and tap root.
- Observe the growth of these roots every day. Measure the length of these roots every day and keep the record.
- Draw a neat and labelled figure of roots of maize and bean.
- Demonstrate those roots to your friends in the classroom.

3.2.2 Shoot System

Shoot system is the part of the plant which is found above the ground. It consists of stem and its branches, sub-branches, leaves, buds, flowers and fruits.

A. Stem

The part of a flowering plant that grows upwards from the soil is called stem. It forms the main axis of the shoot system. Trees and bushes have hard and strong woody stem but most of the small plants have green, soft and weak stem. Trees and shrubs have many branches and sub-branches in their stem. These branches and sub-branches have leaves, thorns, buds, flowers and fruits.



Fig. 3.10 *Stem of mango*

The stem is thick in its base and it tapers gradually towards the tip. The stem consists of certain points from where branches and leaves sprout. These points are called nodes. The portion of the stem between two nodes is called internode.

Activity 6

- Take a marigold plant and cut the stem at the base.
- Take a beaker with some water. Put a few drops of pink ink in water and stir.
- Immerse the stem of the plant in the beaker and leave it for one day.
- Remove the plant from the beaker and cut the stem above 3 cm obliquely from the base. You can see pink lines in the stem.
- Where did these pink lines come from? How did pink water rise through the stem to reach the leaves?
- This activity shows that stem conducts water from root to the leaves.

Functions of stem

1. Stem transports water and minerals from roots to the leaves.
2. It keeps a plant upright or erect.
3. It transports prepared food from leaves to various parts of the plant.
4. It bears and supports branches, leaves, flowers and fruits.

Modification of stem

Like roots, stems are also modified to perform special functions such as support, food manufacturing and storage.

i. Underground modification

The underground stems of some plants like potato, ginger, onion, garlic, colocasia, etc. are modified to store food. They have thick and fleshy stems that stores starch.

Fig. 3.11



Potatoes



Onions



Colocasia

ii. Sub-aerial modification

The stem of some plants like runner, grass, fern, etc. are modified to reproduce asexually. They contain eyes or buds which grow into new plants.

Fig. 3.12



Runner grass



Runner of plants for reproduction

iii. Aerial modification

The stems of some plants like aloe, cactus, opuntia, etc. have thick and fleshy stems modified for storing food and water. Some plants like rose,

orange, lemon, etc. have thorny stems modified for protection. Plants like cucumber, grapes, pumpkin, gourd, etc. have wire-like structures, tendrils. These tendrils coil round any object and help the plant to climb up. Some stems also contain chlorophyll and help in photosynthesis.

Fig. 3.13



Thick fleshy stem of Aloe vera



Thick fleshy stem of cactus

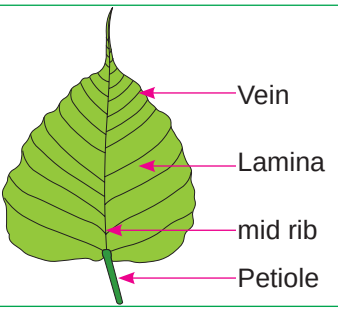


Tendrils of cucumber

B. Leaf

The flat and green part of a plant that sprouts from a node is called leaf. Flowering plants have leaves of various shapes and sizes. Lamina, petiole and leaf base are the three main parts of a leaf. Lamina or leaf blade is the flat and wide green portion of the leaf. Green plants prepare food in the lamina as it has chlorophyll, i.e. green pigment. Chlorophyll traps solar energy and helps plants in photosynthesis.

Fig. 3.14



Leaf

Petiole is a narrow, short stalk of a leaf which remains attached to the stem. Similarly, leaf base is the portion of the stem from which a leaf grows. The petiole extends into the lamina in the form of mid rib. The mid rib gives branches and sub-branches that form a network in the leaf. The network is formed by veins and veinlets which distribute water, minerals and prepared food to the lamina.

Fig. 3.15



Parallel venation

Flowering plants have two types of venations in their leaves. They are parallel venation and reticulate venation. The arrangement of veins and veinlets in a leaf is called venation. In parallel venation, veins are

arranged parallel to each other towards the tip of the leaf. This type of venation is found in leaves of sugarcane, bamboo, rice, maize, wheat, grass, onion, garlic, etc.

In reticulate venation, the veins give rise to lateral veinlets in all directions and form a network. This type of venation is found in leaves of rose, mustard, apple, mango, papaya, orange, bean, Sunflower, etc.



Fig. 3.16 *Reticulate venation*

Functions of leaves

1. Leaves prepare food by using carbon dioxide and water in the presence of sunlight.
2. They remove excess water during transpiration.

Project Work - 1

- Collect leaves of different plants from your surroundings.
- Observe the shape, size and venation of these leaves one by one.
- Identify the types of the leaf.
- Press these leaves inside thick books for a few day.
- Paste these leaves on chart paper and display in your classroom.

Modification of Leaf

Leaves are the green and flat parts of plants having chlorophyll. Leaves help in photosynthesis. They also help in breathing and transpiration. Besides these main functions, leaves of plants are modified to perform special functions as follows.

Some plants like cactus, barberry, etc. have thorns in their leaves for protection. Insectivorous plants like pitcher plants, venus fly-trap, etc. have modified leaves for catching insects. In pea plants, leaf is modified into tendril for support. In cactus, prickly pear, etc. leaves are modified into spines to reduce loss of water due to transpiration.

Fig. 3.17



Leaf of cactus with thorns



Pitcher plant



Tendrils of pea plant

In this way, the roots, stems and leaves of different plants are modified to perform some additional functions.

C. Flower

We see a variety of flowers in our surroundings. Flowers are colourful. They have bright and attractive colours like red, yellow, pink, purple, white, blue, orange, etc. Flowers are the colourful and most attractive parts of plants. Flowers have different shapes, sizes and colours. They help in sexual reproduction.

Fig. 3.18



Flower

A flower consists of four distinct parts. They are sepals, petals, stamen and pistil or carpel. Some flowers contain only one type of reproductive organ, i.e. either stamen (male) or carpel (female). These flowers are called unisexual flowers. Plants like pumpkin, maize, paddy, cucumber, etc. have unisexual flowers.

Fig. 3.19



Unisexual flower

Some flowers contain both male and female reproductive organs. These flowers are called bisexual or complete flowers. Plants like pea, China rose, orange, tomato, apple, bean, etc. contain bisexual flowers.

A flower is connected to the stem by a narrow stalk called pedicel. A flower has a swollen basal portion called thalamus.

A complete flower consists of four distinct whorls or rings. They are as follows:

(i) Calyx
(ii) Corolla
(iii) Androecium
(iv) Gynoecium

(i) Calyx

Calyx is the outermost whorl of a flower. It is made of a number of green leaf like structures called sepals. Calyx protects a flower in the bud stage.

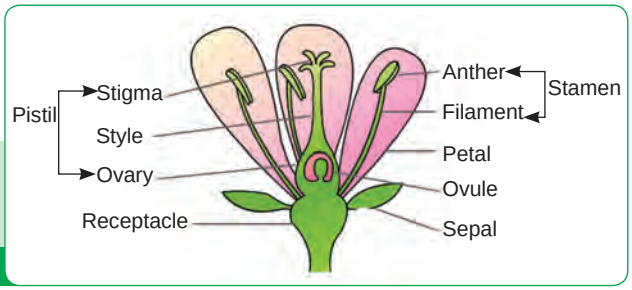


Fig. 3.20 *Bisexual flower*

(ii) Corolla

Corolla forms the second whorl of a flower. It consists of colourful petals. Petals surround and protect the reproductive parts of a flower. Similarly, petals attract insects and help in pollination.

(iii) Androecium

Androecium forms the third inner whorl of a flower. It consists of a number of male reproductive organs called stamens. Each stamen consists of anther, filament and connective. Anther produces pollen grains and filament supports the anther.

(iv) Gynoecium

Gynoecium forms the fourth innermost whorl of a bisexual flower. It represents the female reproductive part called pistil or carpel. Each carpel consists of three parts, viz. stigma, style and ovary. Stigma receives pollen grains and ovary consists of ovules in it. The ovary develops into a fruit and ovules develop into seeds with maturity.

Activity 7

- Visit a nearby garden and collect some flowers.
- Observe calyx, corolla, androecium and gynoecium of those flowers.
- Paste these parts of flowers on a chart paper and let them to dry. Submit the chart paper to your science teacher.

Pollination

The transfer of pollen grains from anther to the stigma of the same flower or different flower is called pollination. Various external agents like air, water, insects, birds, animals, etc. help in pollination.

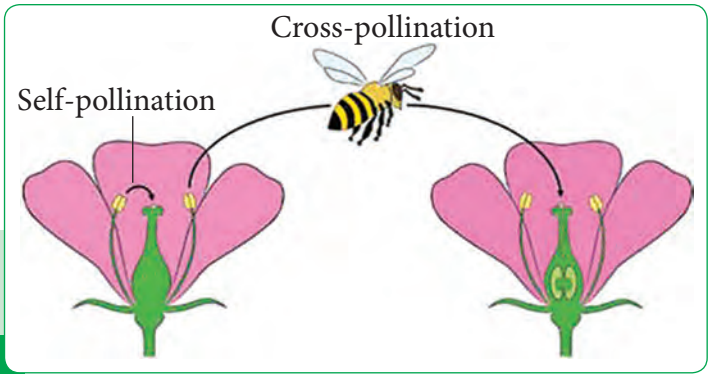


Fig. 3.21 *Pollination*

D. Fruit

The fully matured ovary of a flower is called fruit. A fruit consists of two main parts. They are pericarp and seed. The pericarp may be thin or thick. The pericarp of the fruit consists of three parts, viz. epicarp, mesocarp and endocarp.

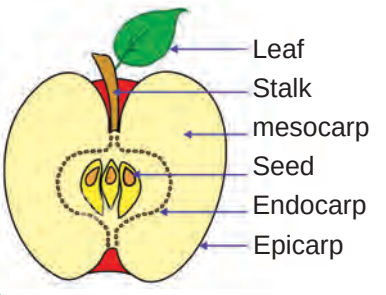


Fig. 3.22 *Parts of a fruit*

The outermost thin and leathery part of a fruit is called the epicarp. The middle fleshy portion of the fruit is called the mesocarp and the innermost hard portion of the fruit is called the endocarp. The endocarp encloses the seeds.

Functions of a fruit

1. Fruit stores food materials.
2. It develops seeds and helps in reproduction.
3. It helps in seed dispersal.

Activity 8

- Collect some fruits and study their structure.
- Identify endocarp, mesocarp and epicarp of these seeds.
- Draw a neat figure of each fruit and label the main parts.

E. Seed

The matured ovule that germinates into a new plant is called a seed. Different plants have different types of seeds. Seeds of some plants are very small whereas the seeds of some plants are large. Seeds of different plants have different colours.

Fig. 3.23



Seed of mango



Seeds of peach



Seeds of papaya

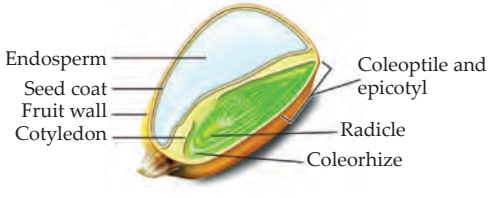


Seeds of sesame

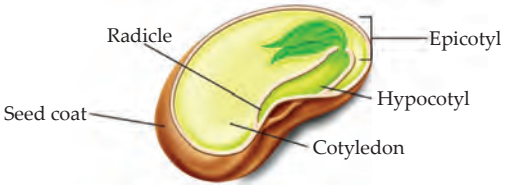
Structure of a seed

Different plants have different types of seeds. They differ in shape and size. However, their basic structure is similar. A typical seed has three main parts. They are (i) embryo (ii) endosperm or cotyledons and (iii) seed coat. The embryo is an immature plant which grows into a new plant on favourable condition. It consists of two parts, viz. radicle and plumule. The radicle develops into root system and plumule develops into shoot system. Seeds store food for the embryo in endosperm or cotyledons. In monocots, only one cotyledon is present in a seed and in dicots two cotyledons are present.

Fig. 3.24



Structure of a monocot seed



Structure of a dicot seed

In monocots, the food storage tissue is called endosperm but in dicots the cotyledons serve as storage tissues. A seed coat is the outer cover which protects a seed. It is essential to protect the embryo from mechanical injury and from drying out.

A seed consists of a small scar on the seed coat called the hilum. It is found where the seed was attached to the ovary wall. There is a small opening near the hilum which is called micropyle. Water enters inside the seed through this opening and helps in germination of seed.

Differences between Radicle and Plumule

Radicle	Plumule
1. The radicle is the embryonic root.	1. The plumule is the embryonic shoot.
2. It grows towards the soil.	2. It grows away from the soil.

Activity 9

- Collect the seeds of some plants and study their structure.
- Identity various parts of those seeds such as embryo, cotyledon, endosperm, hilum, micropyle, etc.
- Draw a neat figure of each and label the main parts.

Types of seed

On the basis of number of cotyledons, there are two types of seeds. They are (i) Monocot seed (ii) Dicot seed.

i. Monocot seed

The seed which consists of only one cotyledon or seed leaf is called monocot seed. Maize seed, wheat seed, paddy seed, etc. are examples of monocot seeds.

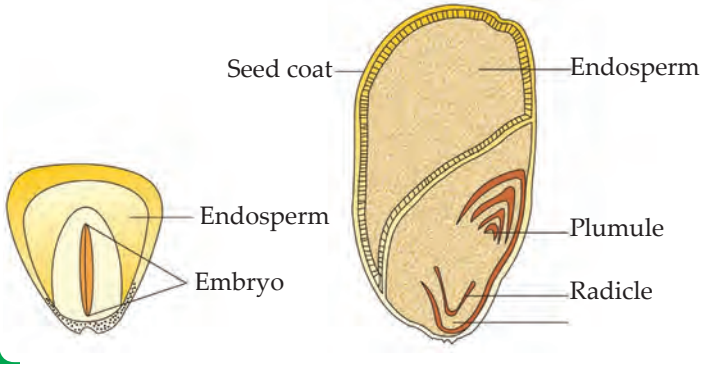


Fig. 3.25 *Detailed structure of a maize seed*

In monocot seeds, endosperm occupies the major portion of a seed. In a maize seed, the broader part contains endosperm which consists of white or yellow reserved food material. The narrower part of the

seed contains cotyledon. The cotyledon consists of a small embryo. Endosperm and embryo are separated by a thin membrane. Plumule is present on the broader part of the seed and radicle is present on the opposite side of the plumule.

Seeds of maize, paddy, wheat, millet, barley, etc. are endospermic monocot seeds.

ii. Dicot seeds

A seed having two cotyledons or seed leaves is called dicot seed. Examples: seeds of pea, grams, orange, beans, lentils, etc. In dicot seeds, endosperm is absent. The cotyledons acts as storage tissues in dicot seeds.

In bean seeds, the middle portion of the seed contains embryo. The embryo contains radicle and plumule.

In dicot seeds, micropyle and hilum can be seen with our naked eyes. Dicot seeds are found inside pods.

Differences between monocot seed and Dicot seed

Monocot seed	Dicot seed
1. Only one cotyledon is present in a seed.	1. Two cotyledons are present in a seed.
2. Embryo is small.	2. Embryo is large.
3. Micropyle and hilum cannot be seen with our naked eyes.	3. Micropyle and hilum can be seen with our naked eyes.
4. Endosperm is present.	4. Endosperm is absent.
5. Plumule is very small.	5. Plumule is large.

On the basis of presence or absence of endosperm, seeds are of two types. They are:

i. Endospermic seed

ii. Non-endospermic seed

i. Endospermic seed

The seeds in which food is stored in endosperm are called the endospermic seeds. Seeds of wheat, maize, paddy, barley, etc. are examples of the endopsermic seeds. All monocot seeds contain endosperm. But caster seed is a dicot seed which contains endosperm.

Fig. 3.26



maize



Wheat



Caster

ii. Non-endospermic seeds

The seeds in which food is stored in cotylenods are called non-endospermic seeds. Seeds of pea, bean, lentil, orange, lemon, soyabean, peanut, etc. are examples of non-endospermic seeds. All dicot seeds are non-endospermic except caster seeds.

Fig. 3.27



Pea



Peanut



Bean

Functions of seeds

1. Seeds help in sexual reproduction in flowering plants.
2. Seeds store food materials.
3. The seed coat protects the embryo.

Activity 10

- Collect some seeds of maize, soyabean, raazma, bean,wheat, etc.
- Soak these seeds separately for one day.
- Study their structure and classify them as monocot seeds or dicot seeds.
- Identity endosperm, cotyledon, radicle and plumule in these seeds.

Activity 11

- Take a beaker and keep some water in it.
- Take three seeds of bean and tie them on a scale as shown in the figure.
- Adjust seeds in the scale in such a way that one seed gets completely immersed in water, the middle is half-immersed and the uppermost seed is in the air.
- Observe the seeds after 4-5 days.

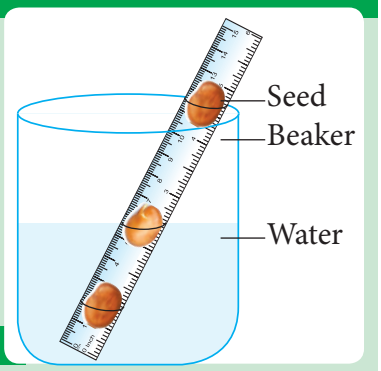


Fig. 3.28

You can see the germination of half-immersed seed only. What can you conclude from this activity?

Project work - 1

- Select some small plants in your locality.
- Collect root, stem, leaves and flowers of these plants.
- Press these parts of plants inside thick books and let them dry.
- Paste these parts of plants in a chart paper. Write their features and label their main parts.
- Paste the chart paper in the classroom

Key concepts

1. Different types of living beings are found on the earth. These living beings are broadly classified into two kingdoms, viz (i) Animal Kingdom and (ii) Plant Kingdom.
2. Animals and plants are found in different habitat and climatic conditions. They have different structures and characteristics according to their habitat.
3. The plants that bear flowers, fruits and seeds are called flowering plants.
4. A flowering plant can be divided into two parts, viz. root system and shoot system.
5. The underground part of a plant is called root system.
6. The root system having primary root, its branches and sub-branches is called tap root system.

7. Tap root system is found in dicot plants like bean, pea, mustard, apple, mango, rose, soyabean, orange, etc.
8. The root system having cluster of roots of the same size and thickness is called fibrous root system.
9. Fibrous root system is found in monocot plants like sugarcane, onion, maize, bamboo, paddy, wheat, garlic, etc.
10. The roots of some plants like radish, turnip, carrot, etc. are modified to store food.
11. The roots of plants that are found in marshy places are modified for breathing.
12. Shoot system is the part of the plant which is found above the ground.
13. The part of a flowering plant that grows upwards from the soil is called stem.
14. The portion of the stem between two nodes is called internode.
15. Stems are also modified to perform special functions such as support, food manufacturing and storage.
16. The flat and green part of a plant that sprouts from a node is called leaf.
17. Chlorophyll traps solar energy and helps plants in photosynthesis.
18. The arrangement of veins and veinlets in a leaf is called venation.
19. Leaves prepare food by using carbon dioxide and water in the presence of sunlight.
20. Insectivorous plants like pitcher plants, venus fly-trap, etc. have modified leaves for catching insects.
21. Flowers are the colourful and most attractive parts of plants.
22. A flower consists of four distinct parts. They are sepals, petals, stamen and pistil or carpel.
23. The transfer of pollen grains from anther to the stigma of the same flower or different flower is called pollination.
24. Pollination is of two types, viz. self-pollination and cross-pollination.
25. The fully matured ovary of a flower is called fruit.
26. The pericarp of the fruit consists of three parts. They are epicarp, mesocarp and endocarp.
27. A seed is a mature ovule produced inside the fruit.

Exercise

1. Tick (√) the best answer from the given alternatives.

a. Which of the following is a flowering plant?

☐ mushroom ☐ mustard ☐ moss ☐ marchantia

b. The underground part of a plant is called the .....

☐ root system ☐ shoot system ☐ soil system ☐ stem system

c. Parallel venation is found in the leaves of a .....

☐ mango ☐ apple ☐ pea ☐ sugarcane

d. The male reproductive organ of a flower is called .....

☐ sepal ☐ stamen ☐ petal ☐ pistil

e. Which of the following dicot seed has an endosperm?

☐ Seed of castor ☐ Seed of bean

☐ Seed of lemon ☐ Seed of peanut

2. Put a tick (√) for the correct statement and a cross (×) for the incorrect one.

a. The underground part of a plant is called the root system. ☐

b. The fibrous root system is found in pea and bean. ☐

c. Leaves help in photosynthesis. ☐

d. Corolla forms the outermost whorl of a flower. ☐

e. The seed of maize contains two cotyledons. ☐

3. Fill in the blanks using appropriate words.

a. The part of the plant which is found above the ground is called .....

b. The root system which is found in monocot is ..... root system.

c. Stem transports water and minerals from ..... to leaves.

d. The arrangement of veins and veinlets in a leaf is called .....

e. The pericarp of fruit contains three parts. They are epicarp, ... and endocarp.

4. Match the following :

a.	Sepal	☐	Female reproductive organ
b.	Petal	☐	male reproductive organ
c.	Stamen	☐	Outermost whorl of a flower
d.	Pistil	☐	Young fruit
		☐	Second whorl of a flower

5. Answer the following questions.

a. What are flowering plants? Give any four examples.

b. What is the root system? Write down the functions of roots.

c. What is the shoot system? Write down the functions of the shoot system.

d. What are leaves? Write the major functions of leaves.

e. What is a flower? Name the four whorls of a flower.

f. What is calyx? Write its function.

g. What is corolla? Write its function.

h. Define androecium and gynoecium.

i. How are roots of plants modified? Give examples.

j. How are stems of plants modified? Write with any three examples.

k. How are leaves of plants modified?

l. What are fruits? Write down the major function of seed.

m. Define monocot and dicot seeds with any three examples of each.

6. Differentiate between:

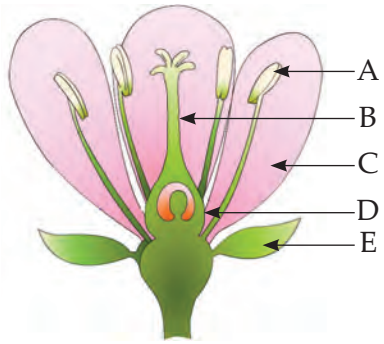
a. Root system and shoot system
b. Tap root and fibrous root
c. Sepals and petals
d. Stamen and pistil
e. Monocot and dicot seeds

7. Give suitable reasons.

a. Plants cannot survive without roots.
b. Petals are attractive parts of a flower.
c. Sugarcane is called a monocotyledonous plant.
d. Bean is called a dicotyledonous plant.
e. Pumpkin flower is called a unisexual flower.

8. Study the given figure and answer the following questions.

a. Name the part of a plant shown in the figure.
b. Label the parts A, C and E.
c. Write down the major function of D and E.
d. Write any two differences between C and E.



9. Draw a neat and labelled figure showing:

a. Tap root system
b. Fibrous root system
c. A bisexual flower

10. Draw a neat figure of a dicot seed and label cotyledon, radicle, plumule and endosperm in it. Also, write the major function of each.

B. Invertebrates

3.2. Introduction to Invertebrates

Activity 12

- Observe any ten animals in your locality and write their names.
- Study their features and find out whether they have backbone or not.
- Classify these animals in terms of invertebrates and vertebrates.

S.N.	Invertebrates	Vertebrates

Animals like earthworm, mosquito, grasshopper, butterfly, dragonfly, honeybee, cockroach, leech, snail, slug, etc. do not have backbone or vertebral column. These animals are called invertebrates. They are primitive animals having less developed organs and systems. Invertebrates are those animals which do not have backbone or vertebral column. Examples: Amoeba, sponge, hydra, tapeworm, roundworm, earthworm, butterfly, snail, starfish, etc.



Fig. 3.29

mosquito *Butterfly* *Earthworm* *Starfish*

3.2.1 Characteristics of Invertebrates

1. Invertebrates do not have backbone or vertebral column.
2. Some of them are unicellular and the rests are multicellular.
3. Their organs and systems are less developed.
4. Their body may have a hard protective covering.
5. They are found in water, land and air.

3.2.2 Classification of Invertebrates

On the basis of structure and development, invertebrates are classified into nine phyla (groups). They are as follows:

1. Protozoa
2. Porifera
3. Coelenterata
4. Platyhelminthes
5. Aschelminthes
6. Annelida
7. Arthropoda
8. Mollusca
9. Echinodermata

1. Phylum Protozoa or Unicellular Animals

Phylum Protozoa consists of unicellular and microscopic animals.

Habitat

Protozoans are commonly found in water and moist places. Some of them are found inside the body of other animals as parasites.

Do You Know

- Protozoans cannot be seen with our naked eyes. So, they are called microscopic animals. However, they can be seen through compound microscope.
- The method of reproduction in which an organism divides into two or more daughter organisms is called fission.

Salient features

a. Protozoans are unicellular and microscopic animals.
b. They breathe through general body surface.
c. They reproduce by fission, i.e. binary fission or multiple fission.
d. All life processes of protozoans occur in the single cell.

Examples: Amoeba, Paramecium, Euglena, Plasmodium, etc.

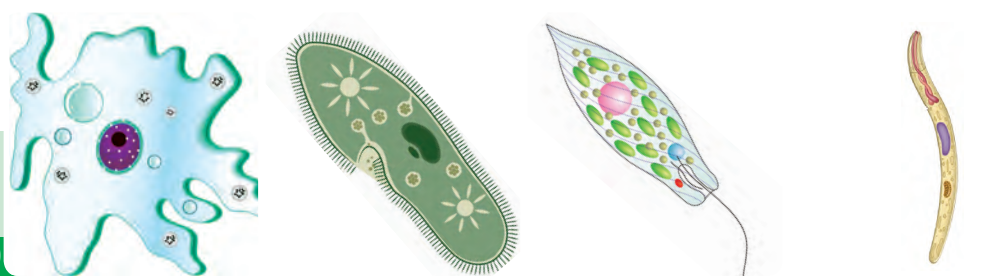


Fig. 3.30 *Amoeba* *Paramecium* *Euglena* *Plasmodium*

Activity 13

- Go to science laboratory and observe the structure of amoeba, paramecium and euglena under the compound microscope.
- Draw a neat and labelled figure of each in practical file.
- Write salient features of each.

2. Phylum Porifera or Spongy Animals

Phylum Porifera consists of primitive multicellular animals having numerous pores in their bodies. They are commonly known as sponges.

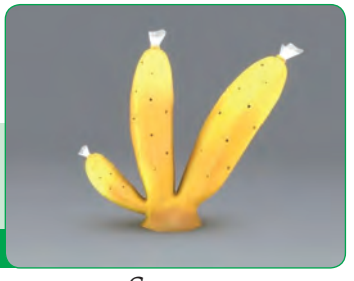
Habitat

Sponges are commonly found in water, i.e. fresh water and marine water. Their body remains attached to the substratum with the help of basal disc.

Salient features

a. They have numerous pores on their bodies.
b. They are multicellular animals.
c. Their body remains attached to the surface of rocks, woods, etc. with the help of basal disc.
d. They don't have head, eyes and legs.

Examples: Sycon, Spongilla, Euspongia, etc.


Sycon


Spongilla


Euspongia

Fig. 3.31

3. Phylum Coelenterata or Hollow-bodied Invertebrates

Phylum Coelenterata consists of aquatic invertebrates having hollow body cavity called coelenteron.

Habitat

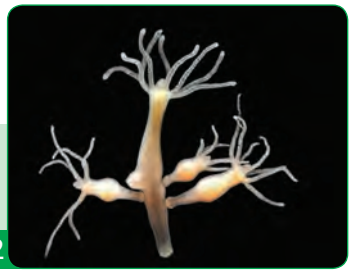
Coelenterates are found in fresh water and marine water.

Salient features

a. Coelenterates have a coelenteron, i.e. hollow body cavity.
b. Mouth is present but anus is absent.
c. Mouth remains surrounded by tentacles.
d. Breathing takes place through general body surface.
e. They reproduce by budding or regeneration.

Examples: Hydra, Sea anemone, Coral, etc.

Fig. 3.32



Hydra



Sea anemone



Coral

Activity 14

- Go to the science laboratory and study the museum specimen of the invertebrates belonging to phylum porifera and coelenterata.
- Draw neat and labelled figure of each with their salient features.

4. Phylum Platyhelminthes or Flatworms

Phylum Platyhelminthes consists of invertebrates having flat body. These animals are commonly known as flatworms.

Habitat

Flatworms live as parasites of animals. They are found in the intestine or liver of cow, buffalo, pig, human, dog, etc.

Do You Know

- Parasites are organisms that take food and shelter from their hosts, e.g. tape worm, liver fluke, mosquito, etc.
- The animals having male and female reproductive organs in the same body are called bisexual animals, e.g. tape worm, liver fluke, etc.
- Host is an organism which provides food and shelter to a parasite.

Salient features

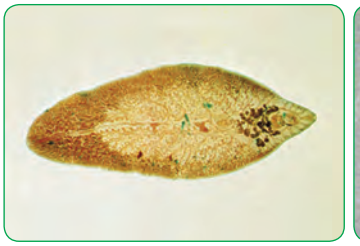
a. Their body is flat which may be leaf-like, ribbon-like or tape-like.
b. Their body may be segmented (e.g. tapeworm) or unsegmented (e.g. Liver fluke).
c. They are bisexual animals.
d. They suck blood from their hosts.

Examples: Tapeworm, Liver fluke, Planaria, etc.

Fig. 3.33



Tapeworm



Liver fluke



Planaria

Activity 15

- Visit a nearby meat shop (fresh house) and ask the butcher to collect tapeworm and liver fluke.
- Study the structure of these invertebrates.
- Draw a neat figure of each and label the main parts.

5. Phylum Aschelminthes or Nemathelminthes or Roundworms

Phylum Aschelminthes consists of invertebrates having round and unsegmented body. They are commonly known as roundworms.

Habitat

most of the roundworms live as parasites. They are found in the intestine of animals. They suck blood of their host. However, some roundworms are found in soil.

Do You Know

The organism having only one type of sex organs (male or female) in its body is called unisexual organism, e.g. round worm.

Salient features

a. The body is round, cylindrical and unsegmented.

b. Mouth and anus both are present.

c. Both the ends of their body are pointed.

d. They are unisexual animals.

Examples: Roundworm, Hookworm, Pinworm, etc.

Fig. 3.34



Roundworm (Ascaris)



Hookworm



Pinworm

Project Work - 1

- Collect a roundworm and study its structure.
- Identify its head and tail.
- Take a bottle and immerse it in 10% formalin under the supervision of your science teacher.
- Draw a neat figure in a chart paper and label the main parts and submit it to your science teacher.

6. Phylum Annelida or Segmented Invertebrates

Phylum Annelida consists of invertebrates having many segmented rings in their bodies. They are commonly known as annelids.

Habitat

They are found in water, soil and sand. Some of them are parasites (e.g. leech) and others are free-living (e.g. earthworm).

Salient features

a. Their body consists of numerous segmented rings.
b. Their body is elongated, cylindrical and segmented.
c. Their body is covered with soft and moist skin (cuticle).
d. These animals may be unisexual or bisexual.

Examples: Earthworm, Leech, Sandworm, etc.

Do You Know

- Leech sucks the blood of vertebrates like human, cow, goat, etc. So, it is called a parasite of vertebrates.
- Earthworm is found in soil. It is a free living animal.



Fig. 3.35 *Earthworm* *Leech* *Sandworm*

Project Work - 2

- Collect earthworm and leech from moist places in rainy season.
- Study the structure of each and find out similarities and differences between them.
- Submit the earthworm and leech to the science lab-in-charge.
- Draw a neat figure of each and label the main parts.

7. Phylum Arthropoda or Jointed-legged Invertebrates

Phylum Arthropoda consists of invertebrates having jointed legs. They are commonly known as arthropods.

Habitats

Arthropods are found on land, air and water.

Do You Know

Thorax is the middle part of an insect's body to which the wings and legs are attached.

Salient features

a. Arthropods have jointed legs.

b. Their body can be divided into head, thorax and abdomen.

c. They have wings and legs for movement.

d. Their body is protected with a hard cover.

Examples: Crab, Butterfly, Prawn, Grasshopper, Ant, Honeybee, moth, Spider, Scorpion, etc.

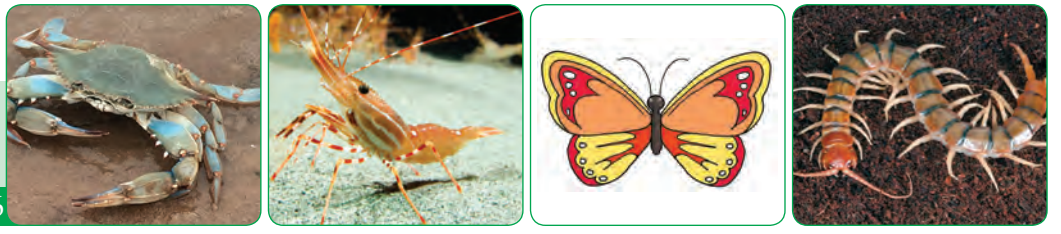


Fig. 3.36

Crab *Prawn* *Butterfly* *Centipede*

Project Work - 3

- Collect some arthropods from your locality.
- Study their structure and identify different body parts.
- Find out similarities and differences among them.
- Take a chart paper and draw a neat figure of each and label their main parts.
- Submit your work to your science teacher.

8. Phylum mollusca or Soft-bodied Invertebrates

Phylum mollusca consists of invertebrate animals having soft and unsegmented body. They are commonly called molluscs.

Habitat

Molluscs are found in water and moist soil.

Salient features

a. Molluscs have soft and unsegmented body.
b. Their body is generally covered with one or two hard shells.
c. They breathe through gills or lungs.
d. They have a distinct head which contains tentacles, eyes and mouth.

Examples: Snail, Slug, Unio, Octopus, etc.

Fig. 3.36


Snail


Slug


Unio


Octopus

Project Work

- During rainy season, collect some molluscs (snail, slug, pila, unio, etc.) from your locality.
- Study their structure carefully. Draw a neat and labelled figure of each in a chart paper and submit to your science teacher.

9. Phylum Echinodermata or Spiny Invertebrates

Phylum Echinodermata consists of marine invertebrates having spiny skin. They are commonly known as echinoderms.

Habitat

Echinoderms are found only in marine water.

Salient features

a. Echinoderms have spiny skin.
b. Their body may be star-shaped (e.g. Starfish), globular (e.g. Sea urchin) or cylindrical (e.g. Sea cucumber).

c. Distinct head is absent.

d. They move with the help of tube feet.

Examples: Starfish, Sea cucumber, Sea urchin, Brittle star, etc.

Fig. 3.38



Starfish



Sea cucumber



Sea urchin



Brittle star

Activity 16

- Visit the science laboratory and observe specimen of echinoderms.
- Study their structure and draw a neat and labelled figure of each.

Activity 17

- Observe the invertebrate animals like earthworm, leech, butterfly, snail, dragonfly, slug, cockroach, mosquito, honey bee, spider, grasshopper, moth, etc. in your locality.
- Study their structure carefully.
- Draw a neat and labelled figure of each on a chart paper.
- Write any three salient features of each and submit to your science teacher.

Key concepts

1. Invertebrates are those animals which do not have backbone or vertebral column.
2. Protozoans cannot be seen with our naked eyes. So, they are called microscopic animals.
3. Phylum porifera consists of primitive multicellular animals having numerous pores in their bodies.
4. Flatworms live as parasites of animals. They are found in the intestine or liver of cow, buffalo, pig, human, dog, etc.
5. Phylum mollusca consists of invertebrate animals having soft and unsegmented body.
6. Phylum echinodermata consists of marine invertebrates having spiny skin.

Exercise

1. Tick (√) the best answer from the given alternatives.

a. Which of the following animals belongs to Phylum Protozoa?

- ☐ snail
- ☐ amoeba
- ☐ hydra
- ☐ tapeworm

b. Sea anemone belongs to Phylum .....

- ☐ Coelenterata
- ☐ Mollusca
- ☐ Protozoa
- ☐ Arthropoda

c. Which of the following animals lives as a parasite?

- ☐ hydra
- ☐ tapeworm
- ☐ earthworm
- ☐ butterfly

d. Which of the following animals have jointed legs?

- ☐ snail
- ☐ mosquito
- ☐ starfish
- ☐ octopus

e. Which of the given animals moves with the help of tube feet?

- ☐ slug
- ☐ sea anemone
- ☐ leech
- ☐ sea urchin

2. Tick (√) the correct statements and cross (×) the incorrect ones.

a. Paramecium belongs to Phylum Protozoa. ☐

b. Coelenterates have numerous pores in their bodies. ☐

c. Roundworm is found in the intestine of animals. ☐

d. Cockroach is kept in Phylum Arthropoda. ☐

e. Starfish has tentacles for movement. ☐

3. Fill in the blanks using appropriate words.

a. Amoeba belongs to Phylum .....

b. Tapeworm is found in ..... of animals.

c. Leech sucks ..... of vertebrates.

d. Cockroach has jointed ..... for movement.

e. Snail is grouped in Phylum .....

4. Match the following.

a. Amoeba	☐ Phylum Arthropoda
b. Roundworm	☐ Phylum Protozoa
c. Coral	☐ Phylum Aschelminthes
d. Honeybee	☐ Phylum Annelida
e. Octopus	☐ Phylum Coelenterata
	☐ Phylum Mollusca

5. Answer the following questions.

a. Define invertebrates with any five examples.

b. State any two features of invertebrates.

c. Define coelenterates and flatworms with any three examples of each.

d. Write any three salient features of the animals that belong to Phylum Aschelminthes.

e. Define arthropods with any four examples.

f. Write any three salient features of the animals belonging to Phylum Mollusca.

g. Why is octopus kept in Phylum Mollusca?

h. Define echinoderms with any two examples.

i. Why is earthworm kept in Phylum Annelida? How does it differ from *Ascaris* (Roundworm)?

6. Differentiate between:

a. Tapeworm and Liverfluke

b. Roundworm and Tapeworm

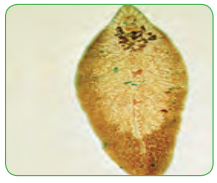
c. Earthworm and Roundworm

7. Identify the given animals. Write their phylum with any two salient features.

a. 

b. 

c. 

d. 

8. Give suitable reason.

a. Spongilla is called an invertebrate.

b. Tapeworm is called a parasite.

c. Leech is grouped in Phylum Annelida.

d. Sea cucumber is kept in Phylum Echinodermata.

9. Tapeworm and earthworm both have segmented body. But they are kept in different phylum, why?

10. Liver fluke is unsegmented but tapeworm is segmented. But both of them are kept in the same phylum, why?

C. Cell: The Basic Unit of Life

3.3. Introduction to Cell

Activity 18

- Visit a nearby place where a new house is being built. Observe the different materials. What are the units to build a big house? Bricks or stones?



Fig. 3.39

- These bricks or stones are the building blocks. You can compare these bricks as cells in our body.

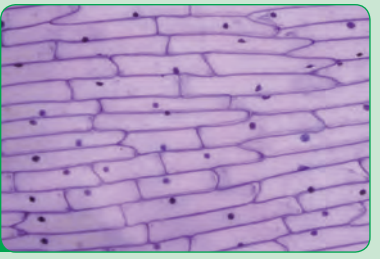


Fig. 3.40

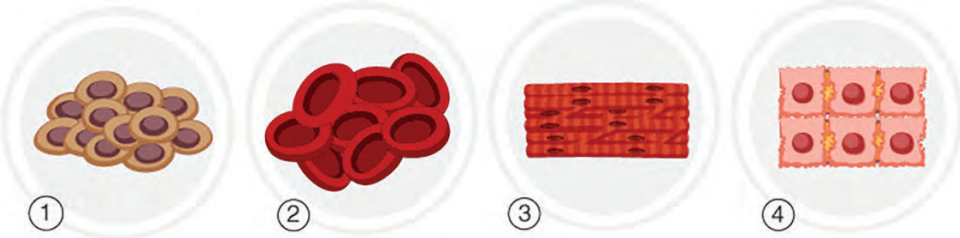
The bodies of living beings are made of tiny units called cells. Different types of plants and animals are found around us. Some of them are made of only one cell, whereas most of the plants and animals are made of many cells. The cells in living beings can be compared with the bricks in a building. Cells are very small in size and cannot be seen with our naked eyes. Therefore, we use compound microscope to see the detailed structure of cells. The basic, structural and functional unit of life is called cell. Various activities like growth, reproduction, respiration, excretion, etc. occur inside the cell.

Do You Know

- Cell was discovered by an English scientist Robert Hooke in 1665 AD.
- most of the cells are microscopic and cannot be seen with our naked eyes.

Plants and animals differ greatly in their shapes and sizes. Similarly, cells also differ in their shapes. They may be rectangular, hexagonal, oval, spherical, polygonal, etc. most of the cells are microscopic. They are very small in size. However, some plant cells and animal cells can be seen with our naked eyes.

Fig. 3.41



Cells of different shape and size

Activity 19

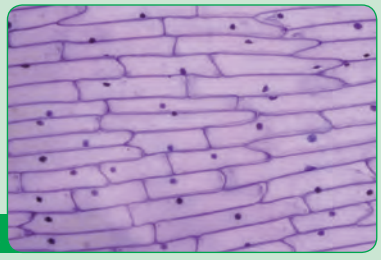
- Go to the science laboratory along with your science teacher.
- Observe the slides of plant cell and animal cell under the compound microscope.
- Draw neat and labelled figure of each.

Activity 20

To observe onion cells under a compound microscope:

- Take a bulb of onion and remove outer dry scales. Cut the bulb into small pieces vertically.
- Take a fleshy scale and bend its outer surface and pull the broken thin layer using foreceps.
- Place the thin layer in a watch glass containing water and sefranin.
- Take a glass slide and put a drop of glycerine at the middle of the slide.

Fig. 3.42



Onion cells under the compound microscope

- Place the thin layer of onion, cover it gently with a cover slip and observe it under the compound microscope.
- Draw a neat figure after your observation.

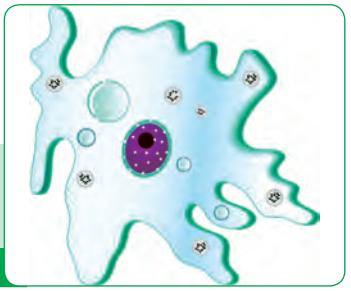
3.3.1 Unicellular and multicellular Organisms

Unicellular organisms

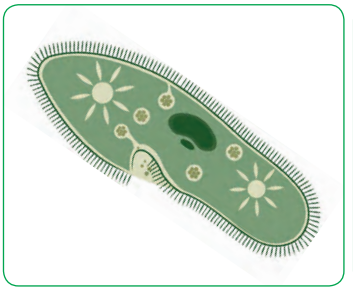
The organisms having only one cell in their bodies are called unicellular organisms. They are very less developed. They do not have tissues, organs

and systems. Examples: Amoeba, Paramecium, Euglena, Plasmodium, chlamydomonas, etc. In unicellular organisms, all life processes like respiration, digestion, excretion, etc take place in a single cell.

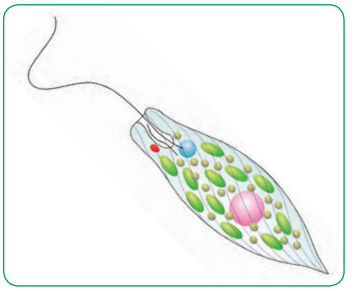
Fig. 3.43



Amoeba



Paramecium



Euglena

multicellular organisms

The organisms having many cells in their bodies are called multicellular organisms. They are more developed than unicellular organisms. They have tissues, organs and systems. Examples: Hydra, tapeworm, earthworm, butterfly, fish, frog, snake, crow, elephant, rose, mango, spirogyra, etc. multicellular organisms have different organs and systems to perform various life processes.

Fig. 3.44







3.3.2 Structure of Cell (Plant cell and Animal cell)

Though cells are very small in size, they are made of various parts such as cell wall, cell membrane, mitochondria, vacuoles, plastids, centrosome, endoplasmic reticulum, ribosomes, etc. A brief description of various parts of a cell is given below:

1. Cell wall

The outermost covering layer of plant cells is formed by cell wall. It is a hard and rigid structure made of a non-living substance called cellulose.

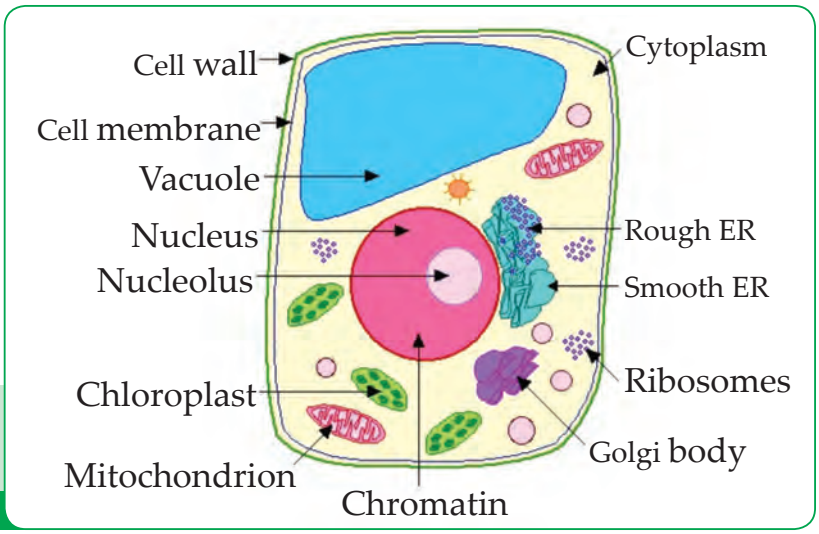


Fig. 3.45

Plant cell

Functions

(i) Cell wall provides a fixed shape to the plant cell.

(ii) It also protects the internal parts of plant cells.

(iii) Cell wall allows all substances to enter or leave the cell.

2. Cell membrane

Cell membrane forms the outermost covering layer of animal cells. It is a thin, living and elastic membrane. Cell membrane is found just inside the cell wall in plant cells.

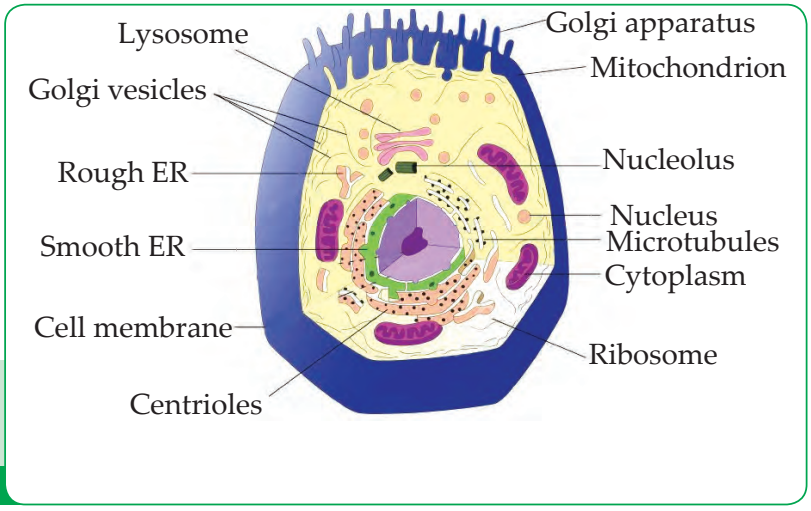


Fig. 3.46

Animal cell

Functions

(i) It provides an outer boundary to an animal cell and protects internal parts of the cell.

(ii) Cell membrane allows only selected substances to enter or leave the cell.

3. Cytoplasm

The jelly-like substance found in a cell is called cytoplasm. It is made of water, carbohydrate, protein, fat droplets, etc. Cytoplasm is enclosed by cell membrane and surrounds the nucleus. The cytoplasm consists of cell organelles and inclusions.

Do You Know

- The living bodies present inside the cell are called cell organelles, e.g. nucleus, mitochondria, plastids, etc.
- The non-living bodies present in a cell are called inclusions, e.g. vacuoles, fat droplets, etc.

Function

(i) Cytoplasm provides space for various cell organelles and inclusions.

4. Nucleus

Nucleus is the most important cell organelle present in the cytoplasm. It is round or spherical in shape. It is made of nuclear membrane, nucleoplasm, nucleolus and chromosomes.

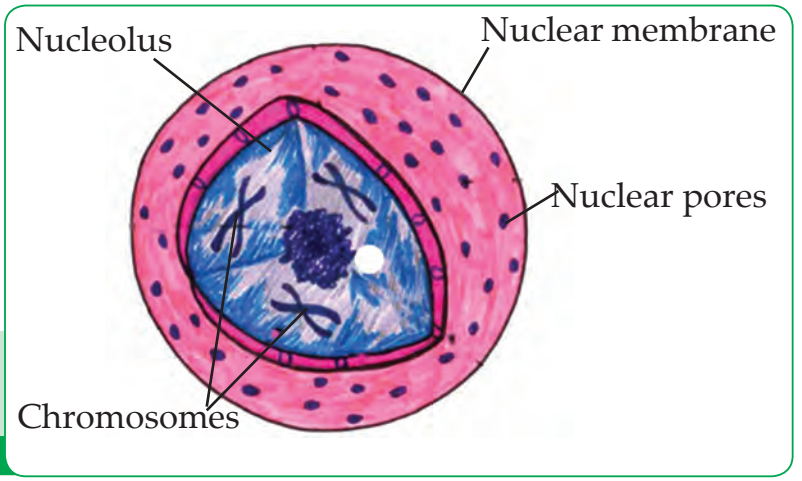


Fig. 3.47 *Nucleus*

The nucleus is found nearly at the centre in animal cells but it is slightly shifted towards the side in plant cells.

Functions

(i) Nucleus controls various activities of a cell.

(ii) It takes part in cell division.

Do You Know

- Chromosomes are thread-like structures present in the nucleus of a cell.
- Nucleus is called the director or controller of a cell.

5. Endoplasmic recticulum

The space between cell membrane and nuclear membrane is occupied by an irregular network of channels which is called endoplasmic reticulum. It is of two types, i.e. smooth endoplasmic reticulum and rough endoplasmic reticulum. Ribosomes are attached to the surface of rough endoplasmic reticulum.

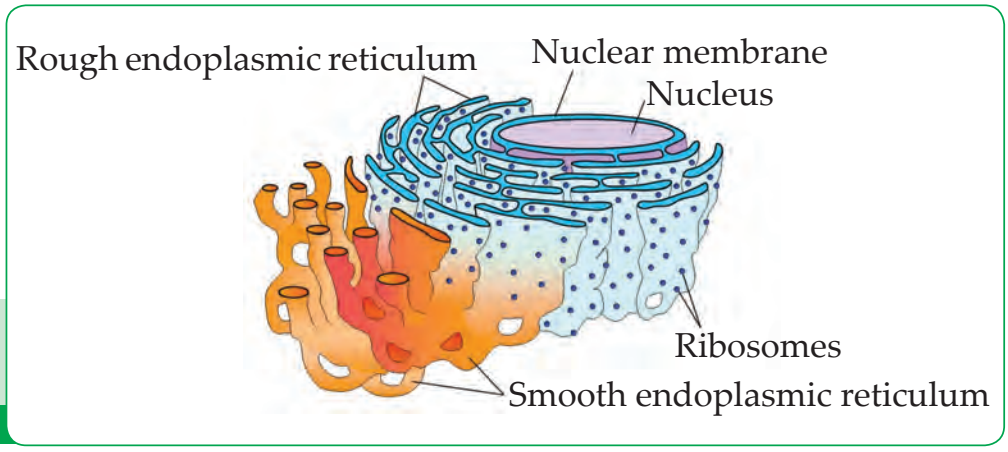


Fig. 3.48

Endoplasmic reticulum

Functions

(i) Endoplasmic reticulum forms the supporting framework of the cell.

(ii) It provides mechanical support to the cytoplasm.

6. Mitochondria

Mitochondria are spherical, oval or thread-like cell organelles present in the cytoplasm. They have an outer membrane and an

inner membrane. Mitochondria are the sites of energy production and storage. Therefore, they are called the power houses of a cell.



Fig. 3.49 *mitochondrion*

Functions

(i) Mitochondria produce energy required for the cell.

(ii) They store energy.

7. Vacuoles

Vacuoles are non-living, fluid-filled structures found in the cytoplasm. In animal cells, vacuoles are smaller but more in number, whereas they are larger but less in number in plant cells. Vacuoles are filled with water, waste materials, carbohydrates, minerals, etc.

Functions

(i) Vacuoles help in excretion.

(ii) They help in the growth of the cell.

8. Ribosomes

Ribosomes are very small round or spherical structures present in the cytoplasm. They are also found attached to the tubes of rough endoplasmic retciculum.

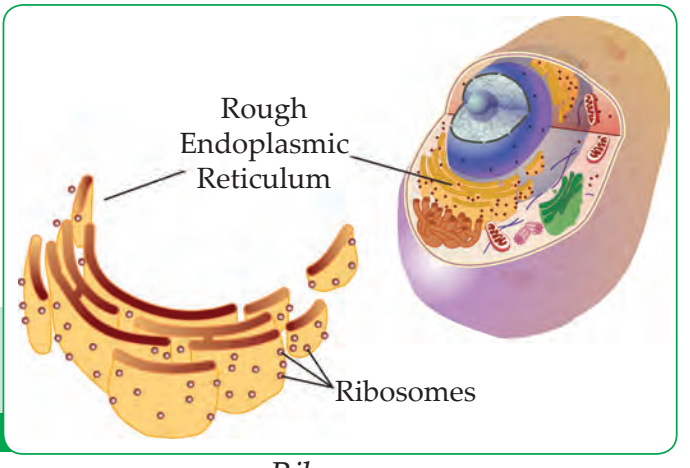


Fig. 3.50 *Ribosomes*

Function

(i) Ribosomes help is protein synthesis.

Do You Know

- Chlorophyll traps the solar energy and helps the green plants in photosynthesis.
- The process of making food by green plants in their leaves is called photosynthesis.

9. Plastids

Plastids are spherical, oval or disc-shaped structures found in plants cells. They are located in the cytoplasm. In plant cells, plastids are of three types. They are:

(i) Chloroplast

(ii) Chromoplast and

(iii) Leucoplast

Chloroplasts include green pigment called chlorophyll. The leaves and young stem of plants appear green due to the presence of chlorophyll.

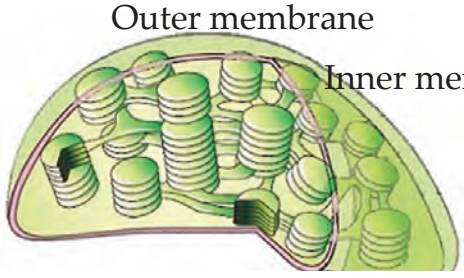


Fig. 3.51 *Plastids*

Chromoplasts are found in petals of flowers and pericarp of fruits. They contain colourful pigments.

Leucoplasts are found in underground parts of the plants such as roots. They contain colourless pigments.

Functions

(i) Chloroplasts trap the solar energy and help in photosynthesis.

(ii) Chromoplasts give colour to petals and fruits.

(iii) Leucoplasts store food.

10. Centrosome

Centrosome is a very small protoplasmic structure present near the nucleus in the cytoplasm. It is found only in animal cells.

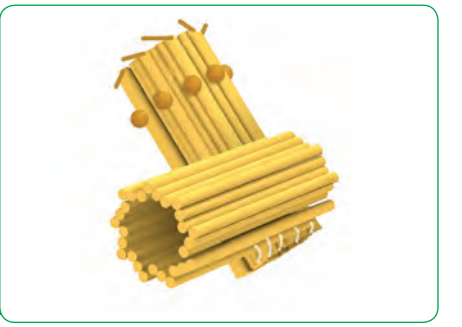


Fig. 3.52 *Centrosome*

Function

(i) It helps in cell division of animals cells.

Project Work 4

- Take a cardboard paper. Collect materials like thread, bits of bead, paper, glue, grains, pulses, etc.
- Use these materials and prepare models of plant cell and animal cell.
- Label various parts of these cells and submit to your science teacher.

3.3.3 Differences between Plant Cell and Animal Cell

Plant cell	Animal cell
1. Cell wall is present.	1. Cell wall is absent.
2. Plastids are present.	2. Plastids are absent.
3. Centrosome is absent.	3. Centrosome is present.
4. Vacuoles are less but larger is size.	4. Vacuoles are more but smaller in size.
5. The shape may be rectangular or hexagonal.	5. The shape may be round or oval.

Activity 21

Prepare a venn-diagram showing the parts of cell that are found in plant cell and animal cell.

Key concepts

1. The bodies of living beings are made of tiny units called cells.
2. The cells in living beings can be compared with the bricks in a building.
3. The basic, structural and functional unit of life is called cell.
4. The outermost covering layer of plant cells is formed by cell wall.
5. Cell membrane forms the outermost covering layer of animal cells. It is a thin, living and elastic membrane.
6. The jelly-like substance found in a cell is called cytoplasm.
7. Nucleus is the most important cell organelle present in the cytoplasm. It is round or spherical in shape.
8. The space between cell membrane and nuclear membrane is occupied by an irregular network of channels which is called endoplasmic reticulum.
9. Mitochondria are the sites of energy production and storage.
10. Vacuoles are non-living, fluid-filled structures found in the cytoplasm.
11. Ribosomes are very small round or spherical structures present in the cytoplasm.
12. The organisms having only one cell are called unicellular organisms and the organisms having many cells are called multicellular organisms.

Exercise

1. Tick (√) the best answer from the given alternatives.

a. Which of the following controls the various activities of a cell?

☐ vacuole ☐ nucleus

☐ centrosome ☐ plastid

b. The outermost covering layer of animal cell is called .....

- ☐ nucleus
- ☐ cell membrane
- ☐ cell wall
- ☐ cytoplasm

c. Which of the following cell organelle helps in photosynthesis?

- ☐ plastid
- ☐ mitochondrion
- ☐ centrosome
- ☐ nucleus

d. The cell organellele which is found only in plant cell is .....

- ☐ centrosome
- ☐ plastid
- ☐ mitochondrion
- ☐ ribosome

3. Which of the following helps in cell division in animals?

- ☐ ribosome
- ☐ centrosome
- ☐ plastids
- ☐ vacuole

2. Tick (√) the correct statement and cross (×) the incorrect one.

a. Cell is the fundamental unit of life. ☐

b. Cell wall is the outermost covering layer of plant cells. ☐

c. Mitochondrion controls various activities of a cell. ☐

d. Plastids help in photosynthesis. ☐

e. Nucleus is found only in animal cells.

f. Amoeba is a multicellular animal. ☐

3. Fill in the blanks using appropriate words.

a. The structural and functional unit of life are called .....

b. Cell wall is made of .....

c. Chloroplasts help in .....

d. Mitochondria are also called ..... of a cell.

e. Chromoplasts are found in ..... of flowers.

f. The organisms having only one cell are called ..... animals.

4. Match the following :

a.	Controls various activities of a cell	☐	Vacuole
b.	Helps in photosynthesis	☐	Cell wall
c.	Helps in protein synthesis	☐	Centrosome
d.	Provides shape to a cell	☐	Plastid
e.	Helps in excretion	☐	Nucleus
		☐	Ribosome

5. Answer the following questions.

a. Define cell. Why is cell called fundamental unit of life?

b. Name the instrument which is used to see the details of a cell.

c. Name the scientist who discovered the cell.

d. What is cell wall? Write down its functions.

e. Name the outermost covering layer of animal cells.

f. What is cytoplasm? Write its functions.

g. What is nucleus? Write its two functions.

h. What is endoplasmic reticulum? Write its functions.

i. What are plastids? Where are they found?

j. Name three types of plastids. Also, write down the functions of each.

k. What are ribsomes? Write down their function.

l. What is a centrosome? Write down its function.

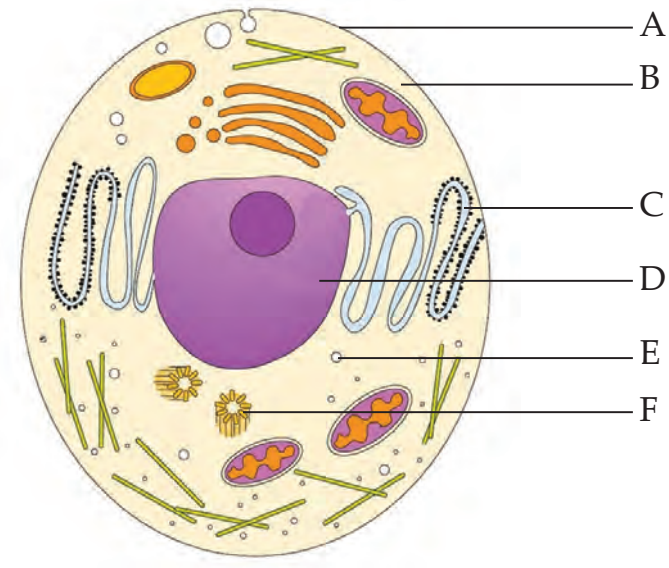
m. Define unicellular and multicellular organisms.

6. Write any four differences between plant cell and animal cell.

7. Draw a neat and labelled figure showing the detailed structure of a

(i) Plant cell (ii) Animal cell

8. Name the parts of A to F shown in each of the given figures. Also, write down the major function of each.



9. Give suitable reason.

a. Cell is called the basic unit of life.

b. Nucleus is called the controller of the cell.

c. Mitochondria are called the power houses of a cell.

10. Describe the structure of a plant cell with a neat and labelled figure.

UNIT
04

Biodiversity and Environment

Estimated teaching hours : 10

Before You Begin

Biodiversity is the existence of different types of plants and animals on the earth. A variety of living organisms, viz. plants and animals are found around us. They differ in habitat, structure, shape, size, colour, behaviour, life cycle, reproduction, etc. In simple words, biodiversity is the biological diversity. It refers to the genetic variation, ecosystem variation and species variation on the earth.

Environment is the natural world around us where plants and animals live. Environment consists of the physical world as well as the biological world. The earth is the common habitat for all plants and animals. Living beings get air, water, food, habitat, etc. from the earth. Environment is made of the abiotic and the biotic components. The abiotic components of the environment include sunlight, air, water, soil, temperature, pressure, rainfall, etc. Similarly, the biotic components of an environment include different types of plants and animals.

Learning Outcomes

After completing the study of this unit, students will be able to:

- introduce environment and its balance.
- define natural resources, classify them and describe their importance.
- introduce water resources, watersheds and wetlands and explain their importance.
- state causes and effects of depletion of natural resources.
- manage solid wastes by following 3Rs (reduce, reuse and recycle).

Syllabus

- Biodiversity - Introduction
- Environment and its balance
- Natural resources and their classification
- Importance of water sources, watersheds and wetlands
- Depletion of natural resources
- Management of solid wastes (reduce, reuse and recycle)

Glossary

afforestation	:	the act or process of planting a forest
biodiversity	:	the existence of large number of plants and animals
conservation	:	a careful preservation and protection of something, planned management of natural resources to prevent exploitation, destruction, etc.
degradation	:	the damage or disturbance to any aspect of something
ecosystem	:	the structural, functional and self-sustaining unit made of living beings and non-living things
embankment	:	a raised structure used specially to hold back water or to carry a roadway
environment	:	the natural world around us where plants and animals live
genetic	:	heritable, relating to or determined by the origin
mutual	:	shared between two or more people or groups
perpetual	:	everlasting or continuing forever
species	:	a group of closely related organisms which can interbreed freely to produce fertile offspring
sustainable	:	capable of being sustained, able to be used without being completely used up or destroyed

A. Biodiversity, Environment and Its Balance

4.1 Introduction to Biodiversity

Activity 1

- Observe different types of plants and animals found in your locality.
- Write the names of these plants and animals in a chart paper.
- If you don't know the names of plants and animals, ask to your teachers and seniors.

The occurrence of different types of plants and animals is called biodiversity. In simple words, biodiversity is the variety of life on the earth. Biodiversity is the shortened form of two words 'biological' and 'diversity'. Biodiversity refers to all variety of life found on the earth which includes plants, animals, fungi and micro-organisms.



Fig. 4.1

Biodiversity is of three types. They are species diversity, genetic diversity and ecosystem diversity. Species diversity refers to the variety of different species of living beings. Genetic diversity refers to the variety of genes contained in plants, animals, fungi and micro-organisms. Similarly ecosystem diversity refers to all different habitats that exist on the earth. Biodiversity is essential for human health and well being, food safety and security economic prosperity and other areas. Biodiversity also supports ecosystem to provide and purify water. Similarly, biodiversity is an important and irreplaceable source for medicines as well. Therefore, we should conserve biodiversity.

Nepal is rich in biodiversity. Different species of plants and animals are found in terai, hilly and himalayan regions. However, all the species of organisms that are found in terai region are not found in hilly and himalayan region. Different types of plants and animals are found in different climatic conditions. For example, elephant and rhinoceros are found in terai region but not in hilly region and himalayan region. Similarly, yak is found in mountainous region but not in terai region. It is due to variation in geographical and climatic conditions.

4.2 Environment and its Balance

Environment is the place where plants and animals live. There is a continuous interaction between/among various biotic and abiotic components of an environment. This interaction maintains proper relationship between/among them. The proper and close relationship between/among various biotic and abiotic components of environment is called environmental balance. For example, there should be continuous interaction between plants and animals to create balance between animals and plants. Similarly, the balance between amount of oxygen and that of carbon dioxide creates balance in atmosphere for the survival of both animals and plants.



Fig. 42

The condition of environment where all the components of environment are closely interrelated to one another for their existence and survival is called balanced environment. The disturbance in any components in environment causes imbalance in the environment. For example, in the absence of plants, the existence of animals is impossible. Similarly, destruction of plants causes increment of amount of carbon dioxide and reduction of oxygen gas. As a result, animals cannot survive in the absence of oxygen gas. Therefore, it is necessary to maintain proper natural relationship between all components of the environment to maintain environmental balance. The importance of environmental balance is given in the following points.

i. Living beings can survive only in a balanced environment without any problem.
ii. Balanced environment is useful for both animals and plants for their existence.
iii. Natural disasters can be minimized by maintaining balanced environment.
iv. Natural resources can be conserved in balanced environment.
v. Environment degradation and pollution can be minimized.

vi. Environmental sanitation can be maintained by maintaining proper balance in environment.
vii. Rare animals and plants can be saved in balanced environment.
viii. Developmental works are sustainable in balanced environment.
ix. Proper growth and development of all living beings is possible in balanced environment.

4.2.1 Ways of maintaining Environmental Balance

Various activities of human beings are responsible for disturbing natural environment. Therefore, it is the duty and responsibility of human beings to maintain environmental balance.

The following ways can be adopted to maintain the environment in a balanced condition.

i. Wise and judicious use of natural resources with their conservation
ii. Proper management and disposal of waste materials
iii. Conserving wildlife and vegetation
iv. Discouraging deforestation and encouraging afforestation
v. Conducting environment friendly development activities
vi. Maintaining environmental sanitation
vii. Scientific way of agriculture
viii. Proper management of grazing and pasture land for domesticated animals
ix. General awareness regarding importance of environment

Activity 2

Observe various natural resources that are found in your locality. Name these resources and write their utilities in the given table.

S.No.	Name of natural resources	Utilities
1.		
2.		
3.		
4.		
5.		

4.3 Natural Resources

Natural resources refer to the resources that are available in natural environment. These resources are water, air, land, forest, minerals, animals, plants, sunlight, etc. These resources are naturally created in the environment. Both living beings and non-living things are natural resources. Living beings include all types of plants and animals, whereas air, water, soil, minerals, etc. are non-living things. Natural resources provide suitable environment for all living beings for their life in the environment. All living beings in the environment get food and habitat from natural resources. Thus, natural resources are very important for living beings.

Fig. 4.3


Forest


Sunlight


River


Coal mine

Natural resources

4.3.1 Kinds of natural resources

Natural resources are classified into perpetual, renewable and non-renewable on the basis of their properties and utility. The brief description of each type of natural resource is provided below:

a. Perpetual natural resources

The natural resources like solar energy, wind energy, tidal energy, etc. have never-ending supply. These are perpetual natural resources. In this case, the natural resources which do not get exhausted after large exploitation are called perpetual resources of energy. They have never ending supply of energy and do not get depleted due to their continuous use. Perpetual resources are unlimited in nature.

Fig. 4.4



Sun



Tides of sea

b. Renewable natural resources

The natural resources like water, air, forests, soil, etc. can be used again and again by producing them are renewable resources. They never get exhausted from the environment and can be maintained repeatedly for our use. The natural resources that can be used repeatedly by creating them again and again and do not deplete from the environment are called renewable resources.

c. Non-renewable natural resources

Some natural resources like petroleum products, minerals, natural gas, etc. are limited in nature and get exhausted after their use. They cannot be obtained and produced again and again in a short period of time. Such types of natural resource are non-renewable resources. Non-renewable natural resources refer to the resources that cannot be used again and again and get exhausted after their use. Some examples of non-renewable resources are petrol, diesel, coal, kerosene, minerals, etc. They are found in specific places of the earth and their store gets finished after their use.

Fig. 45



Coal



Petrol



Marble

Activity 3

- Make a list of any 15 natural resources available in your locality.
- Classify them under the headings: perpetual renewable and non-renewable by making a table.

4.3.2 Importance of natural resources

Various natural resources available in nature have their own importance. For example, living beings cannot survive in the absence of food, water, air, etc. The importance of natural resources can be explained in the following points.

a. Sources of food

Various natural resources found in nature are the sources of food for living beings. Green plants prepare their food by using water and carbon dioxide in the presence of sunlight. Human beings grow various crops in soil to get their food. Herbivores feed on plants and carnivores feed on various creatures. Thus, living beings or non-living things found in the form of natural resources are the sources of food for living beings.

b. Habitat

Land, water, forest, etc. are the habitats of various kinds of living beings. For example, human beings build houses on land by using various natural resources like soil, water, wood, etc. Aquatic animals live in water and wild animals live in forest. Various types of plants grow in water and on land. Thus, natural resources are habitat of both plants and animals.

c. Fresh air and water

Air and water are vital components essential for survival of living beings. Both animals and plants need air and water for their survival and these natural resources are available in nature.

d. Beauty

Natural resources are the sources of beauty of the place where they are available. For example, forest, wildlife, water bodies, mountains, falls, valleys, etc. have their own beauty in nature.

Fig. 4.6



Rara lake



Falls

e. Tourism

Human beings are attracted towards natural beauty. Natural beauty is the result of natural resources and it is the major source of attraction of tourists. The flow of tourists results in flourishing of tourism. Thus, natural resources are important for tourism.

Fig. 4.7



Phewa lake



Annapurna Base Camp

f. Economic development

Fig. 4.8



Hydroelectricity power plant

Various natural resources are used for operating various developmental activities. For example, soil, stone, etc. are used to construct roads, buildings, etc. Similarly, various natural resources are used as raw materials to produce various goods in the factories or industries. Water resources are used to produce hydroelectricity. All these activities conducted for physical development are the sources of economic development also. Thus, natural resources have a great importance for economic development of a country.

4.3.3 Conservation of natural resources

Human beings use various natural resources for their livelihood. In the absence of natural resources, the lives of human beings and other living beings are not possible. The rational use of natural resources is essential. Misuse or abuse of natural resources invites environmental degradation resulting in environmental imbalance. Thus, it is necessary to conserve various types of natural resources available in nature to maintain balance in natural environment. In this connection, brief description of some natural resources with their importance and ways of conservation is presented.

4.4. Importance of Water resources, Watershed and Wetlands

4.4.1 Water resources



Fig. 4.9

There are various water resources on the earth. They are surface water, underground water, rain water, etc. The sources of water found on the earth are called water resources. Water is a very essential natural resource for all living beings for their survival. Similarly, water is useful for various purposes like irrigating, washing, cleaning, etc. besides drinking. Living beings ranging from micro-organisms to large animals along with all types of plants cannot survive without water. Thus, water is a very important natural resource for all living beings.

Various types of water bodies like lake, pond, river, etc. are available on the earth surface. The water found in such bodies is called surface water. It is collected on the earth by rain. Surface water evaporates due to the heat of the sun. The sources of water found under the earth surface are called sources of underground water. Underground water is pulled on the earth surface for various purposes. The water obtained from precipitation (rain) is called rain water. Rain water is very essential for both animals and plants. Our country is rich in water resources. Various types of water resources like rivers, streams, ponds, lakes, wetlands, watersheds, fountains, etc. are abundant in Nepal.

Importance of water resources

Various types of water resources are the main sources of water on the earth. These water sources are essential for all living beings for their survival. Similarly, water is equally important for various activities like washing, cleaning, irrigating, industrial work, transportation, recreation, etc. The importance of water is given in the following points.

1. Water is an essential component for all living beings for their survival. Animals drink water and green plants need water to prepare their food during photosynthesis. Thus, water resources are important for the survival of all living beings.
2. Water resource are important for household works like cleaning, washing, cooking, bathing, etc.
3. Water resources are essential for irrigating agricultural farms.
4. Water resources are important for tourism industry. Boating, rafting, swimming, rowing, etc. are water related sports of tourism industry.
5. The major source of renewable energy, hydroelectricity is generated from water resources.
6. Various means of transportation like boat, ship, motor boat, etc. are operated on water.
7. Water resources are essential to conserve wildlife and vegetation.
8. Hydroelectricity generated from water resources is used to operate various means of transportation like cable car, trolley bus, train, electric car, etc.

Fig. 4.10



Deer drinking water



Boating



Cable car

9. Water is used in industries, factories, construction areas, etc. for various purposes. For example, water is used to construct buildings, bridges, etc. Similarly, water is essential for producing thermoelectric power, refining oil, extracting natural gas, etc. in the factories and industries.

10. Water resources are very much helpful for maintaining environment balance by helping the survival of both animals and plants in their natural environment.
11. Water resources are the habitats of various aquatic animals and plants.

Conservation of water resources

Water resource is one of the important natural resources that provides water to all living beings and non-living things. It is necessary to conserve various water resources for the existence of both plants and animals in the earth. Water resources should be conserved to meet the need of increasing population at present. Similarly, it is necessary to protect habitats of both aquatic animals and plants to maintain environment balance. The overuse and unmanaged use of water should be avoided. Likewise, water resources should not be polluted. Conservation of forests is essential to conserve water resources.

Activity 4

- make a visit to a nearby water resource area in your locality to study about the water resource.
- make a short note on importance and ways of conservation of that water resource on the basis of your study.

4.4.2 Watershed

A watershed refers to the entire region draining into a river, river system or other water bodies. It is an area of land that contains a common set of streams and rivers that all drain into a larger body of water. In such area surface water from rain or melting snow converges to a single point. Thus, the area around various water resources is a watershed. In Kathmandu valley, the water collected in Shivapuri-Nagarjun area is an example of watershed. This watershed is source of water of Bagmati and Bishnumati rivers in Kathmandu. Similarly, the area around Phewa taal in Pokhara is Phewa taal watersed. In Kulekhani, human made lake is formed for collecting water from Kulekhani watershed. Likewise, Gandaki, Koshi and Karnali are big watershed of our country. There are many small watersheds in Nepal.

Fig. 4.11



Watershed



Kulekhani Watershed

Importance of watershed

Watersheds are sources of water required for various purposes. The importance of watershed is pointed out below.

Fig. 4.12



1. Watersheds fulfill the requirement of water for animals and plants of the watershed located areas.
2. Watersheds conserve forests and vegetation of the watershed area.
3. Watersheds protect agricultural lands and help increase agricultural productivity.
4. Watersheds maintain the system of environmental balance and also conserve environmental balance.
5. Watersheds provide habitats to various animals and plants.

Conservation of watersheds

Watersheds are good sources of water required for various purposes. It is necessary to conserve watershed to conserve source of water essential for both animals and plants. But, watersheds are in crisis due to the massive exploitation of land and forest resources to fulfill the needs of increasing population. Conserving watersheds is essential to conserve natural environment. Afforestation, planting grass, management in farming, etc. can be done to conserve watersheds. Similarly, awareness programmes related to importance and conservation of water should be conducted for awareness to conserve watersheds.

4.4.3 Wetland

A land area which is saturated with water permanently or seasonally, is called wet land. It is the link between land and water. Swamp, marsh, blog, etc. are some of the common names of different types of wetlands. According to the nature and type of wetland, it may be filled mostly with moss, grasses, herbs, shrubs, trees, etc. Marshes and ponds, the edge of a lake or ocean, low-lying areas that frequently flood are examples of wetlands. Generally, wetlands are common in the Terai region. The water bodies having a water level less than 6 m are defined as wetlands.

According to the study of IUCN, there are 163 wetlands in the Terai region of Nepal. Similarly, 164 wetlands are in the Hilly region and 78 wetlands are in the mountain region. The Koshi Tappu Wildlife Reserve is the first wetland enlisted as the Ramsar site in 1987 AD. There are many ponds, lakes, swamps, glaciers, marshes, etc. in our country. Both natural and artificial wetlands are found in Nepal. Thus, Nepal is rich in wetlands.

Fig. 4.13



Koshi Tappu Wetland



Ghodaghodi Lake

Importance of wetlands

Wetlands are the sources of water essential for both animals and plants. The importance of wetlands is pointed out below.

1. Wetlands are suitable habitats for birds.
2. Wetlands provide water for agricultural activities.

Fig. 4.14



Birds of Koshi Tappu Wetland

3. Wetlands help in maintaining environmental balance.
4. Wetlands provide habitats to different kinds of creatures.
5. Wetlands are good water resources for human beings.
6. Wetlands are used for fish farming.
7. Wetlands help in water-tourism.
8. Wetlands are important for conservation of biodiversity.
9. Wetlands help in controlling soil erosion and flood.

Conservation of Wetlands

Various activities of human beings adversely affect wetlands. Such activities are expanding residential areas, extending farming lands by drying water of wetlands, excessive use of water from the wetlands, polluting wetlands by throwing garbages and agricultural by products, etc. Thus, it is essential to conserve wetlands in order to conserve natural source of water.

Various efforts have been made at the national and international level to conserve wetlands. An international conference was held in the city of Ramsar of Iran in 1971 AD. It rectified an accord regarding conserving wetlands. Many wetlands of Nepal have been enlisted as the wetlands of international importance. Such wetlands are the Koshi Tappu Wildlife Reserve, Bis Hajari Lake of Chitwan, Ghodaghodi Lake of Kailali, etc. It is necessary to conserve wetlands to maintain natural ecosystem, to conserve biodiversity and for community development. It is necessary to stop misuse and overuse of water of wetlands.

Wetlands can be conserved by stopping expansion of farming land and residential areas by drying wetlands. Similarly, we should not pollute wetlands by throwing garbages, industrial by products, etc. in wetlands. Likewise, various programmes regarding the importance of wetlands should be conducted to generate awareness among people in order to conserve wetlands.

Activity 5

Make a visit to a nearby wetland in your locality and prepare a short description by addressing the following questions.

1. What is the importance of the wetland of your study area?
2. What are the problems of the area that may harm wetlands?
3. What may be the ways of conserving the wetland of the study area?

4.5 Depletion of Natural Resources

Activity 6

Study the given figures and discuss how these events/activities deplete natural resources.









Fig. 4.15

Activity 7

Ask your seniors regarding the status of natural resources like forest, wildlife, medicinal plants, mineral mines, etc. in your locality.

- Prepare a list of these resources and also discuss the main causes of depletion of these natural resources.
- Suggest measures to conserve these natural resources.

Various unwise and careless activities of human beings are especially major causes of depletion of natural resources. Overuse and destruction of natural resources for the immediate benefit of human beings is mostly responsible in creating imbalance in natural

environment. At present, overuse of natural resources due to rapid growth in population and migration is the major factor of degradation in environment. Some of the major human causes of environmental degradation are population growth, excessive use of natural resources, nature-friendly developmental works, urbanization, industrialization, etc. These causes of environmental degradation are described below briefly.

1. Population Growth and Overuse of Natural Resources

Human beings obtain food and shelter from environment. They use natural resources for various purposes like producing food, constructing shelters, operating industries and factories, etc. Growth in population results in more use of natural resources. As a result, natural resources are getting destroyed to fulfill the demands of increasing population. It creates environmental imbalance resulting in environmental degradation. Thus, it is essential to control rapid population growth to conserve environment.



Fig. 4.16

Similarly, migration of people to urban and city areas in search of facilities like education, health, transportation, etc. also causes over pressure on natural resources of urban areas. It becomes a challenge to manage and dispose waste materials in the areas having dense population. Unmanaged disposal of wastage, sewage, etc. is also responsible for polluting various components of natural environment like air, water, land, etc. Therefore, overuse of natural resources should be stopped and proper management of waste materials is essential to maintain environmental sanitation.

2. Industrialization

Industrialization is one of the major causes of environmental degradation. The rapid growth in industries, factories, etc. is industrialization. With the advancement in science and technology, many industries and factories are in operation to meet the various demands of people.

Industries and factories are essential for economic development of the nation. But, unplanned and unmanaged rapid growth in industrialization causes environmental degradation. More natural resources as raw materials are needed to operate industries. It creates over pressure on natural resources. Over pressure on natural resources result in degradation of natural resources. Similarly, the by products, sewage, wastage, gases etc. emitted from industries pollute environmental components like air, water, soil etc.

Sound produced from industries or factories is the cause of sound pollution. Inorganic components like plastics produced from industries pollute land. Thus, unmanaged industrialization degrades natural environment and hence it is necessary to control rapid growth of unplanned industrialization in order to conserve environment.

Activity 8

Make a visit to an industry or a factory in your locality and study its adverse effects on environment of the surrounding area. Prepare a short report on the basis of your study. Present the report in the classroom.

3. Urbanization

Urbanization is the process of expanding residential areas or establishing cities or towns by construction of large buildings in search of modern facilities. At present, people migrate to city areas in search of various facilities like employment, education, health, etc. It causes over population and is the cause of over pressure and over use of natural resources like water, air, etc. Ultimately, excessive use of natural resources results in environmental degradation. Similarly, various types of pollutions like air pollution, water pollution, land pollution, etc. are responsible for environmental degradation in urban areas. Unmanaged and unplanned urbanization is the major cause of environment degradation in recent days.



Fig. 4.17

People have established cities and markets in farming lands. In the process of urbanization, deforestation has taken place which is the major cause of air pollution, water pollution, etc. It also invites natural disasters like soil erosion, landslides, flood, etc. Increasing use of the vehicles and rapid growth of industrialization in human residential areas also pollute natural environment essential for animals and plants. Ultimately, it degrades the whole natural environment and disturbs environmental balance. Thus, it is necessary to control unmanaged and unplanned urbanization in order to conserve environment.

Activity 9

Make a study of any one natural disasters (flood, landslide, fire) of your locality and enlist its causes, impacts and preventive measures. Also, present it in your classroom.

4. Deforestation



Fig. 4.18

Forest is a very important natural resource. It provides food and habitat to animals including human beings. Human beings obtain various materials from forest that are used for various purposes like construction, making furniture, etc. Forest is the home for wild animals. Both wild animals and domesticated animals get fed from forest. Different human activities are responsible for destruction of forest. The act of clearing forest for various purposes like excessive use of forest timber for construction work, expansion of agricultural land and residential area, etc. is called deforestation. The major causes of deforestation are given below.

Causes of deforestation

i. Expansion of cultivating land and residential area by clearing forest haphazardly.
ii. Unplanned and unmanaged grazing and extension of pasture land.
iii. Forest fire and wild fire.

iv. Expansion of unmanaged industrialization.
v. Migration of people in unplanned manner
vi. Rapid growth in construction works leading to overuse of timber
vii. Using firewood as major source of fuel
viii. Natural disasters like soil erosion, landslides, flood, etc.

Effects of deforestation

The major effects of deforestation is environmental imbalance. Forest plays a prominent role to create natural environment. It maintains balance between carbon dioxide and oxygen. It results in environmental balance required for both animals and plants. Also, forest maintains proper water cycle. Deforestation has various adverse effects on natural environment which are mentioned below.



Fig. 4.19 *Landslide*

i. Imbalance between carbon dioxide and oxygen by reducing the amount of oxygen and increasing amount of carbon dioxide in environment.
ii. Climate change and global warming.
iii. Disturbance in natural water cycle.
iv. Destruction of habitats of wildlife
v. Loss in medicinal herbs and timber
vi. Extinction of various rare plants and animals
vii. Reduction in fertility of soil
viii. Possibility of various natural disasters like soil erosion, landslides, floods, etc.
ix. Adverse effect in agricultural system due to climate change, acid rain, drought, scarcity of water, natural disasters, etc.

Thus, it is necessary to conserve forest resources by afforestation, conducting awareness programmes, conserving forest plants, grass land and pasture land, utilizing forest resources wisely, stopping forest fire

and prohibiting haphazard clearing of forests.

5. Fire

Fire is a natural disaster which is especially caused by carelessness of human beings. Fire is the condition of becoming flames out of control. Generally, it occurs during summer season in the Terai and Hilly regions of Nepal. It destroys lives and properties.

Major causes of fire

i. Natural disasters like volcanic eruption and thunder.
ii. Careless human activities like misuse of fire by children, throwing cigarette buts near forest, residential areas, etc.
iii. Short circuit in electricity supply
iv. Introducing fire in forest, dry grassland, etc.



Fig. 4.20

Major impacts of fire

i. Destroys lives and properties.
ii. Damages habitats of wild animals and plants by destroying vegetation.
iii. Kills wildlife and damages vegetation (in case of forest fire)
iv. Causes air pollution
v. Degrades natural environment by destroying natural balance.
vi. Destroys infrastructures like building , electric components, etc.

4.6 Effects due to Depletion of Natural Resources

Various living beings and non-living things are natural resources. These resources are wildlife, vegetation, air, water, soil, minerals, fossil fuel, etc. All living beings depend on natural resources for their survival and to fulfill their various needs. Air and water are life components of all kinds of animals and plants because plants and animals cannot survive in the absence of these components. But, excessive and unmanaged use

of natural resources is the major cause of degradation and depletion of natural resources. At present, increasing population, rapid growth in urbanization and industrialization, excessive use of natural resources are the major causes of creating over pressure on natural resources. Thus, natural resources are being degraded and destroyed day by day.

The degradation and destruction of natural resources results in environmental degradation and imbalance among various components of environment. Both biotic and abiotic components of environment get affected adversely due to the environmental degradation created by degradation of natural resources. Vegetation, animals and birds, water resources, air, land, minerals, etc. are adversely affected by unmanaged human activities.

Key concepts

1. It is necessary to maintain proper natural relationship between all components of the environment to maintain environmental balance.
2. Natural resources refer to the resources that are available in natural environment.
3. The natural resources like solar energy, wind energy, tidal energy, etc. have never-ending supply. These are perpetual natural resources.
4. The natural resources that can be used repeatedly by creating them again and again and do not deplete from the environment are called renewable resources.
5. Non-renewable natural resources refer to the resources that cannot be used again and again and get exhausted after their use.
6. Various natural resources found in nature are the sources of food for living beings.
7. Misuse or abuse of natural resources invites environmental degradation resulting in environmental imbalance.
8. Various types of water resources like rivers, streams, ponds, lakes, wetlands, watersheds, fountains, etc. are abundant in Nepal.
9. Water is equally important for various activities like washing, cleaning, irrigating, industrial work, transportation, recreation, etc.
10. It is necessary to conserve various water resources for the existence of both plants and animals in the earth.

11. A watershed refers to the entire region draining into a river, river system or other water bodies.
12. Watersheds fulfill the requirement of water for animals and plants of the watershed located areas.
13. A land area which is saturated with water permanently or seasonally, is called wet land.
14. Overuse and destruction of natural resources for the immediate benefit of human beings is mostly responsible in creating imbalance in natural environment.

Exercise

1. Tick (√) the correct statements and cross (×) the incorrect ones.

a. Biodiversity refers to all variety of life found on the earth. ☐

b. Perpetual resources are limited in nature. ☐

c. Forest is the habitat of wild animals ☐

d. Watersheds and wetlands are resources of water. ☐

e. Volcanic eruption and thunder are natural causes of fire. ☐

2. Fill in the blanks using appropriate words.

a. Both living beings and ..... are natural resources.

b. Non-renewable resources are ..... in nature.

c. Water resources are essential for ..... tourism.

d. A land area saturated with water is called .....

e. The act of clearing forest for various purposes is called .....

3. Answer the following questions.

a. What is biodiversity? Give one example.
b. What is environment? What does balance in environment mean?
c. Define natural resources with any three examples.
d. What are perpetual resources? Give any four examples.
e. What does habitat of animals and plants mean?

f. Define water resources with examples.
g. Why is it necessary to conserve water resources?
h. What are watersheds? Why are they important?
i. What are wetlands? Give any two examples.
j. What is deforestation? Write its two causes and three effects.
k. Define industrialization and urbanization.
l. What is fire? Write its causes and impacts to deplete natural resources.
m. Write any three main causes of depletion of natural resources.

4. Differentiate between:

a. Renewable resources and Non-renewable resources

b. Watersheds and Wetlands

5. Write short notes on:

a. Water resources
b. Wetlands
c. Industrialization
d. Watersheds

6. Explain the importance of natural resources in brief.

7. Mention any five importance of water resources.

8. How can we conserve water resources? Explain in detail.

9. Why are watersheds and wetlands important? How can we conserve them?

10. Study the given figure and write short note on it.



11. Describe the role of human beings to maintain environmental balance.

12. List any five impacts of human activities on depletion of natural resources.

13. What are the effects of depletion of natural resources on human beings? Mention any five major ones.

14. How can human beings conserve natural resources? Enumerate any five major ways.

B. Solid Wastes

4.7 Solid Wastes and Their mangement

4.7.1 Introduction to solid wastes

The waste materials that exist in solid state are called solid wastes. We produce a lot of solid wastes from houses and industries. Peel of fruits and vegetables, meat bones, waste foods, plastics, waste papers, animal dung, human excreta, pieces of leather and clothes, etc. are some examples of solid wastes.



Fig. 4.21 *Solid Waste*

Solid wastes are produced from homes, schools, hotels, hospitals, industries, cattle sheds, crop fields, etc. All these solid wastes cause environmental pollution if not disposed properly.

Activity 10

What kinds of solid wastes are produced at your home and school in one week. Name these waste. Classify them in terms of biodegradable and non-biodegradable wastes.

4.7.2 Classification of Solid Wastes

Some solid wastes decay due to the action of microbes but others don't. On this basis, solid wastes are classified into following two groups:

1. Biodegradable wastes
2. Non-biodegradable wastes

1. Biodegradable wastes

The solid wastes that decay easily are called biodegradable wastes. Examples: peel of fruits and vegetables, animal dung, human excreta, used flowers, parts of plants, dead bodies of plants and animals, etc. All waste materials derived from animals and plants get mixed with



Fig. 4.22 *Biodegradable wastes*

soil. Therefore, the waste materials derived from plants and animals are called biodegradable wastes.

2. Non-biodegradable wastes

The solid wastes that do not decay easily are called non-biodegradable wastes. Examples: plastic bags, pieces of glass, old bottles, cold drink bottles, metal cans, light bulbs, etc. These waste materials remain in the solid for a long time and cause environment pollution. Non-biodegradable wastes do not decay due to the action of microbes.

4.7.3 Methods of Waste Disposal

Questions to Discuss

1. How are solid wastes managed at your home?
2. How are solid wastes managed at your school?

Every household produces wastes or garbage everyday. In cities, a large amount of wastes is produced everyday. So it is very difficult to dispose them safely. Biodegradable and non-biodegradable wastes require different methods for their disposal. First of all, we should separate the solid wastes into biodegradable and non-biodegradable wastes. We should have two garbage bins in our house, one for biodegradable and another for non-biodegradable wastes. Then, these waste materials should be disposed by scientific methods. Some of the common methods of waste disposal are described below:

1. Recycling
2. Preparation of compost and biogas
3. Sanitary landfill
4. Incineration

1. Recycling

The process of treating things that have already been used is called recycling. We can recycle solid wastes like polythene bags, glass bottles, tin cans, metal containers, used papers, etc. The broken plastic materials like buckets, troughs, jugs, bags, plates,



Fig. 4.23 *Recycling*

Approved by CDC

etc. are sent to plastic factories for recycling. Similarly, glass paper and metal can be sent to respective factories for recycling.

2. Preparation of compost and biogas

The organic manure produced by decaying biodegradable wastes is called compost. The cooking gas which is produced by decaying cattle dung and other biodegradable wastes is called biogas. Biodegradable wastes produced from houses and industries can be used to prepare compost and biogas. Preparing compost and biogas is a natural way of reducing wastes.



Fig. 4.24 *Compost manure*

Household waste materials like animals dung, fruit and vegetable wastes, parts of plants, etc. are buried into a pit and covered with soil. Those waste materials decay after 3-4 months due to the action of microbes. As a result, waste materials are converted into compost. The compost can be used to increase the fertility of soil. It can also be sold to earn money. The crops, fruits and vegetables grown by using compost are tasty and healthy. We can also prepare compost at our homes by using biodegradable wastes produced at our homes. This method helps to reduce environmental pollution.

3. Sanitary landfill

Sanitary landfill is the process of burying waste materials under the ground. In this method, the waste materials are buried in a low lying area.



Fig. 4.25 *Sanitary landfill*

A landfill site is constructed away from the residential area, water resources and agricultural land. We should cover the landfill site with soil, when full. It prevents foul smell and breeding of insects and micro-organisms.

4. Incineration

Incineration is the process of burning of waste materials at very high temperature. Incineration is carried out in incinerators or furnaces. This method is used to burn household wastes, industrial wastes and wastes from hospitals. Incineration does not allow microbes and flies to breed. This method should be carried out away from residential areas as it causes air pollution.



Fig. 4.26 *Incinerator*

Project work

To prepare compost manure:

- Select a suitable place in the school garden and dig a pit about one metre deep and one metre wide.
- Collect biodegradable wastes and dump them into the pit.
- When full, cover the pit with soil.
- Open the pit after 4 months and observe the compost manure.

The compost manure can be used in the school garden to increase the fertility of soil.

4.7.4 Reduce, Reuse and Recycle

'Reduce, reuse and recycle' (The 3R's) is the most effective technique of waste management. We should follow this technique to reduce environmental pollution.

a. Reduce

To reduce environmental pollution, we should reduce the amount and number of wastes as far as possible. We should not use more materials than we need. It helps to reduce wastes.



Fig. 4.27 *The 3R's*

b. Reuse

Some waste materials like old books, old bottles, plastic bags, cartons, tin cans, papers, etc. can be used again and again. Old books and papers can be used by students, old plastic bags, old tin cans and bottles can be reused to store things. This activity helps to reduce environment pollution.

c. Recycle

Some wastes like broken plastics, broken glasses, used papers, etc. can be recycled to make new things. This process helps to reduce environmental pollution.

Thus, the 3R's technique helps to reduce wastes, save environment and save money too. Therefore, we should adopt 'The 3R's rule' to reduce environment pollution.

Key concepts

1. The waste materials that exist in solid state are called solid wastes.
2. The process of treating things that have already been used is called recycling.
3. The organic manure produced by decaying the biodegradable wastes is called compost.
4. Sanitary landfill is the process of burying a large amount of waste materials under the earth.
5. Incineration is the burning of waste materials at very high temperature (above 1000°C).
6. 'Reduce, reuse and recycle' (The 3R's) is the most effective technique of waste management.
7. To reduce environmental pollution, we should reduce the amount and number of wastes as far as possible.

Exercise

1. Put a tick (√) for the correct statements and a cross (×) for the incorrect one.

a. The wastes that exist in solid state are called solid wastes. ☐

b. Solid wastes do not cause environmental pollution. ☐

c. Biodegradable wastes do not decay for a long time. ☐

d. Compost is prepared by using biodegradable wastes. ☐

e. A sanitary landfill is the process of burning of waste materials. ☐

2. Fill in the blanks using appropriate words.

a. Solid wastes exist in ..... state.

b. The two groups of solid wastes are: ..... and .....

c. Compost manure is produced by decaying ..... wastes.

d. The process of burying of waste materials under the earth is called .....

e. Incineration is carried out in .....

3. Answer the following questions.

a. What are solid wastes? Give any three examples.

b. How many types of solid wastes are there? Name them.

c. Define biodegradable wastes with any three examples.

d. Define non-biodegradable wastes with any three examples.

e. Name any four methods of waste disposal.

f. What is meant by recycling? Name any two wastes that can be recycled.

g. What is compost manure? Write its use.

h. What is a sanitary landfill?

i. What is incineration? Name the equipment in which this process is carried out.

4. Differentiate between biodegradable and non-biodegradable wastes.

5. How is compost prepared? Describe in brief.

6. 'Reduce, reuse and recycle' of wastes is very important to reduce environmental pollution. Justify this statement.

UNIT
05

Life Processes

Estimated teaching hours : 10

Before You Begin

Living beings perform various activities like nutrition respiration, digestion, absorption, transportation, excretion, etc. for survival. These activities are called life processes. No organism can survive without life processes. Life is the result of various metabolic activities that occur continuously in living organisms. Life processes are simple in primitive organisms. All life processes occur within a single cell in unicellular organisms. But there are different organs and systems in developed organisms to perform various life processes. In this unit, we will study some life processes like transportation, absorption, excretion and respiration that occur in plants and animals.

Learning Outcomes

After completing the study of this unit, students will be able to:

- define life processes with examples.
- explain absorption and transportation that occur in plants and animals.
- describe the excretion that occurs in plants and animals with comparison.
- introduce respiration in plants and animals and explain its importance.

Syllabus

- Introduction to life processes
- Transportation and absorption
  - Transportation and absorption in plants
  - Transportation and absorption in animals
- Excretion
  - Excretion in plants
  - Excretion in animals
  - Differences between excretion in animals and that in plants
- Respiration
  - Respiration in plants
  - Respiration in animals

Glossary

breathing	:	the process in which oxygen is inhaled and carbon dioxide is exhaled
diffuse	:	to mix slowly a substance
excretion	:	the process of removing waste materials from the body
nutrition	:	the process of providing or obtaining the food necessary for health and growth
pulmonary	:	related to the lungs
respiration	:	the process of releasing energy by breaking down food in the presence of oxygen

5.1 Introduction to Life Processes

Activity 1

Study the given figures and answer the following questions.

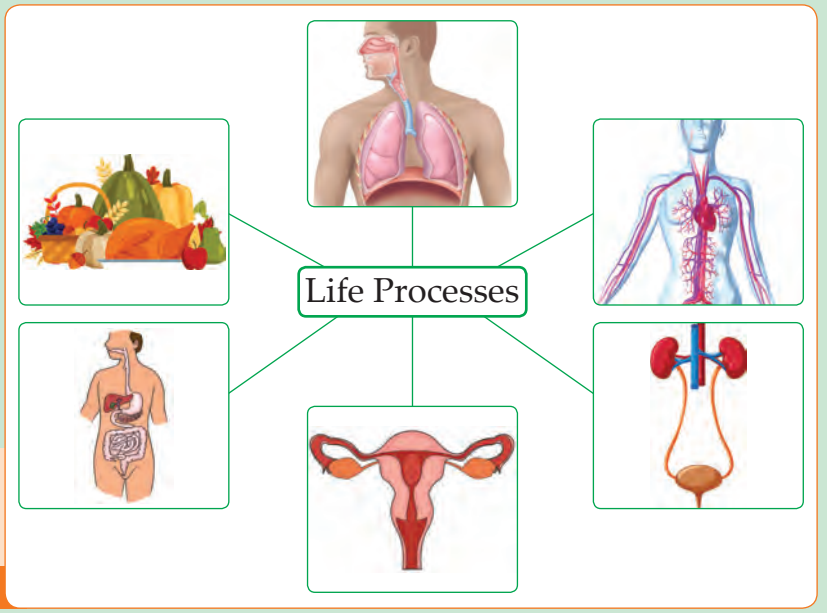


Fig. 5.1

Questions:

i) Which processes are shown in figure? Name them.

ii) List the processes that occur in plants and animals.

iii) Which process helps to transport nutrients to different body parts?

iv) Which process helps to remove waste products from the body?

v) Which processes occur both in plants and animals?

Life processes are essential for survival of living beings. Living beings take food. They breathe. They excrete. They transport materials from one part of body to another. Similarly, they reproduce their own kinds. These activities are known as life processes. Growth, nutrition, respiration, digestion, excretion, internal transport, sensitivity, reproduction, etc. are the life processes that occur in living organisms.

Life processes are those activities which are performed by living organisms for survival. In this unit, we will study some common life processes like transport, abortion, excretion, and respiration that occur in plants and animals.

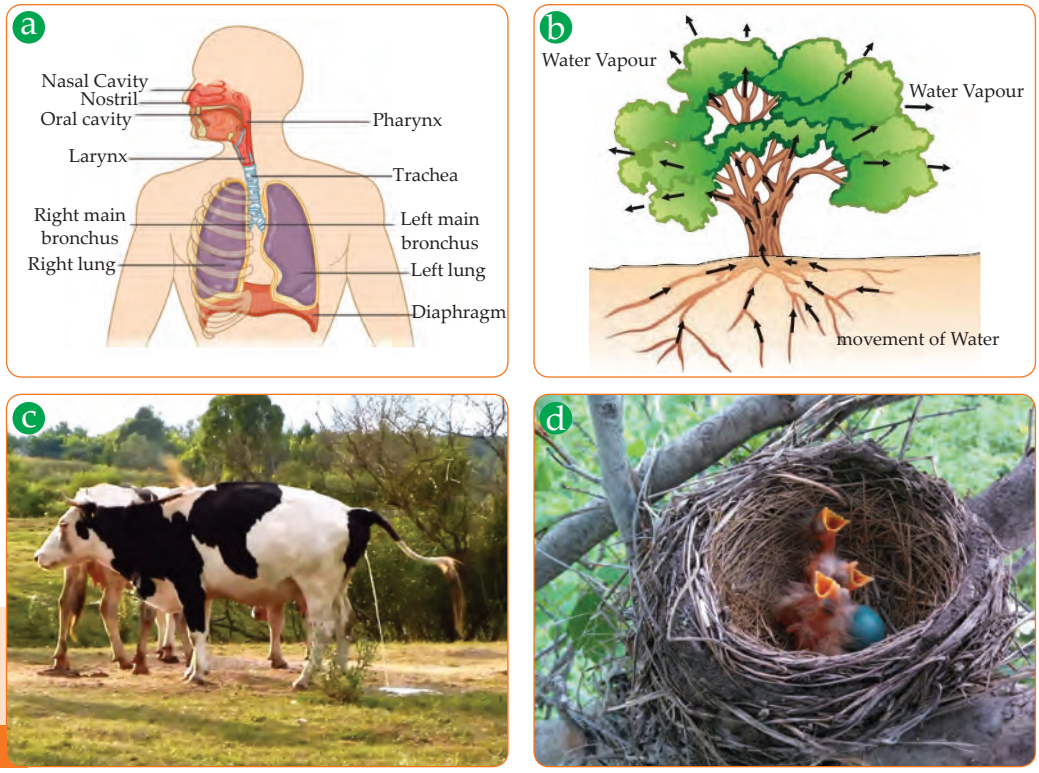


Fig. 5.2

5.2 Transportation and Absorption

Living beings transport water, oxygen and digested food from one part of the body to another. Similarly, they transport various waste materials for their removal from the body. The process by which living beings carry various substances from one part of the body to another is called internal transport.

Plants have xylem and phloem tissues to transport various substances from one part of the body to another. These tissues are called vascular tissues. In developed plants, xylem transports water and minerals from roots to leaves for photosynthesis. Similarly, phloem transports prepared food from leaves to various parts of a plant.

In unicellular organisms, cytoplasm helps in internal transport. In developed animals, blood transports various substances from one part of the body to another. Blood transports oxygen, digested food, carbon dioxide, water and waste products. The system which transports various substances from one part of the body to another with the help of blood is called blood circulatory system.

5.2.1 Absorption and Transport in Plants

The roots of plants fix the plant body to the soil. Roots have branches, sub-branches and root hairs. The roots of plants form a network to the soil. The root hairs of plants absorb water and minerals from the soil. This process is called absorption.

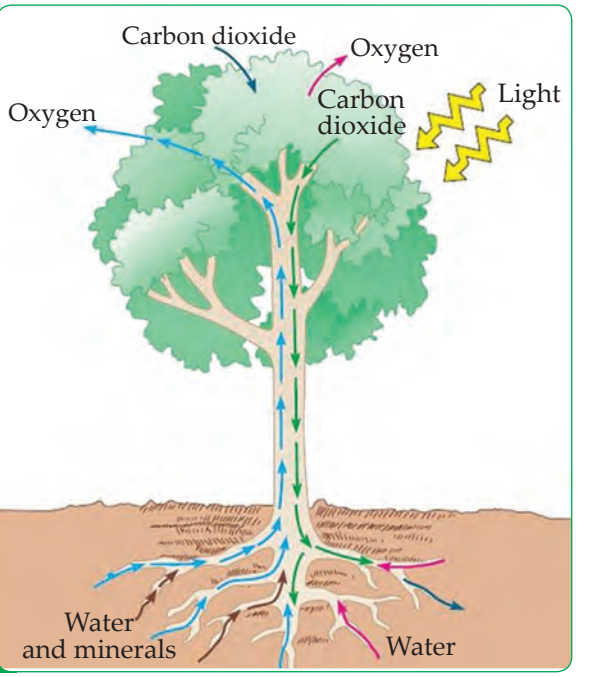


Fig. 53

Green plants prepare food in leaves by using water and carbon dioxide in the presence of sunlight. So, the water absorbed by roots should be transported to the leaves. Xylem tissue transports water from roots to the leaves. Similarly, phloem tissue transports prepared food from leaves to different parts of plants.

Green plants have transport system to transport water, minerals and prepared food from one part to another. The system which is responsible for distribution of water, minerals and food to different parts of the plant is called transport system. This system is also called vascular system. In plants, vascular system contains two types of tissues. They are xylem tissue and phloem tissue.

In plants, the transportation of oxygen and carbon dioxide also occurs. The transportation of oxygen and carbon dioxide occurs through stomata and lenticels present in plants.



Fig. 54

Stomata in leaf *Lenticles in potato* *Lenticles in mango*

5.2.2 Absorption and Transport in Animals

A variety of animals are found in our surroundings. They have different structure and size. Animals may be unicellular or multicellular. Similarly, they may be invertebrates and vertebrates. So transportation occurs in different organisms by different methods.

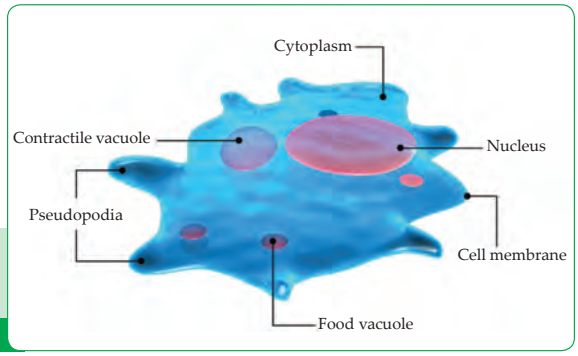


Fig. 5.5 *Transportation in Amoeba*

In unicelluar and less developed animals, no special organs are found for transportation. Some simple organs are found in primitive invertebrates for absorption and transportation. But vertebrate animals have special organs and system for absorption and transportation of various materials.

Animals like amoeba, paramecium, euglena, etc. have only one cell in their bodies. These animals are called unicellular animals. In these animals, the nutrients and oxygen enter the cell through the cell membrane and transported in cytoplasm. The waste materials are released from the body through cytoplasm. In these animals, substances are transported from more dense substances to less dense substances. This process is called diffusion.

In primitive multicellular animals like sponge, all the cells are more or less similar. Their bodies contain numerous small pores called oscula and only one or few large pores called oscula. These two types of holes play great role in transportation.

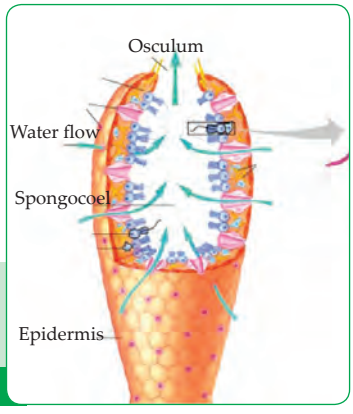


Fig. 5.6 *Transportion in Sponge*

In sponge, food, water and oxygen enter the body though small pores called ostia (singular - ostium). These substances are absorbed by body cells. The waste materials are removed from the body though large pores called oscula (singular-osculum).

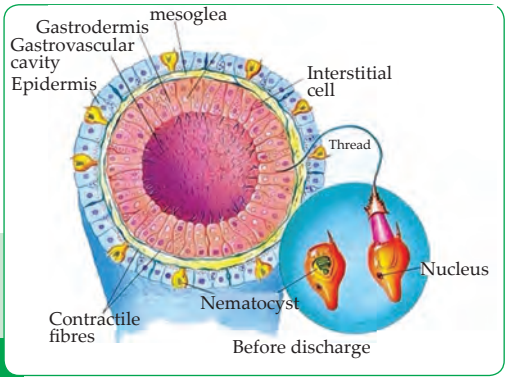


Fig. 5.7

In multicellular animals like hydra jelly fish, etc. Special tissues and structures are found for transportation. The body of hydra has hollow cavity called coelenteron which looks like a pipe.

The outer layer protects the body and inner layer helps in digestion, absorption and transport. In hydra, tentacles catch food and food enters the body through mouth. After digestion, waste materials are excreted through the same opening, i.e. mouth.

In insects like butterfly, grasshopper, etc have an open circulatory system. In an open circulatory system blood isn't transported in the body though veins and arteries, it flows freely within body cavity and makes direct contact with the internal tissues and organs.

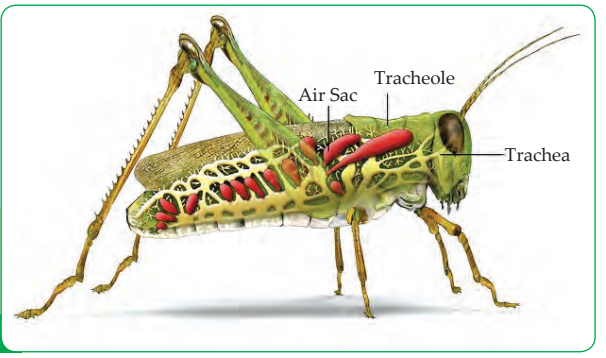


Fig. 5.8

Vertebrates have well developed system for transportation which is called blood circulatory system. This system is made of blood, heart and blood vessels. After digestion, nutrients are absorbed by the epithelial cells of intestine. The nutrients and oxygen are transported to each and every cell of out body with the help of blood circulatory systems. Cells absorb nutrients and oxygen though diffusion. The waste materials like urea, carbon dioxide, etc. are also excreted with the help of circulatory system.

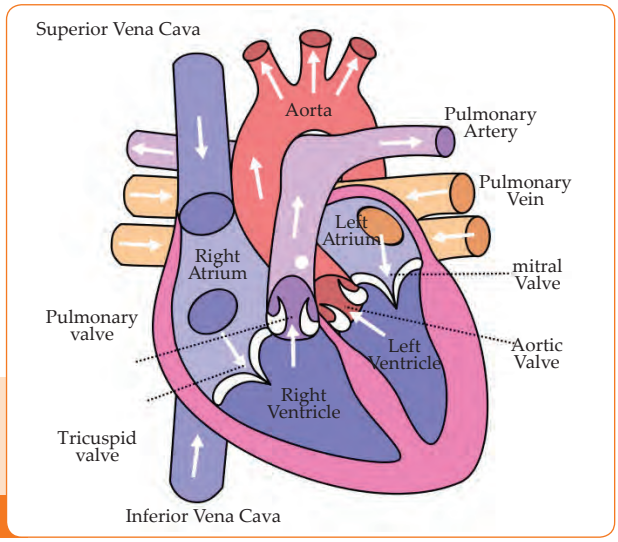


Fig. 5.9



Heart plays a significant role in transportation. Heart pumps blood to different parts of body and helps in transportation.

5.3 Excretion in Plants and Animals

A variety of waste materials are formed in the bodies of plants and animals while performing metabolic activities. These waste products may be toxic or poisonous when accumulated inside the body for a line time. Therefore, these wastes should be removed from the body. So, excretion is the process of removing waste materials from the body.



Fig. 5.10

The system which excretes waste products from the body is called excretory system. This system consists of kidneys, lungs and skin. Carbon dioxide, salts, urea, uric acid, ammonia, etc. are the waste products produced by animals. Different organisms have different organs for excretion.

5.3.1 Excretion in plants

Plants use carbon dioxide and throw oxygen during photosynthesis. Similarly, they use oxygen and throw carbon dioxide during respiration. Plants throw excess water through stomata. This process is called transpiration. Plants also produce waste products like resin, gum, latex, etc. However, these waste products do not harm plants.

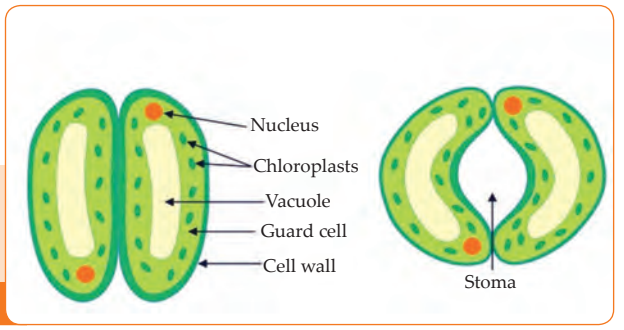


Fig. 5.11



Resin

5.3.2 Excretion in animals

Different animals have different organs for excretion. Unicellular animals like amoeba, paramecium, etc. excrete through general body surface with the help of contractile vacuole. Similarly, some multicellular animals also breathe through the body surface. Developed animals have special organs like, skin, nose, mouth, lungs, large intestine, liver, kidney, etc. for excretion.

Hydra excretes through its mouth. Animals like earthworm, leech, insects, etc. excrete through anus. Fishes release carbon dioxide through gills. Frogs release carbon dioxide through skin and lungs.

Higher invertebrates and vertebrates have digestive system and excretory system to remove waste materials from the body. They remove waste materials through anus, urethra, skin, mouth and nose.

5.3.3 Excretion in Human Body

Human beings have well developed excretory system for removal of various water materials. The major organs in human body that help in excretion are given below:

a. Lungs

Lungs help in removal of carbon dioxide gas produced during cellular oxidation or internal respiration.



Fig. 5.12

Human lungs

b. Skin

Skin helps in removal of urea, uric acid, salts and excess water in the form of sweat.



Fig. 5.13 *Human skin*

c. Kidneys

Kidneys help in removal of urea, uric acid, salt, excess water, etc. in the form of urine.



Fig. 5.14 *Human urinary system*

d. Liver

Liver helps in removal of urea, ammonia, etc. The waste materials produced by liver reach the kidneys through blood circulation and are excreted in the form of urine.

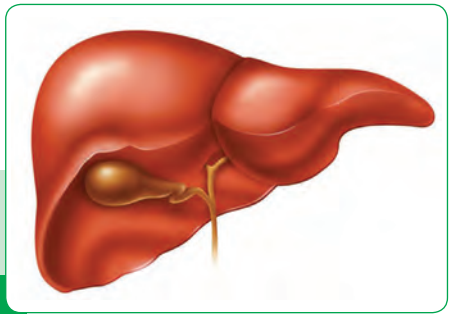


Fig. 5.15 *Human Liver*

e. Large intestine

The undigested solid particles are removed by large intestine through the rectum and anus.

In this way, excretion takes place in human body by means of various organs.



Fig. 5.16 *Human large intestine*

Project work

- Take a chart paper. Draw a neat and labelled figures of different excretory organs of human being. Colour these pictures.
- Submit the chart paper to your science teacher.

5.4 Respiration

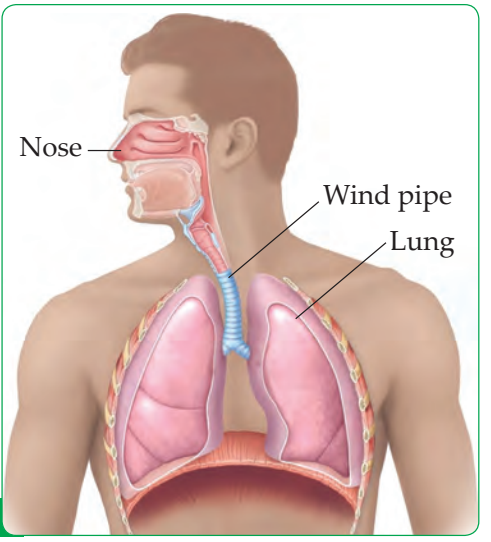


Fig. 5.17 *Respiratory system of human beings*

We need energy to live and to do work. We get energy from the food that we eat. So, we cannot do any work for a long time without having food. Therefore, we eat food to obtain energy. After digestion, the food is absorbed by our body and the absorbed food is transported to each and every cell of our body. The food gets oxidized in mitochondria of the cell in the presence of oxygen. As a result, energy is released. This process is called respiration. So the process of releasing energy by breaking down food in the presence of oxygen in mitochondria is called respiration. Oxygen gas is essential in atmosphere while breathing in.

While breathing, living beings take oxygen in and the oxygen reacts with glucose or carbohydrate in mitochondria releasing energy, water and carbon dioxide gas. Living beings perform life processes from the energy obtained during respiration.

Respiration occurs in two ways. They are external respiration and internal respiration.

External respiration or breathing is the process of inhaling air rich in oxygen and exhaling air rich in carbon dioxide. No energy is released in external respiration.

Internal respiration is the process of oxidation of food in mitochondria of cells. In this process, oxygen reacts with digested food and releases energy along with water and carbon dioxide. The chemical reaction of internal respiration is given below:

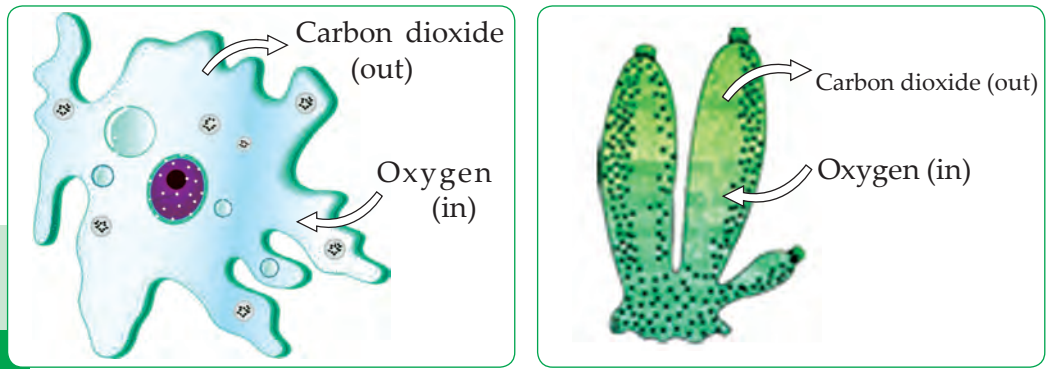
$$\text{Glucose} + \text{Oxygen} \xrightarrow{\text{Enzyme}} \text{Energy} + \text{Water} + \text{Carbon dioxide}$$

Internal respiration is also called cellular respiration as it occurs in cells. Animals and plants breathe by different ways. They have a variety of organs for breathing. Plants breathe through stomata and animals breathe through body surface, trachea, gills, skin or lungs.

5.4.1 Breathing in Animals

In aquatic unicellular animals, breathing takes place through the body surface. Similarly, simple multicellular animals like sponges, coelenterates (hydra, sea anemone, etc.) flatworms (tapeworm, liver fluke, etc.) breathe through their general body surface. In these organisms, exchange of gases take place through simple diffusion. They do not have special organs for breathing.

Fig. 5.18



Amoeba *Sponge*

Developed multicellular animals have a variety of organs for exchange of gases. They are as follows:

1. Skin

Multicellular animals like earthworm, leech, frog, toad, etc. have moist skin. These animals breathe through the moist skin.

Fig. 5.19



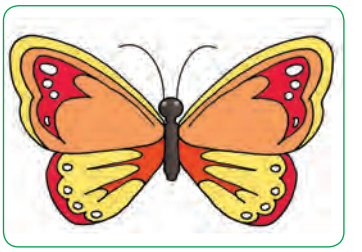
Animals that breathe through moist skin

2. Trachea

Insects like cockroach, grasshopper, butterfly, moth, etc. breathe through trachea or air tubes. These trachea open on the outer surface of the body which are called spiracles. Insects take oxygen and release carbon dioxide through these spiracles.

Fig. 5.20





Animals that breathe through spiracles

3. Gills

Aquatic animals like prawn, fish, tadpoles of frog, octopus, etc. breathe through gills

Fig. 5.21



Do You Know

Tadpoles of frog breathe through gills in water. But adult frogs breathe through skin in water and through lungs on land.

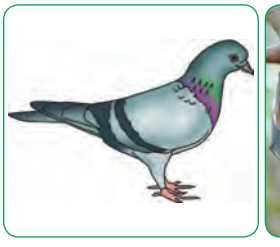
Fish breathes through gills

4. Lungs

Animals like frog, reptiles (snake, lizard, crocodile, tortoise, etc.), birds and mammals breathe through lungs. These animals inhale oxygen and exhale carbon dioxide with the help of lungs.

Fig. 5.22






Animals that breathe through lungs

5.4.2 Breathing in Human Beings

Human beings have well developed system for breathing and respiration. This system is called respiratory system. This system consists of various organs like nose, pharynx, windpipe and lungs. While breathing, air reaches lungs through nose, pharynx and wind pipe.

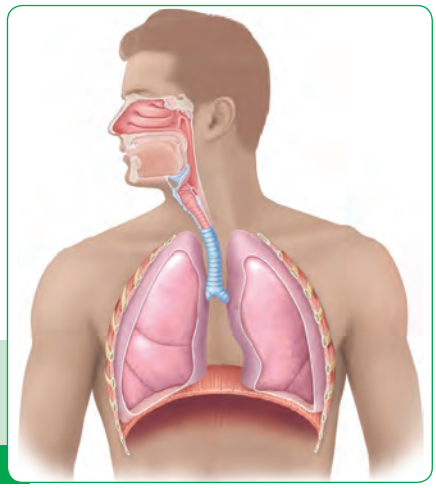


Fig. 5.23 *Respiratory system in human body*

Lungs contain numerous air sacs called alveoli. The walls of alveoli contain blood capillaries. Oxygen diffuses from the thin walls of capillaries into the blood and combines with red blood cells.

Red blood cells supply oxygen to each and every cell of the body. In mitochondria of the cell, oxygen reacts with digested food. As a result, energy is released along with water and carbon dioxide. At the same time, carbon dioxide is collected back to the lungs and is exhaled through the nose. In this way, respiration occurs in the human body.

Activity 2

- Take a beaker with clear solution of limewater.
- Take a straw and blow air in it for 2-3 minutes.
- Observe the colour of limewater in the beaker. Does the limewater turn milky? Why? Discuss the reason behind this fact.

5.4.3 Breathing in Plants

Unlike animals, plants do not have well developed respiratory system. Plants breathe through stomata present on upper and lower surface of leaf, outer stem and general surface of roots. Stomata are very small openings which remain surrounded by guard cells. Stomata open and close due to movement of guard cells. These stomata help in exchange of gases while breathing.

Fig. 5.24



Stomata (open)

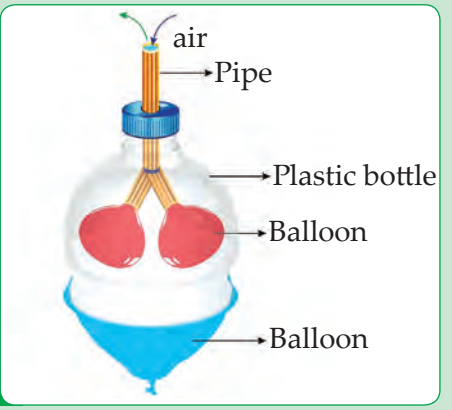


Stomata (closed)

Project work

- **To prepare a model of human respiratory system.**
- Use locally available materials like plastic bottle, balloons, plastic tubes, thread, etc.
- Arrange these materials and prepare a model of human respiratory system.
- Demonstrate the model in the class.

Fig. 5.25



model of human respiratory system

Key concepts

1. Growth, nutrition, respiration, digestion, excretion, internal transport, sensitivity, reproduction, etc. are the life processes that occur in living organisms. Life processes are those activities which are performed by living organisms for survival.
2. The process by which living beings carry various substances from one part of the body to another is called internal transport.
3. In unicellular organisms, cytoplasm helps in internal transport. In developed animals, blood transports various substances from one part of the body to another.
4. The system which transports various substances from one part of the body to another with the help of blood is called blood circulatory system.

5. The root hairs of plants absorb water and minerals from the soil. This process is called absorption.
6. Xylem tissue transports water from roots to the leaves. Similarly, phloem tissue transports prepared food from leaves to different parts of plants.
7. Green plants have transport system to transport water, minerals and prepared food from one part to another.
8. In unicelluar and less developed animals, no special organs are found for transportation.
9. Vertebrates have well developed system for transportation which is called blood circulatory system. This system is made of blood, heart and blood vessels.
10. Excretion is the process of removing waste materials from the body. The system which excretes waste products from the body is called excretory system.
11. Plants throw excess water through stomata. This process is called transpiration.
12. Developed animals have special organs like, skin, nose, mouth, lungs, large intestine, liver, kidney, etc. for excretion.
13. Human beings have well developed excretory system for removal of various water materials.
14. The process of releasing energy by breaking down food in the presence of oxygen in mitochondria is called respiration.
15. Living beings perform life processes from the energy obtained during respiration.
16. External respiration or breathing is the process of inhaling air rich in oxygen and exhaling air rich in carbon dioxide.
17. Internal respiration is the process of oxidation of food in mitochondria of cells. In this process, oxygen reacts with digested food and releases energy along with water and carbon dioxide.
18. Plants breathe through stomata and animals breathe through body surface, trachea, gills, skin or lungs.

19. Human beings have well developed system for breathing and respiration. This system is called respiratory system.
20. In mitochondria of the cell, oxygen reacts with digested food. As a result, energy is released along with water and carbon dioxide.
21. Plants breathe through stomata present on upper and lower surface of leaf, outer stem and general surface of roots.

Exercise

1. Tick (√) the correct statements and cross (×) the incorrect ones.

a. Respiration, digestion, and excretion are examples of life processes. ☐

b. In hydra, transportation takes place through blood circulatory system. ☐

c. In plants roots help in absorption and xylem and phloem tissues help is transportation. ☐

d. Plants breathe through stomata. ☐

e. Resin, gums, latex, etc. are the excretory products of plants. ☐

f. While breathing, we take carbon dioxide and release oxygen. ☐

2. Fill in the blanks using appropriate words.

a. In amoeba, ... helps in transportation.

b. The process of removal of waste materials from the body is called .....

c. Stomata remain surrounded by ..... cells.

d. Animals breathe in ..... gas and breathe out ..... gas

e. Most insects breathe through ..... .

f. The excretory organs of human beings are .....

3. Tick (√) the best answer from the given alternatives.

a. Which of the given processes are life processes?

☐ nutrition ☐ respiration ☐ reproduction ☐ all of them

b. Which of the given animals breathe through general body surface?

☐ fish ☐ amoeba ☐ frog ☐ snake

c. The gas essential for photosynthesis is .....

☐ oxygen ☐ nitrogen ☐ carbon dioxide ☐ air

d. Which of the given organs are found in human beings for respiration?

☐ stomata ☐ lungs ☐ kidneys ☐ heart

e. The excretory organs of plants are .....

☐ lungs ☐ stomata ☐ kidneys ☐ gills

4. Answer the following questions.

a. What are life processes? Give any three examples.

b. What is transportation? Differentiate between transportation in plants and animals.

c. How does transportation take place in primitive animals?

d. Name any two animals that excrete through body surface.

e. How does excretion occur in primitive animals ? Write.

f. How does excretion occur in human beings?

g. What is respiration? Define internal and external respiration.

h. Name any four organisms that breathe through lungs.

i. How does breathing occur in plants?

j. Name any three organs that help in breathing.

k. How does breathing take place in unicellular organisms?

l. What is excretion? Name any three excretory organs of human beings.

5. Differentiate between :

a. External respiration and Internal respiration

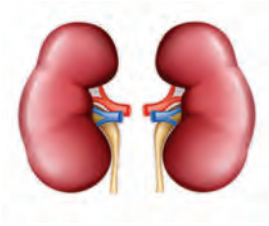
b. Respiration and Photosynthesis

c. Respiration and Excretion

6. **Draw a neat and labelled figure showing human respiratory system.**
7. **Draw a neat figure showing urinary system of human beings.**
8. **Write down the role of following organs in excretion.**

   – Liver – Kidney – Gills – Lungs – Skin
9. **Draw a chart showing various excretory organs of human body. Also, write their role in excretion.**
10. **Name the excretory organ of following organisms.**

    – fish – frog – bird – human – plants
11. **Describe an activity to demonstrate that carbon dioxide gas is evolved in respiration.**
12. **Identify the organs/ parts given below and describe their role in life processes.**

a. 

b. 

c. 

13. **When we run fast, our heart beat increases, Why?**
14. **Differentiate between breathing in plants and breathing in human beings.**
15. **Differentiate between breathing in insects and breathing in human beings.**

UNIT
06

Force and motion

Estimated teaching hours : 13

Before You Begin

Force can be defined as the pull or push which changes or tends to change the position of a body. In our daily life, force is used for pulling, pushing, pressing, lifting, stretching, twisting, etc. Force can change the shape and size of a body. Force can stop a moving body and change its direction. Similarly, force can bring a body from rest to motion. The SI unit of force is newton (N). Force is a vector quantity as it has both magnitude and direction. A body is said to be in motion when it changes its position with respect to the objects in its surroundings.

If a person can do a lot of work, we say the person is very energetic. Energy of a body is the capacity or ability of a body to do work. Living beings cannot survive in the absence of energy. Similarly, energy is required to operate machines in industries, to run automobiles and so on. Work is said to be done when the force acting on a body produces motion in the direction of the force. In SI system, work is measured in joule (J). The rate of doing work is called power. Its SI unit is watt (W). Energy, work and power are interrelated to each other.

Learning Outcomes

After completing the study of this unit, students will be able to:

- introduce distance, displacement, speed and velocity with illustration.
- tell the differences between distance and displacement and speed and velocity.
- solve simple numerical problems related to distance, displacement, speed and velocity.
- introduce gravity and describe that the earth pulls every object towards its centre and demonstrate this fact practically.
- measure the weight of objects using spring balance and calculate the weight of the bodies of different masses.
- introduce friction and demonstrate the factors affecting friction.
- tell the methods of reducing friction and state the advantages and disadvantages of friction in our daily life.
- introduce work and power and describe the relationship between work and power.
- solve simple numerical problems related to work and power.

Syllabus

- Introduction to force and motion
- Distance and displacement
- Speed and velocity
- Gravity
- Load (weight) and its measurement
- Friction and its nature
- Advantages and disadvantages of friction
- Measures of minimizing friction
- Work and power

Glossary

acceleration	:	the rate of increase in the velocity of a moving body
displacement	:	the distance travelled by a moving body in a certain direction
energy	:	the capacity of doing work
gravity	:	the force with which a body is pulled towards the surface of the earth or a planet
kinetic energy	:	the form of energy that an object gains when it moves
motion	:	if the position of a body changes with respect to other objects in its surroundings
nuclear	:	related to nucleus of an atom
potential energy	:	the form of energy that an object gains when it is lifted
power	:	the rate of doing work
reference	:	a standard by which something can be compared
retardation	:	the rate of decrease in velocity of a moving body
transformation	:	conversion of one form of a substance into another
velocity	:	the rate of change in displacement of a moving body
work	:	the product of force and displacement

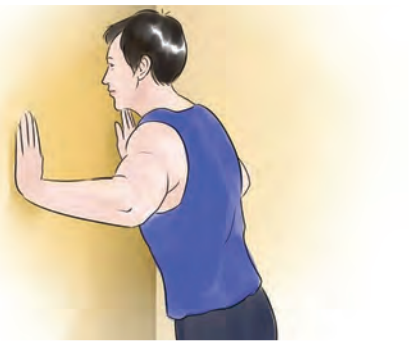
6.1 Concept of Force

6.1.1 Force



Fig. 6.1

Horses are pulling a cart



A man is pushing a wall

We do different activities and works in our daily life. For example, pulling a bucket from the well, opening (pushing) and closing (pulling) door and windows, kicking a foot ball, lifting different loads. We push the door while opening and pull the door while closing. The pulling or pushing process of an object brings the change in the position and motion. So, the pull or push which changes or tends to change the position of an object from rest to motion or motion to rest is called force. Force is used for pulling, pushing, lifting, pressing, twisting and so on. Force is an external agent which is applied on a body and it has magnitude as well as direction.

6.1.2 Effects of force

Force has many effects. Some major effects of force are as follows:

i. Force can change the position of an object.
ii. Force can change the shape and size of an object.
iii. Force can change the direction of a moving object.
iv. Force can change the speed of a moving object.

i. Force can change the position of an object

Force is an external agency which can change the position, i.e. rest or motion of a body. Force can produce motion in a body at rest and stop a body in motion. If we kick a football at rest, the

Do You Know

Force can change the position of a body, i.e. from rest to motion and from motion to rest. However, it is not necessary that a force always makes a body at rest to move, e.g. when we push a wall or a tree, it does not move at all.

ball moves. Similarly, we can stop a rolling football by applying a force. We should apply force in opposite direction to stop a moving body.

Fig. 6.2



Kicking a ball at rest



Stopping a moving football with leg

Activity 1

- Take a football and go to the ground. Keep the football in a place. The football is at rest. Kick the football and observe the motion of the football.
- Now, stop the rolling football by applying force in the opposite direction of the motion of the football.

This activity shows that force can change the position of an object.

ii. Force can change the shape and size of a body

When we stretch an elastic, its shapes and size increase and when we release, its shapes and size decrease. So when force is applied on a body, the shape and size of the body may change.

Fig. 6.3



Pressing a balloon

Activity 2

- Take a balloon and inflate it. So the size and shape of the balloon change while inflating it.
- Now, press the balloon with hands to change its shape and size. What do you observe?

- Now, take a tube of toothpaste and press it. Can you change the shape of the toothpaste tube.

These activities show that force can change the shape and size of an object.

iii. Force can change the direction of a moving body

Force can change the direction of a moving body. By applying force in the steering, a driver can change the direction of a moving vehicle. Similarly, when we kick a football, we can change its direction of motion.

Activity 3

- Take a football and go to the ground. Roll the football in a straight line.
- Now, kick the football to change its direction.

What can you conclude from this activity?



Fig. 6.4

iv. Force can change the speed of a moving body

Force can increase or decrease the speed of a moving body. When we apply force in the direction of the moving body, the speed of the moving body increases. On the other hand, when force is applied in the direction opposite to the motion of the body, the speed decreases.

6.2 Concept of Rest and motion

If we look around in the classroom, we see a variety of things. All these things do not move, they are said to be at rest. A body is said to be at rest, if it does not change its position with respect to a fixed point taken as reference point in its surroundings. A book lying on a table, walls of a house, blackboard and desk are some examples of body at rest.

Do You Know

A reference point is a body at rest with respect to which the state of another body is compared. Reference point may be a certain point, object or place about which the state, i.e. rest or motion, of a body is studied.

Human beings, animals, birds, insects, etc. move from one place to another. A man running on a road, a bus plying on a road, a bird flying in the sky, etc. keep on changing their position continuously. These are some examples of things in motion. A body is said to be in motion, if it changes its position with respect to a fixed point taken as reference point in its surroundings. However, rest and motion are relative terms.

Fig. 6.5



Book at rest



Bird in motion

6.2.1 Rest and motion are relative terms

Let us consider that we are sitting in a moving train. We are in motion with respect to the trees or buildings outside the train because our position is changing with respect to them. However, if we compare our position with respect to the things inside the train, i.e. other passengers, seats, fan of the train, walls and roof of the train, etc. They are at rest. Thus, an object can be at rest in relation to one object while it can be in motion in relation to another object at the same instant of time. Therefore, we can say that rest and motion are relative terms.

Fig. 6.6



moving train

6.3 Distance and Displacement

6.3.1 Distance

The total length of the path travelled by a body is called distance. In SI system, it is measured in metre (m). For example, if a motorbike travels from Chapagaun to Lagankhel, the distance covered by the motorbike is the total length of the road from Chapagaun to Lagankhel.

Suppose, a motorbike travels from a place A to B (5 km), B to C (2 km) and C to D (10 km), then the total distance travelled by the motorbike is AB + BC + CD = 5km + 2 km + 10 km = 17 km.

Therefore, the distance travelled by the motorbike is 17 km.

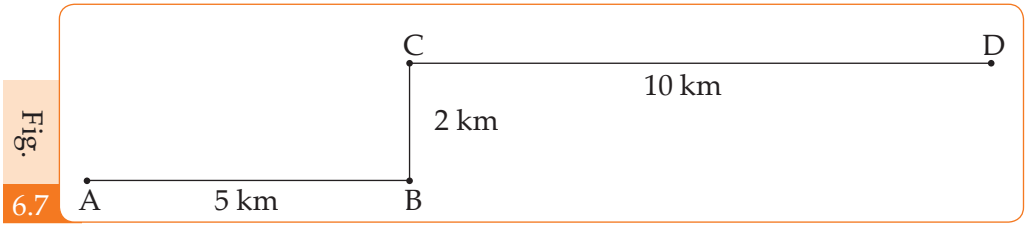


Fig. 6.7

Distance is a scalar quantity as it has magnitude but no direction. The distance covered by a body can be calculated by the given formula.

Distance covered = Speed × time taken

The SI unit of distance is metre (m).

6.3.2 Displacement

Displacement is the shortest distance between the initial position and the final position travelled by a moving body in a particular direction. The SI unit of displacement is metre (m).

It is also measured in centimeter (cm), kilometre (km), etc. For example, if the motorbike travelled from Chapagaun to Lagankhel, the displacement of the bike is given by straight distance between Chapagaun to Lagankhel towards north.

When a motorbike travels, from a place A to place D, the distance covered by the motorbike is 17 km but the displacement is only 15 km.

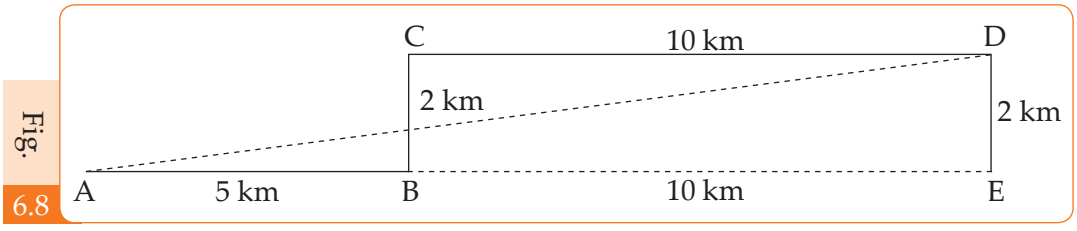


Fig. 6.8

Displacement is a vector quantity as it has both magnitude and direction. The displacement can be calculated by the given formula.

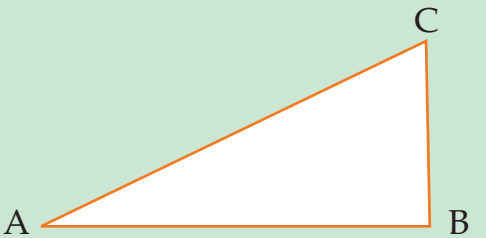
Displacement (s) = velocity (v) × time taken (t)

or, $s = v \times t$

The SI unit of displacement is also metre (m).

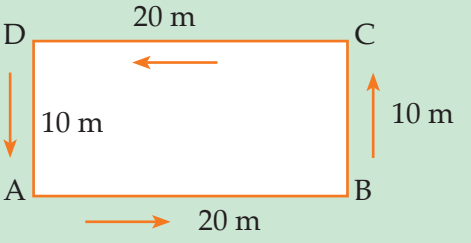
Activity 4

- Take a measuring tape and go to the school ground.
- Mark three points A, B and C as shown in the figure.
- Join these points using line.
- Ask your friends to cover the distance from A to B and then B to C. Calculate the distance covered.
- Now, ask them to cover the distance from A to C.
- Calculate the distance covered and displacement.



Activity 5

Sita walks through A to B, B to C and C to D in a rectangular path. What will be the distance and displacement when she moves from A to D? In which condition will the displacement be zero and negative? Discuss.



6.4 Scalar and Vector Quantities

A physical quantity which is described completely by its magnitude only is called a scalar quantity. Thus, a scalar quantity has only magnitude but no direction. Length, distance, time, area, temperature, speed, mass, energy, power and volume are some examples of scalar quantities.

Do You Know

- The sum of scalar is always positive but the sum of vectors may be positive, zero or negative.
- Scalars are added by the rules of simple algebra but vectors are added by the rules of vector algebra.
- Scalars are not written in a special way but vectors are written in a special way, e.g. vector PQ is denoted by $\overrightarrow{PQ}$.

A physical quantity which requires both magnitude and direction for its complete description is called a vector quantity. Thus, a vector quantity has both magnitude and direction. Displacement, velocity, force, acceleration and weight are some examples of vectors quantities.

Differences between Scalars and Vectors

Scalars		Vectors	
1.	Scalars have magnitude but no direction.	1.	Vectors have both magnitude and direction.
2.	The sum of scalars is always positive.	2.	The sum of vectors may be positive, zero or negative.
3.	They are added by the rules of simple algebra.	3.	They are added by the rules of vector algebra.

6.5 Speed and Velocity

The speed of a moving body is defined as the distance covered by it per unit time, i.e.

$$\text{Speed} = \frac{\text{Distance covered}}{\text{Time taken}}$$

The SI unit of speed is metre per second (m/s) and CGS unit is centimetre per second (cm/s). Speed is a scalar quantity. The speed of fast moving bodies like car, bus, motorcycle, aeroplane, etc. is expressed in kilometre/hour (km/h). The speed of a moving body may be uniform or non-uniform.

Worked out Example: 1

A bus travels a distance of 400 km in 6 hours. Calculate the speed of the bus.

Solution

Given,

Distance covered by the bus (s) = 400 km

Time taken by the bus (t) = 6 hr

Speed of the bus (v) = ?

According to the formula

$$v = \frac{s}{t}$$

$$= \frac{400}{6}$$

$$= 66.67 \text{ km/hr}$$

$\therefore$ The speed of the bus is 66.67 km/hr.

The velocity of a moving body is defined as the distance covered by a body per unit time in a fixed direction. It is also called the rate of change of displacement.

$$\text{Velocity (v)} = \frac{\text{Displacement (s)}}{\text{Time taken (t)}}$$

The SI unit of velocity is metre per second (m/s). Velocity is a vector quantity.

Difference between Speed and Velocity

	Speed		Velocity
1.	The rate of change of distance of a moving body is called speed.	1.	The rate of change of displacement of a moving body is called velocity.
2.	Its magnitude is always positive.	2.	Its magnitude can be negative, zero or positive.
3.	It is a scalar quantity.	3.	It is a vector quantity.

Worked out Example: 2

A car is moving in a straight line towards the north. If it covers a distance of 8 km in 40 minutes, calculate the velocity of the car.

Solution

Displacement (s) = 8km

= 8 × 1000 [$\because$ 1km = 1000 m]

= 8000 m

Time taken (t) = 40 minutes

= (40 × 60) seconds

= 2400 s

According to the formula,

$$\text{Velocity (v)} = \frac{s}{t}$$

$$= \frac{8000}{2400} = 3.34 \text{ m/s}$$

∴ The velocity of the car is 3.34 m/s.

Worked out Example: 3

A motorcycle is moving towards west with a speed of 60 km/h. Calculate the time taken to cover a distance of 15 km.

Solution

$$\text{Speed (v)} = 60 \text{ km/h} = \frac{60 \times 1000}{60 \times 60} \text{ m/s} = 16.66 \text{ m/s}$$

Distance covered (d) = 15 km = 15 × 1000 m = 15000 m

Time taken (t) = ?

We know,

$$\text{Speed} = \frac{\text{Distance covered}}{\text{Time taken (t)}}$$

or, $$\text{Time taken (t)} = \frac{\text{Distance covered}}{\text{Speed}}$$

$$= \frac{15{,}000}{16.66}$$

= 900.36 sec

$$= \frac{900.36}{60} \text{ min.} \qquad [\because \text{ 1 min. = 60 seconds}]$$

= 15.006 min.

6.6 Gravity

Activity 6

Take a ball and throw it upward. What do you observe after a while? After sometime, the ball returns to the ground. It is due to the gravity of the earth.

If we throw a stone upwards, it returns to the ground. Similarly, flowers and fruits of plants fall on the ground. Water flows from high to low land. These activities are caused due to the force of attraction exerted by the earth on all the bodies towards its centre which is called gravity. Like the earth, other planets and satellites have their own gravity. The planets of the solar system revolve around the sun. A kind of force exists between the planets and the sun. The force of all attraction between any two objects due to their masses is called gravitational force.



Fig. 6.9

The major effects of earth's gravity are as follows:

i. Existence of atmosphere on the earth.

ii. Rain fall

iii. Flowing of river

iv. Blowing of wind

v. Returning back of the objects thrown upwards.

The velocity of objects changes when thrown upwards or thrown downwards from a certain height. This rate of change in velocity of the bodies due to effect of gravity is called acceleration due to gravity. Its average value on the earth is 9.8 m/s^2.

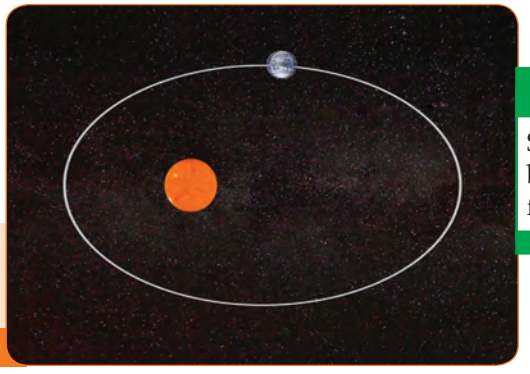


Fig. 6.10

Do You Know

Some effects of gravity of the earth are rainfall, blowing of wind, flowing of river, falling of fruits towards the earth's surface, etc.

6.7 Load (Weight) and its measurement

The earth pulls every object towards its centre with a certain force. This force is called weight. It is also called load. Fruits of a tree fall down due to the gravity of the earth. So, the weight of a body is the force with which the body is pulled towards the centre of the earth. The weight of a body is the gravity acting on the body. The direction of weight is towards the centre of the earth/planet. Weight is a variable quantity. It depends on the mass of a body (m) and the value of acceleration due to gravity (g) at a place. The weight of a body is measured by a spring balance. The SI unit of weight is newton (N).



Fig. 6.11 *Spring balance*

Do You Know

The weight of body differs from place to place because weight depends on the value of acceleration due to gravity (g) and the value of acceleration due to gravity (g) changes from place to place on the earth's surface.
[∵W = m × g]

Worked out Numerical: 4

The mass of a box is 25 kg. Calculate its weight [Given, g = 9.8 m/s^2].

Solution:

Mass of a box (m) = 25 kg

Acceleration due to gravity (g) = 9.8 m/s^2

Weight of the box (W) = ?

We know,

$W = m \times g$

$= 25 \times 9.8$ N

$= 245$ N

∴ The weight of the box is 245 N.

Worked out Numerical: 5

The weight of a body is 550 N and value of acceleration due to gravity is 9.8 m/s². Calculate the mass of the body.

Solution:

Weight of a body (W) = 550 N

Acceleration due to gravity (g) = 9.8 m/s²

Mass of a body (m) = ?

According to the formula,

We know,

$W = m \times g$

or, $550 = m \times 9.8$

or, $m = \frac{550}{9.8}$

$= 56.12$ kg

Activity 7

- Take a beam balance and some standard weights of milligram, gram and kilogram.
- Now, measure the mass of your school bag, science book, pen, calculator, pencil, eraser, etc. by using the beam balance.
- Take a spring balance and measure the weight of these objects.
- Compare the mass and weight of these objects what do you find? Discuss.

6.8 Friction and its Nature

6.8.1 Frictional force

Activity 8

- Take a wooden log and tie it with a rope and drag it with the help of a rope on the ground.
- Now put some pieces of cylindrical wood below the log and drag it again on the ground.
- How much effort do you apply in both of the cases?
- What do you conclude from this activity?

The force which opposes the motion of one body over another when they are in close contact is called a frictional force. It depends on the extent of roughness and smoothness of the surfaces in contact. If the contact surfaces are rough, the friction will be more. But if contact surfaces are smooth, the friction will be less. Frictional force also depends on the weight of the sliding body on the surface of another body. If weight is more, frictional force will be more and if weight is less, frictional force will be less.

The amount of frictional force depends on (i) surface texture (ii) adhesion property and (iii) the amount of forcing pressing a surface. It is not affected by surface area of contact and speed of a body.

Friction is mainly of two types. They are (i) Dry friction and (ii) Fluid friction.

1. Dry friction

It is the friction that occurs between the surfaces of solid objects. It is of following four types.

i. Static friction ii. Kinetic friction

iii. Rolling frictions iv. Sliding friction

The value of static friction is more than that of kinetic friction. Similarly, the value of sliding friction is less than that of rolling friction. Due to this reason, we feel easier to roll a cylindrical wooden log than to drag it.



Fig. 6.12 *Dry friction*

2. Fluid friction

It is the friction that occurs between gases or liquids.

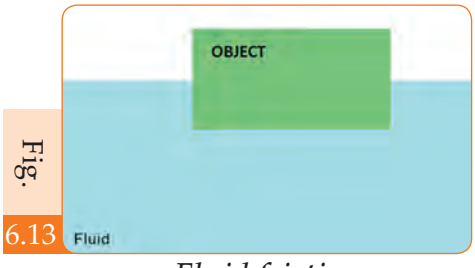


Fig. 6.13 *Fluid friction*

6.8.2 Advantages of frictional force

1. Friction enables us to write on paper with a pen.
2. Friction enables us to apply brakes and stop a moving vehicle.
3. Friction enables us to walk on the ground without slipping.

Fig. 6.14



Writing



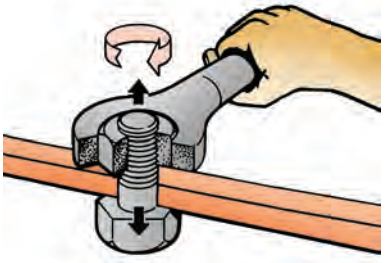
Applying brakes



Sliding

4. Friction enables nails and screws to hold things together and nuts to be tied, to cut wood, to burn a matchstick, etc.

Fig. 6.15



Tightening nut bold



Scratching matchstick

6.8.3 Disadvantages of frictional force

1. Friction reduces the efficiency of machines.
2. The moving parts of machines get heated up due to friction.
3. Friction gradually tears away the sole of our shoes and tyres of vehicles.
4. Friction slows down the motion of moving parts of a machine.

Fig. 6.16

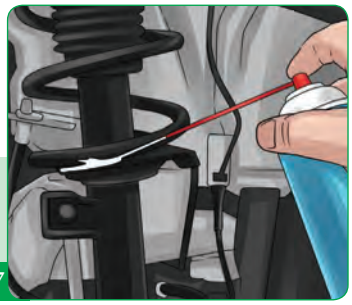


Wearing and tearing of tyre

6.8.4 methods of reducing friction

1. The friction between movable parts of a machine can be reduced by using lubricants like oil or grease.
2. The friction between moving parts of some complex machines can be reduced by using ball bearings between the moving surface.
3. The friction of rough surface can be reduced by polishing the surface.

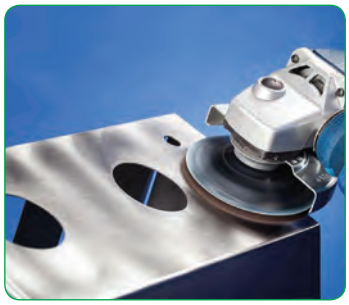
Fig. 6.17



Greasing vehicle parts



Ball bearing



Cleaning rough surface

6.9 Work and Power

6.9.1 Work

Activity 9

- Go to the school ground. Take a wooden log. Tie it with a rope and drag it to a certain distance. You apply a force to drag the wooden log and you cover some distance. You have done some work. Can you calculate the work done?

Work is said to be done when the force acting on a body produces motion in it in the direction of the force. In other words, work done is defined as the product of force and displacement. In SI system, work is measured in joule (J) or newton-metre (Nm).

Formula of work done

Work done (W) = Force (F) × Displacement (s)

$$\therefore \quad W = F \times s$$

No mechanical work is done when a student studies for 2-3 hours sitting on a chair. Similarly, no work is done by a teacher teaching a class. Work is said to be done only if the force applied to a body succeeds in moving it.

When a person pushes a wall, no work is done because the wall does not cover distance. But work is done when a person pushes a cart because the cart covers some distance. Therefore, the work done by a body depends on:

a. The magnitude of force applied (F)

b. The distance covered in the direction of the force (s) applied

Fig. 6.18



A man is pushing a wall (No work is done)



A man is pushing a cart (Some work is done)

One joule work done

When one newton force displaces a body through a distance of one metre, the work done is called one joule.

In short,

1 joule = 1 newton × 1 metre [$\because W = F \times s$]

6.9.2 Types of Work

There are two types of work in physics. They are:

a. Work done against friction b. Work done against gravity

a. Work done against friction

Fig. 6.19



In the figure, a person is pushing a cart on the road. He is doing work against friction. The work done by pushing or pulling an object on a surface is called work done against friction. For example, work done by pulling a wooden log on the road, work done by pushing a cart, etc.

b. Work done against gravity

In the figure, a lady is pulling a bucket of water from a well. She is applying force against gravity and the bucket covers a distance against gravity. So, the work done by the lady is called work down against gravity. The work done by lifting a body vertically upward from the earth's surface is called work done against gravity. For example, work done by a crane by lifting a wooden log vertically upward from the ground.



Fig. 6.20

Do You Know

Friction is the force which opposes the motion of a body moving on other body when they are in contact.

Formula of work done against gravity

Work done against gravity (W) = Force × displacement

or, W = Weight × height [$\because$ Force = Weight (mg), Displacement = Height (h)]

$\therefore$ $W = mgh$

Activity 10

Study the given figures and identify the type of work done in each figure. Also, discuss the reason for your answer.



a.



b.

Fig. 6.21

Worked out Numerical: 3

A force of 300 N displaces a body through 20 m. Calculate the work done.

Given,

Force (F) = 300 N

Displacement (s) = 20 m

Work done (W) = ?

We know,

$W = F \times s = (300 \times 20)\ Nm = 6000\ J$

$\therefore$ Work done (W) = 6000 J.

Worked out Numerical: 4

A crane lifts a wooden log of 150 kg upto a height of 10 m from the earth's surface. Calculate the work done against gravity.

[Take $g = 9.8\ m/s^2$.]

Given,

Mass of wooden log (m) = 150 kg

Height (h) = 10 m

Acceleration due to gravity (g) = $9.8\ m/s^2$

Work done (W) = ?

We know,

$W = mgh$

$= 150 \times 9.8 \times 10$

$= 14700\ J$

$\therefore$ The work done against gravity (W) = 14700 J.

6.9.3 Power

A crane (A) lifts a load of 1000 N and covers a height of 10 m in 10 seconds. Another crane (B) lifts the same load of 1000 N and covers the same height of 10 m in 5 seconds. Which crane has more power? Why? Discuss in the classroom.

Power can be defined as the rate of doing work. The SI unit of work done is joule (J) and that of time is second (s). So the SI unit of power is J/s or W (watt). Power is also measured in kilowatt (kW), megawatt (MW), horsepower (h.p.), etc.

Formula to calculate power (P)

$$\text{Power (P)} = \frac{\text{Work done (W)}}{\text{Time taken (t)}}$$

$$\therefore \quad P = \frac{W}{t}$$

From the above relation, it becomes clear that power (P) depends on two factors, viz. amount of work done (W) and time taken (t).

Two persons that do the same amount of work can have different power. For example, Ram completes 100 J work in 10 seconds. But Hari completes 100 J work in 5 seconds.

$$\text{Power of Ram (P)} = \frac{W}{t} = \frac{100}{10} = 10 \text{ W}$$

$$\text{Power of Hari (P)} = \frac{W}{t} = \frac{100}{5} = 20 \text{ W}$$

From the above calculation, it becomes clear that when a body or a person takes lesser time to do a particular work, the power is said to be greater and vice-versa.

One watt power

One watt power can be defined as the rate of doing one joule work in one second time.

In short, $1 \text{ watt} = \frac{1 \text{ joule}}{1 \text{ second}}$

meaning 20 W written on an electric bulb: It means that the electric bulb converts 20 J of electrical energy into heat energy and light energy in 1 second.



Fig. 6.22

$$\therefore \quad 20\ W = \frac{20\ J}{1s}$$

Relation among watt (W), kilowatt (kW), megawatt (MW) and horse power (h.p.):

1000 W	= 1 kW
1000 kW	= 1 MW
746 W	= 1 h.p.

Worked out Numerical: 5

A man pulls a cart of 40 kg and covers a distance of 10 m in 5 seconds. Calculate the power.

Given,

Mass (m) = 40 kg

$\therefore$ Weight or Force (F) = m × g

or, Force (F) = 40 × 9.8 [$\because$ g = 9.8 m/s^2]

= 392 N

Distance (s) = 10 m

Time (t) = 5 s

We know,

$$P = \frac{W}{t}$$

$$= \frac{F \times s}{t}$$

$$= \frac{392 \times 10}{5}$$

$$= 784\ W$$

$\therefore$ Power of the person (P) = 784 W

Worked out Numerical: 6

A crane lifts a load of 50000 N upto a height of 50 m in 10 seconds. Calculate the power of the crane in horsepower.

Given,

Load (F) = 50000 N

Height (h) = 50 m

Time (t) = 10 s

Power (P) = ?

We know,

$$P = \frac{W}{t}$$

$$= \frac{F \times h}{t} \quad [\because W = F \times h]$$

$$= \frac{50000 \times 50}{10}$$

$$= 250000 \text{ W}$$

$$= \frac{250000}{746} \text{ h.p.} \quad [\because 1 \text{ h.p.} = 746 \text{ W}]$$

$$= 335.12 \text{ h.p .}$$

$\therefore$ Power of the crane (P) = 335.12 h.p.

Key concepts

1. The pull or push which changes or tends to change the position of an object from rest to motion or motion to rest is called force.
2. Force can produce motion in a body at rest and stop a body in motion.
3. A body is said to be at rest, if it does not change its position with respect to a fixed point taken as reference point in its surroundings.
4. A body is said to be in motion, if it changes its position with respect to a fixed point taken as reference point in its surroundings.

5. The total length of the path travelled by a body is called distance.
6. Displacement is the shortest distance between the initial position and the final position travelled by a moving body in a particular direction.
7. A physical quantity which is described completely by its magnitude only is called a scalar quantity.
8. A physical quantity which requires both magnitude and direction for its complete description is called a vector quantity.
9. The velocity of a moving body is defined as the distance covered by a body per unit time in a fixed direction.
10. The force of all attraction between any two objects due to their masses is called gravitational force.
11. Gravity is the force with which a body is pulled towards the centre of the earth.
12. The value of acceleration due to gravity on the surface of the earth is 9.8 m/s^2.
13. The force which opposes the motion of one body over another when they are in close contact is called a frictional force.
14. Work is said to be done when the force acting on a body produces motion in it in the direction of the force. Its SI unit is joule (J).
15. The work done by pushing or pulling an object on a surface is called work done against friction.
16. Power can be defined as the rate of doing work. Its SI unit is watt (W).

Exercise

1. Tick (√) the correct statement and cross (×) the incorrect one.

a. Force can change the direction of a moving body. ☐

b. Rainfall occurs on the earth due to effect of gravity. ☐

c. The SI unit of displacement is m/s. ☐

d. Vector quantity has magnitude but no direction. ☐

e. Velocity is a vector quantity. ☐

f. The SI unit of work is joule. ☐

g. The rate of doing work is called power. ☐

2. Fill in the blanks with appropriate words.

a. The pull or push which changes the position of a body is called .....

b. An apple falls towards the earth's surface due to .....

c. The shortest distance between any two points is called .....

d. The SI unit of velocity is .....

e. The formula of speed is .....

f. The rate of doing work is called .....

g. The SI unit of work done is .....

h. The formula of power is .....

3. Tick (√) the best answer from the given alternatives.

a. In SI system, force is measured in .....

☐ pascal ☐ newton

☐ dyne ☐ metre

b. The force that acts towards the centre of the earth is called .....

☐ power ☐ pushing force

☐ gravity ☐ work

c. The force used by a man to pull a bucket from a well is .....

☐ pushing force ☐ muscular force

☐ pulling force ☐ gravitational force

d. The SI unit of velocity is .....

☐ m/s ☐ km/s

☐ ms ☐ m

e. The SI unit of work done is .....

☐ N ☐ J ☐ Pa ☐ W

f. The formula to calculate power is .....

☐ $P = \frac{W}{t}$ ☐ $P = W \times t$ ☐ $P = W \times d$ ☐ $P = \frac{W}{F}$

4. Answer the following questions.

a. What is force? Write any four effects of force.

b. Define frictional force. Write the types of friction.

c. How can you demonstrate the pulling and pushing force? Write with an example.

d. How does frictional force produce? Write any two effects of friction.

e. Define vectors and scalars with any three examples of each.

f. What is meant by distance and displacement?

g. What do you mean by average velocity? Write its SI unit.

i. What is meant by work done? Define one joule work.

j. What is meant by work done against gravity? Give one example of work done against friction.

k. What is power? Write its SI unit.

l. Define one watt power.

5. Write differences between:

a. Distance and Displacement

b. Scalar and Vector quantity

c. Speed and Velocity

d. Work done against friction and Work done against gravity

e. Work and Power

6. Give reason.

a. Speed is called a scalar quantity.

b. Displacement is called a vector quantity.

c. If we drop a stone from the roof of a house, it falls downwards.

d. Grease is applied to the moving parts of a machine.

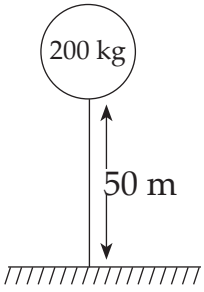
Numerical Problems

a. A bicycle covers a distance of 100 metres in 5 seconds. Calculate the speed of the bicycle. [Ans: 20 m/s]

b. A car is moving with the velocity of 20 m/s. Calculate the distance covered by the car in 10 seconds. [Ans: 200 m]

c. Calculate the work done and power in a metal ball of a mass of 80 kg kept by a crane at the height of 15 m in 5 seconds from the earth's surface. [Take g = 9.8 m/s^2] [Ans: 11760 J, 2352 W]

d. Study the given figure and calculate the work done against gravity. [Take g = 9.8 m/s^2] [Ans: 98000 J]



e. Sanu carries an object 20 m away by applying 500 N force. Calculate the work done. [Ans: 16000 W]

f. A crane lifts a load of 4000 N to a height of 20 m in 5 seconds. Calculate the power of the crane in horse power. [Ans: 32.17 h.p.]

UNIT
07

Energy in Daily Life

Estimated teaching hours : 25

Before You Begin

If a person can do a lot of work, we say the person is very energetic. Energy of a body is the capacity or ability of a body to do work. Living beings cannot survive in the absence of energy. Similarly, energy is required to operate machines in industries, to run automobiles and so on. Due to population growth, the demand of energy sources is increasing day by day. The acute scarcity of energy sources is called energy crisis. We should conserve traditional energy sources and develop alternative sources of energy and reduce energy crisis.

When we touch a hot iron pot we feel hot and when we touch ice we feel cold. How do we get such a sensation? It is due to the flow of heat from a hot object to a cold one. When we touch a burning candle, heat flows from the flame of candle to our body and we feel hot. When we touch ice, heat flows from our body to the ice and we feel cold. Heat is the form of energy which gives us the sensation of warmth, i.e. hotness or coldness. The degree of hotness or coldness of a body is called its temperature. Heat is measured in joule and temperature is measured in kelvin.

In our surroundings, we use different things that produce sound. When materials vibrate, sound is produced. So, sound is the form of energy which is produced due to vibration of a material medium. Sound produces sensation of hearing. The substances that produce sound are called sources of sound. Temple bell, horn of vehicles, loudspeaker, guitar, television, etc. are some sources of sound. Sound waves are produced when a material vibrates. Sound propagates in the form of a wave.

In a dark room, we cannot see the things kept there although our eyes are open. We need light to see the things kept there. So, light is a form of energy which makes things visible. It is produced from extremely hot objects. The objects which emit light are called the sources of light. The sun is the main source of light on the earth. Some other sources of light are light bulb, burning candle, kerosene lamp, etc.

In this unit, we will study energy, its sources, energy crisis, heat and temperature, sound, wave, light and reflection of light in brief.

Learning Outcomes

After completing the study of this unit, students will be able to:

- classify energy sources of daily use with examples.
- introduce fossil fuels and state their advantages and disadvantages.
- explain the importance of energy sources and adopt the measures to conserve them.
- introduce heat and state its units.
- define temperature and write the interrelationship among units of temperature and convert them.

- introduce thermometer and measure the temperature of objects using thermometer.
- describe the structure and working of laboratory thermometer.
- state the temperature of melting ice and boiling water at sea level and human body.
- demonstrate that heat flows from a body at higher temperature to the body at lower temperature.
- demonstrate that temperature increases by getting heat and decreases by losing heat.
- introduce wave and its types.
- perform activities to show the origin of wave.
- define wave length, amplitude, frequency and wave velocity.
- define reflection of light and identify its applications and effects in our daily life.
- state laws of reflection of light and prove them.
- demonstrate reflection of light on a plane mirror and draw necessary ray diagrams.
- make a model of periscope and explain its working mechanism and utilities.

Syllabus

- Introduction to energy
- Renewable and non-renewable sources of energy
- Fossil fuel - Introduction, advantages and disadvantages
- Alternative energy and ways of saving energy
- Heat and temperature
- Thermometer and units of temperature
- Relationship between different scales of temperature
- Relation between heat and temperature
- Introduction to sound
- Transmission of sound
- Types of wave - Transverse wave and longitudinal wave
- Some terms related to waves (crest, trough, amplitude, wave length, frequency and wave velocity)
- Introduction to light
- Reflection of light (regular reflection and irregular reflection)
- Some terms related to reflection of light
- Laws of reflection of light
- Applications of reflection of light
- Periscope - Structure, working and application

Glossary

beam	:	a collection of several rays of light
conduction	:	the process of transfer of heat from one particle to another without actual movement of particles
convection	:	the process of transfer of heat by the actual movement of molecules of a medium
energy	:	the capacity of doing work
frequency	:	the number of complete cycles made in one second
heat	:	the form of energy which gives us the sensation of warmth
image	:	a picture of something/somebody seen in a mirror
kinetic energy	:	the form of energy that an object gains when it moves
light	:	the form of energy which makes things visible
longitudinal wave	:	a wave that vibrates in the direction that it is moving
luminous	:	shining in the dark due to its own light
normal	:	a perpendicular drawn on the surface at the point of incidence
nuclear	:	related to nucleus of an atom
potential energy	:	the form of energy that an object gains as it is lifted
radiation	:	the transmission of heat from a hot body to a cold body without affecting a medium
sound	:	the form of energy which is produced due to vibration of a body
temperature	:	the degree of hotness or coldness of a body
transverse wave	:	a wave that vibrates at 90° to the direction in which it is moving
wave motion	:	a periodic disturbance travelling through a medium which is produced by a vibrating body

7.1. Energy

7.1.1 Introduction to Energy

Activity 1

We need energy to survive. We need energy to perform various activities. Observe the given figures and identify the sources of energy to do these activities.

a. 

b. 

c. 

d. 

e. 

f. 

g. 

h. 

i. 

Fig. 7.1

- Name the energy sources required to do each of the given activities.
- Which of the above energy sources can be used again and again?
- Which of the energy sources get exhausted after their use?

Divide above energy sources into two groups on the basis of their use as follows :

Energy sources that can be used again and again	Energy sources that get exhausted after their use

Living beings cannot survive without energy. We need energy to do work. Food provides us energy to walk, run, jump and do other activities. Diesel provides energy to run vehicles and operate machines in industries. The capacity to do work is called energy. We get energy from various things such as food, firewood, petrol, diesel, coal, kerosene, LP gas, running water, blowing wind, etc. The sun is the main source of energy. Energy is required for cooking food, running vehicles, operating machines in industries, lighting bulbs, operating computers, etc. All plants and animals need energy to survive. In this unit, we will study the sources and forms of energy, applications of energy and energy crisis in brief.

Fig. 72



Eating food



Bulb



Computer

We get light and heat energy from the sun. Therefore, the sun is the source of light and heat. Temple bell, radio, television, loudspeaker, etc. are the sources of sound energy. Burning coal, fire, electric heater, etc.

are the sources of heat energy. Bread, petrol, coal, diesel, kerosene, etc. are the sources of chemical energy. Cell, photocell, battery, etc. are the sources of electrical energy. So, the substances from which we get energy are called sources of energy. Examples: Heater, petrol, coal, rice, wind, water, battery, etc.

Fig. 73






The sun *Dry cell* *Bread* *Coal*

Sources of energy

7.1.2 Types of Energy Sources

The sources of energy available on the earth can be divided into two types. They are (i) renewable and (ii) non-renewable sources of energy.

i. Renewable sources of energy

The sources of energy like solar energy, wind energy, energy from running water, biomass energy and biogas are called renewable sources of energy. Because these sources of energy will never finish from nature and hence can be used again and again. The sources of energy which are produced continuously in nature and can be used again and again are called renewable sources of energy.

Fig. 74





Firewood *Running water* *sun*

Some renewable sources of energy

ii. Non-renewable sources of energy

The sources of energy which cannot be used again and again after their use are called non-renewable sources of energy. Coal, petrol, diesel, petroleum gas, etc. are some examples of non-renewable sources of energy. These sources of energy have a limited stock in nature and take millions of years to form once again in nature. Therefore, non-renewable sources of energy cannot be used again and again.

Fig. 75





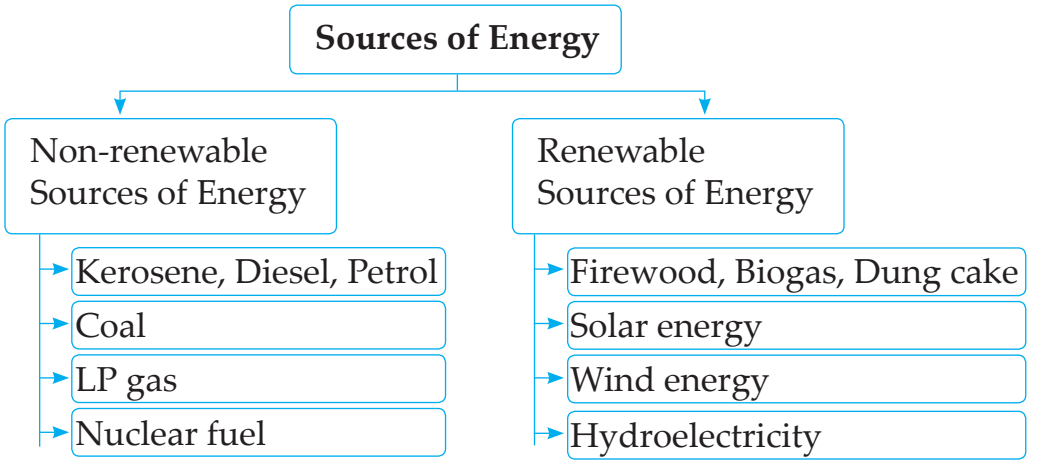


Coal *Petrol* *Diesel* *LP gas*

Some non-renewable sources of energy

Differences between renewable and non-renewable sources of energy

S.N.	Renewable sources of energy	S.N.	Non-renewable sources of energy
1.	Renewable sources of energy can be obtained continuously and can be used again and again.	1.	Non-renewable sources of energy cannot be used again and again as they have limited stock in nature.
2.	These sources of energy never get depleted and can be replaced within a short period of time.	2.	These sources of energy get depleted and take millions of years to be replaced.



Activity 2

- Prepare a list of various sources of energy that are used at your home. Classify them into renewable and non-renewable sources of energy.

Activity 3

- Prepare a list of various forms of energy. Also, write down their applications in our daily life.

7.1.3 Fossil Fuels

Fossil fuels are fuels that are formed in nature by the decomposition and preservation of organic materials under high temperature and pressure over a long time period. The most important fossil fuels are coal, petroleum and natural gases. A brief description of these fossil fuels is given below.



Fig. 7.6 *Petrol*

a. Coal

Coal is an important fossil fuel which is found in the form of sedimentary rocks. It is a hard black mineral found below the ground. Coal is burnt to produce heat energy. Coal is found between stones or sedimentary rocks.



Fig. 7.7 *Different types of coal*

Formation of coal

Natural disasters like earthquake, volcano, floods, etc. are responsible for forming coal. In ancient time, destroyed animals and plants got

covered under the ground due to various geological phenomena like natural disasters. The remains of dead bodies and plants were pressed under high pressure and temperature under the ground for a long time in the form of fossils. Over a long period of time, these fossils are converted into coal. The process of forming coal from plants due to the high pressure and temperature under the ground is called carbonization. Since, carbonization is a slow and gradual process, it takes about thousand years to form coal from fossils.



Fig. 7.8 *Formation of coal*

Importance of coal

i. Coal is an important source of fuel.
ii. It is used to generate electricity.
iii. It is used in railway transportation, industries, brick and iron factories, etc.
iv. It is used to manufacture petrol, natural gas, coke, etc.
v. It is used to make various organic compounds like phenol, benzene, etc.



Fig. 7.9 *Coal is used in industry to get heat.*

b. Mineral Oil

mineral oil (or mineral fuel) is a black coloured viscous liquid with foul smell. It is the mixture of hydrocarbons and other materials like oxygen, sulphur, nitrogen, etc. About 90% hydrocarbons are found in mineral oil. Mineral oil is found in nature between rocks on the earth crust. Generally, carbon and hydrogen are the prominent components of mineral oil. Unprocessed mineral oil is called crude oil.







Fig. 7.10 *Petrol* *Diesel* *Kerosene*

Formation of mineral oil

In nature, mineral oils are formed by the decomposition of animals and plants that are burried under the ground for a long period of time. The hard parts of animals and plants are pressed by sedimentary rocks under high pressure and temperature for a long time. As a result, various chemical reactions take place and crude oil is formed from the hydrocarbons.

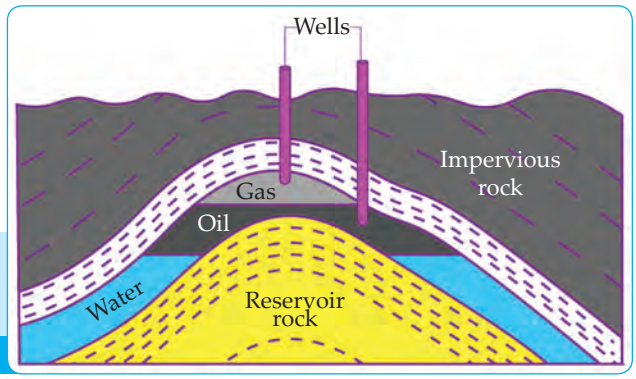


Fig. 7.11 *Formation of mineral oil*

After purification of crude oil, mineral oils are obtained. The crude oils are obtained by drilling the holes on the earth's surface. The crude oil contains water, mineral salts, rocks, etc. The crude oil is processed by fractional distillation and various petroleum-products are extracted from it.

Advantages of fossil fuel

The main advantages of fossil fuel (mineral oil and coal) are mentioned below:

1. Fossil fuel is cheaper as compared to other fuels.
2. It is a multipurpose fuel as it can be used in automobiles, industries, etc.
3. It can be transported easily.
4. It can be used to generate electricity.
5. It can be used in those industries that require maximum heat.
6. It can be used for cooking foods, heating rooms, boiling water, etc.


Fig. 7.12 *Air pollution*

In spite of above mentioned advantages, fossil fuels produce harmful gases and smoke while burning and hence cause environmental pollution. Similarly, they are non-renewable sources of energy and cannot be obtained again and again after their use.

Activity 4

- Classify given energy sources into renewable sources and non-renewable sources. Also, write their advantages and disadvantages.

S.N.	Sources of Energy	Types of Energy Sources	Advantages	Disadvantages
1.	Petrol			
2.	Coal			
3.	Biogas			
4.	Wind energy			
5.	Solar energy			
6.	Hydroelectricity			

7.1.4 Alternative Sources of Energy

Activity 5

Which sources of energy do you use in place of electricity and petroleum products? Discuss in the classroom and prepare a list of these energy sources.

Now-a-days, coal, mineral oil and natural gas are widely used throughout the world. These sources of energy are non-renewable. So these sources of energy cannot be used again and again. As a result, energy crisis occurs in the world. Therefore, alternative sources of energy should be developed and used.

Fig. 7.13



Biogas plant



Wind mill



Solar panel

The energy sources which are used in place of conventional sources of energy are called alternative sources of energy. Biofuel, tidal energy, wind energy, solar energy, etc. are the examples of alternative sources of energy. In present day world, it is very necessary to develop and use alternative sources of energy to solve energy crisis. In this unit, we will discuss following alternative sources of energy only.

a. Bio fuel

The fuel which is obtained from different parts of plants and animal dung is called bio fuel. Biomass energy is the energy obtained from straw, saw dust, etc. Nepal is an agricultural country. So, the raw materials for biomass energy are easily available in different parts of the country. Therefore, bio fuel is one of the major alternative sources of energy.

Do You Know

Natural gases are odourless. So it is difficult to find out the leakage of those gases. Therefore, ethyl mercaptan is mixed in natural gases to get the smell if there is leakage of these gases.

In rural areas, cattle dung is used for making dung cake and biogas or gobar gas. Biogas is the cooking gas which is produced by decomposition of animal dung.

In rural areas, biogas (gobar gas) is used as a fuel for cooking food. It is also used to get light and to run engines. Now-a-days, farmers are encouraged to install biogas plants and the government of Nepal also provides subsidy to the farmers of rural areas to install biogas plant.

Fig. 7.14



Cooking from biogas



Light obtained from bio gas

Advantages of bio fuel

1. Animal dung is used to produce biogas. Biogas is used for cooking food and lightning bulb.
2. The residue produced while preparing biogas can be used as organic fertilizer.
3. It produces less smoke while burning. So it does not affect our health.
4. It produces more heat.

5. It is cheaper and can be produced easily.
6. It can be used to run engines.

Project Work

- Visit a nearby biogas plant with your science teacher.
- Study the structure and working mechanism of the biogas plant.
- Prepare a report and submit it to your science teacher.

b. Wind energy

The energy which is obtained from fast blowing wind is called wind energy. It is a renewable source of energy which is being used from ancient time. Wind energy can be used to run sea boat, wind mill, etc. It is also used for generating electricity, pumping water, etc.



Fig. 7.15 *Wind mills are used to generate electricity.*

Strong wind blows in the hilly and Himalayan regions of Nepal. The blowing wind is used to rotate turbines for generating electricity. Wind energy is being used in some parts of our country. In the context of Nepal, wind energy can be a good alternative source of energy.

c. Solar energy

Solar energy is the best alternative source of energy as it is available in different parts of the earth. The energy obtained from the sun is called solar energy. The solar cell is a device which converts solar energy directly into electrical energy with the help of photo cells.

Solar energy can be trapped by solar panel to charge the battery. The electricity generated from solar energy can be used to get light, heat water and operate various electric as well as electronic equipment. In context of Nepal, solar energy is one of the major alternative sources of energy to solve energy crisis.

Fig. 7.16



Solar in satellite



Solar in rural area



Solar panel

Solar energy is used to operate artificial satellites and communication devices in remote areas. Solar energy does not cause pollution. Solar energy is a very good alternative source of energy in remote areas of Nepal.

Project Work

- Visit a nearby place having solar energy production unit. Observe solar panel, battery, wires and bulbs. Discuss the process of getting electricity from solar energy. Prepare a report and present it in the classroom.

7.1.5 Energy Crisis

Now-a-days, we are facing the shortage of energy sources due to population growth. We are facing shortage of electricity, petrol, diesel, gas, etc. Most of the sources of energy that we use now-a-days are petroleum products like petrol, diesel, coal, LP gas, etc. These sources have a limited stock in nature. We are using them at a rapid rate that their stock will be finished from nature in a very near future. It will result in great scarcity of energy sources. The acute scarcity of energy sources is called energy crisis. Population growth, careless use of existing energy sources and lack of development of alternative sources of energy are the main causes of energy crisis.

Fig. 7.17



Energy crisis

Measures of Saving Energy and Solving Energy Crisis

It is our duty to contribute to push energy crisis further. Some methods of saving energy sources and solving the problem of energy crisis are as follows:

1. We should use the existing sources of energy wisely and economically.
2. Alternative sources of energy such as solar energy, wind energy, biomass energy, etc. should be developed and used.
3. Solar water heaters and solar cookers should be used to heat water and cook our food.
4. Food should be cooked in pressure cookers to save energy.
5. Computer, television, bulbs, etc. should be switched off if they are not necessary.
6. Lead bulbs should be used instead of electric bulbs to save electricity.
7. The use of electric vehicles should be increased.
8. The production of hydroelectricity should be increased as Nepal in rich in water resources.
9. In rural areas of Nepal, biogas plants should be instilled.
10. Public awareness should be generated to conserve energy sources.

Key concepts

1. The substances from which we get energy are called sources of energy.
2. The sources of energy which are produced continuously in nature and can be used again and again are called renewable sources of energy.
3. The sources of energy which cannot be used again and again after their use are called non-renewable sources of energy.
4. Fossil fuels are fuels that are formed in nature by the decomposition and preservation of organic materials under high temperature and pressure over a long time period.
5. Coal is an important fossil fuel which is found in the form of sedimentary rocks. It is a hard black mineral found below the ground.

6. The process of forming coal from plants due to the high pressure and temperature under the ground is called carbonization.
7. Mineral oil (or mineral fuel) is a black coloured viscous liquid with foul smell.
8. In nature, mineral oils are formed by the decomposition of animals and plants that are burried under the ground for a long period of time.
9. The energy sources which are used in place of conventional sources of energy are called alternative sources of energy.
10. The fuel which is obtained from different parts of plants and animal dung is called bio fuel.
11. Wind energy can be used to run sea boat, wind mill, etc. It is also used for generating electricity, pumping water, etc.
12. Solar energy is the best alternative source of energy as it is available in different parts of the earth.

Exercise

1. Tick (√) the best answer from the given alternatives.

a. The capacity of doing work is called .....

☐ heat ☐ light ☐ sound ☐ energy

b. Which of the following is a renewable source of energy?

☐ petrol ☐ coal ☐ diesel ☐ biomass

c. Which of the following is the non-renewable sources of energy?

☐ wind energy ☐ petrol

☐ biogas ☐ hydroelectricity

d. Which energy source is used to run automobiles?

☐ mineral oil ☐ wind energy

☐ solar energy ☐ biogas

e. Which of the given source is suitable to generate maximum electricity in context of Nepal?

☐ wind ☐ sun ☐ water ☐ coal

2. Put a tick (√) for the correct statements and a cross (×) for the incorrect ones.

a. Energy is not required to do work. ☐

b. Coal and petrol are renewable sources of energy. ☐

c. Solar energy is an alternative source of energy. ☐

d. We should use existing energy sources wisely and economically. ☐

e. We should decrease the use of electric vehicles to solve energy crisis. ☐

3. Fill in the blanks using appropriate words.

a. Hydroelectricity is ..... sources of energy.

b. The energy sources that can be obtained again and again after use are called ..... sources of energy.

c. The acute scarcity of energy sources is called .....

d. The fuel obtained from the fossils is called ..... fuel.

e. The gas which is produced while burning fossil fuel is .....

4. Answer the following questions.

a. What is energy? Name two types of sources of energy.

b. Define renewable sources of energy with any two examples.

c. Define non-renewable sources of energy with any two examples.

d. Why are coal and petrol called non-renewable sources of energy?

e. What are alternative sources of energy? Give any two examples.

f. Name any three alternative sources of energy suitable for Nepal.

g. What is solar energy? Name any two advantages of it.

h. What is wind energy? Write its advantages.

i. What is energy crisis? Write any four ways of solving energy crisis.

5. Match the following:

a.	Coal	☐	Renewable source of energy
b.	Solar energy	☐	Energy obtained from the sun
c.	Wind energy	☐	Alternative source of energy
d.	Biogas	☐	Fossil fuel

6. **Write any four applications of energy in our day-to-day life.**
7. **The sun is considered as the main source of energy. Explain in brief.**
8. **Differentiate between :**
   a. Renewable and Non-renewable sources of energy
   b. Biofuel and Fossil fuel
   c. Fossil fuel energy and Wind energy
9. **Which sources of alternative energy will be appropriate in context of Nepal? Write in brief.**
10. **The wise and economic use of energy sources is the best way of conserving existing energy sources. Justify this statement.**
11. **Study the given figures and write short note on each.**

a. b. c.





12. **What type of alternative sources of energy do you use at your home? Write their advantages and disadvantages.**
13. **The use of electric vehicles should be increased to reduce energy crisis? Why?**
14. **How can you save energy sources at your home and school? Write any five points.**
15. **How are fossil fuels formed? Explain.**

7.2. Heat and Temperature

7.2.1 Introduction to Heat

Activity 6

Study the given figures. Identify which form of energy is required by each of the given events/phenomena?



Fig. 7.18

Why is heat essential in our daily life? What are the sources of heat that you use at your home? Discuss in the classroom.

We feel hot when we touch a burning coal and we feel cold while touching ice cubes. When heat energy flows into our body, we get sensation of warmth and when heat flows out from our body, we get the sensation of coldness. The sensation of warmth or coldness is caused due to gain or loss of heat. So, heat is a form of energy which gives sensation of warmth or coldness.

When we rub palm of our hands against each other, they become warm. Heat is produced due to the movement of molecules. Heat is measured in joule (J) or calorie (Cal.). It is measured by a device called calorimeter. In our day to day life, we use heat energy for various purposes such as cooking foods, drying clothes, boiling tea, running engines, etc.



Fig. 7.19

We get heat energy from different sources like the sun, burning substances, electric heater, light bulb, running vehicles, etc. The sun is the main source of heat energy.

Effects of Heat

The major effects of heat are as follows:

1. Expansion of the substances
2. Change in the state of substances
3. Change in the temperature of substances
4. Change in the solubility of substances

7.2.2 Introduction to Temperature

When we get fever, we use a thermometer to measure the body temperature. The thermometer measures the degree of hotness or coldness of our body.



Fig. 7.20

Activity 7

- Take three beakers, one with cold water, another with hot water and third with hot milk.
- Take a laboratory thermometer and measure the temperature of each liquid and fill in the given table.

S.N.	Substances	Temperature	
		In °C	In °F
1.	Cold water		
2.	Hot water		
3.	Hot milk		

Concept of Temperature

Do You Know

Heat always flows from the body at higher temperature to the body at lower temperature.

The temperature of a body is defined as the degree of hotness or coldness of the body. It can also be defined as the average kinetic energy of the molecules present in a body. Temperature of a body is the measure of the average kinetic energy or thermal energy of its molecules. Temperature is the property of a substance which determines the direction of the flow of heat. Temperature is measured by using thermometer.

Units of temperature

The SI unit of temperature is kelvin (K). But temperature is commonly measured in degree Celsius (°C) and degree Fahrenheit (°F).

Differences between Heat and temperature

S.N.	Heat	S.N.	Temperature
1.	Heat is the sum of kinetic energy present in the molecules of a body.	1.	Temperature is the average kinetic energy present in the molecules of a body.
2.	It is measured by using calorimeter.	2.	It is measure by using thermometer.
3.	Its SI unit is joule (J).	3.	Its SI unit is kelvin (K).

7.2.3 Thermometer

We can feel hotness or coldness of a body by touching it. But we cannot measure the temperature of that body just by touching. A device that is used to measure the temperature of a body is called thermometer. So, thermometer is the device which is used to measure the temperature of a body.

Fig. 7.21



Thermometer

Principle of construction of thermometer

When a body is heated, it expands and when it is cooled, it contracts. This is the working principle of a thermometer. Thermometer can be made by using

liquid or gas as they expand more than the solids. However, we commonly use liquid thermometers.

7.2.3.1 Types of Thermometer

There are different types of thermometers. But in this unit, we will study two types of thermometers, viz. laboratory thermometer and clinical thermometer.

a. Laboratory thermometer

The thermometer which is used to measure the temperature of various objects in a laboratory is called the laboratory thermometer. It consists of a capillary tube made of glass in which one end is closed and another end is connected to a cylindrical bulb.

Fig. 7.22



Laboratory thermometer

The cylindrical bulb has a small portion of the capillary tube filled with mercury or coloured alcohol. The air from the capillary tube is completely taken out before closing the open end of the capillary tube. *The scale in the laboratory thermometer ranges from – 10° C to 110° C.*

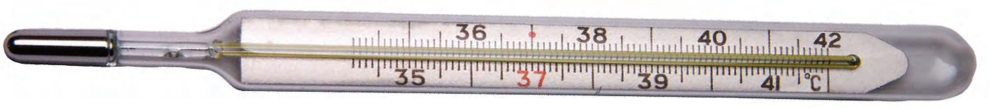
While measuring the temperature of a body, the bulb of the thermometer is kept in close contact of the body. As the bulb comes in contact with the hot body, the thermometric liquid inside the bulb expands and rises upwards in the capillary tube. Finally the liquid gives a constant level, which is the temperature of the body. When the bulb of the thermometer is kept in a cold body, the thermometric liquid contracts upto a constant level which shows the temperature of the cold body.

b. Clinical thermometer

The thermometer which is used to measure the temperature of the human body is called clinical thermometer. It consists of a prismatic glass tube having a constriction in the capillary tube near the bulb. The constriction allows the mercury to rise up in the capillary tube while measuring the

temperature. But it does not let mercury to fall back immediately when removed from the body. It helps to take accurate reading of the body temperature.

Fig. 7.23



Clinical thermometer

In a clinical thermometer, the temperature scale ranges from 35°C to 42°C because the average human body temperature is 37°C.

While measuring temperature of the human body, the bulb of the clinical thermometer is kept in the mouth or armpit of the person for a while. The mercury remains at the original level due to contraction after its removal from the body. It helps to take accurate measurement of the body temperature.

Differences between Clinical thermometer and Simple thermometer

S.N.	Clinical thermometer	S.N.	Simple thermometer
1.	It is constructed for measuring the temperature of human body.	1.	It is constructed for measuring the temperature of different bodies in laboratory.
2.	It has constriction near the bulb.	2.	It has no constriction near the bulb.
3.	In this thermometer, the scale ranges from 35°C to 42°C.	3.	In this thermometer, the scale ranges from –10°C to 110°C.

Activity 8

- Go to your science laboratory with the science teacher. Study the structure and working mechanism of a clinical and laboratory thermometer.
- Measure the temperature of melting ice, hot water and boiling water using a laboratory thermometer.

Activity 9

- Take a clinical thermometer and measure your body temperature.
- Compare your body temperature with your friend's body temperature.

7.2.4 Thermometric Liquids

Two liquids, i.e. mercury and alcohol are used in the thermometer. These liquids are called thermometric liquids. The liquids which are used in a thermometer are called thermometric liquids.

Advantages of mercury as a thermometric liquid

1. Mercury can be seen clearly in the capillary tube as it is a silvery white liquid.
2. It has a uniform rate of expansion and contraction.
3. It is a good conductor of heat as it is a liquid metal.
4. It can measure a wide range of temperature because the freezing point of mercury is –39°C and boiling point is 357°C.
5. Mercury does not stick to the inner wall of capillary tube.

Fig. 7.24



mercury thermometer

Disadvantage of mercury as a thermometric liquid

A mercury thermometer cannot measure very cold temperature as the freezing point of mercury is –39°C. Therefore, mercury thermometer is not suitable to measure very low temperature in cold countries.

Advantages of alcohol as a thermometric liquid

1. Alcohol is suitable to measure very low temperature in cold countries as the freezing point of alcohol is –115°C.
2. It can measure accurate temperature as its rate of expansion is six times more than that of mercury.
3. It is not very expensive.

Fig. 7.25



Alcohol thermometer

Disadvantages of alcohol as a thermometric liquid

1. Alcohol is not suitable to measure the temperature above 78°C because the boiling point of alcohol is 78°C.
2. It is a bad conductor of heat. So, it has no uniform rate of expansion and contraction.
3. It cannot give accurate measurement of temperature because it sticks to the inner wall of the capillary tube.

Differences between mercury and Alcohol

S.N.	mercury	S.N.	Alcohol
1.	Its boiling point is 357°C and freezing point is –39°C.	1.	Its boiling point is 78°C and freezing point is –115°C.
2.	It is a metal.	2.	It is a non-metal.

7.2.5 Calibration of Thermometer

Calibration of thermometer is the process of determining the scale in a thermometer. For this process, two fixed points, viz. lower fixed point and upper fixed point are determined.

a. Lower fixed point

The temperature of pure melting ice at the standard temperature and pressure is called the lower fixed point. It is 0°C or 273 K at standard atmospheric pressure, i.e. 760 mmHg.

b. Upper fixed point

The temperature of pure boiling water at the standard temperature and pressure is called the upper fixed point. It is 100°C or 373 K at standard atmospheric pressure, i.e 760 mm Hg.

During calibration of a thermometer, first of all, the upper fixed point and the lower fixed point are determined. Then the distance between these two points is divided into 100 equal divisions in Celsius and Kelvin scale and into 180 equal divisions in Fahrenheit scale.

Activity 10

To determine the lower fixed point of the thermometer, i.e. ice point

- Take a glass funnel and keep some ice cubes into it.
- Take a thermometer and insert its bulb into ice cubes.
- As the bulb is inserted in the ice cube, the level of mercury drops down in the capillary tube and shows a constant reading after sometime.

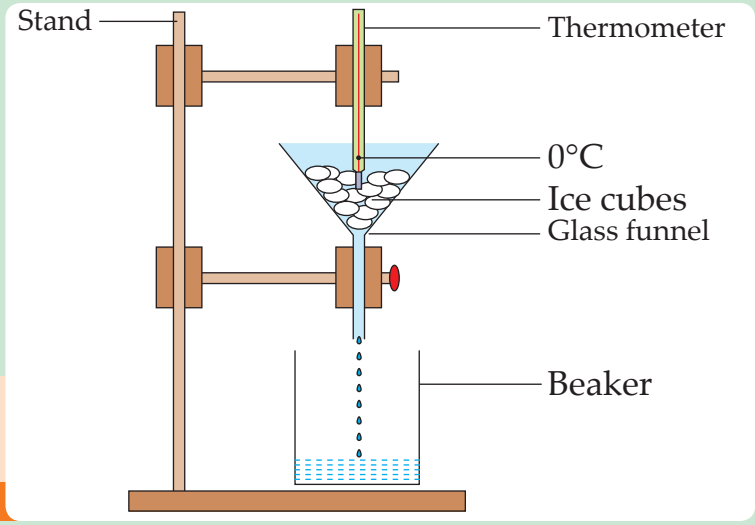


Fig. 7.26

The constant temperature is the melting point of ice. It is called the lower fixed point or ice point. Its value is 0°C or 32°F or 273 K.

Activity 11

To determine the upper fixed point of the thermometer, i.e. steam point

- Take a round bottom flask and keep some pure water into it.
- Insert a thermometer and a glass tube with the help of cork as shown in the figure.
  Please note that the bulb of the thermometer should not touch water in the flask.
- Take a bunsen burner and boil the water in the flask for a while. Observe the level of mercury in the thermometer.

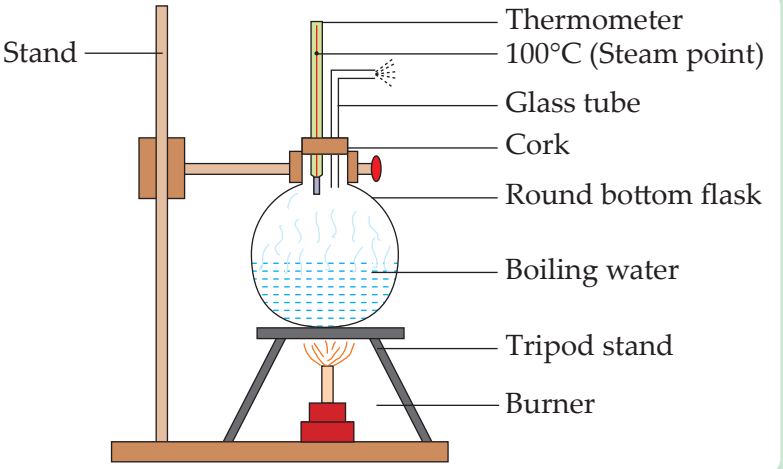


Fig. 7.27

When water is heated, the level of mercury rises up in the capillary tube.

When water boils, the thermometer shows a constant reading which is known as the upper fixed point or steam point. Its value is 100°C or 212°F or 373 K.

7.2.6 Temperature Scales

There are three temperature scales for measuring temperature by thermometer. They are as follows:

1. Celsius scale
2. Fahrenheit scale
3. Kelvin scale

1. Celsius scale

In Celsius scale, the melting point of ice, i.e. 0°C is taken as the lower fixed point and the boiling point of water, i.e. 100°C is taken as the upper fixed point. There are 100 equal division between 0°C and 100°C in this scale. Each division is called 1°C.

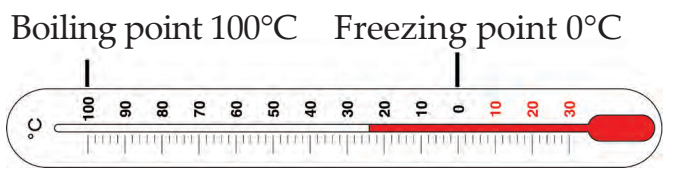


Fig. 7.28

Celsius scale

2. Fahrenheit scale

In Fahrenheit scale, the temperature of melting ice, i.e. 32°F is taken as the lower fixed point and the boiling point of water, i.e. 212°F is taken as the upper fixed point. In this scale, there are 180 equal divisions between 32°F and 180°F. Each division is called 1°F.

3. Kelvin scale

In Kelvin scale, the melting point of ice, i.e. 273 K is taken as the lower fixed point and the boiling point of water, i.e. 373 K is taken as the upper fixed point. There are 100 equal divisions between 273 K and 373 K. Each division is called 1 K.

Temperature scales	melting point of ice	Boiling point of water
Celsius scale	0°C	100°C
Fahrenheit scale	32°F	212°F
Kelvin scale	273 K	373 K

Relation among Celsius, Fahrenheit and Kelvin scales

$$\frac{C-0}{100-0}=\frac{F-32}{212-32}=\frac{K-273}{373-273}\left[\because \frac{\text{Scale}-\text{Lower fixed point}}{\text{Upper fixed point}-\text{Lower fixed point}}\right]$$

$$\therefore \quad \frac{C-0}{100}=\frac{F-32}{180}=\frac{K-273}{100}$$

Relation between Celsius scale and Fahrenheit scale

$$\frac{C-0}{100}=\frac{F-32}{180}$$

Relation between Celsius scale and Kelvin scale

$$\frac{C-0}{100}=\frac{K-273}{100}$$

Relation between Fahrenheit scale and Kelvin scale

$$\frac{F-32}{180}=\frac{K-273}{100}$$

Do You Know

The boiling temperature of alcohol is only 78°C. So, very high temperature cannot be measured by alcohol thermometer.

Worked out Numerical: 1

Convert 98.6°F in °C.

We know,

$$\frac{C-0}{100} = \frac{F-32}{180}$$

or, $\frac{C}{100} = \frac{98.6-32}{180}$

or, $C = \frac{66.6}{180} \times 100$

or, $C = 37$

$\therefore$ 98.6°F = 37°C

Worked out Numerical: 3

Convert 100°C into °F.

We know,

$$\frac{C-0}{100} = \frac{F-32}{180}$$

or, $\frac{100-0}{100} = \frac{F-32}{180}$

or, $1 = \frac{F-32}{180}$

or, $180 = F - 32$

or, $F = 180 + 32$

or, $F = 212$

$\therefore$ 100°C = 212°F

Worked out Numerical: 2

Convert –40°F into °C.

We know,

$$\frac{C-0}{100} = \frac{F-32}{180}$$

or, $\frac{C}{100} = \frac{-40-32}{180}$

or, $\frac{C}{100} = \frac{-72}{180}$

or, $180 \times C = -72 \times 100$

or, $C = \frac{-7200}{180}$

or, $C = -40$

$\therefore$ 40°F = –40°C

Activity 12

- Collect water in a glass from the tap every day at 7 o'clock.
- Take a thermometer and measure its temperature in °C and °F scales and fill in the given table.

S.N.	Date	Time	Temperature	
			°C	°F
1				
2				
3				
4				
5				
6				

What can you conclude from this activity?

Activity 13

- Take some water in a round bottom flask.
- Take a thermometer and measure its temperature.
- Now, place the flask on a tripod stand and fix it with the help of a stand with a clamp.
- Heat the water in a flask with the help of a Bunsen burner.
- Note down the temperature of water after every three minutes.
- Plot a graph showing the time along X-axis and corresponding temperature along Y-axis.
- What is the relation between increase in heat and raise in the temperature? What can you conclude from this activity?

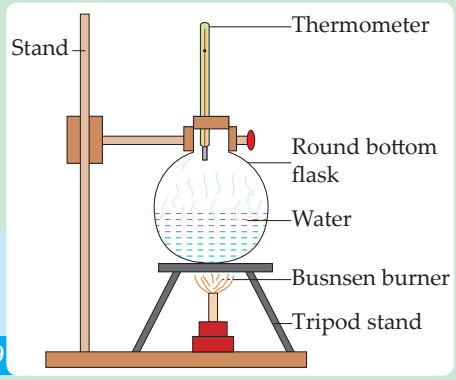


Fig. 7.29

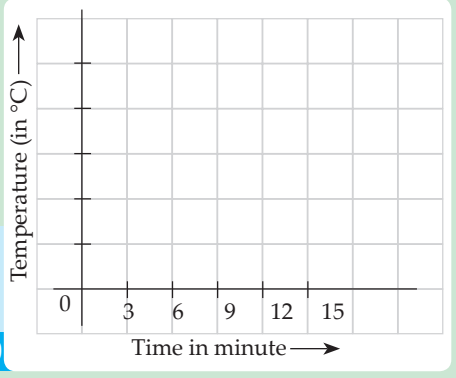


Fig. 7.30

Activity 14

- Take a laboratory thermometer and measure the temperature of following objects one by one.

Substances	°C	°F	Substances	°C	°F
Cold water			Ice		
Hot water			Boiling water		
Cold milk			Hot milk		
Tea					

- Out of cold water and boiling water, which one has more temperature and why?
- What will be the temperature of boiling water if allowed to cool for 5 minutes? Why ?

7.2.7 Relation between Heat and Temperature

During winter season, we feel very cold and we generally use hot water to take bath. We boil water and mix it with cold water to make it suitable for bathing. The boiling water is very hot and has a high temperature. Cold water has low temperature. When we mix hot water in cold water, hot water loses heat and cold water gains heat. It shows that heat flows from a body a higher temperature to the body at lower temperature.

We prepare tea or coffee by boiling water, sugar, tea/coffee and milk. When we supply heat, the temperature of the mixture increases and finally boils. When we remove the flame, the temperature decreases gradually and finally becomes cold.



Fig. 7.31

When the mixture (tea/coffee) absorbs heat, its temperature increases and when it loses heat, its temperature decreases. After a while, the temperature of tea or coffee becomes same as the temperature of its surrounding. The temperature of a body depends on the amount of heat present in it. So we can say that heat is the cause of increases or decrease in temperature and temperature is the effect of heat.

During winter, the temperature of surrounding is very low as compared to that of our body temperature (98.6°F). So heat flows outside from our body and we feel very cold. Therefore, we wear thick clothes to prevent the loss of heat from our body.

Activity 15

- Take three beakers, two of 50 ml each and another of 100 ml capacity.
- Fill the smaller beakers, one with hot water and another with cold water.
- Measure the temperature of hot water and cold water using a laboratory thermometer.
- Now, pour hot water and cold water in the large beaker.

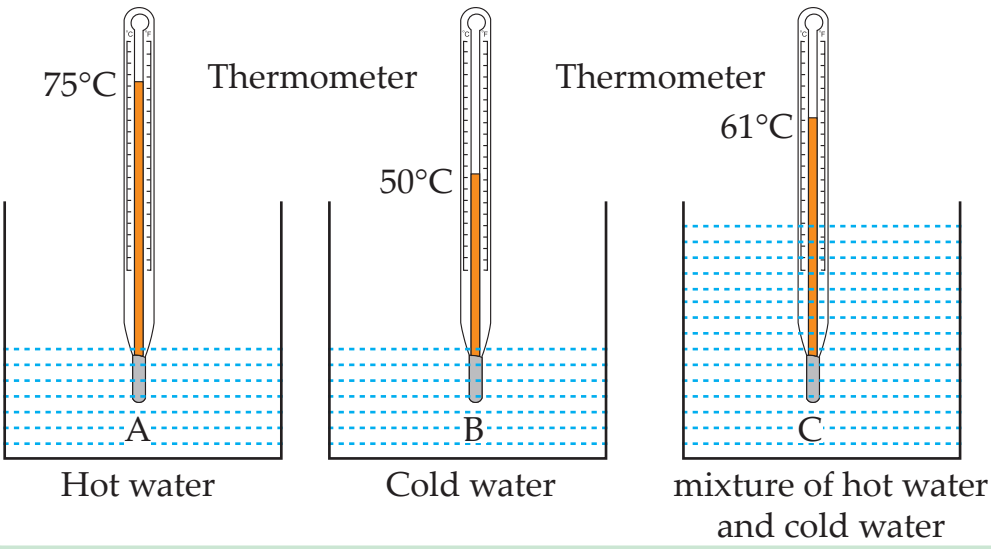


Fig. 7.32

- Measure the temperature of the mixture. What do you find?
- What can you conclude from this activity?

Key concepts

1. Heat can be defined as the sum of kinetic energy of the molecules present in a body. Its SI unit is joule (J).
2. Temperature can be defined as the average kinetic energy of the molecules present in a body. Its SI unit is kelvin (K).
3. A device which is used to measure the temperature of a body is called thermometer.
4. When a body is heated, it expands and when it is cooled, it contracts. This is the working principle of a thermometer.

5. The thermometer which is used to measure the temperature of a human body is called clinical thermometer.
6. Two liquids, i.e. mercury and alcohol are used in a thermometer. These liquids are called thermometric liquids.
7. Calibration of thermometer is the process of determining the scale in a thermometer.
8. The temperature of pure melting ice at the standard temperature and pressure is called the lower fixed point or ice point.
9. The temperature of pure boiling water at the standard temperature and pressure is called the upper fixed point or steam point.
10. There are three scales for measuring temperature by thermometer. They are (i) Celsius scale (ii) Fahrenheit scale and (iii) Kelvin scale.

Exercise

1. Put a (√) for the correct statements and a cross (×) for the incorrect ones.

a. Heat is the sum of kinetic energy present in the molecules of a body. ☐

b. Temperature is measured by using calorimeter. ☐

c. The melting point of ice is taken as the lower fixed point. ☐

d. Alcohol thermometer cannot measure the temperature of boiling water. ☐

e. Mercury and alcohol are thermometric liquids. ☐

2. Fill in the blanks using appropriate words.

a. The SI unit of heat is .....

b. The average kinetic energy of molecules is called .....

c. The boiling point of water is .....

d. The thermometer which is not suitable to measure the temperature in very cold countries is ..... thermometer.

e. The melting point of pure ice is ..... °C.

3. Tick (√) the most appropriate answer from the given alternatives.

a. The SI unit of temperature is .....

☐ K ☐ °C ☐ °F ☐ J

b. The boiling point of mercury is .....

☐ 100°F ☐ 100°C ☐ 212°C ☐ 357°C

c. The average temperature of the human body is .....

☐ 37°F ☐ 37°C ☐ 98.6°C ☐ 32°F

d. In Fahrenheit scale, there are ..... equal divisions between lower fixed point and upper fixed point.

☐ 100 ☐ 180 ☐ 212 ☐ 32

e. Which of the following relation is correct?

☐ $\frac{C-0}{100} = \frac{F-32}{180}$ ☐ $\frac{C-0}{180} = \frac{F-32}{100}$

☐ $\frac{C-0}{100} = \frac{F-32}{273}$ ☐ $\frac{C-0}{180} = \frac{F-32}{373}$

4. Answer the following questions.

a. Define heat and write its SI unit.
b. Name the instrument which is used to measure heat.
c. What is temperature? Write its SI unit.
d. What is thermometer? Write down its working principle.
e. What is laboratory thermometer? Draw a neat and labelled figure of a laboratory thermometer.
f. Why is clinical thermometer used?
g. What are thermometric liquids? Give two examples.
h. Write any two advantages and two disadvantages of alcohol as a thermometric liquid.
i. Why is mercury used as a thermometric liquid? Give any two reasons.
j. What is meant by calibration of a thermometer?
k. Define lower fixed point and upper fixed point.
l. What are temperature scales? Write down the relation among Celsius, Fahrenheit and Kelvin scales.

5. Give reason.

a. Clinical thermometer has a constriction near the bulb.

b. Mercury thermometer is not suitable to measure extremely low temperature.

c. Clinical thermometer cannot measure the temperature of boiling water.

d. If we leave a hot coffee for a while, it becomes cold.

6. Differentiate between:

a. Heat and Temperature

b. Laboratory thermometer and Clinical thermometer

c. Mercury and Alcohol

d. Celsius scale and Fahrenheit scale

7. Describe the structure of a clinical thermometer with a neat figure.

8. Describe an activity to determine the:

a. lower fixed point b. upper fixed point

8. At what temperature both Celsius and Fahrenheit scale show the same reading? Show by calculation.

9. Describe an activity to prove that hot object loses heat and cold object gains heat when they are mixed together.

10. Name the thermometer shown in the given figure and describe its structure in brief.



Numerical Problems

1. Convert 37°C into °F. [Ans: 98.6°F]
2. Convert 212°F into °C. [Ans: 100°C]
3. Convert 0°C in K. [Ans: 273 K]
4. Convert 373 K into °F. [Ans: 212°F]
5. Convert 32°F into °C. [Ans: 0°C]
6. Convert 100 °C into °F. [Ans: 212°F]
7. Convert 98.6°F into °C. [Ans: 37°C]
8. Convert –40°C into °F. [Ans: –40°F]

7.3 Sound

7.3.1 Introduction to Sound

Activity 16

Study the given figures. Identify which form of energy that can be produced while playing them. How is this form of energy produced? Discuss.







Fig. 7.33

a. b. c.

We hear different types of sound around us everyday. We hear the sound of our parents and friends, the sound of vehicles running on the roads, the barking of dogs, sound of aeroplanes, the clatter of pans in the kitchen, the chirping of birds and so on. In the night, most sounds cease but we can still hear the sound of some insects. All these sounds produce a sensation of hearing in our ears. So, sound is form of energy which produces a sensation of hearing in our ears.

Activity 17

Make a list of any eight types of sound heard by you. Write down the names of the object, living or non-living, which sound the loudest and which the faintest.

Sound is Produced by Vibrating Bodies

When a school bell is hammered, it vibrates and produces sound. When it stops vibrating, sound is ceased. Sound is produced by the vibration of bodies. So, every vibrating body is a source of sound. Can you name some sources of sound?



Fig. 7.34

Activity 18

Take a scale and hold its one end firmly on the table with your one hand. Flick the free end of the scale with your another hand. What do you observe? the scale is seen vibrating and a humming sound is heard. The humming sound is produced by the 'to and fro' motion of the ruler. The ruler produces sound as long as it remains vibrating.

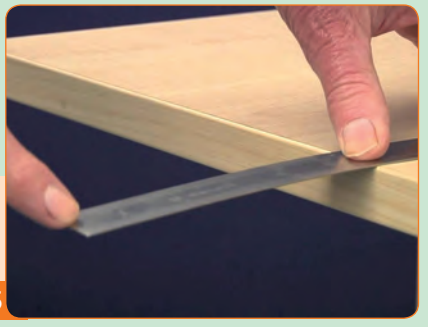


Fig. 7.35 *Vibrating ruler*

Activity 19

Pluck the wire of a guitar or sitar. It produces sound. Touch the wire when it is producing sound. What happens to the sound? Why?



Fig. 7.36 *Pulling guitar string*

From the above examples, it can be concluded that sound is produced from vibrating bodies. When vibration stops, the sound also stops. So, we can conclude that the main source of sound is a vibrating body.

7.3.2 Sources of Sound

We have seen many things like bell, guitar, loudspeaker, radio, television, etc. that produce sound. These things are called sources of sound. An object which produces sound due to vibration is called a source of sound. Radio, television, guitar, animals, vehicles, machines, etc. are some examples of sources of sound. Actually, every vibrating object is the source of sound.

Do You Know

Vibration is the rapid to and fro motion of a particle or a body about its mean position. A body can be vibrated by hitting, stroking, plucking, blowing, etc.

Fig. 7.37


Radio


Television


Guitar

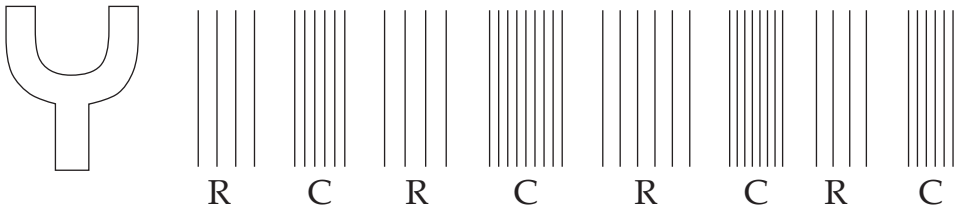

Loud speaker

Some sources of sound

7.3.3 Sound Wave

A wave produced due to the vibration of a material medium is called a sound wave. It is produced due to vibration of solid, liquid and gas. A sound wave needs a medium (solid, liquid or gas) for propagation. It cannot propagate through vacuum.

Fig. 7.38



Sound wave

When sound waves coming from a source propagate through air, and reach our ears, we hear the sound. Sound propagates in the form of longitudinal waves. A longitudinal wave consists of alternately arranged compressions and rarefactions. When a sound wave passes through air, the particles of air vibrate back and forth parallel to the direction of propagation forming compressions and rarefactions.

Do You Know

- A compression is that part of a longitudinal wave in which the particles of the medium are closer to one another.
- Rarefaction is the part of a longitudinal wave in which the particles are farther apart.

7.3.4 Propagation or Transmission of Sound Wave

Sound needs material medium for its propagation. The sound from a vibrating body propagates through air and reaches our ears

Do You Know

Propagation of sound is the transmission of sound wave from one place to another.

and we hear the sound. So the transmission of the sound from one place to another is called propagation of sound. The propagation of sound takes place through solids, liquids and gases. Sound cannot propagate through vacuum.

Air is one of the media for the propagation of sound. The speed of sound in air is about 332 m/s. Sound wave cannot propagate in the absence of air. So, sound cannot propagate on the surface of the moon as that happens on the surface of the earth.

Liquid is another medium for propagation of sound. The speed of sound in water is about 1498 m/s. The sound produced by aquatic animals like dolphin, whale, etc. propagates through water.

Similarly, solid is a medium through which sound propagates. The speed of sound in the steel medium is about 5200 m/s. The sound wave travels farther in solids than in liquids or gases.

Sound propagates in the form of longitudinal wave. When sound wave propagates through air, the particles of air vibrates to and fro parallel to the directions of propagation of sound wave. It forms regions of compressions and rarefactions which are shown in the given figure.

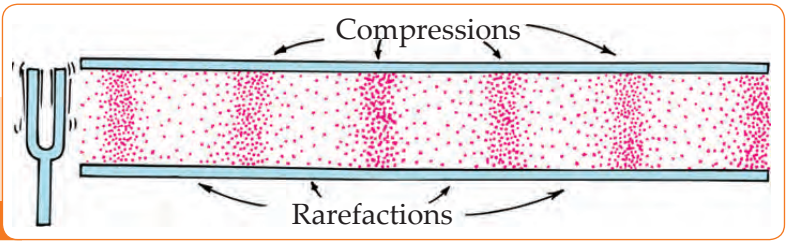


Fig. 7.39

Activity 20

To demonstrate the propagation of sound through a solid



Fig. 7.40

- Make a toy telephone by using two empty cans, two small buttons and a long thread.
- Make a hole at the bottom of each tin can, pass the thread through the hole and tie its ends to a button.

- Use this toy telephone to talk to your friends.
- This activity proves that sound can travel through a thread (solid).

Activity 21

To demonstrate the propagation of sound through liquid.

- Take a squeaking toy and keep it in a polythene bag.
- Hold the toy in a bucket of water and squeeze it.
- Can you hear its squeak. Place your ear against the side of the bucket and squeeze the toy again.
- Do you hear its squeak?
- In which case did you hear the sound more clearly?
- This activity shows that the sound travels through liquids.

7.3.5 Types of Wave

There are two types of wave. They are:

i. Transverse wave

ii. Longitudinal wave

i. Transverse wave

Visit a nearby pond and drop a piece of stone at the centre of the pond. You can see ripples on the surface of water in the pond. The ripples produced on the surface of pond are called transverse waves. The wave in which the particles of the medium vibrate up and down perpendicular to the direction of the wave is called a transverse wave.



Fig. 7.41

For example: Ripples produced on the water surface in a pond, vibration of stretched string in musical instruments, waves formed in a slinky when move up and down. A transverse wave can propagate only in solids and at the surface of liquids.

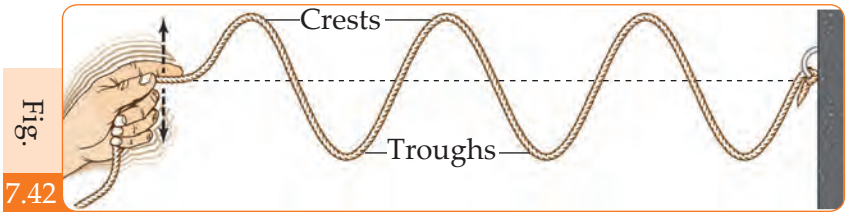


Fig. 7.42

Transverse wave

A transverse wave consists of crests and troughs. Crest is the point of maximum positive displacement of a transverse wave. Similarly, trough is the point of maximum negative displacement of a transverse wave.

ii. Longitudinal wave

A wave in which particles of the medium vibrate to and fro in the direction of the wave is called a longitudinal wave. For example, sound wave, wave formed in a slinky when pulled and pushed, etc.


Fig. 7.43

Sound waves produced from a loud speaker

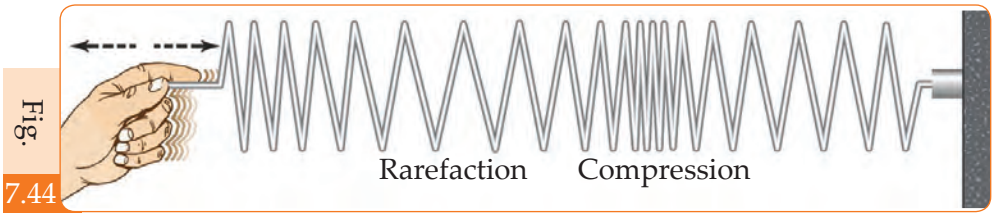


Fig. 7.44

Longitudinal wave

A longitudinal wave consists of regions of compressions and rarefactions. A compression is that part of a longitudinal wave in which the particles of the medium are closer to one another and rarefaction is the part of the wave in which the particles are farther apart.

Differences between transverse wave and longitudinal wave

S.N.	Transverse wave	S.N.	Longitudinal wave
1.	In this wave, the particles of the medium vibrate up and down perpendicular to the direction of the wave.	1.	In this wave, the particles of the medium vibrate to and fro in the direction of the wave.

2.	It is produced only in solids and surface of liquids.	2.	It is produced in solid, liquid and gas.
3.	It consists of crests and troughs.	3.	It consists of compression and rarefaction.

Activity 22

- Take a rubber pad and a tuning fork.
- Hit the rubber pad with the tuning fork. Do you hear vibrations?
- Now, touch the tuning fork. What do you feel?
- Write down the conclusion of this activity.



Fig. 7.45

Activity 23

- Take a small stone and go to a nearby pond with your seniors.
- Throw the stone in the pond. Be careful while throwing the stone.
- Do you see ripples in the pond?
- Now, throw a leaf on the surface of the ripples. What do you observe? Discuss.



Fig. 7.46

7.3.6 Terminology Related to Wave

1. Frequency of sound

Frequency of sound is defined as the number of complete cycles produced in one second. It is denoted by 'f'. In SI system, frequency is measured in

Do You Know

The frequency of a sound wave is 40 Hz means that the sound wave produces 40 completes cycles or vibrations in one second.

hertz (Hz). The larger units of frequency are kilohertz(kHz), megahertz (MHz), etc. The relation between hertz, kilohertz and megahertz is given below:

1000 Hz	= 1 kHz
1000 kHz	= 1MHz
1 MHz	= 1000000 Hz

2. Time period

The total time taken to from a complete wave is called time period. It is denoted by T. In the SI system, the unit of time period is second (s).

Time period is calculated by the given formula:

$$\text{Time period (T)} = \frac{1}{\text{frequency (f)}}$$

In short,

$$T = \frac{1}{f}$$

3. Wavelength

The total distance covered by a sound wave in one vibration is called wavelength. It is denoted by the Greek symbol *Lambda* (λ). In the SI system, wavelength is measured in meter (m).

4. Amplitude

Amplitude of a sound wave is defined as the maximum displacement of vibrating particle from its mean position. It is denoted by 'a'. Its SI unit is metre (m).

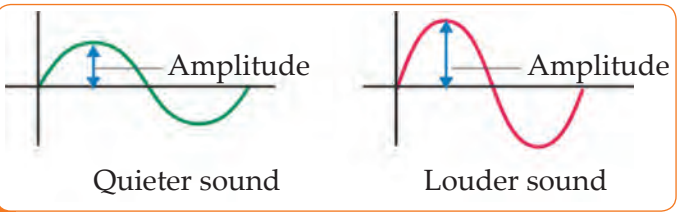


Fig. 7.47

5. Wave velocity

Wave velocity can be defined as the total distance covered by a sound wave per unit time. Its SI unit is meter per second (m/s).

The mathematical relation between wave velocity, frequency and wavelength is called wave equation, which is $v = f \times \lambda$.

Wave velocity (v) = frequency of sound (f) × wavelength (λ)

In short,

$$v = f \times \lambda$$

Solved Numerical: 1

The frequency of a sound wave is 60 Hz and its wave length is 85 m. Calculate the speed of sound in the medium.

Given,

Frequency (f) = 60 Hz

Wavelength (λ) = 85 m

Speed of sound (v) = ?

We know,

$v = f \times \lambda$

$= 60 \times 85 = 5100$ m/s

$\therefore$ The speed of sound (v) = 5100 m/s

Solved Numerical: 2

The speed of sound in water is 1500 m/s. If the wavelength is 12.5 m, calculate the frequency of the sound.

Given,

Speed of sound (v) = 1500 m/s

Wavelength (λ) = 12.5 m

Frequency (f) = ?

We know,

$v = f \times \lambda$

or, $1500 = f \times 12.5$

or, $f = \frac{1500}{12.5} = 120$ Hz

$\therefore$ The frequency of sound is 120 Hz.

7.3.7 Relation between Velocity of sound and medium

Sound wave can propagate through solids, liquids and gases. Sound travels with different speed in different media. The speed of sound is maximum in solids and minimum in gases. The molecules in solids are closely packed together and hence carry more vibrations. As a result, the speed of sound is maximum in solids.

The speed of sound in some common media is given below:

S.N.	medium	Speed of sound
1.	Iron (20 °C)	5130 m/s
2.	Glass (25 °C)	5500 m/s
3.	Aluminium (25 °C)	5100 m/s
4.	Water (20 °C)	1498 m/s
5.	Alcohol (25 °C)	1210 m/s
6.	Air (0 °C)	332 m/s
7.	Hydrogen (0 °C)	1284 m/s

Activity 24

- Take a madal and place it vertically as shown in the figure.
- Place a few grains of rice on the skin.
- Hit on the skin gently and observe the displacement of the grains from the skin.
- Now, hit strongly on the skin and observe the displacement of the grains from the skin.
- What can you conclude from this activity?

When we hit on the skin of madal gently, the skin vibrates and rice grains jump vertically upward due to vibration. If we hit on the skin strongly, more vibrations are produced and the rice grains show more displacement from the skin. From this activity, it can be concluded that amplitude increases when vibration of particles increases.

Key concepts

1. Sound is a form of energy which gives the sensation of hearing in our ears.
2. Sound is produced due to the vibrating body, so vibrating body is the source of sound.
3. Sound can travel in solid, liquid and gas but it cannot travel in a vacuum.
4. A periodic disturbance travelling through a medium which is produced by a vibrating body is called wave motion.
5. There are two types of waves. They are transverse wave and longitudinal wave.
6. Sound travels in the form of longitudinal wave.
7. A transverse wave is the wave in which particles of the medium vibrates up and down perpendicular to the direction of the wave. A transverse wave consists of crests and trough.
8. Crest is the point of maximum positive displacement of a transverse wave.

9. Trough is the point of maximum negative displacement of transverse wave.
10. Longitudinal wave is the wave in which the particles of the medium vibrate to and fro in the direction of the wave.
11. Propagation of sound is the transmission of sound from one place to another.
12. Frequency of sound is defined as the number of complete cycles produced in one second. It is denoted by 'f'.
13. The total time taken to from a complete wave is called time period. It is denoted by T.
14. The total distance covered by a sound wave in one vibration is called wave length. It is denoted by the Greek symbol *Lambda* (λ).
15. Amplitude of a sound wave is defined as the maximum displacement of vibrating particle from its mean position.
16. Wave velocity can be defined as the total distance covered by a sound wave per unit time. Its SI unit is meter per second (m/s).
17. The mathematical relation between wave velocity, frequency and wavelength is called wave equation, which is $v = f \times x$.
18. Sound travels with different speed in different media. The speed of sound is maximum in solids and minimum in gases.

Exercise

1. Tick (√) the correct statements and cross (×) the incorrect ones.

a. Sound is a form of energy which produces sensation of hearing. ☐

b. Sound can propagate through a vacuum. ☐

c. Sound travels faster in gas than in solid medium. ☐

d. The speed of sound in the air is 332 m/s. ☐

e. Longitudinal wave consists of crests and troughs. ☐

2. Fill in the blanks with appropriate words.

a. Sound is produced from a ..... body.

b. The wave of sound is a ..... wave.

c. A medium is required for the ..... of sound.

d. A ..... wave consists of crests and troughs.

e. Sound cannot travel in .....

3. Choose the best answer from the given alternatives.

a. Sound is a form of energy which gives the sensation of .....

- ☐ vision
- ☐ warmth
- ☐ hearing
- ☐ all of above

b. Sound cannot travel through a .....

- ☐ solid
- ☐ liquid
- ☐ gas
- ☐ vacuum

c. The speed of sound in air is .....

- ☐ 332 m/s
- ☐ 1500 m/s
- ☐ 5200 m/s
- ☐ 2500 m/s

d. The speed of sound is minimum in .....

- ☐ solid
- ☐ liquid
- ☐ gas
- ☐ air

e. Which one of the following medium produces sound?

- ☐ solid medium
- ☐ liquid medium
- ☐ gas medium
- ☐ vibrating medium

4. Answer the following questions.

a. What is sound?

b. How is sound produced?

c. What is a source of sound? Write any four examples.

d. What is a wave motion?

e. What are two types of wave?

f. What is a transverse wave? Write any two examples.

g. What is a longitudinal wave? Write any two examples.
h. What is meant by propagation of sound?
i. Why is speed of sound more in solids than in gases?

5. Write the differences between:

a. Transverse wave and Longitudinal wave
b. Crests and Troughs
c. Compressions and Rarefactions
d. Frequency and Wavelength

6. Give reason:

a. We cannot talk in the moon as in the earth.
b. The speed of sound is higher in solids than in liquids.
c. Sound cannot propagate through a vacuum.

7. Describe an activity to prove that sound can travel in a liquid medium.

8. Describe an activity to prove that sound can travel in a solid medium.

Numerical Problems

a. The sound of wavelength 0.022 m has a frequency of 15 kilohertz. Calculate the speed of the wave. [Ans: 330 m/s]
b. If the speed of a sound wave in a medium is 5100 m/s and the frequency is 200 Hz, calculate the wavelength. [Ans: 25.5 m]
c. The speed of sound in a medium is 1200 m/s and the wavelength is 15.5 m. Calculate the frequency of the sound wave. [Ans: 77.41 Hz]

7.4 Light

7.4.1 Introduction to Light

Activity 25

- Observe the given figures. Identify the form of energy that can be obtained from these objects.



Fig. 7.48

Why do we use these objects? Discuss in the classroom.

Animals are able to see things of their surroundings due to the presence of light. We can easily experience and understand about the effect of light in our vision. We cannot see anything in a dark place though we keep our eyes open. But we can see things with the help of a torch light. We can see things only in the presence of light. So, light is a form of energy which gives sensation of vision.



Fig. 7.49

Light travels in a straight line as long as it propagates in the same medium. It travels very fast with the speed of 3 lakh kilometer per second (300000 km/s). The sunlight takes 500 seconds to reach the earth from the sun.

7.4.2 Sources of Light

Those objects which emit light are called sources of light. For example, the sun, star, torchlight, burning candle, glowing bulb, firefly, etc. The sun is the main source of light. Some sources of light which can emit their own light like the sun, star, glowing bulb, firefly, etc. are known as luminous objects. So, luminous objects are the objects which emit light of their own.

Fig. 7.50


sun


Star


Torchlight


Burning candle

Some luminous objects

Some objects like plastics, glass, rock, paper, soil, etc. do no emit light of their own. Those objects which do not emit light of their own are called non-luminous objects.

Fig. 7.51


Paper


Stone


Wood

Some non-luminous objects

Activity 26

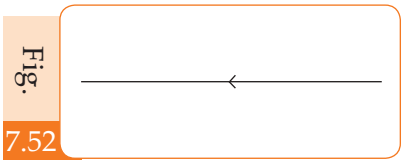
Classify the given objects in terms of luminous and non-luminous sources of light.

- star - sun - stone - soil - sand - plastic - pencil
- pen - paper - book - bulb - burning candle - black board

7.4.3 Ray and Beam of Light

Ray of Light

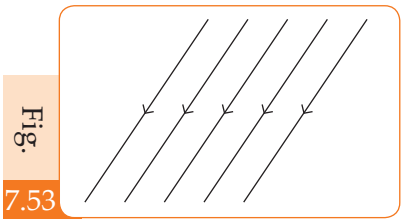
A very narrow path of light is called a ray of light. It is represented by a line with an arrowhead. The arrowhead shows the direction of propagation of light.



A ray

Beam of Light

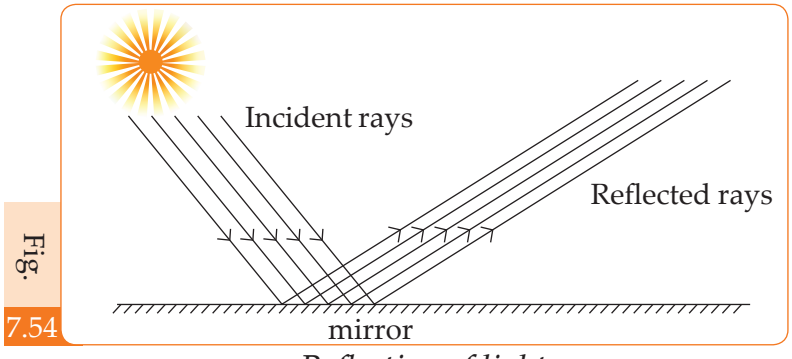
The collection of several rays of light is called a beam of light. It is broader and consists of many rays.



A beam of light

7.4.4 Reflection of Light

When we stand in front of a plane mirror, we see our own image in it. It is possible only due to the reflection of light by the mirror. When the rays of light fall on a shiny or polished surface, the rays are returned to the same medium. This phenomenon is called reflection of light. The phenomenon of returning of the light to the same medium after striking a surface is called reflection of light.



Reflection of light

We are able to see things when light from a luminous body falls on these things. It is due to the reflection of light by these things. Non-luminous objects do not absorb all light, they reflect some light which enters our eyes. As a result, we see them. Therefore, the objects in our surroundings are visible due to the reflection of light.

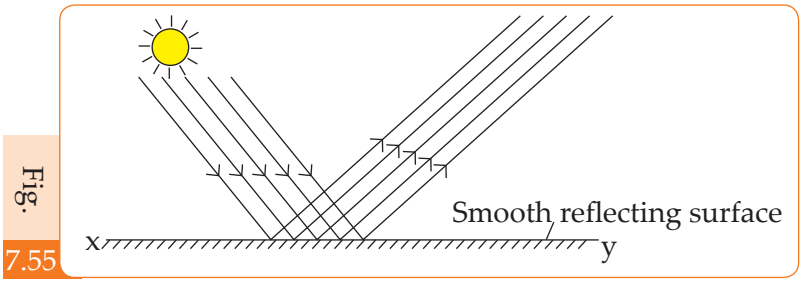
Types of Reflection of Light

There are two types of reflection of light on the basis of direction of reflected rays. They are as follows:

a. Regular reflection of light
b. Irregular reflection of light

a. Regular reflection of light

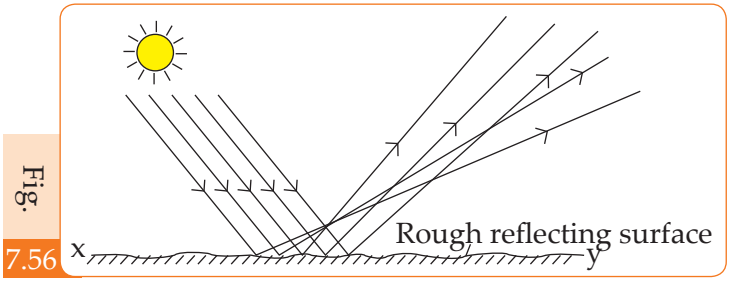
When a parallel beam of light strikes a smooth surface, the reflected rays are also parallel to each other. This type of reflection of light is called regular reflection. For example, reflection of light from a plane mirror or any highly polished surface. A plane mirror or polished surface appears bright due to the regular reflection of light.



Regular reflection of light

b. Irregular reflection of light

When a parallel beam of light strikes a rough surface, the reflected rays are not parallel to each other. This type of reflection of light is called irregular reflection. The reflected rays scatter in different directions. For example, reflection of light from furniture, clothes and other rough surfaces.



Irregular reflection of light

7.4.5 Some Terms Related to Reflection

1. Mirror
2. Incident ray
3. Point of incidence
4. Reflected ray
5. Normal
6. Angle of incidence

7. Angle of reflection

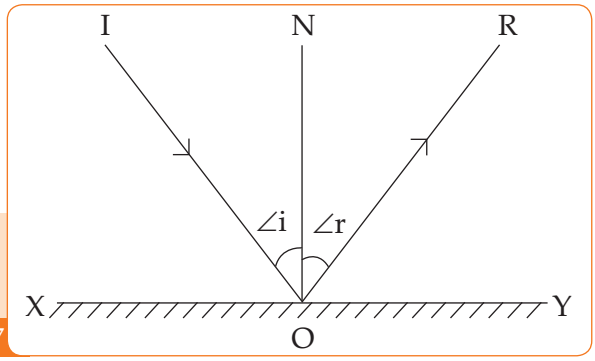


Fig. 7.57

In the figure 7.8

XY - mirror

IO - Incident ray

O - Point of incidence

OR - Reflected ray

ON - Normal

∠ION - Angle of incidence

∠RON - Angle of reflection

1. Mirror

Any smooth or polished surface which can return back the rays of light into the same medium is called mirror. For example, looking glass, highly polished metal surface, still water or oil, polished furniture, etc.



Fig. 7.58 *mirror*

2. Incident ray

A ray of light striking a reflecting surface is called the incident ray.

3. Point of incidence

The point at which the incident ray strikes the reflecting surface is called point of incidence.

4. Reflected ray

The light ray obtained after reflection from the surface in the same medium in which incident ray is travelling is called reflected ray.

5. Normal

The perpendicular drawn to the surface at the point of incidence is called normal.

6. Angle of incidence

The angle which the incident ray makes with the normal at the point of incidence is called the angle of incidence. It is denoted by ∠i.

7. Angle of reflection

The angle which the reflected ray makes with the normal at the point of incidence is called angle of reflection. It is denoted by ∠r.

7.4.6 Laws of Reflection of Light

Laws of reflection of light state that:

i. the incident ray, the reflected ray and the normal lie on the same plane at the point of incidence.

ii. the angle of incidence is equal to the angle of reflection.

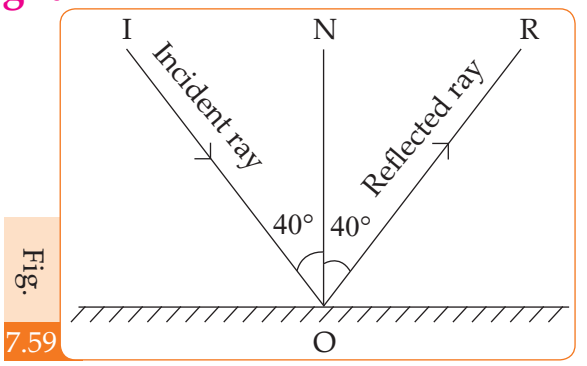


Fig. 7.59

7.4.7 Reflection of Light from a Plane mirror

A plane mirror consists of a smooth or polished surface which can return back the rays of light falling on it into the same medium. A looking glass is a mirror. One side of it is coated with silver due to which another side of it acts as a reflecting surface. Similarly, highly polished metal surface, still water or oil, highly polished furniture, etc. act as plane mirror.

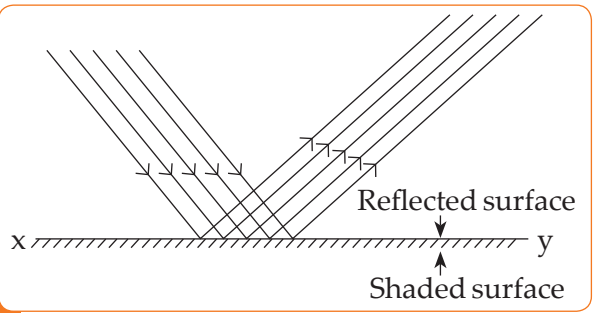


Fig. 7.60

While drawing the diagram of a mirror, the reflecting surface is represented by a straight line and the silver coated side is represented by shaded lines.

Activity 27

- Fix a sheet of white paper firmly on a fixing board with the help of thumb pins.
- Draw a straight line XY on the paper.
- Place the long edge of the mirror along the line.
- Fix two pins A and B vertically in front of the mirror.
- Try to locate image A' and B' of the two pins.
- Fix two more pins C and D on the paper in front of the mirror, so that they both lie along the line A' and B'.

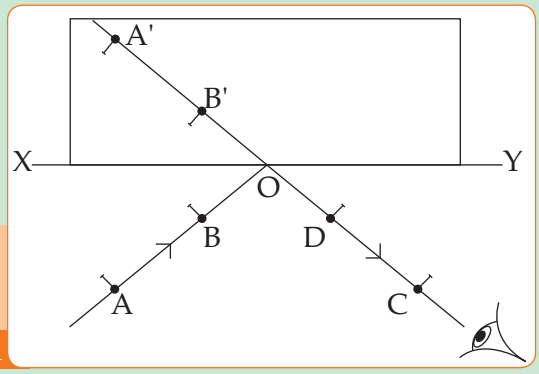


Fig. 7.61

- Mark the position of pins with a pencil and remove the pins and the mirror.
- Draw a line joining the point A and B. It meets the mirror at point O on the line XY. Now, join the O, D and C.
- Now, measure the angle of incidence and angle of reflection.

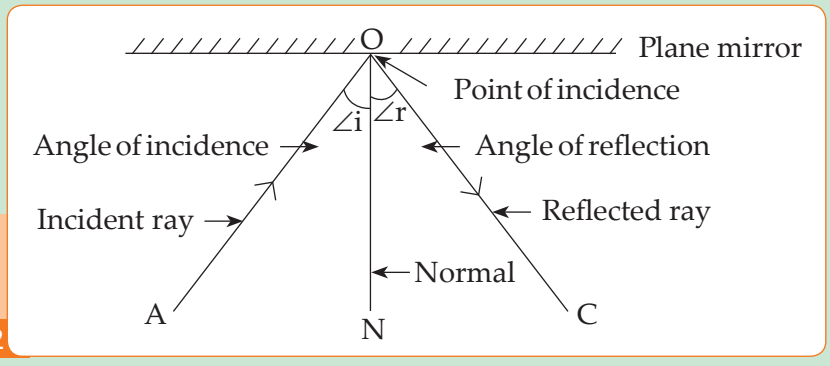


Fig. 7.62

7.4.8 Periscope

A periscope is a simple device based on the principle of successive reflections from two plane mirrors.

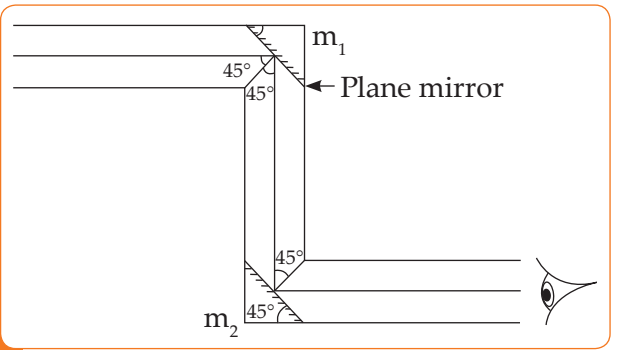


Fig. 7.63

A periscope consists of two plane mirrors m_1 and m_2 facing each other fixed at 45° to the frame-work of a tube (card board or wooden) which is bent twice at right angle.

The beam of light entering the tube from the object strikes the mirror m_1 at 45°. That beam is reflected by the mirror m_1 and travelled through the tube and strike at the mirror m_2 at 45°. That beam finally gets reflected from the mirror m_2 parallel to its original path and reaches to the eye of the viewer.

The main uses of a periscope are as follows:

1. It is used to see over the heads of a crowd.
2. It is used to observe the enemies activity above the ground by a soldier sitting in a trench.
3. It is used to see the movement of ships over the surface of the sea from a sub-marine.

7.4.9 Kaleidoscope

Project Work

Make you own Kaleidoscope

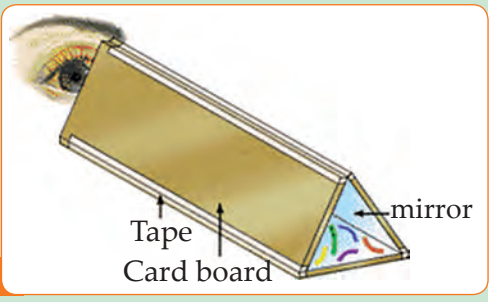


Fig. 7.64

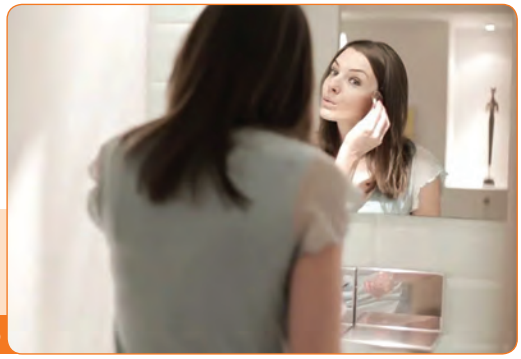
- Take three mirror strips and join them to form a triangular prism.
- Join the strips with the help of rubber bands or cello tape.
- Wrap them by a black paper.
- Now, place a few pieces of coloured glass (broken bangles) inside the tube.
- Cover both the open ends of the tube with white tissue papers.
- Now hold and rotate the kaleidoscope pointing towards light. You can see beautiful patterns of colours.

Kaleidoscope is a simple toy based on the principle of the formation of several images by inclined mirrors.

7.4.10 Application of Reflection of Light

1. Reflection of light is utilized to see our face, for doing make up and shaving by using a plane mirror.

Fig. 7.65



Applying make up in-front of mirror



Shaving in-front of mirror

2. Reflection of light is utilized to see details of microscopic objects by reflecting light from the mirror of compound microscope and simple microscope.
3. Reflection of light is utilized to see back view in the mirror of vehicles or automobiles.
4. Reflection of light is utilized to construct periscope to see over the heads of a crowd, observe enemies activity above the ground by sitting in a trench and to see movement of ships on the sea through submarine.

Fig. 7.66



Reflection of light on microscope



Reflection of light on vehicle mirror



Reflection of light on periscope

Activity 28

Prepare a periscope under the guidance of your science teacher and demonstrate in your school.

Key concepts

1. Light is a form of energy which gives the sensation of vision.
2. The speed of light in a vacuum is about three lakh kilometer per second.
3. An object which emits lights of its own is called a luminous object.
4. An object which does not emit light of its own is called non-luminous object.
5. A very narrow path of light represented by a straight line with an arrowhead is called a ray.
6. The collection of several rays of light is called a beam of light.
7. Regular reflection of light means when a parallel beam of light strikes a smooth surface and the reflected rays are parallel to each other.
8. Irregular reflection of light means when a parallel beam of light strikes on a rough surface and the reflected rays are not parallel to each other.
9. A ray of light striking a reflecting surface is called an incident ray.
10. A ray of light which gets reflected after striking a reflecting surface is called a reflected ray.
11. The perpendicular drawn on the surface at the point of incidence is called normal.
12. A periscope is constructed on the principle of reflection of light.

Exercise

1. Tick (√) the correct statements and cross (×) the incorrect ones.

a. Light travels in a straight line. ☐

b. Light is a form of energy which makes things visible. ☐

c. Reflection of light on a smooth surface is irregular reflection. ☐

d. Smooth and highly polished surface is called a mirror. ☐

e. The angle between a normal and an incident ray is called angle of incidence. ☐

2. Fill in the blanks with appropriate words.

a. Light is a form of energy which gives the sensation of .....

b. The speed of light in a vacuum is ..... km/s.

c. An object which emits light of its own is called a ..... of light.

d. A ray of light which strikes a surface is called ..... ray.

e. The perpendicular drawn at a point of incidence is called .....

3. Tick (√) the best answer from the given alternatives.

a. Which of the following object is a luminous object?

- ☐ wood
- ☐ water
- ☐ star
- ☐ soil

b. Which one of the following is a living source of light?

- ☐ oil-lamp
- ☐ torch light
- ☐ firefly
- ☐ burning candle

c. If the angle of incidence is 45°, the angle of reflection is .....

- ☐ 35°
- ☐ 54°
- ☐ 45°
- ☐ 50°

d. The angle between normal and a reflected ray is .....

- ☐ acute angle
- ☐ reflected angle
- ☐ incident angle
- ☐ right angle

e. The phenomenon of returning the light to the same medium after striking a surface is called ..... of light.

- ☐ dispersion
- ☐ refraction
- ☐ reflection
- ☐ propagation

4. Answer the following questions.

a. Define light. Write down the speed of light in a vacuum.

b. What is source of light? Give any four examples.

c. What is reflection of light? mention its types.

d. What is regular reflection of light? Draw a figure showing regular reflection.
e. State the laws of reflection of light.
f. Write the name of devices which works on the principle of reflection of light.
g. What is a periscope? Write its use.
h. What is a kaleidoscope? Write its use.
i. Define the following terms.
   i. Incident ray
   ii. Reflected ray
   iii. Normal
   iv. Angle of incidence
   v. Angle of reflection

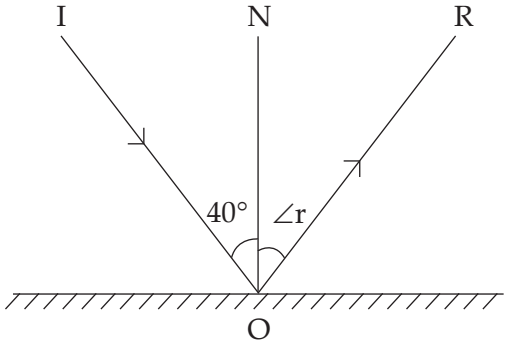
5. Draw diagrams showing regular and irregular reflection of light.

6. Differentiate between:

a. Luminous object and Non-luminous object
b. Regular reflection and Irregular reflection
c. Ray and Beam of light
d. Incident ray and Reflected ray

7. Study the given figure and answer the following questions.

a. Which phenomenon is shown in the given diagram?
b. Name the angle of incidence, angle of reflection and normal.
c. What is the magnitude of ∠r? Why?



8. Write any three applications of reflection of light.

9. Describe the working of a periscope with necessary day diagram.

10. How do you utilize reflection of light at your home? Write.

UNIT
08

Electricity and Magnetism

Estimated teaching hours : 10

Before You Begin

The form of energy which is produced due to the continuous flow of electrons or flow of charges is called electricity. It is of two types, viz. static electricity and current electricity. Static electricity is the electricity which is produced in an insulator which does not flow and remains bound to the surface of that insulator. Occurrence of lightning and thunderstorm are two common effects of static electricity. The electricity which is produced due to the continuous flow of electrons through a conductor is called current electricity. Cell and battery are the sources of electricity. We can convert electrical energy into heat energy, light energy, mechanical energy, sound energy, etc. Therefore, electricity is the most important form of energy. In this unit, we will study about static electricity and current electricity in brief.

Learning Outcomes

After completing the study of this unit, students will be able to:

- demonstrate the production of static electricity by rubbing two objects.
- introduce static electricity and describe its effects.
- describe the causes of thunderstorm and lightning and tell the function of lighting conductor.
- introduce current electricity and its sources.
- define combination of cells and state and utilities of series combination and parallel combination of cells.

Syllabus

- Introduction to static electricity
- Effects of static electricity and its uses
- Introduction to thunderstorm and lightning rod
- Introduction to current electricity
- Combination of cells
  - Series combination
  - Parallel combination
- Utilities of series and parallel combination of cells

Glossary

cell	:	the device which converts chemical energy into electrical energy
conductors	:	the substances through which electricity can flow
dynamo	:	a device which converts mechanical energy into electrical energy
electricity	:	the form of electricity which is produced due to flow of charges/electrons
generator	:	a very big dynamo which produces electricity in a large scale
insulators	:	the substances through which electricity cannot flow
lightning	:	a bright flash of electricity produced by a thunderstorm
thunderstorm	:	a storm with thunder and lightning

8.1 Static Electricity

8.1.1 Introduction to Static Electricity

Activity 1

- Take a plastic comb and rub against the hair for several times.
- Now, bring the comb near the pieces of paper or dust particles. What do you observe? What can you conclude from this activity?



Fig. 8.1

When a plastic comb is rubbed against your hair, the comb becomes negatively charged due to flow of electrons from the hair to the comb. When the comb is brought near the pieces of paper, the positive charges in the paper get deposited in the comb. As a result, the comb attracts the pieces of paper. The electricity produced in the comb while rubbing is static electricity. So, static electricity can be defined as electricity produced in an insulator which do not flow and remain bound to the surface of that insulator. The electric charges remain at rest in static electricity.



Fig. 8.2 *A girl combing her hair*

8.1.2 How a Body Gets Charged

All substances are made of molecules and molecules are made of atoms. Each atom contains equal number of protons and electrons having opposite charges. So, an atom becomes electrically neutral.

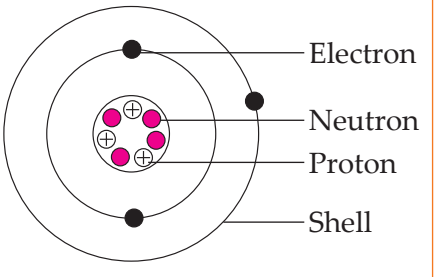


Fig. 8.3 *A neutral atom*

When one body is rubbed on the surface of another body, electrons get transferred from one body to another due to friction. As a result, one body becomes negatively charged and another body becomes positively charged. The body which gains electrons will be negatively charged and which loses electrons will be positively charged. Therefore, when a comb is rubbed against the hair, electrons flow from hair to the comb. As a result, the comb becomes negatively charged and the hair becomes positively charged.

Activity 2

- Take a balloon and inflate it.
- Now, rub the balloon against woolen sweater for 2-3 minutes.
- Now, keep the inflated balloon near the wall of your room. What do you observe? Why does the balloon stick to the wall after rubbing to the woolen sweater?



Fig. 8.4 *Blowing air in a balloon*

- Take another balloon and inflate it. Keep the balloon near the wall. Does the balloon stick to the wall?
  Why does the balloon not stick to the wall? Discuss the reason.

Various insulators like wool, plastic, rubber, polyster, acrylic, etc. develop charges due to friction. When we wear clothes made of wool, polyster, acrylic, etc. they become negatively charged due to friction with our body. When we put on these, clothes charges move fast. As a result, sound like tik-tik can be heard along with flashes while putting on these clothes in a dark room. The electricity which is produced in insulators due to friction is called static electricity.

8.1.3 Effects of Static Electricity

There are many effects of static electricity. Some of them are given below:

1. Occurrence of lightning
2. Occurrence of thunderstorm
3. Getting electric shock

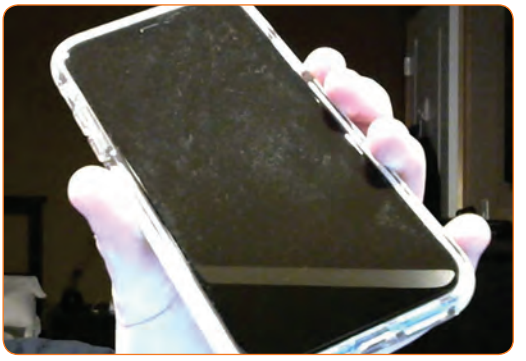


Fig. 8.5

4. Early damage of electronic equipment and chips due to storage of charge.
5. Attachment or attraction of hair and dust particles on the surface of clothes and electric equipment like computer, mobile, TV, etc.



Fig. 8.6



8.1.4 Lightning and Thunderstorm

Static electricity has many effects. The major effects of static electricity are lightning and thunderstorm. Lightning is also the flow of electricity. This fact was discovered by Benjamin Franklin in 1752 A.D.



Fig. 8.7 *Benjamin Franklin*

The bright flash of electricity that can be seen in the sky is called lightning. It is a massive electrostatic discharge between the clouds or between the cloud and surface of the earth.

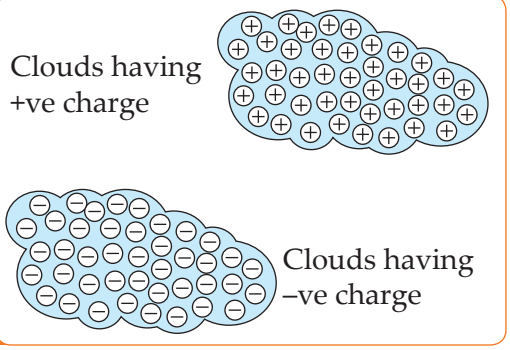


Fig. 8.8



Cloud is made of very small droplets of water and these droplets fall downwards slowly and hot air and molecules move upwards.

Generally, positive charges develop in upper clouds and negative charges develop in lower clouds. Electrons flow from negatively charged clouds to the positively charged clouds. It produces a large amount of heat energy due to sudden transfer of charges. This heat makes nearby air quite hot which can be seen as a fast moving flash in the sky. A loud sound is heard immediately after lightning due to sudden expansion and contraction of hot air.

A storm with lightning and thunder is called thunderstorm. It mainly occurs in spring and summer during the afternoon and evening. When charged clouds come close to the earth, charged clouds flow towards the earth through trees or tall buildings.



Fig. 8.9 *Lightning damages trees and houses*

When negatively charged clouds come close to the earth, trees or buildings develop positive charge and when positively charged clouds come close to the earth, trees or buildings develop negative charge. When unlike charges come nearby, heavy charges flow between them. As a result, a large amount of energy is released in the form of heat, light and sound which is called thunderstorm. It damages life and property. It kills human beings, domestic animals and destroys houses, trees, towers, buildings, etc.

8.1.5 Lightning Rod

Now-a-days, lightning rod or lightning conductor is used to protect tall houses and buildings from thunderstorm. A lightning rod consists of a number of sharp and pointed rods connected to the ground with a thick copper or iron wire. A lightning rod protects the house or building from thunderstorm.



Fig. 8.10 *Lightning*

A lightning rod is a metal rod or wire fixed to an exposed part of a building to divert lightning harmlessly to the ground. This rod is designed to protect a house or tall structure from a direct lightning strike.

A lightning rod is made of conductive materials such as copper and aluminium. Copper and its alloys are the most common materials used in lightning conductors. We can protect tall buildings, houses, etc. by installing lightning conductors.



Fig. 8.11 *Working of lightning conductor*

The lightning rod is kept on the roof top which is connected to the ground using a thick conducting wire such as copper wire. The lower end of the conducting wire is inserted into the ground to a metallic plate kept in the mixture of rock salt and pieces of coal.

During rainy season or during a storm, when a negatively charged thunder cloud passes over a tall building fitted with a lightning rod, the charges are induced on the pointed tips of the conductor. When lightning strikes, the charge is conducted down into the earth via the thick metal rod which prevents the building from possible hazards due to thunderstorm.

Project Work

- Every year many person die due to thunderstorm and many tall structures are destroyed. Surf the internet and find news regarding death and damage due to thunderstorm in Nepal and Bhutan. Prepare a report and present it in the classroom.

8.1.6 Uses of Static Electricity in Our Daily Life

Static electricity is utilized to do many works in our day to day life. Some of them are as follows :

1. Static electricity is utilized in paint sprayers.
2. It is used in air filters.
3. Static electricity is utilized in dust removal equipment.
4. It is utilized in printers and photo copy machines to attract photocopy paper by toner or ink.

8.2 Current Electricity

8.2.1 Introduction to Current Electricity

Activity 3

- Take a dry cell, a bulb, a bulb-holder, a switch and piece of copper wire.
- Connect them and form an electric circuit.
- Does the bulb glow when the switch is turned 'ON' ? Why?

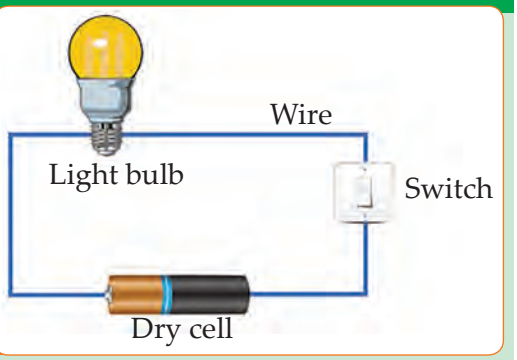


Fig. 8.12

- Now, turn the switch 'OFF' and observe. Does the bulb glow? Why?
- Now, break the connecting wire and turn the switch 'ON'. Does the bulb glow? Why?

What can you conclude from this activity?

When a cell is connected to a bulb with copper wires, the bulb glows due to continuous flow of electrons through the wire. Such flow of electrons through a conductor is called current electricity. So, the form of energy which is produced due to continuous flow of electrons is called current electricity. Cell, battery, dynamo and generator are the sources of current electricity.



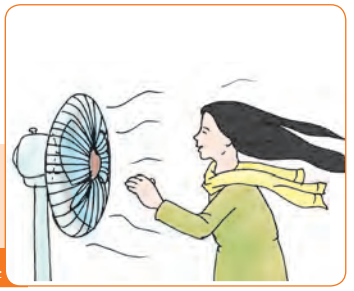


Fig. 8.13

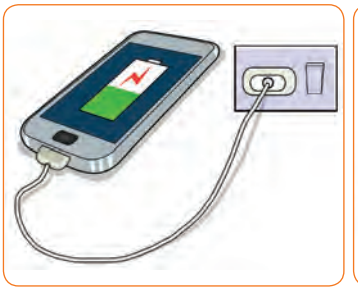
Torchlight *Bulb*

Current electricity is a very useful form of energy. It can be converted into heat energy, light energy, sound energy, magnetic energy and so on. It is used to light bulb, to operate heater, television, computer, radio, fan, telephone, etc.

Fig. 8.14



Electric fan



Charging mobile



Loudspeaker

8.2.2 Electric Circuit

Electric current requires a continuous path to flow. It can be made by connecting a conducting wire with the source of electricity and a load. So, the path made by connecting a source, conducting wire and load is called electric circuit.

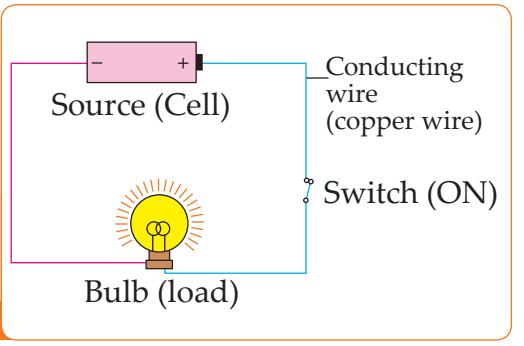


Fig. 8.15

The components of an electric circuit are i. cell or battery, ii. conducting wire, iii. load (bulb) and iv. switch.

Do You Know

- Battery is the group of cells.
- In an electric circuit, cell or battery acts as a source of electricity.

In an electric circuit, a cell or battery acts as a source of electricity. Conducting wire (copper wire) acts as the medium which offers flow of electric current through it. A bulb is the device which converts electrical energy into heat and light energy. Similarly, a switch is used to open and close the circuit when required.

a. Open electric circuit

The electric circuit in which a load does not work is called open circuit. In an open circuit, electric current does not flow continuously. So the load (bulb) does not work. A circuit may be open (i) if the switch is turned 'OFF', (ii) wire has broken or (iii)load (bulb) is damaged.

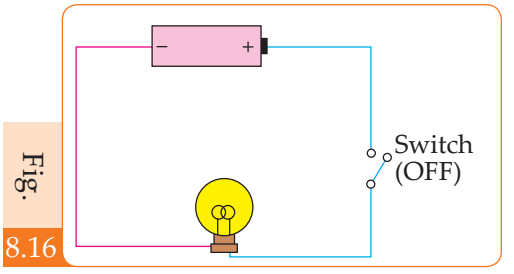


Fig. 8.16

Open circuit

b. Closed electric circuit

The electric circuit in which a load works continuously is called closed electric circuit. In this condition, current flows continuously through the circuit. The switch is turned 'ON' in a closed circuit.

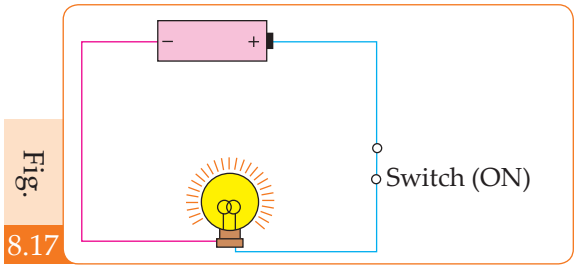


Fig. 8.17 *Closed circuit*

Activity 4

- Prepare an open electric circuit by connecting a dry cell, a bulb and connecting wire. Leave a gap AB in the circuit as shown in the figure.

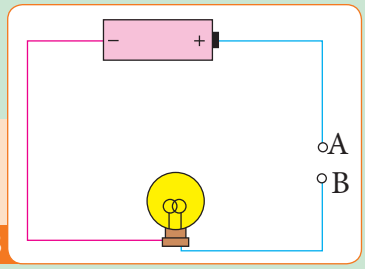


Fig. 8.18

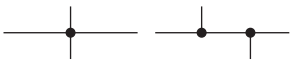
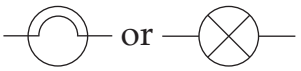
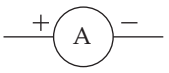
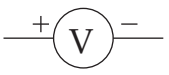
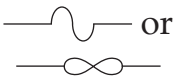
- Bring small pieces of different metals and non-metals such as piece of iron, copper, aluminium, lead, silicon, rubber, plastic, thread, dry wood, paper, glass, etc.
- Place each object turn by turn to fill the gap AB in the circuit. Observe carefully whether the bulb glows or not.

  If the bulb glows while filling the gap, these objects are conductors. When the bulb glows brightly, they are good conductors, if the bulb glows dim, they are semi-conductors and if the bulb does not glow, they are insulators.

8.2.3 Symbols Used in Circuit Diagrams

While drawing circuit diagrams, electrical equipment and components of electric circuit are represented by their symbols. The main components and electrical equipments with their symbols and functions are as follows:

S. No.	Components/Devices	Symbols	Function
1.	Wire		To make circuit
2.	Wires (not connected)		To make electric path

3.	Wires (connected)		To make electric path
4.	Switch		To open and close circuit
5.	Electric cell		Source of electricity
6.	Battery		Source of electricity
7.	Resistor/Load		To convert electrical energy into another form
8.	Bulb		To convert electricity into light
9.	Ammeter		To measure the current
10.	Voltmeter		To measure the voltage
11.	Fuse		To break the circuit in case of overloading
12.	Galvanometer		To detect electric current

An electric circuit showing various components in proper order of combination is given below:

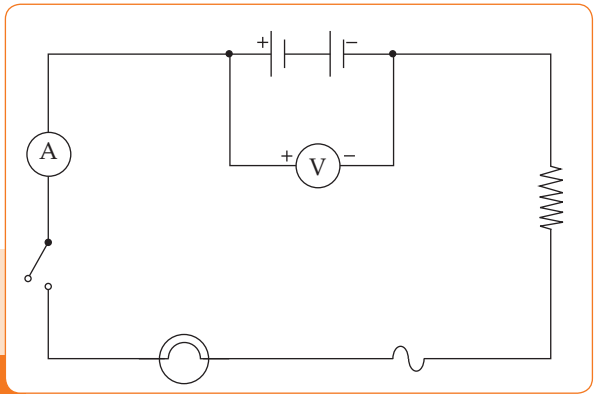


Fig. 8.19 *Electric circuit*

8.2.4 Combination of Cells

In order to increase the voltage or current, we combine a number of cells. The process of connecting two or more cells in an electric circuit is called combination of cells. In practice, cells are connected by two ways.

a. Series combination of cells

b. Parallel combination of cells

a. Series combination of cells

The combination of cells in which the positive terminal of one cell is connected to the negative terminal of another cell is called series combination of cells. When we need more voltage and more current, we combine a number of cells in series.

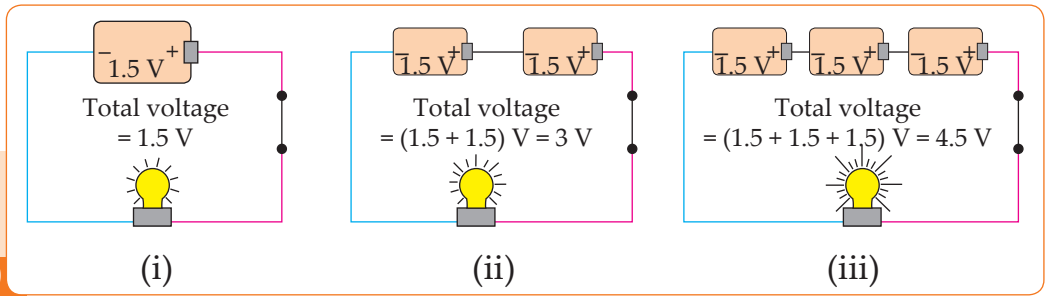


Fig. 8.20

Series combination of cells

Characteristics of series combination of cells

i. The brightness of the bulb increases on increasing the number of cells.

ii. The voltage increases on increasing the number of cells. The total voltage is equal to the sum of the voltage of the individual cell, i.e. $V = V_1 + V_2 + V_3$

b. Parallel combination of cells

The combination of cells in which positive terminals of all cells are connected to one point and negative terminals of all cells are connected to another point is called parallel combination of cells. When we need low voltage and high current, we combine a number of cells in parallel.

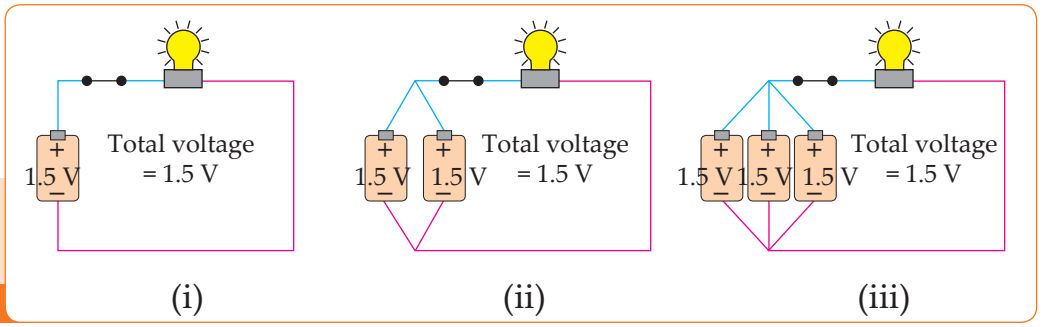


Fig. 8.21

Parallel combination of cells

Characteristics of parallel combination of cells

i. The brightness of bulb does not increase on increasing the number of cells.

ii. This type of circuit works for a long time.

iii. The total voltage of the circuit is equal to that of the single cell, i.e. $V = V_1 = V_2 = V_3$

Activity 5

- Observe the combination of cells in torchlight, Fm radio, remote of TV and wall clock.
- Take a chart paper and draw actual figure and symbolic figure showing combination of cells in these devices.
- Demonstrate the chart paper in the classroom.

Activity 6

- Take pieces of copper wire, a bulb, a switch and three dry cells of 1.5 V each.
- Combine these cells in series and parallel and observe the brightness of the bulb.
- Take a voltmeter and measure the voltage in each case.
- Write down the conclusion of this activity after your observation.

Key concepts

1. Static electricity can be defined as the electricity produced in an insulator which do not flow and remain bound to the surface of that insulator.
2. The electricity which is produced in insulators due to friction is called static electricity.

3. The bright flash of electricity that can be seen in the sky is called lightning.
4. A lightning rod protects the house or building from the thunderstorm.
5. The electric circuit in which a load does not work is called open electric circuit.
6. The electric circuit in which a load works continuously is called closed electric circuit.
7. The combination of cells in which the positive terminal of one cell is connected to the negative terminal of another cell is called series combination of cells.
8. The combination of cells in which positive terminals of all cells are connected to one point and negative terminals of all cells are connected to another point is called parallel combination of cells.

Exercise

1. Tick (√) the correct statements and cross (×) the incorrect ones.

a. Electricity is produced due to flow of charges/electrons. ☐

b. Thunderstorm damages life and property. ☐

c. A load does not work in an open circuit. ☐

d. Voltmeter is used to measure the current. ☐

e. The brightness of bulb can be increased by combining cells in series. ☐

2. Fill in the blanks using appropriate words.

a. The electricity which is produced due to friction is called .....

b. The group of cells is called .....

c. The device which is used to measure the voltage is .....

d. The brightness of bulb ..... on increasing the number of cells in series combination.

e. In torchlight, cells are combined in .....

3. Tick (√) the best answer from the given alternatives.

a. Which of the following is the effect of current electricity.?

☐ lightning ☐ thunderstorm

☐ operating computer ☐ friction

b. Which of the following is used to open and close the circuit?

☐ bulb ☐ switch ☐ wire ☐ ammeter

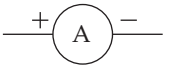
c. Which of the following converts electrical energy into light energy?

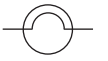
☐ heater ☐ CFL ☐ voltmeter ☐ fuse

d. When three cells of 1.5 V each are connected in parallel, the total voltage will be .....

☐ 4.5 V ☐ 1.5 V ☐ 3 V ☐ 2 V

e. Which of the following is the symbol of fuse?

☐  ☐  ☐ 

☐ 

4. Answer the following questions.

a. What is electricity? What are its types?

b. Define static electricity? How is it produced?

c. What is lightning? Write any two effects of thunderstorm.

d. Why is lightning conductor used?

e. Define current electricity? Name any two sources of current electricity.

f. What is electric circuit? Draw a figure showing closed electric circuit.

g. Define series combination and parallel combination of cells with any two features of each.

h. Why are cells combined in series? Write down its features.

i. Why are cells combined in parallel? Write its features.

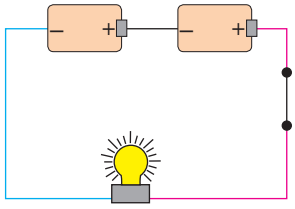
5. Write any two differences between:

a. Static electricity and Current electricity

b. Open circuit and Closed circuit

c. Series combination and Parallel combination of cells

6. **Draw a closed electric circuit by combining the given components:**
   - two dry cells
   - a bulb
   - a switch
   - a voltmeter



7. **Name the types of combination of cells shown in the figure. Also, write its two characteristics. What happens to the brightness of bulb on increasing the no. of bulbs in this type of circuit. Write one advantage of this type of circuit.**

8. **What is done to protect tall buildings from thunderstorm? Describe.**

9. **Write one advantage of using symbols of electric appliances while drawing circuit diagrams.**

10. **What is shown in the figure? Write down its working and use.**



11. **In a dark night, you have to go outside. You have three dry cells and a long torch light? Which combination of cells would you prefer to increase the brightness of the bulb. Write with illustration.**

UNIT
09

Matter

Estimated teaching hours : 15

Before You Begin

matter can be defined as anything having a mass and volume. All matter have mass and they occupy space. For example, air, soil, water, milk, stone, brick, wood, smoke, cloud, petrol, kerosene, iron, gold, plastic, etc. Sound, light, shadow, heat, etc. do not have mass and volume. So they are not matter. Matter can be soluble or insoluble, transparent or opaque and good conductor or bad conductor of heat and electricity. Matter exist in three different states, viz. solid, liquid and gas. Same matter can exist in three different states. For example, water can exist in all three states. They are solid (ice), liquid (water) and gas (vapour).

Light, beauty, shadow, heat, etc. are not regarded as matter because they don't have mass and volume. Some substances are heavy and some are light. For example, iron is heavy and cotton of the same volume is light. In heavy substances the molecules are closely packed together and in light substances, molecules are loosely arranged. The density of heavy objects is more than that of light objects.

Matter can be pure or impure. Gold, silver, iron, sodium chloride, copper sulphate, etc. are examples of pure matter. Pure matter can be classified as elements and compounds. Gold, silver, iron, etc. are elements whereas sodium chloride and copper sulphate are compounds. Matter keep on changing physically or chemically. Physical change is temporary change whereas chemical charge is permanent. In this unit, we will study about density, elements, compounds and change in matter in brief.

Learning Outcomes

After completing the study of this unit, students will be able to:

- introduce density and solve simple numericals related to density.
- find relative density of different substances comparing their densities with that of water and identify floating and sinking substances on water.
- introduce elements and compounds with examples.
- introduce sub-atomic particles and write their charges.
- write name, symbol and number of sub-atomic particles of the elements having atomic number 1 to 20.
- introduce compounds and molecules.
- introduce physical change and chemical change in matter and differentiate between them.

Syllabus

- Introduction to matter
- Density and its unit
- Relative density and numerical problems related to density
- Elements and compounds
- Atomic structure and sub-atomic particles
- molecules
- Physical change and chemical change

Glossary

abbreviation	:	a short form of a word
atom	:	the smallest particles of an element
chemical	:	involving or resulting from a reaction between two or more substances
density	:	the mass per unit volume of a substance
gas	:	matter having no fixed shape and volume
liquid	:	matter having no fixed shape but having fixed volume
matter	:	anything having mass and volume
molecule	:	the smallest particle of matter that exist freely
physical	:	connected with the things that actually exist or are present and can be seen, felt, etc.
relative	:	in relation to somebody/something, in comparison with somebody/something else
solid	:	matter having a fixed shape and fixed volume
symbol	:	an abbreviation of the full name of an element
valency	:	the combining capacity of an atom with another atom to form a molecule

9.1 Density of Matter

9.1.1 Introduction to Density

Activity 1

- Take a beam balance, a brick and some cotton.
- Keep the brick on one pan of the balance.
- Now, keep cotton on another pan of the balance.
- Keep on adding cotton till both pans come in equilibrium. Compare the volume of brick and cotton.



Fig. 9.1

- Out of brick and cotton, which one will have more volume and why? Discuss. What can you conclude from this activity?

An iron block is felt heavier than the wooden block of the same shape and size. Similarly, sand is felt heavier than soil. It means that the density of iron is more than that of the wood. Similarly, the density of sand is more than that of soil. The density of a substance can be defined as the mass per unit volume of the substance.

a. Formula of density,

$$\text{Density (d)} = \frac{\text{Mass (m)}}{\text{Volume (V)}}$$

$$\therefore \quad d = \frac{m}{V}$$

b. Units of density

The SI unit of mass is kilogram (kg) and that of volume is cubic metre (m^3). Therefore, the SI unit of density is kilogram per cubic metre (kg/m^3).

The CGS unit of density is gram per cubic centimetre (g/cm^3).

Activity 2

- Repeat the activity 1 with
  a. iron and soil
  b. stone and soil
  c. wood and sand
  d. brick and stone
- Find out the objects having more density and less density.
- What can you conclude from this activity. Discuss.

Activity 3

To calculate the density of soil and water

- Take a cuboid of a tin and fill it completely with soil. Measure the mass of the soil filled in the cuboid.

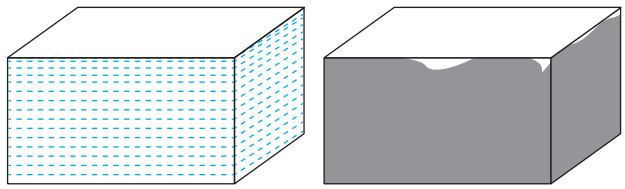


Fig. 9.2

- Remove the soil from the cuboid and fill it completely with water. Measure the mass of the water.
- Now, measure the length, breadth and height of the cuboid and calculate its volume.
- Now, calculate the density of soil and water using the given formula, $d = \frac{m}{V}$
- Which one has more density? Why do different objects have different density?
- Now, repeat this activity with water and sand. What do you find? which one has more density?

9.1.2 Relative Density

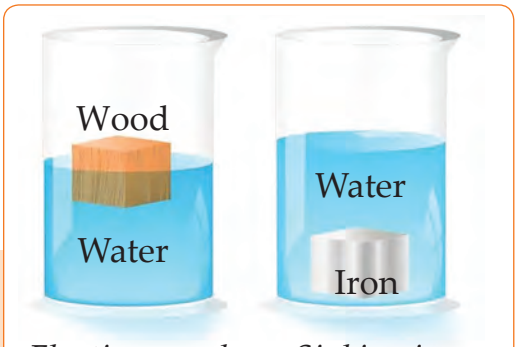


Fig. 9.3

The density of pure water is 1 g/cm³ and the density of ice is 0.92 g/cm³. Similarly, the density of iron is 7.8 g/cm³ and that of mercury is 13.6 g/cm³. it shows that different objects have different densities. If we compare the density of a substance with the density of water, we get the relative density. The relative density of a substance is the ratio of the density of substance to the density of pure water at 4°C. It is calculated by the given formula.

$$\text{Relative density (R.D.)} = \frac{\text{Density of a substance}}{\text{Density of pure water at 4°C}}$$

Since relative density is the ratio of two densities, it has no unit.

The concept of relative density is used to compare the density of a given substance to the density of pure water. The substances whose relative density is less than that of water, float on water. Similarly, the substances whose relative density is more than that of water, sink in water.

Density of Some Substances and Relative Density

S.N.	Name of substances	Density (in kg/m^3)	Density in (g/cm^3)	Relative density
1.	Water	1000	1	-
2.	Ice	920	0.92	0.92
3.	Iron	7800	7.8	7.8
4.	Aluminium	2700	2.7	2.7
5.	Gold	19300	19.3	19.3
6.	milk	1030	1.03	1.03
7.	mercury	13600	13.6	13.6
8.	Kerosene	800	0.8	0.8
9.	Wood	600-800	0.6-0.8	0.6-0.8

Differences between Density and Relative density

S.N.	Density	S.N.	Relative density
1.	It is the mass per unit volume of a substance.	1.	It is the ratio of the density of a substance to the density of pure water at 4°C.
2.	Its SI unit is kg/m^3.	2.	It has no unit.

Worked out Numerical: 1

The mass of a wooden block is 1600 kg and its volume is 2 m^3. Calculate the density of the wooden block.

Given,

mass of wood (m) = 1600 kg

Volume of wood (V) = 2 m^3

Density (d) = ?

We know,

$$d = \frac{m}{V} = \frac{1600}{2} = 800 \text{ kg/m}^3$$

∴ The density of wooden block is 800 kg/m^3.

Worked out Numerical: 2

The density of gold is 19300 kg/m^3 and that of water is 1000 kg/m^3. Calculate the relative density of gold.

Given,

Density of gold = 19300 kg/m^3

Density of water = 1000 kg/m^3

Relative density = ?

We know,

$$\text{Relative density} = \frac{\text{Density of gold}}{\text{Density of water}} = \frac{19300}{1000} = 19.3$$

∴ Relative density of gold = 19.3

Worked out Numerical: 3

The relative density of mercury is 13.6. Calculate the density of mercury.

Given,

Relative density of mercury = 13.6

Density of mercury = ?

We know,

$$\text{Relative density} = \frac{\text{Density of mercury}}{\text{Density of water at 4°C}}$$

or, $$13.6 = \frac{\text{Density of mercury}}{\text{Density of water at 4°C}}$$

or, $$13.6 = \frac{\text{Density of mercury}}{1000}$$ [∵ Density of pure water at 4°C = 1000 kg/m^3]

or, 13.6 × 100 = Density of mercury

or, Density of mercury = 13600 kg/m^3

Worked out Numerical: 4

The dimension of an wooden box is 20 cm × 15 cm × 15 cm and its mass is 3600 g. Calculate the relative density. Also, find our whether the box float or sink in water. The density of water at 4°C is 1g/cm³.

Given,

Volume of wooden box (V) = 20 cm × 15 cm × 15 cm

= 4500 cm³

mass of wooden box (m) = 3600 g

Density of wooden box (d) = ?

We know,

$$\text{Density} = \frac{\text{mass}}{\text{volume}} = \frac{3600\ \text{g}}{4500\ \text{cm}^3} = 0.8\ \text{g/cm}^3$$

Now,

Density of water at 4°C = 1 g/cm³

Density of wooden box = 0.8 g/cm³

$$\text{Relative density (R.D)} = \frac{\text{Density of wooden box}}{\text{Density of water at 4°C}} = \frac{0.8}{1} = 0.8$$

The density of wooden box is 0.8 g/cm³ or the relative density of the wooden box is 0.8. So, the wooden box will float on water because the density of wooden box is less than that of water.

Project Work

- Take a bucket and fill it with water.
- Collect different materials like a piece of stone, a piece of brick, dry wood, plastic, rubber, coin, copper wire, eraser, lead of pencil, iron nail, piece of paper, cap of ball pen, etc,
- Keep each of them on water and observe floating and sinking of substances.
- Note down the objects that float and sink in water.
- Why do some objects float and some sink in water? What is the relation between density of objects and floating or sinking? Discuss in the classroom.
- Prepare a short report and submit it to your science teacher.

Activity 4

Observe the given table and discuss the following questions. Also, complete the given table.

S.N.	Object	Density	Will float or sink in water	Reason
1.	Ice	920 kg/m^3		
2.	Aluminium	2700 kg/m^3		
3.	Wood	800 kg/m^3		
4.	Kerosene	800 kg/m^3		

i. Which of the given objects will float and which will sink in water? Why?

ii. Name any two objects that are heavier than water.

iii. What will happen when kerosene is kept in water? Why?

9.1.3 Floating and Sinking

A piece of ice floats on water but an iron nail sinks. Similarly, a piece of dry wood floats in water but a piece of stone sinks. The density of ice and wood are less than that of water. So they float in water. The density of iron and stone is more that of water. So they sink. It shows that the substances whose density is less than that of water will float in water and the substances whose density is more than that of water will sink.

Do You Know

The floating and sinking of a substance depends on the density of the object and the density of liquid in which the body is kept.

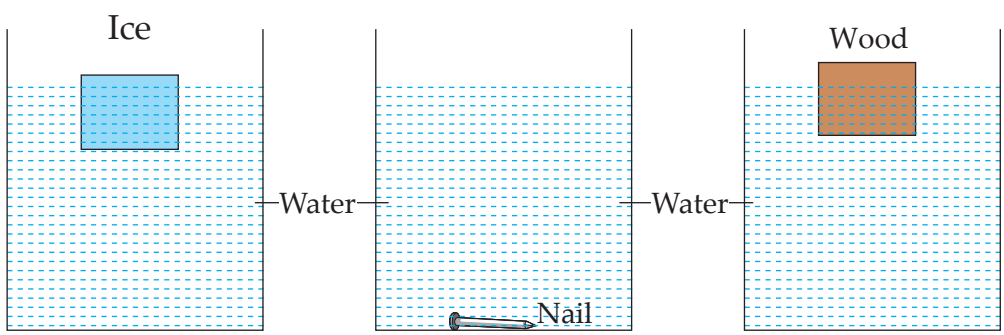


Fig. 9.4

Activity 5

- Take a beaker and fill it with fresh water. Now, keep an egg in the beaker. The egg sinks in water because the density of egg is more than that of water.
- Now, dissolve some salt in water. Add some more salt and dissolve in water till the egg floats. In this case, the density of salt solution becomes more than that of the egg. So the egg floats.

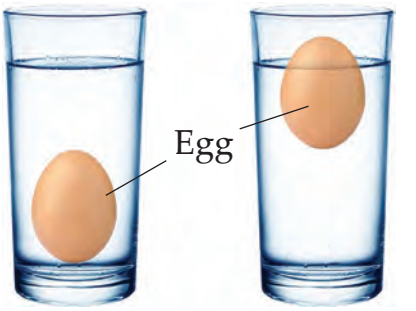


Fig. 9.5

Do You Know

An egg sinks in pure water but floats on concentrated salt solution, why?

The density of egg is more than that of water. So, an egg sinks in pure water but the density of egg is less than that of concentrated salt solution. So, an egg floats on concentrated salt solution.

Key concepts

1. Matter can be defined as anything having a mass and volume.
2. The density of a substance can be defined as the mass per unit volume of the substance.
3. In SI system, the density of water is measured in kg/m^3 and CGS system, it is measured in g/cm^3.
4. Relative density has no unit as it is the ratio of two densities.
5. The relative density of a substance is the ratio of the density of substance to the density of pure water.
6. The substances whose density is less than that of water will float in water and the substances whose density is more than that of water will sink.

Exercise

1. Put a tick (√) for the correct statements and a cross (×) for the incorrect ones.

a. Mass per unit volume of a substance is called density. ☐

b. The SI unit of density is g/cm³. ☐

c. All objects have the same density. ☐

d. Relative density has no unit. ☐

e. The objects having more density than that of water will float in water. ☐

2. Fill in the blanks using appropriate words.

a. The CGS unit of density is .....

b. Density of a body depends on mass and .....

c. Mass per unit volume of a substance is called .....

d. The object whose density is less than water ..... in water.

e. The density of mercury is ..... times more than that of water.

3. Tick (√) the most appropriate answer from the given alternatives.

a. The mass per unit volume is called .....

☐ thrust ☐ pressure ☐ density ☐ volume

b. In the SI system, density is measured in .....

☐ N/m² ☐ Nm² ☐ g/cm³ ☐ kg/m³

c. Which of the following is the SI unit of relative density?

☐ kg/m³ ☐ g/cm³ ☐ kg/cm³ ☐ No unit

d. The floating and sinking of a body depends on .....

☐ pressure ☐ thrust ☐ density ☐ mass

e. Which of the given object floats on water?

☐ ice ☐ iron ☐ gold ☐ mercury

4. Answer the following questions.

a. What is density? Write down its SI unit.

b. What is relative density?

c. What types of objects float in water?

d. What types of objects sink in water?

e. What are two factors in which density of a body depends?

f. What is the density of water at 4°C?

g. Name any two objects that float on water.

h. Name any two objects that sink in water.

5. Differentiate between:

a. Density and Relative density

b. Floating and Sinking

6. Give reason.

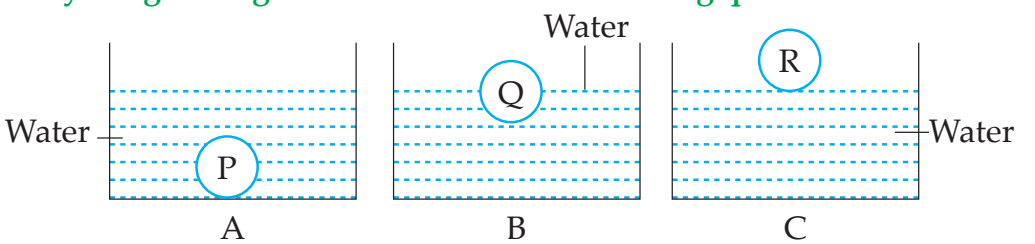
a. Ice floats on water but an iron nail sinks.

b. Relative density has no unit.

7. Describe an activity to prove that floating and sinking of objects depends on density.

8. The density of an object is 0.8 g/cm³. Find out whether it floats or sinks in water? Also, write the reason.

9. Study the given figures and answer the following questions.



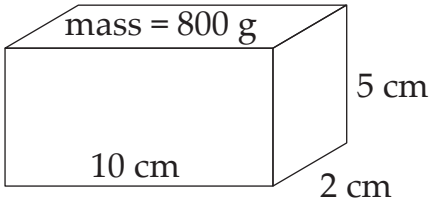
a. Which object has maximum density and which has minimum density?

b. Name the object whose density is more than that of water.

c. Why does object 'P' sink and 'R' float on water?

Numerical Problems

1. The mass of an ice block is 500 kg and its density is 920 kg/m^3. Calculate the volume of the ice block. [Ans: 0.54 m^3]
2. The density of mercury is 13600 kg/m^3 and that of water is 1000 kg/m^3. Calculate the relative density. [Ans: 13.6]
3. The density of ice is 920 kg/m^3 and that of water is 1000 kg/m^3. Calculate the relative density. [Ans: 0.92]
4. Study the given figure and calculate the density.



   Also, find out whether this object float or sink in water. [Ans: 8 g/cm^3]
5. The density of gold is 19300 kg/m^3. Calculate the relative density of gold.

   [Ans: 19.3]

9.2 States of Matter, Elements and Compounds

9.2.1 States of Matter

Activity 6

- Study various objects in your surroundings.
- Identify them as solid, liquid and gas.
- Complete the given table after your observation.

Solids	Liquids	Gases

A variety of matter are found in our surroundings. Stone, water, air, milk, cloud, snow, ice, wood, plastic, etc. are some examples of matter. Matter can exist in three different states. They are: i. solid ii. liquid and iii. gas.

a. Solids

Solids are substances having a fixed shape and a fixed volume. Examples: ice, wood, stone, brick, plastic, soil, iron, sand, etc.



Fig. 9.6

Ice *Wood* *Stone*

Characteristics of solids

1. Solids have a fixed shape.
2. They have a fixed volume.
3. They are generally hard.
4. They do not flow from one place to another.
5. Their molecules are closely packed.

Do You Know

- Matter exist in three states, viz. solid, liquid and gas.
- Diamond is the hardest known solid substance.

b. Liquids

Liquids are substances having a fixed volume but no fixed shape. Examples: water, milk, kerosene, diesel, alcohol, petrol, oil, blood, etc.

Fig. 9.7



milk *Petrol* *Water*

Characteristics of liquids

1. Liquids have a fixed volume.
2. They do not have a fixed shape. They take the shape of the container in which they are kept.
3. They flow easily because their molecules are loosely arranged.

c. Gases

Gases are substances which neither have a fixed shape nor a fixed volume. Examples: air, smoke, carbon dioxide, nitrogen, oxygen, neon, helium, water vapour, argon, etc.

Fig. 9.8



Air inside a balloon

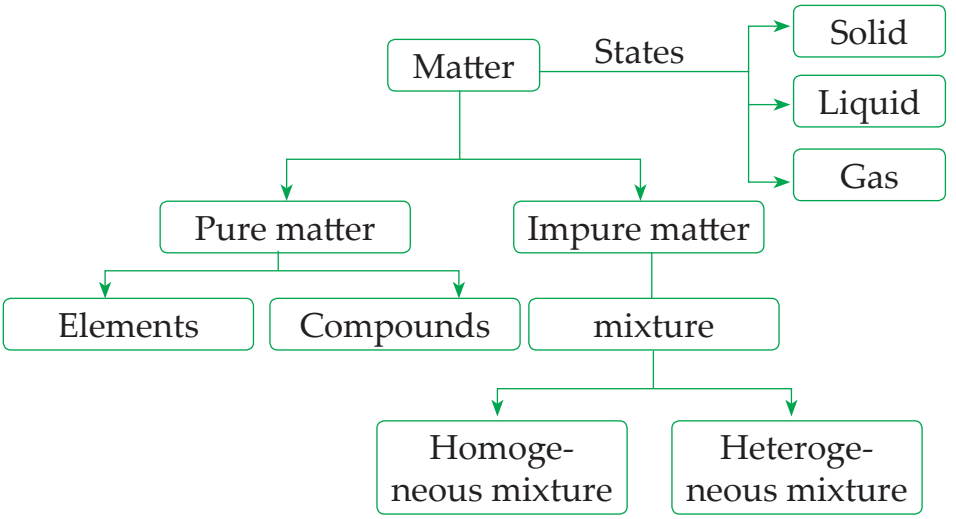
Characteristics of gases

1. Gases do not have a fixed shape.
2. They do not have a fixed volume.
3. They flow from one place to another.
4. Their molecules are loosely arranged.
5. They can be compressed easily.

9.2.2 Elements

Activity 7

- Take a brick and a hammer.
- Break the brick into many small pieces. Take a small piece of brick and break it again into the possible smallest piece. Does the smallest piece of the brick contain different properties than that of the large piece of the brick? Discuss in the classroom.



Different types of substances are found in our surroundings. Among them, some cannot be broken down into simple substances by ordinary chemical means. These substances are called elements. An element is a pure substance which cannot be divided into two or more simpler substances by ordinary chemical means. Hydrogen (H), Oxygen (O), Sodium (Na), Copper (Cu), Silver (Ag), Gold (Au), etc. are examples of elements. Elements are pure substances formed by only one kind of atoms.

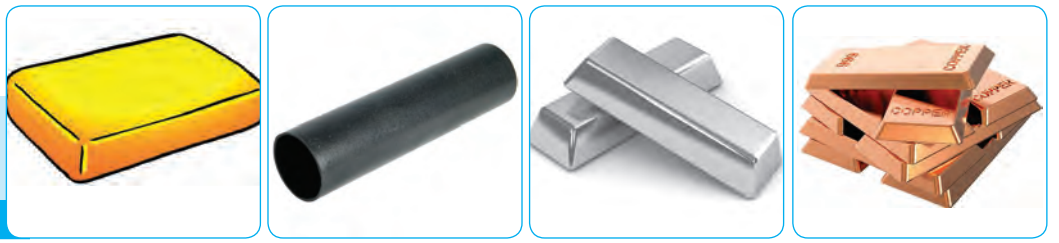


Fig. 9.9

Gold *Iron* *Silver* *Copper*

Gold, iron, silver and copper are called elements because they are formed by only one type of atoms and they cannot be broken down into simpler

substances by ordinary chemical methods. All the atoms of the same element are identical but atoms of different elements are different.

Scientists have discovered 118 elements so far. Among them 92 are found in nature and remaining 26 elements have been discovered by chemists in the laboratory. At normal temperature and pressure, elements exist in all three states. They are solid, liquid and gas.

Elements like iron, copper, gold, silver, sodium, magnesium, aluminium, etc. are found in solid state. Elements like mercury, bromine, caesium and gallium are found in liquid state and elements like hydrogen, helium, nitrogen, oxygen, neon, argon, etc. are found in gaseous state.

9.2.3 Symbol, Atomic Structure and Electronic Configuration

It takes time and consumes more space while writing the full names of elements. So an element is denoted by its first letter or first letter and another significant letter, which is called symbol. A symbol can be defined as the first letter or the first letter and another letter of the English name or Latin name of an element. For example, the symbol of hydrogen is H, the symbol of nitrogen is N and the symbol of oxygen is O.

Generally, the first letter of an element is written as the symbol. However, there are some elements whose names begin with the same letter. In such cases, one of the elements is given a one letter symbol but all other elements are given two letter symbol. For example, carbon, chlorine, calcium, chromium and cobalt all begin with the letter 'C'. So only carbon is symbolized by its first letter 'C' and all other elements are symbolized by two letters, i.e. Cl for chlorine, Ca for calcium, Cr for chromium and Co for cobalt.

The names of the first twenty elements and their symbols and other details are given below:

Atomic number	Name of elements	Symbol	Number of			Atomic mass ($p^+ + n°$)	Electronic configuration				Valency
			p^+	$n°$	e^-		K	L	m	N	
1.	Hydrogen	H	1	0	1	1 + 0 = 1	1	×	×	×	1
2.	Helium	He	2	2	2	2 + 2 = 4	2	×	×	×	0
3.	Lithium	Li	3	4	3	3 + 4 = 7	2	1			1
4.	Beryllium	Be	4	5	4	4 + 5 = 9	2	2			2

5.	Boron	B	5	6	5	5 + 6 = 11	2	3			3
6.	Carbon	C	6	6	6	6 + 6 = 12	2	4			4
7.	Nitrogen	N	7	7	7	7 + 7 = 14	2	5			3
8.	Oxygen	O	8	8	8	8 + 8 = 16	2	6			2
9.	Fluorine	F	9	10	9	9 + 10 = 19	2	7			1
10.	Neon	Ne	10	10	10	10 + 10 = 20	2	8			0
11.	Sodium	Na	11	12	11	11 + 12 = 23	2	8	1		1
12.	Magnesium	Mg	12	12	12	12 + 12 = 24	2	8	2		2
13	Aluminium	Al	13	14	13	13 + 14 = 27	2	8	3		3
14.	Silicon	Si	14	14	14	14 + 14 = 28	2	8	4		4
15.	Phosphorus	P	15	16	15	15 + 16 = 31	2	8	5		3
16.	Sulphur	S	16	16	16	16 + 16 = 32	2	8	6		2
17.	Chlorine	Cl	17	18	17	17 + 18 = 35	2	8	7		1
18.	Argon	Ar	18	22	18	18 + 22 = 40	2	8	8		0
19.	Potassium	K	19	20	19	19 + 20 = 39	2	8	8	1	1
20.	Calcium	Ca	20	20	20	20 + 20 = 40	2	8	8	2	2

The atomic structure and electronic configuration of the first 20 elements is given below:

1. Hydrogen (H)
   Atomic number = 1
   Atomic mass = 1

Shells	K	L	m	N
No. of e^-	1	×	×	×

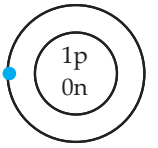


Fig. 9.10 *Hydrogen*

2. Helium (He)
   Atomic number = 2
   Atomic mass = 4

Shells	K	L	m	N
No. of e^-	2	×	×	×

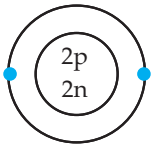


Fig. 9.11 *Helium*

3. Lithium (Li)
   Atomic number = 3
   Atomic mass = 7

Shells	K	L	m	N
No. of e^-	2	1	×	×

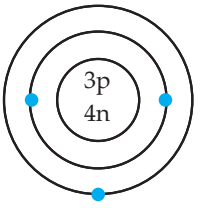


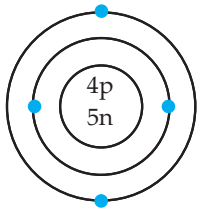
Fig. 9.12 *Lithium*

Approved by CDC

4. Beryllium (Be)
Atomic number = 4
Atomic mass = 9

Shells	K	L	m	N
No. of e^-	2	2	×	×

Fig. 9.13

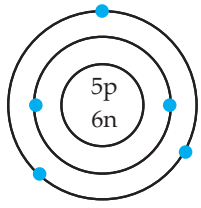


Beryllium

5. Boron (B)
Atomic number = 5
Atomic mass = 11

Shells	K	L	m	N
No. of e^-	2	3	×	×

Fig. 9.14

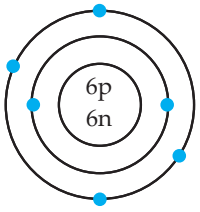


Boron

6. Carbon (C)
Atomic number = 6
Atomic mass = 12

Shells	K	L	m	N
No. of e^-	2	4	×	×

Fig. 9.15

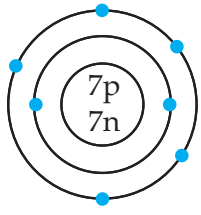


Carbon

7. Nitrogen (N)
Atomic number = 7
Atomic mass = 14

Shells	K	L	m	N
No. of e^-	2	5	×	×

Fig. 9.16

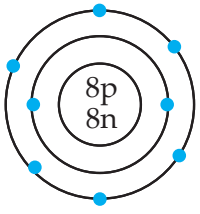


Nitrogen

8. Oxygen (O)
Atomic number = 8
Atomic mass = 16

Shells	K	L	m	N
No. of e^-	2	6	×	×

Fig. 9.17

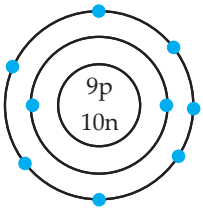


Oxygen

9. Fluorine (F)
Atomic number = 9
Atomic mass = 19

Shells	K	L	m	N
No. of e^-	2	7	×	×

Fig. 9.18



Fluorine

10. Neon (Ne)
Atomic number = 10
Atomic mass = 20

Shells	K	L	m	N
No. of e^-	2	8	×	×

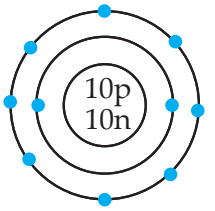


Fig. 9.19 *Neon*

11. Sodium (Na)
Atomic number = 11
Atomic mass = 23

Shells	K	L	m	N
No. of e^-	2	8	1	×

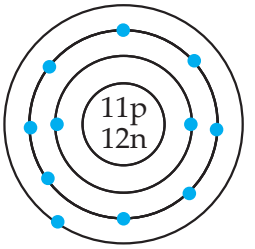


Fig. 9.20 *Sodium*

12. Magnesium (Mg)
Atomic number = 12
Atomic mass = 24

Shells	K	L	m	N
No. of e^-	2	8	2	×

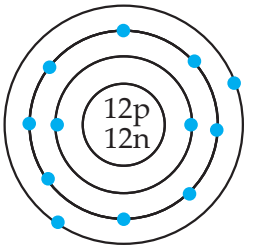


Fig. 9.21 *Magnesium*

13. Aluminium (Al)
Atomic number = 13
Atomic mass = 27

Shells	K	L	m	N
No. of e^-	2	8	3	×

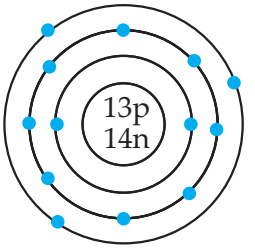


Fig. 9.22 *Aluminium*

14. Silicon (Si)
Atomic number = 14
Atomic mass = 28

Shells	K	L	m	N
No. of e^-	2	8	4	×

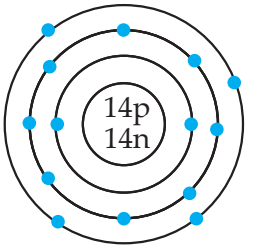


Fig. 9.23 *Silicon*

15. Phosphorus (P)
Atomic number = 15
Atomic mass = 31

Shells	K	L	m	N
No. of e^-	2	8	5	×

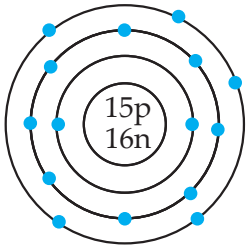


Fig. 9.24 *Phosphorus*

16. Sulphur (S)
Atomic number = 16
Atomic mass = 32

Shells	K	L	m	N
No. of e^-	2	8	6	×

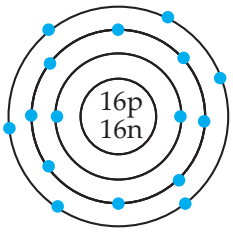


Fig. 9.25 *Sulphur*

17. Chlorine (Cl)
Atomic number = 17
Atomic mass = 35

Shells	K	L	m	N
No. of e^-	2	8	7	×

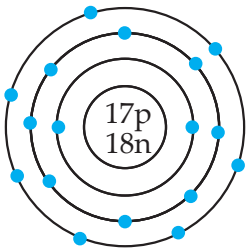


Fig. 9.26 *Chlorine*

18. Argon (Ar)
Atomic number = 18
Atomic mass = 40

Shells	K	L	m	N
No. of e^-	2	8	8	×

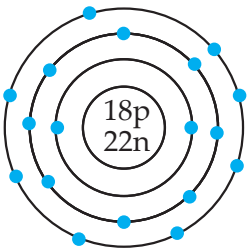


Fig. 9.27 *Argon*

19. Potassium (K)
Atomic number = 19
Atomic mass = 39

Shells	K	L	m	N
No. of e^-	2	8	8	1

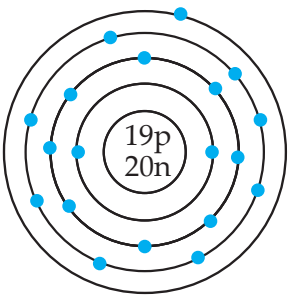


Fig. 9.28 *Potassium*

20. Calcium (Ca)
Atomic number = 20
Atomic mass = 40

Shells	K	L	m	N
No. of e^-	2	8	8	2

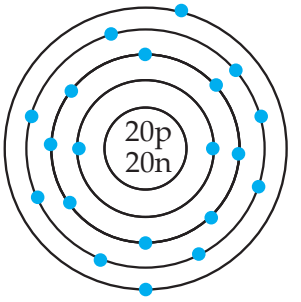


Fig. 9.29 *Calcium*

Project Work

- Take chart papers and draw atomic structures of the elements from Hydrogen to Calcium.
- Also, write down the electronic configuration of these elements.
- Demonstrate the chart paper in the classroom.

9.2.4 Compound

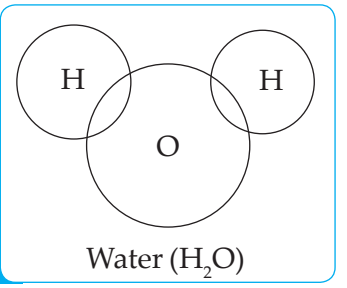


Fig. 9.30 Water (H_2O)

Substances like water (H_2O), sodium chloride (NaCl), carbon dioxide (CO_2), calcium carbonate ($CaCO_3$) etc. are some examples of compounds. They are formed by combination of two or more elements in a fixed proportion by weight. So, the chemical substance formed by a combination of two or more elements in a fixed proportion by weight is called a compound.

A compound is made of two or more atoms. Two or more active elements undergo chemical reaction which results in the formation of a compound. A compound does not contain the properties of its constituent elements.

Water (H_2O) is a compound formed by combination of two atoms of hydrogen and one atom of oxygen.

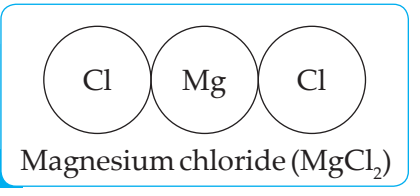


Fig. 9.31 Magnesium chloride ($MgCl_2$)

Carbon dioxide (CO_2) is a compound formed by combination of one atom of carbon and two atoms of oxygen.

Magnesium chloride ($MgCl_2$) is a compound formed by a combination of one atom of magnesium and two atoms of chlorine.

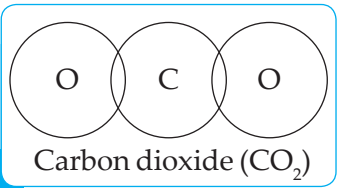


Fig. 9.32 Carbon dioxide (CO_2)

Differences between Elements and Compounds

S.N.	Elements	S.N.	Compounds
1.	An element is a pure substance formed by only one type of atoms.	1.	A compound is a pure substance formed by a combination of two or more types of atoms.
2.	The smallest particle of an element is called atom.	2.	The smallest particle of a compound is called a molecule.
3.	An element cannot be split into simpler substances by ordinary chemical means.	3.	A compound can be split into two or more simpler substances by ordinary chemical means.

9.2.5 Atom

An atom is the smallest particle of an element which can take part in a chemical reaction. All atoms of an element are similar but atoms of different elements are different. For example, all atoms of gold are identical but the atom of gold differs from that of copper or silver. Scientists have discovered 118 types of atoms so far. Among them, most atoms cannot exist freely in nature but atoms of helium (He), neon (Ne), argon (Ar), krypton (Kr), xenon (Xe) and radon (Rn) exist freely in nature. Carbon (C), hydrogen (H), oxygen (O), sodium (Na) and calcium (Ca) are some examples of atom.

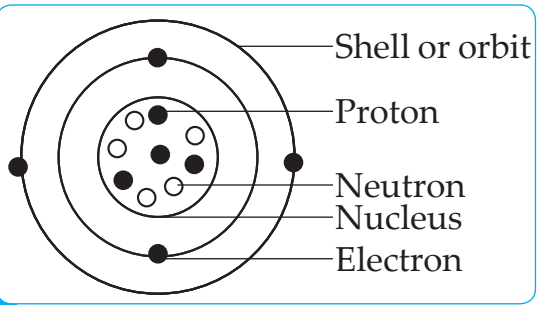


Fig. 9.33 *Structure of an atom*

Structure of an atom

An atom is made of three fundamental particles or sub-atomic particles. They are proton, neutron and electron. Among them, proton and neutron are located in the nucleus whereas electrons revolve around the nucleus in elliptical orbits or shells.

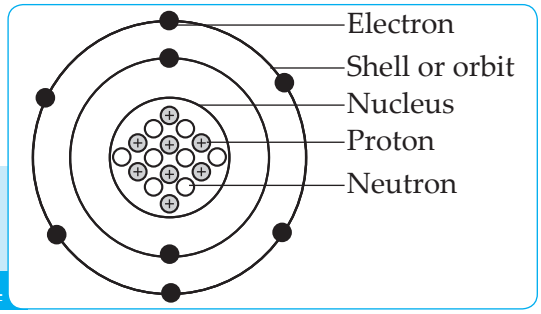


Fig. 9.34 *Oxygen atom*

Protons are positively charged sub-atomic particles located in the nucleus of an atom. The mass of one proton is equal to that of one hydrogen atom. The mass of one hydrogen atom is considered as one amu (atomic mass unit). The mass of one proton is 1837 times more than that of one electron. A proton is denoted by (p^+).

Neutrons are chargeless sub-atomic particles located in the nucleus of an atom. The mass of a neutron is equal to that of a proton. A neutron is denoted by n°.

Electrons are negatively-charged sub-atomic particles that revolve around the nucleus in elliptical orbits or shells. The mass of one electron is 1837 times smaller than that of one proton. An electron is denoted by e^-.

S.N.	Sub-atomic particles	Symbol	Charge	mass	Location
1.	Proton	p+	+ve	1amu	Nucleus
2.	Neutron	n°	nil	1 amu	Nucleus
3.	Electron	e^-	–ve	$\frac{1}{1837}$ amu	Orbit or shell

Project Work

- Take chart papers and draw the molecular structure of water, Carbon dioxide and magnesium chloride.
- Demonstrate the chart paper in the classroom.

9.2.6 molecule

The smallest particle of an element or a compound which can exist freely in nature is called a molecule. There are a thousand types of molecules. The molecule of an element consists of two or more atoms of the same kind where as the molecules of a compound consists of two or more atoms of different elements. Hydrogen (H_2), oxygen (O_2), ozone (O_3), water (H_2O), calcium carbonate ($CaCO_3$), etc. are some examples of molecules.

A molecule of oxygen consists of two atoms of oxygen. Similarly, a molecule of carbon dioxide consists of one atom of carbon and two atoms of oxygen.

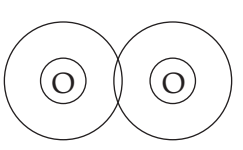
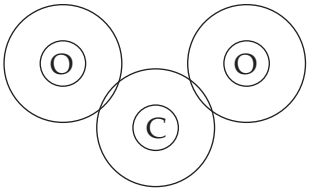


Fig. 9.35 Oxygen molecule



Carbon dioxide molecule

Differences between Atom and Molecule

S.N.	Atom	S.N.	molecule
1.	An atom of an element is the smallest particle of that element.	1.	A molecule is the smallest particle of an element or compound which can exist freely.
2.	It can take part in chemical reaction.	2.	It is the result of chemical reaction.

9.2.7 Molecular Formula

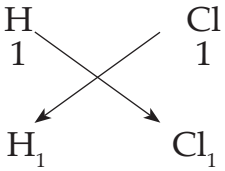
Molecular formula is defined as the symbolic representation of the molecule of an element or a compound in a molecular form. It represents the number and type of atoms present in a molecule. For example, the molecular formula of Sodium chloride (Common salt) is NaCl. It means that one molecule of Sodium chloride is formed by a combination of one atom of sodium and one atom of chlorine. Similarly, the molecular formula of Calcium carbonate is $CaCO_3$. It means that one molecule of Calcium carbonate is formed by one atom of calcium, one atom of carbon and three atoms of oxygen. We follow criss-cross method while writing molecular formulae.

Steps for writing molecular formulae

1. First of all, the symbols of radicals are written side by side.
2. The valency of each radicals is written just below the symbol.
3. The valency of these radicals is exchanged. HCF is taken when required.
4. Radicals should be combined with exchanged valency to get the correct molecular formula.

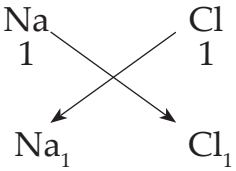
Examples:

1. Hydrochloric acid



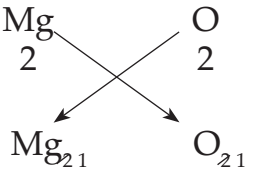
= HCl

2. Sodium chloride



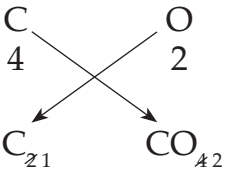
= NaCl

3. Magnesium oxide



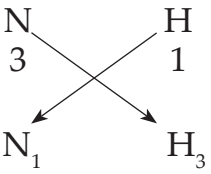
$= MgO$

4. Carbon dioxide



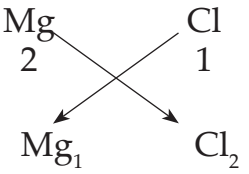
$= CO_2$

5. Ammonia



$= NH_3$

6. Magnesium chloride



$= MgCl_2$

The molecular formulae of some common compounds are as follows:

Water	$\rightarrow H_2O$	Calcium carbonate	$\rightarrow CaCO_3$
Sodium chloride	$\rightarrow NaCl$	Hydrogen	$\rightarrow H_2$
Ammonia	$\rightarrow NH_3$	Oxygen	$\rightarrow O_2$
Carbon dioxide	$\rightarrow CO_2$	Nitrogen	$\rightarrow N_2$

9.3 Change in States of Matter

When ice is heated, it changes into water and when water is heated, it changes into vapour. The physical properties of water and vapour are different but their chemical properties are the same. This type of change is called temporary change.

$$\text{Ice} \xrightarrow{\text{Heat}} \text{Water} \xrightarrow{\text{Heat}} \text{Vapour}$$

When a piece of wood is burnt, it changes into ash and carbon dioxide gas. This type of change is a permanent change. On the basis of properties of the substances formed, change in matter occur in two ways. They are physical change and chemical change.

9.3.1 Physical Change

Activity 8

- Take a lump of ice and keep it in a beaker. Leave the beaker in the sun for a while. What do you observe? The ice melts slowly and changes into water.
- Now, keep the beaker with water inside refrigerator for 2-3 hours. What do you observe?



Fig. 9.36

The water again changes into ice after cooling.

It shows that this change is a temporary change or physical change.



Fig. 9.37

The temporary change in which only physical properties are changed is called physical change. In a physical change, the properties of matter like shape, size, colour, etc. are changed but the chemical properties of the matter remain the same. Physical change is temporary and reversible. In a physical change, new type of substances are not formed.

Some examples of physical change are given below:

i. Melting of ice
ii. Melting of wax
iii. Conversion of water into vapour
iv. Tearing a piece of paper
v. Breaking a piece of glass
vi. Magnetizing of a substance

9.3.2 Chemical Change

Activity 9

- Take a piece of paper and burn it. The paper changes into ash and carbon dioxide. Can we make paper again by combing the ash and carbon dioxide?



Fig. 9.38

We cannot make paper again once paper is burnt. So this type of change is called permanent change or chemical change.

Activity 10

- Take a small piece of iron and leave it in a moist place for a few days.
- Observe the piece of iron after 2-3 days. What do you observe? What types of change is this? Why?



Fig. 9.39

The permanent change in which new type of substances are formed is called a chemical change. In a chemical change, the physical as well as chemical properties of matter are changed. A chemical change is a permanent and irreversible change.

Some examples of chemical change are as follows:

i. Burning of a paper
ii. Burning of a wood or coal
iii. Rusting of iron
iv. Formation of curd from milk
v. Electrolysis of water, etc.

Do You Know

Physical change is a reversible change but most chemical changes are irreversible.

Differences between Physical change and Chemical change

S.N.	Physical change	S.N.	Chemical change
1.	Only physical properties like shape, size, colour, etc. are changed.	1.	Both physical as well as chemical properties are changed.
2.	New substances are not formed.	2.	New substances are formed.
3.	It is a temporary change.	3.	It is a permanent change.
4.	It is a reversible change.	4.	It is an irreversible change.

Report writing 1

- Go to the science laboratory.
- Perform an activity to demonstrate a physical change and a chemical change under the guidance of your subject teacher. Prepare a short report and present in the classroom.

Key concepts

1. Matter can be defined as anything having mass and volume.
2. Matter can exist in three different states. They are i. solid ii. liquid and iii. gas.
3. Liquids are substances having a fixed volume but no fixed shape.
4. Gases are substances which neither have a fixed shape nor a fixed volume.
5. An element is the pure substance which cannot be divided into two or more simpler substances by ordinary chemical means.
6. All the atoms of the same element are identical but atoms of different elements are different.
7. A symbol can be defined as the first letter or the first letter and another letter of the English name or Latin name of an element.
8. The chemical substance formed by a combination of two or more elements in a fixed proportion by weight is called a compound.
9. A compound does not contain the properties of its constituent elements.
10. An atom is the smallest particle of an element which can take part in a chemical reaction.
11. An atom is made of three fundamental particles or sub-atomic particles. They are proton, neutron and electron.
12. Molecular formula is defined as the symbolic representation of the molecule of an element or a compound in a molecular form.
13. The temporary change in which only physical properties are changed is called physical change.
14. The permanent change in which new types of substances are formed is called a chemical change.

Exercise

1. Tick (√) the correct statements and cross (×) the incorrect ones.

a. Matter does not have mass. ☐

b. Liquids take the shape of a container in which they are kept. ☐

c. Gases do not flow from one place to another. ☐

d. The symbol of calcium is C. ☐

e. Burning of a paper is a physical change. ☐

2. Fill in the blanks using appropriate words.

a. Matter exists in ..... states.

b. Solids have a fixed ..... and a fixed .....

c. Scientists have discovered ..... elements so far.

d. The smallest particle of an element is called .....

e. The molecular formula of carbon dioxide is .....

3. Tick (√) the best answer from the given alternatives.

a. Which of the given substances is a solid?

☐ wax ☐ water ☐ milk ☐ petrol

b. Which of the given substances is made by only one type of atoms?

☐ gold ☐ water

☐ sodium chloride ☐ carbon dioxide

c. Which of the following is the symbol of potassium?

☐ P ☐ K ☐ Po ☐ Pt

d. Which of the following is the molecular formula of magnesium chloride?

☐ MgCl ☐ $MgCl_2$ ☐ Mg_2Cl ☐ $MgCl_3$

e. Which of the following is a chemical change?

☐ rusting of iron ☐ melting of ice

☐ tearing of a paper ☐ melting of wax

4. Answer the following questions.

a. What is matter? Give any three examples.
b. Name the three states of matter.
c. What are solids? Write any three properties of solids with any three examples.
d. What are liquids? Give any four examples.
e. Write any three properties of liquids.
f. What are gases? Give any three examples.
g. Write any three characteristics of gases.
h. What are elements? Give any five examples.
i. What is a symbol? Write down the symbol and draw atomic structure of following elements.

- helium - carbon - oxygen - sodium
- silicon - phosphorus - argon - calcium

j. What are compounds? Give any four examples.
k. Define atom and molecule with any two examples of each.
l. What is molecular formula? Write down the molecular formula of
- Water - Sodium chloride
- Carbon dioxide - Ammonia
m. Define physical change with any three examples.
n. Define chemical change with any three examples.

5. Give reason.

a. Sodium is called an element.
b. Water is called a compound.
c. The melting of ice is called a physical change.
d. The rusting of iron is called a chemical change.

6. Differentiate between:

a. Solid and Gas
b. Element and Compound
c. Atom and Molecule
d. Physical change and Chemical change

7. Draw a neat figure to show a:

a. Physical change.
b. Chemical change.

UNIT
10

Materials of Daily Use

Estimated teaching hours : 15

Before You Begin

We use a variety of substances such as acids, bases and salts in our day to day life. Sour fruits like lemon, orange, citrus, amla, apple, etc. contain acids. Edible soda, lime, bitter gourd, etc. are bases. Similarly, edible salt (Sodium chloride), Copper sulphate, etc. are salts.

Acids are substances that produce hydrogen (H^+) ions when dissolved in water. Hydrochloric acid (HCl), Sulphuric acid (H_2SO_4), Nitric acid (HNO_3), carbonic acid (H_2CO_3), etc. are examples of acids. Bases are substances that produce hydroxyl (OH^-) ions when dissolved in water. Calcium hydroxide [$Ca(OH)_2$], Sodium hydroxide (NaOH), Ammonium hydroxide (NH_4OH), etc. are examples of bases. Salts are the substances formed by partial or complete replacement of hydrogen atoms by a metal or electro-positive radical, e.g. Sodium chloride (NaCl), Calcium sulphate ($CaSO_4$), Ammonium chloride (NH_4Cl), etc. Acids are sour, bases are bitter and salts are salty in taste.

We use a number of metals, non-metals and metalloids in our daily life. Scientists have discovered 118 elements so far. These elements have been classified into metal, non-metals and metalloids on the basis of their physical and chemical properties. Among the 118 elements, most elements are metals and only a few are metalloids.

Metals are hard, malleable and ductile elements which are good conductor of heat and electricity, e.g. iron, copper, aluminiun, gold, silver, zinc, etc. Non-metals are soft, non-malleable and non-ductile elements which are bad conductor of heat and electricity, e.g. nitrogen, oxygen, chlorine, sulphur, carbon, iodine, etc. Similarly, metalloids are those elements that show properties of both metals and non-metals e.g. silicon, arsenic, germanium, etc.

Learning Outcomes

After completing the study of this unit, students will be able to:

- introduce acid, base and salt and state their physical properties.
- introduce indicators and identify acid, base and salt using them.
- prepare indicators using local materials.
- introduce metals and state physical properties and uses of metals like aluminium, zinc, silver, iron, copper and gold.
- introduce non-metals and state physical properties and uses of non-metals like sulphur and iodine.

Syllabus

- Acid, base and salt (introduction, examples and physical properties)
- Introduction to indicators
- Types of indicators (litmus paper, phenolphthalein and methyl orange)
- making indicators in local level and using them
- metals and non-metals (introduction, examples and physical properties)
- Introduction, physical properties and uses of metals like aluminium, zinc, iron, gold, copper and silver
- Introduction, physical properties and uses of non-metals like sulphur and iodine

Glossary

alkali	:	a base that dissolves in water
acid	:	a substance that gives hydrogen (H^+) ions when dissolved in water
base	:	a substance that gives hydroxyl (OH^-) ions when dissolved in water
corrosive	:	tending to destroy something slowly
crystalline	:	having a fixed geometrical shape, smooth surface and sharp edges
ductile	:	that can be made into a thin wire
indicators	:	chemical substances which are used to indicate whether a substance is acid, base or salt
malleable	:	that can be beaten into different shapes easily without breaking or cracking
metal	:	solid substances which are malleable, ductile and good conductor of heat and electricity
metalloids	:	the substance which shows properties of both metals and non-metals
non-metal	:	soft, non-malleable and non-ductile substances
salt	:	a substance formed by complete or partial replacement of hydrogen ions by a metal or ammonium radical

10.1 Acid, Base and Salt

10.1.1 Introduction

Activity 1

Observe the given objects of daily use and classify them on the basis of their taste (sour, bitter and salty).



Lemon



Bitter gourd



Orange



Apple



Amla



Common salt



Black salt



Ash

Fig. 10.1

Sour	Bitter	Salty

10.1.2 Acids

Do You Know

most acids are sour in taste. But it is dangerous to touch and taste acids in laboratory as acids burn our skin and tongue.

The word 'acid' refers to a sour substance. However, it does not mean that all acids are sour. Most acids are sour. *The word 'acid' has been derived from the Latin word 'acidus' which means sour in taste.* Citric acid, lactic acid, carbonic acid, hydrochloric acid, sulphuric acid and nitric acid are some examples of acids.

The chemical substances which give hydrogen (H^+) ions when dissolved in water are called acids. For example: Hydrochloric acid (HCl), Sulphuric acid (H_2SO_4), Nitric acid (HNO_3), Carbonic acid (H_2CO_3), etc.

Fig. 10.2



Hydrochloric acid (HCl)



Sulphuric acid (H_2SO_4)



Nitric acid (HNO_3)

Activity 2

- Collect lemon, orange, green mango, green apple, amala, chuk and other sour fruits.
- Cut a small piece of each and taste them.
- Do they taste sour, why?
- Search in the internet and find out the name of acids found in each of them.

10.1.2.1 Types of Acids on the Basis of Source

There are two types of acids on the basis of source or chemical nature. They are (i) Inorganic acids and (ii) Organic acids.

i. Inorganic acids

The acids which are obtained from minerals are called inorganic acids. Acids like Hydrochloric acid (HCl), Sulphuric acid (H_2SO_4), Nitric acid (HNO_3), Carbonic acid (H_2CO_3), etc are inorganic acids. These acids are commonly used in laboratory. Inorganic acids are also called mineral acids.

ii. Organic acids

The acids which are obtained from living organisms are called organic acids. Citric acid, Acetic acid, Oxalic acid, Tartaric acid, Formic acid, Lactic acid, etc. are some examples of organic acids.

Fig. 10.3



Lemon contains citric acid



Tomato contains oxalic acid



Grapes contain tartaric acid



Apple contain malic acid

Differences between Organic acids and Inorganic acids

S.N.	Organic acids	S.N.	Inorganic acids
1.	Acids which are obtained from living organisms and have hydrocarbon are called organic acids.	1.	Acids which are obtained from minerals and do not have hydrocarbon are called inorganic acids.
2.	These are weak acids.	2.	These acids may be strong or weak.

10.1.2.2 Types of Acids on the Basis of Strength

There are two types of acids on the basis of strength. They are (i) Strong acids and (ii) Weak acids.

a. Strong acids

The acids which produce a high concentration of hydrogen (H^+) ions when dissolved in water are called strong acids. They are more corrosive in nature. Examples: Hydrochloric acid (HCl), Sulphuric acid (H_2SO_4), nitric acid (HNO_3), etc.

b. Weak acids

The acids which produce a low concentration of hydrogen (H^+) ions when dissolved in water are called weak acids. They are less corrosive in nature. Examples: Carbonic acid (H_2CO_3), Acetic acid (CH_3COOH), Formic acid (HCOOH), etc.

Differences between Strong acids and Weak acids

S.N.	Strong acids	S.N.	Weak acids
1.	Acids which undergo almost complete dissociation in aqueous solution and produce high concentration of hydrogen ions are called strong acids.	1.	Acids which undergo partial dissociation in aqueous solution and produce low concentration of hydrogen ions are called weak acids.
2.	They are good conductor of heat and electricity.	2.	They are poor conductor of heat and electricity.
3.	They have low pH value.	3.	They have high pH value.

10.1.2.3 Physical Properties of Acids

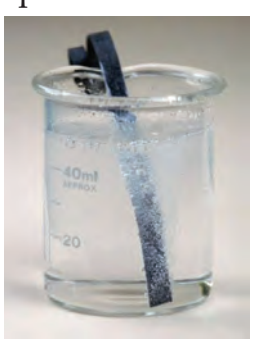
1. Most acids are sour in taste.
2. They change blue litmus paper into red and methyl orange into red.
3. They are corrosive in nature.
4. They do not change the colour of phenolphthalein.

Do You Know

most acids are sour in taste but acids like Boric acid, Stearic acid and Salicylic acid are not sour.



Fig. 10.4 *Acid changes blue litmus into red*



Acid corrodes metals

Activity 3

- Identify various acids that are used at your home.
- Name these acids and write their uses.

10.1.2.4 Uses of Acids

1. Hydrochloric acid, sulphuric acid and nitric acid are used in science laboratories and industries to do various experiments.
2. Sulphuric acid is used for making chemical fertilizers, drugs and detergents.
3. Hydrochloric acid is used in tanning and printing industries.
4. Nitric acid is used for making plastics, dyes and explosives.
5. Carbonic acid is used in soft drinks like coca-cola, soda water, beer, etc.
6. Acetic acid (vinegar) is used in pickles.
7. Carbolic acid (phenol) is used to kill germs.
8. Citric acid is used as a source of vitamin C.

Some acids of daily use and their sources are given below.

S.N.	Acids	Source
1.	Citric acid	Orange, lemon, tomato
2.	Tartaric acid	Grape fruit, grapes
3.	Formic acid	Red ant
4.	Lactic acid	milk, curd
5.	Ascorbic acid	Sour fruits (Amla)
6.	Oxalic acid	Chari amilo

Activity 4

- Collect various substances like lemon juice, sour milk, curd, tomato juice, vinegar, bottle gourd juice, chuk, common salt solution, etc.
- Go to the science laboratory and immerse red litmus and blue litmus paper turn by turn.
- Observe the change in colour and fill in the given table.

	Substances	Red litmus paper	Blue litmus paper
1.			
2.			
3.			

4.			
5.			
6.			
7.			
8.			

10.1.3 Bases

Bases are metallic oxides and metallic hydroxides. For example, Sodium oxide (Na_2O), Calcium oxide (CaO), magnesium oxide (MgO), Sodium hydroxide (NaOH), Calcium hydroxide [$Ca(OH)_2$], etc. The bases that dissolve in water and produce hydroxyl (OH^-) ions are called alkalis.

Do You Know

The bases that dissolve in water are called alkalis. But bases like CuO, HgO, BaO, PbO, etc. do not dissolve in water. So, all alkalis are bases but all bases are not alkalis.

Sodium hydroxide (NaOH), Potassium hydroxide (KOH), Calcium hydroxide [$Ca(OH)_2$], etc. are examples of alkalis. Bases are bitter in taste.

Differences between Acids and Bases

S.N.	Acids	S.N.	Bases
1.	Acids produce hydrogen (H^+) ions when dissolved in water.	1.	Bases produce hydroxyl (OH^-) ions when dissolved in water.
2.	They turn blue litmus paper into red.	2.	They turn red litmus paper into blue.

10.1.3.1 Types of bases

On the basis of strength, there are two two types of bases. They are (i) Strong bases and (ii) Weak bases.

i. Strong bases

The bases that produce a high concentration of hydroxyl (OH^-) ions in water are called strong bases. Examples: Sodium hydroxide (NaOH),

Potassium hydroxide (KOH), Magnesium hydroxide [$Mg(OH)_2$], Calcium hydroxide [$Ca(OH)_2$], etc.

ii. Weak bases

The bases that produce a low concentration of hydroxyl (OH^-) ions in water are called weak bases. Examples: Copper hydroxide ([Cu)$OH)_2$], Ferric hydroxide [$Fe(OH)_3$], etc.

Activity 5

- Take a bittergourd and an unripened persimmon.
- Wash them and cut into small pieces.
- Taste both of them one by one.
- Do they taste bitter? Why? Discuss in the classroom.

  Bitter gourd and persimmon contain base. So, they taste bitter. It shows that bases taste bitter.

Do You Know

Strong bases/alkalis burn our skin, So, we should not touch bases/alkalis in a laboratory.

10.1.3.2 Physical Properties of Bases/Alkalis

1. Bases are bitter in taste.
2. They have a soapy touch.
3. They turn red litmus into blue, methyl orange into yellow and phenolphthalein into pink.
4. Strong alkalis dissolve oil and grease.
5. Strong alkalis burn our skin.



Fig. 10.5 *Base changes red litmus into blue*

10.1.3.3 Uses of Bases/Alkalis

1. Sodium hydroxide (NaOH) is used for making soap, paper, etc.
2. Potassium hydroxide (KOH) is used for making soft soap, chemical fertilizers, etc.
3. Aluminium hydroxide [$Al(OH)_3$] and magnesium hydroxide [$Mg(OH)_2$] are used for reducing hyperacidity of stomach.

4. Calcium hydroxide [$Ca(OH)_2$] or lime water is used to reduce hardness of water.
5. Ammonium hydroxide (NH_4OH) is used for making chemical fertilizers and plastics.
6. Calcium oxide (CaO) is used for softening hard water, for making cement and in purification of sugar.

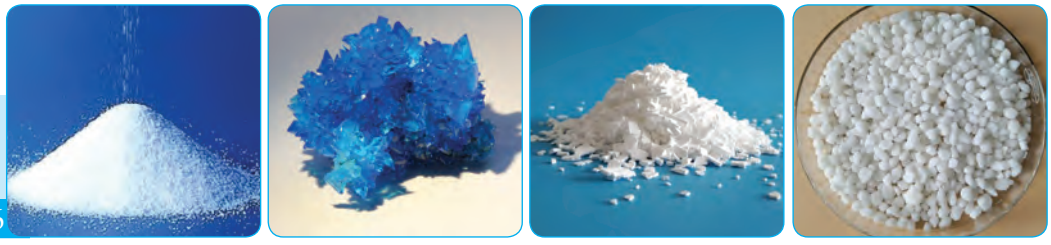
Differences between Strong bases and Weak bases

S.N.	Strong bases	S.N.	Weak bases
1.	Bases which give more amount of hydroxyl ions in aqueous solution are called strong bases.	1.	Bases which give very less amount of hydroxyl ions in aqueous solution are called weak bases.
2.	They have high degree of ionization.	2.	They have low degree of ionization.
3.	They have high pH value.	3.	They have low pH value.

10.1.4 Salt

We use table salt in our food. Its chemical name is sodium chloride (NaCl). It is the most common example of a salt that we have seen and tasted. A salt is a neutral substance formed by the chemical reaction between an acid and a base. Most salts are neutral but some are acidic and some are basic in nature. The process in which an acid reacts with a base and forms two neutral substances, i.e. salt and water is called neutralization reaction.

Fig. 10.6



Sodium chloride *Copper sulphate* *Calcium chloride* *Ammonium nitrate*

10.1.4.1 Properties of Salts

1. Most salts are bitter in taste. Some are salty.
2. Most salts are neutral but some may be acidic or basic.
3. Most salts dissolve in water.

4. They may be white, colourless or colourful.
5. They conduct electricity in solution or molten state.

10.1.4.2 Uses of salts

1. Common salt (NaCl) is used in our foods.
2. Copper sulphate ($CuSO_4$) is used to make fungicides.

Do You Know

- Salts of metals like Na, K, Mg, Ca, Al and Ba are white or colourless.
- Salts of metals like Cu, Co, Mn, Fe, Ni and Cr are colourful.

3. Calcium sulphate ($CaSO_4$) is used for making cement and plastering of fractured bones.
4. Ammonium sulphate [$(NH_4)_2SO_4$] is used for making chemical fertilizers.
5. Sodium bicarbonate ($NaHCO_3$) is used for making baking powder.
6. Magnesium sulphate ($MgSO_4$) is used for treating constipation.
7. Sodium carbonate (Na_2CO_3) is used for making glass, soap and detergent.

10.1.5 Indicators

We cannot identify whether a given chemical substance is an acid, base or salt just by observing it. We use some chemicals to identify them. These chemicals are called indicators. The chemical substances are used to indicate whether a substance is acidic, basic or neutral in nature are called indicators. For example, litmus paper (red and blue), methyl orange, phenolphthalein, etc. These indicators are called ordinary indicators.



Fig. 10.7

Red litmus paper *Blue litmus paper* *Methyl orange* *Phenolphthalein*

Indicators are obtained from different parts of plants like roots, flowers, leaves, etc. These parts are collected, crushed and mixed with organic solvents to get indicators.

Following table shows the various indicators and their effects in acid, base and salt.

S. No.	Indicators	Colour in acid solution	Colour in basic solution	Colour in neutral salt solution
1.	Litmus paper (red)	No change in colour	Changes into blue	No change in colour
2.	Litmus paper (blue)	Changes into red	No change in colour	No change in colour
3.	methyl orange	Changes into red	Changes into yellow	No change in colour
4.	Phenolphthalein	No change in colour	Changes into pink	No change in colour

Activity 6

Prepare your own indicator

- Collect locally available materials like, petals of rose, beet root, onion, leaves of red cabbage, turmeric powder.
- Crush each of them separately. Immerse the pieces into alcohol and boil the mixture for 20 minutes using water bath. After boiling let the mixture cool and filter. Your indicator is ready.

Now use above indicators to test acid, base and salt. The result can be obtained as follows.

Indicator	Colour in acid	Colour in base	Colour in salt
Indicator of onion	Red	Green	Violet
Indicator of cabbage	Red or Rose red	Green or blue	Purple
Indicator of turmeric	Yellow	Red	Yellow

10.1.5.1 Universal Indicator

Ordinary indicators can indicate whether a substance is acidic, basic or neutral in nature but cannot measure the strength. Therefore, a special kind of indicator is used to measure the strength of the given substance which is called the universal indicator. So, a universal indicator is a special kind of indicator which is used to measure the strength of acidity or alkalinity of a solution. It changes colour when kept in an acidic, basic or neutral solution which is strength of the solution. A universal indicator is prepared by mixing several ordinary indicators of different colour.

Differences between Ordinary indicators and Universal indicator

S.N.	Indicator	S.N.	Universal Indicator
1.	Ordinary indicators indicate only whether the substance in acidic, basic or neutral in nature.	1.	Universal indicator indicates whether the substance in acidic, basic or salty along with their strength.
2.	They are obtained from the parts of plant like leaves, flowers, roots, etc.	2.	It is obtained by mixing different types of ordinary indicators.

10.1.5 pH and pH Scale

A pH is the measure of hydrogen ion concentration present in a solution. It is measured by using pH paper and pH meter.



Fig. 10.8 *pH meter*

A pH scale is the standard scale which is used to measure the strength of acidic or alkaline solution. It consists of numbers 1 to 14 with their corresponding colours in the scale. The pH value 1 to 6 represents acidity, pH value 7 represents neutrality and pH value 8 to 14 represents the basicity or alkalinity. The solution having pH value 1 is the strongest acid and that having 14 is the strongest alkali.

← Acidity increases				Neutral	Alkalinity increases →		
pH 1	2	3	4 5 6	7	8 9 10	11 12	13 14
Red	Rose	Yellow	Light green	Green	Greenish blue	Blue	Deep blue

The pH value of some common chemicals

Chemicals		pH value
Acidic	Hydrochloric acid (HCl)	1
	Sulphuric acid (H_2SO_4)	1.2
	Lemon juice (citric acid)	2.5
	Carbonic acid, vinegar	3

Neutral	Common salt solution Water Sugar solution	7
Basic/Alkaline	Human blood Baking soda Washing soda Sodium hydroxide (NaOH)	7.3 8.5 11.5 13

Activity 7

- Take red and blue litmus paper and three test tubes. Mark the test tubes 1, 2 and 3.
- Keep the solution of acid in test tube 1, solution of alkali in test tube 2 and solution of common salt in test tube 3.
- Now, take red litmus papers and immerse one litmus paper separately in each test tube. Observe the change in colour.
- Take blue litmus papers and repeat the above activity.
- Prepare a chart after your observation. Demonstrate the chart in your classroom.

Activity 8

- Go to the science laboratory with your science teacher.
- Take solution of acids, bases and salts in different test tubes.
- measure the pH value of each by using a pH meter.

Do You Know

Ordinary indicators indicate only whether the substance is acid, base or salt whereas the universal indicator indicates whether the substance is acid, base or salt along with their strength (pH value). So, universal indicator is more meaningful than an ordinary indicator.

Key Concepts

1. The chemical substances which give hydrogen (H^+) ions when dissolved in water are called acids.
2. The acids which are obtained from minerals are called inorganic acids.

3. The acids which are obtained from living organisms are called organic acids.
4. Bases are metallic oxides and metallic hydroxides.
5. The bases that dissolve in water and produce hydroxyl (OH^-) ions are called alkalis.
6. The bases that produce a high concentration of hydroxyl (OH^-) ions in water are called strong bases.
7. The bases that produce a low concentration of hydroxyl (OH^-) ions in water are called weak bases.
8. A salt is a neutral substance formed by the chemical reaction between an acid or a base.
9. The process in which an acid reacts with a base and forms two neutral substances, i.e. salt and water is called the neutralization reaction.
10. Those chemical substances which are used to indicate whether a substance is acidic, basic or neutral in nature are indicators.
11. Indicators are obtained from different parts of plants like roots, flowers, leaves, etc. These parts are collected, crushed and mixed with organic solvents to get indicators.
12. A universal indicator is a special kind of indicator which is used to measure the strength of acidity or alkalinity of a solution.
13. A pH is the measure of hydrogen ion concentration present in a solution.
14. A pH scale is the standard scale which is used to measure the strength of acidic or alkaline solution.

Exercise

1. Put a tick (√) for the correct statements and a cross (×) for the incorrect ones.

a. Acids produce hydrogen ions when dissolved in water. ☐

b. Carbonic acid is a strong acid. ☐

c. All bases are alkalis. ☐

d. Litmus paper is a universal indicator. ☐

e. The pH value of neutral salt is 7. ☐

2. Fill in the blanks using appropriate words.

a. Acids are ..... in taste.

b. Acids react with ..... and form hydrogen gas.

c. Bases are ..... oxides or metal hydroxides.

d. Base reacts with ..... and form salt and .....

e. The pH value of the strongest alkali is .....

3. Tick (√) the most appropriate answer from the given alternatives.

a. Which of the given substance is an acid?

☐ NaOH ☐ H_2SO_4 ☐ NaCl ☐ K_2SO_4

b. Which of the following is used as a source of vitamin C?

☐ Carbonic acid ☐ Citric acid

☐ Sulphuric acid ☐ Acetic acid

c. Bases react with acid and form ..... and water.

☐ nitrates ☐ carbonates ☐ sulphates ☐ salt

d. The acid which is found in human stomach is .....

☐ H_2SO_4 ☐ H_2CO_3 ☐ HCl ☐ HNO_3

e. The pH value of the strongest acid is .....

☐ 1 ☐ 6 ☐ 7 ☐ 14

4. Answer the following questions.

a. Define acids with any four examples.

b. What are strong acids? Give any two examples of weak acids.

c. Define organic acids and inorganic acids with any two examples of each.

d. Write any three physical properties of acids.

e. Name any two organic acids that are found in fruits.

f. Write down the uses of given acids.

i. Acetic acid ii. Nitric acid

iii. Carbonic acid iv. Sulphuric acid

v. Tartaric acid vi. Formic acid

g. What are bases? Give any three examples.
h. What are alkalis? Give any three examples.
i. Write any three physical properties of bases.
j. Write any four uses of bases.
k. What is a salt? Give any three examples.
l. Write any three properties and four uses of salt.
m. Define indicator and universal indicator.
n. What is a pH? Write down the pH value of the strongest acid, neutral salt and the strongest alkali.
o. What is a pH-scale?

5. Give reason.

a. We should not touch and taste acids in a science laboratory.
b. Sodium chloride is called a salt.
c. All bases are not alkalis but all alkalis are bases.
d. Methyl orange is called an indicator.
e. Universal indicator is better than an ordinary indicator.
f. We eat aluminium hydroxide to reduce hyperacidity.
g. Bitter gourd tastes bitter but lemon tastes sour.
h. Burning sensation occurs when ant bites.
i. We add chuk while cooking colocasia (*pidalu*).

6. Differentiate between:

a. Inorganic acids and Organic acids
b. Bases and Alkalis
c. Acids and Alkalis (Bases)
d. Ordinary indicator and Universal indicator

7. All alkalis are bases but all bases are not alkalis. Justify this statement.

8. Write down the effects of litmus paper, methyl orange and phenolphthalein on acid, base and salt.

9. Describe the method of preparing indicator using the petals of rose.

10. You are given three colourless solutions of acid, base and salt. How can you find them as acid, base or salt?

11. Prepare a list of acid, base and salt that are used at your home.

10.2 Metal and Non-metal

10.2.1 Introduction

We use various types of materials in our daily life. These materials may be metals, non-metals or mettalloids. Iron, copper, silver, gold, aluminium, etc. are the examples of metals. They are good conductors of heat and electricity. They are malleable and ductile. Metals are widely used in our daily life for various purposes. Metals are those elements which conduct heat and electricity.

Carbon, chlorine, nitrogen, oxygen, sulphur, phosphorus, etc. are the examples of non-metals. They are bad conductor of heat and electricity. They are neither malleable nor ductile. Non-metals are these elements which do not conduct heat and electricity.

Metalloids are those elements which show properties of both metals and non-metals. Silicon, germanium, arsenic, antimony, etc. are the examples of metalloids. In this unit, we will study about metals, non-metals and metalloids in brief.

Activity 9

- Collect following materials from your home or market.



Copper wire *A sheet of iron* *a piece of glass* *Brick*

Pencil *Pencil lead* *Magnet* *Plastic*

Fig. 10.9

- Classify them in terms of metals and non-metals after studying their features.

10.2.2 metals

We use metals like iron, aluminium, copper, silver, gold, etc. in our daily life. Metals are used for making cooking utensils, construction materials, vehicles, ornaments, furniture, electric wires, weapons, etc.

Metals are those substances which are hard, malleable, ductile and good conductors of heat and electricity. For example, iron, copper, aluminium, gold, silver, etc. They are shiny (lustrous) and produce tinkling sound when hammered. All solids exist in solid state except mercury.

Fig. 10.10



Cooking utensil made of iron



Cooking utensils made of copper



Cooking utensils made of aluminium

Properties of metals

1. Most metals are found in solid state except mercury.
2. Most metals are malleable. It means that, they can be beaten into thin sheets.
3. Most metals are ductile. It means that, a thin and long wire can be made from metals.
4. Metals are lustrous, i.e. shiny nature.
5. Metals are good conductor of heat and electricity.
6. They produce tinkling sound on hitting.
7. Most metals are hard except lithium, sodium and potassium.

10.2.3 Non-metals

Non-metals are those substances which are generally soft, non-malleable, non-ductile and bad conductors of heat and electricity. They exist in all three states. They are solid, liquid and gas. Carbon,

Do You Know

Graphite is a non-metal that conducts heat and electricity.

iodine, sulphur, phosphorus, chlorine, etc. are examples of non-metals.

We use many non-metals in our daily life. Non-metals are used in construction works, to make containers, utensils, medicines, etc.

Fig. 10.11



Carbon



Phosphorus



Sulphur

Properties of Non-metals

1. Non-metals are found in all three states, i.e. solid, liquid and gas.
2. They are non-malleable.
3. They are non-ductile.
4. They are non-lustrous except iodine.
5. They are non-conductors of heat and electricity except graphite.
6. They do not produce tinkling sound on hitting.
7. Non-metals are generally soft.

Do You Know

- All non-metals are bad conductor of heat and electricity except graphite.
- Metals are sonorous and non-metals are non-sonorous.

Activity 10

- Collect various materials found at your home like metal wires, coins, spoon, brick, pencil, lead of pencil, plastics, iron nail, etc.
- Study the characteristics of these substances like malleability, ductility, conductivity, etc.
- Classify them in terms of metal and non-metals.

Differences between Metals and Non-metals

S.N.	Metals	S.N.	Non-metals
1.	Metals are good conductors of heat and electricity.	1.	Non-metals are bad conductors of heat and electricity.

2.	They are malleable.	2.	They are non-malleable.
3.	They are ductile.	3.	They are non-ductile.
4.	They are lustrous.	4.	They are non-lustrous.
5.	Most metals are hard.	5.	Most metals are soft.
6.	They are sonorous.	6.	They are non-sonorous.

10.2.3 Introduction, Properties and Uses of Some Common Metals

1. Aluminium

Aluminium is a bluish-white metal which is extracted from bauxite ore. It is a reactive metal. So, it is not found in free state in nature.

Properties of aluminium

a. It is a light metal having bluish-white colour.
b. It is malleable and ductile.
c. It is a good conductor of heat and electricity.
d. It is not affected by air and water.
e. Rusting doesn't occur in aluminium.
f. It has low melting point.

Fig. 10.12



Bauxite ore



Aluminium utensils

Uses of aluminium

a. Aluminium is used for making cooking utensils, foils and food wrappers.
b. It is used for making bodies and parts of aeroplene, car, motor

Do You Know

Aluminium is a light, malleable and rusting free metal as well as it is not affected by air and water. So, aluminium is used for making body and parts of aeroplane.

cycles, ship, etc. as it is a light and rust-free metal.

c. It is used for making over head electric cables, coins and alloys.

d. It is used for making silver paint.

2. Iron

Iron is a greyish-white metal which is mainly extracted from haematite and magnetite ores. It is not found in free-state in nature. Iron is widely used in our daily life for various purposes.

Fig. 10.13



Haematite ore



Magnetite ore

Properties of iron

a. It is a greyish-white metal.

b. It is malleable and ductile.

c. It is a good conductor of heat and electricity.

d. It reacts with moist air and get rusted.

e. It reacts with acids.

f. It can be magnetized.

Fig. 10.14



Iron rods



Iron utensils

Uses of iron

a. Iron is used for making cooking utensils.
b. It is used for making vehicles like bus, truck, car, motorcycle, bicycle, etc.
c. It is used for making weapons, tools and furniture.
d. It is used for making rods, pipes, nuts and bolts.
e. It is used for making steel.

3. Copper

Copper is a reddish-brown metal which is extracted from chalcopyrite ore. It is found in pure as well as combined state in nature.

Fig. 10.15



Chalcopyrite ore



Copper utensils

Properties of copper

a. It is a reddish-brown metal.
b. It is malleable and ductile.
c. It is a good conductor of heat and electricity.
d. It reacts with acids.
e. It does not undergo rusting.
f. It becomes black when kept in moist and cold places for a long time.

Uses of copper

a. Copper is used for making electric wires and electronic equipment.
b. It is used for making cooking utensils, coins, medals and statues.
c. It is used for making medicines and fungicides.
d. It is used for making brass, bronze, bell metal, etc.

Fig. 10.16



Copper wire



Bronze utensil

4. Silver

Silver is a shiny-white metal which is extracted from argentite ore. It is found in pure as well as combined state in nature.

Properties of silver

a. It is a shiny-white metal.
b. It is malleable and ductile.
c. It is a very good conductor of heat and electricity.
d. It does not react with dilute acids.
e. It does not undergo rusting.



Fig. 10.17

Uses of silver

a. It is used for making ornaments.
b. It is used for making medicines.
c. It is used for filling cavities in teeth.
d. It is used for making coins, idols and statues.

5. Gold

Gold is a yellow, shiny and expensive metal. It is extracted from sandy alluvial soil and quartz veins. It occurs in free state in nature.

Properties of gold

a. It is a yellow shiny metal.
b. It is malleable and ductile.
c. It is a very good conductor of heat and electricity.

d. It does not react with air, water and acids.

Fig. 10.18



Gold



Gold ornaments

Uses of gold

a. It is used for making ornaments and jewelery.

b. It is used for making medals, coins, statues and idols.

c. It is used for making medicines.

d. It is used for filling cavities in teeth.

Do You Know

Gold is a noble metal. It does not react with air, water, acids and other chemicals in normal condition of temperature and pressure. So, gold is found in pure state. But iron combines with air, acids and other chemicals in ordinary condition to form various types of compounds. So, iron is not found in pure state in nature.

6. Zinc

Zinc is a mineral which is essential to the human body. It is one of the most widely used metal. It is a reactive metal and found in several ores like zinc sulphide and zinc silicates. Zinc is a bluish white metal. It is good conductor of heat and electricity. It is commonly found in minerals together with sulphur. It is found in small amount in the earth. Zinc is essential for all living beings.

Fig. 10.19



Zinc metal



Ore of zinc

Properties of zinc

a. The colour of zinc is bluish white.
b. It is melleable and ductile.
c. It conducts heat and electricity.
d. It is lighter than iron.
e. It produces hydrogen gas by reacting with acids.
f. It has low melting point and boiling point.

Uses of zinc

a. Zinc is used for galvanizing metals like iron.
b. It is used to make die-castings of automobiles, electrical equipment and hardware industries.
c. It is used for manufacturing batteries and electric equipment.
d. It is used for making alloys like brass.
e. It is used for making ink, paint, plastics and cosmetics.
f. It is used for making medicines, X-ray screens and fluorescent lights.

Do You Know

Zinc is needed for DNA synthesis, immune function, metabolism and growth. It may reduce inflammation and your risk of some age-related diseases.

10.2.4 Introduction, Properties and Uses of Some Non-metals

1. Sulphur

Sulphur is a crystalline solid without taste and odour. It is yellow coloured solid which is found in free as well as combined state in nature. It is extracted from underground deposits.

Properties of sulphur

a. It is a yellow crystalline solid.
b. It is odourless and tasteless.
c. It is insoluble in water.
d. It burns in air.
e. Its vapour is poisonous for bacteria and fungi.
f. It does not react with acids.



Fig. 1020

Uses of sulphur

a. Sulphur is used for making sulphuric acid, fire crackers, gun powder, matches and dyes.
b. It is used for making skin ointment for curing skin diseases.
c. It is used in beauty parlours for hair-setting.
d. It is used for making germicides, fungicides and insecticides.
e. It is used for hardening rubber.

2. Iodine

Iodine is a very useful non-metal. Human beings are using iodine from pre-historic time. Our body requires certain amount of iodine. Therefore, we use iodized salt.



Fig. 1021

Properties of iodine

a. Iodine is a heavy non-metal of violet black colour.
b. It is found in solid state at room temperature.
c. It is a lustrous non-metal.
d. It has strong harsh smell.
e. It is a crystaline non-metal.

Do You Know

Thyroid gland swells due to lack of iodine in diet. This condition is called goitre. New born child may have many deformities due to lack of iodine during pregnancy.

Uses of iodine

1. Iodine is used for treating wounds and minor cuts.
2. It is used in photography.
3. It is used for making tincture iodine.
4. It is used for making iodex.
5. It is used to prevent goitre by adding it in table salt.
6. It is used to treat thyroid cancer.

Do You Know

- A person suffers from goitre due to lack of iodine in diet.
- Iodine is used to treat thyroid cancer.

Project Work

- Take a chart paper.
- Name any two alloys and two non-metals that are used at your home.
- Write down the major uses of these substances.
- Demonstrate the chart paper in the classroom.

Key concepts

1. Metals are hard and solid substances which are malleable, ductile and good conductor of heat and electricity.
2. Non-metals are soft substances which are non-malleable, non-ductile and bad conductors of heat and electricity.
3. We use different types of metals, non-metals and metalloids in our daily life.
4. Iron is a greyish-white metal which is used for making cooking utensils, weapons, vehicles, rods, pipes, etc.
5. Gold is a yellow shiny metal which is used for making coins, idols, medals, jewellery, medicines, etc.
6. Aluminium is a bluish-white metal which is extracted from bauxite ore. It is a reactive metal.
7. Aluminium is used for making cooking utensils, foils and food wrappers and body parts of aeroplane.
8. Iron is a greyish-white metal which is mainly extracted from haematite and magnetite ores.
9. Copper is a reddish-brown metal which is extracted from chalcopyrite ore. It is found in pure as well as combined state in nature.
10. Copper is used for making electric wires and electronic equipment.
11. Silver is a shiny-white metal which is extracted from argentite ore.
12. Zinc is a mineral which is essential to the human body. It is one of the most widely used metal.
13. Zinc is used for galvanizing metals like iron.
14. Iodine is used for treating wounds and minor cuts.

Exercise

1. Put a tick (√) for the correct statements and a cross (×) for the incorrect ones.

a. Metals are malleable and ductile. ☐

b. Non-metals do not conduct heat. ☐

c. Metalloids show the properties of both metals and non-metals. ☐

d. Iron is extracted from the argentite ore. ☐

e. Gold is found in a pure state in nature. ☐

f. Copper is extracted from chalcopyrite. ☐

g. Iodine is used for treating wounds. ☐

2. Fill in the blanks using appropriate words.

a. Metals are ..... conductors of ..... and electricity.

b. Non-metals are found in solid, ... and gaseous states.

c. Silicon is a .....

d. Iron is extracted from ..... and .....

e. Gold is a ..... shiny metal.

f. Silver is extracted from ..... ore.

g. Iodine is used to treat ..... cancer.

3. Tick (√) the most appropriate answer from the given alternatives.

a. Which of the given elements is a non-metal?

☐ silver ☐ iron ☐ copper ☐ sulphur

b. Which of the given metal is used for making silver paint?

☐ aluminium ☐ silver ☐ copper ☐ iron

c. Which of the given element is a bad conductor of heat and electricity.

☐ gold ☐ sulphur ☐ iron ☐ silver

d. Which of the given element is used for making skin ointment?

☐ gold ☐ aluminium ☐ sulphur ☐ silver

e. Which of the following is used in beauty parlors for hair setting?

☐ iodine ☐ sulphur ☐ silver ☐ gold

f. Which of the following is a bluish-white metal?

☐ copper ☐ gold ☐ zinc ☐ iron

4. Answer the following questions.

a. What are metals? Give any four examples.

b. What are non-metals? Give any four examples.

c. What are metalloids? Give any two examples.

d. Write down the names of metals and non-metals that are used at your home and school.

e. Name the ore from which aluminium is extracted.

f. Write any three properties and three uses of each aluminium and iron.

g. Write down the ores and properties of each copper, silver and gold.

h. Write any three properties and uses of each sulphur, zinc and iodine.

i. Write any three uses of each copper, silver, gold and sulphur.

j. Where is gold found in nature?

5. Differentiate between:

a. Metals and Non-metals

b. Silicon and Sulphur

c. Gold and Sulphur

d. Zinc and Copper

e. Mineral and Ore

6. Give reason:

a. Iron and copper are used for making cooking utensils.
b. Copper is used for making electric wires.
c. Silicon is called a metalloid.
d. Aluminium is used for making bodies and parts of aeroplane.
e. Iodine is mixed in table salt.

7. Study the given figures and identify them.

a. 

b. 

c. 

d. 

e. 

Also, write any two properties and main uses of each.

8. We use gold for making jeweleries but not iron, why?

9. Name any two non-metals that are used for making medicine. Also, write any two properties of each.

10. Describe the importance of metals and non-metals in our daily life.

UNIT
11

The Earth and Space

Estimated teaching hours : 10

Before You Begin

The earth is the common habitat for all living beings. The surface of the earth is made of rocks, soil and water. Rocks are the solid and hard substances found on the earth's surface. More than three-fourth parts of the earth remain covered with water and the rest with soil. If we dig a layer of soil to a certain depth, bed rocks can be seen from the ancient time. Rocks are being used by human beings for various purposes. Rocks are widely used in construction of buildings, houses, roads, pavements, bridges, dams, walls, canals, etc. Similarly, different types of minerals are also obtained from the rocks.

The earth is our home planet. All planets and animals live on the earth. The earth revolves around the sun in an elliptical orbit. The earth is a member of solar system. The family of the sun that includes the sun, eight planets, natural satellites, comets, asteroids, meteors, meteorites, etc. is called the solar system. Similarly, planets are heavenly bodies that revolve around the sun.

When an opaque object blocks the light coming from a luminous object, a dark patch is formed behind the opaque object. This dark patch is called a shadow. There are two types of shadows, i.e. umbra and penumbra. When the sun, the earth and the moon lie in a straight line, on same occasions the earth and moon cast shadow on one another. This phenomenon is known as an eclipse. There are two types of eclipses. They are lunar eclipse and solar eclipse.

In this unit, we will study about rocks and their types, solar system, planets of solar system, phases of the moon, shadow and eclipse.

Learning Outcomes

After completing the study of this unit, students will be able to:

- define rocks and describe different types of rocks.
- describe the importance of rocks and identify the rocks found in Nepal.
- compare the planets of solar system on the basis of their features (shape, distance from the sun, duration of day and year).
- introduce moon and describe its shape, size, distance and revolution around the earth.
- introduce lunar calendar and explain the phases of the moon.
- introduce eclipse and demonstrate the process of eclipse.

Syllabus

- Rocks - Introduction and formation
- Types of rocks
- Importance of rocks
- Planets of the solar system
- Brief introduction to moon
- Phases of the moon
- Introduction to shadow and eclipse
- Types of eclipse
  - Solar eclipse
  - Lunar eclipse

Glossary

constellations	:	a small group of brilliant stars which seems to form the pattern or shape of some objects
full moon	:	the moon when it appears as a full circle
igneous	:	formed by solidification of magma
magma	:	molten rock material within the earth from which igneous rock results by cooling
minerals	:	a substance that is naturally formed under the ground
new moon	:	the moon when it looks like a thin curve
opaque	:	object which does not allow light to pass through
penumbra	:	the lighter patch of the shadow that surrounds the umbra
planets	:	the heavenly bodies that revolve around the sun
rocks	:	the hard and solid structures on the surface of the earth
sedimentary	:	formed by or from deposits of sediment
solar	:	related to or of the sun
satellites	:	the heavenly bodies that revolve around the planets
stars	:	the bright twinkling objects having their own source of light
shadow	:	the dark patch formed behind an opaque object when it blocks the light coming from the source
umbra	:	the completely dark central patch of a shadow

11.1 Rocks

11.1.1 Introduction to Rocks

Project Work

- Observe the different types of rocks present in your locality.
- Study their shape, size, colour, hardness, etc.
- Find out how rocks are used in your locality?
- Prepare a short report on rocks and present in the classroom.

Rocks are hard solid substances that from the surface of the earth. The earth's crust is made of rocks. They are found everywhere in our surroundings. They form cliffs, hills and mountains. Rocks form the bed of the sea. Rocks are also found below the layer of soil, on the banks of rivers, streams, etc. Rocks are made of fine grains of minerals. Different types of metals and non-metals are found in rocks. Over a period of time, rocks undergo weathering which results in the formation of soil.



Fig. 11.1

11.1.2 Physical Properties of Rocks

1. Generally, rocks are hard but some soft rocks are also found in nature.



Soft rock



Hard rock

Fig. 11.2

2. They have different colours. The colour of a particular rock is due to the type of minerals present in it. Rocks may be white, red, yellow, brown, green, gray, etc.

Fig. 11.3



Red rock *White rock* *Green rock* *Yellow rock*

3. Surface of the rock may be rough or smooth. The rocks that contain big grains of minerals appear rough and the rocks that contain small grains of minerals appear smooth.

Fig. 11.4



Rough rock *Smooth rock*

4. Rocks contain different types of metallic and non-metallic minerals.
5. Rocks exist in solid state.
6. Most rocks have high density, i.e. they are heavy.

Do You Know

Rocks are hard and solid substances having metallic and non-metallic minerals.

11.1.3 Classification of Rocks

There are three types of rocks on the basis of method of formation and origin of rocks. They are as follows:

1. Igneous rocks 2. Sedimentary rocks 3. Metamorphic rocks

1. Igneous rocks

The rocks formed by solidification of magma are called igneous rocks. Examples: basalt, pumice, granite, dunite, etc. During volcanic eruption, hot molten magma comes out through the cracks on the surface of the earth. The magma which comes out on the surface of the earth is called lava. The lava cools down slowly and becomes solid resulting in the formation of rocks. Sometimes, the magma cannot come out on the surface and cools down just below the surface of the earth, which also forms igneous rocks. On the basis of formation, igneous rocks are of two types, viz. (i) volcanic rocks and (ii) plutonic rocks.

Fig. 11.5



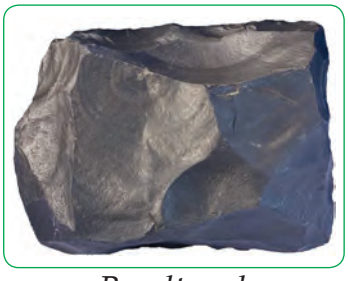
Igneous rock

The igneous rocks which are formed by solidification of magma on the surface of the earth are called volcanic rocks. Basalt, pumice, obsidian, etc. are the examples of volcanic rocks.

Fig. 11.6



Obsidian rock



Basalt rock



Pumice rock

Volcanic rocks are made of small granules. Some of them may be porous or glassy in appearance.

The igneous rocks which are formed just below the surface of the earth by solidification of magma are called plutonic rocks. Graphite, dunite, gabbro, etc. are examples of plutonic rocks.

Fig. 11.7



Graphite rock



Dunite rock



Gabbro rock

Plutonic rocks contain big crystals. They are the hardest rocks and hence are suitable for construction works.

Some useful igneous rocks

a. Granite

Granite is a black or grey plutonic igneous rock having large granules. It is rich in quartz and felspar. It is a hard and strong igneous rock. It is widely used in construction works.

Fig. 11.8



Granite rock

b. Pumice

Pumice is a light and porous volcanic igneous rock. It is formed by solidification of lava having gas. It has different colours like pale, white, black, blue-grey, green, brown, etc. Pumice is used to make cosmetic items, toothpastes, polishes, pencils, erasers, light concrete, etc.

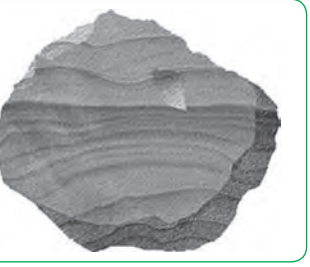
c. Obsidian rock

Obsidian is a glass-like volcanic rock. It is a dark coloured weak rock formed by rapidly cooling lava. Due to its glass-like appearance, obsidian is also called volcanic glass. It is used for making gemstones, arrowheads, cutting tools, spear points, knives, etc.

2. Sedimentary rocks

The rocks formed by the sedimented substances under high temperature and pressure are called sedimentary rocks. Limestone, sandstone, coal, shale, conglomerates, etc. are examples of sedimentary rocks. During the process of soil erosion, many organic as well as inorganic substances are carried away by water, air, etc. and these substances get deposited in some other places. In this way, hundreds of layers are formed over a period of time.

Fig. 11.9



Sedimentary rock

Under high temperature and pressure, the sedimented materials become hard resulting in the formation of rocks which are known as sedimentary rocks. These rocks contain many layers and are soft in nature. Since

sedimentary rocks may contain fossils and hence, help to know about evolution of organisms.



Limestone *Sandstone* *Shale*



Fig. 11.10

Conglomerates *Dolostone*

Some important sedimentary rocks

a. Limestone

Limestone is a very useful sedimentary rock having fine granules. It consists of calcium carbonate. Limestone is formed from the skeleton of marine organisms. It may be red, green, white, blue, black, gray, etc. It is widely used in construction works. Limestone finally changes into marble after a long time under the earth crust.

b. Sandstone

Sandstone is a sedimentary rock having sand-sized granules. It consists of minerals like quartz, felspar and organic matter. Its colour may be red, white, black, yellow, grey, pink, etc. It is used in construction works.

c. Conglomerate

The sedimentary rock having round granules is called conglomerate. It is made of silica, quartz and granules. Conglomerate is formed by combination of sand particles with silica or quartz. The conglomerate having silica is used in construction works.

d. Shale

The sedimentary rock having clay and silt is called shale. Its colour may be grey or black. Clay is the collection of very small granules whereas silt is the collection of granules which are smaller than sand. It is used in artwork, pottery and in architecture.

3. Metamorphic rocks

The rocks which are formed by the modification of igneous and sedimentary rocks due to high temperature and pressure under the earth's surface are called metamorphic rocks. These rocks are formed over a long period of time due to metamorphosis of both igneous and sedimentary rocks. Marble, state, gneiss, schist, quartzite etc. are examples of metamorphic rocks. The physical and chemical properties of metamorphic rocks are different from that of their original forms.



marble



Slate



Gnesis



Schist



Quarzite

Fig. 11.11

Following table shows some metamorphic rocks and their previous forms before metamorphosis.

	Igneous/Sedimentary rocks	metamorphic rocks
1.	Shale	Slate
2.	Shale	Schist

3.	Sandstone	Quarzite
4.	Granite	Gnesis
5.	Limestone	marble

Project Work

- Study the features of the rocks that are found in your locality.
- Classify these rocks into igneous, sedimentary and metamorphic rocks.
- Write down their characteristics and uses.
- Prepare a short report and submit it to your science teacher.

11.1.4 Some Important Rocks Found in Nepal

1. Marble



Fig. 11.12

marble is a very useful metamorphic rock formed by modification of limestone. It has many layers and different colours. A large deposit of marble is located in Godawari, Lalitpur. Marble is widely used in construction and for decorative purposes.

2. Limestone



Fig. 11.13

Limestone is a sedimentary rock formed by calcium carbonate. It is used for making cement and lime. It is also used in construction works. It has different colours. Limestone is found in different parts of Nepal like Chobhar, Godawari, Udaypur, Jogimara, Bhaise, Ghorahi, etc.

3. Slate



Fig. 11.14

Slate is a metamorphic rock having fine granules and various layers. It is formed by modification of schist. It is used for making writing boards and roofing of houses, temples, etc. A large deposit of slate is located in Bandipur.

4. Silica

Silica is formed by weathering of rocks. It is made of silica and oxygen. It is found on the bank of rivers. It is used in construction works.



Fig. 11.15

5. Conglomerate

It is a sedimentary rock having round granules. It consists of silica, quartz and granules connected together. It is found on the banks of rivers. It is used in construction works.

6. Sandstone

It is a sedimentary rock having sand-sized granules of different colours. It consists of quartz, feldspar and organic matter. It is found on the banks of rivers in Nepal. It is also used in construction works.

11.1.5 Uses of Rocks

1. Rocks are widely used in construction of houses, temples, buildings, bridges, walls, dams, road, monuments, columns, palaces, etc.
2. Rocks like marble, limestone, slate, etc. are used in decoration of walls, temples, floors, etc.
3. Rocks are used for extraction of minerals.
4. Rocks are used for extraction of metals.
5. Rocks like slate are used for roofing of houses and temples.
6. Rocks are used for making gemstones and decorative items.



Fig. 11.16

Uses of rocks

Key Concepts

1. Rocks are hard solid substances that contain different types of metallic and non-metallic minerals.
2. The rocks formed by solidification of magma are called igneous rocks.
3. The igneous rocks which are formed by solidification of magma on the surface of the earth are called volcanic rocks.
4. The igneous rocks which are formed just below the surface of the earth by solidification of magma are called plutonic rocks.
5. The rocks which are formed by the modification of igneous and sedimentary rocks due to high temperature and pressure under the earth's surface are called metamorphic rocks.
6. Rocks are widely used in construction of houses, temples, buildings, bridges, walls, dams, road, monuments, columns, palaces, etc.

Exercise

1. Tick (√) the correct statements and cross (×) the incorrect ones.

a. Rocks are hard and solid substances found on the earth. ☐

b. Igneous rocks contain fossils. ☐

c. Granite is an example of sedimentary rocks. ☐

d. Marble is formed by modification of limestone. ☐

e. Sandstone contains quartz and feldspar. ☐

2. Fill in the blanks using appropriate words.

a. The rocks that contain big granules appear .....

b. Igneous rocks are formed by solidification of .....

c. Granite and dunite are the examples of ..... rocks.

d. Quartzite is formed by modification of .....

e. A large deposit of ..... is located in Godawari, Lalitpur.

3. Answer the following questions.

a. What are rocks? What are they made of?
b. Where are rocks found?
c. Name three types of rocks.
d. What are igneous rocks? Give any three examples.
e. What are volcanic and plutonic rocks? Give any two examples of each.
f. What are sedimentary rocks? How are they formed?
g. Give any three examples of sedimentary rocks.
h. What are metamorphic rocks? Give any three examples.
i. Where is marble found in Nepal?

4. Give reason.

a. Fossils are found in sedimentary rocks.
b. Igneous rocks are widely used in construction works.
c. Marble is called a metamorphic rock.
d. Rocks are very useful for human beings.

5. Differentiate between:

a. Sedimentary rocks and Igneous rocks
b. Volcanic rocks and Plutonic rocks
c. Limestone and marble
d. Igneous rock and metamorphic rock

6. Give a brief account of the rocks found in Nepal.

7. Identify the rocks given below and write any two features of each.

a. 

b. 

c. 

8. Write down the major uses of rocks.

9. How are rocks being used in your locality? Write.

11.2. Solar System

11.2.1 The sun and Solar System

The sun is the brightest heavenly object. It is a medium sized star close to the earth. The sun is extremely hot. It is a huge ball of burning gas. So it is extremely hot. It releases a large amount of heat and light energy. All the plants, animals and human beings use the solar energy. Life would not exist on the earth in the absence of the sun.

Solar system is the family of the sun which consists of eight planets and their satellites, comets, asteroids, meteors, meteorites, etc. The sun occupies the central position of the solar system. All the planets and other members of the solar system revolve around the sun in fixed paths called orbits.

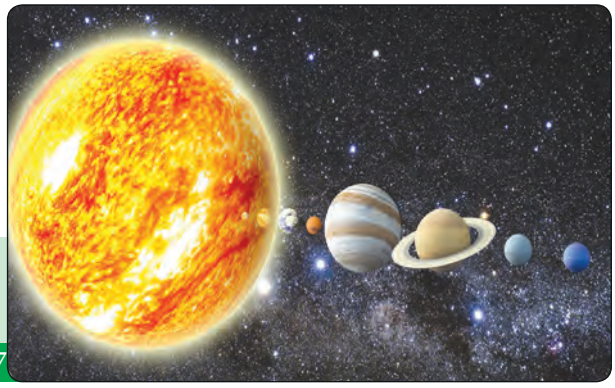


Fig. 11.17 *Solar System*

Project work

- Take a chart paper and draw a neat and labelled figure of the solar system.
- Put suitable colour on the picture and demonstrate in your classroom

Do You Know

- The sun is the brightest heavenly body that we see from the earth.
- Animals and plants cannot survive on the earth in the absence of the sun.

11.2.2 Planets

We know that the earth revolves around the sun in its own orbit. So, it is called a planet. Planets are heavenly bodies that revolve around the sun in elliptical paths called orbits. Planets do not have their own source of light for shining. So they are called non-luminous bodies. However, planets appear bright in the sky as they reflect the light coming from the sun. The sun holds all planets together with its strong force of attraction which is called gravitation.

There are eight planets in the solar system. The eight planets of the solar system in the order of their increasing distance from the sun are given below:

(i) mercury (ii) Venus (iii) Earth (iv) mars
(v) Jupiter (vi) Saturn (vii) Uranus (viii) Neptune

A brief description of all the planets of the solar system is given below:

1. Mercury

Out of the eight planets, mercury is the closest planet to the sun. It is the smallest planet of the solar system. Life cannot exist on the mercury as it has no atmosphere. The part of the mercury that faces the sun is extremely hot and the other part is extremely cold. Mercury has no satellites.

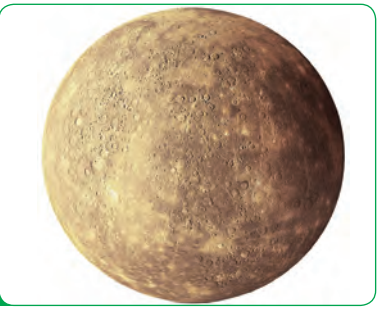


Fig. 11.18 *mercury*

Activity 1

- mercury can be seen just before the sunrise in September and October. It can also be seen just after the sunset in march and April.
- Observe the mercury in the sky and write its three features after your observation

Do You Know

- mercury is the smallest planet of the solar system.
- Venus is the hottest and brightest planet of the solar system.

2. Venus

Venus is the nearest planet to the earth. It is the brightest and hottest planet of the solar system. This planet is known as morning star or evening star. The shape of this planet resembles that of the earth. So, venus is called the twin planet of the earth. Life cannot exist on the venus. The atmosphere of the venus consists of carbon dioxide. This planet also has no satellites.

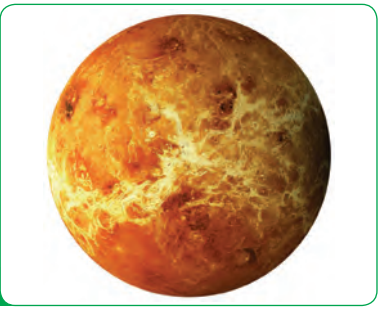


Fig. 11.19 *Venus*

Activity 2

- Venus can be seen just before the sunrise and just after the sunset.
- Observe the venus and write its three salient features.

Do You Know

- Mars is called a red planet.
- Jupiter is the largest planet of the solar system.

3. Earth



Fig. 11.20 *The earth*

The earth is our home planet. It is the third nearest planet from the sun. The earth has plenty of water, suitable temperature and life supporting gases. Therefore, life can exist on the earth. The venus is the nearest planet from the earth. The earth is the only planet having all the requirements for the existence of life. The earth takes 24 hours to complete one rotation in its own axis. Similarly, the earth takes 365.25 days to complete one revolution around the earth. The revolution of the earth around the sun causes the change in seasons and the rotation of the earth causes day and night. The earth has only one satellite, i.e. the moon.

4. Mars



Fig. 11.21 *mars*

Mars is commonly known as a red planet. It is the fourth distant planet from the sun. It is nearly half the size of the earth. The mars can be seen with our naked eyes and it looks like a bright orange red star. The atmosphere of the mars mainly consists of nitrogen gas. It has two satellites. They are Deimos and Phobos.

5. Jupiter



Fig. 11.22 *Jupiter*

Jupiter is the largest planet of the solar system. It looks like a bright star with our naked eyes. Jupiter is the third brightest object in the night sky after the moon and the venus. The jupiter consists of bands of clouds and a big red spot. This planet has

79 known satellites. Jupiter is also known as the king of planets. It revolves around the sun at highest speed.

6. Saturn

Saturn is the second largest planet of the solar system. It is the third farthest planet from the sun. The saturn is surrounded by three flat rings of dust and rocks. This planet has 62 known satellites. Titan is the largest satellite of the saturn.

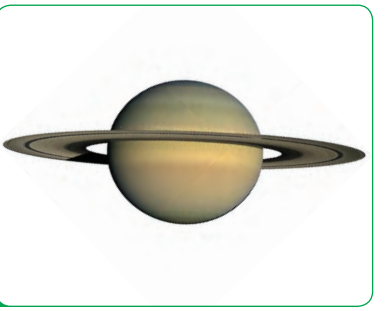


Fig. 11.23 *Saturn*

7. Uranus

Uranus is the second farthest planet from the sun. It is a very cold planet. It is made of gas and liquid. It has rings around it like the saturn. This planet has 27 known satellites.

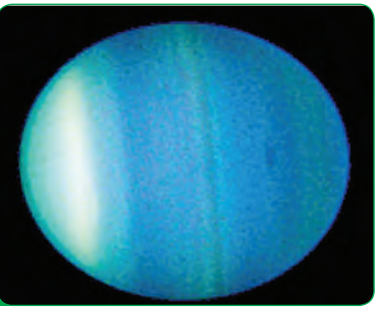


Fig. 11.24 *Uranus*

8. Neptune

Neptune is the coldest planet of the solar system. It cannot be seen with our naked eyes. This is the farthest planet of the solar system. Neptune has 14 known satellites.



Fig. 11.25 *Neptune*

11.2.3 Comparative Study of Eight Planets of Solar System

S.N.	Name of the planet	Average diameter (in km)	Period of rotation (hour, days)	Period of revolution (days/years)	Number of satellite
1.	Mercury	4851.2	58.85 days	87.97 days	0
2.	Venus	12035.2	243.02 days	224.7 days	0
3.	Earth	12672	23 hrs. 56 min.	365.25 days	1
4.	Mars	6742.4	23 hrs. 37 min. 22 sec.	286.98 days	2

5.	Jupiter	6742.4	9 hrs. 55 min. 30 sec.	12 years	79
6.	Saturn	115811.2	10 hrs. 30 min.	29.5 years	62
7.	Neptune	50441.6	17 hrs. 14 min. 24 sec.	84 years	27
8.	Uranus	48972.8	16 hrs. 6 min. 36 sec.	164 years	14

Source: World Almanac

11.2.4 Introduction to Stars



Fig. 11.26 *Stars*

Stars are extremely large burning balls of gases. We can observe millions of stars when we see at a dark and clear night sky. Stars twinkle at night. The extremely large and hot balls of gases that twinkle at night are called stars. Stars have their own source of light for shining. So they are called luminous bodies.

Stars are the extremely large masses of gases. But they appear very small from the earth since they are very far from the earth. The sun is a medium-sized yellow star. Some of the stars are thousands times larger than the sun whereas some stars are smaller than the sun. The sun is the star nearest to the earth. So it appears very large and bright in comparison to other stars. Stars are extremely large in size as compared to the size of the planets of the solar system.

Differences Between Planets and Stars

S.N.	Planets	S.N.	Stars
1.	Planets are non-luminous objects.	1.	Stars are luminous objects.
2.	They are relatively small.	2.	They are relatively large.
3.	Their surface temperature is relatively low.	3.	Their surface temperature is relatively high.
4.	They revolve around the sun.	4.	They do not revolve around the sun.

Project Work

- Observe the sky at clear night. You can see numerous heavenly bodies.
- Try to identify these heavenly bodies.
- Draw a picture of the things you observed.
- Prepare a short report and submit to science teacher.

Key concepts

1. The sun is the brightest heavenly object. It is a medium sized star closed to the earth.
2. The sun is located about 15 crore kilometers far away from the earth.
3. All the plants, animals and human beings use the solar energy. Life would not exist on the earth in the absence of the sun.
4. Solar system is the family of the sun which consists of eight planets and their satellites, comets, asteroids, meteors, meteorites, etc.
5. Planets do not have their own source of light for shining. So they are called non-luminous bodies.
6. The earth is the only planet having all the requirements for the existence of life.
7. The revolution of the earth around the sun causes the change in seasons and the rotation of the earth causes day and night.
8. Jupiter is the largest planet of the solar system. It looks like a bright star with our naked eyes.
9. The extremely large and hot balls of gases that twinkle at night are called stars.
10. Stars are extremely large in size as compared to the size of the planets of the solar system.

Exercise

1. Tick (√) the correct statements and cross (×) the incorrect ones.

a. There are eight planets in the solar system. ☐

b. The distance between the sun and the earth is about 15 crore meters. ☐

c. Jupiter is the largest planet of the solar system. ☐

d. Saturn is the smallest planet. ☐

e. Satellites revolve around the planets. ☐

f. Stars are luminous bodies. ☐

2. Fill in the blanks using appropriate words.

a. The sun occupies the central portion of the ..... system.

b. The nearest planet from the sun is .....

c. The coldest planet of the solar system is .....

d. The luminous objects that twinkle at night are called .....

e. The ..... is a medium-sized star.

f. The nearest planet to the earth is .....

g. The farthest planet of the solar system is .....

h. The brightest planet of the solar system is .....

3. Tick (√) the best answer from the given alternatives.

a. Solar system does not include the .....

☐ sun ☐ stars ☐ planets ☐ comets

b. The smallest planet of the solar system is the .....

☐ earth ☐ mercury ☐ jupiter ☐ uranus

c. How many planets are there in the solar system?

☐ 9 ☐ 8 ☐ 7 ☐ 6

d. Which of the following is the smallest planet?

☐ Venus ☐ Jupiter ☐ Mars ☐ Mercury

e. Which of the following is the coldest planet?

☐ Mars ☐ Venus ☐ Neptune ☐ Saturn

f. Which of the following objects twinkle at night?

☐ planets ☐ stars ☐ satellites ☐ comets

4. Match the following:

a. Mercury	☐ Red planet
b. Venus	☐ Largest planet
c. Earth	☐ Smallest planet
d. Mars	☐ Dwarf planet
e. Jupiter	☐ Brightest planet
f. Neptune	☐ Living planet
	☐ Coldest planet

5. Answer the following questions.

a. What is the solar system? Write any three features of the sun.

b. What are planets? Name the eight planets of the solar system.

c. Write any two features of each mercury, earth, mars, jupiter and saturn.

d. Name the largest and smallest planet of the solar system.

e. Name the coldest and hottest planet of the solar system.

f. Name the nearest and farthest planet of the solar system.

g. Define stars and write any three features of stars.

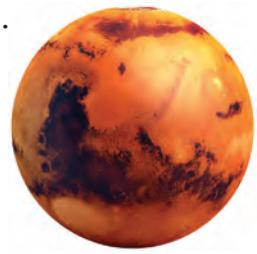
6. Write any three differences between planets and stars.

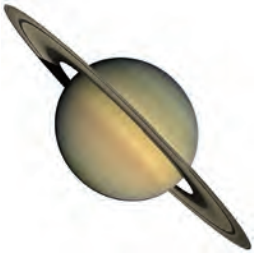
7. Write any two differences between planets and satellites.

8. Draw a neat figure showing solar system.

9. Identify the given heavenly bodies and write any two features of each.

a 

b. 

c. 

10. Name the following:

(i) nearest planet to the sun

(ii) smallest planet

(iii) nearest planet to the earth

(iv) largest planet

(v) coldest planet

(vi) farthest planet

(vii) natural satellites of the earth

11. Write any two features of each of the following planets.

(i) Venus

(ii) Uranus

(iii) Neptune

(iv) Earth

12. Why do stars appear small when viewed from the earth? Explain.

13. Give suitable reason.

a. The sun is called a luminous body.

b. The earth is called a planet.

c. Moon is called a satellite.

d. Life exists on the earth but not on the moon.

14. Draw a neat and labelled figure showing solar system.

11.3 The Moon

11.3.1 Introduction to the Moon

Have you seen the moon in the sky? It is the brightest object in the sky after the sun. Moon is the natural satellite of the earth. The diameter of the moon is about 3456 km. The mean distance between the earth and the moon is about 382400 km. Gravitational force of the earth holds the moon in its orbit. The moon has no air and water. Days are extremely hot and nights are very cold on the moon.



Fig. 11.27 *The moon*

The size of the moon is very small though the size of both sun and moon appears similar. The size of the sun is extremely large as compared that of the earth and moon. If the size of the moon is considered as that of a mustard grain, the size of the earth and the sun will be that of pea and basketball respectively.

The diameter of the sun is about 1400000 km and that of the earth is 12735 km. It shows that the sun is 110 times larger than the earth. Similarly, the diameter of the moon is about 3475 km. It shows that the size of the sun is about 403 times larger than that of the moon. Similarly, the size of the earth is 3.66 times larger than that of the moon.

11.3.2 Phases of the Moon, New Moon and Full Moon

Different shapes of moon can be seen every day when viewed from the earth. What is the reason behind this fact? Have you seen different shapes of the moon or not?

The planets and satellites do not have their own source of light for shining. They shine by reflecting the light from the



Fig. 11.28 *Phases of moon*

Approved by CDC

sun. The moon is the natural satellite of the earth. It does not have its own source of light. The moon always presents its same face towards the earth. When the reflected light of the moon reaches the earth, the moon becomes visible. We see only that part of the moon which reflects the sunlight towards the earth.



Fig. 11.29

When the moon lies in between the sun and the earth, the reflected light from the moon does not reach the earth and the moon is not visible. This day is called the new moon day. The dark side of the moon faces the earth on the new moon day.

Do You Know

Few days before full moon day, only a small portion of the moon appears dark, which is called waxing gibbous.

On the night just after the new moon day, a crescent moon can be seen which is called waxing crescent. The other part of the moon is only faintly visible. The crescent goes on increasing till the 15th day from the new moon day when the full bright face of the moon is visible. The day is called the full moon day.

After full moon, only a small portion of the moon remains dark, which is called waning gibbous. The black portion of the moon increases gradually after full moon and just before new moon, only a small portion of the moon appears bright which is called waning crescent.

The gradual increase in the bright disc of the moon is called waxing of the moon. The bright disc of the moon increases for 15 days after the new moon day. This duration is called the bright half. After the full moon, the bright face of the moon goes on decreasing every day for 15 days. This duration is called the dark half. The gradual decrease in the bright disc of the moon is called waning of the moon. So, the waxing and waning of the disc of the moon, as the moon revolves around the earth, is called the phases of the moon.



Fig. 11.30 *Full moon*

Major causes of the phases of the moon

1. The moon revolves around the earth in its own axis.
2. The moon does not have its own source of light.
3. Light always travels in a straight path.

Differences between New moon and Full moon

S.N.	New moon	S.N.	Full moon
1.	When the moon lies between the sun and the earth, the reflected light from the moon does not reach the earth and hence the moon is not visible. This phase of moon is called new moon.	1.	When the earth lies between the moon and the sun, the full bright face of the moon is seen from the earth. This phase of moon is called full moon.
2.	Night of new moon is dark.	2.	Night of full moon is bright.

11.3.3 Sidereal month and Synodic month

On the full moon day, the moon rises in the eastern sky and it rises 50 minutes later the next day. The moon revolves around the earth in its own orbit. The moon completes one revolution around the earth in $27\frac{1}{3}$ days. This duration is called the sidereal month. Similarly, the duration between two consecutive new moons or full moons is $29\frac{1}{2}$ days. This duration is called the synodic month.

Do You Know

When the earth lies between the moon and the sun, the full bright face of the moon is seen from the earth. This day is called the full moon day.

Differences between Synodic month and Sidereal month

S.N.	Synodic month	S.N.	Sidereal month
1.	It is the duration between two consecutive full moons or new moons.	1.	It is the duration that the moon completes one revolution around the earth.
2.	Its duration is 29.5 days.	2.	Its duration is 27 days, 7 hours, 43 minutes and 11 seconds.

11.3.4 Adhik maas and Kshaya maas

a. Adhik maaas

Adhik maas is the thirteenth month of the lunar calendar. It is also called malamaas or purushottam month. Adhik maas is inserted to keep the lunar and solar calendar alinged. It helps to adjust the gap between solar and lunar year. Adhik maas or extra month falls every 32.5 months on an average. Lunar month begins from every new moon. The name of the lunar month is kept same as the moon may fall in the same solar month. So, the name of next lunar month should be kept same as the solar month. Such as occurrence is called adhik mass or malmaas.

In Asoj 1st of 2077 B.S., there was new moon day. So the name of the lunar month was also Asoj. And in 30th Asoj, next new moon occurred. So, the name of next lunar month was also kept Asoj lunar month. In this case, Asoj lunar month was repeated. This extra month is the Adhik maas or malmaas.

The twelve hindu lunar months (maas) are equal to approximately 365 days, while solar year has 365 or 366 days (in leap year). It creates a difference of 9 to 10 days. Thus, the Hindu lunar calendar adds one extra month every third year. This extra month is actually adhik maas or malmaas.

b. Kshaya maas or Lost month

The lunar month in which there are two solar transitions (Saur sankaranti) is known as Kshaya maas in Astrology. It may take place in either Kartik, Mangsir or Poush.

While adjusting solar month and lunar month, when the moon remains farthest from the earth and the lunar month becomes longer. At the same condition, the earth remains near to the sun and solar month becomes short. In this situation, new moon may not fall on the short solar month and new moon or lunar month is lost in the solar month which is called Kshaya maas or lost month. If a year has lost month or Kshaya maas, the year may have two adhik maas.

Project work

- Take a chart paper and draw a neat and coloured figure showing the phases of the moon.
- Observe the shape of the moon every day starting from full moon, for 15 days. Draw the figure of the moon after observation.
- Prepare a short report and present in the classroom.

Key concepts

1. Moon is the natural satellite of the earth. The diameter of the moon is about 3456 km.
2. If the size of the moon is considered as that of a mustard grain, the size of the earth and the sun will be that of pea and basketball respectively.
3. The planets and satellites do not have their own source of light for shining.
4. The moon is the natural satellite of the earth. It does not have its own source of light.
5. On the night just after the new moon day, a crescent moon can be seen which is called waxing crescent.
6. After full moon, only a small portion of the moon remains dark, which is called waning gibbous.
7. The gradual increase in the bright disc of the moon is called waxing of the moon.
8. The gradual decrease in the bright disc of the moon is called waning of the moon.
9. The waxing and waning of the disc of the moon, as the moon revolves around the earth, is called the phases of the moon.
10. The moon completes one revolution around the earth in $27\frac{1}{3}$ days. This duration is called the sidereal month.
11. Synodic month is the duration between two consecutive full moons or new moons.
12. Sidereal month is the duration that the moon completes one revolution around the earth.

Exercise

1. Put a tick (√) for the correct statements and a cross (×) for the incorrect ones.

a. The earth is the natural satellite of the moon. ☐

b. The diameter of the moon is about 3456 km. ☐

c. Planets and satellites have their own source of light. ☐

d. The dark side of the moon faces the earth on full moon day. ☐

e. The moon appears as a full circular disc on the new moon day. ☐

2. Fill in the blanks using appropriate words.

a. The diameter of the sun is ..... km

b. The size of the earth is ..... time larger than that of the moon.

c. Waxing crescent can be seen just after ..... moon day.

d. The gradual increase in the bright disc of the moon is called .....

e. The duration of synodic month is ..... days.

3. Answer the following questions.

a. What is the distance between the earth and the moon?
b. Write any three features of the moon?
c. Compare the size of the sun, earth and moon.
d. What is the diameter of the moon?
e. What is meant by phases of the moon?
f. What is synodic month?
g. What is sidereal month?
h. What is meant by the bright half?
i. What is meant by the dark half?
j. Define new moon and full moon.
k. What are waxing and waning of the moon?
l. Define Adhik maas and Kshaya maas.

4. Differentiate between:

a. New moon and Full moon
b. Bright half and Dark half
c. Waxing crescent and Waning crescent
d. Sidereal month and Synodic month

5. Draw a neat and labelled figure showing the phases of the moon.

6. Write down the measure causes of phases of the moon.

11.4 Shadow and Eclipse

11.4.1 Introduction to Shadow

Activity 3

- Take a torch light and go in a dark room.
- Keep an opaque object on a table and turn on the torch light.
- Observe the shadow behind the opaque object.
- Identify umbra and penumbra in the shadow.



Fig. 11.31

When the light coming from a source is blocked by an opaque object, a dark patch is formed behind the object. This dark patch is called a shadow.

Luminous objects like the sun, torchlight, burning candle, etc. spread light around them. When an opaque object is kept in front of the source of light, two types of shadows are formed behind the object. They are umbra and penumbra.

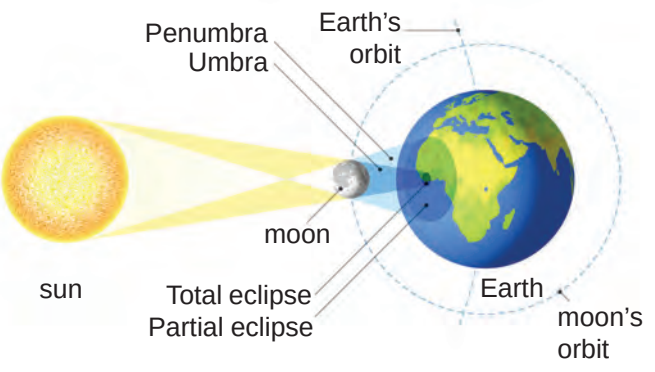


Fig. 11.32 *Formation of a shadow*

a. Umbra

The umbra is the completely dark patch of a shadow. It is formed at the centre of a shadow. The umbra appears completely dark as it does not get any light. The umbra is surrounded by penumbra.

b. Penumbra

The penumbra is the lighter patch of a shadow that surrounds the umbra. It does not appear completely dark as it receives some light. It can be seen around the umbra.

11.4.2 Eclipse

Fig. 11.33



Lunar eclipse

Out of three heavenly bodies (i.e. the sun, the earth and the moon), only the sun is a luminous object. The earth revolves around the sun and the moon revolves around the earth. In the course of revolution, on some occasions, the earth and the moon cast shadows on each other. In this condition, the sun, the earth and the moon lie in a straight line. This phenomenon is called an eclipse. Thus, an eclipse can be defined as the phenomenon in which the shadow of the earth and the moon fall on one another when the sun, the earth and the moon lie in a straight line.

During an eclipse, the non-luminous body (either the earth or the moon) blocks the light coming from the sun and casts its shadow on another body. A eclipse occurs only on a new moon day or a full moon night.

Do You Know

The sun is a luminous object and the moon and the earth are opaque and non-luminous objects.

a. Causes of eclipse

i. The moon revolves around the earth and the earth revolves around the sun.

ii. In certain days, the sun, earth and moon all lie in a straight line.

iii. Light always travels in a straight line.

b. Types of eclipse

There are two types of eclipse, they are:

1. Lunar eclipse
2. Solar eclipse

1. Lunar eclipse

During the course of revolution, when the earth lies in-between the sun and the moon in a straight line, the shadow of the earth falls on the moon. This phenomenon is called a lunar eclipse. During a lunar eclipse, we cannot see all or a part of the moon for a certain period of time. So, a lunar eclipse can be defined as the phenomenon in which the shadow of the earth is cast on the moon.

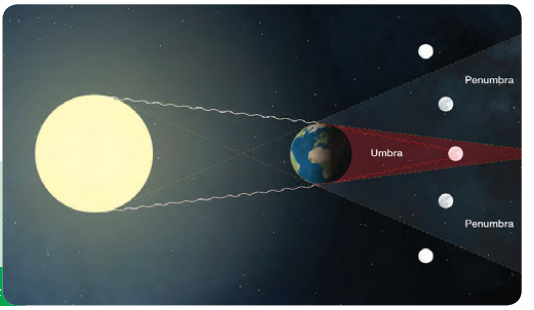


Fig. 11.34 *Lunar eclipse*

A lunar eclipse occurs only on a full moon night when the earth lies in between the moon and the sun in a straight line.

A lunar eclipse is of two types. They are (i) partial lunar eclipse, and (ii) total lunar eclipse.

(i) Partial lunar eclipse

When the moon lies in a penumbra cone of the earth, it gets some light from the sun, and the moon becomes partially visible. This phenomenon is called a partial lunar eclipse.

(ii) Total lunar eclipse

During a lunar eclipse, when the moon lies in the umbra cone of the earth, the moon does not get any light and appears completely dark. This phenomenon is called a total lunar eclipse.

Do You Know

When the moon appears as a full circle from the earth, it is called a full moon.

Project work

- See the calendar and find the date and time of lunar eclipse.
- Observe the moon before, during and after the eclipse. Prepare a report after observation.
- Present the report in the class using multimedia.

Project work

- Collect various materials like cricket ball, tennis ball or clay balls and torch light.
- Prepare a model of a lunar eclipse using these objects. Demonstrate the model in your classroom.

2. Solar eclipse

When the moon lies in-between the earth and the sun in a straight line, the shadow of the moon falls on the earth and a part of the sun cannot be seen for a certain period of time. This natural event is called a solar eclipse. So, a solar eclipse can be defined as the phenomenon in which the shadow of the moon is cast on the earth.

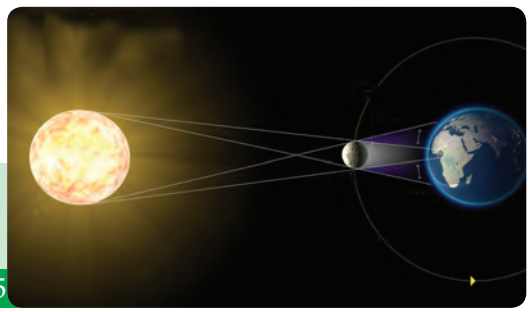


Fig. 11.35 *Solar eclipse*

A solar eclipse occurs only on a new moon day when the moon lies in-between the sun and the earth in a straight line.

During a solar eclipse, the region of the earth that lies in the penumbra cone has a partial solar eclipse. Similarly, the region of the earth that falls on in the umbra region has a total solar eclipse. The sun can be seen as a black circular disc with a ring of light during a total solar eclipse.



Fig. 11.36 *Annular solar eclipse*

We should not observe the solar eclipse with naked eyes because it damages our eye sight.

Project work

- Prepare a model of a solar eclipse and demonstrate it in your classroom.

Report Writing

- Collect information about solar and lunar eclipse from the internet.
- Study about phases of the moon, bright half, dark half, adhik maas, Kshaya maas, etc.
- Prepare a short report and present in the classroom.

Key concepts

1. When the light coming from a source is blocked by an opaque object, a dark patch is formed behind the object. This dark patch is called a shadow.
2. The umbra is the completely dark patch of a shadow. It is formed at the centre of a shadow.
3. The penumbra is the lighter patch of the shadow that surrounds the umbra.
4. An eclipse can be defined as the phenomenon in which the shadow of the earth and the moon fall on one another when the sun, the earth and the moon lie in a straight line.
5. A lunar eclipse can be defined as the phenomenon in which the shadow of the earth is cast on the moon. It occurs on full moon night.
6. A solar eclipse can be defined as the phenomenon in which the shadow of the moon is cast on the earth. It occurs in new moon day.

Exercise

1. Tick (√) the best answer from the given alternatives.

a. Which of the following objects can form a shadow when it blocks light?

- ☐ luminous object
- ☐ non-luminous object
- ☐ transparent object
- ☐ opaque object

b. The lighter patch of a shadow is called .....

- ☐ eclipse
- ☐ umbra
- ☐ penumbra
- ☐ patch

c. A lunar eclipse occurs only on a .....

- ☐ full moon night
- ☐ full moon day
- ☐ new moon day
- ☐ new moon night

d. A solar eclipse occurs when the .....

- ☐ moon lies in between the earth and the sun
- ☐ sun lies in between moon and the earth
- ☐ earth lies in between the sun and the moon

e. Which eclipse occurs when umbra of the moon falls on the earth?

- ☐ partial solar eclipse
- ☐ total solar eclipse
- ☐ partial lunar eclipse
- ☐ total lunar eclipse

2. Put a tick (√) for the correct statements and a cross (×) for the incorrect ones.

a. A shadow is formed by a luminous object. ☐

b. The moon is an opaque object. ☐

c. The completely dark patch of a shadow is called the penumbra. ☐

d. A lunar eclipse occurs when the earth lies in-between the sun and the moon. ☐

e. A solar eclipse occurs only on a full moon day. ☐

3. Fill in the blanks using appropriate words.

a. There are two types of shadows, viz. ..... and .....

b. The completely dark patch of a shadow is called the .....

c. In a ..... eclipse, the moon lies in-between the earth and the sun.

d. A ..... eclipse occurs only on a new moon day.

e. In a total solar eclipse, the sun appears as a .....

4. Match the following:

a.	Penumbra	☐	New moon day
b.	Umbra	☐	Full moon day
c.	Solar eclipse	☐	New moon night
d.	Lunar eclipse	☐	Completely dark patch
		☐	Lighter patch of a shadow

5. Answer the following questions.

a. What is a shadow? Name two types of shadows.

b. How is a shadow formed? Describe in brief.

c. Define penumbra and umbra.

d. What is an eclipse? What are two types of eclipses?

e. What is a lunar eclipse? When does it occur?

f. What is a solar eclipse? When does it occur?

g. When does a partial lunar eclipse take place?

h. When does a total solar eclipse take place?

i. Write any two conditions for an eclipse to occur.

j. Which eclipse occurs on a new moon day?

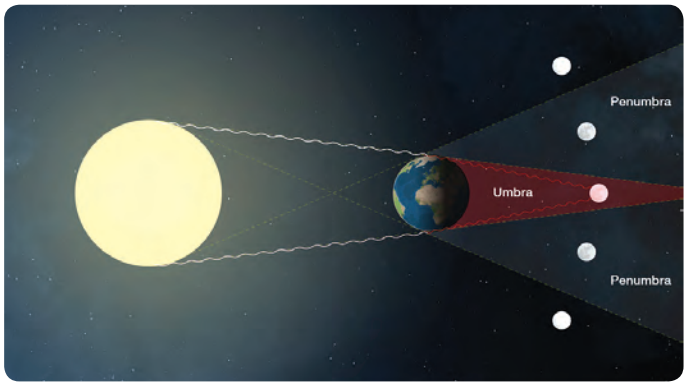
6. Differentiate between:

a. Penumbra and Umbra

b. Lunar eclipse and Solar eclipse

c. Total eclipse and Partial eclipse

7. Name the type of eclipse shown in the given figure. In which date does this eclipse occur? In which condition does total eclipse occur? Write.



8. Draw a neat and labelled figure of a solar eclipse.

9. Draw a neat and labelled figure showing total and partial lunar eclipse.

10. Name the type of eclipse that occurs when the moon lies in between the sun and the earth in a straight line? Draw a neat figure and label it.

Model Question

Class : 7 Time : 1hr. 30 min.

Attempt all the questions.

Group 'A' (Objective Questions) [10×1=10]

Tick (√) the best answer from the given alternatives.

1. Which of the following is the first step of report writing?

   ☐ Procedure ☐ Observation

   ☐ Topic ☐ Result

2. Which of the following provides information on various topics all over the world via the internet?

   ☐ Search engine ☐ Web Browser

   ☐ www ☐ eBook

3. Parallel venation is found in the leaves of a .....

   ☐ mango ☐ apple

   ☐ pea ☐ sugarcane

4. Which of the following is a non-bidegradable waste?

   ☐ fruit peels ☐ animal dug

   ☐ plastics ☐ vegetable peels

5. Which of the given processes are life processes?

   ☐ nutrition ☐ respiration

   ☐ reproduction ☐ all of them

6. The force used by a man to pull a bucket from a well is .....

- [ ] pushing force
- [ ] muscular force
- [ ] pulling force
- [ ] gravitational force

7. Which energy source is used to run automobiles?
   - [ ] mineral oil
   - [ ] wind energy
   - [ ] solar energy
   - [ ] biogas
8. When three cells of 1.5 V each are connected in parallel, the total voltage will be .....
   - [ ] 4.5 V
   - [ ] 1.5 V
   - [ ] 3 V
   - [ ] 2 V

e. Which of the following is used in beauty parlors for hair setting?
   - [ ] iodine
   - [ ] sulphur
   - [ ] silver
   - [ ] gold

e. Which eclipse occurs when umbra of the moon falls on the earth?
   - [ ] partial solar eclipse
   - [ ] total solar eclipse
   - [ ] partial lunar eclipse
   - [ ] total lunar eclipse

Group 'B' (Very short questions) [8×1=8]

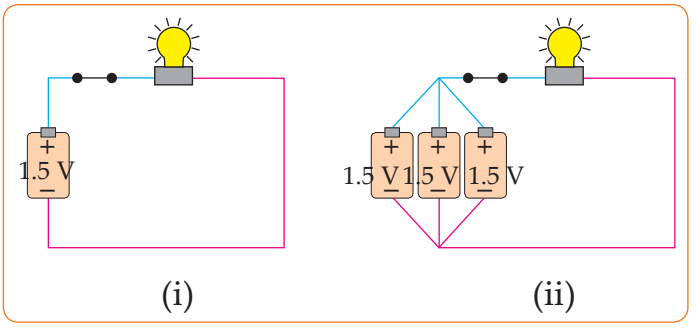
1. What is a web browser?
2. Write one difference between application software and system software.
3. What are two function of seeds?
4. How is incineration carried out?
5. Why is solar energy called perpetual natural resource?

6. Mercury thermometer is not suitable to measure very low temperature in cold countries, why?



7. Name the equipment shown in the figure. Write its use.

8. Find out the total voltage in each of the given electric circuits.

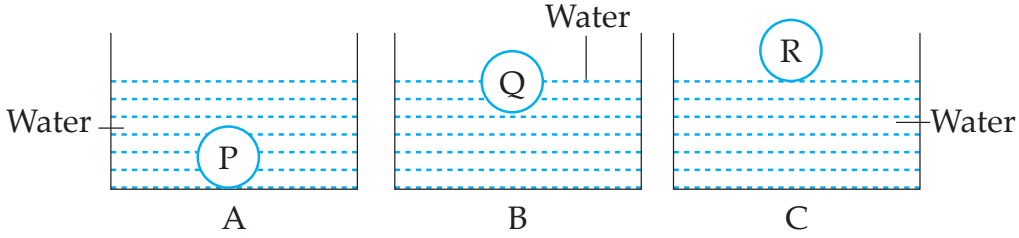


Group 'C' (Short questions) [8×2=16]

1. Write any two differences between collage model and 3D model.
2. Write down the process of transferring photoes from digital camera to a computer.
3. Write any two differences between tapeworm and roundworm.
4. Name the excretory organ of following organisms.
   – fish – frog – bird – human
5. Convert 100°C into °F.
6. Draw diagrams showing regular and irregular reflection of light.
7. Draw a closed electric circuit by combining the given components:
   - two dry cells - a bulb
   - a switch - a voltmeter
8. How are rocks being used in your locality? Write.

Group 'D' (Long questions) [4×4=16]

1. Write down the code of conduct that we should follow while using computer and internet.
2. The wise and economic use of energy sources is the best way of conserving existing energy sources. Justify this statement. Describe an activity to prove that sound can travel in a solid medium.
3. Study the given figures and answer the following questions.



   a. Which object has maximum density and which has minimum density?

   b. Name the object whose density is more than that of water.

   c. Why does object 'P' sink and 'R' float on water?

4. Write down the effects of litmus paper, methyl orange and phenolphthalein on acid, base and salt.

Specification Grid 2078

Subject: Science and Technology

Class: 7

S.N.	Unit	Credit Hours	Cognitive domains				Unit-wise weighting
			Knowledge (20%)	Understanding (10%)	Application (30%)	Higher Ability (20%)	
1.	Scientific Learning	10	MCQs (2 × 1)	MCQs (3 × 1)	MCQs (3 × 1)	MCQs (2 ×1)	3
2.	Information and Communication Technology	30					9
3.	Living Beings and Their Structure	12	Very Short Questions (2 × 1)	Very Short Questions (2 × 1)	Very Short Questions (2 × 1)	Very Short Questions (2 × 1)	4
4.	Biodiversity and Environment	10					3
5.	Life Process	10	Short Questions (1 × 2)	Short Questions (3 × 2)	Short Questions (3 × 2)	Short Questions (1 × 2)	3
6.	Force and Motion	13					4
7.	Energy in Daily Life	25	Long Questions (1 × 4)	Long Questions (1 × 4)	Long Questions (1 × 4)	Long Questions (1 × 4)	8
8.	Electricity and Magnetism	10					3
9.	Matter	15					5
10.	Materials Used in Daily Life	15					5
11.	The Earth and Space	10					3
	Total	160	10	15	15	10	50